

# Package ‘GCDkit’

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**Title** Geochemical Data Toolkit for Windows

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**Depends** R (>= 3.2.0), stats, methods, utils, graphics, MASS, grid, lattice, foreign, RODBC, R2HTML, tcltk, sp

**Description** A program for recalculation of geochemical data from igneous and metamorphic rocks. Runs under Windows Vista/7/8, complete function/stability under 2000/NT/XP cannot be guaranteed.

**License** GPL (>= 2)

**URL** <http://www.gcdkit.org>

## R topics documented:

.claslist . . . . .	1
about . . . . .	2
accessVar . . . . .	2
Add contours . . . . .	3
addResults . . . . .	4
addResultsIso . . . . .	4
AFM . . . . .	5
ageEps . . . . .	7
Agrawal . . . . .	9
Ague . . . . .	11
appendSingle . . . . .	14
apSaturation . . . . .	14
assign1col . . . . .	16
assign1symb . . . . .	17
assignColLab . . . . .	17
assignColVar . . . . .	18
assignSymbGroup . . . . .	19
assignSymbLab . . . . .	20
assignSymbLett . . . . .	20

Batchelor	21
binary	23
binaryBoxplot	24
Boolean conditions	26
bpplot2	27
calc	28
calcCore	29
Catanorm	31
CIPW	32
classify	34
cluster	35
contourGroups	36
coplotByGroup	39
coplotTri	41
correlationCoefPlot	43
Cox	44
crosstab	47
customScript	48
cutMy	49
Debon	50
deleteSingle	53
Edit labels	54
Edit numeric data	54
editLabFactor	55
elemIso	56
epsEps	57
Export to Access	59
Export to DBF	60
Export to Excel	60
Export to HTML tables	61
FeMiddlemost	64
figAdd	65
figaro.identify	67
figCol	68
figEdit	69
figGbo	70
figLoad	71
figMulti	71
figRedraw	74
figSave	75
figScale	75
figUser	76
figZoom	77
filledContourFig	79
Frost	80
gcdOptions	83
graphicsOff	85
groupsByCluster	86
groupsByDiagram	87
groupsByLabel	87
Harris	88
Hastie	90

ID	92
info	93
isochron	93
isocon	95
Jensen	98
joinGroups	100
Jung	101
Laroche	103
LaRocheCalc	106
loadData	107
Maniar	110
mergeData	113
Meschede	114
Mesonorm	115
Middlemost	116
millications	118
Misc	119
Miyashiro	120
Mode	122
Molecular weights	124
Mullen	125
MullerK	126
Multiple plots	130
mzSaturation	132
NaAlK	133
Niggli	135
OConnor	136
pairsCorr	139
pdfAll	141
Pearce 1982	142
Pearce and Cann	143
Pearce and Norry	144
Pearce et al. 1977	146
Pearce Nb-Th-Yb	147
Pearce Nb-Ti-Yb	149
Pearce1996	151
PearceGranite	153
PeceTaylor	155
peterplot	157
Plate	159
Plate editing	161
plateLabelSlots	163
plotPlate	164
plotWithCircles	165
prComp	167
printSamples	168
printSingle	169
profiler	170
psAll	172
QAPF	173
quitGCDkit	176
r2clipboard	177

recast . . . . .	177
reciprocalIso . . . . .	178
Regular expressions . . . . .	179
rtSaturation . . . . .	181
saveData . . . . .	183
saveResults . . . . .	183
saveResultsIso . . . . .	184
sazava . . . . .	185
Schandl . . . . .	186
selectAll . . . . .	188
selectByDiagram . . . . .	189
selectByLabel . . . . .	190
selectColumnLabel . . . . .	191
selectColumnsLabels . . . . .	192
selectNorm . . . . .	194
selectPalette . . . . .	196
selectSubset . . . . .	198
setCex . . . . .	200
setShutUp . . . . .	201
setTransparency . . . . .	201
Shand . . . . .	202
Shervais . . . . .	204
showColours . . . . .	205
showLegend . . . . .	206
showSymbols . . . . .	207
spider . . . . .	208
spider2norm . . . . .	214
spiderBoxplot . . . . .	217
spiderByGroupFields . . . . .	219
spiderByGroupPatterns . . . . .	220
srnd . . . . .	221
statsByGroup . . . . .	222
statsByGroupPlot . . . . .	223
statsIso . . . . .	224
strip . . . . .	227
stripBoxplot . . . . .	228
Subset by range . . . . .	229
summaryAll . . . . .	230
summaryByGroup . . . . .	231
summarySingle . . . . .	233
summarySingleByGroup . . . . .	235
Sylvester . . . . .	236
TAS . . . . .	237
TASMiddlemost . . . . .	240
ternary . . . . .	243
tetrad . . . . .	246
threeD . . . . .	247
tkSelectVariable . . . . .	249
trendTicks . . . . .	250
Verma . . . . .	252
Villaseca . . . . .	254
Wedge . . . . .	256

Whalen . . . . .	260
WinFloyd1 . . . . .	261
WinFloyd2 . . . . .	263
Wood . . . . .	265
zrSaturation . . . . .	267

---

.claslist

*List of available classification schemes*

---

## Description

The function returns a list of classification diagrams available in the system.

## Usage

.claslist()

## Value

A matrix with two columns:

menu	menu items
function	the attached functions

## Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>

---

about

*About GCDkit*

---

## Description

Prints short information about the current version of GCDkit and contact addresses of its authors.

## Usage

about()

## Arguments

None.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

accessVar	<i>Accessing data in memory of R</i>
-----------	--------------------------------------

---

## Description

Loads data already present in memory of R into GCDkit.

## Usage

```
accessVar(var=NULL)
```

## Arguments

`var` a text string specifying the variable to be accessed

## Details

This function makes possible to access a variable, already present in R, most importantly the sample data sets. Firstly these need to be made available using the command `data`.

## Value

<code>WR</code>	numeric matrix: all numeric data
<code>labels</code>	data frame: all at least partly character fields; <code>labels\$Symbol</code> contains plotting symbols and <code>labels\$Colour</code> the plotting colours

The function prints a short summary about the attached data. It also loads and executes the Plugins, i.e. all the R code that is currently stored in the subdirectory `'\Plugin'`.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```
data(swiss)
accessVar("swiss")
binary("Catholic", "Education")

data(sazava)
accessVar("sazava")
binary("SiO2", "Ba")
```

---

Add contours

*Add contours*


---

**Description**

Superposes contour lines to a Figaro-compatible plot.

**Usage**

```
addContours()
```

**Details**

This is, in principle, a front end to the standard R function [contour](#).

**Value**

None.

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>

**See Also**

['filled.contour'](#) ['figaro'](#)

---

addResults

*Appending results to data*


---

**Description**

Appends the most recently calculated results to the data stored in memory.

**Usage**

```
addResults(what="results", save=TRUE, GUI=FALSE)
```

**Arguments**

what	character; the name of variable to be appended.
save	logical; Append to the data matrix 'WR'?
GUI	logical; Is the function called within the GUI environment?

**Details**

This function appends the variable 'results' (a matrix or vector) returned by most of the calculation algorithms to a the numeric data stored in the matrix 'WR'.

**Value**

Modifies the matrix 'WR'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

addResultsIso

*Append Sr-Nd isotopic data*

---

**Description**

Appends the calculated isotopic parameters stored in the matrix 'init' to the numeric data already in the system.

**Usage**

addResultsIso()

**Value**

Modifies the numeric data matrix('WR') to which it appends the following columns:

Age (Ma)	Age in Ma
87Sr/86Sri	Sr isotopic ratios
143Nd/144Ndi	Initial Nd isotopic ratios
EpsNdi	Initial $\epsilon(Nd)$ values
TDM	Single-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> )
TDM.Gold	Single-stage depleted-mantle Nd model ages ( <i>Goldstein et al., 1988</i> )
TDM.2stg	Two-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> )

**Plugin**

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138

Goldstein S L, O'Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236

**See Also**

'[addResults](#)'



AFM

*AFM diagram (Irvine + Baragar 1971)***Description**

Assigns data for AFM ternary diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

```
AFM(equ=FALSE)
```

**Arguments**

equ                      Logical: Should the template use boundary defined by equation?

**Details**

The AFM diagram is a triangular plot with apices A, F and M defined as follows:

$$A = (K_2O + Na_2O) \text{ wt. \%}$$

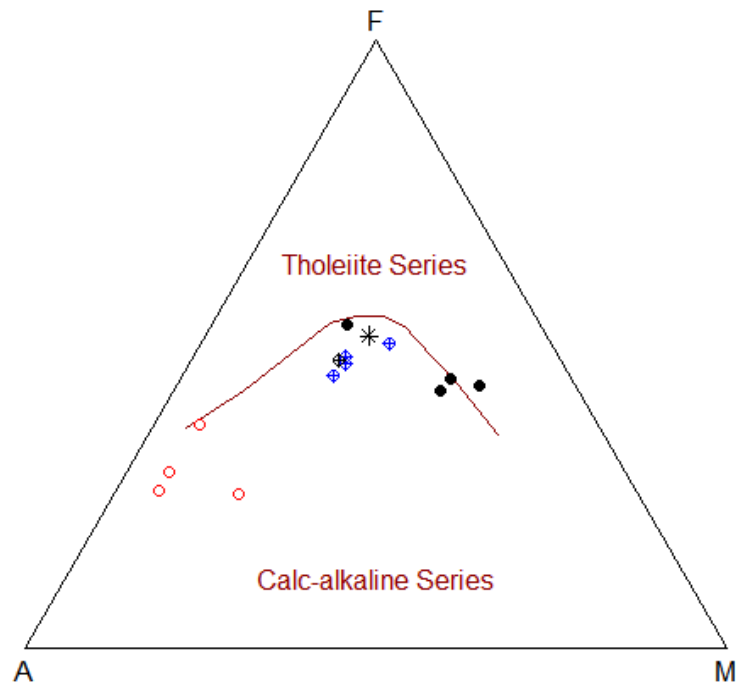
$$F = \text{FeO}_{\text{tot}} \text{ wt. \%}$$

$$M = \text{MgO} \text{ wt. \%}$$

$$A + F + M = 100 \%$$

The classification diagram divides data into 'tholeiite series' and 'calc-alkaline series' as proposed by Irvine & Baragar (1971). For extreme values linear extrapolation of boundary curve is employed.

### AFM plot (Irvine and Baragar 1971)



#### Value

sheet                    list with Figaro Style Sheet data  
x.data, y.data    A, F, M values (see details) transformed into 2D

#### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

#### References

Irvine T M & Baragar W R (1971) A guide to the chemical classification of common volcanic rocks.  
Canad J Earth Sci 8: 523-548 doi: [10.1139/e71-055](https://doi.org/10.1139/e71-055)

#### See Also

[classify figaro plotDiagram](#)

## Examples

```
#Within GCDkit, AFM is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("AFM")

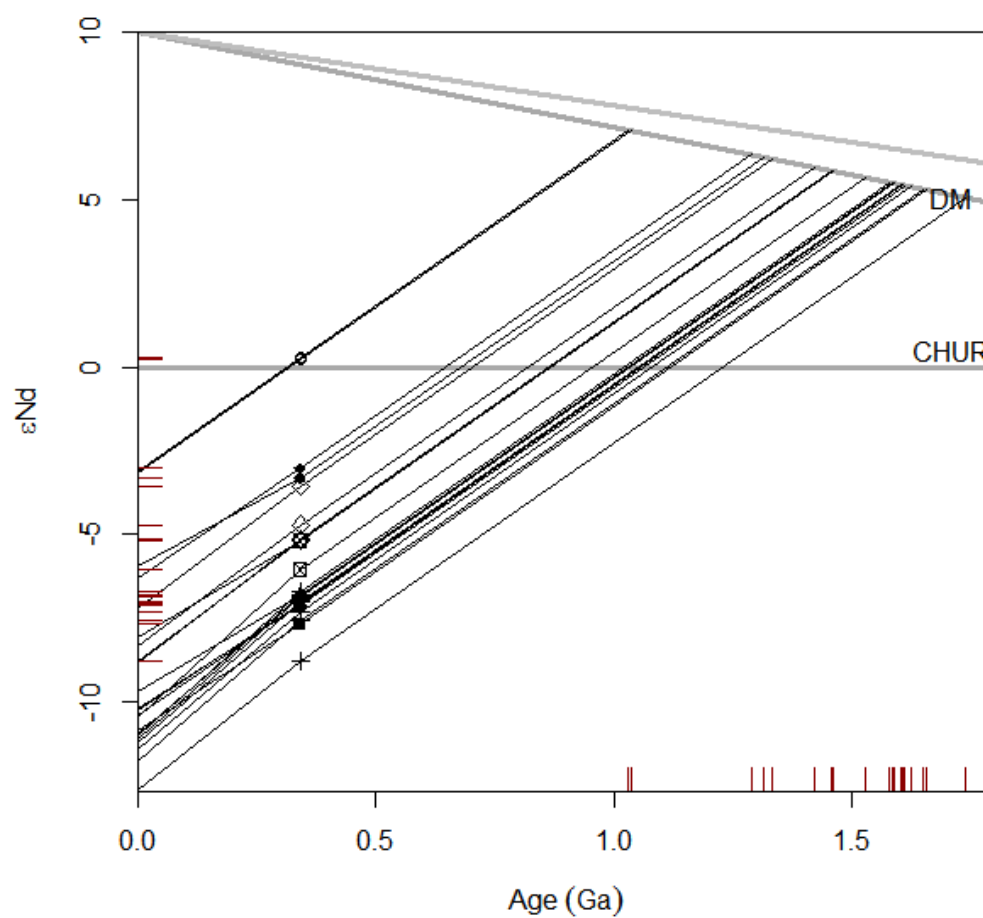
#To plot data stored in WR or its subset (menu Classification)
plotDiagram("AFM", FALSE)
```

ageEps

*Plot Sr or Nd growth lines*

## Description

Plots Nd or Sr growth curves in the binary diagram age- $\epsilon(Nd)$  or age-Sr isotopic ratio.



**Usage**

```
ageEps()
ageEps2()
ageSr()
```

**Arguments**

None.

**Details**

The Nd growth curves in individual samples can be plotted using either a single- or two-stage (*Liew & Hofmann 1988*) models.

In case of Nd are shown growth curves for the two main mantle reservoirs, CHUR and Depleted Mantle (DM) (the latter in two modifications, after *Goldstein et al. (1988)* and *Liew & Hofmann (1988)*).

For Sr only uniform reservoir (UR) development is calculated using parameters of *Faure (1986 and references therein)*.

The small ticks, or rugs, on x axis correspond to Nd model ages, on y axis to initial  $\epsilon(Nd)$  values.

This function is, so far with the exception of rugs, Figaro compatible.

**Value**

None.

**Plugin**

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Faure G (1986) Principles of Isotope Geology. J.Wiley & Sons, Chichester, 589 pp
- Goldstein S L, O’Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236
- Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138

Agrawal

Trace-element based discrimination plots for (ultra-)basic rocks  
(Agrawal *et al.* 2008)**Description**

Plots data stored in 'WR' into discrimination plots proposed by Agrawal *et al.* (2008) for (ultra-)basic rocks ( $SiO_2 < 52$  wt. %).

**Usage**

```
Agrawal(plot.txt = getOption("gcd.plot.text"))
```

**Arguments**

plot.txt                      logical, annotate fields by their names?

**Details**

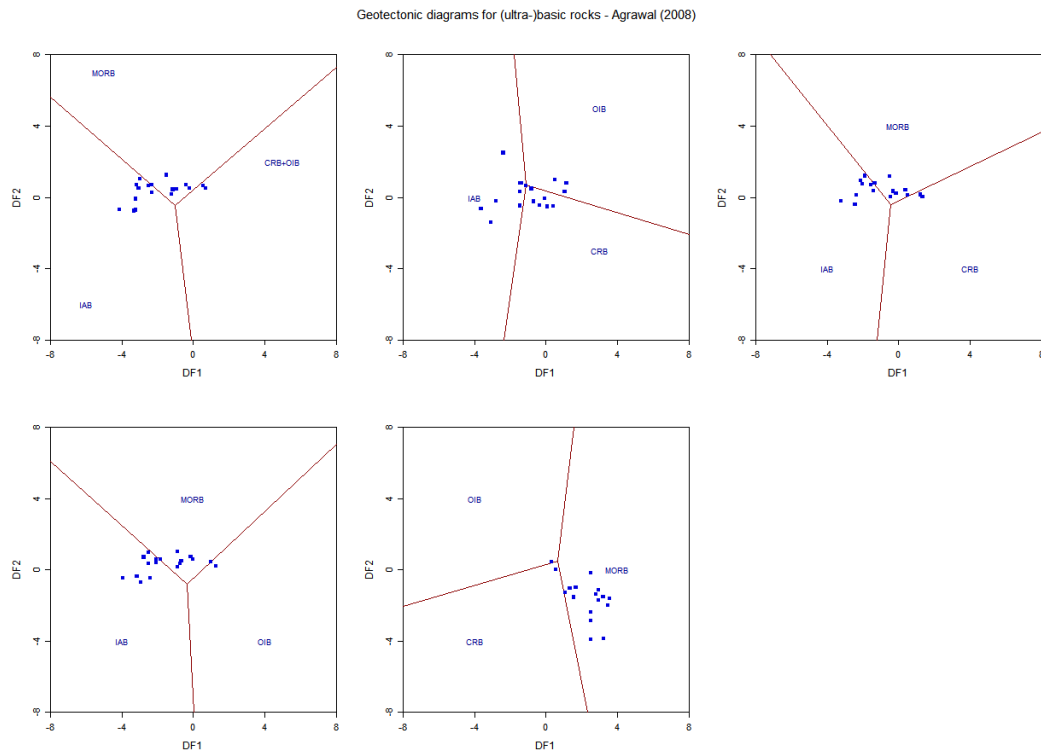
Suite of five diagrams for discrimination of geotectonic environment of ultrabasic and basic rocks, proposed by Agrawal *et al.* (2008). It is based on linear discriminant analysis applied to log-transformed concentration ratios of five trace elements (La, Sm, Yb, Nb, and Th), i.e., using four ratios  $\ln(La/Th)$ ,  $\ln(Sm/Th)$ ,  $\ln(Yb/Th)$ , and  $\ln(Nb/Th)$ . The two discriminant functions, DF1 and DF2, are mathematically designed to maximize the separation between the groups and account for 100 percent of the variance in the data.

Note that only samples with  $SiO_2 < 52$  wt. % are plotted.

Also note that each diagram applies only to environments explicitly mentioned. Samples from the environment not taken into account will be misinterpreted (the CRB + OIB + MORB diagram is not designed for IAB etc.) See the Agrawal *et al.* (2008) for further details.

Following geotectonic settings may be deduced:

Abbreviation used	Environment
IAB	<i>island arc basic rocks</i>
CRB	<i>continental rift basic rocks</i>
OIB	<i>ocean-island basic rocks</i>
MORB	<i>mid-ocean ridge basic rocks</i>



## Value

None.

## Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots.

See [Plate](#), [Plate editing](#) and [figaro](#) for details.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Agrawal S, Guevara M, Verma S (2008) Tectonic discrimination of basic and ultrabasic volcanic rocks through log-transformed ratios of immobile trace elements. *Int Geol Review* 50: 1057-1079  
doi: [10.2747/0020-6814.50.12.1057](https://doi.org/10.2747/0020-6814.50.12.1057)

## See Also

[Verma](#), [Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

## Examples

```
#plot the diagrams
plotPlate("Agrawal")
```

Ague

Concentration ratio diagram (Ague 1994)

## Description

Implementation of Concentration ratio diagrams after *Ague (1994)* used for judging the mobility of elements or oxides in course of various geochemically open-system processes such as alteration or partial melting.

## Usage

```
Ague(x = NULL,
     whichelems = "SiO2,TiO2,Al2O3,FeOt,MnO,MgO,CaO,Na2O,K2O,P2O5",
     immobile = NULL, bars = NULL, plot = TRUE)
```

## Arguments

x	two sample names for analyses of the protolith and altered rock compositions, respectively.
whichelems	list of elements to be plotted.
immobile	list of (one or more) elements considered as immobile.
bars	optional name of the variable containing $1\sigma$ errors for plotting error bars.
plot	logical, should be the diagram plotted or just the results calculated?

## Details

The Concentration ratio diagram shows concentration ratio of each geochemical species of interest (element or oxide) in the 'altered rock' to that in its presumed 'protolith'. These ratios are plotted on the y-axis, and the elements are arranged in any convenient order along x.

Following an open-system geological process, any of the perfectly immobile constituents  $i$  should ideally have exactly the same concentration ratio  $r_{inv}$  defined as (*Ague 2003*):

$$r_{inv} = \frac{c_i^A}{c_i^0}$$

where  $c_i$  is the concentration of the species  $i$ , 0 refers to the 'protolith' and  $A$  to the 'altered rock'.

This ratio, however, would only exceptionally equate unity, when the mass of the whole system is conserved. Using the presumably immobile species  $i$  as the geochemical reference frame, the change in the rock mass can be defined as *Ague (1994)*:

$$\Delta_{Mass} = \frac{c_i^0}{c_i^A} - 1$$

Thus  $r_{inv} > 1$  indicates overall rock mass loss due to removal of mobile constituents; this has the effect of increasing the concentrations of the immobile species ("residual enrichment"). Conversely,  $r_{inv} < 1$  shows an overall rock mass gain ("residual dilution").

The mass change of any mobile constituent  $j$  can be expressed as (*Ague 1994*):

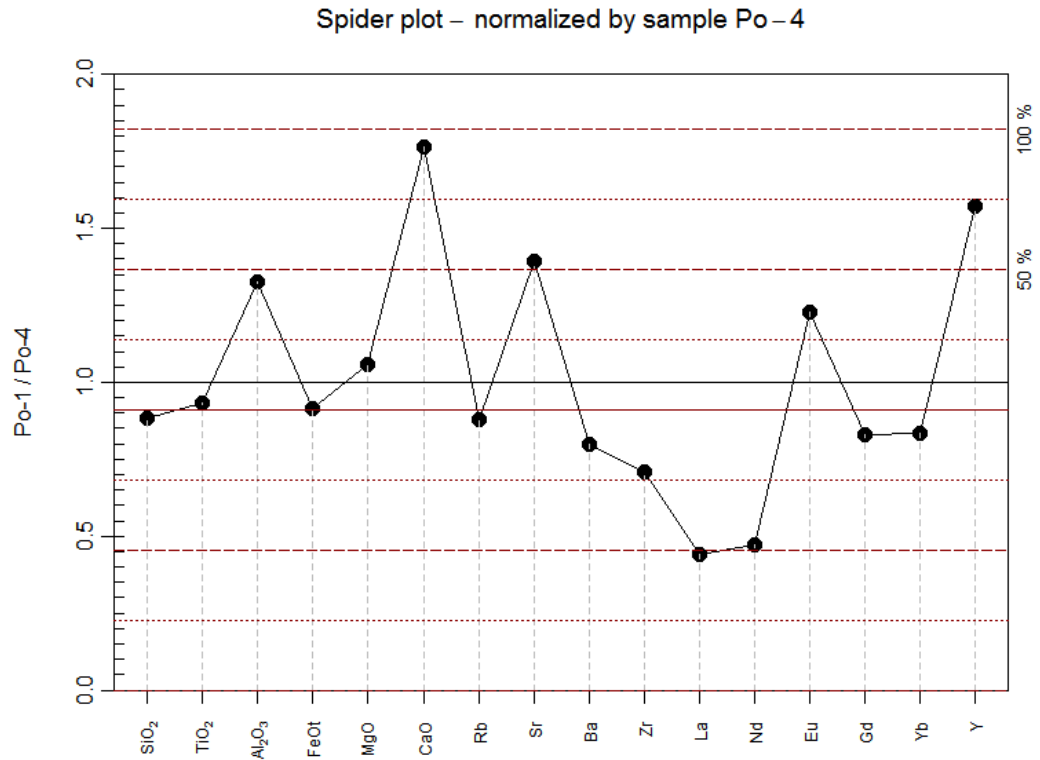
$$\Delta_j = \frac{1}{r_{inv}} \frac{c_j^A}{c_j^0} - 1$$

Mobile species  $j$  that have  $\frac{c_j^A}{c_j^0}$  ratios greater than  $r_{inv}$  have been added to the system, and those with ratios lower than  $r_{inv}$  have been lost.

In the GCDkit's implementation of the Concentration ratio diagrams, firstly the parental and altered rock samples can be chosen interactively from a binary plot  $MgO - SiO_2$ , if not specified at the function call. Then the user is prompted for the elements/oxides to be plotted.

If not provided as a comma delimited list among the arguments, the presumably immobile elements are to be specified. To facilitate this choice, printed and plotted as barplots are ordered ratios of the elemental concentrations in the 'altered rock' to that in the 'protolith' ( $\frac{c_j^A}{c_j^0}$ ).

Finally the concentration ratio diagram is plotted. If the parameter `bars` is given, error bars are also shown corresponding to  $\pm 1\sigma$ .



### Value

Returns a matrix 'results' with the following columns:

Altered/Protolith

concentration ratios of the given geochemical species in the 'altered rock' to that in the 'protolith' - primary y axis of the plot



Gain/loss in % relative gains (positive) or losses (negative) corrected for the rock mass change  
- secondary y axis of the plot

### Plugin

Isocon.r

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Ague J J (1994) Mass transfer during Barrovian metamorphism of pelites, south-central Connecticut; I, Evidence for changes in composition and volume. *Amer J Sci* 294: 989-1057 doi: [10.2475/ajs.294.8.989](https://doi.org/10.2475/ajs.294.8.989)
- Ague J J (2003) Fluid infiltration and transport of major, minor, and trace elements during regional metamorphism of carbonate rocks, Wepawaug Schist, Connecticut, USA. *Amer J Sci* 303: 753-816 doi: [10.2475/ajs.303.9.753](https://doi.org/10.2475/ajs.303.9.753)
- Grant J A (1986) The isocon diagram - a simple solution to Gresens equation for metasomatic alteration. *Econ Geol* 81: 1976-1982 doi: [10.2113/gsecongeo.81.8.1976](https://doi.org/10.2113/gsecongeo.81.8.1976)
- Grant J A (2005) Isocon analysis: a brief review of the method and applications. *Phys Chem Earth (A)* 30: 997-1004 doi: [10.1016/j.pce.2004.11.003](https://doi.org/10.1016/j.pce.2004.11.003)
- Gresens R L (1967) Composition-volume relationships of metasomatism. *Chem Geol* 2: 47-55 doi: [10.1016/0009-2541\(67\)90004-6](https://doi.org/10.1016/0009-2541(67)90004-6)

### See Also

[Wedge](#), [isocon](#)

### Examples

```
data<-loadData("sazava.data",sep="\t")

Ague(c("Po-4","Po-1"),
      "SiO2,TiO2,Al2O3,FeOt,MgO,CaO,Rb,Sr,Ba,Zr,La,Nd,Eu,Gd,Yb,Y",
      "TiO2,SiO2,FeOt")
```

---

appendSingle

*Append empty label or variable*

---

### Description

Appends an empty numeric data column or a new label to the current data set.

### Usage

```
appendSingle()
```

### Value

Returns the corrected version of the data frame 'labels' or numeric matrix 'WR'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

apSaturation

*Apatite saturation*

---

**Description**

Calculates apatite saturation temperatures for observed whole-rock major-element compositions. Prints also phosphorus saturation levels for the given major- element compositions and assumed magma temperature.

**Usage**

```
apSaturation(Si = WR[, "SiO2"], ACNK = WR[, "A/CNK"],
P2O5 = WR[, "P2O5"], T = 0)
```

**Arguments**

Si	<i>SiO<sub>2</sub></i> contents in the melt (wt. %)
ACNK	vector with A/CNK (mol %) values
P2O5	vector with <i>P<sub>2</sub>O<sub>5</sub></i> concentrations
T	assumed magma temperature in C

**Details**

\* Calculates phosphorus saturation levels following *Harrison & Watson (1984)*:

$$\ln(D_P) = \frac{8400 + 26400(SiO_2 - 0.5)}{T} - 3.1 - 12.4(SiO_2 - 0.5)$$

$$P_2O_5.HW = \frac{42}{D_P}$$

where 'T' = absolute temperature (K), '*D<sub>P</sub>*' = distribution coefficient for phosphorus between apatite and melt and '*SiO<sub>2</sub>*' is the weight fraction of silica in the melt, *SiO<sub>2</sub>* wt. %/100.

These formulae were shown to be valid only for metaluminous rocks, i.e. A/CNK < 1, and were modified for peraluminous rocks (A/CNK > 1) by *Bea et al. (1992)*:

$$P_2O_5.Bea = P_2O_5.HW e^{\frac{6429(A/CNK-1)}{(T-273.15)}}$$

and *Pichavant et al. (1992)*:

$$P_2O_5.PV = P_2O_5.HW + (A/CNK - 1)e^{\frac{-5900}{T} - 3.22SiO_2 + 9.31}$$

Note that the phosphorus saturation concentrations are not returned by the function but printed only.

\* Calculates saturation temperatures in C using the observed *P<sub>2</sub>O<sub>5</sub>* concentrations (*Harrison & Watson, 1984*):

$$T.HW = \frac{8400 + 26400(SiO_2 - 0.5)}{\ln(\frac{42}{P_2O_5}) + 3.1 + 12.4(SiO_2 - 0.5)} - 273.15$$

for peraluminous rocks ( $A/CNK > 1$ ) the equation of *Bea et al. (1992)* needs to be solved for 'T' (in K) by iterations:

$$P_2O_5.Bea = \frac{42}{e^{\frac{8400+26400(SiO_2-0.5)}{T} - 3.1 - 12.4(SiO_2-0.5)}} e^{\frac{6429(A/CNK-1)}{(T-273.15)}}$$

as is that of *Pichavant et al. (1992)*:

$$P_2O_5.PV = \frac{42}{e^{\frac{8400+26400(SiO_2-0.5)}{T} - 3.1 - 12.4(SiO_2-0.5)}} + (A/CNK - 1)e^{\frac{-5900}{T} - 3.22SiO_2 + 9.31}$$

## Value

Returns a matrix 'results' with the following columns:

A/CNK	A/CNK values
Tap.sat.C.H+W	saturation T of <i>Harrison &amp; Watson (1984)</i> in C
Tap.sat.C.Bea	saturation T of <i>Bea et al. (1992)</i> in C, peraluminous rocks only
Tap.sat.C.Pich	saturation T of <i>Pichavant et al. (1992)</i> in C, peraluminous rocks only

## Plugin

Saturation.r

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

- Bea F, Fershtater G B & Corretge L G (1992) The geochemistry of phosphorus in granite rocks and the effects of aluminium. *Lithos* 29: 43-56 doi: [10.1016/0024-4937\(92\)90033-U](https://doi.org/10.1016/0024-4937(92)90033-U)
- Harrison T M & Watson E B (1984) The behavior of apatite during crustal anatexis: equilibrium and kinetic considerations. *Geochim Cosmochim Acta* 48: 1467-1477 doi: [10.1016/0016-7037\(84\)90403-4](https://doi.org/10.1016/0016-7037(84)90403-4)
- Pichavant M, Montel J M & Richard L R (1992) Apatite solubility in peraluminous liquids: experimental data and extension of the Harrison-Watson model. *Geochim Cosmochim Acta* 56: 3855-3861 doi: [10.1016/0016-7037\(92\)90178-L](https://doi.org/10.1016/0016-7037(92)90178-L)



**Details**

This function sets the same plotting symbol to all the data points. If 'pch' = -1 (the default), the user is prompted to specify its code.

**Value**

Sets 'labels\$Symbol' to code of the selected plotting symbol.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

To display the current legend use [showLegend](#). Symbols and colours by a single label can be assigned by [assignSymbLab](#) and [assignColLab](#) respectively, symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours are obtained by [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

---

 assignColLab

*Colours by label*


---

**Description**

Assigns plotting colours according to the levels of the chosen label.

**Usage**

```
assignColLab()
```

**Arguments**

None.

**Details**

The label is selected using the function '[selectColumnLabel](#)'.

**Value**

Sets 'leg.col' to a sequence number of column in 'labels' that is to be used to build the legend; 'labels\$Colour' contains the codes of desired plotting colours.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

To display the current legend use [showLegend](#). Symbols by a single label can be assigned by [assignSymbLab](#), symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours and symbols are obtained by [assign1symb](#) and [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

Selecting a label: [selectColumnLabel](#).

---

assignColVar

*Colours by a variable*


---

**Description**

Assigns plotting colours according to the values of the variable.

**Usage**

```
assignColVar(what=NULL,pal="heat.colours",save=TRUE,n=15)
```

**Arguments**

what	variable name or a formula; if NULL a dialogue is displayed
pal	palette
save	should the newly picked colours be assigned to 'labels'?
n	Desired approximate number of colours to be assigned.

**Details**

For selection of the variable is employed the function '[selectColumnLabel](#)'. The user can specify either existing data column in the 'WR' or a formula. The colours can be optionally (default behaviour) assigned globally, so that all the plots will use these from this point on. If not specified upon function call, the palette is picked using [selectPalette](#). The possible values are: 'grays', 'reds', 'blues', 'greens', 'cyans', 'violets', 'yellows', 'cm.colors', 'heat.colors', 'terrain.colors', 'topo.colors', 'rainbow' and 'jet.colors'. The analyses with no data available for the colours assignment will remain black.

**Value**

A list of two components, col and leg. The former are the plotting colours, the latter information to build a legend. If save = TRUE, 'labels\$Colour' will acquire the codes of desired plotting colours.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

Colours by a single variable can be assigned by [assignCollab](#), symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours are obtained by [assign1col](#). Table of available plotting colours is obtained by [showColours](#).

**Examples**

```
assignColVar("Na2O/K2O", "greens")
plotDiagram("PeceTaylor", F, F)
```

---

assignSymbGroup	<i>Symbols/colours by groups</i>
-----------------	----------------------------------

---

**Description**

Lets the user to assign plotting symbols and colours according to the levels of the defined groups.

**Usage**

```
assignSymbLab()
```

**Arguments**

None.

**Value**

Sets 'leg.col' and 'leg.pch' to zero, 'labels\$Symbol' contains the codes of desired plotting symbols, 'labels\$Colour' of plotting colours.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

To display the current legend use [showLegend](#). Symbols by a single label can be assigned by [assignSymbLab](#), colours using [assignCollab](#). Uniform colours and symbols are obtained by [assign1symb](#) and [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

---

assignSymbLab	<i>Symbols by label</i>
---------------	-------------------------

---

**Description**

Assigns plotting symbols according to the levels of the chosen label.

**Usage**

```
assignSymbLab()
```

**Arguments**

None.

**Details**

The label is selected using the function '[selectColumnLabel](#)'.

**Value**

Sets 'leg.pch' to a sequence number of column in 'labels' that is to be used to build the legend; 'labels\$Symbol' contains the codes for desired plotting symbols.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

To display the current legend use [showLegend](#). Colours by a single label can be assigned by [assignCollab](#), symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours and symbols are obtained by [assign1symb](#) and [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

Selecting a label: [selectColumnLabel](#).

---

assignSymbLett

*Symbols by label - initial letters*


---

**Description**

Assigns plotting symbols according to the levels of the chosen label.

**Usage**

```
assignSymbLett()
```

**Arguments**

None.

**Details**

The label is selected using the function '[selectColumnLabel](#)'.

**Value**

Sets 'leg.pch' to a sequence number of column in 'labels' that is to be used to build the legend; 'labels\$Symbol' contains the plotting symbols, which correspond to initial letters for the levels of the specified label.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>



**See Also**

To display the current legend use [showLegend](#). Symbols by a single label can be assigned by [assignSymbLab](#), colours by [assignCollab](#), symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours or symbols are achieved by [assign1symb](#) and [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

---

Batchelor

*Batchelor and Bowden (1985)*


---

**Description**

Plots data stored in 'WR' (or its subset) into Batchelor and Bowden's  $R_1 - R_2$  diagram.

**Usage**

```
Batchelor(ideal=TRUE)
```

**Arguments**

ideal                      logical, plot ideal minerals composition?

**Details**

Diagram in  $R_1 - R_2$  space, proposed by *De la Roche et al. (1980)*, with fields defined by *Batchelor & Bowden (1985)* as characteristic for following geotectonic environments:

*Mantle Fractionates*

*Pre-plate Collision*

*Post-collision Uplift*

*Late-orogenic*

*Anorogenic*

*Syn-collision*

*Post-orogenic*



binary

*Binary plot***Description**

These functions display data as a binary plot.

**Usage**

```
binary(x=NULL,y=NULL,log="",samples=rownames(WR),
      new=TRUE, ...)

plotWithLimits(x.data, y.data,
  digits.x=NULL, digits.y=NULL,log = "",new = TRUE,
  xmin=.round.min.down(x.data,dec.places=digits.x,expand=TRUE),
  xmax=.round.max.up(x.data,dec.places=digits.x,expand=TRUE),
  ymin=.round.min.down(y.data,dec.places=digits.y,expand=TRUE),
  ymax=.round.max.up(y.data,dec.places=digits.y,expand=TRUE),
  xlab = "", ylab = "", fousy = "",
  IDlabels=getOption("gcd.ident"), fit = FALSE, main = "",
  pch = labels[names(x.data), "Symbol"],
  col = labels[names(x.data), "Colour"],
  cex=labels[names(x.data),"Size"],title=NULL,interactive=FALSE)
```

**Arguments**

<code>x,y</code>	character; specification of the plotting variables (formulae OK).
<code>log</code>	a vector ' ', 'x', 'y' or 'xy' specifying which of the axes are to be logarithmic
<code>samples</code>	character or numeric vector; specification of the samples to be plotted.
<code>new</code>	logical; should be opened a new plotting window?
<code>...</code>	Further parameters to the function 'plotWithLimits'.
<code>x.data</code>	a numerical vector with the x data.
<code>y.data</code>	a numerical vector with the y data.
<code>digits.x</code>	Precision to which should be rounded the x axis labels.
<code>digits.y</code>	Precision to which should be rounded the y axis labels.
<code>xmin, xmax</code>	limits of the x axis.
<code>ymin, ymax</code>	limits of the y axis.
<code>xlab, ylab</code>	labels for the x and y axes, respectively.
<code>fousy</code>	numeric vector: if specified, vertical error bars are plotted at each data point.
<code>IDlabels</code>	labels that are to be used to identify the individual data points
<code>fit</code>	logical, should be the data fitted by a least squares line?
<code>main</code>	main title for the plot.
<code>pch</code>	plotting symbols.
<code>col</code>	plotting colours.
<code>cex</code>	relative size of the plotting symbols.
<code>title</code>	title for the plotting window.
<code>interactive</code>	logical; for internal use by our French colleagues.

**Details**

The function 'plots.with.limits' sets up the axes, labels them, plots the data and, if desired, enables the user to identify the data points interactively.

'binary' is the user interface to 'plotWithLimits'.

The variables to be plotted are selected using the function '[selectColumnLabel](#)'. In the specification of the variables can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

The functions are Figaro-compatible.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[plot](#)

**Examples**

```
binary("K2O/Na2O", "Rb")

binary("Rb/Sr", "Ba/Rb", log="xy", samples=1:10, col="red", pch="+", main="My plot")

plotWithLimits(WR[, "SiO2"]/10, WR[, "Na2O"]+WR[, "K2O"], xlab="SiO2/10",
ylab="alkalis")

plotWithLimits(WR[, "Rb"], WR[, "Sr"], xlab="Rb", ylab="Sr", log="xy")

plotWithLimits(WR[, "SiO2"], WR[, "Rb"], fousy=WR[, "Rb"]*0.05, xlab="SiO2",
ylab="Rb", fit=TRUE)
```

---

binaryBoxplot

*Binary boxplot*

---

**Description**

A binary plot combined with boxplots for both variables.

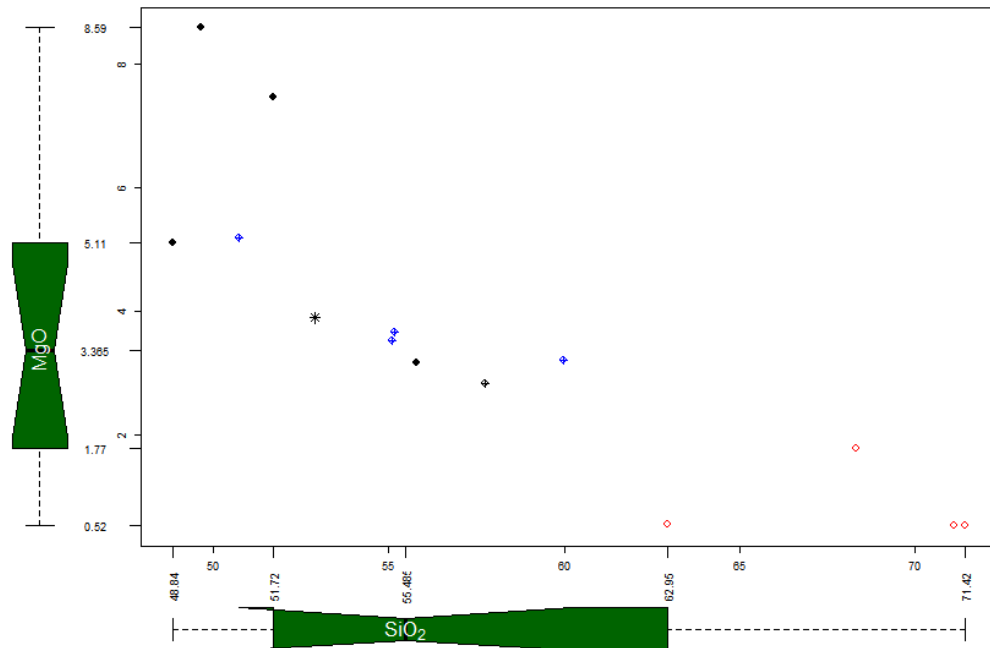
**Usage**

```
binaryBoxplot(xaxis="", yaxis="")
```

**Arguments**

xaxis, yaxis      specification of the variables. Formulae are OK.

## Details



Unless specified in the call, the variables to be plotted are selected using the function '[selectColumnLabel](#)'.

In the specification of the variables can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

## Value

None.

## Warning

This function IS NOT Figaro-compatible.

## Author(s)

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

## See Also

[plot boxplot](#)

## Examples

```
binaryBoxplot("SiO2/10", "Na2O+K2O")
```

---

Boolean conditions	<i>Select subset by Boolean condition</i>
--------------------	---

---

**Description**

Selecting subsets of the current dataset using Boolean conditions that can query both numeric fields and labels. Regular expressions can be employed to search the labels.

**Details**

The menu item 'Select subset by Boolean', connected to the function [selectSubset](#), enables the user to query by any combination of the numeric columns and labels in the whole dataset. The current data will be replaced by its newly chosen subset.

First, the user is prompted to enter a search pattern which can contain conditions that may employ most of the comparison operators common in R, i.e. < (lower than), > (greater than), <= (lower or equal to), >= (greater or equal to), = or == (equal to), != (not equal to). The character strings should be quoted. The conditions can be combined together by logical and, or and brackets.

Logical and can be expressed as .and. .AND. &

Logical or can be expressed as .or. .OR. |

Please note that at the moment no extra spaces can be handled (apart from in quoted character strings).

**Value**

Overwrites the data frame 'labels' and numeric matrix 'WR' by subset that fulfills the search criteria.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[regular.expressions regex](#)

**Examples**

```
## Not run:
# Valid search patterns

Intrusion="Rum"
# Finds all analyses from Rum

Intrusion="Rum".and.SiO2>65
Intrusion="Rum".AND.SiO2>65
Intrusion="Rum"&SiO2>65
# All analyses from Rum with silica greater than 65
# (all three expressions are equivalent)

MgO>10&(Locality="Skye"|Locality="Islay")
```

```
# All analyses from Skye or Islay with MgO greater than 10

MgO>=10&(Locality!="Skye"&Locality!="Islay")
# All analyses from any locality except Skye and Islay with MgO greater
# or equal to 10

Locality="^S"
# All analyses from any locality whose name starts with capital S

## End(Not run)
```

bpplot2

*Box-Percentile Plot*

## Description

Displays statistical distribution each of the variables in a data frame using a box-percentile plot (*Esty & Banfield 2003*).

## Usage

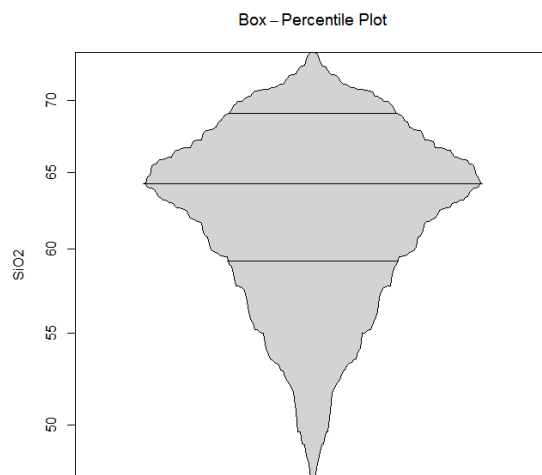
```
bpplot2(x,main="Box-Percentile Plot",sub="",xlab = "",
        ylab="",log="y",col="lightgray",horizontal=FALSE,ylim = NULL,axes=TRUE,...)
```

## Arguments

x	data frame with the data to be plotted
main	main title for the plot
sub	sub title for the plot
xlab	label for x axis
ylab	label for y axis
log	which of the axes is to be logarithmic?
col	colour to fill the boxes
horizontal	logical, should be the orientation horizontal?
ylim	optional; limits for the y axis
axes	logical; should be the axis drawn?
...	additional plotting parameters

## Details

The box-percentile plot is analogous to a [boxplot](#) but the width of the box is variable, mimicking the distribution of the given variable. As in boxplots, the median and two quartiles are marked by horizontal lines.



### Value

None.

### Warning

This function IS NOT Figaro-compatible. It means that the set of diagrams cannot be further edited in GCDkit (e.g. tools in "Plot editing" menu are inactive).

### Author(s)

The code represents a modified function 'bplot' from the package 'Hmisc' by Frank E Harrell Jr. (originally designed by Jeffrey Banfield). Adopted for GCDkit by Vojtech Janousek, <vojtech.janousek@geology.cz>.

### References

Esty, W. W. & Banfield, J. D. (2003). The Box-Percentile Plot. *Journal of Statistical Software* 8 (17)

---

calc

*Calculate a new variable*

---

### Description

Calculates a single numeric variable and appends it to the data.

### Usage

`calc()`



## Details

The formula can invoke any combination of names of existing numerical columns, with the constants, brackets, arithmetic operators  $+ - * / ^$  and R functions. See [calcCore](#) for a correct syntax.

If the result is a vector of the length corresponding to the number of the samples in the system, the user is prompted for the name of the new data column. Unless a column with the specified name already exists or the given name is empty, the newly calculated column is appended to the data in memory ('WR').

## Value

results                      numerical vector with the results

Modifies, if appropriate, the numeric matrix 'WR'.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[selectColumnLabel](#).

## Examples

```
## Not run:
# examples of valid formulae...
(Na2O+K2O)/CaO
Rb^2
log10(Sr)
mean(SiO2)/10

# ... but this command is in fact a simple R shell -
# meaning lots of fun for power users!
summary(Rb, na.rm=T)
cbind(SiO2/2, TiO2, Na2O+K2O)
cbind(major)
hist(SiO2, col="red")
boxplot(Rb~factor(groups))

# possibilities are endless
plot(Rb, Sr, col="blue", pch="+", xlab="Rb (ppm)", ylab="Sr (ppm)", log="xy")

## End(Not run)
```

---

calcCore

---

*Calculation of user-defined parameters*


---

## Description

Calculates a user-defined parameter specified by the equation.

## Usage

```
calcCore(equation, where = "WR", redo = TRUE)
```

## Arguments

equation	a text string to be evaluated.
where	which matrix should be used?
redo	logical; should be the routine called again and again?

## Details

This is a core calculation function.

The expression specified by 'equation' can involve any combination of names of existing numerical columns in the matrix 'where', numbers (i.e. constants), arithmetic operators  $+-*/^$  and R functions.

The most useful of the latter are 'sqrt' (square root), 'log' (natural logarithm), 'log10' (common logarithm), 'exp' (exponential function), 'sin', 'cos' and 'tan' (trigonometric functions).

Potentially useful can be also min (minimum), max (maximum), length (number of elements/cases), 'sum' (sum of the elements), 'mean' (mean of the elements), and 'prod' (product of the elements).

However, any user-defined function can be also invoked here.

For most statistical functions, an useful parameter 'na.rm=T' can be specified. This makes the function to calculate the result from the available data only, ignoring the not determined value (see Examples).

The quotation marks in 'equation' need to be preceded by a backslash. Option 'redo' specifies whether the routine should be called repeatedly until some meaningful result is obtained. Otherwise 'NA' is returned.

## Value

A list of three items:

equation	equation as entered by the user
results	numeric vector with the results or NA if none can be calculated
formula	the unevaluated expression corresponding to the 'equation'
,	

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```
calcCore("SiO2/10")

calcCore("Na2O+K2O")

calcCore("log10(Na2O+K2O)")

calcCore("SiO2/MW[\"SiO2\"]")
# dividing by the built-in molecularWeight, NB the backslashes

calcCore("length(MgO)")

calcCore("mean(MgO,na.rm=TRUE)")
# na.rm is a safety measure in case some missing values are present
# otherwise the result would be 'NA'
```

Catanorm

*Niggli's Molecular Norm (Catanorm)***Description**

Calculates the Niggli's Molecular Norm (Catanorm) using the algorithm given by *Hutchison (1974)*.

**Usage**

```
Catanorm(WR,precision=getOption("gcd.digits"))
```

**Arguments**

WR                    a numerical matrix; the whole-rock data to be normalized.  
precision            precision of the result.

**Details****Normative minerals of the Catanorm**

Parameter	Full name	Formula
Q	Quartz	$SiO_2$
C	Corundum	$AlO_{1.5}$
Or	Orthoclase	$KO_{0.5}.AlO_{1.5}.3SiO_2$
Plag	Plagioclase	$Ab_x.An_{100-x}$
Ab	(Albite)	$NaO_{1.5}.AlO_{1.5}.3SiO_2$
An	(Anorthite)	$CaO.2AlO_{1.5}.2SiO_2$
Lc	Leucite	$KO_{0.5}.AlO_{1.5}.2SiO_2$
Ne	Nepheline	$NaO_{0.5}.AlO_{1.5}.SiO_2$
Kp	Kaliophilite	$KO_{0.5}.AlO_{1.5}.SiO_2$
Ac	Acmite	$NaO_{0.5}.FeO_{1.5}.2SiO_2$
Ns	Sodium metasilicate	$2NaO_{0.5}.SiO_2$
Ks	Potassium metasilicate	$2KO_{0.5}.SiO_2$
Hy	Hypersthene	$En_x.Fs_{100-x}$
Di	Diopside	$Wo_{50}.En_x.Fs_{50-x}$
Wo	(Wollastonite)	$CaO.SiO_2$
En	(Enstatite)	$MgO.SiO_2$
Fs	(Ferrosillite)	$FeO.SiO_2$
Ol	Olivine	$Fo_x.Fa_{100-x}$
Fo	(Forsterite)	$2MgO.SiO_2$
Fa	(Fayalite)	$2FeO.SiO_2$
Cs	Calcium orthosilicate	$2CaO.SiO_2$
Mt	Magnetite	$FeO.2FeO_{1.5}$
Hm	Hematite	$FeO_{1.5}$
Il	Ilmenite	$FeO.TiO_2$
Tn	Sphene	$CaO.TiO_2.SiO_2$
Pf	Perovskite	$CaO.TiO_2$
Ru	Rutile	$TiO_2$
Ap	Apatite	$9CaO.6PO_{2.5}.CaF_2$
	or with no F	$5CaO.3PO_{2.5}$
Fr	Fluorite	$CaF_2$

Pr	Pyrite	$FeS_2$
Cf	Calcite	$CaO.CO_2$

**Value**

A numeric matrix 'results'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Hutchison C S (1974) Laboratory Handbook of Petrographic Techniques. John Wiley & Sons, New York, p. 1-527

---

CIPW	<i>CIPW norm</i>
------	------------------

---

**Description**

Calculates various modifications of the CIPW norm.

**Usage**

```
CIPW(WR, precision = getOption("gcd.digits"), normsum =
FALSE, cancrinite = FALSE, spinel = FALSE, complete.results = FALSE)
```

```
CIPWhb(WR, precision = getOption("gcd.digits"), normsum = FALSE,
cancrinite = FALSE, spinel = FALSE, complete.results = FALSE)
```

**Arguments**

WR	a numerical matrix; the whole-rock data to be normalized.
precision	precision of the result.
normsum	logical; shall be the normative minerals recast to 100 %?
cancrinite	logical; is cancrinite present/to be calculated?
spinel	logical; is spinel to be calculated (for ultrabasic rocks, i.e. for samples with $SiO_2 < 45$ % only)?
complete.results	logical; should be returned more extensive list of minerals, including the end members making up Di, Hy, Ol, Bi and Hbl?

**Details**

The method adopted for 'classic' CIPW norm calculation is that of *Hutchison (1974, 1975)*. The function 'CIPWHB' is its modification with biotite and hornblende (*Hutchison 1975*).

**Normative minerals of the standard CIPW norm**

Parameter	Full name	Formula	Molecular weight
Q	Quartz	$SiO_2$	60.08
C	Corundum	$Al_2O_3$	101.96
Or	Orthoclase	$K_2O.Al_2O_3.6SiO_2$	556.64
Ab	Albite	$Na_2O.Al_2O_3.6SiO_2$	524.42
An	Anorthite	$CaO.Al_2O_3.2SiO_2$	278.20
Lc	Leucite	$K_2O.Al_2O_3.4SiO_2$	436.48
Ne	Nepheline	$Na_2O.Al_2O_3.2SiO_2$	284.10
Kp	Kaliophilite	$K_2O.Al_2O_3.2SiO_2$	316.32
Nc	Sodium carbonate	$Na_2O.CO_2$	105.99
Ac	Acmite	$Na_2O.Fe_2O_3.4SiO_2$	461.99
Ns	Sodium metasilicate	$Na_2O.SiO_2$	122.06
Ks	Potassium metasilicate	$K_2O.SiO_2$	154.28
Di	Diopside		
__(MgDi)	__(Mg-diopside)	$CaO.MgO.2SiO_2$	216.55
__(FeDi)	__(Fe-diopside)	$CaO.FeO.2SiO_2$	248.09
Wo	Wollastonite	$CaO.SiO_2$	116.16
Hy	Hypersthene		
__(En)	__(Enstatite)	$MgO.SiO_2$	100.39
__(Fs)	__(Ferrosillite)	$FeO.SiO_2$	131.93
Ol	Olivine		
__(Fo)	__(Forsterite)	$2MgO.SiO_2$	140.70
__(Fa)	__(Fayalite)	$2FeO.2SiO_2$	203.78
Dcs	Dicalcium silicate	$2CaO.SiO_2$	172.24
Mt	Magnetite	$FeO.Fe_2O_3$	231.54
Il	Ilmenite	$FeO.TiO_2$	151.75
Hm	Hematite	$Fe_2O_3$	159.69
Tn	Sphene	$CaO.TiO_2.SiO_2$	196.06
Pf	Perovskite	$CaO.TiO_2$	135.98
Ru	Rutile	$TiO_2.SiO_2$	79.90
Ap	Apatite	$3CaO.P_2O_5.1/3CaF_2$	336.21
Fr	Fluorite	$CaF_2$	78.08
Py	Pyrite	$FeS_2$	119.98
Sp	Spinel		
__(MgSp)	__(Mg-spinel; spinel s. s.)	$CaO.MgO.2SiO_2$	142.27
__(FeSp)	__(Fe-spinel; hercynite)	$CaO.FeO.2SiO_2$	173.81
Cc	Calcite	$CaO.CO_2$	100.09

**Additional minerals of the modification with hornblende and biotite**

Parameter	Full name	Formula	Molecular weight
Bi	Biotite		
__(MgBi)	__(Phlogopite)	$KO_{0.5}.3MgO.AlO_{1.5}.3SiO_2$	798.50
__(FeBi)	__(Annite)	$KO_{0.5}.3FeO.AlO_{1.5}.3SiO_2$	987.74
Hbl	Hornblende		
Act	Actinolite		

__(MgAct)	__(Tremolite)	$2CaO.5MgO.8SiO_2$	794.35
__(FeAct)	__(Ferroactinolite)	$2CaO.5FeO.8SiO_2$	952.05
Ed	Edenite		
__(MgEd)	__(Edenite)	$NaO_{0.5}.2CaO.5MgO.AlO_{1.5}.7SiO_2$	1632.48
__(FeEd)	__(Ferroedenite)	$NaO_{0.5}.2CaO.5FeO.AlO_{1.5}.7SiO_2$	1947.88
Ri	Riebeckite	$2NaO_{0.5}.2FeO_{1.5}.3FeO.8SiO_2$	917.87

**Value**

A numeric matrix 'results'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Hutchison C S (1974) Laboratory Handbook of Petrographic Techniques. John Wiley & Sons, New York, p. 1-527
- Hutchison C S (1975) The norm, its variations, their calculation and relationships. Schweiz Mineral Petrogr Mitt 55: 243-256

---

classify

*Generic Classification Algorithm*

---

**Description**

Classifies rocks using specified diagram.

**Usage**

```
classify(diagram = "NULL", grp = TRUE, labs = FALSE,
source.sheet = TRUE, overlap = FALSE, X = x.data,
Y = y.data, silent = FALSE, clas=sheet$d$t, ...)
```

**Arguments**

diagram	name of diagram to be used, see details for more info
grp	logical: if TRUE, results are assigned to the variable 'groups'
labs	logical: if TRUE, yes/no dialogue for results assignment into the matrix 'labels' appears
source.sheet	logical: if TRUE, the sheet for diagram is newly assigned
overlap	logical: if TRUE, possible overlap between polygons of diagram is expected, and duplicate positive result for one sample is treated as polygon intersection
X	vector of values for abscissa
Y	vector of values for ordinate
silent	logical: if TRUE, informative outputs are reduced to minimum
clas	classification template to be used
...	any additional graphical parameters

## Details

Function looks for the name of the polygon within the classification diagram, into which falls the rock analysis represented by the coordinates [x.data,y.data].

In some cases (TAS diagram, Winchester & Floyd's diagram) additional computations are performed. The argument 'diagram' may acquire one of following values:

```
'AFM', 'PeceTaylor', 'Shand', 'TAS', 'CoxPlut', 'CoxVolc',
'Jensen', 'LarochePlut', 'LarocheVolc', 'WinFloyd1',
'WinFloyd2', 'TASMiddlemostPlut', 'TASMiddlemostVolc',
'DebonPQ', 'DebonBA', 'MiddlemostPlut', 'QAPFPlut',
'QAPFVolc', 'OConnorPlut', 'QAPFVolc', 'OConnorVolc',
'Miyashiro', 'Hastie', 'Pearce1996', 'Villaseca', 'NaAlK'.
```

The function is based on the sp package.

## Value

Vector of resulting rock names is stored in a variable 'results'. If 'grp = TRUE' results are also assigned to the 'groups' and 'grouping' is set to -1 (as if called from the menu 'Data handling'). If rock projection falls on the boundary between two or more fields, rock names in question are merged together with comment 'boundary between ...'.

## Author(s)

The sp package was written by Edzer Pebesma, Roger Bivand and others.

Vojtech Erban, <vojtech.erban@geology.cz>

## See Also

[plotDiagram](#)

[.claslist](#)

[figaro](#)

[AFM](#), [PeceTaylor](#), [Shand](#), [NaAlK](#), [TAS](#), [Cox](#), [TASMiddlemost](#), [Jensen](#), [Laroche](#), [WinFloyd1](#), [WinFloyd2](#), [DebonPQ](#), [DebonBA](#), [Middlemost](#), [QAPF](#), [OConnor](#) [Miyashiro](#) [Hastie](#) [Pearce1996](#) [Villaseca](#)

---

cluster

*Statistics: Hierarchical clustering*

---

## Description

Hierarchical cluster analysis on a set of dissimilarities.

**Usage**

```
cluster(elems = "SiO2,TiO2,Al2O3,FeOt,MnO,MgO,CaO,Na2O,K2O",
        method = "average")
```

**Arguments**

elems	numerical columns to be used for cluster analysis, typically major elements
method	the agglomeration method to be employed. This should be one of (or an unambiguous abbreviation thereof): 'ward', 'single', 'complete', 'average', 'mcquitty', 'median', 'centroid'.

**Details**

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Even though a list of major elements is assumed as a default, different variables can be specified by the function '[selectColumnsLabels](#)'.

The user is also asked to specify a label for the individual samples, default are their names.

After the dendrogram is drawn, the individual clusters can be identified. For each sample falling into the given group, specified information (e.g. Locality, Rock Type and/or Author) can be printed.

For further details on the clustering algorithm, see the R manual entry of 'hclust'.

**Value**

None.

**Warning**

Names of existing numeric data columns and not formulae involving these can be handled at this stage. Only complete cases are used for the cluster analysis.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

'[hclust](#)'

---

contourGroups

*Outline individual groups in a binary plot*

---

**Description**

The functions outline the individual clusters of data (groups by default) on a binary plot. Implemented methods are the convex hull or contours. This can be useful for a quick appreciation of the data distribution, e.g. in classification diagrams.



## Usage

```
contourGroups(clusters=groups, border=NULL, fill=FALSE, precision=50, ...)
```

```
chullGroups(clusters=groups, border=NULL, fill=FALSE, ...)
```

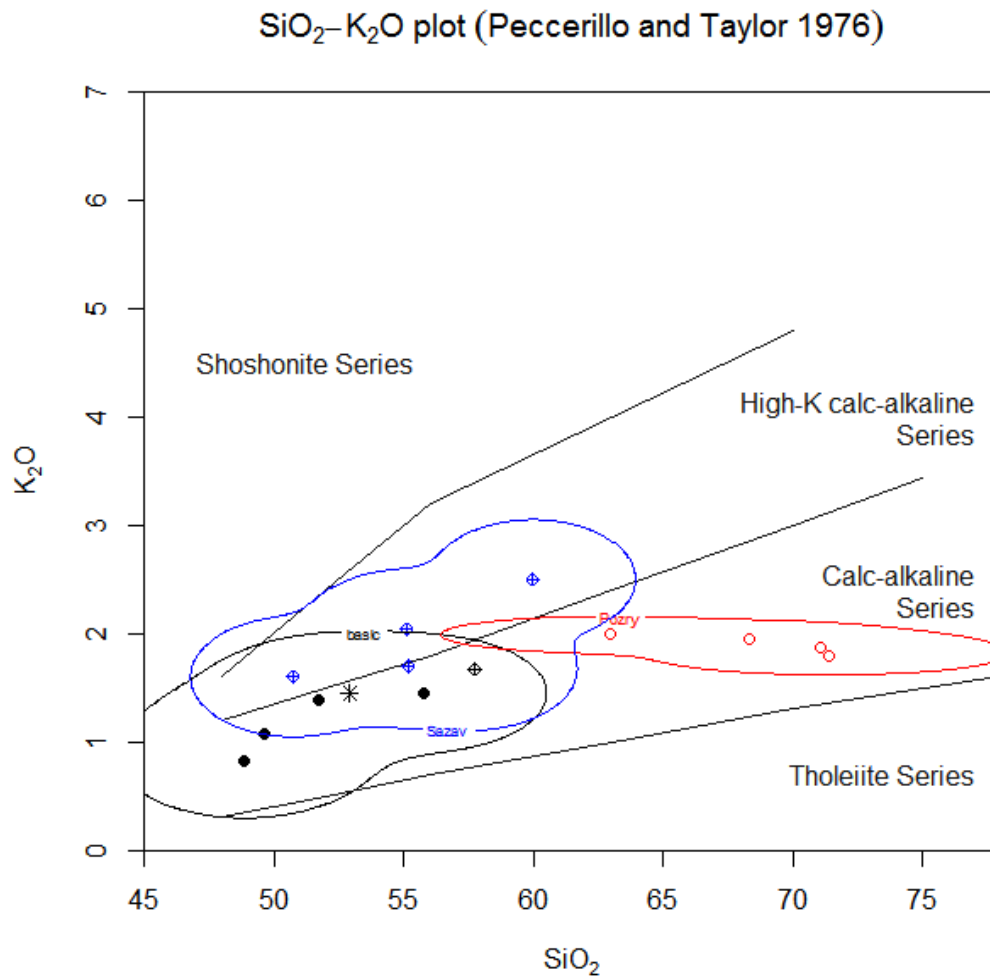
## Arguments

clusters	grouping information for each of the samples.
border	outline colours.
fill	logical; should the polygons be filled by the border colour?
precision	a number indicating how tight the contours should be.
...	additional parameters to the functions <a href="#">contour</a> and <a href="#">polygon</a> , respectively.

## Details

If not specified, the colours are selected as the most frequently occurring one defined among samples within each group.

For the function *contourGroups*, the shape of the contours drawn can be controlled using the parameter (*precision*). The higher it is, the smoother contours result.

**Value**

None.

**Author(s)**

Vojtech Janousek, &lt;vojtech.janousek@geology.cz&gt;

**See Also**[chull](#), [contour](#), [polygon](#)**Examples**

```
data<-loadData("sazava.data",sep="\t")
groupsByLabel("Intrusion")
plotDiagram("PeceTaylor",FALSE,FALSE)
chullGroups()

chullGroups(fill=TRUE)
```

```
plotDiagram("PeceTaylor",FALSE,FALSE)
contourGroups()
```

---

coplotByGroup	<i>Coplot by groups</i>
---------------	-------------------------

---

## Description

Plots a series of binary plots, for each of the groups separately.

## Usage

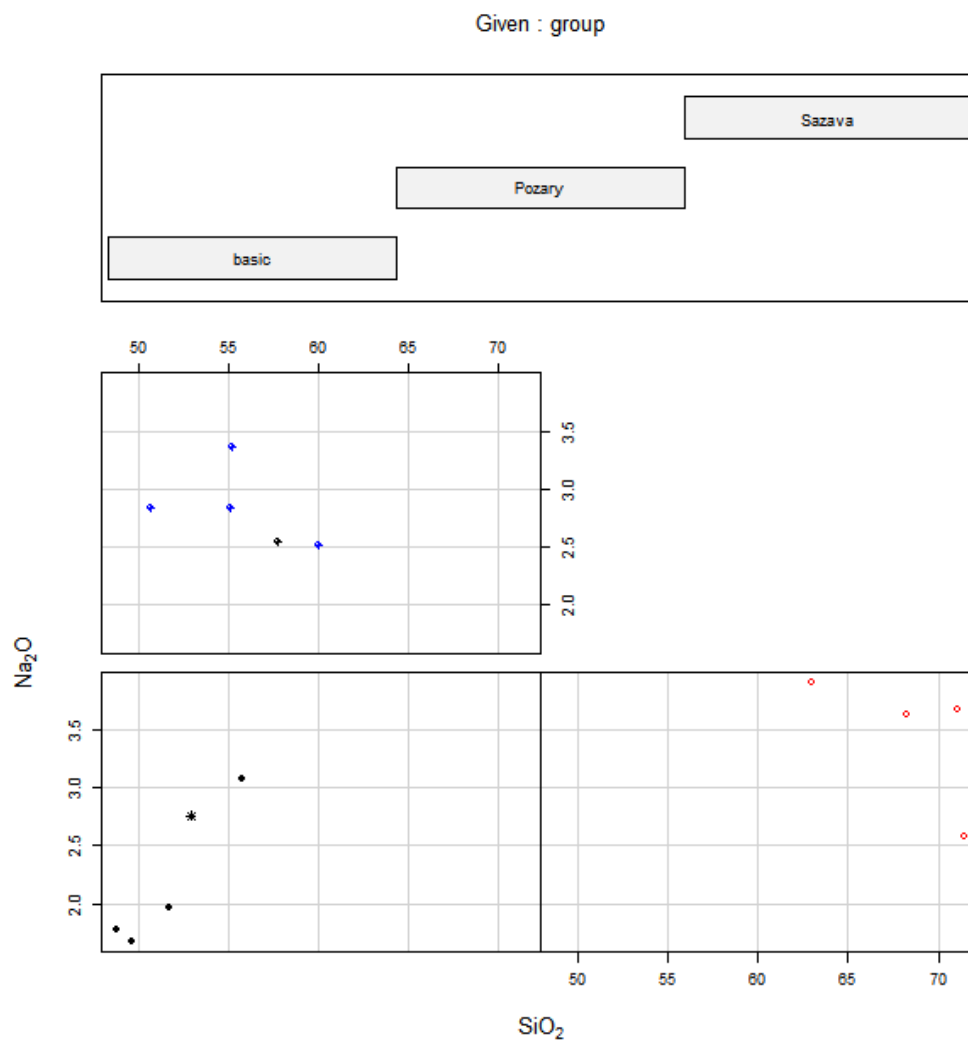
```
coplotByGroup(xaxis = "",yaxis = "",show.leg = "")
```

## Arguments

xaxis	Name of the data column to be used as x axis.
yaxis	Name of the data column to be used as y axis.
show.leg	Logical: are the levels of the conditioning variable ('groups') to be shown?

## Details

For examination of large datasets split into user-defined subsets serves in R function [coplot](#). It produces a set of binary diagrams with the data filtered out according to the values of the third (conditioning) variable. In case of the function 'coplotByGroup' it is done by groups.



If no parameters 'xlab', 'ylab' and 'show.leg' are given, the user is prompted to specify them.

The variables to be plotted are selected using the function `'selectColumnLabel'`.

See manual entry for `'coplot'` for further details.

### Value

None.

### Warning

Please note that no formulae can be handled at this stage.

This function IS NOT Figaro-compatible.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz> & Vojtech Erban, <vojtech.erban@geology.cz>

See Also

['coplot'](#)

Examples

```
coplotByGroup("SiO2", "Na2O", show.leg=TRUE)
```

---

coplotTri	<i>Coplot for three variables</i>
-----------	-----------------------------------

---

Description

Plots a series of binary plots split into several groups according to the values of the third, so called conditioning, variable.

Usage

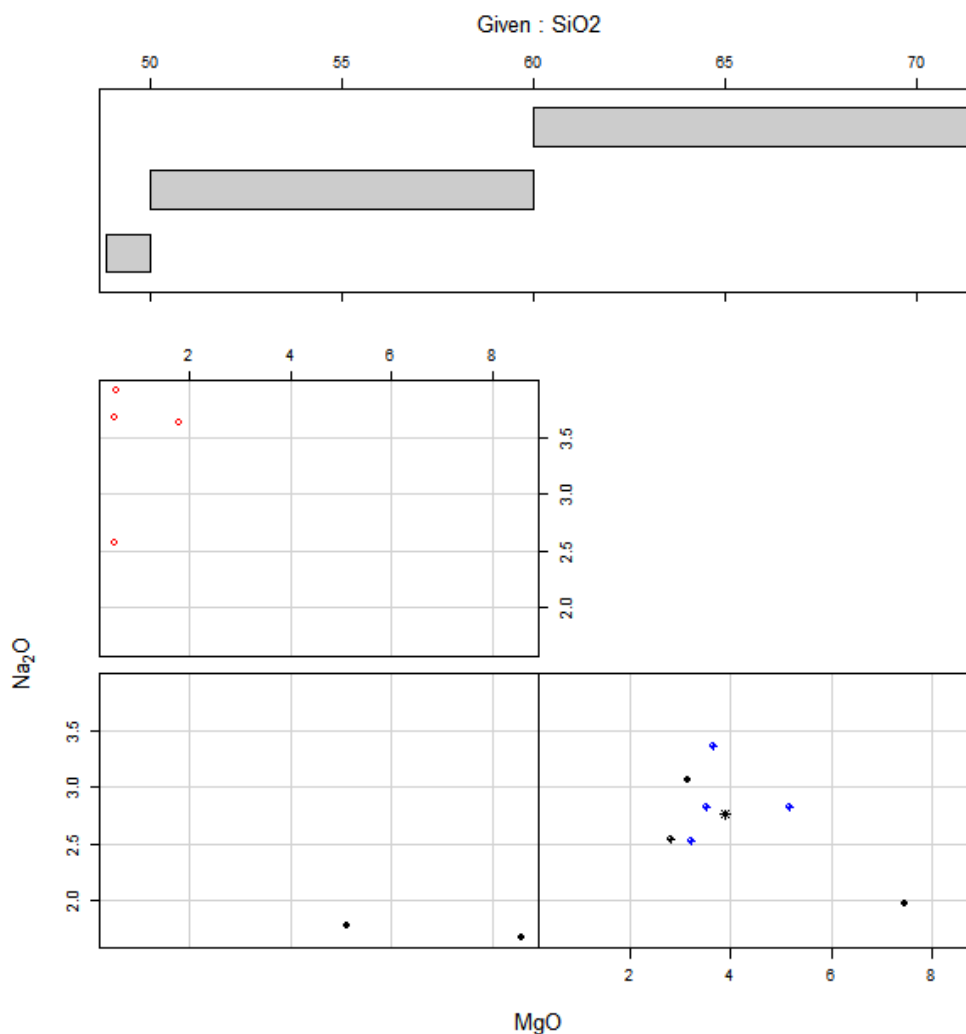
```
coplotTri(xaxis = "", yaxis = "", zaxis = "", int = "")
```

Arguments

xaxis	Name of the data column to be used as x axis.
yaxis	Name of the data column to be used as y axis.
zaxis	Name of the data column with the conditioning variable.
int	The specification of the intervals: either 'auto' or a list of break points separated by commas.

Details

For examination of large datasets split into user-defined subsets serves in R the function '[coplot](#)'. It displays a series of binary diagrams with the data filtered out according to the values of the third (conditioning) variable.



If no parameters 'xlab', 'ylab' and 'zlab' are given, the user is prompted to specify them.

The variables to be plotted are selected using the function `'selectColumnLabel'`.

After this is done, the user is prompted to enter a comma-delimited list of at least one break point defining the intervals. The default includes the mean, that will be automatically supplemented by minimum and maximum (i.e. two intervals).

See manual entry for `'coplot'` for further details.

### Value

None.

### Warning

Please note that no formulae can be handled at this stage.

This function IS NOT Figaro-compatible.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz> & Vojtech Erban, <vojtech.erban@geology.cz>

**See Also**

`'coplot'`

**Examples**

```
coplotTri("SiO2", "Na2O", "MgO", "auto")

coplotTri("MgO", "Na2O", "SiO2", "50,60")
# the intervals of the conditioning variable, SiO2,
# will be (min(SiO2) - 50), (50 - 60) and (60 - max(SiO2))
```

---

correlationCoefPlot	<i>Statistics: Correlation coefficient patterns</i>
---------------------	---

---

**Description**

Produces, for each group a separate, set of plots of correlation coefficient patterns.

**Usage**

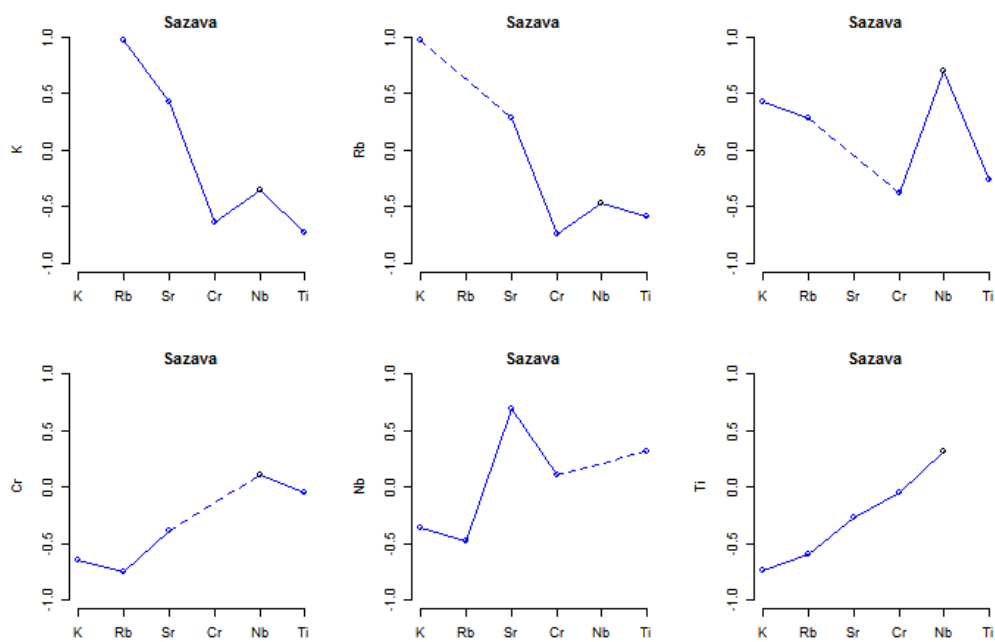
```
correlationCoefPlot(elems = NULL)
```

**Arguments**

elems	list of desired elements
-------	--------------------------

**Details**

The utility of correlation coefficient patterns was discussed by *Rollinson (1993 and references therein)*. Basically similarity in correlation patterns between two or more elements means their analogous geochemical behaviour, potentially controlled by the same geochemical process (fractional crystallization, partial melting, weathering, hydrothermal alteration...)



The variables are selected using the function `'selectColumnsLabels'`.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Rollinson H R (1993) Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman, London, p. 1-352

**Examples**

```
correlationCoefPlot(elems="K,Rb,Sr,Cr,Nb,Ti")
```

---

Cox	<i>TAS diagram (Cox et al. 1979)</i>
-----	--------------------------------------

---

**Description**

Assigns data for Cox's diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.



**Usage**

```
CoxVolc(alkline=TRUE)
```

```
CoxPlut(alkline=TRUE)
```

**Arguments**

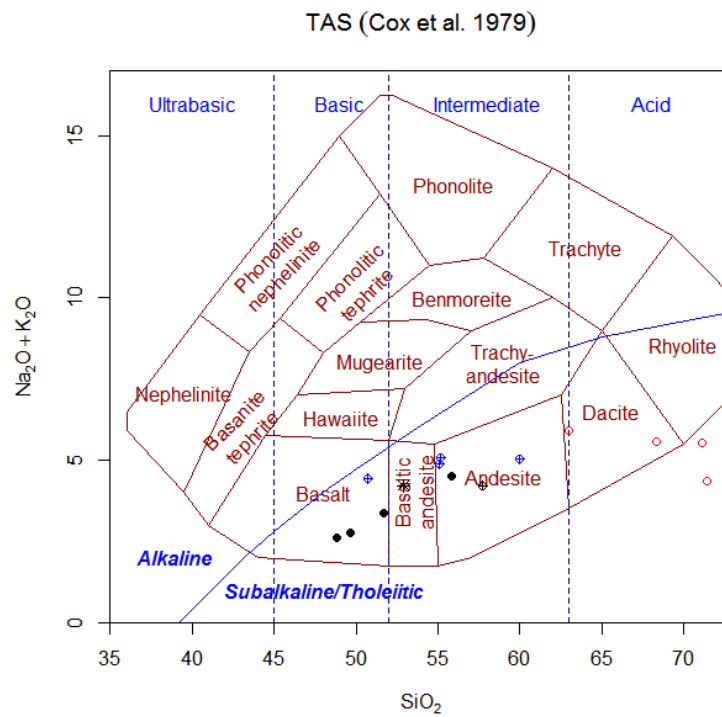
**alkline** Logical: Should the boundary between alkaline and subalkaline rocks (Irvine & Baragar 1971) be drawn?

**Details**

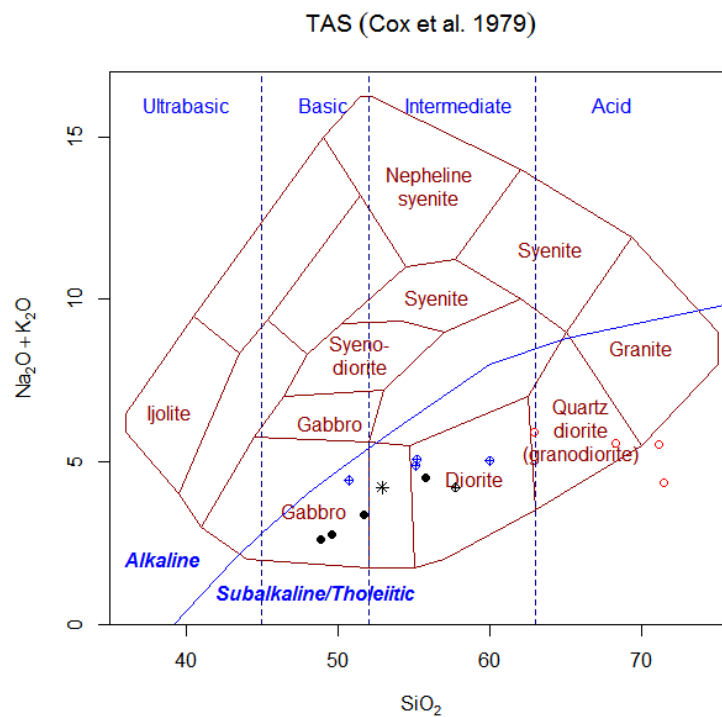
TAS diagram, as proposed by *Cox et al. (1979)* for volcanic rocks and adapted by *Wilson (1989)* for plutonic rocks contains following fields:

<b>volcanic rocks</b>	<b>plutonic rocks</b>
<i>basalt</i>	<i>gabbro</i>
<i>basaltic andesite</i>	<i>undefined</i>
<i>andesite</i>	<i>diorite</i>
<i>dacite</i>	<i>quartz diorite (granodiorite)</i>
<i>rhyolite</i>	<i>alkali granite/granite</i>
<i>hawaiite</i>	<i>gabbro</i>
<i>trachyandesite</i>	<i>undefined</i>
<i>basanite/tephrite</i>	<i>undefined</i>
<i>mugearite</i>	<i>syeno-diorite</i>
<i>benmorite</i>	<i>syenite</i>
<i>trachyte</i>	<i>syenite</i>
<i>nephelinite</i>	<i>ijolite</i>
<i>phonology nephelinite</i>	<i>undefined</i>
<i>phonolitic tephrite</i>	<i>undefined</i>
<i>phonolite</i>	<i>nepheline syenite</i>

For volcanic rocks, the following diagram is plotted:



And this is the version for plutonic rocks:



**Value**

sheet	list with Figaro Style Sheet data
x.data	SiO <sub>2</sub> weight percent
y.data	Na <sub>2</sub> O+K <sub>2</sub> O weight percent

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Cox K G, Bell J D & Pankhurst (1979) The Interpretation of Igneous Rocks. Allen & Unwin, London  
 Wilson M (1989) Igneous Petrogenesis. Chapman & Hall, London  
 Irvine T M & Baragar W R (1971) A guide to the chemical classification of common volcanic rocks. Canad J Earth Sci 8: 523-548 doi: [10.1139/e71-055](https://doi.org/10.1139/e71-055)

**See Also**

[classify figaro plotDiagram](#)

**Examples**

```
#TAS diagram is called using following auxiliary functions:
#Classifies data stored in WR (Groups by diagram)
classify("CoxVolc")
#or
classify("CoxPlut")

#Plots data stored in WR or its subset (menu Classification)
plotDiagram("CoxVolc", FALSE)
#or
plotDiagram("CoxPlut", FALSE)
```

---

crosstab

---

*Cross table of labels*


---

**Description**

Prints a cross table (contingency table) for 1-3 labels.

**Usage**

```
crosstab(plot = TRUE)
```

**Arguments**

plot                      logical; should be also a barplot plotted?

**Details**

This command prints a frequency distribution (for a single label) or a contingency table (for 2-3 labels) useful for inspection of the data structure. Optionally a barplot is plotted (for 1-2 labels).

Just press Enter (enter an empty field), when the desired number of variables is reached.

**Value**

results            the frequency/contingency table

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

customScript	<i>Add a new variable to a script</i>
--------------	---------------------------------------

---

**Description**

Adds a formula to calculate a single numeric variable to the specified \*.r file (a R script).

**Usage**

customScript()

**Details**

A formula can be entered that can involve any combination of names of existing numerical columns, with the constants, brackets, arithmetic operators +-\*/^ and R functions. See [calcCore](#) for a correct syntax.

Then the user is prompted for the name of the variable and any comments that should appear in the file.

The filename is chosen interactively, the default suffix for the R programs is .r. If the file exists already, the script is appended to its end.

If desired, the calculated variable can be, after the script is executed, added automatically to the numeric data, i.e. the numeric matrix WR. If not, the contents of the calculated variable can be viewed by simply typing its name in the R Console window.

The script can be run at a later time using the R command File|Source. Alternatively, it can be placed among the so-called plugins into the subdirectory Plugin. All files placed here with a suffix \*.r are executed each time when the new data file is being loaded into the GCDkit.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```
## Not run:
# examples of valid formulae...
(Na2O+K2O)/CaO
Rb^2
log10(Sr)
mean(SiO2)/10

# ... but this command is in fact a simple R shell -
# meaning lots of fun for power users!
summary(Rb,na.rm=T)
cbind(SiO2/2,TiO2,Na2O+K2O)
cbind(major)
hist(SiO2,col="red")
boxplot(Rb~factor(groups))

# possibilities are endless
plot(Rb,Sr,col="blue",pch="+",xlab="Rb (ppm)",ylab="Sr (ppm)",log="xy")

## End(Not run)
```

---

cutMy

*Groups by numerical variable*


---

## Description

Grouping the data according to the interval of a single numerical variable it falls into.

## Usage

```
cutMy(where=NULL,int=NULL,int.lab=NULL,na.lab="Unclassified")
```

## Arguments

where	Numeric data column in 'WR' - the basis of the classification.
int	Boundaries of intervals.
int.lab	Labels for the intervals
na.lab	Labels for samples that cannot be classified

## Details

The numeric data column is selected using the function '[selectColumnLabel](#)'.

After this is done, the user is prompted to enter a comma-delimited list or at least one break point defining the intervals. The default includes the mean, that will be automatically supplemented by minimum and maximum (i.e. two intervals).

Then the names of the individual groups are to be specified; values out of range are automatically labeled as 'Unclassified'. The vector containing the information on the current groups can be appended to the data frame 'labels'.

**Value**

groups	character vector: the grouping information
grouping	If the new column was appended the data frame labels, sequence number of this column; if not appended, though, this variable is set to -100.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[cut](#)

---

Debon	<i>BA and PQ diagrams (Debon + Le Fort 1983)</i>
-------	--

---

**Description**

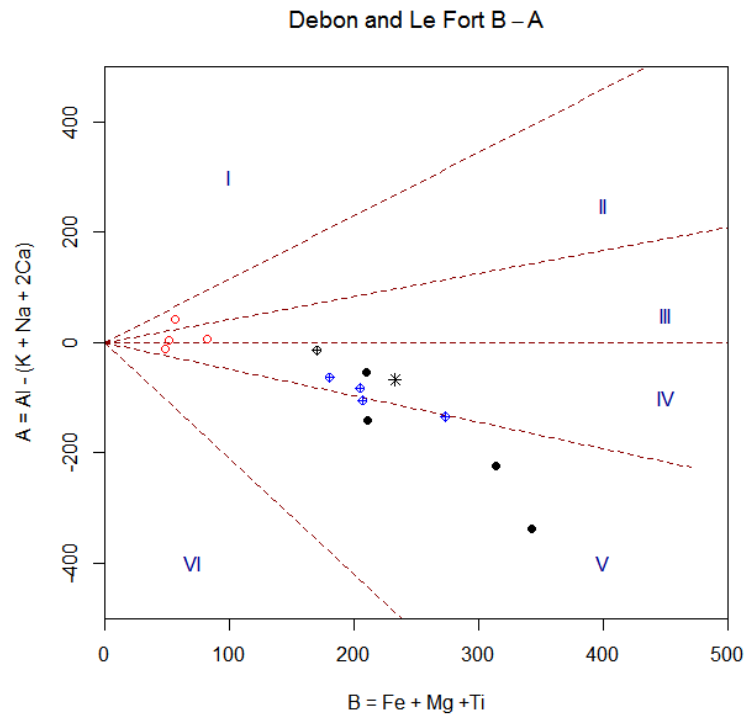
Assigns data for Debon & Le Fort's B-A and P-Q diagrams into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

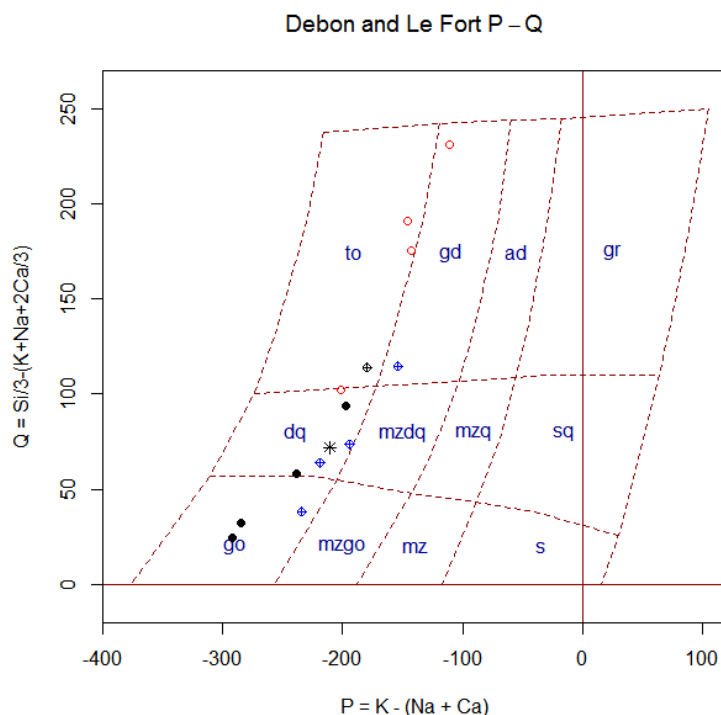
```
DebonBA()
DebonPQ()
```

**Details**

The B-A diagram as proposed by *Debon and Le Fort (1983)* defines six sectors (I - VI), reflecting alumina balance of samples. Following minerals are characteristic for individual sectors:



Layout of the P-Q diagram of the same authors corresponds to cationic proportions of quartz, K-feldspar and plagioclase.



Abbreviations used as classification output represent following rocks groups:

label	plutonic rocks	volcanic rocks
go	<i>gabbro, diorite, anorthosite</i>	<i>basalt, andesite, kenningite</i>
mzgo	<i>monzogabbro, monzodiorite</i>	<i>latibasalt, latiandesite</i>
mz	<i>monzonite</i>	<i>latite</i>
s	<i>syenite</i>	<i>trachyte</i>
dq	<i>qtz diorite, qtz gabbro, qtz anorthosite</i>	<i>qtz andesite, qtz basalt</i>
mzdq	<i>qtz monzodiorite, qtz monzogabbro</i>	<i>qtz latiandesite, qtz latibasalt</i>
mzq	<i>quartz monzonite</i>	<i>quartz latite</i>
sq	<i>quartz syenite</i>	<i>quartz trachyte</i>
to	<i>tonalite, trondhjemite</i>	<i>dacite</i>
gd	<i>granodiorite, granogabbro</i>	<i>rhyodacite</i>
ad	<i>adamellite</i>	<i>dellenite</i>
gr	<i>granite</i>	<i>rhyolite</i>

Parameters for the diagram are calculated by the function 'DebonCalc'. All of them are based on millications (1000 gram-atoms per 100 grams).

$$P = \text{K} - (\text{Na} + \text{Ca})$$

$$Q = \text{Si} / 3 - (\text{K} + \text{Na} + 2 * \text{Ca} / 3)$$

$$A = \text{Al} - (\text{K} + \text{Na} + 2 \text{Ca})$$

$$B = \text{Fe} + \text{Mg} + \text{Ti}$$

Note that the diagrams B-A and P-Q are recommended as complementary, i.e. resulting names should be used in conjunction (*granite II* etc.). For details, see *Debon & Le Fort (1983)* or *(1988)*.



**Value**

sheet	list with Figaro Style Sheet data
x.data	P or B value. See details.
y.data	Q or A value. See details.

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Debon F & Le Fort P (1983) A chemical-mineralogical classification of common plutonic rocks and associations. Trans Roy Soc Edinb; Earth Sci 73: 135-149

Debon F & Le Fort P (1988) A cationic classification of common plutonic rocks and their magmatic associations: principles, method, applications. Bull. Mineral 111: 493-511

**See Also**

[classify figaro plotDiagram DebonCalc](#)

---

deleteSingle	<i>Delete label or variable</i>
--------------	---------------------------------

---

**Description**

Deletes a single numeric variable or a label.

**Usage**

```
deleteSingle()
```

**Details**

The variables to be deleted is selected using the function '[selectColumnLabel](#)'. In any case, a confirmation is required before a variable is deleted from the system. Note that some variables are required by the system and cannot be deleted.

**Value**

Returns the corrected version of the data frame 'labels' or numeric matrix 'WR'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

Edit labels

*Edit labels*


---

### Description

Simultaneous editing of all labels using a spreadsheet-like interface.

### Usage

```
editLabels()
```

### Arguments

none.

### Details

The function invokes a spreadsheet-like interface that enables the user to edit the labels for individual samples. When all the desired changes have been performed, close button is to be clicked.

### Value

Returns the corrected version of the data frame 'labels'.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### See Also

['data.entry'](#)

---

Edit numeric data

*Edit numeric data*


---

### Description

Simultaneous editing of all numeric data using a spreadsheet-like interface.

### Usage

```
editData(x=WR)
```

### Arguments

x data frame/numeric matrix to be edited; default is 'WR', i.e. numeric data

**Details**

The function invokes a spreadsheet-like interface that enables the user to edit the numeric data for individual samples. When all the desired changes have been performed, close button is to be clicked.

The system then performs some recalculations as if the data set was loaded from the disc afresh (calling `'Gcdkit.r'`).

**Value**

Returns the corrected version of the numeric matrix `'WR'`.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[`data.entry`](#)

---

editLabFactor

*Edit label as factor*


---

**Description**

Global replacement each of the discrete values (levels) for a selected label.

**Usage**

```
editLabFactor()
```

**Details**

The label to be edited is selected using the function [`selectColumnLabel`](#).

Then the function invokes a spreadsheet-like interface that enables the user to overwrite directly any of the discrete values for the a given label, in the R jargon called *levels*. When all the desired changes have been performed, close button is to be clicked.

**Value**

Returns the corrected version of the data frame labels.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[`data.entry`](#)

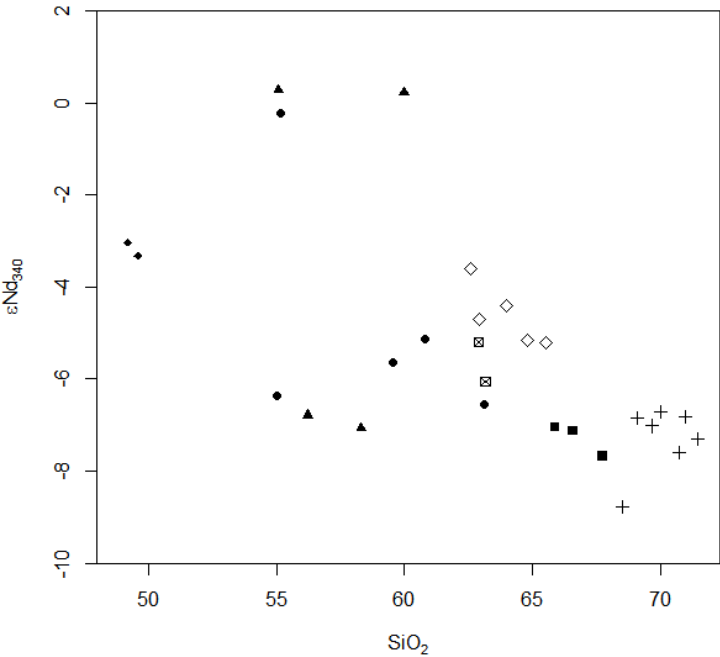
---

elemIso	Binary plot of a WR geochemical parameter vs isotopic ratio
---------	---

---

**Description**

Plots a diagram of a selected whole-rock geochemical parameter vs initial Sr isotopic ratios or initial  $\epsilon(Nd)$  for selected samples.



**Usage**

elemIso()

**Arguments**

None.

**Details**

The variable to be plotted as x axis is selected using the function '[selectColumnLabel](#)'. In the specification of the variable can be used also an arithmetic expression, see [calcCore](#) for the correct syntax.

The plotted isotopic parameters (y axis) can be one of:

Menu item	Explanation
87Sr/86Sr	Initial Sr isotopic ratios
143Nd/144Nd	Initial Nd isotopic ratios

EpsNdi	Initial $\epsilon(Nd)$ values
1 stg DM model ages ( <i>Goldstein et al. 1988</i> )	Single-stage DM Nd model ages
1 stg DM model ages ( <i>Liew &amp; Hofmann 1988</i> )	Single-stage DM Nd model ages
2 stg DM model ages ( <i>Liew &amp; Hofmann 1988</i> )	Two-stage DM Nd model ages

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

### Value

None.

### Plugin

SrNd.r

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138
- Goldstein S L, O'Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236

---

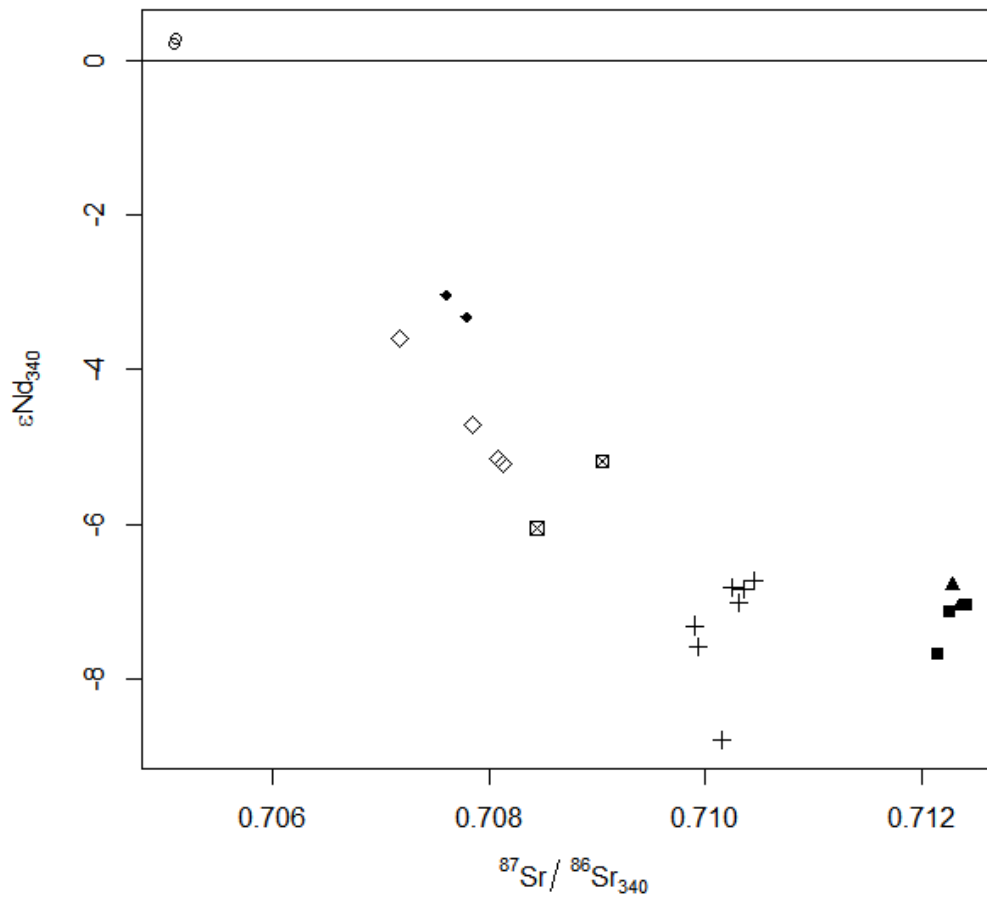
epsEps

*Binary plot of initial Sr isotopic ratios vs. initial epsilon Nd values*

---

### Description

Plots a diagram of initial Sr isotopic ratios vs. initial  $\epsilon(Nd)$  values for selected samples.



### Usage

epsEps()

### Arguments

None.

### Details

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

### Value

None.

### Plugin

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

Export to Access

*Export to Access*

---

**Description**

This function serves for exporting the specified data into MDB (MS Access) format (via the ODBC interface).

**Usage**

```
accessExport(what=cbind(labels, WR), tablename=NULL,
transpose=FALSE, dec.places=NULL)
```

**Arguments**

what	a matrix, data frame or a list
tablename	name of the data table
transpose	logical; transpose the data?
dec.places	numeric; number of decimal places

**Details**

The function `accessExport` outputs the specified data via Microsoft's ODBC interface, taking an advantage of the library 'RODBC'. Unlike for the function '`excelExport`', ODBC makes possible opening a new file.

If the argument 'what' is a matrix or data frame, the name of the table can be specified using the optional parameter 'tablename'.

For a list, several tables are created, their number and names corresponding to the items present.

**Value**

None.

**Warning**

This function is not available on 64-bit systems!

**Author(s)**

The RODBC package was written by Brian Ripley.  
 Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

'`excelExport`' '`dbfExport`'

**Examples**

```
accessExport(results) # Saves the last calculated results
```

---

 Export to DBF

*Export to DBF*


---

### Description

This function serves for exporting the specified data into DBF (dBase III) format (using the function `'write.dbf'` of the package `'foreign'`).

### Usage

```
dbfExport(what=cbind(labels,WR), transpose=FALSE)
```

### Arguments

<code>what</code>	a matrix or data frame
<code>transpose</code>	logical; transpose the data frame?

### Details

The function `dbfExport` outputs the specified data. Note that it cannot handle lists.

### Value

None.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### See Also

`'write.dbf'` `'excelExport'` `'accessExport'`

### Examples

```
dbfExport(results) # Saves the last calculated results
```

---

 Export to Excel

*Export to Excel*


---

### Description

This function serves for exporting the specified data into XLS or XLSX (MS Excel) formats (via the ODBC interface).

### Usage

```
excelExport(what=cbind(labels, WR), tablename =NULL,  
transpose=FALSE, dec.places=NULL)
```

```
excel2007Export(what=cbind(labels, WR), tablename =NULL,  
transpose=FALSE, dec.places=NULL)
```



**Arguments**

what	a matrix, data frame or a list
tablename	name of the data sheet
transpose	logical; transpose the data?
dec.places	numeric; number of decimal places

**Details**

The functions `excelExport` and `excel2007Export` output the specified data via Microsoft's ODBC interface, taking an advantage of the library 'RODBC'.

If the argument 'what' is a matrix or data frame, the name of the sheet can be specified using the optional parameter 'tablename'.

For a list, several sheets are attached, their number and names corresponding to the items present.

**Value**

None.

**Warning**

These functions are not available on 64-bit systems!

Unfortunately the way the ODBC is programmed by Microsoft does not make opening a new Excel file possible. Thus only adding new sheet(s) to a pre-existing spreadsheet file is feasible.

**Author(s)**

The RODBC package was written by Brian Ripley.

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['accessExport'](#) ['dbfExport'](#)

**Examples**

```
excelExport(results) # Saves the last calculated results in XLS format
```

```
excel2007Export(results) # Saves the last calculated results in XLSX (or XLS) format
```

---

Export to HTML tables *Export to HTML tables*

---

**Description**

Outputs the specified data with (optional) labels into HTML. This format is useful for importing into spreadsheets, word processors or publishing on the WWW.

**Usage**

```
HTMLTableMain(what,digits=2,desc=NULL,title=" ",sum.up=FALSE,open=TRUE,
close=TRUE,filename=paste(gcdx.dir,"R2HTML/htmltable",sep="/"),rotate=FALSE)
```

```
HTMLtableOrdered(what,which=rownames(what),labs=labels,digits=2,desc=NULL,
title=" ",sum.up=FALSE,key1=NULL,key2=NULL,
filename=paste(gcdx.dir,"R2HTML/htmltable",sep="/"),split.by=25,rotate=TRUE)
```

```
HTMLTableWR(filename="htmltable")
```

```
HTMLTableResults(filename="htmltable")
```

**Arguments**

<code>what</code>	numeric matrix; data to be exported
<code>digits</code>	required precision
<code>desc</code>	name of the columns within 'labels' to be attached to the table
<code>title</code>	main title
<code>sum.up</code>	logical; should be a sum calculated?
<code>open</code>	logical; should be opened a new HTML file?
<code>close</code>	logical; should be the HTML file closed when finished?
<code>filename</code>	optional name for the file produced
<code>rotate</code>	logical, should be the table transposed, with samples in columns and variables in rows?
<code>which</code>	(optional) sample names in numeric matrix 'what' for the output
<code>labs</code>	name of variable with textual labels
<code>key1</code>	is a variable in numeric matrix 'what'
<code>key2</code>	is a grouping information (name of a column in 'labs')
<code>split.by</code>	maximal number of data columns per page

**Details**

HTMLTableWR and HTMLTableResults are GUI front ends to HTMLTableMain, the former enabling the user to choose samples (rows) and columns for the output using the searching mechanisms common in the GCDkit.

HTMLTableWR outputs the numeric data (with optional labels and sum) stored in the data matrix 'WR'.

HTMLtableOrdered also outputs the numeric data stored in the numeric matrix specified by parameter 'what'. Optional argument 'which' gives the list of sample names (rows) in the matrix to be saved. The data are first sorted based on 'key2', which typically gives a grouping information (name of a column in 'labs'). Within each of the groups, the data are further sorted based on the numeric variable 'key1'. See example.

HTMLTableResults outputs the results of the most recent calculation (with optional labels and sum) as stored in the variable 'results'.

The plugin attempts to format sub- and superscripts in the names of variables.

The created file 'filename' is placed in the subdirectory 'R2HTML' of the current working directory; when finished, it is previewed in a browser. The style for the table is determined by the cascade style file R2HTML.css in the subdirectory 'Plugin'.

**Sazava data [wt. %]**

	Intrusion	SiO <sub>2</sub>	MgO	FeOt
Sa-1	Sazava	59.98	3.21	6.67
Sa-2	Sazava	55.17	3.67	7.65
Sa-3	Sazava	55.09	3.52	7.73
Sa-4	Sazava	50.72	5.18	9.62
Sa-7	Sazava	57.73	2.82	6.33
SaD-1	basic	52.90	3.89	8.56
Gbs-1	basic	49.63	8.59	8.59
Gbs-20	basic	51.72	7.47	8.63
Gbs-2	basic	48.84	5.11	5.69
Gbs-3	basic	55.80	3.16	8.73
Po-1	Pozary	62.95	0.55	2.25
Po-3	Pozary	68.30	1.77	2.48
Po-4	Pozary	71.09	0.52	2.46
Po-5	Pozary	71.42	0.52	2.83

Generated on: *Fri Oct 23 17:03:41 2015* - GCDkitDevelop via R2HTML

**Value**

None.

**Warning**

The plugin uses R2HTML library, which must be downloaded from CRAN and properly installed. Its presence is checked before the code is executed.

**Author(s)**

The R2HTML package was written by Eric Lecoutre.

Vojtech Janousek, <vojtech.janousek@geology.cz>

**Examples**

```
# Works on the 'sazava' test data set
setwd(paste(gcdx.dir,"Test_data",sep="/"))
loadData("sazava.data")
```

```
HTMLTableMain(WR[,c("SiO2", "MgO", "FeOt")], digits=2, desc="Intrusion", title="Sazava [wt.%]")
```

```
HTMLtableOrdered(WR[,LILE], digits=1, key1="SiO2", key2="Intrusion", title="Large Ion Lithophile  
Elements (ppm)", split.by=3)
```

FeMiddlemost

*Adjustment of Fe oxidation ratio (Middlemost 1989))***Description**

Auxiliary function performing adjustment of the iron-oxidation ratio as proposed by *Middlemost (1989)*.

**Usage**

```
FeMiddlemost(anhydrous = TRUE)
```

**Arguments**

anhydrous            logical; should be returned major-element analyses recast to anhydrous basis?

**Details**

This function performs an adjustment of the iron-oxidation ratio for individual volcanic rock types as proposed by *Middlemost (1989)*.

The classification is based on TAS classification (*Le Bas et al. 1986, Le Maitre et al. 1989*).

The  $Fe_2O_3/FeO$  ratios for individual rock types, based on *Verma et al. (2002)* (Fig. 1), are as follows:

foidite, $Na_2O + K_2O \leq 3$	0.15
foidite, $3 < Na_2O + K_2O \leq 7$	0.2
foidite, $7 < Na_2O + K_2O \leq 10$	0.3
foidite, $Na_2O + K_2O > 10$	0.4
microbasalt	0.15
basalt	0.2
basaltic andesite	0.3
andesite	0.35
dacite	0.4
rhyolite	0.5
trachybasalt	0.3
basaltic trachyandesite	0.35
trachyandesite	0.4
trachyte/trachydacite	0.5
tephrite/basanite, $Na_2O + K_2O \leq 6$	0.2
tephrite/basanite, $Na_2O + K_2O > 6$	0.3
phonotephrite	0.35
tephriphonolite	0.4
phonolite	0.5

If the parameter 'anhydrous' is set, returned are the major-element data recast to 100 % anhydrous basis.

**Value**

A matrix with adjusted whole-rock chemical data.  
No permanent changes to either 'WR' or 'WRanh' are made.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Le Bas M J, Le Maitre R W, Streckeisen A & Zanettin B (1986) A chemical classification of volcanic rocks based on the total alkali-silica diagram. *J Petrology* 27: 745-750 doi: [10.1093/petrology/27.3.745](https://doi.org/10.1093/petrology/27.3.745)
- Le Maitre R W et al (1989) *Igneous Rocks: A Classification and Glossary of Terms*, 1st edition. Cambridge University Press
- Middlemost E A K (1989) Iron oxidation ratios, norms and the classification of volcanic rocks. *Chem Geol* 77: 19-26 doi: [10.1016/0009-2541\(89\)90011-9](https://doi.org/10.1016/0009-2541(89)90011-9)
- Verma S P, Torres-Alvarado I S, Sotelo-Rodriguez Z T (2002) SINCLAS: standard igneous norm and volcanic rock classification system. *Comput and Geosci* 28: 711-715 doi: [10.1016/S0098-3004\(01\)00087-5](https://doi.org/10.1016/S0098-3004(01)00087-5)

**See Also**

[TAS Verma](#)

---

figAdd

---

*Plot editing: Add*


---

**Description**

These functions enable adding new components to Figaro-compatible plots.

**Usage**

```
figTicks(major=-0.5,minor=0.25,xmjr=NULL,xmin=NULL,ymjr=NULL,ymin=NULL)

figGrid(lty="dotted", col="gray30")

figLegend()

figAddReservoirs(autoscale=FALSE,reservoirs=NULL,labs=NULL)

figAddText()

figAddArrow()

figAddBox()

figAddFit()

figAddCurve(equation=NULL)
```

## Arguments

major	length of the major tick marks
minor	length of the minor tick marks
xmjr, ymjr	intervals for the major tick marks
xmin, ymin	intervals for the minor tick marks
lty	grid line type
col	plotting colour
autoscale	logical; should be the scaling changed so that all the overplotted values are shown?
reservoirs	text; regular expression specifying reservoirs compositions of which are to be plotted
labs	text; optional abbreviated labels for the individual reservoirs
equation	text with equation expressed as a function of x; see <a href="#">curve</a>

## Details

'figTicks' adds major and minor tick marks for the x and y axes. Their length is specified as a fraction of the height of a line of text. Negative numbers imply outward and positive inward pointing ticks. The user is prompted for four numbers separated by commas, xmjr, xmin, ymjr, ymin. These specify the intervals of major and minor ticks for x and y axes, respectively. Not implemented to logarithmic plots and spiderplots yet.

'figGrid' adds grid lines for x and/or y axes.

'figLegend' adds legend(s) on specified location.

'figAddReservoirs' overplots compositions of selected geochemical reservoirs (from the file 'reservoirs.data', see [selectNorm](#) for the file structure as well as relevant references) and/or ideal minerals (from the file 'idealmins.data'). The optional parameter `reservoirs` enables use in batch mode (see Examples). Please note that this function is available so far for binary plots and spiderplots only.

'figAddText' adds text on specified location. The parameters are the text style ('n' = normal, 'b' = bold, 'i' = italic and 'bi' = bold italic), colour and relative size.

'figAddArrow' adds arrow on specified location. The parameters are colour and line style ('solid', 'dashed', 'dotted' and 'dotdash').

'figAddBox' adds box on specified location (click bottom left and then top right corner).

'figAddFit' adds either a single least-squares fit to all data, or several fit lines, for each of the groups separately. The parameters are colour and line style ('solid', 'dashed', 'dotted' and 'dotdash'). The equation of each fit line is plotted at the user-defined location.

'figAddCurve' adds a curve, specified as a function of variable 'x'. The parameters are colour and line style ('solid', 'dashed', 'dotted' and 'dotdash').

The colours can be specified both by their code (see table under menu 'Data handling|Show available colours') or R name (see Examples).

The additional two menu items, available for binary and ternary plots, allow adding contours or convex hulls outlining individual groups of data. See [contourGroups](#) and [chullGroups](#).

## Warning

These functions serve to adding some extra components/annotations immediately before the graph is printed/exported. Note that all user-defined components added via 'Plot editing: Add' will be lost upon redrawing, zooming ....

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['par'](#) ['showColours'](#) ['colours'](#) ['figaro'](#) ['selectNorm'](#) ['contourGroups'](#) ['chullGroups'](#) ['curve'](#)

**Examples**

```
binary("Zr/Nb", "Ba/La")
figTicks(major=-0.5, minor=0.25, 10, 1, 10, 1)

reserv<-c("MORB|OIB .* McDonough", "Upper .* 1995", "Lower .* 1995")
# Sun & McDonough mantle reservoirs, Taylor & McLennan 1995 Upper and Lower Crust
reserv.names<-c("NMORB", "EMORB", "OIB", "UCC", "LCC")
figAddReservoirs(TRUE, reserv, reserv.names)
```

---

figaro.identify

---

*Plot editing: Identification of plotted symbols*


---

**Description**

These functions allow the user to identify points in Figaro-compatible plots.

**Usage**

```
figIdentify()

highlightSelection()
```

**Details**

'figIdentify' identifies points closest to a mouse pointer, if a mouse button is pressed. For binary and ternary plots, sample names are plotted; for spider plots the function prints the sample name, concentration of the given element (in ppm) and highlights the whole pattern. The identification is terminated by pressing the right button and selecting 'Stop' from the menu.

'highlightSelection' allows the selected analyses to be highlighted. The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

If the search results are empty or embrace all samples, the user is given a chance to select the samples from the list of their names. Press Ctrl+click to select multiple ones.

For binary and ternary plots, Press Esc in the Console window to stop the points blinking. In spider plots are shown overall ranges of normalized concentrations (by a gray field) with superimposed patterns for selected samples.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[identify selectSubset](#) ['figaro'](#)

---

figCol

*Plot editing: Colours*

---

**Description**

These functions enable altering colours for titles or all plotting symbols in Figaro-compatible plots.

**Usage**

```
figCol(col=NULL)
```

```
figColMain(col=NULL)
```

```
figColSub(col=NULL)
```

```
figBw()
```

**Arguments**

col                      colour specification

**Details**

The colours can be specified both by their code (see table under *Data handling\Show available colours*) or R name (see Examples).

figBw sets the whole plot (main title and subtitle, axes and plotting symbols) in black and white, making them ready for printing/exporting.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>

& Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['showColours'](#) ['colours'](#) ['figaro'](#)

**Examples**

```
colours() # prints the list of available colour names

plotDiagram("TAS",FALSE) # example of a classification plot
figSub(txt="My TAS diagram")
figCol(col="green")
figColMain(col="red")
figColSub(col="blue")

figBw()
```



```

spider(WR,selectNorm("Boynton"),0.1,1000,pch=labels$Symbol,col=labels$Colour)
figMain(txt="My REE plot")
figSub(txt="Normalized by Boynton (1989)")
figCol(col="green")
figColMain(col="red")
figColSub(col="blue")

```

figEdit

*Plot editing: Changing titles and axis labels*

## Description

These functions enable altering titles and axis labels of binary (figXlab, figYlab) and ternary (figAlab, figBlab, figClab), Figaro-compatible plots.

## Usage

```
figMain(txt=NULL)
```

```
figSub(txt=NULL)
```

```
figXlab(txt=NULL)
```

```
figYlab(txt=NULL)
```

```
figAlab(txt=NULL)
```

```
figBlab(txt=NULL)
```

```
figClab(txt=NULL)
```

## Arguments

txt	text
-----	------

## Details

If specified, the parameter txt will be passed to the function 'annotate' to guess the correct reformatting to sub- and superscripts for production of "publication quality" plots. Otherwise, the current value (titles or labels for axes/apices) are edited.

## Author(s)

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

'[annotate](#)'

'[figaro](#)'

## Examples

```
plotDiagram("TAS",FALSE) # example of a classification plot
figMain(txt="My TAS diagram")
figSub(txt="test")
figXlab(txt="Silica")
figYlab(txt="Total alkalis")
```

---

figGbo

*Defining groups on Figaro-compatible plots*

---

## Description

Interactive definition of groups on any Figaro-compatible plot.

## Usage

```
figGbo(x.tol = 0, y.tol = 0, max.points = 100, max.polygons = 25)
```

## Arguments

x.tol, y.tol	tolerance for the automatic closing of polygons.
max.points	maximum number of vertices for a single polygon.
max.polygons	maximum number of polygons.

## Details

Each of the groups is defined by clicking vertices of a polygon with the corresponding data points. The polygons are closed automatically. To finish, right click anywhere on the plot and select 'Stop'. The groups are numbered consecutively, points falling into two or more fields form extra groups, as do unclassified samples.

## Author(s)

Vojtech Erban, <vojtech.erban@geology.cz> & Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

['figaro'](#)

---

figLoad

*Loading a Figaro plot*


---

**Description**

Loads a Figaro-compatible plot (both the template and the data) stored in a file.

**Usage**

```
figLoad()
```

**Arguments**

None.

**Details**

The default suffix for the saved diagrams is 'fgr'. Note that only the data needed for the plotting ('x.data', 'y.data') are stored in the 'fgr' files. Thus the data set currently in memory (e.g., variables 'WR', 'labels', ...) is unaffected by the function 'figLoad'.

**Author(s)**

Colin Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[figSave figaro](#)

---

figMulti

*Figaro: Multiple plot by groups*


---

**Description**

Displays multiple plots, for each of the groups one, based on a most recently plotted Figaro-compatible template. For spiderplots, the colour field denotes the total variation with the whole dataset.

**Usage**

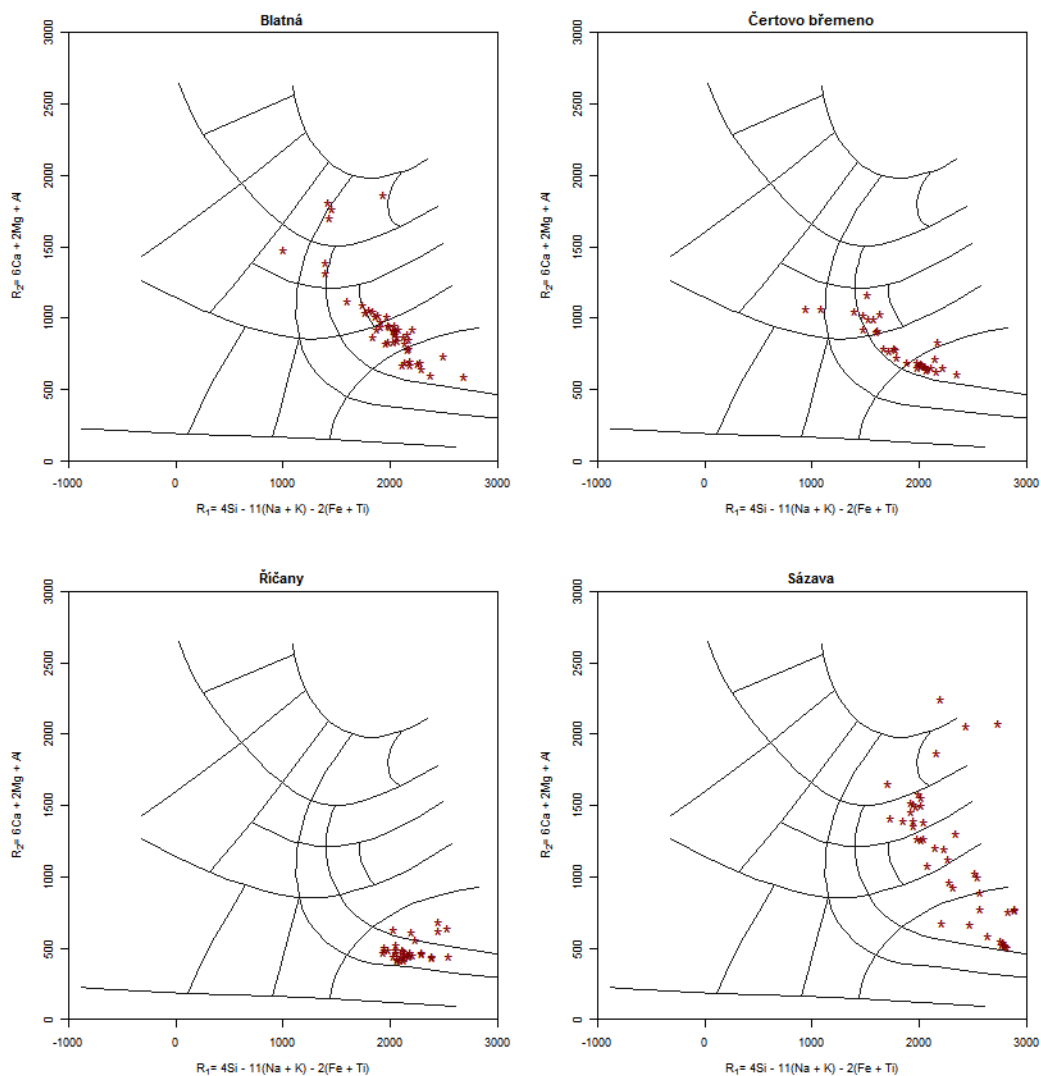
```
figMulti(x=x.data,y=y.data,nrow=NULL,ncol=NULL,xlab=sheet$demo$call$xlab,
        ylab=sheet$demo$call$ylab,pch=NULL,col=NULL,
        cex = NULL,plot.symb=NULL,shaded.col="gray",rotate.xlab=TRUE,
        offset=TRUE,centered=FALSE,title=NULL,...)
```

**Arguments**

<code>x, y</code>	data to be plotted
<code>nrow, ncol</code>	dimensions of the plots' matrix
<code>xlab, ylab</code>	labels for the axes
<code>pch</code>	plotting symbols
<code>col</code>	plotting colours
<code>cex</code>	relative size of the plotting symbols
<code>plot.symb</code>	logical, spiders. Shall be shown also plotting symbols or just lines?
<code>shaded.col</code>	(spiders) Colour for the field portraying the overall variability in the dataset.
<code>rotate.xlab</code>	logical, spiders. Shall be the element names on x axis rotated?
<code>offset</code>	logical, spiders. Shall be the names for odd and even elements shifted relative to each other?
<code>centered</code>	logical, spiders. Shall be the element names on x axis plotted in between tick marks?
<code>title</code>	optional title for the whole plate. If not provided, it is taken from the title of the Figaro template.
<code>...</code>	any additional graphical parameters

**Note**

$R_1 - R_2$  (De la Roche et al. 1980) – multiple by groups



This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

and Colin M. Farrow, <colinfarrow537@gmail.com>

**See Also**

[figaro](#), [Plate](#), [Plate editing](#) binary, [ternary](#), [spider](#)

**Examples**

```
# Note that groups should have been defined before running these.

# switch on the field names (default, valid globally for the whole system)
options("gcd.plot.text"=TRUE)
plotDiagram("TAS",FALSE)
figMulti()

# switch off the field names
options("gcd.plot.text"=FALSE)
plotDiagram("LarochePlut",FALSE)
figMulti(col="black",pch="x",cex=2)
options("gcd.plot.text"=TRUE)

spider(WR,selectNorm("Boynton"),0.1,1000,pch=labels$Symbol,col=labels$Colour,cex=labels$cex)
figMulti(plot.symb=TRUE,cex=2)

figMulti(col="red",plot.symb=FALSE,rotate.xlab=FALSE,offset=TRUE)

figMulti(col="red",plot.symb=FALSE,rotate.xlab=FALSE,offset=FALSE,shaded.col="khaki")
```

figRedraw

*Redrawing/refreshing a Figaro plot***Description**

This function redraws/refreshes a Figaro-compatible plot.

**Usage**

```
figRedraw(x=x.data,y=y.data,zoom=NULL,bw=FALSE)

refreshFig()
```

**Arguments**

x	vector of x coordinates
y	vector of y coordinates
zoom	logical; redraw while zooming?
bw	logical; should be the output black and white?

**Warning**

Note that all user-defined components added via 'Plot editing: Add' (legend, lines, text, boxes, ...) - will be lost.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**[figaro](#)


---

figSave	<i>Saving a Figaro plot</i>
---------	-----------------------------

---

**Description**

Saves the current Figaro-compatible plot, both the template and the data needed for the plotting ('x.data', 'y.data').

**Usage**

```
figSave()
```

**Arguments**

None.

**Details**

The default suffix for the saved diagrams is 'fgr'.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**[figLoad](#) [figaro](#)


---

figScale	<i>Plot editing: Scaling text or plotting symbols</i>
----------	---

---

**Description**

These functions enable changing a size of titles, axis labels or plotting symbols of Figaro-compatible plots. The size is relative to 1 (the original).

**Usage**

```
figCex(x=NULL)
```

```
figCexLab(x=NULL)
```

```
figCexMain(x=NULL)
```

```
figCexSub(x=NULL)
```

**Arguments**

x                      numeric: scaling factor.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

'figaro'

**Examples**

```
plotDiagram("TAS",FALSE) # example of a classification plot
figSub(txt="My TAS diagram")
figCex(2)
figCexMain(1.5)
figCexSub(0.5)

spider(WR,selectNorm("Boynton"),0.1,1000,pch=labels$Symbol,col=labels$Colour)
figMain(txt="My REE plot")
figSub(txt="Normalized by Boynton (1989)")
figCex(2)
figCexMain(1.5)
figCexSub(0.5)
```

---

figUser

*Plot editing: User defined parameter*


---

**Description**

Enables the power users to modify the plot parameters directly.

**Usage**

```
figUser(expression=NULL)
```

**Arguments**

expression            character; expression to be evaluated

**Details**

The parameters can be specified at the function call. If not, they are chosen by a dialogue. Several of the, can entered simultaneously, as a semicolon delimited list. The most useful might be:

main	Main title
sub	Sub title
xlab	Label of x axis
ylab	Label of y axis
xlim	Limits for the x axis



ylim	Limits for the y axis
bg	Colour of background
pch	Plotting symbols
col	Colour of plotting symbols
cex	Relative size of plotting symbols
log	Which of the axes is logarithmic? ("", "x", "y" or "xy")

If no parameters are entered, they can be chosen from a list (still experimental!)

## Menu

Plot editing: User defined parameter

## Warning

If requesting a logarithmic plot, make sure that the axis ranges are positive. See Examples or invoke menu items 'Plot editing: Scale x axis' and 'Plot editing: Scale y axis'.

## Author(s)

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[par figaro](#)

## Examples

```
plotDiagram("TAS")
figUser()

figUser("pch=1; col=2")

figUser("pch=\"+\"")

figUser("col=\"darkblue\"")

figUser("bg=\"khaki\",cex=1.5") # for camouflage purposes

figUser("main=\"My plot\"; las=2; font.main=4; cex.main=2; col.main=\"blue\"")
```

---

figZoom

*Plot editing: Zooming*

---

## Description

These functions zoom in and out Figaro-compatible plots.

**Usage**

```
figZoom()  
  
figUnzoom()  
  
figXlim(range=NULL)  
  
figYlim(range=NULL)
```

**Arguments**

range                    numeric: two limits, minimum and maximum, for the given axis.

**Details**

'figZoom' zooms the specified rectangular area (click bottom left and then top right corner) in a new window. The zoomed area is highlighted in the old window.

'figUnzoom' closes the new window with blown up portion of the plotting window and returns to the original window.

'figXlim' and 'figYlim' allow to change the plotting limits (as a list of two components, separated by commas).

**Warning**

If requesting a logarithmic plot, make sure that the axis ranges are positive.

**Author(s)**

Colin M. Farrow, <colinfarrow537@gmail.com>  
and Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['figaro'](#)

**Examples**

```
## Not run:  
# requires a preexisting Figaro-compatible plot  
plot.diagram("Shand",select.samples=FALSE)  
figXlim(c(0.6,1.2))  
figYlim(c(0.8,3))  
  
## End(Not run)
```

---

filledContourFig	<i>Filled contours plot</i>
------------------	-----------------------------

---

## Description

Generates a frequency plot on the basis of the most recently plotted Figaro template.

## Usage

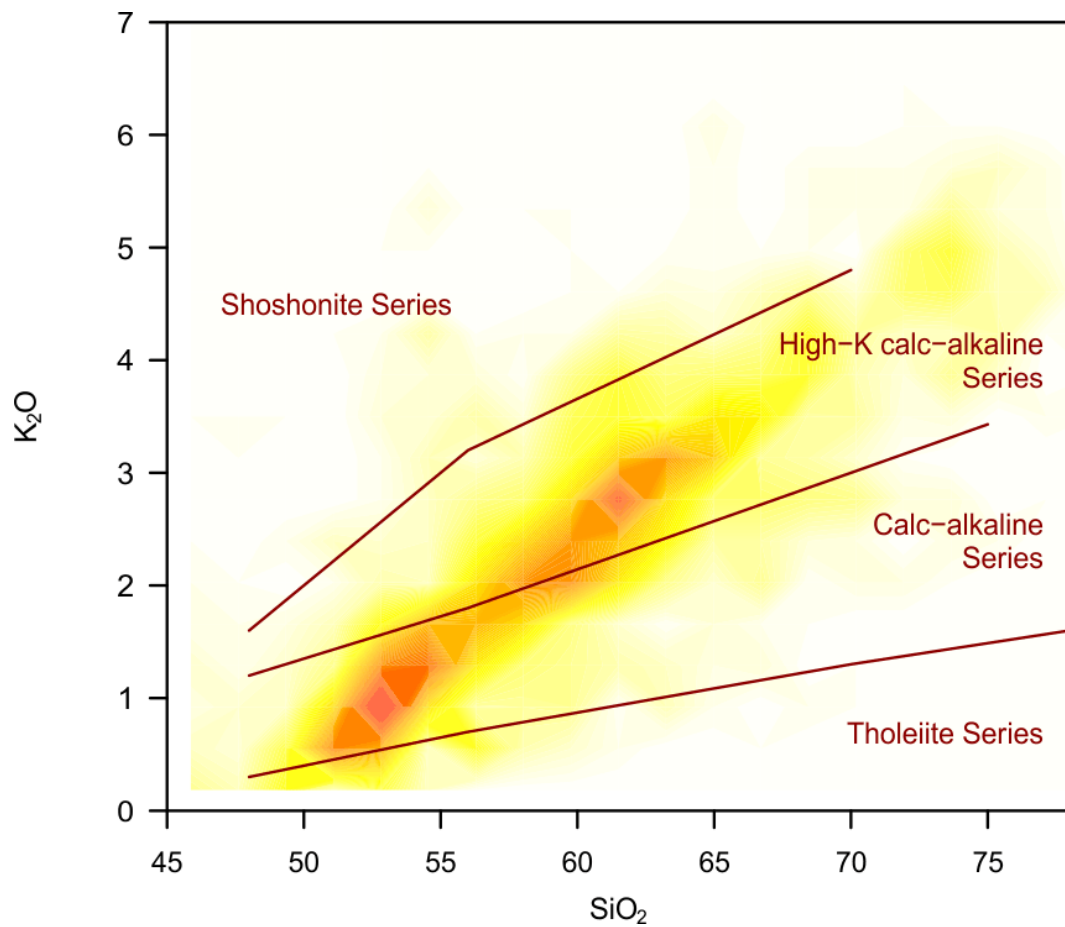
```
filledContourFig(xlab=sheet$demo$call$xlab,ylab=sheet$demo$call$ylab,  
xlim=sheet$demo$call$xlim,ylim=sheet$demo$call$ylim,  
annotate.fields=FALSE,...)
```

## Arguments

xlab	character vector; label for the x axis
ylab	character vector; label for the y axis
xlim	limits for the x axis
ylim	limits for the y axis
annotate.fields	logical; should be the plotted fields labeled by their names?
...	additional plotting parameters

## Details

This is a somewhat modified version of the R function '[filled.contour](#)' that produces a frequency plot on the basis of a Figaro template and superimposes, if desired, selected data points.



First the user is prompted, how many intervals should be each of the axes split into. This corresponds to a density of grid, in which are the individual points classified into. Then a colour scheme (palette) can be chosen. Lastly, after the frequency plot is generated, selected analyses can be plotted ('overplot'). In the latter case, standard GCDkit routine is used to selectSamples.

#### Value

None.

#### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

#### See Also

'addContours' 'selectSubset' 'figaro'

---

Frost

*Frost et al. (2001)*

---

#### Description

Classification of granitic rocks proposed by Frost et al (2001).

## Usage

```
Frost(plot.txt = getOption("gcd.plot.text"),
      classf = FALSE, GUI = FALSE)
```

## Arguments

plot.txt	logical, annotate fields by their names?
classf	logical, should the samples be classified?
GUI	logical, is the function called from a GUI?

## Details

Classification scheme proposed by *Frost et al. (2001)*. It consists of three diagrams:

- *Fe number* vs.  $SiO_2$ . Note, that the Fe-number is calculated as weight proportion of  $FeO/(FeO + MgO)$  (or  $FeO_{tot}/(FeO_{tot} + MgO)$ ), see below). The approach used here should not be confused with the more common usage of the term "Fe-number" (as well as "Mg-number") as molecular proportions.
- $Na_2O + K_2O - CaO$  vs.  $SiO_2$  (in wt. %).
- $A/NK$  vs.  $ASI$ , where  $A/NK$  stands for molecular  $Al_2O_3/(Na_2O + K_2O)$ , and  $ASI$  for molecular  $Al_2O_3/(Na_2O + K_2O + CaO - 1.67P_2O_5)$ . In fact, it is the  $A/CNK$  parameter of *Shand (1943)*, corrected for the Ca content in apatite. As approved by one of the authors (*C. Barnes, pers. comm., 2008*), the equation for  $ASI$  in the original work (*Frost et al. 2001*) was stated erroneously in molecular proportions of elements, instead of oxides. In fact, this diagram was not plotted in the paper, but it replaces the conditions mentioned in the text and is in our view more instructive.

The classification is designed to work both with analyses distinguishing between ferrous and ferric iron (preferred) and those with total iron only. The dialogue box lets the user decide, whether to use the ferrous iron value or the total iron.

Similarly, if some  $P_2O_5$  concentration are missing in the dataset, the user is prompted whether the missing values should be replaced with zero. If not, the problematic analyses are not plotted/classified.

## Value

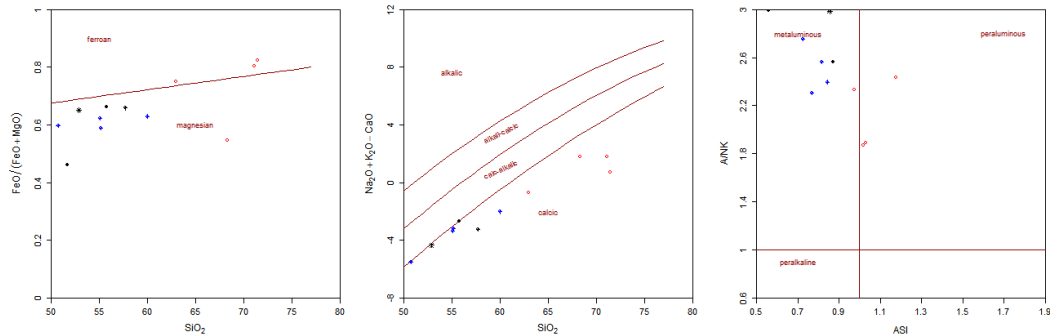
The function returns table of calculated coefficients (Fe-Number, MALI, ASI). There are two values for the ASI: one labeled 'ASI' is calculated from molecular proportions of oxides, and is used for plotting and classification. The other one is labeled 'ASI\_orig', and is calculated exactly as stated in the original paper (i.e.  $Al/(Ca - 1.67P + Na + K)$ ).

The following associations are distinguished:

*ferroan*  
*magnesian*  
*alkalic*  
*alkali-calcic*  
*calc-alkalic*  
*calcic*  
*peralkaline*  
*metaluminous*

*peraluminous*

Granite tectonic discrimination – Frost et al. (2001)



The geologically reasonable combinations, together with examples, are listed in the [../doc/FrostTable.html](#), modified from the original article.

**Note**

Due to the specific design of this classification (combination of multiple diagrams), the classification option is not available via the pull-down menus. Currently, the only way to apply Frost's classification in GCDkit on individual samples is to call the function manually from the Console (`Frost(classf = TRUE)`).

**Note**

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek <vojtech.janousek@geology.cz>

**References**

Frost B R, Barnes C G, Collins W J, Arculus R J, Ellis D J, Frost C D (2001) A geochemical classification for granitic rocks. *J Petrol* 42: 2033-2048. doi: [10.1093/petrology/42.11.2033](https://doi.org/10.1093/petrology/42.11.2033)  
Shand, S J (1943) *Eruptive rocks*, 2nd ed. John Wiley, New York, pp 1-444

**See Also**

[classify](#) [Shand Plate](#) [Plate editing](#) [plotPlate](#) [figaro](#)

**Examples**

```
#plot the diagrams
plotPlate("Frost")

#classify the samples, suppress the graphical output
```

```
Frost(classf = TRUE)
```

gcdOptions

*GCDkit options*

## Description

A graphical user interface (GUI, programmed in Tcl/Tk) for setting the main options controlling the behaviour of the GCDkit.

## Usage

```
gcdOptions()
```

## Arguments

None.

## Details

The settings are stored permanently in the file 'gcdkit.xxx' residing in the main GCDkit directory. They are loaded upon start up. If it is missing or damaged, this file is created anew based on the default values.

The panel connected to the function 'gcdOptions' serves to change several parameters. Most of them are passed to a list accessible in a way similar to the standard R [options](#). See the corresponding manual page for details and Examples for their implementation. Only a few are stored in dedicated variables (see below).

First, the default working directory can be set (and stored in the global variable `data.dir`).

The parameter 'Minimize output on screen?' is linked to the option `gcd.shut.up`. It controls excessive output to the Console window. Its default value is `FALSE`, meaning that detailed information is to be printed. This, however, may become not viable on slower systems and/or for extensive data sets.

The preferred precision of the numeric values that need to be rounded off are controlled by the parameter 'Precision of results' (option `gcd.digits`).

Using the parameter 'Plotting symbols magnification', linked to the option `gcd.cex`, one can define a factor, by which are multiplied the plotting sizes defined for individual analyses upon startup and stored in the variable 'labels[, "Size"]'. Please note that this is effective for the next plot if the GUI frontend is used to set this parameter, otherwise it will work for data files loaded from now on.

In this way, the magnification is maintained proportional to the original sizes. If uniform plotting symbols sizes are desired, one should use the function [setCex](#) invoked from the menu

Plot settings|Set uniform symbol size.

The parameter 'Annotate fields in discrimination plots?' toggles the labeling of the fields on and off, typically for classification or geotectonic diagrams. It is stored in a logical variable `gcd.plot.text`, whose default is `TRUE`. The language for the field annotations can be selected using the list box connected to the option `gcd.language`.

The next possibility is to alter the colours used, e.g. for texts or field boundaries on diagrams. There are in total three colours stored in the list `plt.col`. Alternatively, all the plots can be set to black

and white (check box 'Set to BW?' linked to the option 'gcd.plot.bw'), excluding the data points. The default is FALSE (i.e. colour plotting).

The parameter 'Identify points?' toggles on and off the identification/labelling of individual data points on plots. In general, the identification can be either interactive (option `gcd.ident.each = TRUE`) or all the points can be labeled automatically as soon as the plotting is finished (option

`gcd.ident.each = FALSE`). In the former case, the user may click the left mouse button near the points to be identified, pressing the right mouse button when finished.

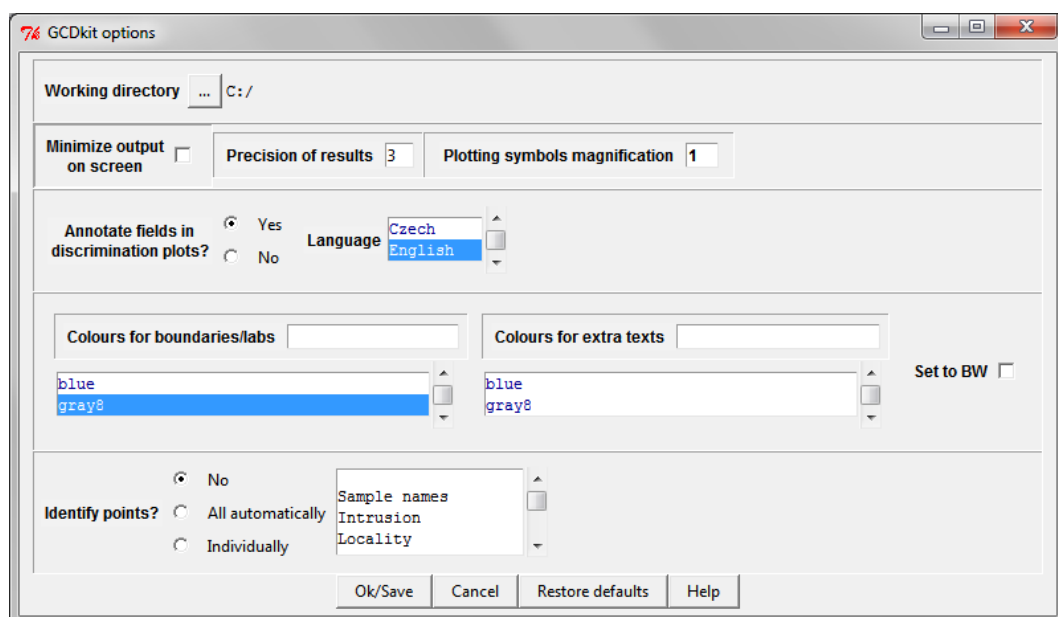
The option `gcd.ident` determines whether identification should take place at all (the default value is zero, which means no identification). If the identification is on, the option `gcd.ident` attains either 1 (identification by sample name), or the sequential number of the column in the data frame 'labels' increased by one (identification by a label).

The identification by sample name for a current plot can be invoked also from the menu 'Plot editing|Identify points'. There can be also chosen alternative means of points identification ('Plot editing|Highlight multiple points').

## Value

Sets the following options:

- `gcd.plot.text` logical; should be fields on classification diagrams labeled by their names?
- `gcd.language` language for these labels.
- `gcd.plot.bw` logical; if TRUE, plots are produced as black and white.
- `gcd.shut.up` logical; determines whether extensive textual output is to be printed.
- `gcd.ident` numeric; if zero, no identification takes place after plotting each diagram. If greater than zero, indicates the variable used to identify individual data points. See Details.
- `gcd.ident.each` logical; are the data points to be identified individually?
- `gcd.digits` preferred number of digits for rounding off the numeric values.
- `gcd.cex` a factor by which are multiplied all symbol sizes previously defined.



Remaining options changed by GCDkit which cannot be altered via the GUI, though:



```

prompt          "GCDkit-> "
windowsBuffered
                FALSE
locatorBell     FALSE
scipen          20
max.print       99999999

```

If necessary they can be set directly in the file 'gcdkit.xxx'.

Apart from that the GUI panel sets the variables `data.dir` (default data directory) and `plt.col` (colours for Figaro-compatible plots).

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### See Also

[options identify ID figaro setCex](#)

### Examples

```

bak <- options()           # backup the current options
options("gcd.ident"=1)     # identify by sample names
options("gcd.ident.each"=FALSE) # to label by sample names automatically,
                             # i.e. without the user interference

plotDiagram("TAS",F,F)
options("gcd.ident"=0)     # to turn off the identification completely
options("gcd.plot.bw"=TRUE) # to set the diagram to black and white
plotDiagram("TAS",F,F)

options("gcd.cex"=2)       # make the plotting symbols double as big
                             # (effective for the data files loaded from now on;
                             # for immediate result use the GUI front end)

getOption("gcd.plot.bw")  # printing the current value of the given option
options(bak)              # restore the previous options

```

---

graphicsOff	<i>Close all graphic windows</i>
-------------	----------------------------------

---

### Description

Closes all graphic windows.

### Usage

```
graphicsOff()
```

### Arguments

None.

**Details**

Under Windows 95/98/ME, the R system may become install, failing to redraw graphical windows if too many of them are being open. It is always a good idea to close the unnecessary ones, for instance using this function.

**See Also**

[`dev.off`](#)

---

groupsByCluster	<i>Groups by cluster analysis</i>
-----------------	-----------------------------------

---

**Description**

Grouping the data using the cluster analysis.

**Usage**

```
groupsByCluster(elems=
  "SiO2,TiO2,Al2O3,FeOt,MnO,MgO,CaO,Na2O,K2O",
  method="ave")
```

**Arguments**

elems	numerical columns to be used for cluster analysis, typically major elements
method	the agglomeration method to be employed. This should be one of (or an unambiguous abbreviation thereof): 'ward', 'single', 'complete', 'average', 'mcquitty', 'median', 'centroid'.

**Details**

After the dendrogram is drawn, the user is asked how many clusters is the dataset to be broken into. The vector containing the information on the current groups can be appended to the data frame 'labels'.

The groups are initially numbered but this can be changed readily using the function [editLabFactor](#).

For further details on the clustering algorithm, see the R manual entry of 'hclust'.

**Value**

groups	character vector: the grouping information
grouping	set to zero.

**Author(s)**

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

**See Also**

[classify](#) [groupsByLabel](#) [groupsByDiagram](#)

---

groupsByDiagram	<i>Groups by diagram</i>
-----------------	--------------------------

---

**Description**

Grouping the data on a basis of selected classification diagram.

**Usage**

```
groupsByDiagram(silent = TRUE)
```

**Arguments**

silent	logical; should be echoed the information about classification each of the samples?
--------	---

**Value**

groups	character vector: the grouping information
grouping	set to -1.

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>

**See Also**

[classify](#) [groupsByLabel](#) [groupsByCluster](#)

---

groupsByLabel	<i>Groups by label</i>
---------------	------------------------

---

**Description**

Grouping the data according to the levels of a single label.

**Usage**

```
groupsByLabel(lab=NULL)
```

**Arguments**

lab	name or sequence number of the label
-----	--------------------------------------

**Details**

Sets the groups on the selected column within the data frame 'labels'. If not specified at the function call, the appropriate label is selected by the function '[selectColumnLabel](#)'.

**Value**

groups            character vector: the grouping information  
 grouping        the sequence number of the column in the data frame 'labels' used for grouping

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[classify](#) [groupsByCluster](#) [groupsByDiagram](#)

**Examples**

```
data<-loadData("sazava.data",sep="\t")
groupsByLabel("Intrusion")
```

---

Harris

*Harris et al. (1986) Hf-Rb/30-Ta\*3*


---

**Description**

Assigns data for the Hf-Rb/30-Ta\*3 ternary diagram of *Harris et al. (1986)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

```
Harris()
```

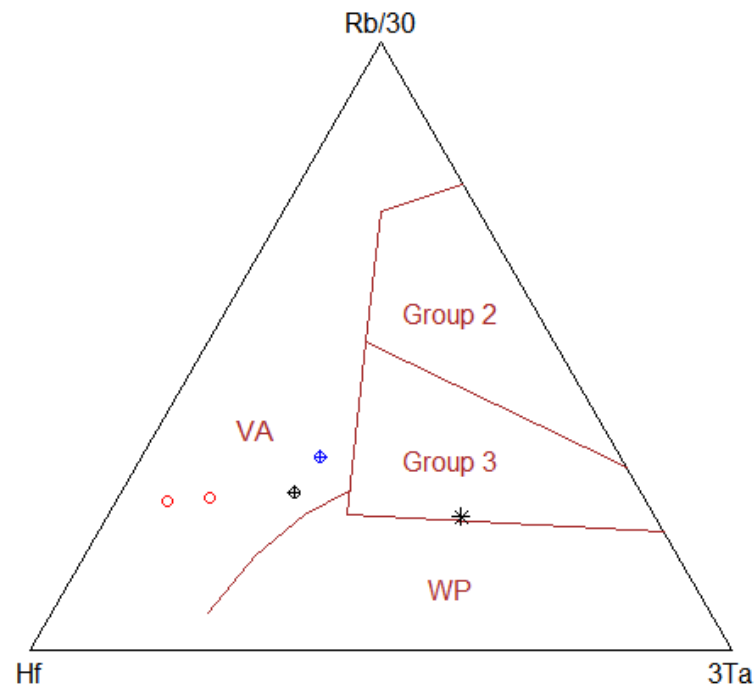
**Details**

Triangular diagram with apices Hf, Rb/30 and Ta\*3, proposed by *Harris et al. (1986)* for classification of collisional granites.

Following fields are defined:

VA	<i>Volcanic-Arc granites (Group 1, VA)</i>
WP	<i>Within-Plate granites (Group 4, WP)</i>
Group 2	
Group 3	

### Hf – Rb/30 – 3Ta (Harris et al. 1986)



Quoting from their abstract:

(i) Group 1 - *Pre-collision calc-alkaline (volcanic-arc) intrusions* which are mostly derived from mantle modified by a subduction component and which are characterized by selective enrichments in LIL elements.

(ii) Group 2 - *Syn-collision peraluminous intrusions (leucogranites)* which may be derived from the hydrated bases of continental thrust sheets and which are characterized by high Rb/Zr and Ta/Nb and low K/Rb ratios.

(iii) Group 3 - *Late or post-collision calc-alkaline intrusions* which may be derived from a mantle source but undergo extensive crustal contamination and can only be distinguished from volcanic-arc intrusions by their higher ratios of Ta/Hf and Ta/Zr.

(iv) Group 4 - *Post-collision alkaline intrusions* which may be derived from mantle lithosphere beneath the collision zones and which carry high concentrations of both LIL and HFS elements.

#### Value

sheet                      list with Figaro Style Sheet data

x.data, y.data    Th, Hf/3 and Ta in ppm recalculated into two dimensions

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Harris N B W, Pearce J A, Tindle A G (1986) Geochemical characteristics of collision-zone magmatism. In: Coward M P, Ries A C (eds) Collision Tectonics. Geological Society London Special Publication 19, pp 67-81

**See Also**

[figaro plotDiagram](#)

**Examples**

```
#plot the diagram
plotDiagram("Harris", FALSE)
```

---

Hastie	<i>Co-Th diagram (Hastie et al. 2007)</i>
--------	---

---

**Description**

Assigns data for Co vs. Th (ppm) diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'

**Usage**

```
Hastie()
```

**Details**

Diagram in Co vs. Th space, proposed by *Hastie et al. (2007)* for subdivision of volcanic arc rocks. This is thought to be a more robust replacement for *SiO<sub>2</sub>* vs. *K<sub>2</sub>O* plot of *Peccerillo & Taylor (1976)* for altered/weathered volcanic rocks. The decreasing Co concentrations are used as an index of fractionation (as a proxy for *SiO<sub>2</sub>*), the Th contents mimic those of *K<sub>2</sub>O*.

The following fields are defined:

*Tholeiite Series*

*Calc-alkaline Series*

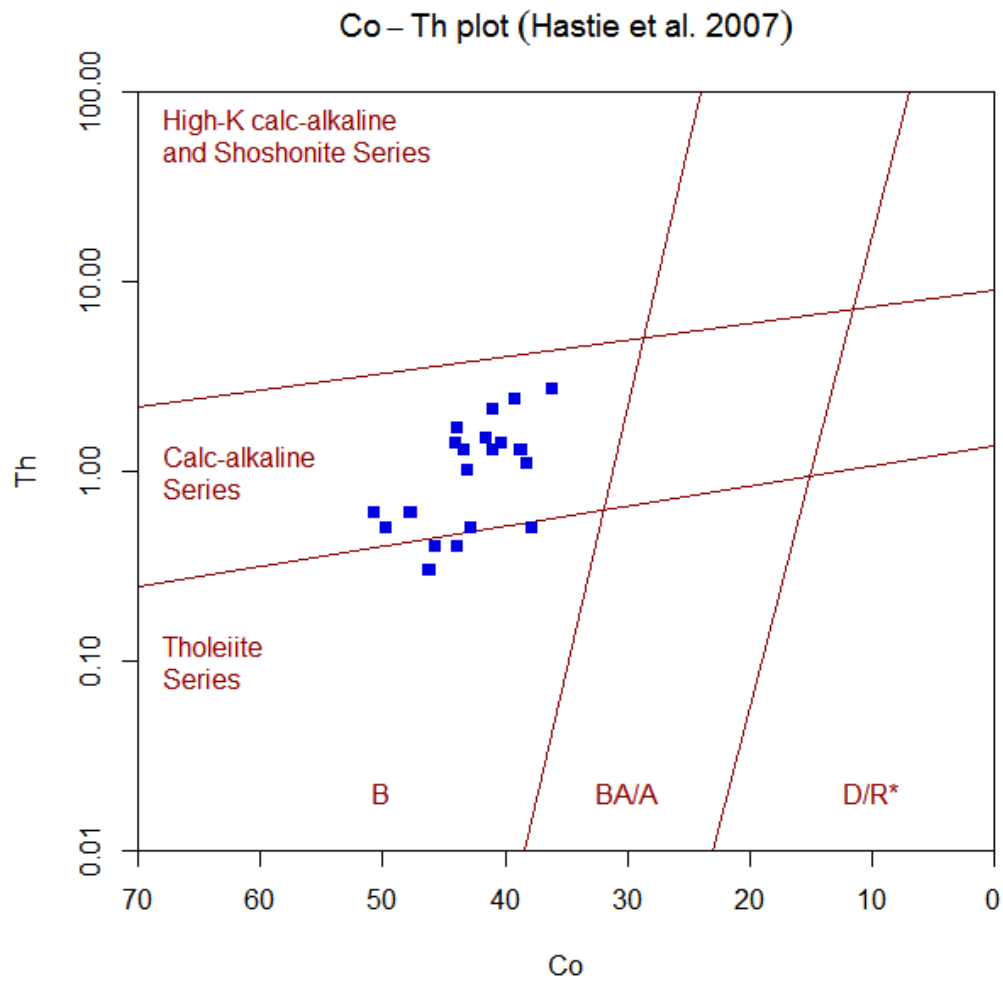
*High-K Calc-alkaline and Shoshonite Series*

Rocks with composition falling beyond defined boundaries are labeled '*undefined*' by the 'classify' function.

In addition, the diagram discriminates between the following rock types:

Abbreviation	Full name
B	basalt
BA/A	basaltic andesite and andesite
D/R*	dacite and rhyolite*

\* latites and trachytes also fall in the D/R fields

**Value**

sheet	list with Figaro Style Sheet data
x.data	Co ppm
y.data	Th ppm

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Hastie AR, Kerr AC, Pearce JA & Mitchell SF (2007) Classification of altered volcanic island arc rocks using immobile trace elements: development of the Th-Co discrimination diagram. *J Pet* 48: 2341-2357 doi: [10.1093/petrology/egm062](https://doi.org/10.1093/petrology/egm062)
- Peccerillo A & Taylor S R (1976) Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamonu area, Northern Turkey. *Contrib Mineral Petrol* 58: 63-81 doi: [10.1007/BF00384745](https://doi.org/10.1007/BF00384745)

**See Also**

[classify](#) [figaro](#) [plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("Hastie")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("Hastie", FALSE)
```

---

ID	<i>Sample identification</i>
----	------------------------------

---

**Description**

Identification/labelling of individual data points on plots.

**Usage**

```
ID(x, y, labs = getOption("gcd.ident"), offset = 0.4,
col = "gray30", cex = 1)
```

**Arguments**

x, y	vector with x-y coordinates of the data points
labs	text to label individual data points, see details
offset	distance (in char widths) between label and identified points.
col	colour of the text
cex	its size

**Details**

In GCDkit, the option 'ident' determines whether the user wishes to identify data points on binary and ternary plots. The default is zero, which means no identification.

If 'ident' differs from zero, internal function 'ID' can be invoked. Its parameter labs is either a single number, or character vector.

In the former case, the variable 'labs' contains either 1 (identification by sample name), or the sequential number of the column in the data frame 'labels' increased by one (identification by a user- defined label).

Alternatively, a character vector labs can be used to specify the text directly.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>



**See Also**

[identify gcdOptions options](#)

**Examples**

```
getOption("ident")      # yields the current value of the given option
```

---

info	<i>Info on datafile</i>
------	-------------------------

---

**Description**

Prints information about the current dataset (and its selected subset, if applicable).

**Usage**

```
info()
```

**Details**

This function prints comprehensive information about the current dataset. For each of the labels, individual levels and their frequencies are given. The number of numeric columns is printed, and for each of the variables number of available values. Moreover, the information concerning the total number of samples, the names of the samples in the selected subset (or all samples if none is defined) and the current grouping are shown.

**Value**

None

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

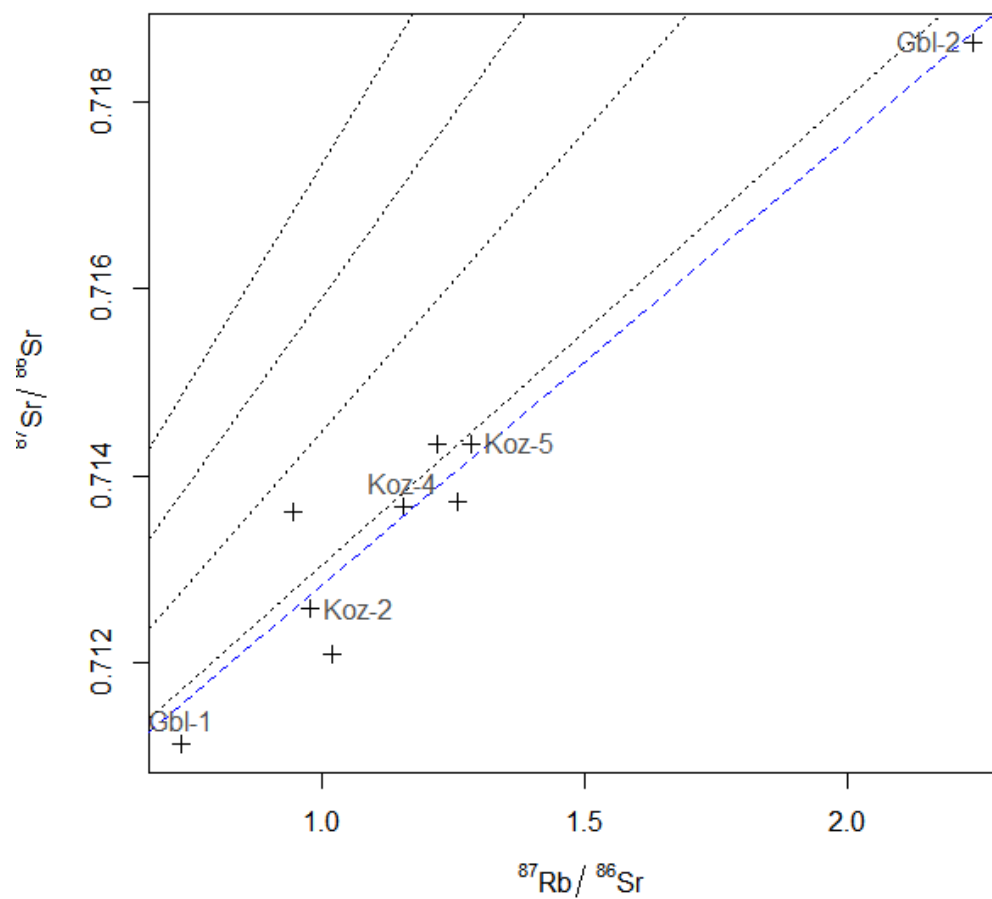
---

isochron	<i>Rb-Sr and Sm-Nd isochrons</i>
----------	----------------------------------

---

**Description**

Plots a Rb-Sr or Sm-Nd isochron diagram and calculates a simple linear fit to the selected data.



### Usage

```
isochron()
```

### Arguments

None.

### Details

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

If empty list is given, all the samples for which the required isotopic data are available are plotted and the user can choose their subset interactively. Then the isochron diagram is redrawn only with those samples.

The data are fitted by simple least-squares linear fit, from which the age and initial ratio are calculated.

**Value**

Returns a numeric vector with the calculated age and initial ratio.

**Plugin**

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

isocon

*Isocon plots (Grant 1986)*

---

**Description**

Implementation of isocon plot after *Grant (1986, 2005)* widely used for quantitative estimates of changes in mass/volume/concentration of elements or oxides in course of various open-system geochemical processes such as alteration or partial melting.

**Usage**

```
isocon(x = NULL, whichelems = NULL, immobile = NULL, atomic = FALSE, plot = TRUE)
```

```
isoconAtoms()
```

```
isoconOxides()
```

**Arguments**

x	numeric matrix with the chemical data
whichelems	list of elements for plotting, separated by commas
immobile	list of presumed immobile elements, separated by commas
atomic	logical; should be atomic wt. % used for oxides?
plot	logical; is the graphical output desirable?

**Details**

Isocon plot (*Grant 1986, 2005*) spans from the theoretical quantitative treatment of losses or gains of geochemical species (elements or oxides). It is applicable to balancing mass, volume and/or concentration changes in course of open-system processes such as weathering, hydrothermal alteration, metasomatic addition/leaching or migmatitization.

According to *Grant (2005 and references therein)* the equation for composition/volume changes in open-system process can be written as:

$$c_i^A = \frac{M^0}{M^A} (c_i^0 + \Delta c_i)$$

where  $c_i$  is the concentration of the species  $i$ , 0 refers to the original rock and  $A$  to the altered rock,  $M^0$  is the equivalent mass before and  $M^A$  after alteration.

For immobile element ( $\Delta c_i = 0$ ) the ratio  $\frac{M^0}{M^A}$  reflecting the overall change in mass can be obtained. This can be done graphically in the plot of the analytical data for presumed protolith ( $c_i^0$ ) and altered rock ( $c_i^A$ ). Such a straight line passing through the origin is termed isocon, the equation of which is:

$$c^A = \left(\frac{M^0}{M^A}\right)c^0$$

Species plotting above the isocon were gained, whereas those plotting below were lost, and the gain or loss is according to *Grant (2005)*:

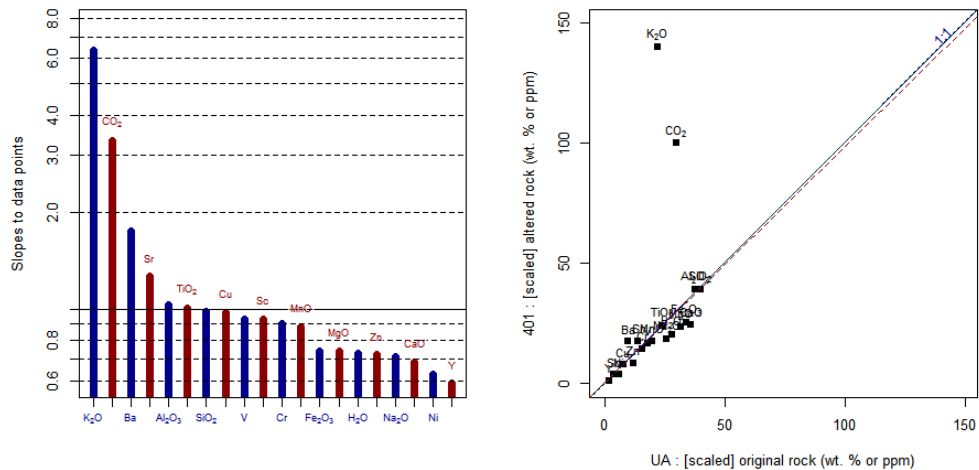
$$\frac{\Delta c_i}{c_i^0} = \frac{M^A}{M^0} \frac{c_i^A}{c_i^0} - 1$$

where  $\frac{c_i^A}{c_i^0}$  is the slope of the tie line from the origin to the data point.

In the GCDkit's implementation of the function 'isocon', firstly the parental and altered rock samples are to be chosen interactively from a binary plot  $MgO - SiO_2$ . Then the user is prompted for the elements/oxides to be used in the isocon analysis. Printed and plotted in the form of barplots are ordered slopes for each data point in the isocon diagram.

The user can choose the presumably immobile elements. These can be either provided as a comma delimited list, or, if empty, chosen interactively from the isocon plot. Finally are plotted two isocons, as well as a blue equiline (a straight line with the slope 1).

Implemented are two methods for assessing the change in mass of the system. Traditionally used has been the slope of the isocon line, obtained by linear regression of the presumably immobile data (dark green). However, this depends on the scaling of the isocon plot, which is arbitrary. In particular, the data plotted close to the origin may appear erroneously to lie on an isocon (*Baumgartner & Olsen, 1995*).



More objectively, the change in the mass can be estimated by clustering slopes to data points, deciphering the elements/oxides with a similar behaviour and averaging the slopes for the selected presumably immobile species.

Functions 'isoconAtoms' and 'isoconOxides' are frontends to the function 'isocon', providing different default values. See Arguments above.

**Value**

Returns a list 'results' with the following components:

slope.avg	slope of the isocon obtained as an average of the slopes for the individual presumably 'immobile' species
slope.regression	slope obtained by linear regression
balance	numeric matrix; balance of individual species. This matrix contains the following columns:
XXX=orig.	composition of the parental (unaltered) rock
XXX=alt.	composition of the altered rock
Slope data point	slope of the line connecting the data point with origin
G/L rel. (LQ)	relative mass gain/loss, isocon slope by least-squares fit
G/L rel. (avg)	relative mass gain/loss, averaged slopes for immobile elements
G/L wt%/ppm(LQ)	absolute mass gain/loss, isocon slope by least-squares fit
G/L wt%/ppm(avg)	absolute mass gain/loss, averaged slopes for immobile elements

**Plugin**

Isocon.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Baumgartner L P & Olsen S N (1995). A least-squares approach to mass transport calculations using the isocon method. *Econ Geol* 90: 1261-1270 doi: [10.2113/gsecongeo.90.5.1261](https://doi.org/10.2113/gsecongeo.90.5.1261)
- Grant J A (1986) The isocon diagram - a simple solution to Gresens equation for metasomatic alteration. *Econ Geol* 81: 1976-1982 doi: [10.2113/gsecongeo.81.8.1976](https://doi.org/10.2113/gsecongeo.81.8.1976)
- Grant J A (2005) Isocon analysis: A brief review of the method and applications. *Phys Chem Earth (A)* 30: 997-1004 doi: [10.1016/j.pce.2004.11.003](https://doi.org/10.1016/j.pce.2004.11.003)
- Gresens R L (1967) Composition-volume relationships of metasomatism. *Chem Geol* 2: 47-55

**Examples**

```
# Grant (2005) - see Tab. 1, Fig. 1
x<-matrix(c(46.45,1.29,14.30,11.05,0.17,5.28,12.14,2.93,0.49,3.00,3.29,42,327,
313,67,77,100,170,29,80,45.62,1.30,14.74,8.20,0.15,3.89,8.29,2.09,3.12,2.18,
10.96,39,305,282,42,75,72,214,17,140), byrow=TRUE,nrow=2)

y<-"SiO2,TiO2,Al2O3,Fe2O3,MnO,MgO,CaO,Na2O,K2O,H2O,CO2,Sc,V,Cr,Ni,Cu,Zn,Sr,Y,Ba"

colnames(x)<-unlist(strsplit(y," "))
rownames(x)<-c("UA","401")

isocon(x,y,atomic=FALSE,plot=TRUE,immobile="Al2O3,SiO2,TiO2,Cu,Sc")
```

```
isocon(x,y,atomic=TRUE,plot=FALSE)
```

---

Jensen

*Jensen cation plot (1976)*

---

## Description

Assigns data for Jensen's cation plot into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

## Usage

```
Jensen()
```

## Details

Jensen's cation plot, proposed by *Jensen (1976)* and modified by *Jensen & Pyke (1982)*. The triangular diagram is defined on the basis of millications as follows:

left apex: Al

upper apex:  $Fe^T + Ti$

right apex: Mg



**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Grunsky E C (1981) An algorithm for the classification of subalkalic volcanic rocks using the Jensen cation plot. In: Wood J, White O L, Barlow R B, Colvine A C (eds). Ontario Geological Survey, Misc Pap 100, pp 61-65

Jensen L S (1976) A new cation plot for classifying subalkalic volcanic rocks. Ont Div Mines, Misc Pap 66, 1-21

Jensen L S & Pyke D R (1982) Komatiites in the Ontario portion of the Abitibi belt. In: Arndt N T & Nisbet E G (eds) Komatiites. Allen & Unwin, London

**See Also**

[classify figaro plotDiagram](#)

**Examples**

```
#plot the diagram
plotDiagram("Jensen", FALSE)
```

---

joinGroups	<i>Merge groups</i>
------------	---------------------

---

**Description**

Enables merging several groups into a single one.

**Usage**

```
joinGroups()
```

**Arguments**

None.

**Details**

This function is the most useful to merge several groups, defined e.g. on the basis of a classification plot. A simple spreadsheet is invoked with two columns, the first ('Old') containing the old levels of groups and the second, 'New', which can be edited. Finally, groups with identical names will be merged into a single one.

Optionally, the vector containing the information on the current groups can be appended to the data frame 'labels'.

**Value**

groups	character vector: the grouping information
grouping	Sequential number of the column with grouping information in labels (if appended) or simply set to -100.



**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

Jung

*Al/Ti thermometer for granitic rocks (Jung + Pfander 2007)*

---

**Description**

This function estimates the temperature of a granitic magma based on measured  $Al_2O_3/TiO_2$  ratio and experimental constraints. The regression formulae were defined by Jung & Pfander (2007).

**Usage**

```
Jung(model = NULL, plot = TRUE)
```

**Arguments**

model	specification of the model
plot	logical; should be shown a $Al_2O_3/TiO_2$ vs. $CaO/Na_2O$ plot?

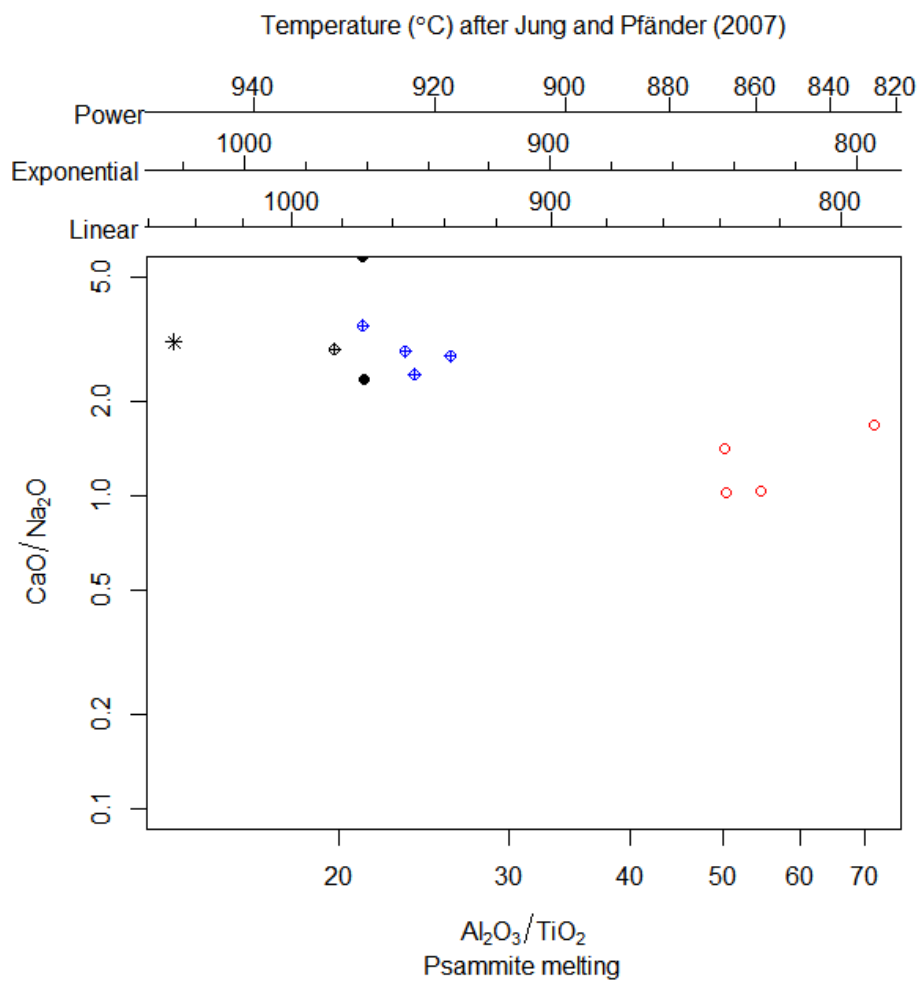
**Details**

As shown by Sylvester (1998), the  $Al_2O_3/TiO_2$  ratio in the granitic magmas is temperature sensitive, decreasing with the increasing temperature of the crustal anatexis. This probably reflects an increasing instability of Ti-bearing phases with progressive crustal fusion.

Jung & Pfander (2007) compiled the available experimental data and defined a set of regression formulae (linear, power law and exponential) for several types of protoliths.

Any of the following models can be chosen: pelite melting, psammite melting, igneous rock melting, A-type granite melting, amphibolite melting after Rapp & Watson (1995) and amphibolite melting after Patino Douce & Beard (1995).

Optionally, also  $Al_2O_3/TiO_2$  vs.  $CaO/Na_2O$  plot could be displayed with three secondary axes annotated by the calculated temperatures.



### Value

Returns a matrix 'results' with the following columns:

$\text{Al}_2\text{O}_3/\text{TiO}_2$  wt. % ratio of  $\text{Al}_2\text{O}_3/\text{TiO}_2$

$\text{T}_{\text{Al/Ti}}.\text{power}.\text{C}$

temperature in C, power law calibration

$\text{T}_{\text{Al/Ti}}.\text{exp}.\text{C}$  temperature in C, exponential calibration

$\text{T}_{\text{Al/Ti}}.\text{linear}.\text{C}$

temperature in C, linear calibration

$\text{T}_{\text{Al/Ti}}.\text{mean}.\text{C}$  mean temperature in C, based on the above three models

### Plugin

Jung.r

## Erratum

As pointed out by *S. Jung (pers. com. 2009)*, in Table 1 of their original paper were printed wrongly several of the regression coefficients. These are:

Rock	Model	<i>Jung and Pfander (2007)</i>	Corrected
A-type	power law	$B = 0.992$	$B = 9.921$
amphibolite ( <i>Rapp and Watson 1995</i> )	power law	$A = 2.82 \times 10^3$	$A = 2.82 \times 10^{30}$

The function implements these corrected values.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

- Jung S, Pfander J A (2007) Source composition and melting temperatures of orogenic granitoids: constraints from  $CaO/Na_2O$ ,  $Al_2O_3/TiO_2$  and accessory mineral saturation thermometry. *Eur J Mineral* 19: 859-870 doi: [10.1127/0935-1221/2007/0019-1774](https://doi.org/10.1127/0935-1221/2007/0019-1774)
- Patino Douce A E, Beard J S (1995) Dehydration-melting of biotite gneiss and quartz amphibolite from 3 to 15 kbar. *J Petrol* 36: 707-738 doi: [10.1093/petrology/36.3.707](https://doi.org/10.1093/petrology/36.3.707)
- Rapp R P, Watson E B (1995) Dehydration melting of metabasalt at 8-32 kbar: implications for continental growth and crust-mantle recycling. *J Petrol* 36: 891-931 doi: [10.1093/petrology/36.4.891](https://doi.org/10.1093/petrology/36.4.891)
- Sylvester P J (1998) Post-collisional strongly peraluminous granites. *Lithos* 45: 29-44 doi: [10.1016/S0024-4937\(98\)00024-3](https://doi.org/10.1016/S0024-4937(98)00024-3)

## Examples

```
Jung()

Jung("A-type")

Jung("psammitic", plot=FALSE)
```

---

Laroche

*R1-R2 diagram (De la Roche et al. 1980)*

---

## Description

Assigns data for the  $R_1 - R_2$  diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

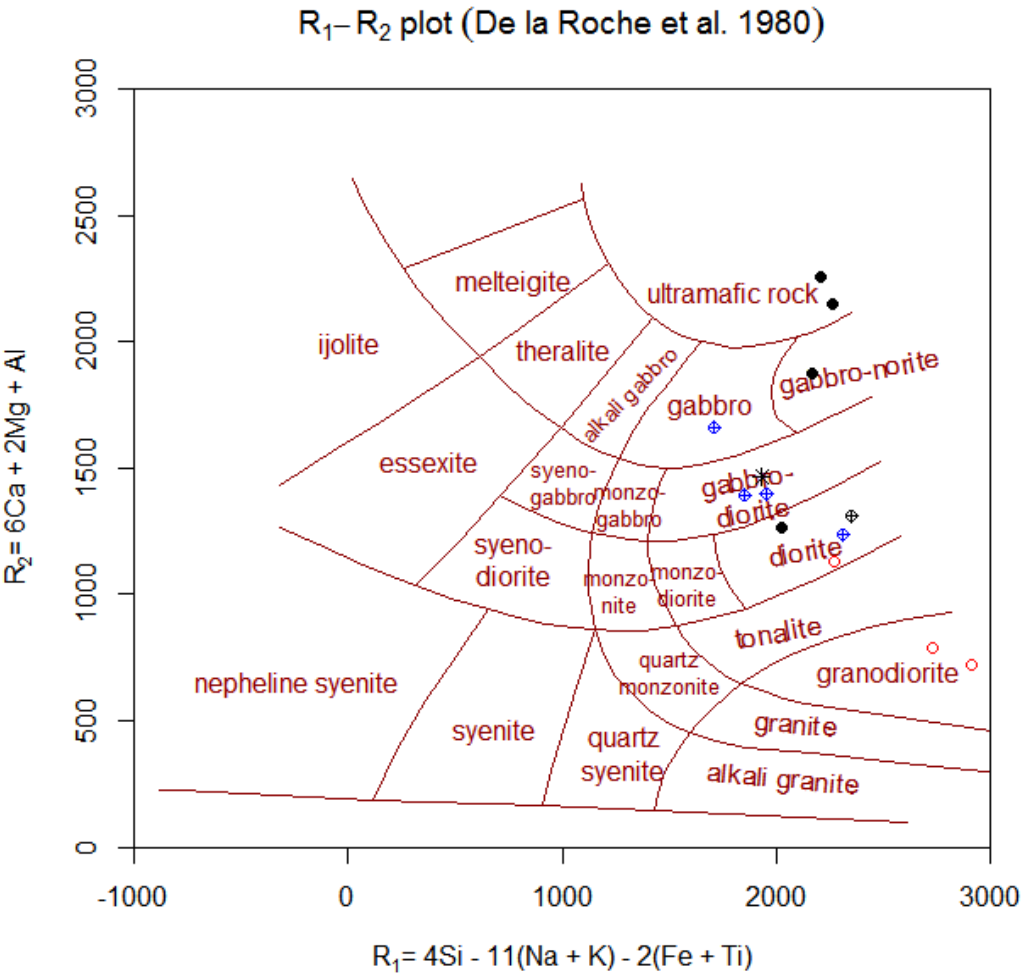
## Usage

```
LarocheVolc()

LarochePlut()
```



<i>nephelinite</i>	<i>ijolite</i>
<i>andesi-basalt</i>	<i>gabbro-diorite</i>
<i>lati-basalt</i>	<i>monzogabbro</i>
<i>hawaiiite</i>	<i>syenogabbro</i>
<i>tholeiite</i>	<i>gabbro-norite</i>
<i>basalt</i>	<i>gabbro</i>
<i>alkali basalt</i>	<i>alkaligabbro</i>
<i>basanite</i>	<i>theralite</i>
<i>ankaratrite</i>	<i>melteigite</i>
<i>picritic rock</i>	<i>ultramafic rock</i>



Value

sheet	list with Figaro Style Sheet data
x.data	$R_1 = 4 * Si - 11 * (Na + K) - 2 * (Fe[total\ as\ bivalent] + Ti)$ , all in millications; as calculated by the function 'LaRocheCalc()'
y.data	$R_2 = 6 * Ca + 2 * Mg + Al$ , all in millications; as calculated by the function 'LaRocheCalc()'

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

De La Roche H, Leterrier J, Grandclaude P, & Marchal M (1980) A classification of volcanic and plutonic rocks using  $R_1R_2$ - diagram and major element analyses - its relationships with current nomenclature. Chem Geol 29: 183-210 doi: 10.1016/0009-2541(80)90020-0

**See Also**

[classify figaro LaRocheCalc millications plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To classify data stored in WR (Groups by diagram)
classify("LarocheVolc")
#or
classify("LarochePlut")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("LarocheVolc", FALSE)
#or
plotDiagram("LarochePlut", FALSE)
```

---

LaRocheCalc

---

*Calculation: De la Roche*


---

**Description**

Recalculates whole-rock data into  $R_1 - R_2$  values of *De La Roche et al. (1980)*.

**Usage**

```
LaRocheCalc(rock=WR)
```

**Arguments**

rock                      a numeric matrix with whole-rock data to be recalculated.

**Details**

$R_1 - R_2$  parameters, as proposed by *De La Roche et al. (1980)*:

$R_1 = 4 * Si - 11 * (Na + K) - 2 * (Fe[\text{total as bivalent}] + Ti)$ , all in millications  
 $R_2 = 6 * Ca + 2 * Mg + Al$ , all in millications

**Value**

results                    numeric matrix with the two above specified parameters

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

De La Roche H, Leterrier J, Grandclaude P, & Marchal M (1980) A classification of volcanic and plutonic rocks using  $R_1R_2$ - diagram and major element analyses - its relationships with current nomenclature. Chem Geol 29: 183-210 doi: [10.1016/0009-2541\(80\)90020-0](https://doi.org/10.1016/0009-2541(80)90020-0)

**See Also**

[LaRoche](#)

---

loadData	<i>Loading data into GCDkit</i>
----------	---------------------------------

---

**Description**

Loads data from a file (or, alternatively, a clipboard) into GCDkit. The files may contain plain text, or, if library RODBC (has been installed, can be in the dBase III/IV (\*.dbf), Excel (\*.xls), Access (\*.mdb), PetroGraph (\*.peg), IgPet or NewPet (\*.roc) formats.

**Usage**

```
loadData(filename=NULL, separators = c("\t", " ", ";", ","),
na.strings = c("NA", "-", "bd", "b.d.", "bd1", "b.d.l.", "N.A.", "n.d."),
clipboard = FALSE, merging = FALSE);
```

```
loadDataOdbc(filename=NULL, na.strings=c("NA", "-", "bd",
"b.d.", "bd1", "b.d.l.", "N.A.", "n.d."), merging=FALSE,
ODBC.choose=TRUE)
```

**Arguments**

filename	fully qualified name of the file to be loaded, including suffix.
separators	strings that should be tested as prospective delimiters separating individual items in the data file.
na.strings	strings that will be interpreted, together with empty items, zeros and negative numbers, as missing values (NA).
clipboard	logical; is clipboard to be read instead of a file?
merging	logical; is the function invoked during merging of two data files?
ODBC.choose	logical; if TRUE, ODBC channel can be chosen interactively.

## Details

If library RODBC is available, the functions attempt to establish an ODBC connection to the selected file, and open it as dBase III/IV (\*.dbf), Excel (\*.xls) or Access (\*.mdb) format. The DBF files are used to store data by other popular geochemical packages, such as IgPet (Carr, 1995) or MinPet (Richard, 1995).

Another format that can be imported is \*.csv. It is employed by geochemical database systems such as GEOROC (<http://georoc.mpch-mainz.gwdg.de/georoc/>) and PETDB (<http://www.petdb.org/>).

The import filter for the \*.csv files has been tailored to keep the structure of these databases in mind.

The package PetroGraph (Petrelli *et al.* 2005) saves data into \*.peg files that are also, in principle, \*.csv files compatible with the GCDkit.

Data files \*.roc are yet another variant of \*.csv files, used by NewPet (Clarke *et al.* 1994). This is not to be confused with the \*.roc format designed for IgPet (Carr, 1995). This is a text file with a quite complex structure, whose import is still largely experimental. DBF files are to be preferred for this purpose.

If not successful, the function 'loadData' assumes that it is dealing with a simple text file.

On the other hand 'loadDataOdbc' allows an ODBC channel to be specified interactively if 'ODBC.choose=TRUE'.

Plain text files can be delimited by tabs, commas or semicolons (the delimiter is recognized automatically). Alternative separators list can be specified by the optional 'separators' parameter. The Windows clipboard is just taken as a special kind of a tab-delimited text file.

In the text file, the first line contains names for the data columns (except for the first one that is automatically assumed to contain the sample names); hence the first line may (or may not) have one item less than the following ones. The data rows start with sample name and do not have to be all of the same length (the rest of the row is filled by 'NA' automatically).

Missing values ('NA') are allowed anywhere in the data file (naturally apart from sample and column names); any of 'NA', 'N.A.', '-', 'b.d.', 'bd', 'b.d.l.', 'bdl' or 'n.d.' are also treated as such, as specified by the parameter `na.strings`.

While loading, the values '#WHATEVER!' (Excel error messages) are also replaced by 'NA' automatically.

Please note that the function 'loadDataOdbc', due to the current limitations of the RODBC package, cannot handle correctly columns of mixed numeric and textual data. In such a column all textual information is converted to 'NA' and this unfortunately concerns the sample names as well. If encountering any problems, please use import from text file or via clipboard, which are much more robust.

The negative numbers and values '< x' (used by some authors to indicate items below detection limit) can be either replaced by their half (i.e. half of the detection limit) or 'NA'. User is prompted which of these options he prefers.

Alternatively, the negative values can be viewed either as missing ('NA') or can be imported, as may be desirable for instance for stable isotope data in the delta notation.

Decimal commas, if present in text file, are converted to decimal points.

The data files can be practically freeform, i.e. no specified oxides/elements are required and no exact order of these is to be adhered to. Analyses can contain as many numeric columns as necessary, the names of oxides and trace elements are self-explanatory (e.g. "SiO2", "Fe2O3", "Rb", "Nd").

In the text files (or if pasting from clipboard), any line starting with the hash symbol ('#') is ignored and can be used to introduce comments or to prevent the given analysis from loading temporarily.



Note that names of variables are case sensitive in R. However, any of the fully upper case names of the oxides/elements that appear in the following list are translated automatically to the appropriate capitalization:

SiO2, TiO2, Al2O3, Fe2O3, FeO, MnO, MgO, CaO, Na2O, FeOt, Fe2O3t,  
 Li2O, mg#, Ac, Ag, Al, As, At, Au, Ba, Be, Bi,  
 Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Dy, Er, Eu,  
 Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, Ir, La, Li, Lu,  
 Mg, Mn, Mo, Na, Nb, Nd, Ne, Ni, Np, Os, Pa, Pb,  
 Pd, Pm, Pr, Pt, Pu, Rb, Re, Rh, Ru, S, Sb, Sc,  
 Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm,  
 Yb, Zn, Zr.

Total iron, if given, should be expressed either as ferrous oxide ('FeOt', 'FeOT', 'FeOtot', 'FeOTOT' or 'FeO\*') or ferric oxide ('Fe2O3t', 'Fe2O3T', 'Fe2O3tot', 'Fe2O3TOT' or 'Fe2O3\*').

Structurally bound water can be named 'H2O.PLUS', 'H2O+', 'H2OPLUS', 'H2OP' or 'H2O\_PLUS'.

Upon loading, all the completely empty columns are removed first. Any non-numeric items found in a data column with one of the names listed in the above dictionary are assumed to be typos and replaced by 'NA', after a warning appears. At the next stage all fully numeric data columns are stored in a numeric data matrix 'WR'.

For any missing major- and minor-element data (SiO2, TiO2, Al2O3, Fe2O3, FeO, MnO, MgO, CaO, Na2O, K2O, H2O.PLUS, CO2, P2O5, F, S), an empty (NA) column is created automatically.

The remaining, that is all at least partly textual data columns are transferred to the data frame 'labels'. To this are also attached a column whose name starts with 'Symbol' (if any) that is taken as containing plotting symbols and a column whose name is 'Colour' or 'Color' (if any, capitalization does not matter) that may contain plotting colours specification. The relative size of the individual plotting symbols may be specified in a column named 'Size' or 'cex' that is also to be attached to the 'labels'.

The plotting symbols can be given either by their code (see [showSymbols](#)) or directly as strings of single characters.

The colours can be specified as codes (1-49) or English names (see [showColours](#) or type 'colours()' into the Console window).

If specifications of the plotting symbols and colours are missing completely, and at least one non-numeric variable is present, the user is prompted whether he does not want to have the symbols and colours assigned automatically, from 1 to  $n$ , according to the levels of the selected label. Otherwise default symbols (empty black circles) are used.

The default grouping is set on the basis of plotting symbols '(labels\$Symbol)' or the data column used to autoassign the plotting symbols and colours.

## Value

WR                      numeric matrix: all numeric data

labels                      data frame: all at least partly character fields; labels\$Symbol contains plotting symbols and labels\$Colour the plotting colours

The function prints a short summary about the loaded file. It also loads and executes the Plugins, i.e. all the R code (\*.r) that is currently stored in the subdirectory '\Plugin'. Finally, the system performs some recalculations (calling 'Gcdkit.r').

### Note

In order to ensure the database functionality, duplicated column (variable) names are not allowed. This concerns, to a large extent, also the sample names. The only exception are CSV files - if duplicated samples are found, sequence numbers are assigned instead.

All completely empty rows and columns in both labels and numeric data are ignored.

### Author(s)

The RODBC package was written by Brian Ripley.

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Carr M (1995) Program IgPet. Terra Softa, Somerset, New Jersey, U.S.A.

Clarke D, Mengel F, Coish RA, Kosinowski MHF(1994) NewPet for DOS, version 94.01.07. Department of Earth Sciences, Memorial University of Newfoundland, Canada.

Petrelli M, Poli G, Perugini D, Peccerillo A (2005) PetroGraph: A new software to visualize, model, and present geochemical data in igneous petrology. Geochemistry Geophysics Geosystems 6: 1-15

Richard LR (1995) MinPet: Mineralogical and Petrological Data Processing System, Version 2.02. MinPet Geological Software, Quebec, Canada.

### See Also

'saveData' 'mergeData' 'showColours' 'showSymbols' 'read.table' 'getwd' 'setwd'

### Examples

```
# Sets the working path and loads the 'sazava' test data set
setwd(paste(gcdx.dir,"Test_data",sep="/"))
loadData("sazava.data")
```

---

Maniar

*Maniar and Piccoli (1989)*

---

### Description

Plots data stored in 'WR' (or its subset) into Maniar and Piccoli's series of diagrams.

### Usage

```
Maniar(plot.txt = getOption("gcd.plot.text"))
```

**Arguments**

plot.txt                      logical, annotate fields by their names?

**Details**

Collection of six binary diagrams, based on major elements chemistry, developed by *Maniar & Piccoli (1989)* for tectonic discrimination of granitic rocks. *Shand's (1943)* diagram is also used. Diagrams are defined as follows:

**x axis** $SiO_2$  $SiO_2$  $SiO_2$ 

$$\frac{100 * MgO}{(Al_2O_3 + Na_2O + K_2O + FeO(T) + MgO)}$$

M and F proportion in the AFM system

$$\frac{100 * CaO}{(Al_2O_3 + Na_2O + K_2O + FeO(T) + MgO + CaO)}$$

C and F proportion in the ACF system  
A/CNK (molar)

**y axis** $K_2O$  $Al_2O_3$ 

$$\frac{FeO(T)}{(FeO(T) + MgO)}$$

$$\frac{100 * FeO(T)}{(Al_2O_3 + Na_2O + K_2O + FeO(T) + MgO)}$$

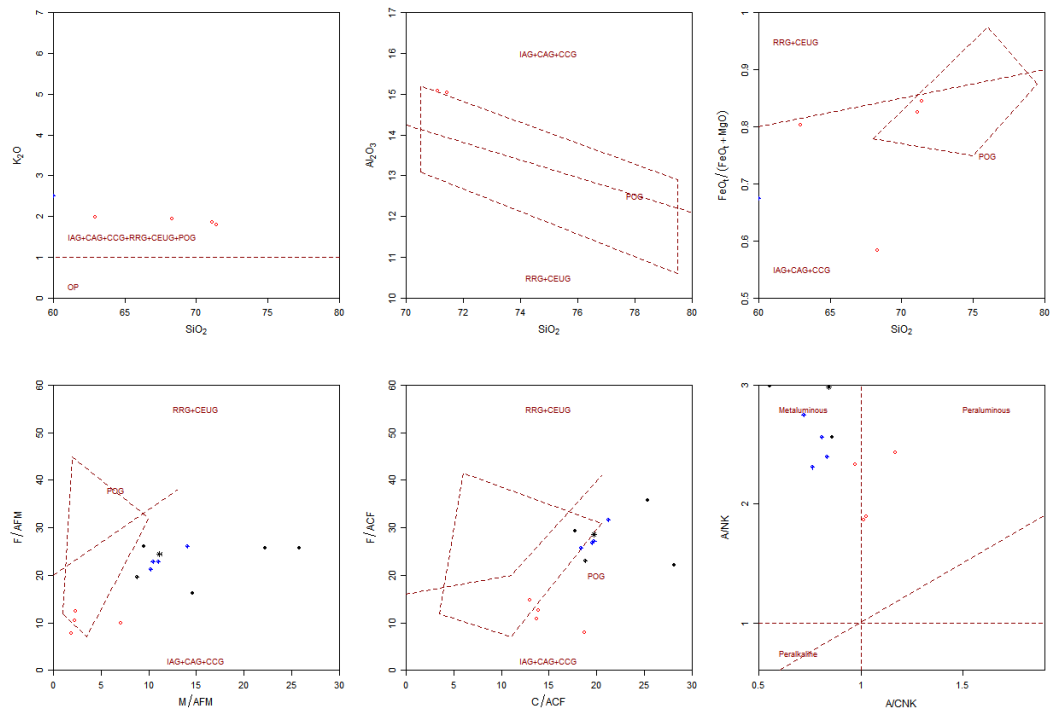
$$\frac{100 * (FeO(T) + MgO)}{(Al_2O_3 + Na_2O + K_2O + FeO(T) + MgO + CaO)}$$

A/NK (molar)

Abbreviations used in diagrams represent granitoids from following geotectonic environments:

IAG	<i>Island Arc Granitoids</i>
CAG	<i>Continental Arc Granitoids</i>
CCG	<i>Continental Collision Granitoids</i>
POG	<i>Post-orogenic Granitoids</i>
RRG	<i>Rift-related Granitoids</i>
CEUG	<i>Continental Epeirogenic Uplift Granitoids</i>
OP	<i>Oceanic Plagiogranites</i>

Granite tectonic discrimination – Maniar and Piccoli (1989)



*Peralkaline, Metaluminous and Peraluminous* rocks are defined in the last (Shand's) diagram.

### Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Maniar P D & Piccoli P M (1989) Tectonic discriminations of granitoids. Geol Soc Amer Bull 101: 635-643. doi: [10.1130/0016-7606\(1989\)101<0635:TDOG>2.3.CO;2](https://doi.org/10.1130/0016-7606(1989)101<0635:TDOG>2.3.CO;2)
- Shand (1943) Eruptive Rocks. John Wiley & Sons.

### See Also

[Plate](#), [Plate editing](#), [figaro](#), [plotPlate](#),

### Examples

```
#plot the diagrams
plotPlate("Maniar")
```

---

mergeData

*Appending data to a current data set*


---

## Description

These functions append new data to the analyses currently stored in the memory of the GCDkit.

## Usage

```
mergeDataRows()
mergeDataCols(all.rows=NULL)
```

## Arguments

<code>all.rows</code>	logical; should be all samples preserved, even those missing in one of the datasets ?
-----------------------	--

## Details

The function 'mergeDataRows' appends new samples (i.e. new rows). The structures of both datafiles are, as much as possible, matched against each other, and, if necessary, new empty columns are introduced to the original data file, if they are missing. If any duplicated sample names are found, they are replaced by sequence numbers and a new column 'old.ID' is appended to the labels. Also appended is a column named 'file' containing the name of the file the particular sample originated from.

'mergeDataCols' adds new data (i.e. new data columns) to the samples stored in the memory. If desired ('all.rows' is 'TRUE'), included are also samples that occur solely in one of the files.

For the guidelines on correct formatting of the data files see [loadData](#).

## Value

<code>WR</code>	numeric matrix: all numeric data
<code>labels</code>	data frame: all at least partly character fields; <code>labels\$Symbol</code> contains plotting symbols and <code>labels\$Colour</code> the plotting colours

The function prints a short summary about the loaded file.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

'[loadData](#)' '[saveData](#)' '[merge](#)'

Meschede

*Meschede (1986) Zr/4-2Nb-Y***Description**

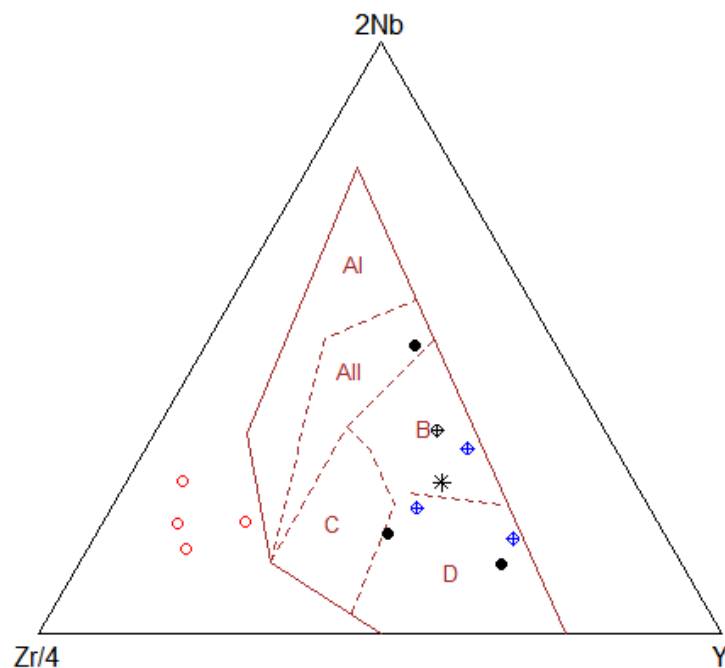
Assigns data for a *Meschede's (1986)* triangular diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

```
Meschede()
```

**Details**

Triangular diagram with apices Zr/4, 2Nb and Y, proposed by *Meschede (1986)*. The plot serves primarily for tectonic discrimination of tholeiitic basalts.

**Zr/4 – 2Nb – Y (Meschede 1986)**

Abbreviations used in diagram represent following geotectonic settings:

AI-AII	<i>Within-Plate Alkaline Basalts</i>
AII-C	<i>Within-Plate Tholeiites</i>
B	<i>P-type Mid-Ocean Ridge Basalts</i>
D	<i>N-type Mid-Ocean Ridge Basalts</i>
C-D	<i>Volcanic Arc Basalts</i>

**Value**

sheet                    list with Figaro Style Sheet data  
x.data, y.data    Zr/4, 2Nb and Y values recalculated into two dimensions

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Meschede M (1986) A method of discriminating between different types of mid-ocean ridge basalts and continental tholeiites with the Nb-Zr-Y diagram. Chem Geol 56: 207-218 doi: [10.1016/0009-2541\(86\)90004-5](https://doi.org/10.1016/0009-2541(86)90004-5)

**See Also**

[figaro plotDiagram](#)

**Examples**

```
#plot the diagram
plotDiagram("Meschede", FALSE)
```

---

Mesonorm

*Improved Mesonorm for granitoid rocks*

---

**Description**

Calculates *eine bessere* Mesonorm for granitoids of *Mielke & Winkler (1979)*.

**Usage**

```
Mesonorm(WR, GUI = FALSE, precision = getOption("gcd.digits"))
```

```
Streckeisen(x, new = TRUE)
```

**Arguments**

WR	a numerical matrix; the whole-rock data to be normalized.
GUI	logical, is the function called from the GUI?
precision	precision of the result.
x	Normative minerals calculated by the function Mesonorm.
new	logical, is a new plotting window to be opened?

### Details

This method of norm calculation should yield mineral proportions close to the actual mode of granitoid rocks. The calculated minerals are:

Orthoclase, Albite, Anorthite, Quartz, Apatite, Magnetite,  
Hematite, Ilmenite, Biotite, Amphibole, Calcite, Corundum,  
Rest

If desired, the function plots Q'-ANOR diagram of Streckeisen & Le Maitre (1979) using the function Streckeisen. The fields in this diagram are labeled as follows:

2	alkali feldspar granite
3	granite
4	granodiorite
5	tonalite
6*	quartz alkali feldspar syenite
7*	quartz syenite
8*	quartz monzonite
9*	quartz monzodiorite/quartz monzogabbro
10*	quartz diorite/quartz gabbro
6	alkali feldspar syenite
7	syenite
8	monzonite
9	monzodiorite/monzogabbro
10	diorite/gabbro

### Value

A numeric matrix 'results'.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>  
& Vojtech Erban, <vojtech.erban@geology.cz>

### References

- Mielke P & Winkler H G F (1979) Eine bessere Berechnung der Mesonorm fuer granitische Gesteine. Neu Jb Mineral, Mh 471-480
- Streckeisen, A. & Le Maitre, R. W. (1979) A chemical approximation to the modal QAPF classification of the igneous rocks. Neu Jb Mineral, Abh 136, 169-206.

---

Middlemost

*Middlemost's diagram (1985)*

---

### Description

Assigns data for Middlemost's diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

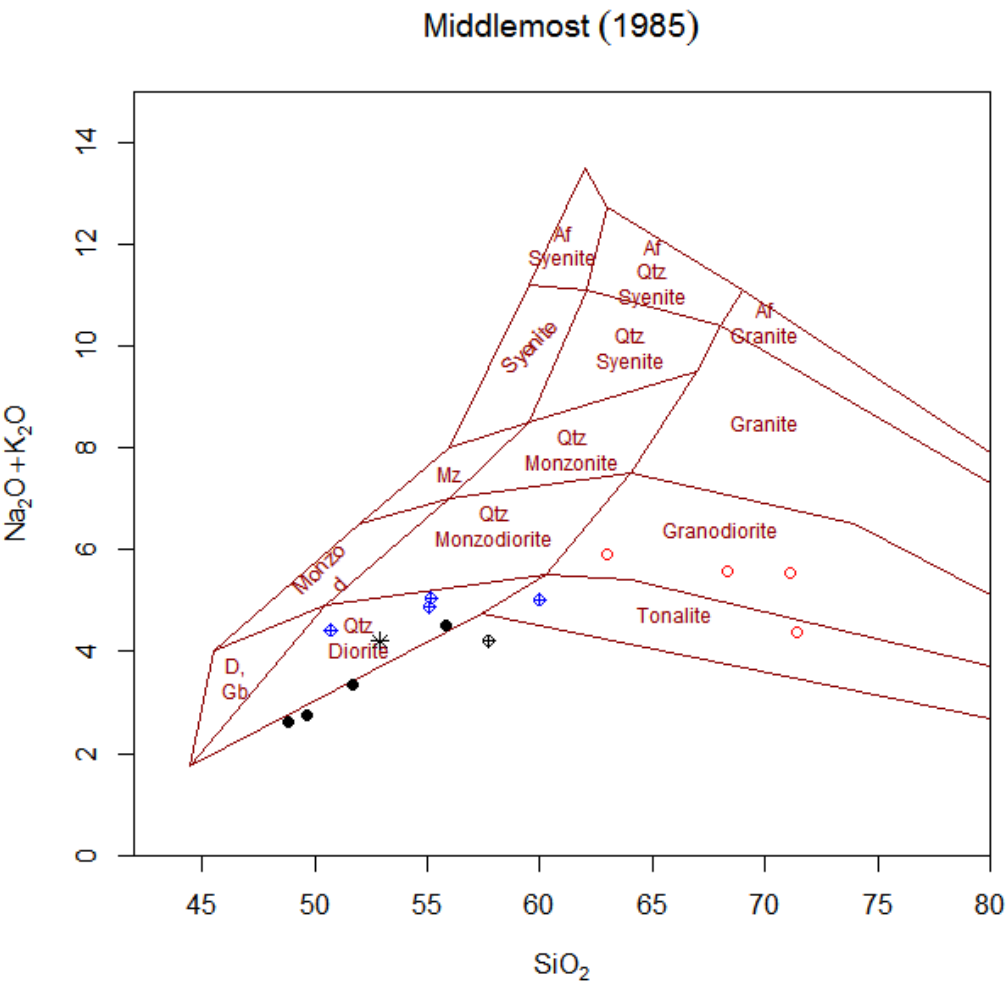


Usage

```
MiddlemostPlut()
```

Details

Classification diagram, as proposed by *Middlemost (1985)* for plutonic rocks.



Value

sheet	list with Figaro Style Sheet data
x.data	SiO2 weight percent
y.data	Na2O+K2O weight percent
results	matrix with classification results
groups	vector with classification results
grouping	set to -1

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
 & Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Middlemost E A K (1985) *Magmas and Magmatic Rocks*. Longman, London

**See Also**

[classify figaro plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To classify data stored in WR (Groups by diagram)
classify("MiddlemostPlut")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("MiddlemostPlut", FALSE)
```

---

millications	<i>Millications</i>
--------------	---------------------

---

**Description**

Returns millications.

**Usage**

```
millications(x, print=FALSE, save=FALSE)
```

**Arguments**

x	matrix or vector with major-element data
print	logical: print the result?
save	logical: should be the results assigned globally?

**Details**

The millications are used for many plots of the French school, e.g. *De la Roche et al. (1980)* or *Debon & Le Fort (1983, 1988)*.

The calculated values are Si, Ti, Al, Fe<sub>3</sub>, Fe<sub>2</sub>, Fe, Mn, Mg, Ca, Na, K, P.

$$Element_i = 1000 \frac{Oxide_i(wt.\%)}{MW(Oxide_i)} * x(Element_i)$$

Where: MW = molecularWeight of the Oxide[i], x = number of atoms of Element[i] in its formula

**Value**

Numeric matrix (or vector) with the millications. If 'save=TRUE', 'results' and 'milli' are assigned globally.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

De La Roche H, Leterrier J, Grandclaude P, & Marchal M (1980) A classification of volcanic and plutonic rocks using R1R2- diagram and major element analyses - its relationships with current nomenclature. *Chem Geol* 29: 183-210

Debon F & Le Fort P (1988) A cationic classification of common plutonic rocks and their magmatic associations: principles, method, applications. *Bull Mineral* 111: 493-510

Debon F & Le Fort P (1983) A chemical-mineralogical classification of common plutonic rocks and associations. *Trans Roy Soc Edinb, Earth Sci* 73: 135-149

---

Misc	<i>Miscellaneous geochemical indexes</i>
------	--

---

**Description**

Calculates a series of useful geochemical indexes.

**Usage**

Misc(WR)

**Arguments**

WR                      a numerical matrix; the whole-rock data to be recalculated.

**Details**

Various petrochemical indexes are calculated, such as:

- total iron as  $Fe_2O_3$
- $Fe_2O_3/FeO$ ,  $Na_2O/K_2O$  and  $K_2O/Na_2O$  ratios
- Larsen's DI - Differentiation index (*Larsen 1938*)
- Kuno's SI - Solidification index (*Kuno 1959*)
- Agpaitic index (*Ussing 1912*)

**Value**

A numeric matrix 'results'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

- Kuno H (1959) Origin of Cenozoic petrographic provinces of Japan and surrounding provinces. *Bull Volcanol* 20: 37-76
- Larsen E S (1938) Some new variation diagrams for groups of igneous rocks. *J Geol* 46: 505-520
- Sorensen H (1997) The agpaitic rocks; an overview. *Min Mag* 61: 485-498
- Ussing N V (1912) Geology of the country around Sulianehaab, Greenland. *Meddr Groenland*, 38: 1-426

---

Miyashiro

---

*SiO<sub>2</sub>-FeO<sub>t</sub>/MgO diagram (Miyashiro 1974)*


---

## Description

Assigns data for *SiO<sub>2</sub>* vs. *FeO<sub>t</sub>/MgO* diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'

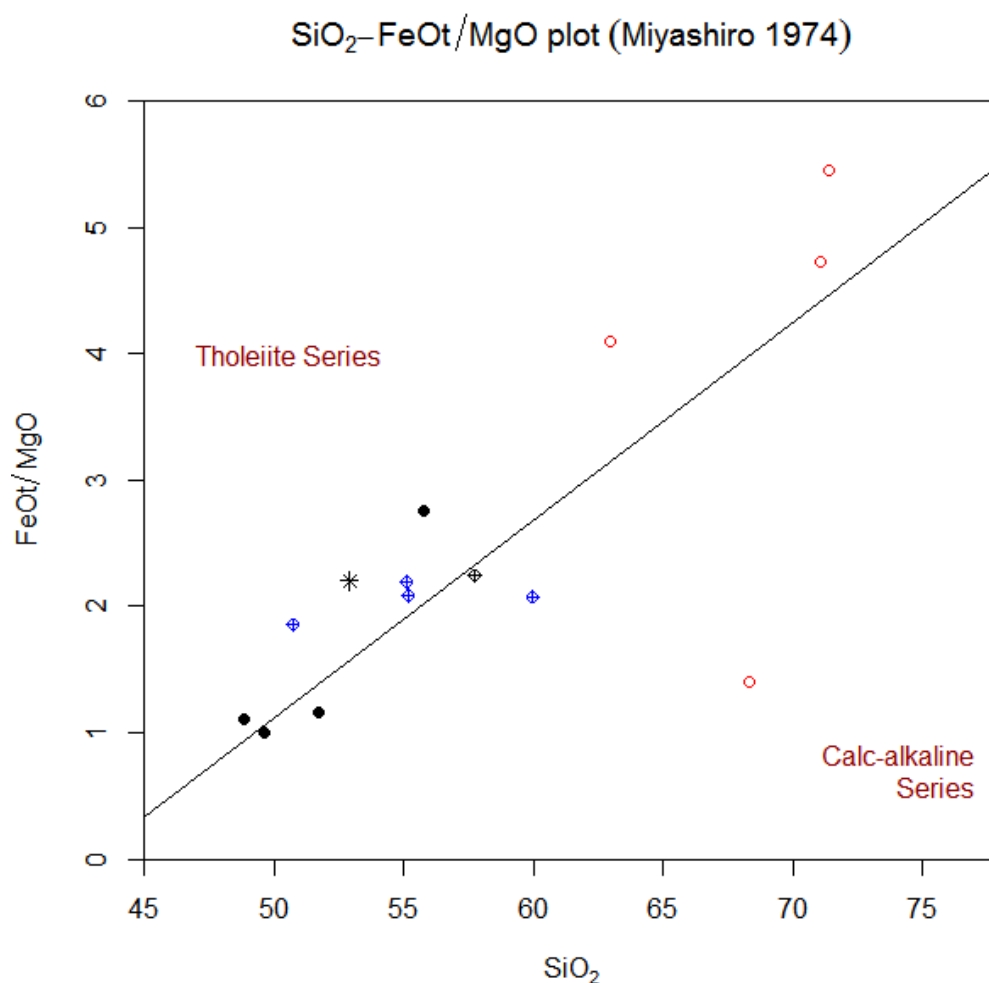
## Usage

Miyashiro()

## Details

Diagram in *SiO<sub>2</sub>* vs. *FeO<sub>t</sub>/MgO* space, proposed by *Miyashiro (1974)*, defines the following fields:

*Tholeiite Series*  
*Calc-alkaline Series*



As the boundary was defined by Akiho Miyashiro as straight line passing through two specific points, no limits of diagram validity for ultrabasic and high-silica rocks were given. Thus, the boundary implemented in GCDkit script spreads from  $FeO_t/MgO = 0$  to  $SiO_2 = 100\%$ .

#### Value

sheet	list with Figaro Style Sheet data
x.data	SiO <sub>2</sub> weight percent
y.data	FeOt/MgO weight percent

#### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

#### References

Miyashiro A (1974) Volcanic rock series in island arcs and active continental margins. Am J Sci 274, 321-355. doi: [10.2475/ajs.274.4.321](https://doi.org/10.2475/ajs.274.4.321)

**See Also**

[classify](#) [figaro](#) [plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("Miyashiro")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("Miyashiro", FALSE)
```

---

Mode

*Approximating the mode by least-squares method*


---

**Description**

The functions 'Mode' and 'ModeC' calculate the best approximations of the mode given major-element compositions of the rock and its main mineral constituents. Function 'WRComp' does the opposite, i.e. yields the whole-rock composition given the chemistry of individual minerals and their modal proportions.

**Usage**

```
ModeMain(WR,sample.id="",select.oxides=TRUE,select.minerals=TRUE)
Mode(rock, mins,sample.id="")
ModeC(rock, mins,sample.id="")
ModeAll(WR)
WRComp(mins, f)
```

**Arguments**

WR	a numerical matrix; the whole-rock data to be normalized.
rock	whole-rock composition of the given sample.
sample.id	(optional) sample name.
select.oxides	(logical) should be selected oxides used for calculation?
select.minerals	(logical) should be selected minerals used for calculation?
mins	composition of its main rock-forming minerals.
f	their modal proportions.

**Details**

'Mode' uses unconstrained least-squares method taking advantage of the standard R function 'lsfit(mins,rock,intercept=F)'. It produces results that generally do not sum up to 100 % due to the presence of elements not used in calculation (such as water), and, or, analytical noise.

'ModeC' is the constrained variation whose output ought to sum up to 100 % by definition (*Albarede 1995*). As such it seems to be more appropriate in most applications.

In both cases, the printed output involves the input data, calculated modal proportions of the individual minerals, the calculated composition of the rock (using the auxiliary function 'WRComp') and differences between the approximated and the real data (residuals).

The sum of squared residuals is a measure of fit (as a rough guide it should be less than ca. 1).

The mineral compositions are provided by a tab-delimited ASCII file, whose first row contains the names of the determined oxides, the following ones start with the mineral abbreviation and the numeric data (hence the first row has one item less than the following ones).

'ModeMain' is entry point to both 'Mode' and 'ModeC' that enables the user to read the mineral data file, select the oxides and minerals to be used in the calculation.

The options 'select.oxides=FALSE' and 'select.minerals=FALSE' read the mineral file in its entirety, using all minerals and oxides present.

'ModeAll' is a front end that performs the constrained least squares calculation for samples specified by the function [selectSamples](#).

## Value

'ModeMain', 'Mode' and 'ModeC' return a list with two items. The first of them ('table') is a matrix with the real composition of the rock and its minerals, the calculated whole-rock composition and the residuals. The second ('(un)constrained') returns calculated mineral proportions and sum of squared residuals.

'ModeAll' returns a simple matrix listing, for each rock sample, calculated proportions of rock-forming minerals and the sum of squared residuals.

'WRComp' yields a vector with the calculated whole-rock composition.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Albarede F (1995) Introduction to Geochemical Modeling. Cambridge University Press, Cambridge, p. 1-543

## See Also

For example of the mineral data, see file 'Test\_data\sazava mins.data'.

## Examples

```
# Albarede (1995) - page 7
# Calculate WRComposition of olivine gabbro containing 40 % olivine,
# 30 % diopside and 30 % plagioclase.

mins<-matrix(c(40.01,0.00,14.35,45.64,0.00,0.00,54.69,0.00,3.27,16.51,
              25.52,0.00,48.07,33.37,0.00,0.00,16.31,2.25),3,6,byrow=TRUE)
rownames(mins)<-c("ol","di","plg")
colnames(mins)<-c("SiO2","Al2O3","FeO","MgO","CaO","Na2O")
print(mins)

f<-c(0.4,0.3,0.3)
names(f)<-c("ol","di","plg")
print(f)
```

```

rock<-WRComp(mins,f)
print(rock)

# Reverse
mode1<-Mode(rock,mins)
mode2<-ModeC(rock,mins)

```

---

Molecular weights

*Calculating molecularWeights of oxides*


---

## Description

These functions plot multiple binary plots with a common x axis, such as Harker plots.

## Usage

```
molecularWeight(formula)
```

## Arguments

formula            a character vector of length 1, a formula of the oxide.

## Details

So far only simple oxide formulae in form of  $A_xO_y$  (where x, y are optional indexes) can be handled. The atomic weights are stored in a file MW.data.

## Value

A list with items:

MW	molecularWeight
x.atoms	number of atoms in the formula
x.oxygen	number of oxygens

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```

molecularWeight("SiO2")

molecularWeight("SiO2")[[1]]

oxides<-c("SiO2","TiO2","Al2O3","Fe2O3","FeO")
sapply(oxides,molecularWeight)

```



Mullen

*Mullen (1983) 10MnO-TiO<sub>2</sub>-10P<sub>2</sub>O<sub>5</sub>***Description**

Assigns data for the diagram of *Mullen (1983)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

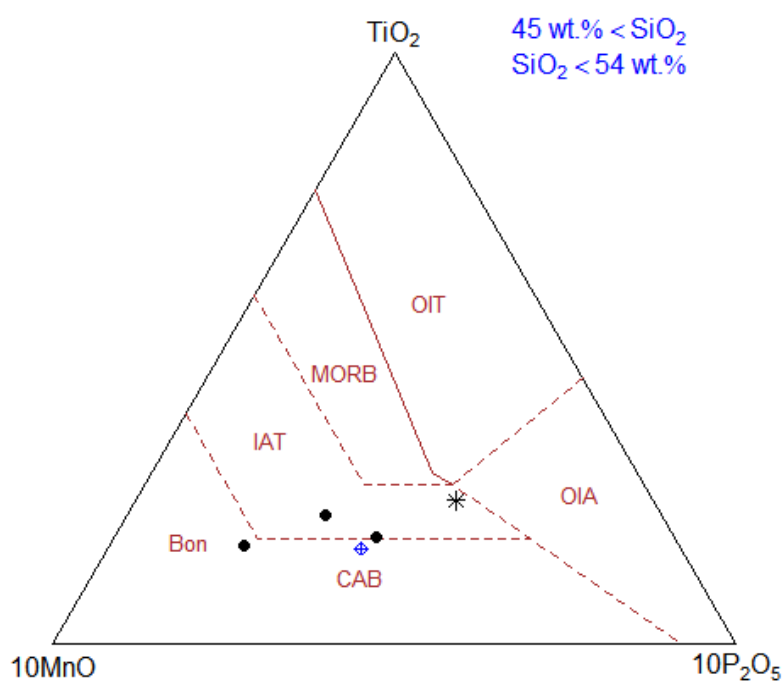
**Usage**

```
Mullen()
```

**Details**

Triangular diagram with apices 10MnO,  $TiO_2$  and  $10P_2O_5$ , proposed by *Mullen (1983)*.

### 10MnO – $TiO_2$ – $10P_2O_5$ (Mullen 1983)



Abbreviations used in diagram represent following geotectonic settings:

CAB	<i>Calc-Alkaline Basalts</i>
IAT	<i>Island Arc Tholeiites</i>
MORB	<i>Mid-Ocean Ridge Basalts</i>
OIA	<i>Ocean Island Andesites</i>
OIT	<i>Ocean Island Tholeiites</i>

### Value

sheet                    list with Figaro Style Sheet data  
 x.data, y.data    10MnO,  $TiO_2$  and  $10P_2O_5$  in wt. % recalculated to 2D

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Mullen E D (1983) MnO/ $TiO_2$ / $P_2O_5$ : a minor element discriminant for basaltic rocks of oceanic environments and its implications for petrogenesis. *Earth Planet Sci Lett* 62: 53-62 doi: [10.1016/0012-821X\(83\)90070-5](https://doi.org/10.1016/0012-821X(83)90070-5)

### See Also

[figaro plotDiagram](#)

### Examples

```
#plot the diagram
plotDiagram("Mullen",FALSE)
```

---

MullerK

---

*Muller et al. (1992) potassic igneous rocks discrimination*


---

### Description

Assigns Figaro templates to geotectonic diagrams for potassic igneous rocks of *Müller et al. (1992)* into the list 'plate') and appropriate values into the list 'plate.data' for subsequent plotting.

### Usage

```
MullerKbinary(plot.txt=getOption("gcd.plot.text"))
MullerKternary(plot.txt=getOption("gcd.plot.text"))
```

### Arguments

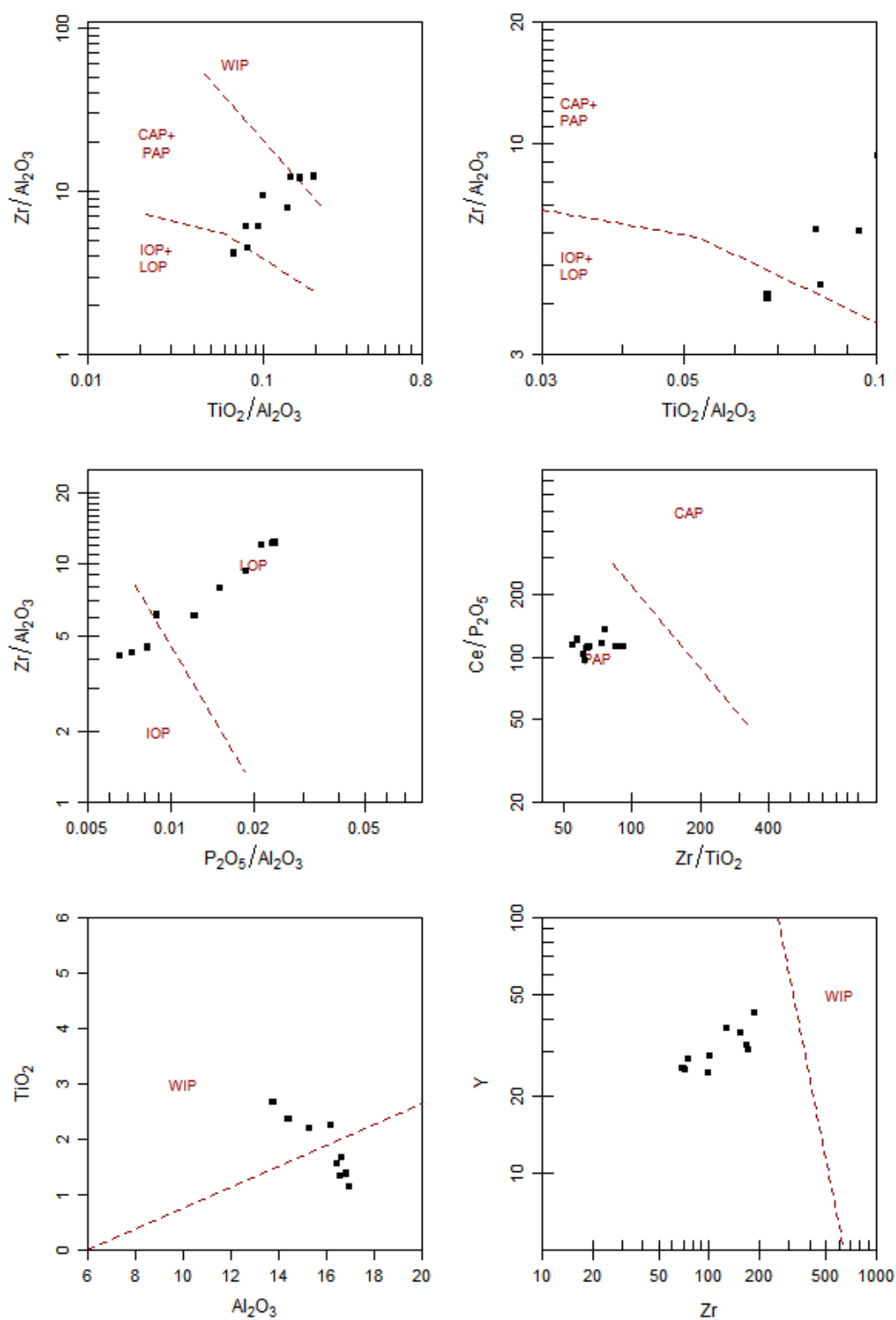
plot.txt                    logical, annotate fields by their names?

### Details

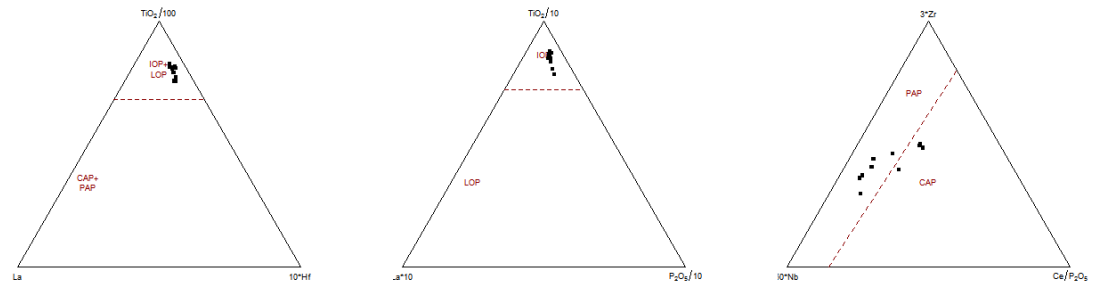
Suite of binary and ternary diagrams for discrimination of geotectonic environment of potassic igneous rocks, proposed by *Müller et al. (1992)* and *Müller & Groves (1995)*. Following geotectonic settings may be deduced:

Abbreviation used	Environment
CAP	<i>Continental Arc</i>
PAP	<i>Postcollisional Arc</i>
IOP	<i>Initial Oceanic Arc</i>
LOP	<i>Late Oceanic Arc</i>
WIP	<i>Within Plate</i>

## Geotectonic classification of potassic rocks – Müller et al. (1992)



Geotectonic classification of potassic rocks – Müller et al. (1992)



### Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Müller D, Rock NMS, Groves DI (1992) Geochemical discrimination between shoshonitic and potassic volcanic rocks in different tectonic settings: a pilot study. *Mineral Petrol* 46: 259-289  
[doi:10.1007/BF01173568](https://doi.org/10.1007/BF01173568)
- Müller D, Groves DI (1995) Potassic Igneous Rocks and Associated Gold-Copper Mineralization. Springer, Berlin, pp 1- 210

### See Also

[Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

### Examples

```
plotPlate("MullerKbinary")

plotPlate("MullerKternary")
```

---

Multiple plots      *Multiple binary plots*


---

**Description**

These functions plot multiple binary plots with a common x axis, such as Harker plots.

**Usage**

```
multiple(x,y=paste(colnames(WR),sep=","),
        samples=rownames(WR),pch=labels$Symbol,
        col=labels$Colour,xmin=NULL,xmax=NULL,GUI=FALSE,nrow=NULL,ncol=NULL,...)

multipleMjr(x = "",
            y = "SiO2,TiO2,Al2O3,FeOt,MgO,CaO,Na2O,K2O,P2O5",
            pch = labels$Symbol, col = labels$Colour, ...)
multipleTrc(x = "",
            y = "Rb,Sr,Ba,Cr,Ni,La,Ce,Y,Zr,mg#,A/CNK,K2O/Na2O",
            pch = labels$Symbol, col = labels$Colour, ...)
```

**Arguments**

x	a character vector, name of the common x axis. Formulae are OK.
y	a character vector, names of oxides/elements to be plotted as y axes separated by commas. Formulae are OK.
nrow, ncol	dimensions of the plots' matrix
samples	character or numeric vector; specification of the samples to be plotted.
pch	plotting symbols.
col	plotting colours.
xmin, xmax	minimum and maximum for the x axis.
GUI	logical; is the call being made from within GCDkit GUI or not?
...	further graphical parameters: see 'help(par)' for details.

**Details**

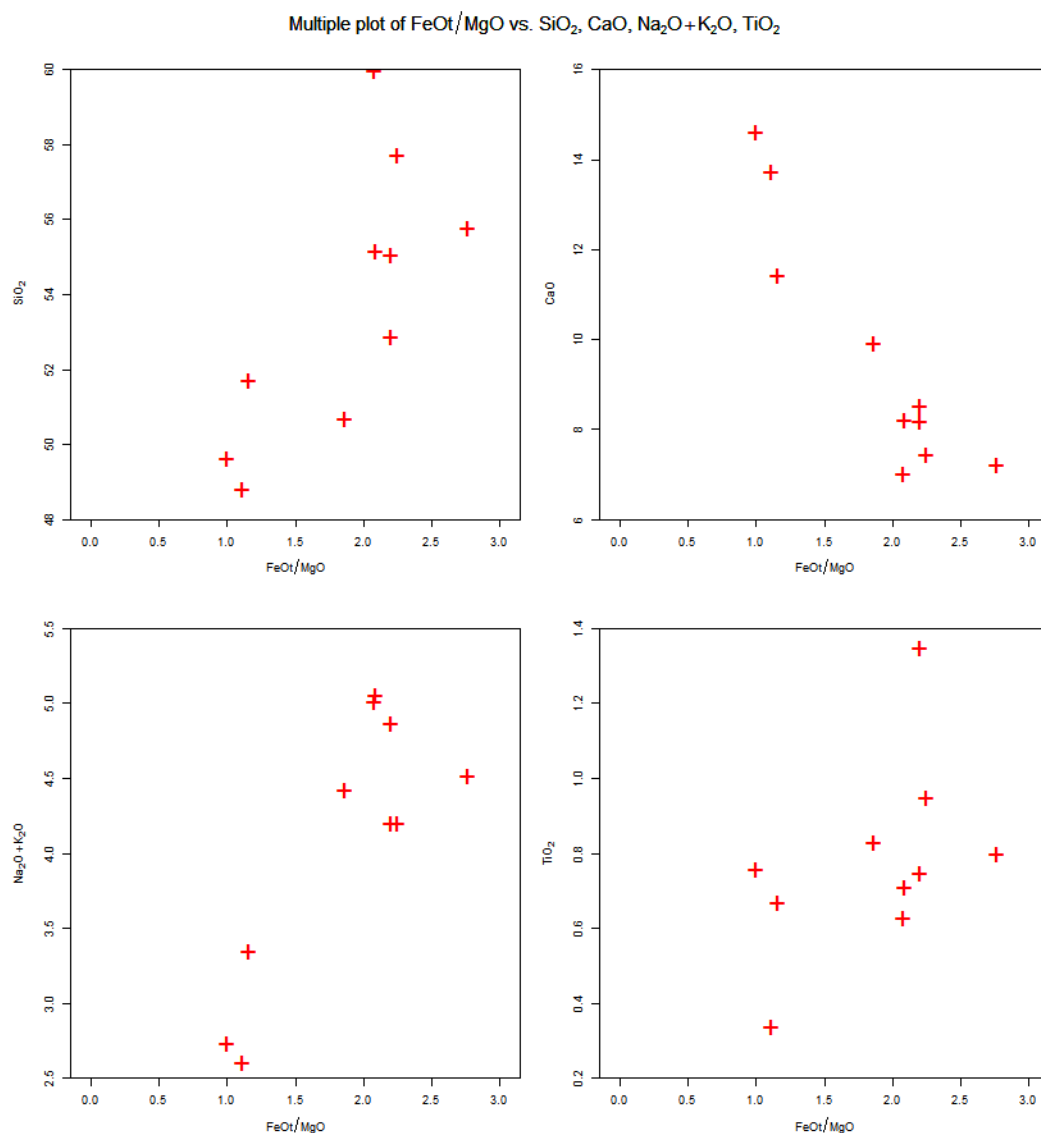
If x axis occurs among the arguments to be plotted as y axes, it is skipped.

Functions 'multipleMjr' and 'multipleTrc' are entry points supplying the default lists for major- and trace elements.

Even though as a default is assumed a list of major (SiO<sub>2</sub>, TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, FeOt, MnO, MgO, CaO, Na<sub>2</sub>O, K<sub>2</sub>O) or trace (Rb, Sr, Ba, Cr, Ni, La, Ce, Y, Zr and mg#) elements, the variable(s) to be displayed can be specified.

The easiest way is to type directly the names of the columns, separated by commas. Alternatively can be used their sequence numbers or ranges. Also built-in lists can be employed, such as 'LILE', 'REE', 'major' and 'HFSE' or their combinations with the column names.

These lists are simple character vectors, and additional ones can be built by the user (see Examples). Note that currently only a single, stand-alone, user-defined list can be employed as a search criterion.



In the specification of the x axis or any of the y axes can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

Lastly, the user is asked to enter the limits for the x axis, two numbers separated by a comma. Note that the scaling takes into account the size of the plotting symbols, i.e. the axes are extended somewhat.

### Value

None.

### Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[figaro](#), [Plate](#), [Plate editing](#)

**Examples**

```
multipleMjr("SiO2")

multiple("Na2O+K2O", LILE, xmin=0)
# Plots the LILE against the sum of alkalis

multiple("FeOt/MgO", "SiO2,CaO,Na2O+K2O,TiO2", pch="+", col="red", samples=1:10, cex=2.5)

multipleTrc("Zr")
# Plots the default trace-element set against the Zr
```

---

mzSaturation

---

*Monazite saturation (Montel 1993)*


---

**Description**

Calculates monazite saturation temperatures for given major-element compositions and LREE contents of the magma.

**Usage**

```
mzSaturation(cats = milli,
             REE = filterOut(WR, c("La", "Ce", "Pr", "Nd", "Sm", "Gd"), 1),
             H2O = 3, Xmz = 0)
```

**Arguments**

cats	numeric matrix; whole-rock data recast to millications
REE	numeric matrix with LREE concentrations - only complete set of La-Gd
H2O	assumed water contents of the magma
Xmz	mole fractions of the REE-phosphates in monazite

**Details**

This function uses saturation model of *Montel (1993)*. The formulae are as follows:

$$LREE = \frac{\sum (\frac{REE_i}{at.weight(REE_i)})}{Xmz}$$

where REE<sub>i</sub>: La, Ce, Pr, Nd, Sm, Gd.

$$Dmz = 100 \frac{Na + K + 2Ca}{Al} \cdot \frac{1}{Al + Si}$$

$$Tmz.sat.C = \frac{13318}{9.5 + 2.34Dmz + 0.3879\sqrt{H_2O} - \ln(LREE)} - 273.15$$



**Value**

Returns a matrix 'results' with the following components:

Dmz	distribution coefficient
Tmz.sat.C	monazite saturation temperature

**Plugin**

Saturation.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Montel J M (1993) A model for monazite/melt equilibrium and application to the generation of granitic magmas. Chem Geol 110: 127-146 doi: [10.1016/0009-2541\(93\)90250-M](https://doi.org/10.1016/0009-2541(93)90250-M)

---

NaAlK

*Na<sub>2</sub>O - Al<sub>2</sub>O<sub>3</sub> - K<sub>2</sub>O (mol. %) diagram*

---

**Description**

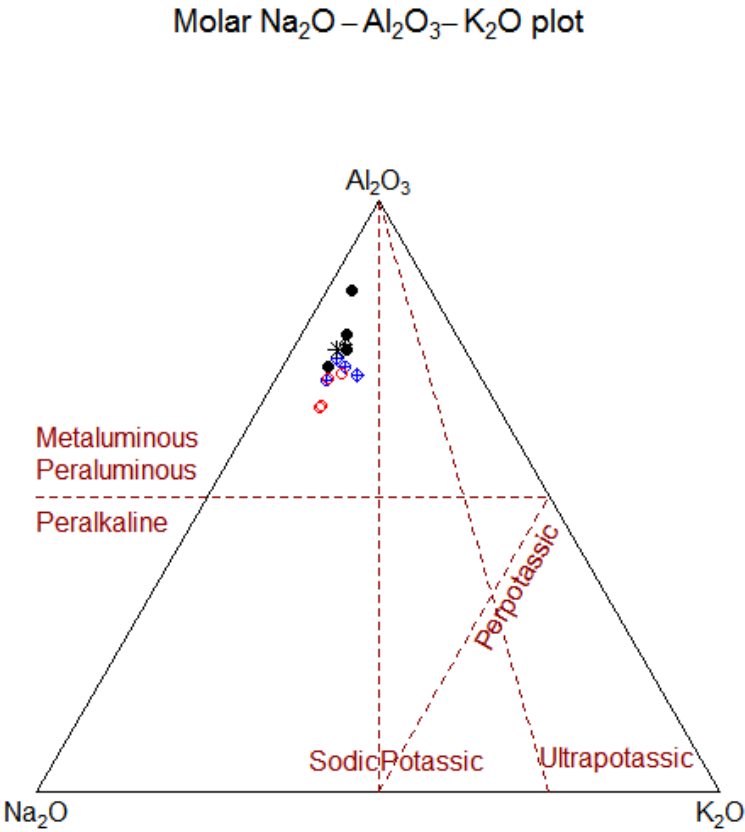
Assigns data for ternary diagram *Na<sub>2</sub>O - Al<sub>2</sub>O<sub>3</sub> - K<sub>2</sub>O* (mol. %) into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'. Calculates molar concentrations of alkalis and alumina, as well as several molar ratios involving these three oxides.

**Usage**

NaAlK()

**Details**

Ternary plot *Na<sub>2</sub>O - Al<sub>2</sub>O<sub>3</sub> - K<sub>2</sub>O* (mol. %). Dashed lines define the following compositional fields (all oxides are expressed in mol. %):



peraluminous + metaluminous (Shand 1943)	$(\text{Na}_2\text{O} + \text{K}_2\text{O})/\text{Al}_2\text{O}_3 < 1$
peralkaline (Shand 1943)	$(\text{Na}_2\text{O} + \text{K}_2\text{O})/\text{Al}_2\text{O}_3 > 1$
perpotassic	$\text{K}_2\text{O}/\text{Al}_2\text{O}_3 > 1$ and $\text{K}_2\text{O}/\text{Na}_2\text{O} > 1$
potassic	$1 < \text{K}_2\text{O}/\text{Na}_2\text{O} < 3$
ultrapotassic	$\text{K}_2\text{O}/\text{Na}_2\text{O} \geq 3$

The molar ratio of  $\text{K}_2\text{O}/\text{Na}_2\text{O} \geq 3$ , is equivalent to  $\text{K}_2\text{O}/\text{Na}_2\text{O} \geq 2$  in wt. %, i.e. to the definition of ultrapotassic igneous rocks by *Foley et al. (1987)*.

Value

sheet	list with Figaro Style Sheet data
x.data, y.data	$\text{Na}_2\text{O}$ , $\text{Al}_2\text{O}_3$ and $\text{K}_2\text{O}$ contents in mol.% transformed into 2D
Na2O	$\text{Na}_2\text{O}$ in mol.%
Al2O3	$\text{Al}_2\text{O}_3$ in mol.%
K2O	$\text{K}_2\text{O}$ in mol.%

(Na2O+K2O)/Al2O3

molecular ratio  $(Na_2O + K_2O)/Al_2O_3$

K2O/Al2O3

molecular ratio  $K_2O/Al_2O_3$

K2O/Na2O

molecular ratio  $K_2O/Na_2O$

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Foley S F, Venturelli G, Green D H, Toscani L (1987) Ultrapotassic rocks: characteristics, classification and constraints for petrogenetic models. *Earth Sci Rev* 24: 81-134 doi: [10.1016/0012-8252\(87\)90001-8](https://doi.org/10.1016/0012-8252(87)90001-8)

Shand (1943) *Eruptive Rocks*. John Wiley & Sons

### See Also

[classify figaro plotDiagram Shand](#)

### Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("NaAlK")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("NaAlK", FALSE)
```

---

Niggli

*Niggli's values*

---

### Description

Calculates cationic parameters of *Niggli (1948)*.

### Usage

```
Niggli(WR, precision = getOption("gcd.digits"))
```

### Arguments

WR	a numerical matrix; the whole-rock data to be normalized.
precision	precision of the result.

### Details

The calculated parameters are:

si, al, fm, c, alk, k, mg, ti, p, c/fm, qz

**Value**

A numeric matrix 'results'.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Niggli P (1948) Gesteine und Minerallagerstätten. Birkhauser, Basel, p. 1-540

---

OConnor

*Classification diagram for siliceous igneous rocks, based on Fsp composition (O'Connor 1965)*

---

**Description**

Assigns data for O'Connor's triangular diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

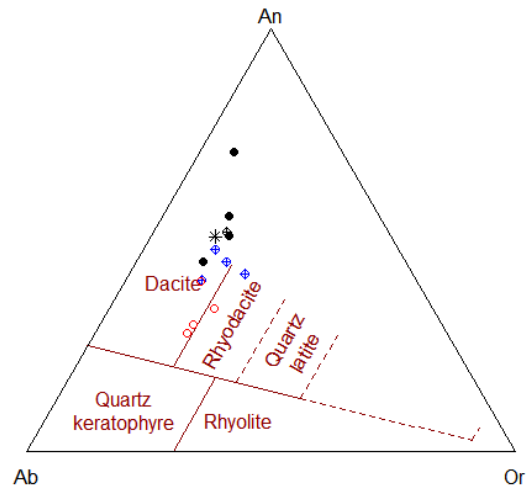
**Usage**

OConnorVolc()

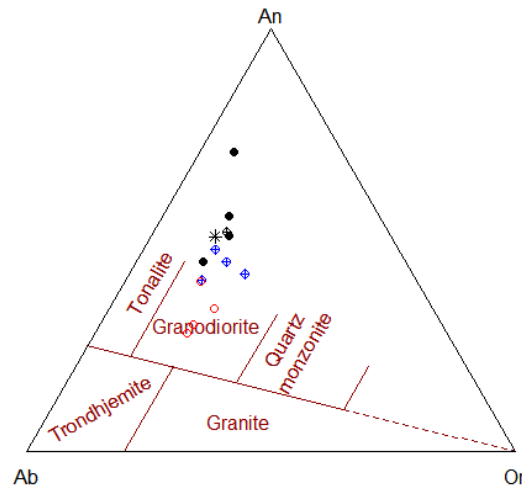
OConnorPlut()

**Details**

The O'Connor's triangular diagram is based on combination of Albite, Anorthite and K-feldspar modal or normative data. While the function 'OConnorPlut' can plot either modal or normative diagrams for plutonic rocks, 'OConnorVolc' is to be used exclusively with normative data computed from chemical compositions of volcanic rocks.

**Feldspar triangle (O'Connor 1965)**

In fact, the triangle represents projection of the Quartz - K-feldspar - Albite - Anorthite tetrahedron. All three diagrams are designed for quartz-rich rocks, i.e. those with quartz contents higher than 10 such silica-rich samples, the rock type can be determined purely on the basis of the feldspars' proportions.

**Feldspar triangle (O'Connor 1965)**

As the specific version of the normative calculation is not mentioned in the original paper by 'O'Connor (1965)', the function 'CIPW', designed after 'Hutchison (1974, 1975)' was implemented.

### Value

sheet                      list with Figaro Style Sheet data

x.data, y.data    An, Ab and Or data (see details) transformed to orthogonal coordinates

### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>

### References

O'Connor J T (1965) A classification for Quartz-rich igneous rocks based on feldspar ratios. U.S. Geol. Survey Prof Paper 525-B: B79-B84

Hutchison C S (1974) Laboratory Handbook of Petrographic Techniques. John Wiley & Sons, New York, p. 1-527

Hutchison C S (1975) The norm, its variations, their calculation and relationships. Schweiz Mineral Petrogr Mitt 55: 243-256

### See Also

[classify figaro CIPW plotDiagram](#)

**Examples**

```
plotDiagram("OConnorVolc", FALSE)

classify("OConnorVolc")
```

---

pairsCorr

*Statistics: Correlation*

---

**Description**

Plots a matrix of scatterplots in the lower panel and one of other pre-defined panel functions in the upper.

**Usage**

```
pairsCorr(elems = major)

pairsMjr()

pairsTrc()
```

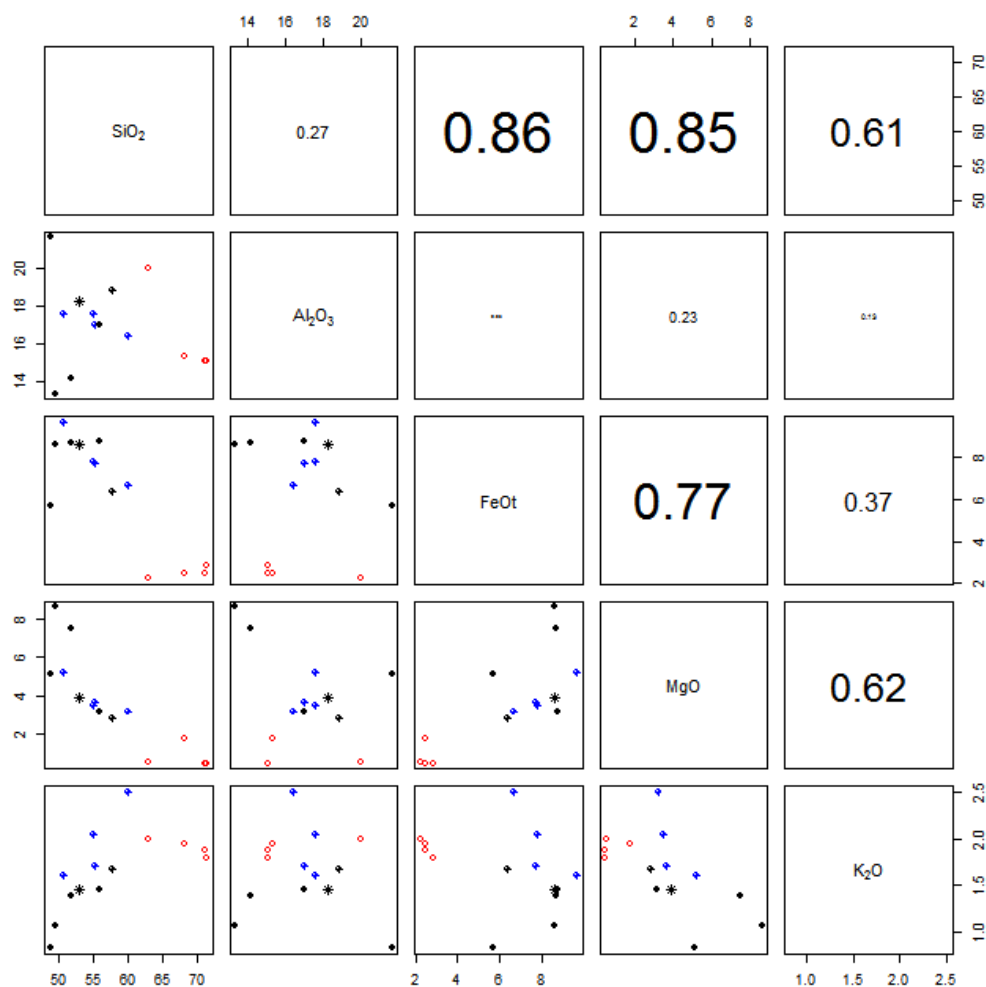
**Arguments**

elems            list of desired elements

**Details**

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Even though a list of major elements is assumed as a default, different variables can be specified by the function '[selectColumnsLabels](#)'.



The upper panels to choose from are:

<code>'panel.corr'</code>	Prints correlations, with size proportional to the correlations;
<code>'panel.cov'</code>	Prints covariances;
<code>'panel.smooth'</code>	Fits smooth trendlines;
<code>'panel.hist'</code>	Plots frequency histograms.

### Value

None.

### Warning

Names of existing numeric data columns and not formulae involving these can be handled at this stage.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>



**Examples**

```
pairsCorr(LILE)

pairsMjr()

pairsTrc()

# user-defined list
my.elems<-c("Rb", "Sr", "Ba")
pairsCorr(my.elems)
```

---

pdfAll

*Save all graphics to PDF*

---

**Description**

Saves all graphical windows to a single PDF file.

**Usage**

```
pdfAll(filename=NULL)
```

**Arguments**

filename            a name of file for saving the output.

**Details**

The function prompts for filename under which it saves all graphical windows, each on a separate page. PDF is the most portable format, that should preserve practically the same layout on all platforms.

Individual diagram can be saved from a menu that appears after clicking on the appropriate graphical window ('File|Save as|PDF').

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['psAll'](#) ['pdf'](#)

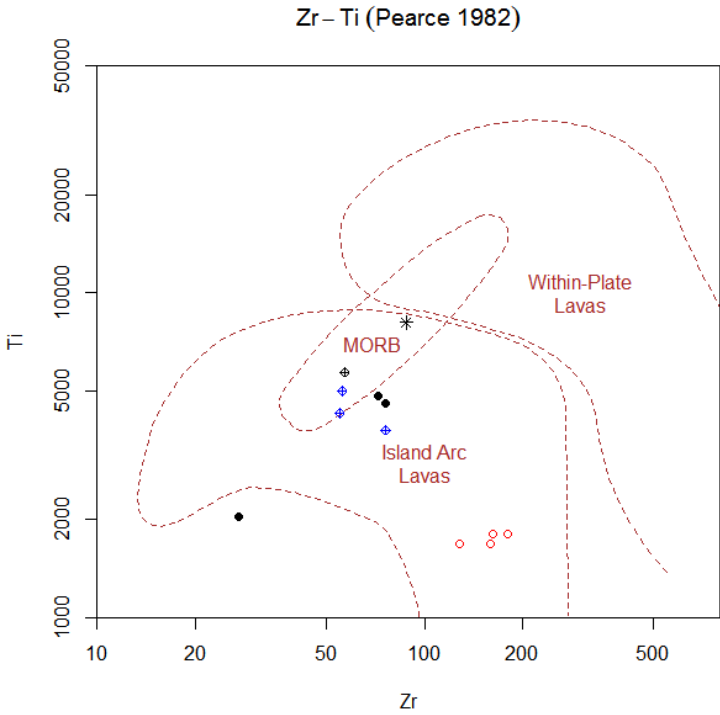
---

Pearce 1982	<i>Pearce (1982)</i>
-------------	----------------------

---

**Description**

Assigns data for the diagram of *Pearce (1982)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.



**Usage**

Pearce1982()

**Details**

Diagram proposed by *Pearce (1982)* for geotectonic discrimination between lavas from distinct geotectonic positions:

- Within-plate lavas*
- Island-arc lavas*
- Mid-ocean Ridge Basalts*

**Value**

sheet	list with Figaro Style Sheet data
x.data	Zr ppm
y.data	Ti ppm

**Author(s)**

Jean-Francois Moyen, <jfmoyen@gmail.com>

**References**

Pearce, J A (1982) Trace element characteristics of lavas from destructive plate boundaries. In: R S Thorpe (ed) Andesites: Orogenic Andesites and Related Rocks. John Wiley & Sons, Chichester, pp 525-548, ISBN 0 471 28034 8

**See Also**

[figaro plotDiagram](#)

**Examples**

```
#plot the diagram
plotDiagram("Pearce1982",FALSE)
```

---

Pearce and Cann	<i>Pearce and Cann (1973)</i>
-----------------	-------------------------------

---

**Description**

Plots data stored in 'WR' (or its subset) into Pearce and Cann's diagrams.

**Usage**

```
Cann(plot.txt = getOption("gcd.plot.text"))
```

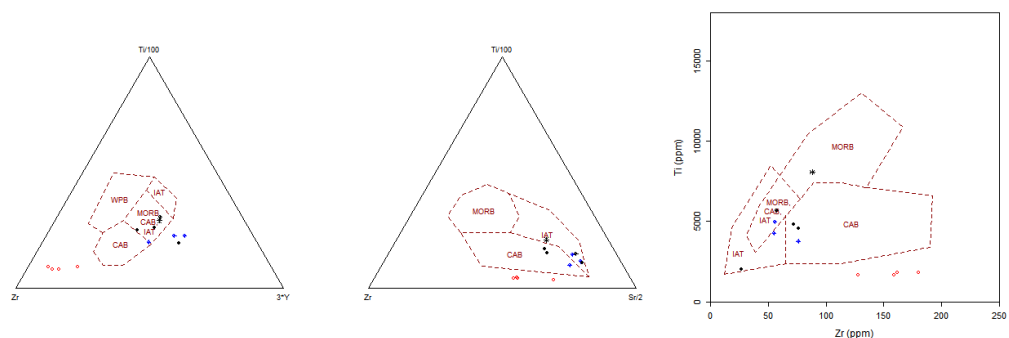
**Arguments**

plot.txt            logical, annotate fields by their names?

**Details**

Set of two triangular and one binary diagram, proposed by *Pearce & Cann (1973)*.

Basalt tectonic discrimination – Pearce and Cann (1973)



Following abbreviations are used:

IAT	<i>Low-K Tholeiites</i>
MORB	<i>Ocean Floor Basalts</i>
CAB	<i>Island Arc Basalts</i>
WPB	<i>Within Plate Basalts</i>

## Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Pearce J A & Cann J R (1973) Tectonic setting of basic volcanic rocks determined using trace element analyses. *Earth Planet Sci Lett* 19: 290-300. doi: [10.1016/0012-821X\(73\)90129-5](https://doi.org/10.1016/0012-821X(73)90129-5)

## See Also

[Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

## Examples

```
#plot the diagrams
plotPlate("Cann")
```

---

Pearce and Norry	<i>Pearce and Norry (1979)</i>
------------------	--------------------------------

---

## Description

Assigns data for the diagram of *Pearce & Norry (1979)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

## Usage

```
Norry()
```

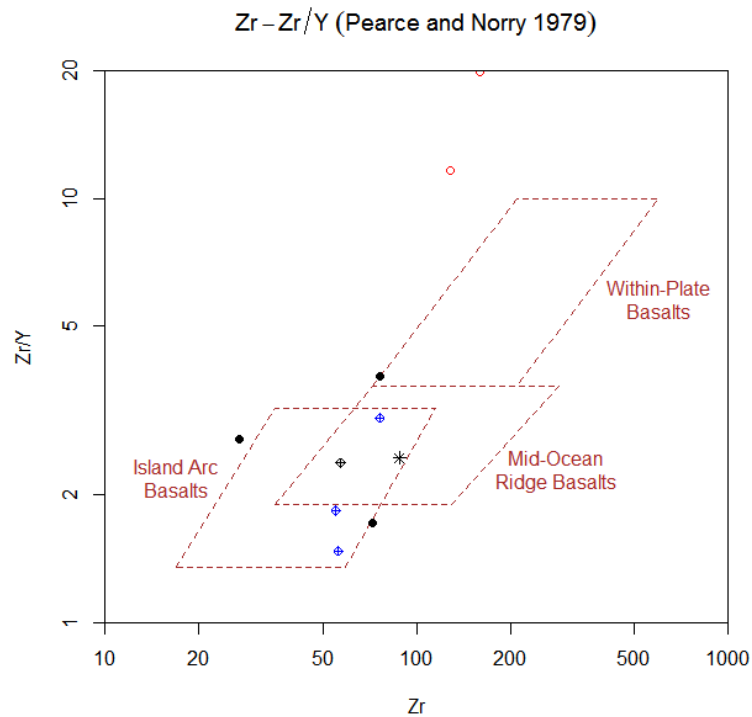
## Details

Diagram proposed by *Pearce & Norry (1979)* for geotectonic discrimination between basaltic rocks from distinct geotectonic positions:

*Within-plate Basalts*

*Island-arc basalts*

*Mid-ocean Ridge Basalts*



### Value

sheet	list with Figaro Style Sheet data
x.data	Zr ppm
y.data	Zr/Y by weight

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Pearce J A & Norry M J (1979) Petrogenetic implications of Ti, Zr, Y, and Nb variations in volcanic rocks. Contrib Mineral Petrol 69: 33-47. doi: [10.1007/BF00375192](https://doi.org/10.1007/BF00375192)

### See Also

[figaro plotDiagram](#)

### Examples

```
#plot the diagram
plotDiagram("Norry", FALSE)
```

---

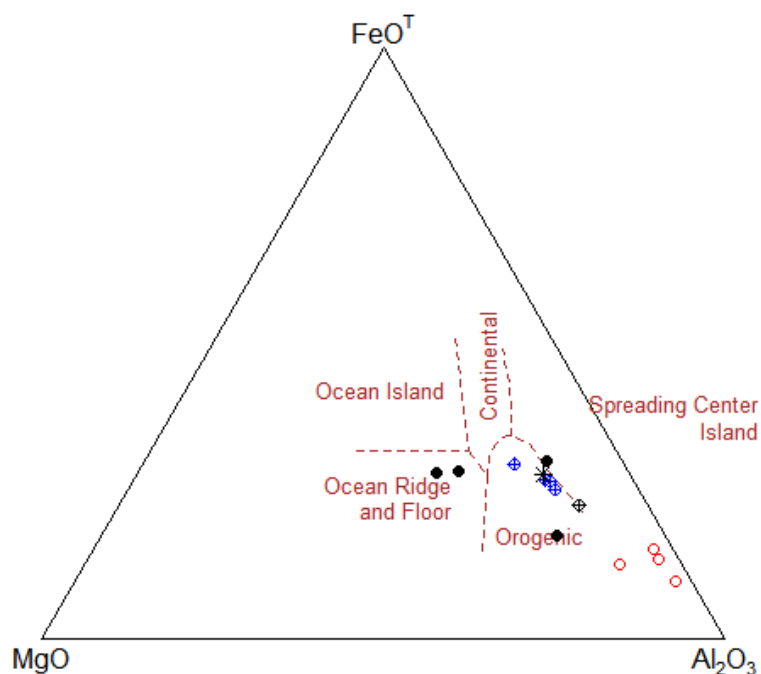
Pearce et al. 1977      *Pearce et al. (1977) MgO-FeOt-Al<sub>2</sub>O<sub>3</sub>*

---

### Description

Assigns data for the MgO-FeOt- $Al_2O_3$  triangle proposed by *Pearce et al. (1977)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

### Pearce et al. (1977)



### Usage

PearceEtAl()

### Details

Triangular diagram with apices MgO, FeOt and  $Al_2O_3$ , proposed by *Pearce et al. (1977)*. The boundaries were defined solely for subalkaline volcanic rocks with  $SiO_2$  between 51-56 wt %. Following geotectonic positions may be identified using the diagram:

*Spreading Center Island* (or inter-plate island) - oceanic islands adjacent to ocean-ridge spreading, such as Iceland or Galapagos; the authors 'do not consider this field well established'.

*Orogenic*

*Ocean Ridge and Floor*

*Ocean Island*

*Continental*

## Value

sheet list with Figaro Style Sheet data

x.data, y.data MgO, FeO and  $Al_2O_3$  in wt. % recalculated to two dimensions

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Pearce T H, Gorman B E & Birkett T C (1977) The relationship between major element geochemistry and tectonic environment of basic and intermediate volcanic rocks. *Earth Planet Sci Lett* 36: 121-132. doi: [10.1016/0012-821X\(77\)90193-5](https://doi.org/10.1016/0012-821X(77)90193-5)

## See Also

[figaro plotDiagram](#)

## Examples

```
#plot the diagram
plotDiagram("PearceEtAl",FALSE)
```

---

Pearce Nb-Th-Yb

*Pearce (2008) Nb/Yb-Th/Yb diagram*

---

## Description

Assigns data for a Th/Yb vs. Nb/Yb diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

## Usage

```
PearceNbThYb(reservoirs=TRUE,xmin=0.1,xmax=1000,ymin=0.01,ymax=100)
```

## Arguments

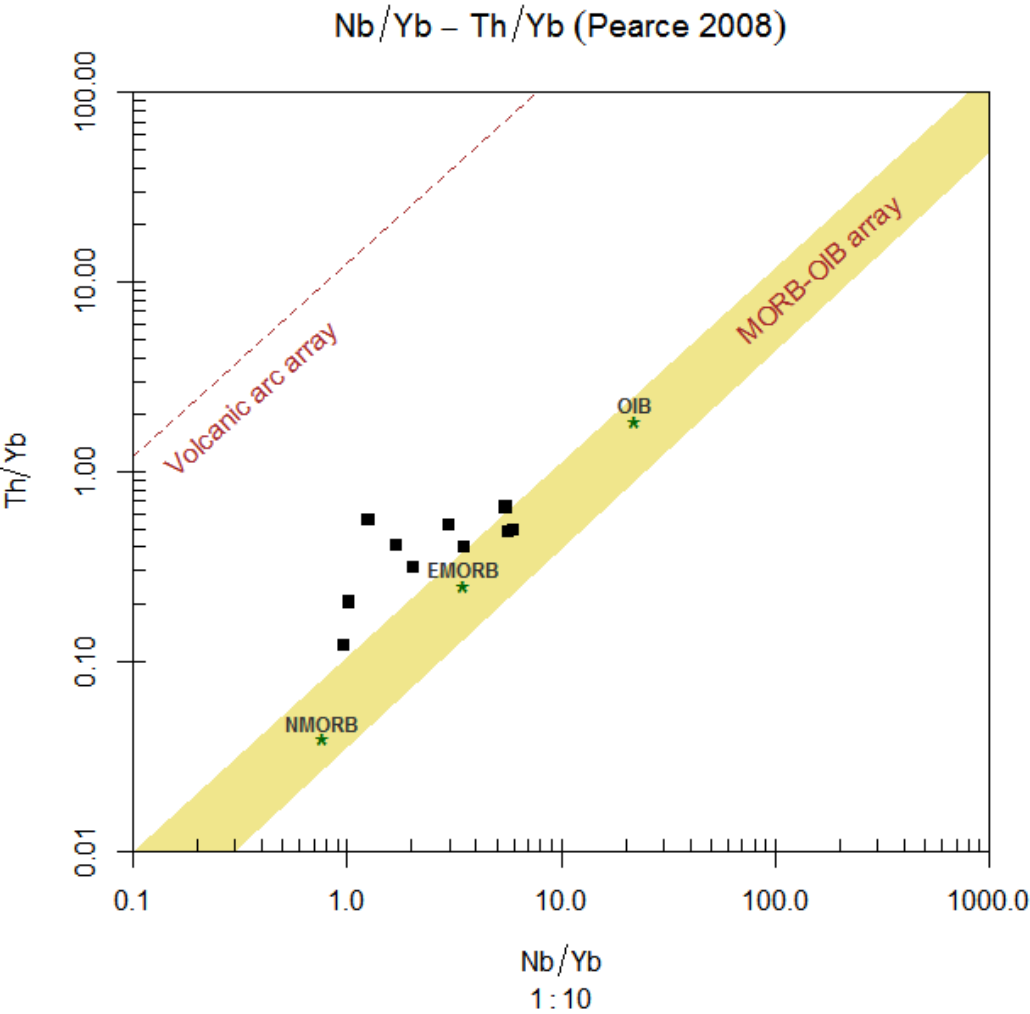
reservoirs	logical, should be plotted average NMORB, EMORB and OIB?
xmin,xmax	numeric, limits for the x axis.
ymin,ymax	numeric, limits for the y axis.

**Details**

This diagram (Th/Yb vs. Nb/Yb) has been developed by J. Pearce in the 2000's to characterize (and discriminate) arc magmatism. The current version is based on paper by *Pearce (2008)* dealing with oceanic basalts, though. According to this author, ThNb serves as a 'crustal input proxy' and hence for demonstrating an oceanic, non-subduction setting.

The 'MORB-OIB array' at the bottom extends from N-MORB to OIB (plotted for reference are average compositions of NMORB, EMORB and OIB taken from *Sun and McDonough (1989)*). Melting of the metasomatized mantle yields trends parallel to the mantle array.

Arc lavas, formed by fluxed melting of the mantle, are shifted above the mantle array; the same effects have mantle-derived magma-crust interactions. The top dashed line is the outer limit of typical arc lavas, but there is a great deal of variation.



**Value**

sheet	list with Figaro Style Sheet data
x.data	Nb/Yb
y.data	Th/Yb



**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz> and Jean-Francois Moyen, <jfmoyen@gmail.com>

**References**

Pearce JA (2008) Geochemical fingerprinting of oceanic basalts with applications to ophiolite classification and the search for Archean oceanic crust. *Lithos* 100: 14-48 doi:10.1016/j.lithos.2007.06.016

Sun SS, McDonough WF (1989) Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes. In: Saunders AD, Norry M (eds) *Magmatism in Ocean Basins*. Geological Society of London Special Publications 42, pp 313-345

**See Also**

[figaro plotDiagram PearceNbTiYb](#)

**Examples**

```
#plot the diagram
plotDiagram("PearceNbThYb", FALSE, FALSE, reservoirs=TRUE)

plotDiagram("PearceNbThYb", FALSE, FALSE, reservoirs=FALSE)
```

---

Pearce Nb-Ti-Yb	<i>Pearce (2008) Nb/Yb-TiO<sub>2</sub>/Yb diagram</i>
-----------------	---

---

**Description**

Assigns data for a  $TiO_2/Yb$  vs.  $Nb/Yb$  diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

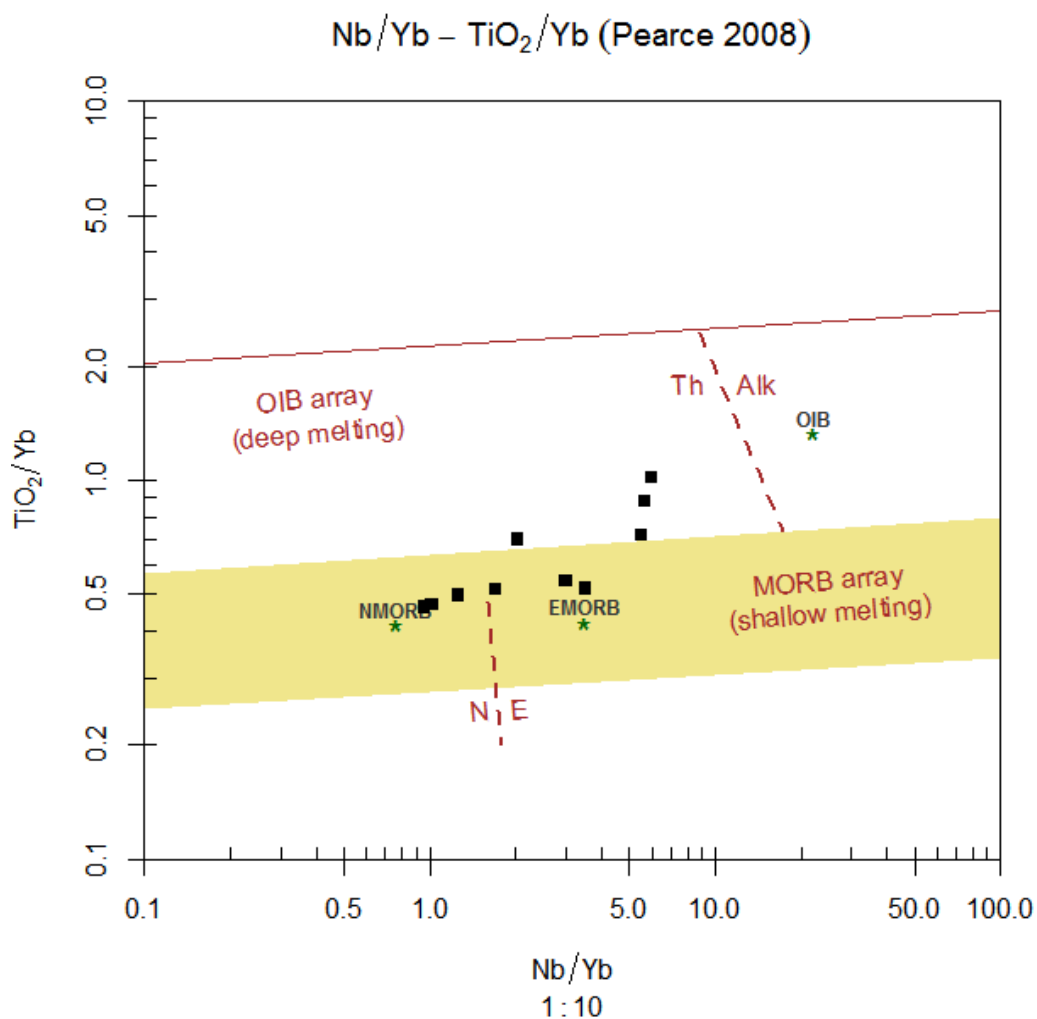
```
PearceNbTiYb(reservoirs=TRUE, xmin=0.1, xmax=100, ymin=0.1, ymax=10)
```

**Arguments**

reservoirs	logical, should be plotted average NMORB, EMORB and OIB?
xmin, xmax	numeric, limits for the x axis.
ymin, ymax	numeric, limits for the y axis.

**Details**

The diagram  $TiO_2/Yb$  vs.  $Nb/Yb$  serves as 'melting depth proxy' and hence for indicating mantle temperature and thickness of the conductive lithosphere (Pearce 2008). It distinguishes basalts, which have originated by shallow melting, out of garnet stability field ('MORB array') from those spanning from deep melting with garnet in the residue ('OIB array'). Plotted for reference are average compositions of NMORB, EMORB and OIB taken from Sun and McDonough (1984).

**Value**

sheet	list with Figaro Style Sheet data
x.data	Nb/Yb
y.data	TiO <sub>2</sub> /Yb

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Pearce JA (2008) Geochemical fingerprinting of oceanic basalts with applications to ophiolite classification and the search for Archean oceanic crust. *Lithos* 100: 14-48 doi:[10.1016/j.lithos.2007.06.016](https://doi.org/10.1016/j.lithos.2007.06.016)
- Sun SS, McDonough WF (1989) Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes. In: Saunders AD, Norry M (eds) *Magmatism in Ocean Basins*. Geological Society of London Special Publications 42, pp 313-345

**See Also**

[figaro plotDiagram PearceNbThYb](#)

**Examples**

```
#plot the diagram
plotDiagram("PearceNbTiYb", FALSE, FALSE, reservoirs=TRUE)

plotDiagram("PearceNbTiYb", FALSE, FALSE, reservoirs=FALSE)
```

---

Pearce1996	<i>Nb/Y - Zr/Ti diagram (Winchester + Floyd 1977, modified by Pearce 1996)</i>
------------	--

---

**Description**

Assigns data for Nb/Y vs. Zr/Ti diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

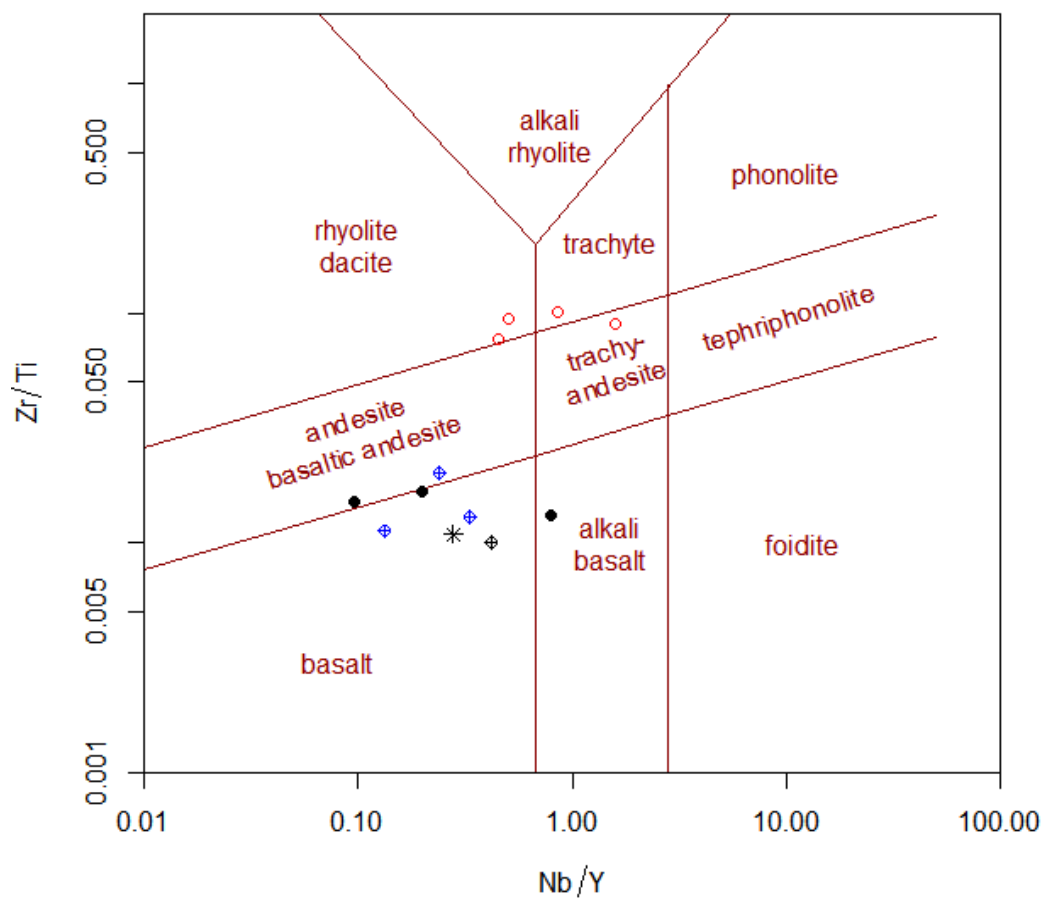
**Usage**

```
Pearce1996()
```

**Details**

Classification diagram proposed by *Winchester & Floyd (1977)* using incompatible element ratios (Nb/Y vs. Zr/Ti). As the original plot has been designed prior to the publication of the TAS diagram *Le Bas et al. 1986*, the field definition has been subsequently modified by *Pearce (1996)*.

Nb/Y – Zr/Ti plot (modified by Pearce 1996)



The following fields are defined:

*(Subalkaline) Basalt*

*Alkali basalt*

*Foidite*

*Andesite/Basaltic andesite*

*Trachyandesite*

*Tephriphonolite*

*Rhyolite/Dacite*

*Trachyte*

*Phonolite*

*Alkali Rhyolite*

#### Value

sheet	list with Figaro Style Sheet data
x.data	Nb/Y wt. % ratio
y.data	Zr/Ti wt. % ratio

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Le Bas M J, Le Maitre R W, Streckeisen A & Zanettin B (1986) A chemical classification of volcanic rocks based on the total alkali-silica diagram. *J Petrology* 27: 745-750 doi: [10.1093/petrology/27.3.745](https://doi.org/10.1093/petrology/27.3.745)

Pearce J A (1996) A User's Guide to Basalt Discrimination Diagrams. In Wyman D A (ed) Trace Element Geochemistry of Volcanic Rocks: Applications for Massive Sulphide Exploration. Geological Association of Canada, Short Course Notes 12, pp 79-113

Winchester J A & Floyd P A (1977) Geochemical discrimination of different magma series and their differentiation products using immobile elements. *Chem Geol* 20: 325-343 doi: [10.1016/0009-2541\(77\)90057-2](https://doi.org/10.1016/0009-2541(77)90057-2)

**See Also**

[WinFloyd1 classify figaro plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("Pearce1996")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("Pearce1996", FALSE)
```

---

PearceGranite

*Pearce et al. (1984)*

---

**Description**

Assigns Figaro templates to Pearce's geotectonic diagrams for granitoids into the list 'plate') and appropriate values into the list 'plate.data' for subsequent plotting.

**Usage**

```
PearceGranite(plot.txt = getOption("gcd.plot.text"))
```

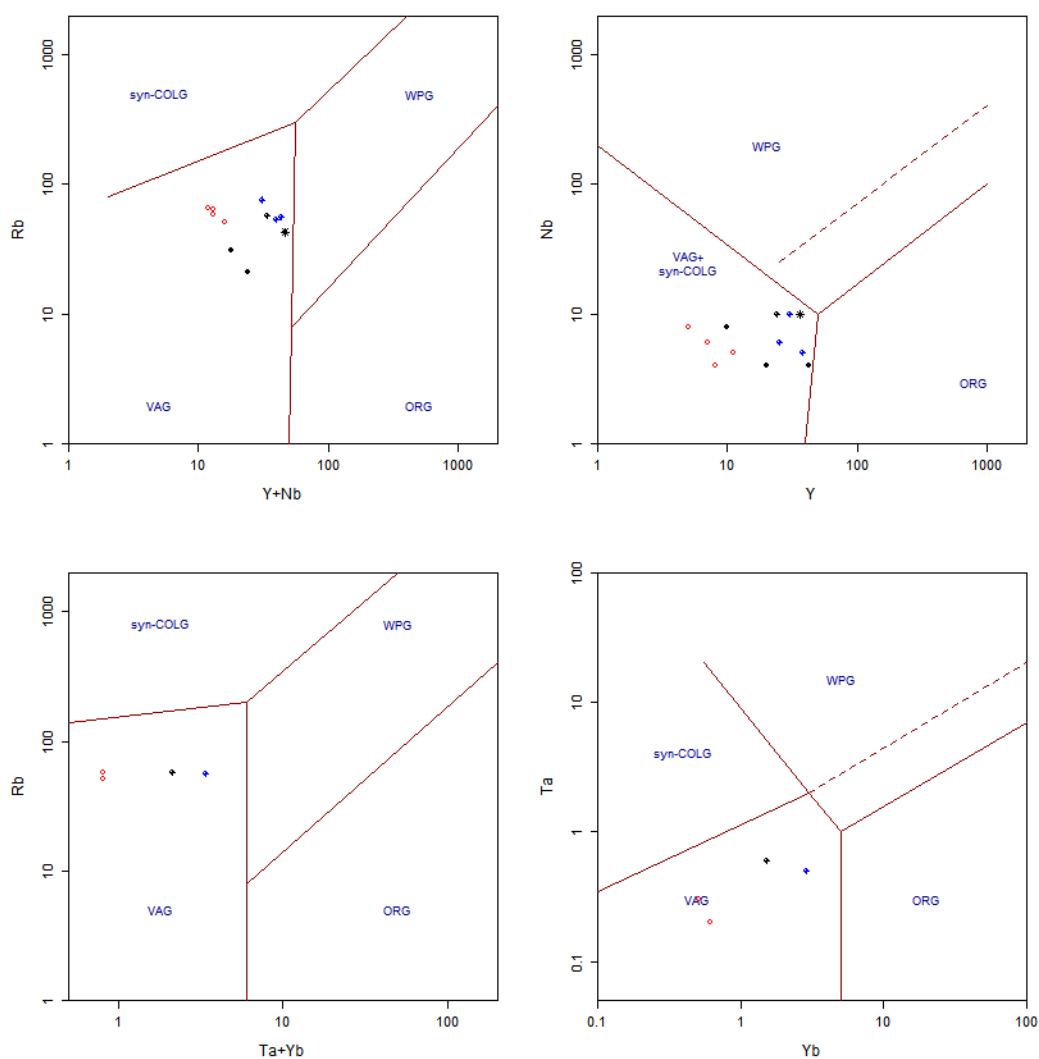
**Arguments**

plot.txt            logical, annotate fields by their names?

## Details

Suite of four diagrams for discrimination of geotectonic environment of granitoid rocks, proposed by *Pearce et al. (1984)*. It is based on combination of five trace elements (namely Y, Nb, Rb, Yb and Ta).

Granite tectonic discrimination – Pearce et al. (1984)



Following geotectonic settings may be deduced:

Abbreviation used	Environment
ORG	<i>Ocean Ridge Granites</i>
VAG	<i>Volcanic Arc Granites</i>
WPG	<i>Within Plate Granites</i>
COLG	<i>Collision Granites</i>

**Note**

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Pearce J A, Harris N W & Tindle A G (1984) Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. J Petrology 25: 956-983. doi:10.1093/petrology/25.4.956

**See Also**

[Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

**Examples**

```
plotPlate("PearceGranite")
```

---

PeceTaylor

*SiO<sub>2</sub>-K<sub>2</sub>O diagram (Peccerillo + Taylor 1976)*

---

**Description**

Assigns data for *SiO<sub>2</sub>* vs. *K<sub>2</sub>O* diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'

**Usage**

```
PeceTaylor()
```

**Details**

Diagram in *SiO<sub>2</sub>* vs. *K<sub>2</sub>O* space, proposed by *Peccerillo & Taylor (1976)*, defines the following fields:

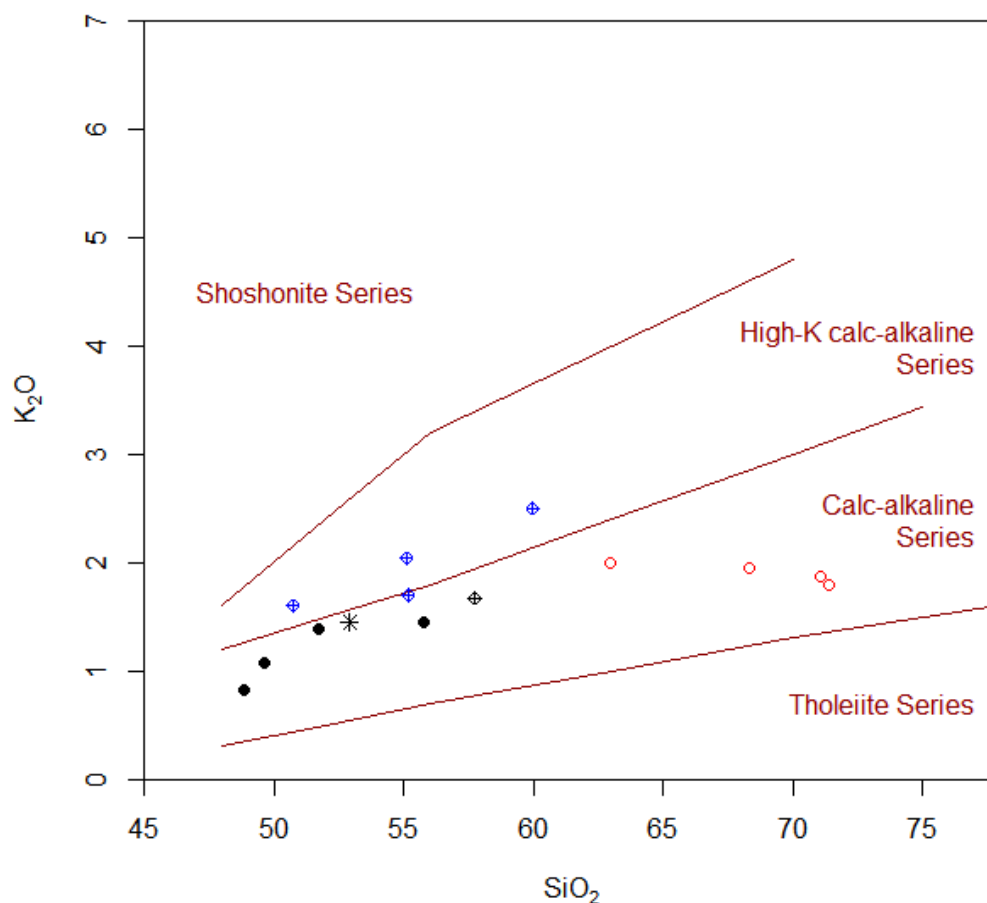
*Tholeiite Series*

*Calc-alkaline Series*

*High-K Calc-alkaline Series*

*Shoshonite Series*

Field boundaries were linearly extrapolated up to 75% of *SiO<sub>2</sub>* between 'Calc-alkaline Series' and 'High-K Calc-alkaline Series', and up to 70% of *SiO<sub>2</sub>* between 'High-K Calc-alkaline Series' and 'Shoshonite Series'.

SiO<sub>2</sub>–K<sub>2</sub>O plot (Peccerillo and Taylor 1976)

To employ boundaries as originally defined by *Peccerillo & Taylor (1976)*, change the value of variable 'extrapolated' to 'FALSE' in the file '[R-root]\library\GCDkit\Diagrams\Classification\PeceTaylor.r'. Also note that the second value for the middle boundary (i.e. [52,1.5]) is in the original paper obviously misquoted as 1.3 .

Rocks with composition falling beyond defined boundaries are labeled 'undefined' by the 'classify' function.

For comparison with similar diagrams used by other authors see *Rickwood (1989)*.

#### Value

sheet	list with Figaro Style Sheet data
x.data	SiO <sub>2</sub> weight percent
y.data	K <sub>2</sub> O weight percent

#### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>



## References

- Peccerillo A & Taylor S R (1976) Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamonu area, Northern Turkey. Contrib Mineral Petrol 58: 63-81 doi: [10.1007/BF00384745](https://doi.org/10.1007/BF00384745)
- Rickwood P C (1989) Boundary lines within petrologic diagrams which use oxides of major and minor elements. Lithos 22: 247-263 doi: [10.1016/0024-4937\(89\)90028-5](https://doi.org/10.1016/0024-4937(89)90028-5)

## See Also

[classify figaro plotDiagram](#)

## Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("PeceTaylor")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("PeceTaylor", FALSE)
```

---

peterplot	<i>Anomaly plot</i>
-----------	---------------------

---

## Description

This function plots a conventional binary diagram but the type and size of the plotting symbols is assigned according to the distribution of a third, conditioning variable.

## Usage

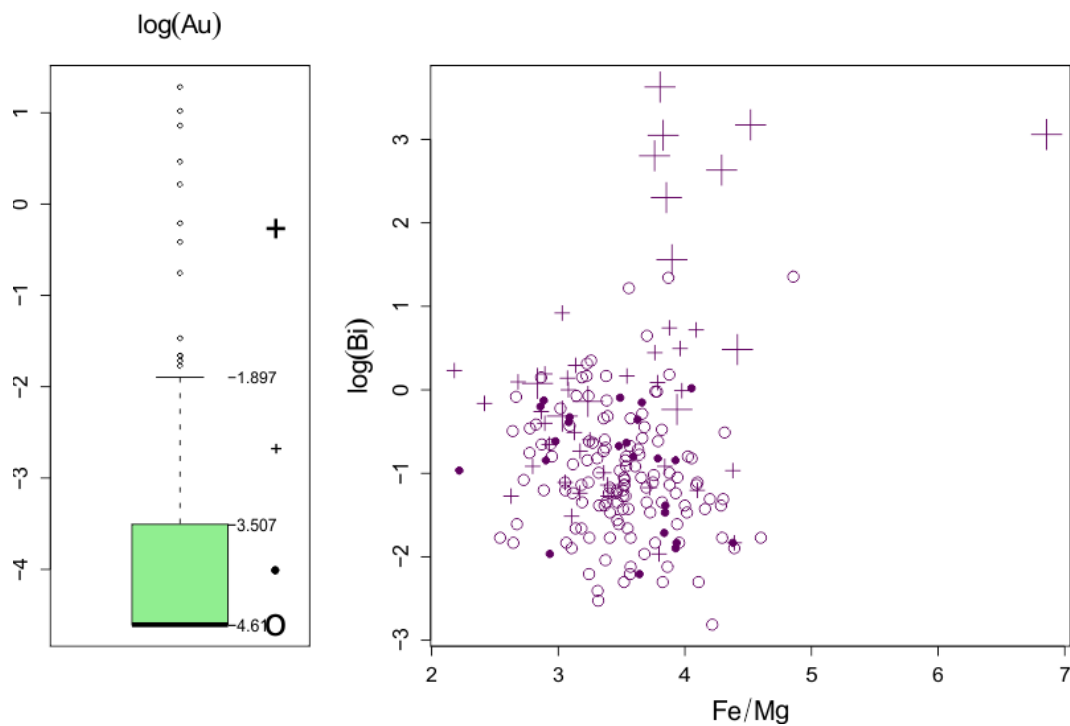
```
peterplot(xaxis = "", yaxis = "", zaxis = "", ident = FALSE,
          scaling.small = labels[1,"Size"], scaling.big = 2 * scaling.small,
          assign.symbols = FALSE)
```

## Arguments

xaxis, yaxis	character; specification of the axes
zaxis	character; conditioning variable
ident	logical; identify the individual points?
scaling.small	scaling factor for the smaller plotting symbols
scaling.big	scaling factor for the larger plotting symbols
assign.symbols	logical; should be the plotting symbols and their sizes assigned permanently?

## Details

If no parameters xaxis, yaxis and zaxis are specified, the user is prompted to do so interactively. The plotting symbols are assigned as follows: the values within 25 quartiles) obtain a dot, the higher ones are denoted by '+' and lower ones by '-'. If the given value is an outlier, its plotting size is doubled.



Optionally, the user can assign the plotting symbols and their sizes permanently, for use in other diagrams throughout the system.

### Value

May modify the variable `cex`, as well as the codes of plotting symbols stored in the data frame labels.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Reimann C, Filzmoser P, Garrett R G (2002) Factor analysis applied to regional geochemical data: problems and possibilities. *Applied Geochemistry* 17: 185-206

### Examples

```
peterplot("SiO2", "MgO", "K2O")

peterplot("SiO2", "MgO", "K2O", assign.symbols=TRUE)
plotDiagram("TAS", F)
```

---

Plate

---

*Plotting plates of several diagrams*


---

## Description

Functions to set up, save or load a so-called 'plate', i.e. a regular grid of slots to accommodate (any mixture of) binary or ternary plots, spiderplots or such alike. For instance, Harker plots are implemented using the plate concept.

## Usage

```
multiplePerPage(which=NULL,nrow=NULL,ncol=NULL,title="Plate",
dummy=TRUE)
```

```
Plate(scr=NULL)
```

```
plateRedraw(device="windows",filename=NULL,colormodel="rgb")
```

```
platePS(colormodel="rgb")
```

```
plateSave()
```

```
plateLoad()
```

## Arguments

<code>which</code>	total number of slots to be occupied by individual diagrams.
<code>nrow</code>	number of rows in the plots' matrix.
<code>ncol</code>	number of columns in the plots' matrix.
<code>title</code>	title for the whole plate.
<code>dummy</code>	logical; if TRUE, dummy plots are shown. See Details.
<code>scr</code>	(optional) number of screen to be selected.
<code>device</code>	output device; either 'windows' or 'postscript'.
<code>filename</code>	name of file if output redirected to Postscript.
<code>colormodel</code>	color mode for Postscript; 'rgb' or 'gray'.

## Details

The function 'multiplePerPage' serves to setting up a matrix of slots, each of which could be taken by a single Figaro-compatible diagram (a binary plot, a ternary plot, a spiderplot,...). If 'which' is NULL, the function asks for their number, and then suggests number of rows ('nrow') and columns ('ncol') for the matrix arrangement.

If desired, the slots can be filled by the so-called 'dummy plots', i.e. gray boxes showing the exact position and the size of each of them.

If 'which' is an integer, specified number of slots is allocated. Alternatively, this argument may represent a vector containing any mixture of names of diagrams that can be plotted by the function [plotDiagram](#) or even plotting commands themselves used to fill the individual slots directly. See Examples.

Once set up, a single slot can be selected for further work using the function 'Plate'. The function can be called directly, with the number of the screen desired. If none is specified, a red box-like cursor appears in the graphical window, which can be moved around using the cursor keys, Spacebar or by mouse. The appropriate slot can be chosen by left mouse button or by pressing Enter. Right-click anywhere on the plate invokes a context menu which enables several actions:

Menu item	Function
Introduce plot	Select a new Figaro-compatible diagram for this slot.
Plot editing	Modify the existing diagram (similarly to the menu Plot editing for stand alone plots).
Plate editing	Functions to modify the overall plate properties or all its diagrams simultaneously.

The function 'plateRedraw' serves for replotting a 'clean!' version of the whole plate, eg. for saving/printing. For this purpose, its output can be redirected to Postscript, either in colour or as black and white. As a wrapper for the Postscript output serves the function 'platePS'

The functions 'plateSave' and 'plateLoad' are designed to save and retrieve definitions of plates (Figaro sheets and the relevant data) for later use. The default suffix for the saved plates is 'mgr'. Note that only the data needed for the plotting ('x.data', 'y.data') are stored in the 'mgr' files. Thus the data set currently in memory (e.g., variables 'WR', 'labels', ...) is unaffected by the function 'plateLoad'.

Starting with GCDkit version 3, the plates concept is used by some built-in functions, such as 'Multiple plots' (function [multiple](#)) or 'Multiple plots by groups' (function [figMulti](#)).

## Value

plate	list of Figaro definitions for individual diagrams
plate.data	list containing 'x.data' and 'y.data' for each of them

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[Plate editing](#), [plotPlate](#), [multiple](#), [figMulti](#), [plot](#), [binary](#), [ternary](#), [spider](#), [figaro](#), [figLoad](#), [figSave](#)

## Examples

```
data<-loadData("sazava.data",sep="\t")
multiplePerPage(which=c("binary(\\"K20/Na20\\",
  \\"Rb\\",new=FALSE)",
  "DebonPQ","AFM","PeceTaylor","Shand"))

Plate()

Plate(3)
plotDiagram("LarochePlut",FALSE,FALSE)
```

**Description**

A collection of functions to modify the properties of a plate (or all its diagrams) simultaneously.

**Usage**

```
plateXLim(xlim=NULL)
plateYLim(ylim=NULL)
plate0YLim()
plateCex(n=NULL)
plateCexLab(n=NULL)
plateCexMain(n=NULL)
plateAnnotationsRemove()
platePch(pch=NULL)
plateCol(col=NULL)
plateBW()
plateExpand(scr=NULL)
plateExtract(diagram,which=NULL,main=NULL,...)
```

**Arguments**

xlim	scaling for the x axis
ylim	scaling for the y axis
n	relative size (use n = 1 for normal one).
pch	plotting symbol specification, either as string or a numeric code ( <a href="#">showSymbols</a> ).
col	colour specification, either by its English name, or by a numeric code ( <a href="#">showColours</a> ).
scr	number of screen to be expanded.
diagram	name of the function plotting a plate.
which	sequential number of plot in its definition.
main	optional alternative main title to the diagram.
...	additional parameters to the diagram (plate) plotting function.

## Details

The functions serve to change properties of all particular diagrams forming the given plate. They can be used to set up the uniform size of plotting symbols ('plateCex'), main title ('plateCexMain') or of the axes' labels ('plateCexLab'), remove the annotation of classification fields ('plateAnnotationsRemove'), uniform plotting symbol ('platePch') and/or colour ('plateCol') to all plots, or set them into black and white ('plateBW'). If the same variable is plotted as x or y axis in all diagrams forming the plate (e.g., on Harker plots), it can be scaled by means of the functions 'plateXLim' and 'plateYLim'. Using the command 'plate0YLim' it is possible to set the origin of all non-logarithmic y axes to zero.

The function 'plateExpand' displays a zoomed up version of the selected diagram in a separate window.

The function 'plateExtract' extracts a Figaro definition of a single plot from a plate plotted by the function 'diagram'.

## Value

None.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Pearce J A, Harris N W & Tindle A G (1984) Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. J Petrology 25: 956-983. doi:10.1093/petrology/25.4.956

## See Also

[Plate](#), [plotPlate](#), [figaro](#), [figScale](#), [figCol](#), [showSymbols](#), [showColours](#)

## Examples

```
data<-loadData("sazava.data", sep="\t")
showSymbols()
showColours()
multiplePerPage(which=c("binary(\\"K2O/Na2O\\",
\\"Rb\\", new=FALSE)", "DebonPQ", "AFM", "PeceTaylor", "Shand"))

plateCex(0.5)

plateCex(2)

platePch(11)

platePch("+")

plateCol(11)

plateCol("red")

plateBW()

multiple("SiO2", major)
```

```

plateXLim(c(50,70))

groupsByLabel("Intrusion")
spider(WR,selectNorm("Boynton"),0.1,1000,pch=labels$Symbol,col=labels$Colour)
figMulti(plot.symb=TRUE)
plateYLim(c(1,100))

graphicsOff()
plotDiagram("DebonBA",FALSE,FALSE)
figMulti()
plateYLim()

plateExpand(2)

plateExtract("PearceGranite",2) # Second plot of Pearce et al. (1984), i.e. Y-Nb

```

---

plateLabelSlots

Annotate individual slots by letters or Roman numerals

---

## Description

Annotates individual slots in a plate by letters or Roman numerals. For instance (a), (b), (c)... or (i), (ii), (iii), (iv), (v)...

## Usage

```
plateLabelSlots(text=letters,style="()",cex=1.5,pos="topright")
```

## Arguments

text	desired type of labels; see Details.
style	optional character strings before and after label, typically brackets.
cex	relative size of the text compared to the current codepar("cex").
pos	character; position of the label relative to the plot.

## Details

The argument 'what' may acquire one of following values:

```
'letters' 'LETTERS' 'numbers' 'roman' 'ROMAN'
```

or can be user-defined character string of longer or of the same length as is the number of slots to be annotated (see the last example).

Possible positions (parameter pos) are:

```
'bottomright' 'bottom' 'bottomleft' 'left'
'topleft' 'top' 'topright' 'right' 'center'
```

.

Value

none

Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

See Also

[Plate](#), [Plate editing](#), [figaro](#)

Examples

```
multipleMjr("SiO2")

plateLabelSlots("letters", "", pos="bottomleft")

plateLabelSlots("ROMAN", "{}")

my_labs<-c("1st", "2nd", "3rd", "4th", "5th", "6th", "7th", "8th", "9th")
plateLabelSlots(my_labs)
```

---

plotPlate	<i>Plot Plate of Diagrams</i>
-----------	-------------------------------

---

Description

Plots a plate of diagrams, based on the Figaro style sheets.

Usage

```
plotPlate(diagram, where="WR", ...)
```

Arguments

diagram	a valid name of the function that uses the plate concept to plot the given diagram. See Details.
where	name of the data matrix/data frame, columns of which are to be used for plotting.
...	optional parameters for the diagram function call.

Details

The argument 'diagram' may acquire one of following values:

'Maniar' 'Frost' 'PearceGranite' 'Schandl'  
'Verma' 'Agrawal' 'Cann' 'Wood'



**Value**

none

**Note**

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[Plate](#), [Plate editing](#), [figaro](#)

**Examples**

```
plotPlate("PearceGranite")
```

---

plotWithCircles	<i>xyz plotWithCircles</i>
-----------------	----------------------------

---

**Description**

Plots a binary diagram of two specified variables and the whole dataset or its selection. The size and colours of the plotted circles correspond to the third.

**Usage**

```
plotWithCircles(xaxis = "", yaxis = "", zaxis = "",
  colour = "heat.colors", scaling.factor = NULL,
  bins = NULL, ident = getOption("gcd.ident"))
```

**Arguments**

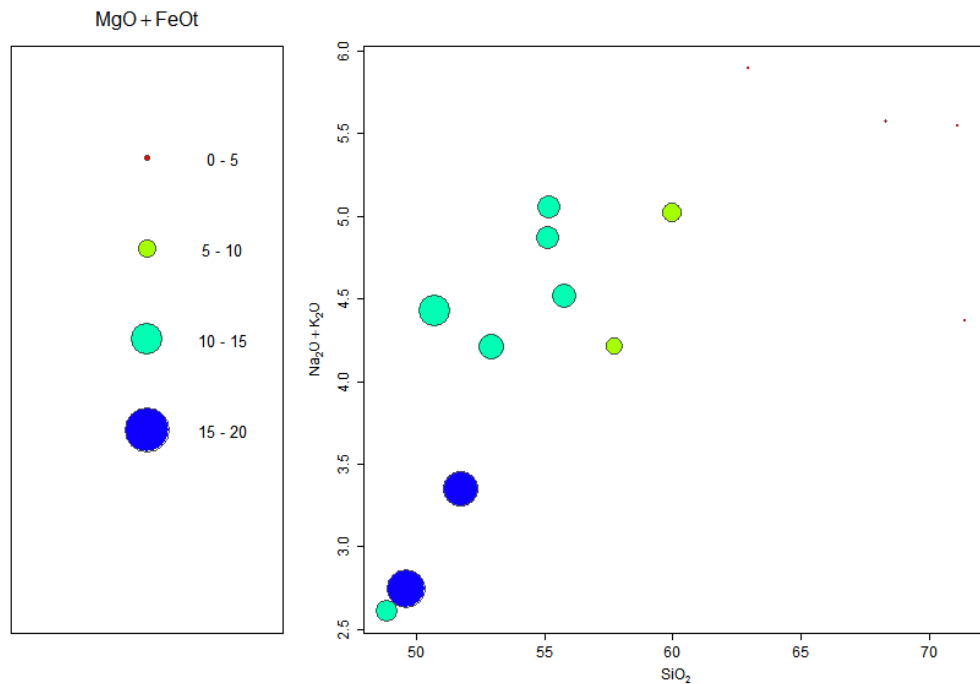
xaxis	Name of the data column to be used as x axis.
yaxis	Name of the data column to be used as y axis.
zaxis	Name of the data column to determine the size/colour of the circles.
colour	colour scheme for the circles.
scaling.factor	a factor determine the size of the circles.
bins	number of intervals for the legend.
ident	Logical: should be the individual samples identified?

### Details

If no parameters 'xlab', 'ylab' and 'zlab' are given, the user is prompted to specify them.

The variables are selected using the function '[selectColumnLabel](#)'.

In the specification of the apices can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.



The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

The legal colour schemes are: "grays", "reds", "blues", "greens", "cyans", "violets", "yellows", "cm.colors", "heat.colors", "terrain.colors", "topo.colors", "rainbow", "jet.colors".

### Value

None.

### Warning

This function IS NOT Figaro-compatible.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>  
& Vojtech Erban, <vojtech.erban@geology.cz>

### Examples

```
plotWithCircles("SiO2", "Na2O+K2O", "MgO+FeOt", colour="rainbow")
```

```
plotWithCircles("SiO2", "MgO", "K2O", colour="grays", scaling.factor=0.5, ident=TRUE)
```

**Description**

Performs principal components analysis (scaled variables, covariance or correlation matrix) and plots a biplot (*Gabriel, 1971*).

**Usage**

```
prComp(elems = "SiO2,TiO2,Al2O3,FeOt,MnO,MgO,CaO,Na2O,K2O",...)
```

**Arguments**

elems	numerical columns to be used for principal components analysis, typically major elements
...	additional parameters

**Details**

Biplot aims to represent both the observations and variables of a data matrix on a single bivariate plot (*Gabriel, 1971; Buccianti & Peccerillo, 1999*).

In the biplots, the length of the individual arrows is proportional to the relative variation of each variable. A comparable direction of two arrows implies that both variables are positively correlated; the opposite one indicates a strong negative correlation. When two links are perpendicular it indicates independence of the two variables (*Buccianti & Peccerillo, 1999*).

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Even though a list of major elements is assumed as a default, different variables can be specified by the function '[selectColumnsLabels](#)'.

**Value**

None.

**Warning**

Names of existing numeric data columns and not formulae involving these can be handled at this stage. Only complete cases are used for the principal components analysis.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Buccianti A & Peccerillo A (1999) The complex nature of potassic and ultrapotassic magmatism in Central-Southern Italy: a multivariate analysis of major element data. In: Lippard S J, Naess A, Sinding-Larsen R (eds) Proceedings of the 5th Annual Conference of the International Association for Mathematical Geology. Tapir, Trondheim, p. 145-150

Gabriel K R (1971) The biplot graphical display of matrices with application to principal component analysis. *Biometrika* 58: 453-467

**See Also**

For further details on the used principal components algorithm and biplots, see the R manual entries of `'princomp'` and `'biplot.princomp'`.

---

printSamples	<i>Display samples</i>
--------------	------------------------

---

**Description**

Displays specified combination of numeric variable(s) and/or labels for selected range of samples.

**Usage**

```
printSamples(elms=NULL, which=NULL, select.samples=FALSE, print=TRUE)
```

**Arguments**

elms	list of variables to be printed
which	list of samples, useful only for select.samples=FALSE
select.samples	logical: if TRUE, samples can be chosen using the appropriate dialogue
print	logical: should be the result indeed printed or just returned for further evaluation?

**Details**

This function prints the desired numerical columns, textual labels, or their combinations, for selected samples.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

The variables to be printed are chosen by the function `'selectColumnsLabels'`. In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

**Value**

results	data matrix with the desired data for the specified samples
---------	---

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**Examples**

```
## Not run:
# Querying names of numeric data columns

Search pattern = SiO2, MgO, CaO

Search pattern = major
SiO2, TiO2, Al2O3, Fe2O3, FeO, MnO, MgO, CaO, Na2O, K2O, P2O5

Search pattern = LILE
```

```

Rb, Sr, Ba, K, Cs, Li

Search pattern = HFSE
Nb, Zr, Hf, Ti, Ta, La, Ce, Y, Ga, Sc, Th, U

Search pattern = REE
La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu

Search pattern = Locality,SiO2,LILE,HFSE
Locality, SiO2, Rb, Sr, Ba, K, Cs, Li, Nb, Zr, Hf, Ti,
Ta, La, Ce, Y, Ga, Sc, Th, U

Search pattern = 1:5, 7
Numeric data columns number 1, 2, ...5, 7

# User-defined list
my.elms<-c("Rb","Sr","Ba")
Search pattern = my.elms
Rb, Sr, Ba

## End(Not run)

```

---

printSingle

*Display a variable*


---

## Description

Displays a single numeric variable or a result of a calculation.

## Usage

```
printSingle(default="")
```

## Arguments

default                      character: list of default column names, separated by commas.

## Details

The variable to be printed is selected using the function '[selectColumnLabel](#)'. In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

## Value

results                      numerical vector/matrix with the results

## Author(s)

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

## Examples

```
## Not run:
# examples of valid formulae....
(Na2O+K2O)/CaO
Rb^2
log10(Sr)
mean(SiO2)/10

# ... but this command is in fact a simple R shell -
# meaning lots of fun for power users!
summary(Rb,na.rm=TRUE)
cbind(SiO2/2,TiO2,Na2O+K2O)
cbind(major)
hist(SiO2,col="red")
boxplot(Rb~factor(groups))

# possibilities are endless
plot(Rb,Sr,col="blue",pch="+",xlab="Rb (ppm)",ylab="Sr (ppm)",log="xy")

## End(Not run)
```

---

profiler

*Profile plotting*

---

## Description

Plotting geochemical profiles. As a x axis can be specified an arbitrary variable or an numerical interval (for equidistant measurements).

## Usage

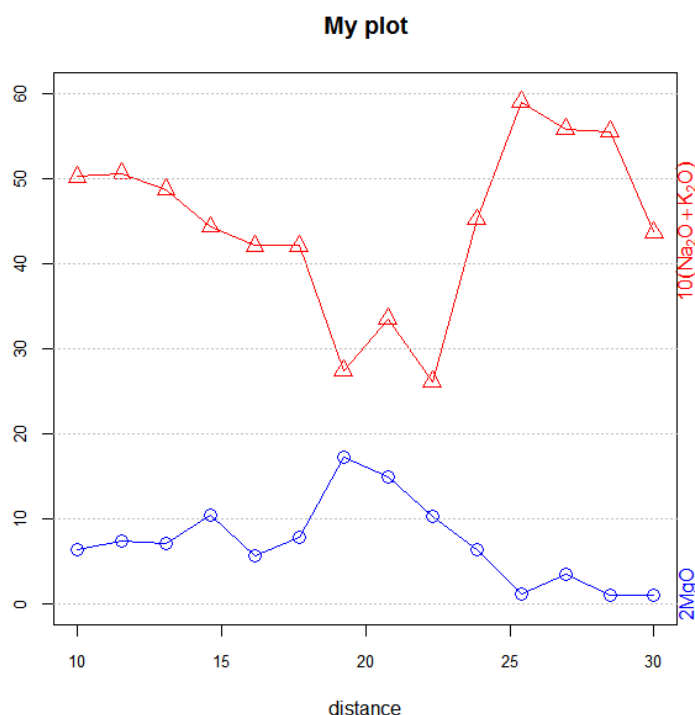
```
profiler(x = NULL, y = NULL, method = "Variable", legend = FALSE,
  pch = 1, col = "black", cex = 1, xaxs = "r", yaxs = "i",
  main = "",xmin = NULL, xmax = NULL)
```

## Arguments

x	character; optional name of variable to be plotted as x axis.
y	character; name(s) of variable(s) for individual profiles.
method	character; which of the methods is to be used? Valid are "Variable","Equidistant" or "From-To".
legend	logical; should be plotted also legend (in a separate window)?
pch	plotting symbols specification.
col	plotting colour(s).
cex	numeric; relative size of the plotting symbols.
xaxs, yaxs	character; type of the axes. See <a href="#">par</a> for details.
main	character; main title for the plot
xmin, xmax	range of the x axis (for methods 'Variable' and 'From/To')

## Details

The function 'profiler' serves for plotting three different types of profiles involving a single or several geochemical parameters.



The first one, 'Variable' uses any numeric variable as the x axis (e.g., SiO<sub>2</sub> contents, depth...). It is in fact a special type of a binary plot, in which the data points are, for each of the y-axis variables, joined by a line.

The remaining two methods are very similar to each other. The x axis is in both cases equidistant, and the order of the individual samples follows from their sequence in the data set.

The method 'Equidistant' uses simply the sequence number of the individual samples in the data set. It does not label the x-axis, just prints the number of samples used for plotting.

The method 'From/To' serves for drawing equidistant profiles, where the x axis can be specified by an interval.

In the specification of the x axis (for the method 'Variable') or any of the y variables (all methods) can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

If not called from the command prompt, the samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

The easiest way to specify the variable(s) to be plotted on individual profile(s) is to type directly the names of the columns, separated by commas. Alternatively can be used their sequence numbers or ranges. Also built-in lists can be employed, such as 'LILE', 'REE', 'major' and 'HFSE' or their combinations with the column names.

These lists are simple character vectors, and additional ones can be built by the user (see Examples). Note that currently only a single, stand-alone, user-defined list can be employed as a search criterion.

If the function is not called from the command prompt, and it desired so, the symbols and colours for each of the profiles can be specified separately in a simple spreadsheet-like interface.

If x axis occurs among the arguments to be plotted as y axes, it is skipped.

Likewise the relative scaling of the plotting symbols and the scale of the y axis can be specified.

Lastly, the user is asked to enter the limits for the axes, which are always two numbers separated by a comma.

### Value

results                  numeric matrix with the values for individual profiles.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### Examples

```
# Profiles of SiO2 versus (scaled) TiO2, MgO and K2O
# if x is specified, method="Variable" assumed automatically
profiler("Na2O+K2O",c("TiO2","6*MgO","SiO2"),pch=c("+","o","@"),col=c("red","blue","darkgreen"),
  xmin=2,xmax=10)

# Equidistant profiles of (scaled) MgO, CaO, and Al2O3 (in sample sequence)
# with default symbols and scaling
profiler(y=c("MgO","3*CaO","2*Al2O3"),method="Equidistant",col=c("red","blue","darkgreen"))

# Equidistant profiles of two calculated variables in custom colour
# and user-defined plotting symbols; range of the x axis will be specified
# interactively
profiler(y=c("2*MgO","10*(Na2O+K2O)"),method="From-To",pch=1:10,
  col=c("blue","red"),cex=1.5,main="My plot",xmin=10,xmax=30)
```

---

psAll

*Save all graphics to PS*

---

### Description

Saves all graphical windows to Postscript files.

### Usage

```
psAll(filename=NULL)
```

### Arguments

filename                  a name of file for saving the output.



**Details**

The function prompts for a common root of the filenames and then saves all graphical windows, each in a separate file, numbering them sequentially. Postscript is the best export format from R, preserving the necessary quality as well as the possibility to be imported by most graphical editors (such as Corel Draw!) for retouching.

Otherwise individual diagram can be saved from a menu that appears after clicking on the appropriate graphical window ('File|Save as|Postscript').

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['pdfAll'](#) ['postscript'](#)

---

QAPF

*QAPF diagram (Streckeisen 1974, 1978)*

---

**Description**

Assigns data for Streckeisen's diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'. The Q, A, P and F coordinates are assigned into matrix 'results'.

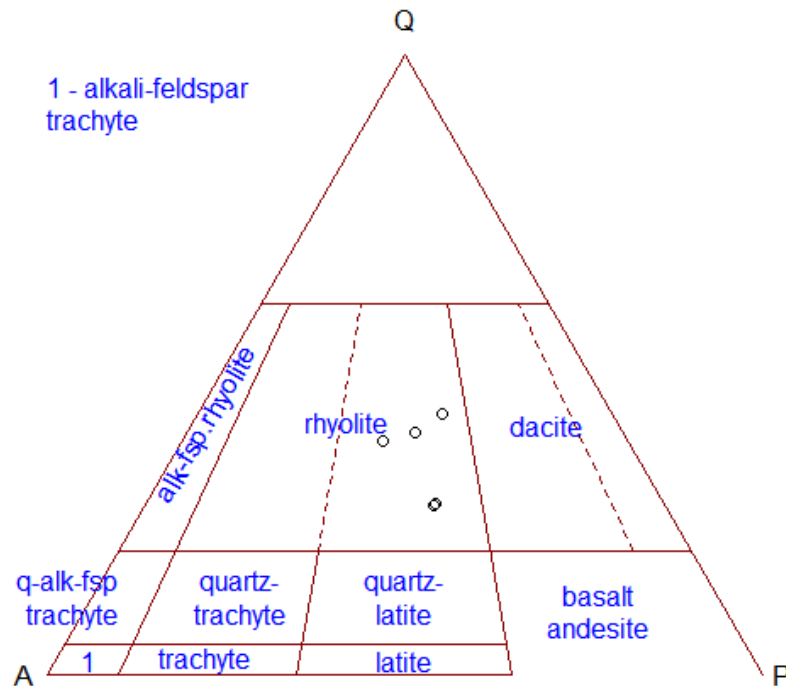
**Usage**

```
QAPFVolc()
QAPFPlut()
```

**Details**

Following the IUGS recommendation (Le Maitre et al 2002), the QAPF diagram should be the prime classification scheme for holocrystalline plutonic and volcanic rocks containing at least 10% of felsic minerals.

### QAPF diagram - Si oversaturated



The apices are defined as follows:

Q = Quartz modal %

A = Alkali feldspar modal %

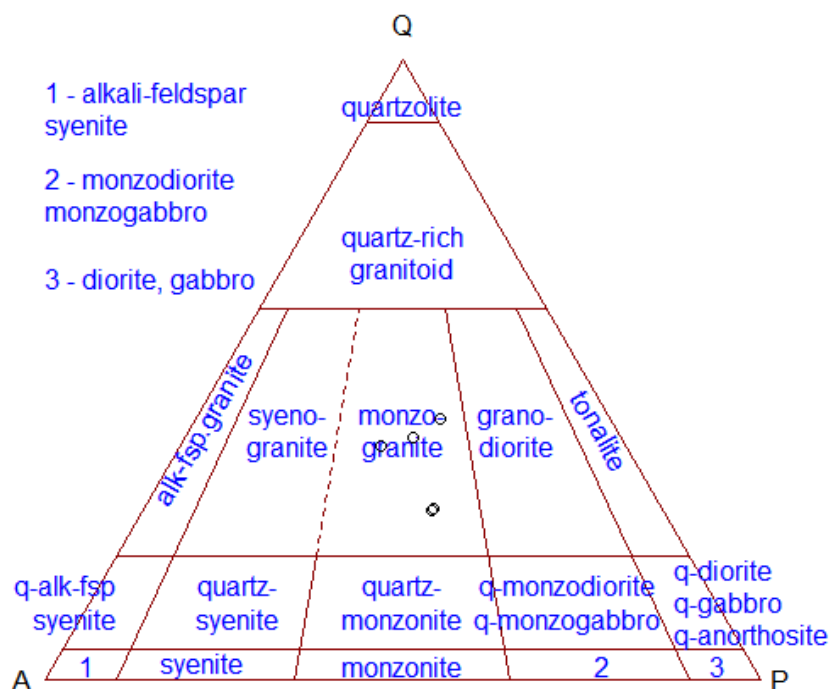
P = Plagioclase modal %

F = feldspathoid modal %

$Q + A + P + F = 100 \%$

As the whole QAPF diagram is rather complicated, GCDkit plots just the appropriate triangle if the dataset contains only Si-oversaturated or only Si-undersaturated rock samples. If both kinds of rock samples are present, the whole double triangle is shown. This behaviour may be changed in the source code of the diagram (in file 'QAPFPlot.r' or 'QAPFVolc.r', stored in the subdirectory GCDkit\Diagrams\Classification, change the 'triangle<-"auto"' to 'triangle<-"both"' and complete double triangle will be always plotted).

### QAPF diagram - Si oversaturated



#### Value

sheet list with Figaro Style Sheet data

x.data, y.data Q, A, P and F data (see details) transformed to orthogonal coordinates

#### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>

#### References

Streckeisen A (1974) Classification and nomenclature of plutonic rocks. Geol Rundsch 63: 773-786  
doi: [10.1007/BF01820841](https://doi.org/10.1007/BF01820841)

Streckeisen A (1978) IUGS Subcommittee on the Systematics of Igneous Rocks: Classification and nomenclature of volcanic rocks, lamprophyres, carbonatites and melilitic rocks; recommendation and suggestions. Neu Jb Min, Abh 134: 1-14.

Le Maitre R. W. et al. (2002) Igneous Rocks. A Classification and Glossary of Terms. 2nd edition. Cambridge University Press.

**See Also**

[classify](#) [figaro](#) [plotDiagram](#)

**Examples**

```
#plots the QAPF diagram for current dataset  
plotDiagram("QAPFVolc", FALSE)  
plotDiagram("QAPFPlut", FALSE)  
  
#classifies the current dataset using the QAPF diagram  
classify("QAPFVolc")  
classify("QAPFPlut")
```

---

quitGCDkit

*Exit GCDkit*

---

**Description**

Exits GCDkit (nicely).

**Usage**

```
quitGCDkit()
```

**Arguments**

None.

**Details**

By invoking this command the user is not prompted whether he wants to save his unfinished work in the 'Workspace image', i.e. file '.RData' in the main GCDkit directory.

**Menu**

GCDkit: Exit GCDkit

**See Also**

['quit'](#)

---

r2clipboard	<i>Copy results to clipboard</i>
-------------	----------------------------------

---

**Description**

Copies the most recently calculated results to a clipboard.

**Usage**

```
r2clipboard(what=results)
```

**Arguments**

what	a variable to be copied, can be either a vector, a matrix, a list or a table.
------	---

**Details**

Copies the variable 'results' returned by most of the calculation algorithms to the Windows clipboard.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

recast	<i>Recast to given sum</i>
--------	----------------------------

---

**Description**

Recasts the selected data to a fixed sum.

**Usage**

```
recast(total = 100)
```

```
normalize2total(what = NULL, total = 100)
```

**Arguments**

what	numeric matrix or character vector with a list of column names to be normalized, separated by commas.
total	a sum the data should be normalized to.

Details

Both functions return the selected elements/oxides (columns in the data matrix 'WR') normalized to the required sum. The function 'recast' is front-end to 'normalize2total'. If 'what' is a comma delimited list, the corresponding columns from the data matrix 'WR' are selected. If 'what' is empty, the user is prompted to supply the list of required column names via the function 'selectColumnsLabels'.

Value

results                      numerical vector/matrix with the results

Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

Examples

```
normalize2total(major,1)
recast() # to select the sum and elements interactively
```

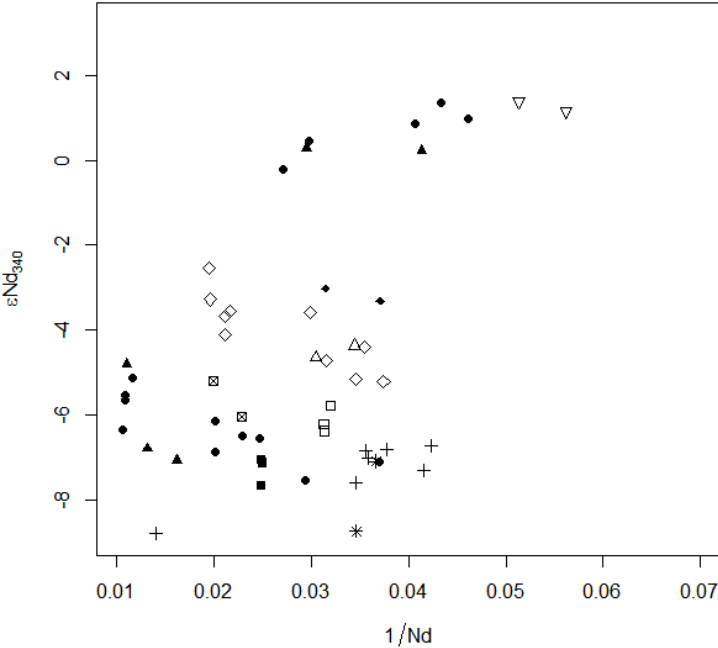
---

reciprocalIso	<i>Binary plots of reciprocal element concentration vs initial isotopic composition</i>
---------------	---

---

Description

Plots a diagram 1/Sr vs initial Sr isotopic ratios or 1/Nd vs initial  $\epsilon(Nd)$  for selected samples.



**Usage**

```
reciprocalIso()
```

**Arguments**

None.

**Details**

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

**Value**

None.

**Plugin**

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

Regular expressions      *Implementation of regular expressions in GCDkit*

---

**Description**

Implementation of regular expressions in the searching patterns.

**Details**

Many enquiries in the GCDkit employ regular expressions. This is a quite powerful searching mechanism more familiar to people working in Unix. Put in simple terms, most characters, including all letters and digits, are regular expressions that match themselves. However, metacharacters with a special meaning ('?' '+' '{' '}' '|' '(' ')') must be preceded by a backslash.

Regular expression	Matches
.	Any character
^	Beginning of the expression
\\$	End of the expression
[ ]	Any of the characters given in square brackets
[m-n]	Any character in the range given by m and n

A subexpression is a regular expression enclosed in '\(' and '\)'. Two such subexpressions may be joined by the infix operator '|' (logical or); the resulting regular expression matches any string matching either of them. For instance:

```
\(South\)|\(North\)Uist
```

yields both

South Uist and North Uist.

A regular expression may be followed by one of several repetition operators:

<b>Repetition operator</b>	<b>The preceding item will be matched</b>
<code>?</code>	At most once (i.e. is optional)
<code>*</code>	Zero or more times
<code>+</code>	One or more times
<code>{n}</code>	Exactly n times
<code>{n,}</code>	At least n times
<code>{n,m}</code>	At least n times, but not more than m times

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### See Also

[regex](#)

### Examples

```
## Not run:
# Subset by label
The searched field corresponds to localities with the following levels:
Mull, Rum, Skye, Coll, Colonsay, Hoy, Westray, Sanday,
Stronsay, Tiree, Islay

Search pattern = ol
Coll, Colonsay

Search pattern = n.a
Colonsay, Sanday, Stronsay

Search pattern = ^S
Skye, Sanday, Stronsay

Search pattern = e$
Skye, Tiree

Search pattern = [ds]ay
Colonsay, Sanday, Stronsay

Search pattern = [p-s]ay
Colonsay, Westray, Stronsay

Search pattern = ol|oy
Coll, Colonsay, Hoy

Search pattern = l{2}
Mull, Coll

# Subset by sample name
The sample names are: B1-1, B1-3, Koz-1, Koz-2, Koz-5, Koz-11,
KozD-1, Ri-1.
```



```

Search pattern = oz-[1-3]
Koz-1, Koz-2, Koz-11

Search pattern = oz-[Bl-
Bl-1, Bl-2, Bl-3, Koz-1, Koz-2, Koz-5, Koz-11

## End(Not run)

```

rtSaturation

*Rutile saturation (Hayden + Watson 2007)*

### Description

Calculates rutile saturation temperatures for the observed major-element data and Ti concentrations. Also returns Ti saturation levels for the given major-element compositions and assumed magma temperature.

### Usage

```
rtSaturation(cats=milli,T=0,P=0,Ti=filterOut(WR,"Ti",1))
```

### Arguments

cats	numeric matrix; whole-rock data recast to millications
T	assumed temperature of the magma in C
P	assumed pressure in kbar, <i>Ryerson &amp; Watson (1987)</i> model only
Ti	numeric vector with Ti concentrations in ppm

### Details

*Ryerson & Watson (1987)* have first formulated rutile saturation model for melts ranging in composition from basalt to rhyodacite. The distribution of  $TiO_2$  between rutile and liquid was given as:

$$D_{TiO_2} = e^{(-3.16 + \frac{9373}{T} + 0.026P - 0.152FM)}$$

where 'T' is the absolute temperature (K) of the magma, 'P' pressure (kbar) and 'FM' is a melt composition parameter:

$$FM = \frac{1}{Si} \frac{Na + K + 2(Ca + Mg + Fe)}{Al}$$

.

The Ti saturation level then would be:

$$Ti.sat.RW = \frac{599342.9}{D_{TiO_2}} (ppm)$$

In turn, when the rutile saturation was reached, the magma temperature (in C) can be calculated as:

$$TRt.sat.C.RW = \frac{9373}{(3.16 + \ln(100/TiO_2) - 0.026P + 0.152FM)} - 273.15$$

The Ti solubility in rutile-saturated hydrous siliceous melts was revisited by *Hayden & Watson (2007)*. According to these authors, it can be expressed as:

$$Ti.sat.HW = 10^{(7.95 - \frac{5305}{T} + 0.124FM)} (ppm)$$

where 'T' is the absolute temperature (K) of the magma, and 'FM' is the melt composition parameter defined above.

The temperature (in C) for rutile-saturated magma can be calculated as:

$$TRt.sat.C.HW = \frac{5305}{7.95 - \log(Ti) + 0.124FM} - 273.15$$

Using these formulae, the function 'rtSaturation' calculates the rutile saturation levels, Ti activities and rutile saturation temperatures following both models.

The formulation of *Ryerson & Watson (1987)* may be more suitable for basic rocks, whereas the more recent model of *Hayden & Watson (2007)* seems to be appropriate for siliceous magmas. Please note also that the latter does not take into account effects of pressure (having been calibrated at 1 GPa; *Hayden & Watson 2007*).

### Value

Returns a matrix 'results' with the following columns:

FM	melt composition parameter
Ti	observed Ti concentrations
Ti.sat.RW	saturation levels of Ti for assumed temperature, <i>Ryerson &amp; Watson (1987)</i>
aTi.RW	activity of Ti (ratio of Ti/Ti.sat), <i>Ryerson &amp; Watson (1987)</i>
TRt.sat.C.RW	rutile saturation temperatures in C, <i>Ryerson &amp; Watson (1987)</i>
Ti.sat.HW	saturation levels of Ti for assumed temperature, <i>Hayden &amp; Watson (2007)</i>
aTi.HW	activity of Ti (ratio of Ti/Ti.sat), <i>Hayden &amp; Watson (2007)</i>
TRt.sat.C.HW	rutile saturation temperatures in C, <i>Hayden &amp; Watson (2007)</i>

### Plugin

Saturation.r

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Ryerson F J, Watson E B (1987) Rutile saturation in magmas; implications for Ti-Nb-Ta depletion in island-arc basalts. *Earth Planet Sci Lett* 86: 225-239 doi: [10.1016/0012-821X\(87\)90223-8](https://doi.org/10.1016/0012-821X(87)90223-8)
- Hayden L A, Watson E B (2007) Rutile saturation in hydrous siliceous melts and its bearing on Ti-thermometry of quartz and zircon. *Earth Planet Sci Lett* 258: 561-568 doi: [doi:10.1016/j.epsl.2007.04.020](https://doi.org/10.1016/j.epsl.2007.04.020)

---

saveData	<i>Save data file</i>
----------	-----------------------

---

**Description**

Saves modified data set into a specified datafile.

**Usage**

```
saveData(sep="\t")
```

**Arguments**

sep	delimiter separating individual items in the data file.
-----	---

**Details**

Labels (stored in data frame 'labels') and numeric data (in numeric matrix 'WR') for the currently selected subset are glued together and saved under the specified filename. The format is such that the data can be retrieved again into GCDkit using the [loadData](#) command. Note that no mg numbers are currently saved.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[loadData](#), [mergeData](#), [showColours](#), [colours](#), [showSymbols](#), [read.table](#)

---

saveResults	<i>Save results</i>
-------------	---------------------

---

**Description**

Saves the most recently calculated results to a text file.

**Usage**

```
saveResults(what = results, sep = "\t", digits = 2)
```

**Arguments**

what	a variable to be saved, can be either a vector, a matrix or a list.
sep	separator; default is a tab-delimited file.
digits	precision of the results to be saved.

**Details**

Saves the variable 'results' returned by most of the calculation algorithms to a tab-delimited ASCII file.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

saveResultsIso

*Save Sr-Nd isotopic data*

---

**Description**

Saves the calculated isotopic parameters stored in the matrix 'init' to a text file.

**Usage**

```
saveResultsIso(digits = 6)
```

**Arguments**

digits                      precision of the results to be saved.

**Details**

Saves the data matrix `init` with the following columns:

Age (Ma)	Age in Ma
87Sr/86Sr	Initial Sr isotopic ratios
143Nd/144Nd	Initial Nd isotopic ratios
EpsNdi	Initial $\epsilon(Nd)$ values
TDM	Single-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> )
TDM.Gold	Single-stage depleted-mantle Nd model ages ( <i>Goldstein et al., 1988</i> )
TDM.2stg	Two-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> )

**Value**

None.

**Plugin**

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138

Goldstein S L, O’Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236

## See Also

`'saveResults'`

---

sazava

*Whole-rock composition of the Sazava suite, Central Bohemian Plutonic Complex*

---

## Description

This data set gives the whole-rock major- and trace-element contents in selected samples (gabbros, quartz diorites, tonalites and trondhjemites) of the c. 355 My old calc-alkaline Sazava suite of the Variscan Central Bohemian Plutonic Complex (Bohemian Massif, Czech Republic).

## Usage

```
data(sazava)
```

## Format

A data frame containing 14 observations.

## Source

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Janousek V, Rogers G, Bowes DR (1995) Sr-Nd isotopic constraints on the petrogenesis of the Central Bohemian Pluton, Czech Republic. *Geol Rundsch* 84: 520-534 doi: [10.1007/BF00284518](https://doi.org/10.1007/BF00284518)

Janousek V, Bowes DR, Rogers G, Farrow CM, Jelinek E (2000) Modelling diverse processes in the petrogenesis of a composite batholith: the Central Bohemian Pluton, Central European Hercynides. *J Petrol* 41: 511-543 doi: [10.1093/petrology/41.4.511](https://doi.org/10.1093/petrology/41.4.511)

Janousek V, Braithwaite CJR, Bowes DR, Gerdes A (2004) Magma-mixing in the genesis of Hercynian calc-alkaline granitoids: an integrated petrographic and geochemical study of the Sazava intrusion, Central Bohemian Pluton, Czech Republic. *Lithos* 78: 67-99 doi: [10.1016/j.lithos.2004.04.046](https://doi.org/10.1016/j.lithos.2004.04.046)

## Examples

```
data(sazava)
accessVar("sazava")
binary("SiO2", "Ba")
```

---

Schandl*Schandl and Gorton (2002)*

---

## Description

Plots data stored in 'WR' (or its subset) into the classification diagrams after *Schandl and Gorton (2002)*.

## Usage

```
Schandl(plot.txt = getOption("gcd.plot.text"))
```

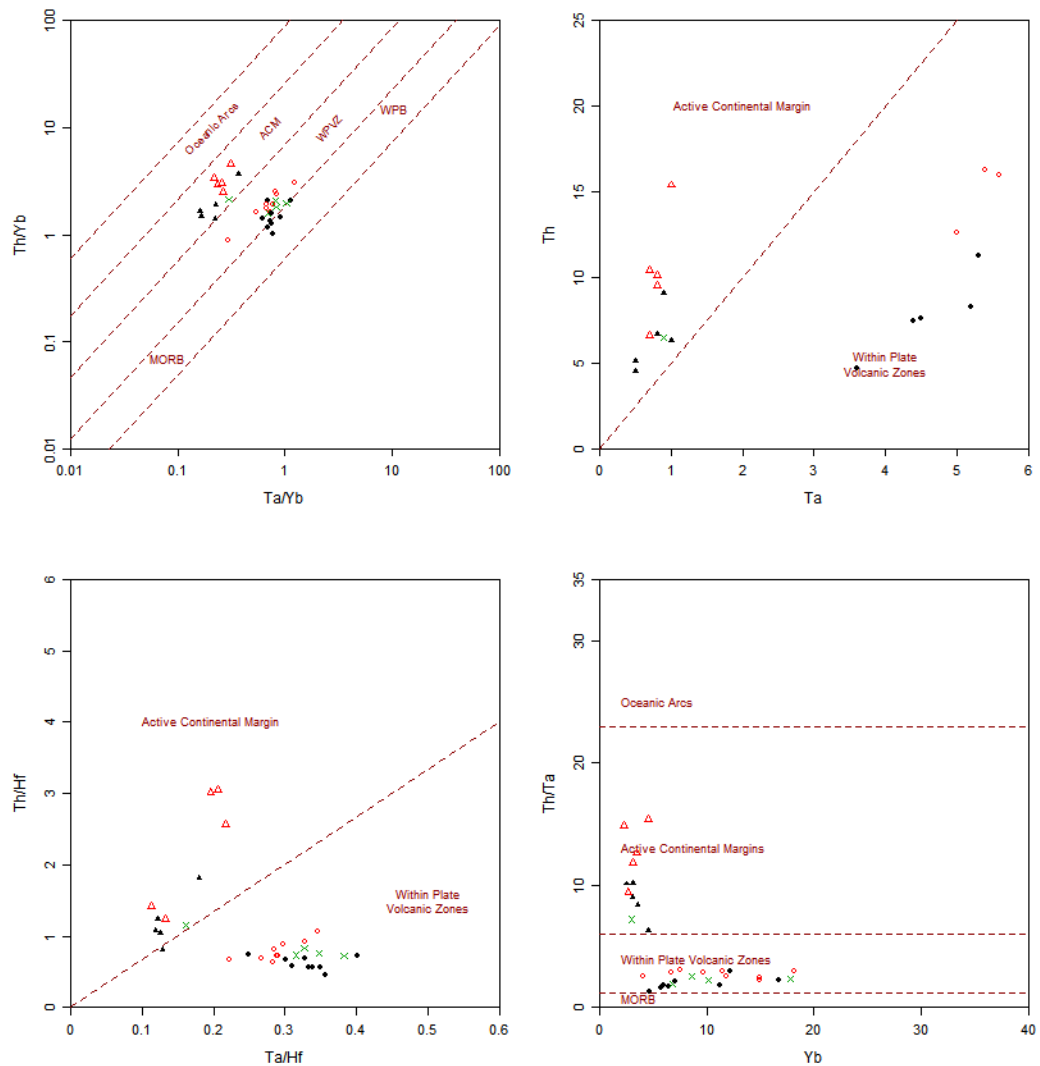
## Arguments

`plot.txt`            logical, annotate fields by their names?

## Details

Suite of four diagrams for geotectonic environment discrimination of felsic volcanic rocks (rhyolites), proposed by *Schandl and Gorton (2002)*. It is based on combination of four presumably little immobile trace elements (namely Ta, Yb, Th, and Hf). Diagrams were designed to decipher the geotectonic setting of felsic volcanic suites, specifically those associated with the volcanogenic massive sulphide (VMS) deposits. a) Ta/Yb versus Th/Yb diagram from *Gorton and Schandl (2000)* is divided into three fields: Oceanic Arcs, Active Continental Margins (ACM) and Within-Plate Volcanic Zones (WPVZ). The Within-Plate Basalts (WPB) and Mid-Ocean Ridge Basalts (MORB) represent compositions previously determined by *Pearce (1982, 1983)*. b) Ta vs. Th diagram demonstrates the Th enrichment of felsic volcanic rocks at post-Archaeon VMS deposits (and of some unmineralized Archaeon rhyolites) with respect to Ta. c) Graph of Ta/Hf vs Th/Hf ratios shows the similar incompatibility between Th and Ta in two different tectonic environments: Active Continental Margins and Within-Plate Volcanic Zones. d) Yb vs. Th/Ta diagram with fields for associations of Oceanic Arcs, Active Continental Margins, Within Plate Volcanic Zones and MORB.

Geotectonic classification of volcanic rocks – Schandl and Gorton (2002)



Taken together, the following geotectonic settings may be deduced:

Rock Association	Abbreviation
Oceanic Arcs	
Active Continental Margins	ACM
Within-Plate Volcanic Zones	WPVZ

Further abbreviations used on the plots:

Rock Association	Abbreviation
Mid-Oceanic Ridge Basalts	MORB
Within-Plate Basalts	WPB

**Note**

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Gorton M P & Schandl E S (2000) From continents to island arcs: A geochemical index of tectonic setting for arc-related and within-plate felsic to intermediate volcanic rocks. *Can Min* 38: 1065-1073. doi: [10.2113/gscanmin.38.5.1065](#)
- Pearce J A (1982) Trace element characteristics of lavas from destructive plate boundaries. In Thorpe R S (ed) *Andesites: Orogenic Andesites and Related Rocks*. John Wiley, Chichester, pp 525-548.
- Pearce J A (1983) Role of the sub-continental lithosphere in magma genesis at active continental margins. In Hawkesworth C J & Norry M J (eds) *Continental Basalts and Mantle Xenoliths*. Shiva, Nantwich. pp 230-249
- Schandl E S & Gorton M P (2002) Application of high field strength elements to discriminate tectonic settings in VMS environments. *Economic Geology* 97: 629-642. doi: [10.2113/97.3.629](#)

**See Also**

[Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

**Examples**

```
#plot the diagrams
plotPlate("Schandl")
```

---

selectAll

*Select whole dataset*

---

**Description**

Restores data for all samples as they were loaded from a data file.

**Usage**

```
selectAll(GUI=FALSE)
```

**Arguments**

GUI                      logical; was the function called from the GUI?.



**Details**

When a datafile is loaded into GCDkit using the [loadData](#) function, the data and their backup copy are stored in the memory.

The subsets of the current dataset can be chosen using the functions [selectByLabel](#) and [selectSubset](#) (menus 'Select subset by sample name or label', 'Select subset by range', 'Select subset by Boolean') and the current data will be replaced by their newly chosen subset.

The backup copy is kept intact ever since the [loadData](#) function has been invoked and can be uploaded any time in place of the current data set using the function 'selectAll'. Note that all changes made e.g. to plotting symbols, grouping, newly calculated variables etc. will be lost.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

selectByDiagram	<i>Selecting subset by diagram</i>
-----------------	------------------------------------

---

**Description**

This function enables selecting samples that plot into certain field(s) of the given classification diagram.

**Usage**

```
selectByDiagram(diagram = select.list(claslist[, "menu"]))
```

**Arguments**

diagram            one of the valid diagram names that appear in '.claslist()'

**Details**

The diagram can be chosen from a list (the default) or specified directly as an argument. Clicking onto a field toggles its inclusion/exclusion - the currently selected fields are cyan.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz> & Vojtech Erban, <vojtech.erban@geology.cz>

**See Also**

'[selectByLabel](#)', '[selectSubset](#)', '[selectAll](#)' and '[classify](#)'.

**Examples**

```
.claslist() # names of existing diagrams
selectByDiagram("TAS")
```

---

selectByLabel

*Select subset by sample name or label*


---

**Description**

Selecting subsets of the data stored in memory by searching sample names or a single label.

**Usage**

```
selectByLabel()
```

**Details**

This function enables the user to query a single textual column, a label, chosen using the function '[selectColumnLabel](#)'. The current data will be replaced by its newly chosen subset. These enquiries employ [regular expressions](#).

**Value**

Overwrites the data frame 'labels' and numeric matrix 'WR' by subset that fulfills the search criteria.

**Author(s)**

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

**Examples**

```
## Not run:
# Subset by label
The searched field corresponds to localities with the following levels:
Mull, Rum, Skye, Coll, Colonsay, Hoy, Westray,
Sanday, Stronsay, Tiree, Islay

Search pattern = ol
Coll, Colonsay

Search pattern = n.a
Colonsay, Sanday, Stronsay

Search pattern = ^S
Skye, Sanday, Stronsay

Search pattern = e$
Skye, Tiree

Search pattern = [ds]ay
Colonsay, Sanday, Stronsay
```

```

Search pattern = [p-s]ay
Colonsay, Westray, Stronsay

Search pattern = ol|oy
Coll, Colonsay, Hoy

Search pattern = l{2}
Mull, Coll

# Subset by sample name
The sample names are: B1-1, B1-3, Koz-1, Koz-2,
Koz-5, Koz-11, KozD-1, Ri-1.

Search pattern = oz-[1-3]
Koz-1, Koz-2, Koz-11

Search pattern = oz-|B1-
B1-1, B1-2, B1-3, Koz-1, Koz-2, Koz-5, Koz-11

## End(Not run)

```

---

selectColumnLabel	<i>Selecting a single variable in GCDkit</i>
-------------------	--

---

## Description

This is an auxiliary function invoked by many others to select a single variable.

## Usage

```

selectColumnLabel(where = colnames(labels),
message = "Select the variable\nor press ENTER to pick from a list",
default = "", sample.names = FALSE, silent = FALSE, print = TRUE,
empty.ok = TRUE)

```

## Arguments

where	names of data columns to choose from
message	prompt
default	comma delimited list of default names
sample.names	logical; should be the sample names listed
silent	logical, echo on/off
print	logical, echo on/off
empty.ok	is empty selection ok?

## Details

The easiest way for specification of the variable is to type directly the name of the numerical column in the data matrix 'WR' (e.g., 'SiO2') or its sequence number (2 for the second column). However, it is not necessary to enter the name in its entirety. Only a substring that appears somewhere in the column name or other forms of [regular.expressions](#) can be specified.

If the result is ambiguous, the correct variable has to be selected by mouse from the list of the multiple matches. Ultimately, empty response invokes list of all variables available in the memory.

## Value

A numeric index of the selected column.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[selectColumnsLabels](#)

---

selectColumnsLabels	<i>Selecting several data columns</i>
---------------------	---------------------------------------

---

## Description

An auxiliary function invoked by many others to select several variables simultaneously.

## Usage

```
selectColumnsLabels(where = colnames(WR),
  message = "Select variable(s), e.g. 'SiO2,TiO2,MgO'
  or press ENTER to pick from a list", default = "", print = TRUE,
  exact.only = TRUE)
```

## Arguments

where	vector of names for data columns to choose from
message	prompt
default	comma delimited list of default names
print	logical, echo on/off
exact.only	logical, should be the input checked for correctness?

## Details

The variable(s) can be specified in several ways. The easiest is to type directly the name(s) of the column(s), separated by commas. Alternatively can be used their sequence numbers or ranges. Also built-in lists can be employed, such as 'LILE', 'REE', 'major' and 'HFSE' or their combinations with the column names.

These lists are simple character vectors, and additional ones can be built by the user (see Examples). Note that currently only a single, stand-alone, user-defined list can be employed as a search criterion.

Empty response invokes list of all variables available. The correct variables have to be selected by mouse + SHIFT from this list.

If exact.only=TRUE, the individual items in the input line are checked against the list of existing column/variable names (i.e. components in the vector 'where').

## Value

Vector with the selected column names.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```
## Not run:
# Querying names of numeric data columns

Search pattern = SiO2, MgO, CaO

Search pattern = major
SiO2, TiO2, Al2O3, Fe2O3, FeO, MnO, MgO, CaO, Na2O, K2O, P2O5

Search pattern = LILE
Rb, Sr, Ba, K, Cs, Li

Search pattern = HFSE
Nb, Zr, Hf, Ti, Ta, La, Ce, Y, Ga, Sc, Th, U

Search pattern = REE
La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu

Search pattern = Locality,SiO2,LILE,HFSE
Locality, SiO2, Rb, Sr, Ba, K, Cs, Li, Nb,
Zr, Hf, Ti, Ta, La, Ce, Y, Ga, Sc, Th, U

Search pattern = 1:5, 7
Numeric data columns number 1, 2, ...5, 7

# User-defined list
my.elms<-c("Rb","Sr","Ba")
Search pattern = my.elms
Rb, Sr, Ba

## End(Not run)
```

selectNorm

*Selecting the normalization data for spiderplots***Description**

Displays available normalization schemes and lets the user to choose one interactively.

**Usage**

```
selectNorm(ref=NULL,elems = "Rb,Sr,Ba,Cr,Ni,La,Ce,Y,Zr",REE.only=FALSE)
```

**Arguments**

ref	character: a specification of the normalizing model.
elems	character: a default list of elements.
REE.only	logical: should be only listed normalization schemes for REE?

**Details**

There are two ways of using this function. Firstly, a search pattern can be specified for a query of the available normalizing model names. The corresponding parameter '*ref*' can contain a substring or even a regular expression. The function fails if no matches are found or the search is ambiguous.

The second possibility is to choose from the list of available normalizing schemes. The first option offers normalization *by a single sample*. Its name can be typed in or, after pressing the Enter key, picked from a list. Then the user is prompted to specify the list and order of elements/oxides that should appear on the plot. The easiest way is to type directly the names of the columns, separated by commas. Alternatively can be used their sequence numbers or ranges. Also built-in lists can be employed, such as 'LILE', 'REE', 'major' and 'HFSE' or their combinations with the column names. These lists are simple character vectors, and additional ones can be built by the user (see Examples). Note that currently only a single, stand-alone, user-defined list can be employed as a search criterion.

The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

The second option is similar but it allows to normalize *by average concentrations* in a group of samples specified by one of the three searching mechanisms as above (see [selectSubset](#)).

The composition of *various standards* available for normalization and subsequent plotting of [spider](#) diagrams is stored in the file 'spider.data' in the main GCDkit directory. It is a comma delimited file such as:

Normalization data used for spiderplots

MORB (Pearce 1983)

Sr,K,Rb,Ba,Th,Ta,Nb,Ce,P,Zr,Hf,Sm,Ti,Y,Yb

120,1245,2,20,.2,.18,3.5,10,534,90,2.4,3.3,8992,30,3.4

REE chondrite (Boynton 1984)

La,Ce,Pr,Nd,Pm,Sm,Eu,Gd,Tb,Dy,Ho,Er,Tm,Yb,Lu

.31,.808,.122,.6,1,.195,.0735,.2590,.0474,

.322,.0718,.21,0.0324,.209,.0322

```

ORG (PearceEtAl.1984)
K2O,Rb,Ba,Th,Ta,Nb,Ce,Hf,Zr,Sm,Y,Yb
0.4,4,50,0.8,0.7,10,35,9,340,9,70,8.0

```

The first row is always skipped and can contain any comments. The following ones have a fixed structure. For each normalization scheme, the first row contains the title and reference. If title starts with 'REE', the normalization is supposed to be for REE only and special parameters, such as 'Eu/Eu\*', are calculated. The second line gives a comma delimited list of elements in the order they should appear on the plot. The last line is a comma delimited list of normalization values. There are empty lines left between the normalization schemes.

As the file 'spider.data' is read every time 'selectNorm' is called, the user can add or delete normalization schemes on his will using a text editor.

### Value

A numeric matrix with one row, containing the normalizing values. The row name contains the name of the model and reference.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

#### Implemented spiderplots:

- Becker H, Horan M F, Walker R J, Gao S, Lorand J-P, Rudnick R L (2006) Highly siderophile element composition of the Earth's primitive upper mantle: constraints from new data on peridotite massifs and xenoliths. *Geochim Cosmochim Acta* 70: 4528-4550 doi: [10.1016/j.gca.2006.06.004](https://doi.org/10.1016/j.gca.2006.06.004)
- Boynton W V (1984) Cosmochemistry of the rare earth elements: meteorite studies. In: Henderson P (eds) *Rare Earth Element Geochemistry*. Elsevier, Amsterdam, pp 63-114
- Jochum K P (1996) Rhodium and other platinum-group elements in carbonaceous chondrites. *Geochim Cosmochim Acta* 60: 3353-3357 doi: [10.1016/0016-7037\(96\)00186-X](https://doi.org/10.1016/0016-7037(96)00186-X)
- McDonough W, Sun S S (1995) The composition of the Earth. *Chem Geol* 120: 223-253 doi: [10.1016/0009-2541\(94\)00140-4](https://doi.org/10.1016/0009-2541(94)00140-4)
- Nakamura N (1974) Determination of REE, Ba, Fe, Mg, Na and K in carbonaceous and ordinary chondrites. *Geochim Cosmochim Acta* 38: 757-775 doi: [10.1016/0016-7037\(74\)90149-5](https://doi.org/10.1016/0016-7037(74)90149-5)
- Pearce J A (1983) Role of sub-continental lithosphere in magma genesis at active continental margins. *Continental Basalts and Mantle Xenoliths*. Shiva, Nantwich, pp 230-249
- Pearce J A (1996) A user's guide to basalt discrimination diagrams. In: Wyman D A (eds) *Trace Element Geochemistry of Volcanic Rocks: Applications for Massive Sulphide Exploration*. Geological Association of Canada, Short Course Notes 12, pp 79-113
- Pearce J A (2014) Immobile element fingerprinting of ophiolites. *Elements* 10: 101-108 doi: [10.2113/gselements.10.2.101](https://doi.org/10.2113/gselements.10.2.101)
- Pearce J A, Harris N W, Tindle A G (1984) Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. *J Petrology* 25: 956-983 doi: [10.1093/petrology/25.4.956](https://doi.org/10.1093/petrology/25.4.956)
- Sun S S, McDonough W F (1989) Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes. In: Saunders A D, Norry M (eds) *Magmatism in Ocean Basins*. Geological Society of London Special Publications 42, pp 313-345

Sun S S, Bailey D K, Tarney J, Dunham K (1980) Lead isotopic study of young volcanic rocks from mid-ocean ridges, ocean islands and island arcs. Philos Trans R Soc London A297: 409-445 doi: [10.1098/rsta.1980.0224](https://doi.org/10.1098/rsta.1980.0224)[10.1029/95RG00262](https://doi.org/10.1029/95RG00262)

Taylor S R, McLennan S M (1985) The Continental Crust: Its Composition and Evolution. Blackwell, Oxford, pp 1-312

Taylor S R, McLennan S M (1995) The geochemical evolution of the continental crust. Reviews in Geophysics 33: 241-265 doi: [10.1029/95RG00262](https://doi.org/10.1029/95RG00262)

Thompson R N (1982) British Tertiary province. Scott J Geol 18: 49-107

Weaver B L, Tarney J (1984) Empirical approach to estimating the composition of the continental crust. Nature 310: 575-577 doi: [10.1038/310575a0](https://doi.org/10.1038/310575a0)

Wood D A, Joron J L, Treuil M, Norry M, Tarney J (1979) Elemental and Sr isotope variations in basic lavas from Iceland and the surrounding ocean floor; the nature of mantle source inhomogeneities. Contrib Mineral Petrol 70: 319-339 doi: [10.1007/BF00375360](https://doi.org/10.1007/BF00375360)

## Examples

```
selectNorm()
selectNorm("Boynton")
# Regular expressions in action, we take the string from beginning
# and then replace space and left bracket by dots
selectNorm("^Primitive Mantle..McDonough 1995")
```

---

selectPalette

*selectPalette*

---

## Description

Picks given number of colours from one of the available palettes.

## Usage

```
selectPalette(n, colour.palette=NULL, GUI=TRUE)
```

## Arguments

n	desired number of colours
colour.palette	one of the colour palette names, see Details
GUI	logical; is the function called from GUI?

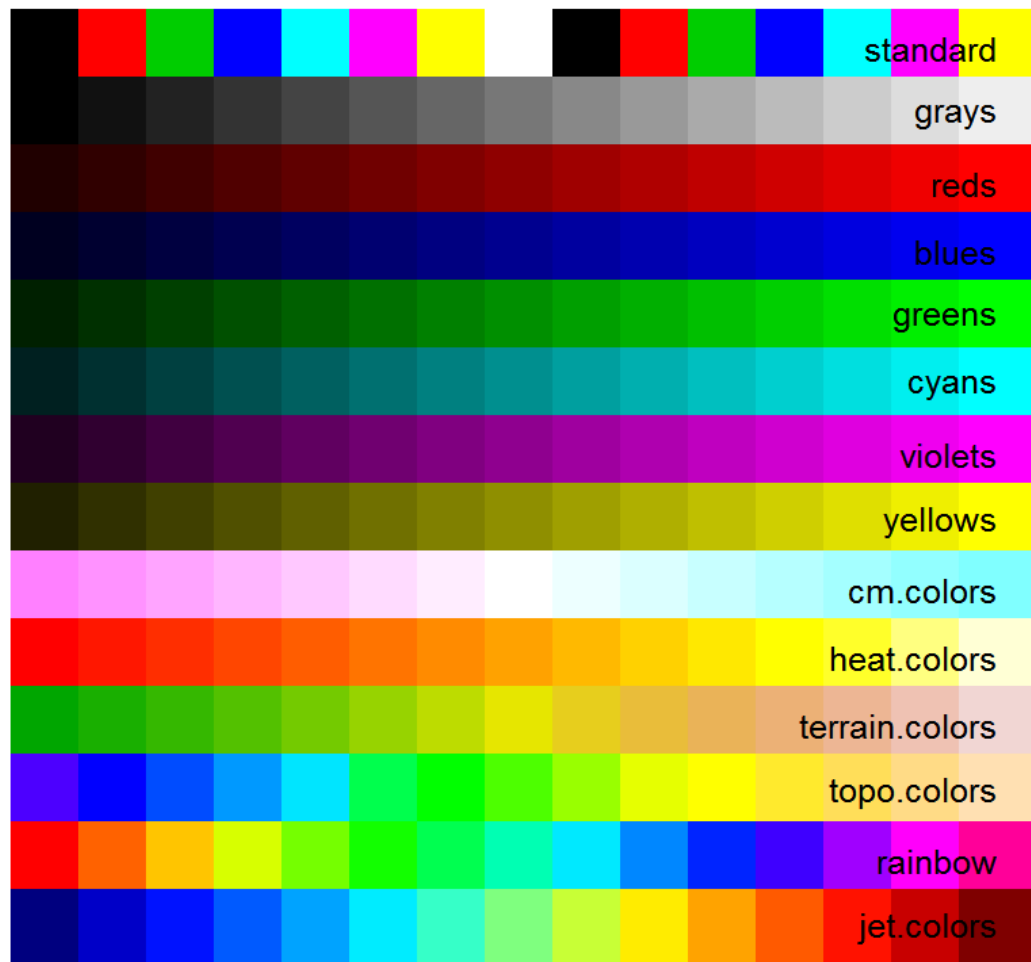
## Details

The desired number of colours has to be given in any case.

The possible palettes are: 'grays', 'reds', 'blues', 'greens', 'cyans', 'violets', 'yellows', 'cm.colors', 'heat.colors', 'terrain.colors', 'topo.colors', 'rainbow' and 'jet.colors'.

If not specified upon function call, the colour palette can be picked from list of available ones. Optionally (if GUI = TRUE) it plots a chart with their preview.



**Value**

Returns a matrix with a single row of hexadecimal codes. Its rownames represent the name of the palette selected.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

Colours by label can be assigned by [assignCollab](#), colours by variable using [assignColVar](#). Uniform colours are obtained by [assign1col](#). Table of available plotting colours is obtained by [showColours](#).

**Examples**

```
ee<-selectPalette(5,"heat.colours")
ee<-selectPalette(5)
ee<-selectPalette(5,GUI=FALSE)
```

selectSubset

*Select subset***Description**

Selects samples corresponding to given criteria.

**Usage**

```
selectSubset(what=NULL,where=cbind(labels,WR),save=TRUE,multiple=TRUE,
text="Press ENTER for all samples, or specify search pattern \n by sample name, range or Boolean co
range=FALSE,GUI=FALSE, all.nomatch=TRUE)
```

```
selectSamples(what=NULL, print=TRUE, multiple=TRUE, text=NULL)
```

**Arguments**

what	search pattern
where	data to be searched
save	should the newly selected subset replace the data in memory, i.e. 'labels' and 'WR'
multiple	logical, can be multiple items selected?
text	text prompt
range	logical: is the search pattern to be interpreted as a range of samples?
GUI	logical: is the function called from within GUI?
all.nomatch	logical: return all samples when there is no match?
print	logical: should be the chosen samples ID printed?

**Details**

The function 'selectSubset' has two purposes.

1. If 'save=TRUE', it is a core function used in selecting subsets of the current data set by ranges (see [subsetRange](#)) or Boolean conditions (see [subsetBoolean](#)).
2. If save=FALSE, no permanent subsetting takes place. This is useful for temporary selections of the data, e.g. in determining which samples are to be plotted on a diagram.

In this case, the samples can be selected based on combination of three searching mechanisms. The search pattern is first tested whether it obeys a syntax of a valid [regular expression](#) that could be interpreted as a query directed to the sample name(s).

If not, the syntax of the search pattern is assumed to correspond to a selection of sample sequence numbers.

At the last resort, the search pattern is interpreted as a Boolean condition that may employ most of the comparison operators common in R, i.e. < (lower than), > (greater than), <= (lower or equal to), >= (greater or equal to), = or == (equal to), != (not equal to). The character strings should be quoted. Regular expressions can be employed to search the textual labels.

The conditions can be combined together by logical and, or and brackets.

Logical and can be expressed as .and. .AND. &

Logical or can be expressed as .or. .OR. |

The function 'selectSamples' is a front-end to 'selectSubset'.

**Value**

If 'save=TRUE', the function overwrites the data frame 'labels' and numeric matrix 'WR' by subset that fulfills the search criteria. Otherwise names of samples fulfilling the given criteria are returned.

**Warning**

So far only names of existing numeric data columns and not formulae involving these can be handled.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[regex](#), [selectByLabel](#) and [selectAll](#)

**Examples**

```
# permanent selection, the variables 'WR' and 'labels' affected
selectSubset("SiO2>70")

# back to the complete, originally loaded dataset
selectAll()

# both expressions below return only sample names of analyses fulfilling
# the given criteria, variables 'WR' and 'labels' NOT affected
selectSamples("SiO2<70&MgO>5")
selectSubset("SiO2<70&MgO>5",save=FALSE)

## Not run:
#EXAMPLES OF SEARCHING PATTERNS
# Searching by sample name

The sample names are: B1-1, B1-3, Koz-1, Koz-2,
Koz-5, Koz-11, KozD-1, Ri-1.

oz-[1-3]
# Samples Koz-1, Koz-2, Koz-11

oz-|B1-
# Samples B1-1, B1-2, B1-3, Koz-1, Koz-2, Koz-5, Koz-11

# Searching by range

1:5
# First to fifth samples in the data set

1,10
# First and tenth samples

1:5, 10:11, 25
# Samples number 1, 2, ...5, 10, 11, 25

# Searching by Boolean
#####
```

```

Intrusion="Rum"
# Finds all analyses from Rum

Intrusion="Rum".and.SiO2>65
Intrusion="Rum".AND.SiO2>65
Intrusion="Rum"&SiO2>65
# All analyses from Rum with silica greater than 65
# (all three expressions are equivalent)

MgO>10&(Locality="Skye"|Locality="Islay")
# All analyses from Skye or Islay with MgO greater than 10

Locality="^S"
# All analyses from any locality whose name starts with capital S

## End(Not run)

```

---

setCex

*Set uniform symbols size*


---

## Description

Defines the default relative size of plotting symbols.

## Usage

```
setCex(x)
```

## Arguments

x                      numeric; scaling for the plotting symbols.

## Details

The coefficient determining the plotting symbols expansion is stored in a variable 'labels[, "Size"]', the default is 1.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[gcdOptions](#)

## Examples

```

setCex(2) # double size
plotDiagram("TAS", FALSE)

setCex(0.5) # half the size
plotDiagram("TAS", FALSE)

```

---

`setShutUp`*Quiet mode?*

---

**Description**

Determines whether extensive textual output is to be printed.

**Usage**

```
setShutUp()
```

**Arguments**

None.

**Details**

The control option is `shut.up`, whose default is `FALSE`, meaning that detailed information is to be printed. This, however, may become not viable on slower systems and/or for extensive data sets.

This can be set from the menu 'GCDkit|Options' by setting the checkbox 'Minimize output on screen?' or directly, from the command line (see Examples).

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

['gcdOptions'](#) ['options'](#)

**Examples**

```
getOption("shut.up")    # query the current value of the given option
options("shut.up"=TRUE) # reduce the printed output to a minimum
```

---

`setTransparency`*Setting transparency of plotting symbols*

---

**Description**

Sets transparency of plotting colours for selected samples.

**Usage**

```
setTransparency(which.samples=NULL, transp=NULL, alpha=NULL, GUI=FALSE)
```

**Arguments**

<code>which.samples</code>	list of samples; if NULL a dialogue is displayed
<code>transp</code>	numeric; transparency to be set
<code>alpha</code>	character; alpha value to be set (opacity)
<code>GUI</code>	logical; is the function called from within GUI?

**Details**

The transparency value has to fall between 1 (completely transparent) to 0 (opaque).

Alternatively, the so-called alpha channel can be specified, which can attain any hexadecimal number between 0 (completely transparent) to ff (opaque).

if `GUI = TRUE`, the samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

**Value**

Assigns `'labels$Colour'`.

**Warning**

As a side product, plotting colours are converted to hexadecimal values, which are not easy to translate back to symbolic names.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

Colours by a single variable can be assigned by [assignCollab](#), symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform colours are obtained by [assign1col](#). Table of available plotting colours is obtained by [showColours](#).

**Examples**

```
setTransparency(transp=0)
setTransparency(transp=0.5)
setTransparency(which.samples=c("Sa-1", "Sa-2", "Sa-3"), transp=0.5)
setTransparency(which.samples=c("Sa-1", "Sa-2", "Sa-3"), alpha="6a")
```

---

Shand

*A/CNK-A/NK diagram (Shand 1943)*

---

**Description**

Assigns data for Shand's diagram into Figaro template (list `'sheet'`) and appropriate values into `'x.data'` and `'y.data'`

**Usage**

`Shand()`

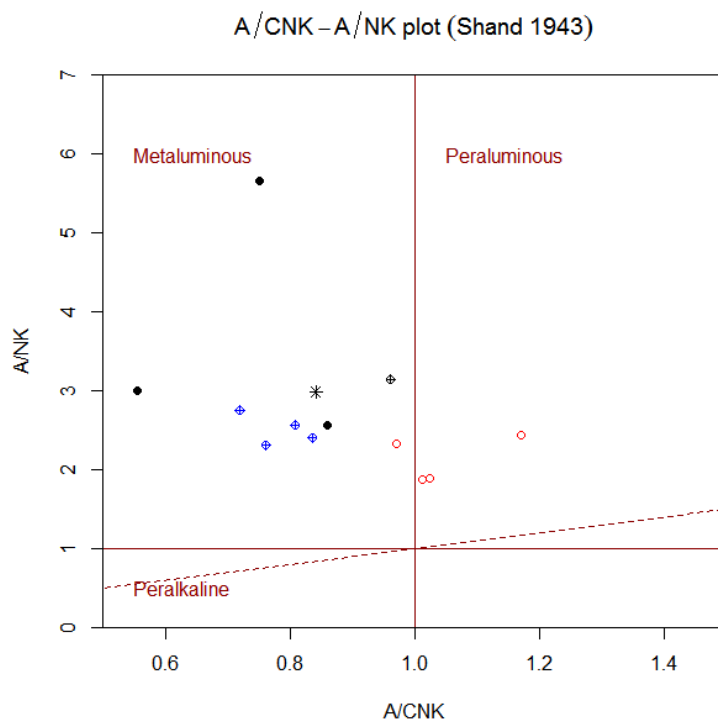
## Details

Classic Shand's diagram (1943). Three rock types are defined in the A/CNK vs A/NK plot:

*Peralkaline*

*Metaluminous*

*Peraluminous*



## Value

sheet	list with Figaro Style Sheet data
x. data	molecular ratio $A/CNK = Al_2O_3 / (CaO + Na_2O + K_2O)$
y. data	molecular ratio $A/NK = Al_2O_3 / (Na_2O + K_2O)$

## Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Shand (1943) Eruptive Rocks. John Wiley & Sons

## See Also

[classify figaro plotDiagram NaAlK](#)

Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("Shand")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("Shand", FALSE)
```

Shervais	<i>Shervais (1982)</i>
----------	------------------------

Description

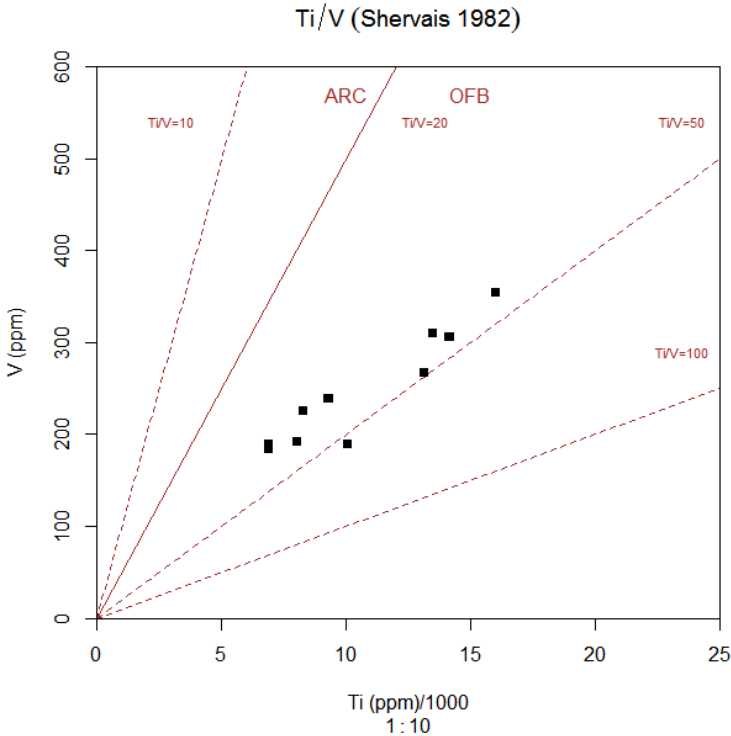
Assigns data for the diagram of *Shervais (1982)* into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

Usage

```
Shervais()
```

Details

Discrimination diagram for basalts, as proposed by *Shervais (1982)* is based on variability of the Ti/V ratio under different oxygen fugacity.



Following environments may be distinguished:

ARC    *Arc Tholeiites*



OFB *Ocean Floor Basalts***Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Shervais J W (1982) Ti-V plots and the petrogenesis of modern and ophiolitic lavas. *Earth Planet Sci Lett* 59: 101-118. doi: [10.1016/0012-821X\(82\)90120-0](https://doi.org/10.1016/0012-821X(82)90120-0)

**See Also**

[figaro plotDiagram](#)

**Examples**

```
#plot the diagram  
plotDiagram("Shervais", FALSE)
```

---

showColours

*Show available colours*

---

**Description**

Display colours available for plotting.

**Usage**

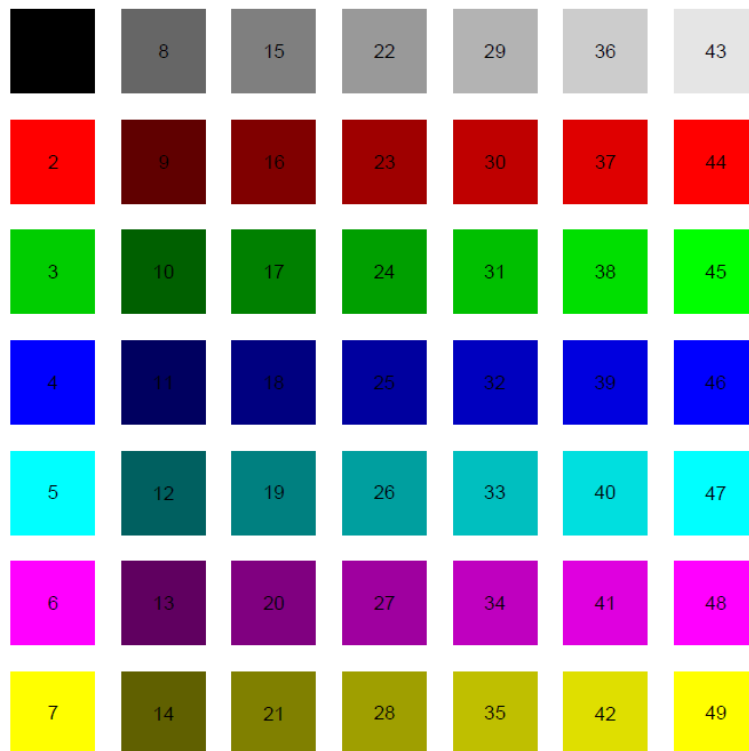
```
showColours(n=49)  
showColours2(n=64)
```

**Arguments**

n                      numeric: number of colours to display

**Details**

The function 'showColours' displays a palette of plotting colours which can be specified by their numeric codes (1-49). On the other hand, 'showColours2' demonstrates the colours which can be given by their English names (there are some 657 of them).

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

'colours'

---

showLegend

*Display legend*

---

**Description**

Displays a graphical legend(s) with assignment of plotting symbols and colours used by majority of the diagrams.

**Usage**

```
showLegend(pch = labels$Symbol, col = labels$Colour,
new.plot = TRUE)
```

**Arguments**

pch	numeric or character: plotting symbols.
col	numeric: code for their colour.
new.plot	logical: shall be opened a new plotting window for the legend?

**Details**

The internal variables 'leg.col' and 'leg.pch' are set to zero, if the current assignment is on the basis of 'groups'. Otherwise they contain the sequential number(s) of column(s) in the data frame 'labels' whose levels are to be used to build the legend(s). If both variables differ, two legends are created, for plotting symbols and colours separately. If both equal zero, the current grouping information is used.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

Symbols and colours by a single label can be assigned by functions [assignSymbLab](#) and [assignCollab](#) respectively, symbols and colours by groups simultaneously by [assignSymbGroup](#). Uniform symbols are obtained by [assign1symb](#), uniform colours by [assign1col](#). Table of available plotting symbols is displayed by [showSymbols](#) and colours by [showColours](#).

**Examples**

```
showLegend()
```

---

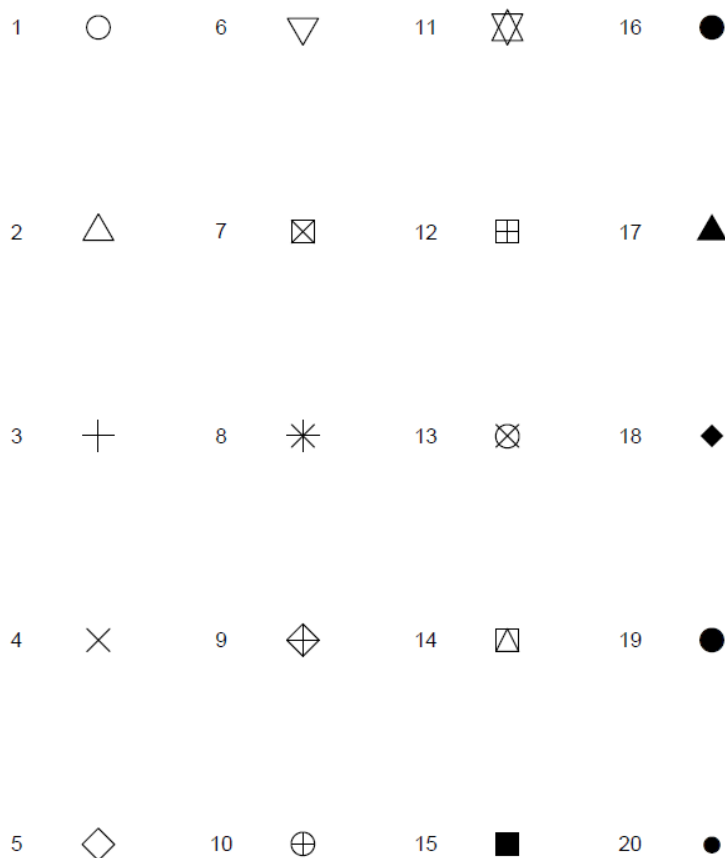
showSymbols

*Show available symbols*

---

**Description**

Shows symbols available for plotting.

**Usage**

```
showSymbols()
```

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

spider

*Spider plot(s): Selected samples*

---

**Description**

Normalization of trace-element data by the given standard and spiderplot plotting.

**Usage**

```
spider.individual(new=TRUE)
```

```
spider.contour(chondrit = selectNorm(), what=NULL,
  colour.palette = "heat.colors", ymin = 0, ymax = 0,
  cex = 1, join = TRUE, pch = 15,
```

```
main = "", sub = "", offset = TRUE, centered = FALSE,
xrotate = FALSE, xaxs = "r", new = TRUE, legend = TRUE)
```

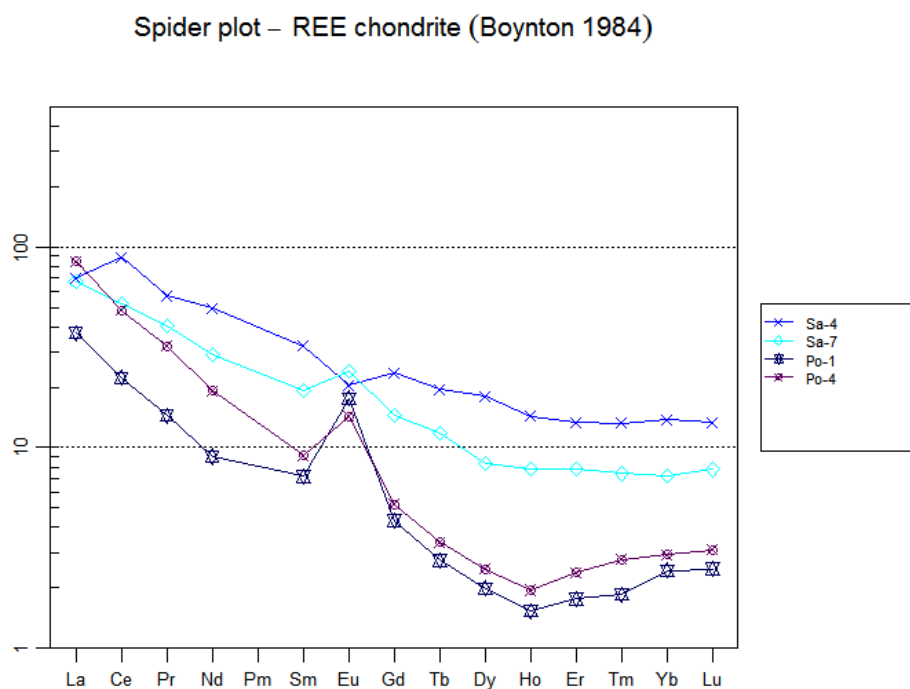
```
spider(rock, chondrit = selectNorm(), ymin = 0,
ymax = 0, cex = 1, plot = TRUE, join = TRUE,
field = FALSE, legend = FALSE, add = FALSE,
pch = 0, col = "black", shaded.col = "gray",
density = 0.02, angle = 0, main = "", sub = "",
offset = FALSE, centered = FALSE, xrotate = FALSE,
xaxs = "r", fill.col = TRUE, log = "y", new = TRUE, ...)
```

## Arguments

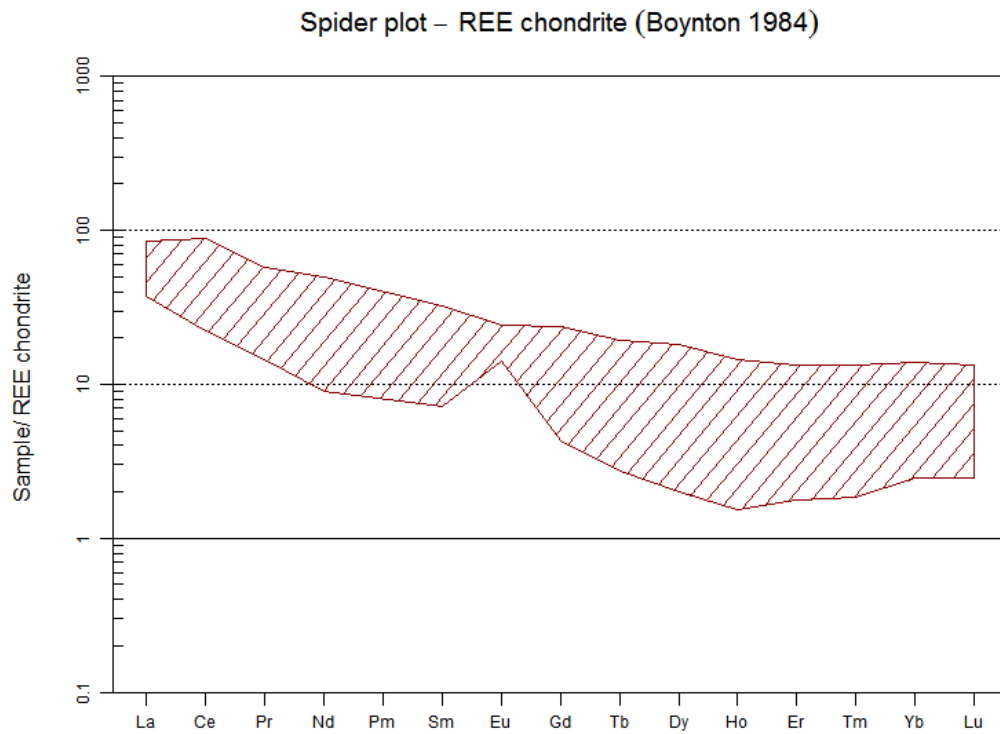
new	logical; if true, new plotting window is opened.
chondrit	a numeric matrix with one row; the normalizing values.
what	variable name or formula.
colour.palette	variable name or formula.
rock	a numeric matrix; the whole-rock data from which will be filtered out those to be normalized.
ymin, ymax	y range of the diagram.
cex	magnification of the plotting symbols.
plot	logical; if set to FALSE, individual patterns are not plotted.
join	logical; if TRUE, the NAs are extrapolated so that the patterns are unbroken.
field	logical; if TRUE, a shaded field denoting the overall data span is plotted
legend	logical; if TRUE, room for legend is reserved.
add	logical; if TRUE, a new plot is started (otherwise overplot).
pch	a vector specifying the plotting symbols.
col	a numeric vector; colour of the plotting symbols and connecting lines.
fill.col	logical; should be the field of overall variability filled by solid colour?
shaded.col	numeric: colour for the cross-hatched or solid fill.
density	numeric: density of the fill pattern (fraction of the whole plotting range).
angle	numeric: angle of the fill pattern (in degrees).
main	character: the main title for the plot.
sub	character: the subtitle for the plot.
xrotate	logical; shall be the element names on x axis rotated?
offset	logical; shall be the names for odd and even elements shifted relative to each other?
centered	logical; shall be the element names on x axis plotted in between tick marks?
xaxs	style of the xaxis: see 'help(par)' for details.
log	which of the axes should be logarithmic?
...	further graphical parameters: see 'help(par)' for details.

## Details

This is a quite flexible function, a true *Mother of All Spiderplots*, that can be used in a number of ways. It is employed by functions of the GCDkit system for normalization and plotting individual patterns for selected samples ('spiderplot.r') or each of the groups ('spider by group individual.r'). In 'spiderplot.r' is stored a user interface to 'spider' for plotting individual patterns.

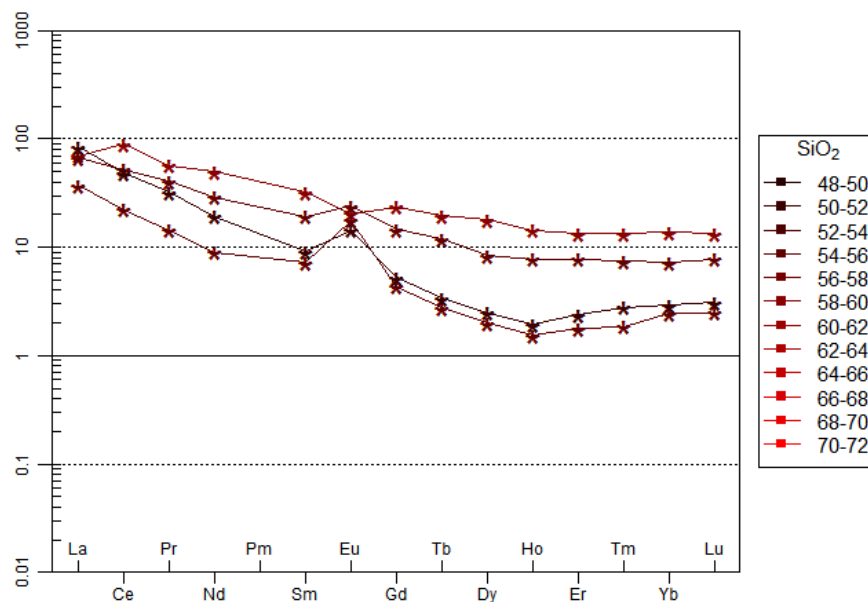


Function 'spider' can also serve for plotting the overall compositional ranges (shown as cross-hatched fields or, optionally, semitransparent filled polygons) in a manner similar to function 'spider by group.r'.



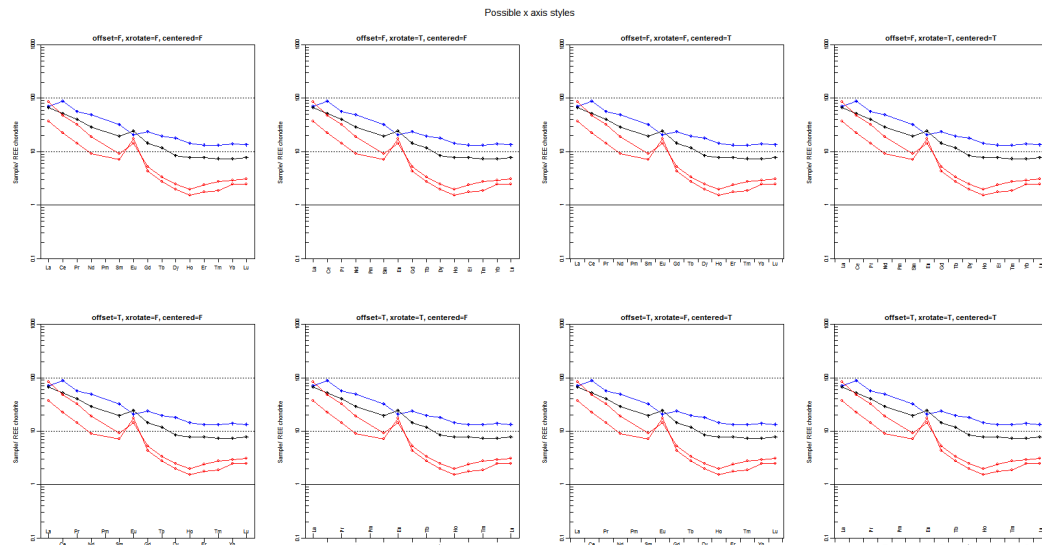
In 'spiderplot\_contour.r' is stored a user interface to 'spider' for plotting individual patterns, in which the plotting symbols is uniform and colour reflects distribution of an independent variable, such as silica contents. The variable (or formula) can be specified using the parameter 'what', the colour scheme by 'colour.palette'. The legal colour schemes are: "grays", "reds", "blues", "greens", "cyans", "violets", "yellows", "cm.colors", "heat.colors", "terrain.colors", "topo.colors", "rainbow", "jet.colors".

Spider plot – REE chondrite (Boynton 1984)



The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details. For choosing the correct normalization values serves the auxiliary function [selectNorm](#). Then the user is prompted whether to use the currently assigned plotting symbols. If desired so, the symbols and colours can be specified in a simple spreadsheet-like interface. Likewise the scale of the y axis can be specified. The exact appearance of the labels to the x axis can be fine tuned by the arguments 'rotate.xlab', 'offset' and 'centered'. See examples.





If 'plot=FALSE', not plotting is done, and only the normalized values are returned.

## Value

results          numeric matrix with normalized concentrations.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>;

Vojtech Erban, <vojtech.erban@geology.cz>, contributed the algorithm hatching closed polygons

## See Also

For the syntax of the setup file with normalizing values and adding new normalization schemes see [selectNorm](#); for further applications of 'spider' see [spider2norm](#), [spiderByGroupPatterns](#) and [spiderByGroupFields](#).

## Examples

```
ee<-spider.contour("Boynton","SiO2","reds",pch="*",cex=2,ymin=0.01,ymax=1000)

ee<-spider(WR,"Boynton",0.1,1000,pch="*",col="red",cex=2)
# the ee<- construction redirects the textual output

ee<-spider(WR[1:14,],"Boynton",1,500,pch=1:14,col=1:14,legend=TRUE)

ee<-spider(WR,"Boynton",field=TRUE,density=0.02,angle=60,col="darkred",fill.col=FALSE,0.1,1000)

ee<-spider(WR,"Boynton",field=TRUE,fill.col=TRUE,shaded.col="khaki",0.1,1000)

# Shade the background field portraying the overall variation

# Shade the background field portraying the overall variation
ee<-spider(WR,"Boynton",0.1,1000,pch=labels$Symbol,col=labels$Colour,cex=labels$Size)
ee<-spider(WR,"Boynton",field=TRUE,fill.col=TRUE,shaded.col="gray",add=TRUE)
```

```

ee<-spider(WR,"Boynton",0.1,1000,pch=labels$Symbol,col=labels$Colour,cex=labels$Size)
ee<-spider(WR,"Boynton",field=TRUE,density=0.02,angle=45,col="gray",fill.col=FALSE,add=TRUE)

# Custom normalization scheme
chon<-c(0.4,4,50,0.8,0.7,10,35,9,340,9,70,8.0)
chon<-matrix(chon,nrow=1)
colnames(chon)<-c("K2O","Rb","Ba","Th","Ta","Nb","Ce","Hf","Zr","Sm","Y","Yb")
rownames(chon)<- "ORG (Pearce et al. 1984)"
spider(WR,chon,ymin=0.01,col="navy",ymax=1000)

# Possible styles for x axis
multiplePerPage(8,nrow=2,ncol=4,"Possible x axis styles", dummy=FALSE)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=F, xrotate=F, centered=F,
           main="offset=F, xrotate=F, centered=F",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=F, xrotate=T, centered=F,
           main="offset=F, xrotate=T, centered=F",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=F, xrotate=F, centered=T,
           main="offset=F, xrotate=F, centered=T",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=F, xrotate=T, centered=T,
           main="offset=F, xrotate=T, centered=T",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=T, xrotate=F, centered=F,
           main="offset=T, xrotate=F, centered=F",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=T, xrotate=T, centered=F,
           main="offset=T, xrotate=T, centered=F",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=T, xrotate=F, centered=T,
           main="offset=T, xrotate=F, centered=T",new=F)
ee<-spider(WR, "Boynton", 0.1, 1000, pch=labels$Symbol,
           col=labels$Colour, cex=labels$Size, offset=T, xrotate=T, centered=T,
           main="offset=T, xrotate=T, centered=T",new=F)

spider(WR,"Boynton",plot=FALSE) # Calculation only

```

---

spider2norm

*Spider plot(s): Selected samples, double normalized*


---

## Description

Plots a double normalized spiderplot. Trace-element data are first normalized by the given standard, as usual (see [spider](#)). Then the normalized concentrations are multiplied by a factor needed to adjust the normalized content of the selected element in each analysis to a desired value (such as unity). The goal is to eliminate effects of fractional crystallization (*Thompson et al. 1983, Pearce et al. 2005, Pearce and Stern 2006*).

**Usage**

```
spider2norm(rock=WR,norm=NULL,norm2=NULL,ymin=0,ymax=0,which=rep(TRUE,nrow(rock)),
legend=FALSE,pch=labels$Symbol,col=labels$Colour,plot=TRUE,join=TRUE,shaded.col="gray",
density=-1,angle=0,xaxs="r",fill.col=FALSE,field=FALSE,add=FALSE,...)
```

**Arguments**

rock	a numeric matrix; the whole-rock data from which will be filtered out those to be normalized.
norm	a character string specifying the model.
norm2	name of the variable for the second normalization.
ymin, ymax	y range of the diagram.
which	specification of the samples to be plotted.
legend	logical; if TRUE, room for legend is reserved.
pch	a vector specifying the plotting symbols.
col	a numeric vector; colour of the plotting symbols and connecting lines.
plot	logical; if set to FALSE, individual patterns are not plotted.
join	logical; if TRUE, the NAs are extrapolated so that the patterns are unbroken.
shaded.col	numeric: colour for the cross-hatched fill.
density	numeric: density of the fill pattern (fraction of the whole plotting range).
angle	numeric: angle of the fill pattern (in degrees).
xaxs	style of the xaxis: see 'help(par)' for details.
fill.col	colour for solid fill
field	logical; if TRUE, a shaded field denoting the overall data span is plotted
add	logical; if TRUE, a new plot is started (otherwise overplot).
...	further graphical parameters: see 'help(par)' for details.

**Details**

The parameter '*norm*' is an optional search pattern to query the available normalizing model names. It can contain a substring or even a regular expression. For choosing the correct normalization values serves the auxiliary function [selectNorm](#). The function fails if no matches are found or the search is ambiguous. See [selectNorm](#) for details.

The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Then the user is prompted whether to use the currently assigned plotting symbols. If desired so, the symbols and colours can be specified in a simple spreadsheet- like interface.

Likewise the scale of the y axis can be specified interactively.

**Value**

results	numeric matrix with normalized concentrations
.	

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Pearce J A, Stern R J (2006) Origin of back-arc basin magmas: Trace element and isotope perspectives. Back-Arc Spreading Systems: Geological, Biological, Chemical, and Physical Interactions. Geophysical Monograph Series 166. American Geophysical Union, pp 63-86

Pearce J A, Stern R J, Bloomer S H, Fryer P (2005) Geochemical mapping of the Mariana arc-basin system: implications for the nature and distribution of subduction components. *Geochem Geophys Geosyst* 6: doi: 10.1029/2004GC000895 doi: [10.1029/2004GC000895](https://doi.org/10.1029/2004GC000895)

Thompson R N, Morrison M A, Dickin A P, Hendry G L (1983) Continental flood basalts... Arachnids rule OK? In: Hawkesworth C J, Norry M J (eds) *Continental Basalts and Mantle Xenoliths*. Shiva, Nantwich, pp 158-185

## See Also

For the syntax of the setup file with normalizing values and adding new normalization schemes see [selectNorm](#); for further variants of spiderplots, see [spider](#), [spiderByGroupPatterns](#) and [spiderByGroupFields](#).

## Examples

```
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch="*",col="red",cex=2)
# the ee<- construction redirects the textual output

ee<-spider2norm(WR,"Boynton","Yb",field=TRUE,density=0.05,angle=60,col="red",0.1,1000)

ee<-spider2norm(WR,"Boynton","Yb",field=TRUE,fill.col=TRUE,shaded.col="khaki",0.1,1000)

# Shade the background field portraying the overall variation
ee<-spider2norm(WR,"Boynton","Lu",0.1,1000,pch=labels$Symbol,col=labels$Colour,cex=labels$Size)
ee<-spider2norm(WR,"Boynton","Lu",field=TRUE,density=0.02,angle=45,col="gray",add=TRUE)

# Shade the background field portraying the overall variation
ee<-spider2norm(WR,"Boynton","Lu",0.1,1000,pch=labels$Symbol,col=labels$Colour,cex=labels$Size)
ee<-spider2norm(WR,"Boynton","Lu",field=TRUE,fill.col=TRUE,shaded.col="gray",add=TRUE)

# Possible styles for x axis
multiplePerPage(8,nrow=2,ncol=4,"Possible x axis styles",dummy=FALSE)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=F,xrotate=F,centered=F,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=F,xrotate=T,centered=F,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=F,xrotate=F,centered=T,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=F,xrotate=T,centered=T,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=T,xrotate=F,centered=F,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=T,xrotate=T,centered=F,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=T,xrotate=F,centered=T,new=F)
ee<-spider2norm(WR,"Boynton","Yb",0.1,1000,pch=labels$Symbol,
  col=labels$Colour,cex=labels$Size,offset=T,xrotate=T,centered=T,new=F)

spider2norm(WR,"Boynton","Yb",plot=FALSE) # Calculation only
```

spiderBoxplot

*Spider plot(s): Selected samples - summary boxplot*

## Description

Normalization of geochemical data by the given standard (optionally also one of the samples) and spiderplot plotting. No individual patterns are drawn; instead, the statistical distribution of each element is portrayed by a boxplot.

## Usage

```
spiderBoxplot(norm = NULL, which = rep(TRUE,nrow(WR)),
  doublenorm = FALSE, norm2 = "",
  ymin = NULL, ymax = NULL, bplot = TRUE,
  col = "lightgray", log = TRUE)
```

## Arguments

norm	a character string specifying the model.
which	specification of the samples to be plotted.
doublenorm	logical; should be the normalization employed? See details.
norm2	name of the variable for the second normalization.
ymin, ymax	y range of the diagram.
bplot	logical; if FALSE, boxplot box (instead of box and percentile plot) is shown.
col	fill colour.
log	logical; should be the y axis scaled logarithmically?

## Details

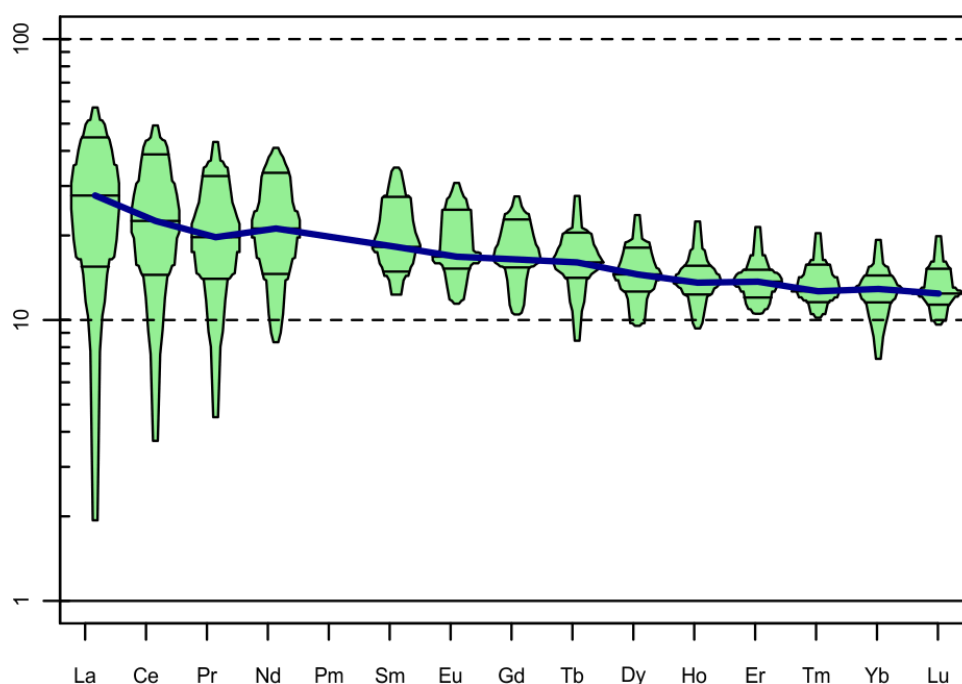
The parameter '*norm*' is an optional search pattern to query the available normalizing model names. It can contain a substring or even a regular expression. The function fails if no matches are found or the search is ambiguous. See [selectNorm](#) for details.

The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

For choosing the correct normalization values serves the auxiliary function [selectNorm](#), which is the same as in ordinary spiderplots. If the user desires so, the data can be normalized by a sample present in the dataset. Then the elements to be plotted and their order is to be specified, as well.

Optionally, double normalization can be used. Trace-element data are first normalized by the given standard, then by the normalized content of the selected element in each analysis to eliminate effects of fractional crystallization (*Thompson et al. 2003, Pearce et al. 2005, Pearce and Stern 2006*). See [spider2norm](#) for details.

Distributions of individual normalized elements are plotted in the form of [boxplot](#) or box and percentile plot (*Esty and Banfield 2003*).



In both cases the box denotes 50% of the population (both quartiles), the horizontal line in the middle is a median and the whiskers denote the overall range. For boxplot this is without outliers. See manual entry for 'boxplot' and 'bplot.my' for further details.

Printed are number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (=50% quartile), 75% quartile and maximum.

### Value

`results` numeric matrix with statistical data for individual elements.

### Warning

This function IS NOT Figaro-compatible. It means that the set of diagrams cannot be further edited in GCDkit (e.g. tools in "Plot editing" menu are inactive).

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Esty, W. W. & Banfield, J. D. (2003). The Box-Percentile Plot. *Journal of Statistical Software* 8 (17)
- Pearce J A, Stern R J (2006) Origin of back-arc basin magmas: Trace element and isotope perspectives. *Back-Arc Spreading Systems: Geological, Biological, Chemical, and Physical Interactions*. Geophysical Monograph Series 166. American Geophysical Union, pp 63-86
- Pearce J A, Stern R J, Bloomer S H, Fryer P (2005) Geochemical mapping of the Mariana arc-basin system: implications for the nature and distribution of subduction components. *Geochem Geophys Geosyst* 6: doi: 10.1029/2004GC000895

Thompson R N, Morrison M A, Dickin A P, Hendry G L (1983) Continental flood basalts... Arachnids rule OK? In: Hawkesworth C J, Norry M J (eds) Continental Basalts and Mantle Xenoliths. Shiva, Nantwich, pp 158-185

### See Also

For the syntax of the setup file with normalizing values and adding new normalization schemes see [selectNorm](#); for further applications of 'spider' see [spiderByGroupPatterns](#), [spider2norm](#) and [spiderByGroupFields](#).

### Examples

```
spiderBoxplot("Boynton",col="yellow",bpplot=FALSE)
spiderBoxplot("Primordial Wood",doublenorm=TRUE,norm2="Y",
  col="khaki",ymin=0.05,ymax=1000,bpplot=TRUE)
```

---

spiderByGroupFields     *Spider plot(s) - by group fields*

---

### Description

Plots a series of spiderplots, for each group one, outlining the overall distribution as a field.

### Usage

```
spiderByGroupFields(rock = WR, norm = NULL,
  bw = FALSE, fill = FALSE, ymin = 0, ymax = 0,
  xrotate = FALSE, offset = TRUE, centered = FALSE)
```

### Arguments

rock	a numeric matrix; the whole-rock data from which will be filtered out those to be normalized.
norm	a character string specifying the model.
bw	logical; should be the plot black and white?
fill	logical; should be the fields filled by solid colour (and not hatched)?
ymin, ymax	y range of the diagram.
xrotate	logical; shall be the element names on x axis rotated?
offset	logical; shall be the names for odd and even elements shifted relative to each other?
centered	logical; shall be the element names on x axis plotted in between tick marks?

### Details

The parameter '*norm*' is an optional search pattern to query the available normalizing model names. It can contain a substring or even a regular expression. For choosing the correct normalization values serves the auxiliary function [selectNorm](#). The function fails if no matches are found or the search is ambiguous. See [selectNorm](#) for details.

A series of spiderplots is plotted, for each group one, in which the whole variation range is outlined as filled/cross-hatched fields.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>; Vojtech Erban, <vojtech.erban@geology.cz>, contributed the algorithm hatching closed polygons

**See Also**

For the syntax of the setup file with normalizing values and adding new normalization schemes see [selectNorm](#). This function is based on [spider](#).

**Examples**

```
## Not run:
data<-loadData("sazava.data",sep="\t")
groupsByLabel("Intrusion")
spiderByGroupFields(norm="Boynton",ymin=1,ymax=1000)

spiderByGroupFields(norm="Boynton",bw=TRUE,ymin=1,ymax=1000,xrotate=TRUE,offset=FALSE)

spiderByGroupFields(norm="Boynton",fill=TRUE,ymin=1,ymax=1000)

## End(Not run)
```

---

spiderByGroupPatterns *Spider plot(s) - by group patterns*

---

**Description**

Plots a series of spiderplots, for each group one, in which individual patterns are shown.

**Usage**

```
spiderByGroupPatterns(rock = WR, norm = NULL, bw = FALSE,
ymin = 0, ymax = 0, xrotate = FALSE, offset = TRUE, centered = FALSE)
```

**Arguments**

rock	a numeric matrix; the whole-rock data from which will be filtered out those to be normalized.
norm	a character string specifying the model.
bw	logical; should be the plot black and white?
ymin, ymax	y range of the diagram.
xrotate	logical; shall be the element names on x axis rotated?
offset	logical; shall be the names for odd and even elements shifted relative to each other?
centered	logical; shall be the element names on x axis plotted in between tick marks?



## Details

Firstly, the normalization scheme is chosen and scaling for all the plots specified. Then, a series of spiderplots is plotted, for each group one, in which patterns for individual samples are shown.

## Value

Returns a list 'results' with the normalized values, and, in case of REE, some extra parameters.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

For the syntax of the setup file with normalizing values and adding new normalization schemes see [selectNorm](#). This function is based on [spider](#).

## Examples

```
# Get the data ready
data(sazava)
accessVar("sazava")
groupsByLabel("Intrusion")

#Plot
spiderByGroupPatterns(norm="Boynton",ymin=1,ymax=1000)
spiderByGroupPatterns(norm="Boynton",bw=TRUE,ymin=1,ymax=1000,xrotate=TRUE,offset=FALSE)
```

---

srnd

*Recalculations of the Sr-Nd isotopic data*


---

## Description

Age-corrects the Sr-Nd isotopic data to a given age; calculates initial  $\epsilon(Nd)$  values and Nd model ages.

## Usage

```
srnd(age="")
initial(x,age,system="Nd")
epsilon(WR,age)
DMage(WR)
DMGage(WR)
DMLHage(WR, age)
```

## Arguments

age	age in Ma: if empty, the user is prompted to enter a value
x, WR	isotopic data to be recalculated
system	character; which isotopic system Sr or Nd?

**Details**

Recalculates the Sr-Nd isotopic data and returns them in the numeric matrix `init` with the following columns:

Age (Ma)	Age in Ma
$^{87}\text{Sr}/^{86}\text{Sr}_i$	Initial Sr isotopic ratios
$^{143}\text{Nd}/^{144}\text{Nd}_i$	Initial Nd isotopic ratios
EpsNdi	Initial $\epsilon(\text{Nd})$ values
TDM	Single-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> ), function Image
TDM.Gold	Single-stage depleted-mantle Nd model ages ( <i>Goldstein et al., 1988</i> ), function DMGage
TDM.2stg	Two-stage depleted-mantle Nd model ages ( <i>Liew &amp; Hofmann, 1988</i> ), function DMLHage

**Value**

`init`                      numeric matrix with the results

**Plugin**

`SrNd.r`

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138

Goldstein S L, O’Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236

**Examples**

```
# recalculation to 500 Ma
srnd(500)

# print the isotopic parameters currently in the memory
init
```

---

statsByGroup

*Statistics by groups*

---

**Description**

Calculates simple descriptive statistics for individual columns of the given data matrix; optionally this can be done for each of the groups separately.

**Usage**

```
statsByGroup(data = WR, groups = groups)
```

**Arguments**

data	numeric data matrix.
groups	a vector, in which is specified, for each sample, a group it belongs to.

**Details**

The function returns a list containing the calculated statistical parameters respecting the desired grouping. The statistical summary involves number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (= 50% quartile), 75% quartile and maximum. This is a core function invoked both by [summarySingle](#) and [summarySingleByGroup](#).

**Value**

results	a list with the results for individual groups
---------	---

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[summarySingle](#)  
[statistics](#)  
[summaryAll](#)  
[summaryByGroup](#)

**Examples**

```
statsByGroup(WR)
statsByGroup(WR[,LILE])
```

---

statsByGroupPlot

*Statistics: Plot summary by element and group*


---

**Description**

Plots crosses in a binary diagram denoting means and standard deviations for individual groups.

**Usage**

```
statsByGroupPlot()
```

**Details**

Displays a binary diagram of two elements/oxides in which are plotted averages for the individual groups with whiskers corresponding to their standard deviations.

The variables are entered via the function '[selectColumnLabel](#)'. In the specification of the variables can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

**Value**

results            a matrix with the results for individual groups and selected two elements/oxides

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

---

statsIso

*Statistical plots of isotopic ratios/model ages*

---

**Description**

Plots a boxplot or stripplot for a given isotopic parameter, respecting groups.

**Usage**

boxplotIso()

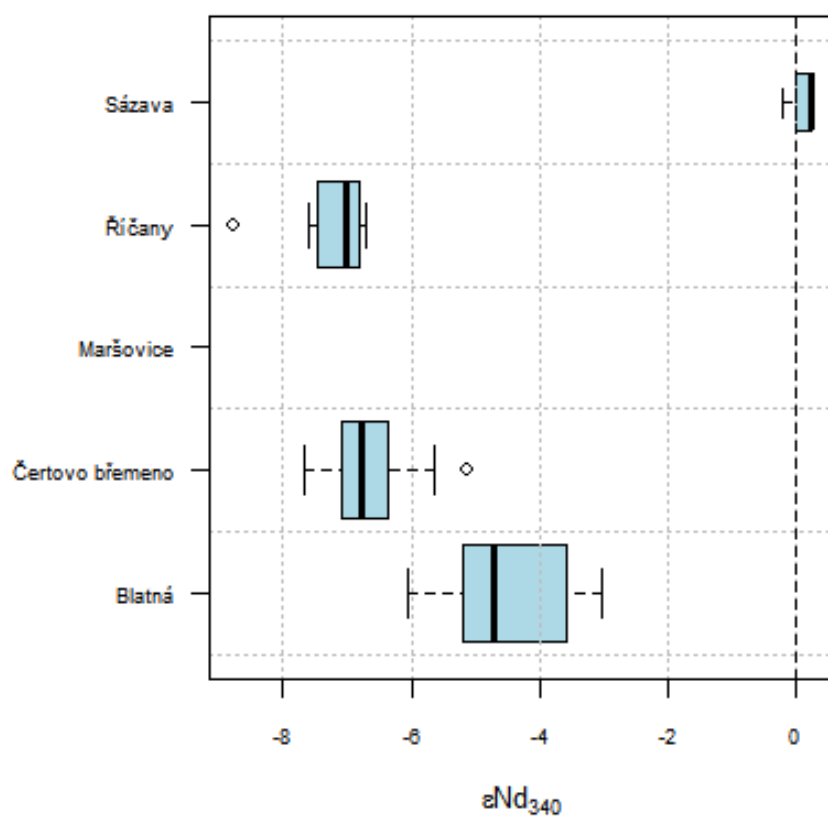
stripplotIso()

**Arguments**

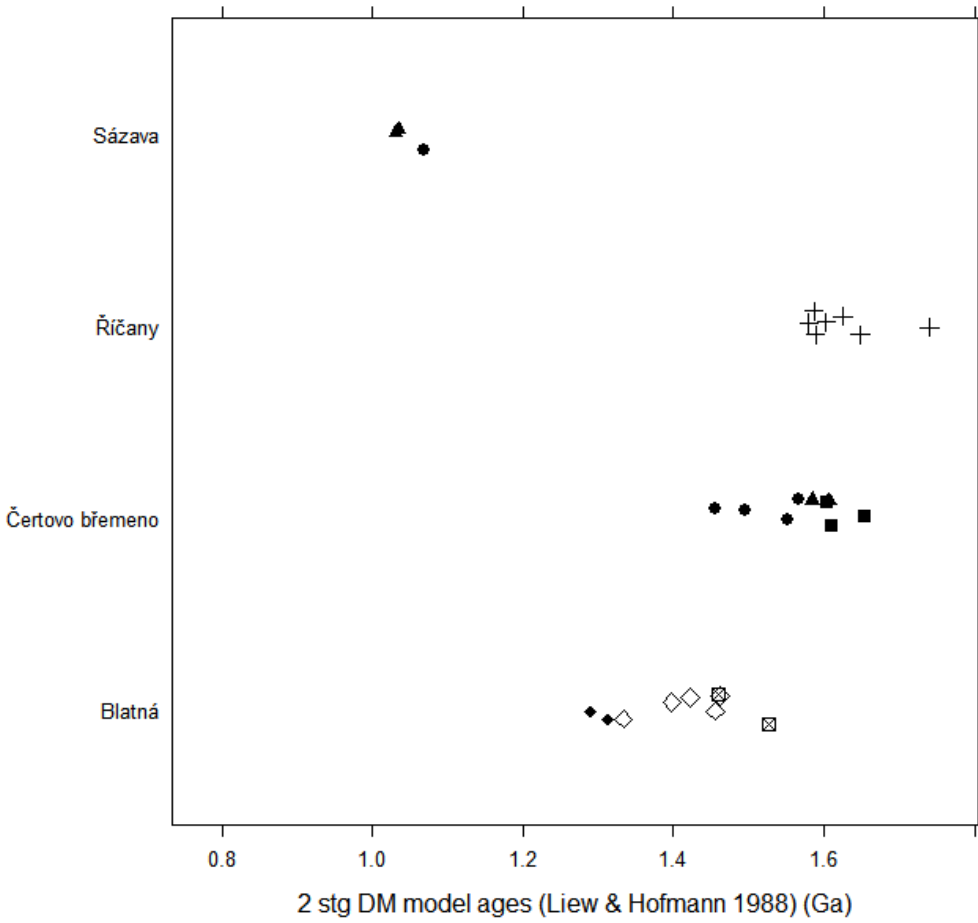
None.

**Details**

The boxplot portrays realistically a statistical distribution of the data. The box represents, for each of the groups, the two quartiles, the line inside is a median, the whiskers show the whole range without outliers.



Stripplot shows 1D scatter plots for each of the groups, with some artificial noise (jitter) added to make the individual points better visible. Stripplots are a good alternative to boxplots when sample sizes are small.



The variables to choose from are:

Menu item	Explanation
87Sr/86Sri	Initial Sr isotopic ratios
143Nd/144Ndi	Initial Nd isotopic ratios
EpsNdi	Initial $\epsilon(Nd)$ values
1 stg DM model ages (Goldstein et al. 1988)	Single-stage DM Nd model ages
1 stg DM model ages (Liew & Hofmann 1988)	Single-stage DM Nd model ages
2 stg DM model ages (Liew & Hofmann 1988)	Two-stage DM Nd model ages

Value

None.

Plugin

SrNd.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Liew T C & Hofmann A W (1988) Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib Mineral Petrol* 98: 129-138

Goldstein S L, O’Nions R K & Hamilton P J (1984) A Sm-Nd isotopic study of atmospheric dusts and particulates from major river systems. *Earth Planet Sci Lett* 70: 221-236

---

strip

---

*Statistics: Stripplot by groups*


---

**Description**

Stripplot for selected samples and variable, respecting the grouping.

**Usage**

```
strip(xlab = "", ...)
```

**Arguments**

xlab	variable name
...	additional parameters to stripplot

**Details**

Stripplot shows 1D scatter plots for each of the groups, with some artificial noise (jitter) added to make the individual points better visible. Stripplots are a good alternative to boxplots when sample sizes are small.

If no variable is specified as an argument 'xlab', the user can enter it using the function '[selectColumnLabel](#)'.

In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

**Value**

None.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[stripplot](#), [stripBoxplot](#)

**Examples**

```
strip("(Na2O+K2O)/Al2O3")
```

stripBoxplot

*Statistics: Stripplot by groups - with boxplots***Description**

Stripplot for selected variable, respecting the grouping. Each of the stripplots for the individual groups are underlain by a boxplot, so that the median, quartiles and range are immediately apparent. Optionally, the data points can be replaced by variously sized/coloured circles, depicting a distribution of a second variable.

**Usage**

```
stripBoxplot(yaxis = "", zaxis = "0", ymin = NULL, ymax = NULL,
             pal = "heat.colors", ident = FALSE, silent=TRUE)
```

**Arguments**

yaxis	specification of the variable used for stripplots/boxplots
zaxis	(optional) specification of the variable depicted by the circles
ymin, ymax	minimum and maximum of the y axis
pal	name of predefined palette
ident	logical; should be the samples identified interactively after plotting?
silent	logical, should be the above chosen by the appropriate dialogues?

**Details**

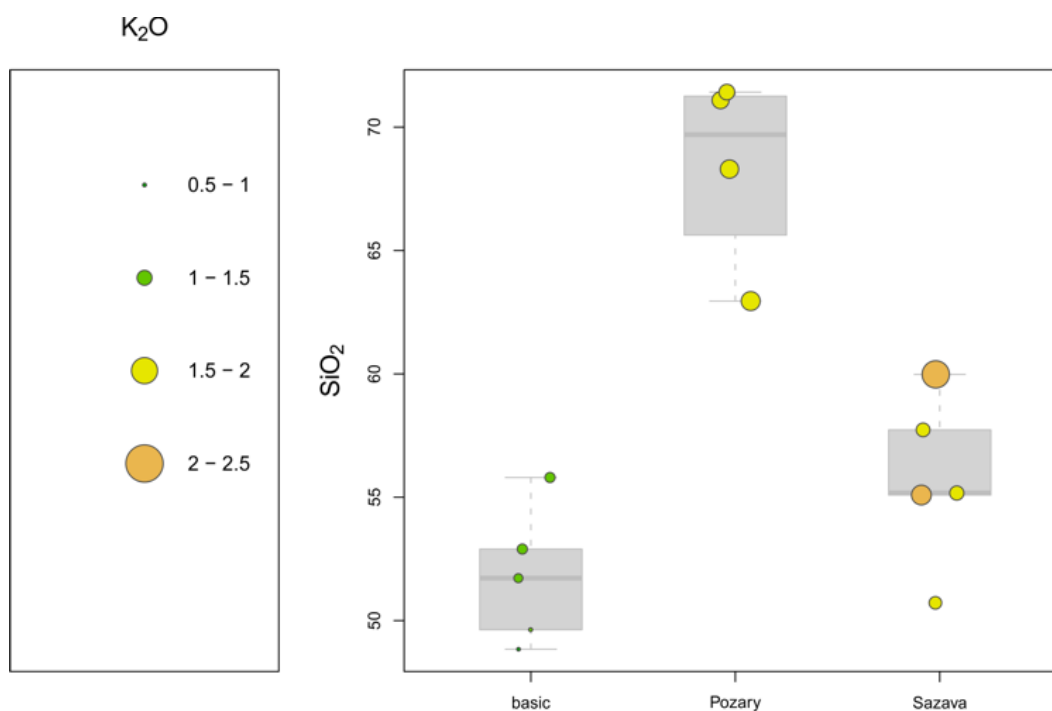
Stripplot shows 1D scatter plots for each of the groups, with some artificial noise (jitter) added to make the individual points better visible. Stripplots are a good alternative to boxplots when sample sizes are small.

If no variable is specified as an argument 'yaxis', the user can enter it using the function '[selectColumnLabel](#)'.

If 'zaxis' is zero, assigned plotting symbols, colours and symbol sizes are used.

If 'zaxis' refers to a valid variable name, the data points are shown as circles, the size and colours of which correspond to this second variable.





In the specification of the variable(s) can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

The colour scheme can be specified by 'pal'. The legal colour schemes are: "grays", "reds", "blues", "greens", "cyans", "violets", "yellows", "cm.colors", "heat.colors", "terrain.colors", "topo.colors", "rainbow" and "jet.colors".

### Value

None.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### See Also

[stripplot](#), [boxplot](#), [strip](#), [plotWithCircles](#)

### Examples

```
stripBoxplot("(Na2O+K2O)/Al2O3")
```

---

Subset by range

Select subset by range

---

### Description

Selecting subsets of the data stored in memory by their range.

## Details

The menu item 'Select subset by range' is connected to the function [selectSubset](#). The search pattern is treated as a selection of sample sequence numbers (effectively a list separated by commas that may also contain ranges expressed by colons). The current data will be replaced by its newly chosen subset.

## Value

Overwrites the data frame 'labels' and numeric matrix 'WR' by subset that fulfills the search criteria.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## Examples

```
## Not run:
Search pattern = 1:5
# First to fifth samples in the data set

Search pattern = 1,10
# First and tenth samples

Search pattern = 1:5, 10:11, 25
# Samples number 1, 2, ...5, 10, 11, 25

## End(Not run)
```

---

summaryAll

*Statistics: Statistical summaries for the whole data set or its subset*


---

## Description

The function 'summaryAll' prints statistical summary for selected list of elements (majors as a default) and the current dataset (or its part). Functions 'summaryMajor' and 'summaryTrace' are entry points supplying the default lists for major- and trace elements.

## Usage

```
summaryAll(elems = major, where = NULL, show.boxplot = FALSE,
           show.hist = FALSE, silent=TRUE)
summaryMajor()
summaryTrace()
```

## Arguments

elems	list of desired elements
where	list of desired samples to be processed
show.boxplot	logical, should be plotted the boxplots?
show.hist	logical, should be plotted the histograms?
silent	logical, should be the above chosen by the appropriate dialogues?

## Details

The statistical summary involves number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (= 50% quartile), 75% quartile and maximum. The function also plots summary boxplots and histograms, if desired so.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Even though as a default are assumed majors (SiO<sub>2</sub>, TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, FeO<sub>t</sub>, MnO, MgO, CaO, Na<sub>2</sub>O, K<sub>2</sub>O for 'summaryMajor') or selected trace (Rb, Sr, Ba, Cr, Ni, La, Eu, Y, Zr for 'summaryTrace') elements, the variable(s) to be displayed can be modified/specified in all cases. To this purpose serves the function '[selectColumnsLabels](#)'.

In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

## Value

results                      numeric matrix with the results

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## See Also

[statistics](#) [summarySingle](#) [summarySingleByGroup](#) [summaryByGroup](#)

## Examples

```
summaryAll(LILE)

summaryAll(LILE, show.hist=TRUE)

summaryAll(LILE, show.boxplot=TRUE)

# user-defined list
my.elems<-c("Rb", "Sr", "Ba")
summaryAll(my.elems)

## Not run:
    summaryMajor()
    summaryTrace()

## End(Not run)
```

---

summaryByGroup

*Statistics: Statistical summaries by groups*


---

## Description

The function 'summaryByGroup' prints a statistical summary for selected list of elements (majors as a default) and the whole dataset or its selection, respecting the current grouping. Functions 'summaryByGroupMjr' and 'summaryByGroupTrc' are entry points supplying the default lists for major- and trace elements. The function 'summaryByGroupTrc' returns only ranges of the given parameter(s).

**Usage**

```
summaryByGroup(elems = major, where = NULL, show.boxplot = FALSE,
               show.hist = FALSE, silent = TRUE)

summaryByGroupMjr()

summaryByGroupTrc()

summaryRangesByGroup(elems=major, where=NULL, silent=TRUE)
```

**Arguments**

<code>elems</code>	list of desired elements
<code>where</code>	list of desired samples to be processed
<code>show.boxplot</code>	logical, should be plotted the boxplots?
<code>show.hist</code>	logical, should be plotted the histograms?
<code>silent</code>	logical, should be the above chosen by the appropriate dialogues?

**Details**

The statistical summary involves number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (= 50% quartile), 75% quartile and maximum. The function also plots a summary boxplots and histograms, if desired so.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

The defaults are lists of major (SiO<sub>2</sub>, TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, FeO<sub>t</sub>, MnO, MgO, CaO, Na<sub>2</sub>O, K<sub>2</sub>O) or trace (Rb, Sr, Ba, Cr, Ni, La, Eu, Y, Zr) elements, respectively.

The desired variables are selected using the function '[selectColumnsLabels](#)'.

In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

**Value**

<code>results</code>	a list with the results for individual groups
----------------------	---

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**Examples**

```
summaryByGroup(LILE)

summaryByGroup(LILE, show.hist=TRUE)

summaryByGroup(LILE, show.boxplot=TRUE)

# user-defined list
my.elems<-c("Rb", "Sr", "Ba/Sr")
summaryByGroup(my.elems)
```

```
## Not run:  
summaryByGroupTrc()  
summaryByGroupMjr()  
summaryRangesByGroup(elems="Rb/Sr,Na20+K20")  
  
## End(Not run)
```

---

summarySingle

*Statistics: Single variable all/selection*

---

## Description

Prints statistical summary for a single variable and the current dataset (or its part).

## Usage

```
summarySingle(xlab="")
```

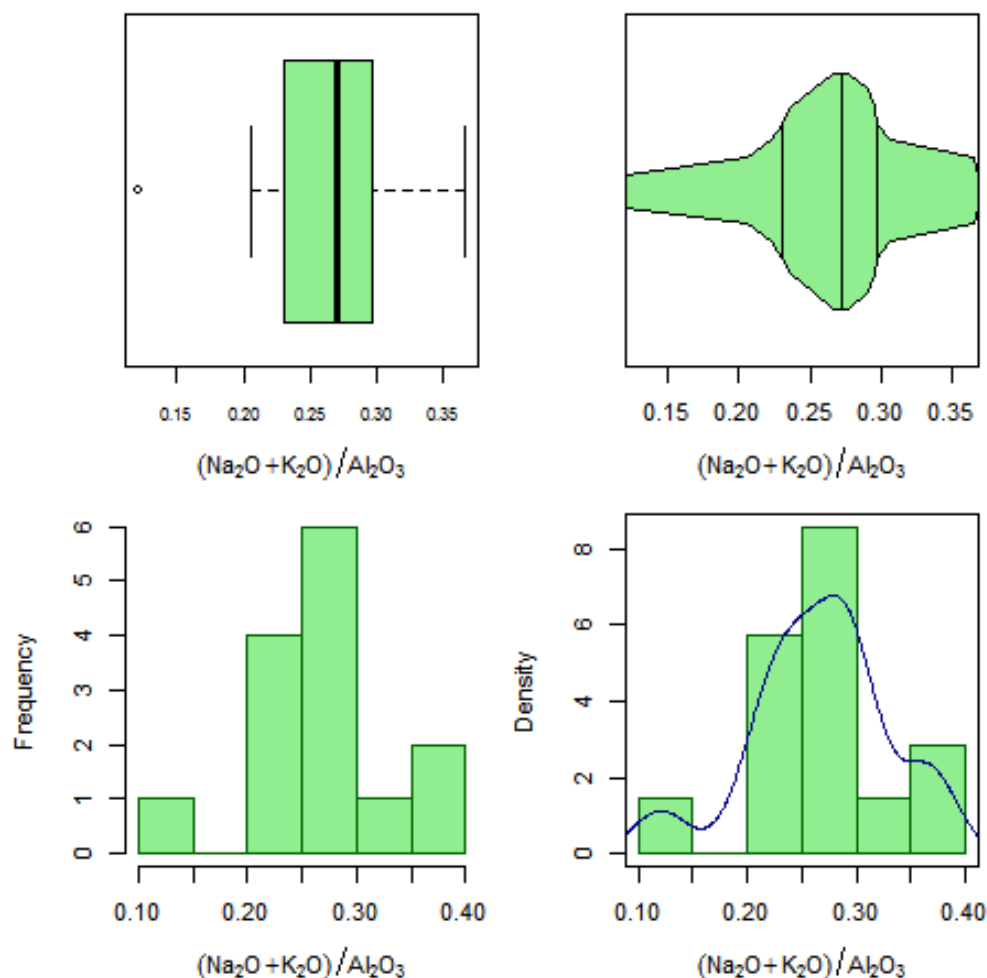
## Arguments

xlab	variable name
------	---------------

## Details

The statistical summary involves number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (=50% quartile), 75% quartile and maximum. The function also plots a summary boxplot and histogram.

In addition the statistical distribution of the given variable is shown as a boxplot, a box-percentile plot and two variants of histograms.



If no variable is specified as an argument 'xlab', the user can enter it using the function '[selectColumnLabel](#)'. In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

The samples can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

### Value

results          numeric matrix/vector with the results

### Author(s)

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

### See Also

[boxplot](#)  
[bplot2](#)  
[statistics](#)

[summarySingleByGroup](#) [summaryAll](#) [summaryByGroup](#)

## Examples

```
summarySingle("(Na2O+K2O)/Al2O3")
```

---

summarySingleByGroup	<i>Statistics: Single variable by groups</i>
----------------------	--

---

## Description

Prints statistical summary for a single variable and the whole dataset, divided by groups.

## Usage

```
summarySingleByGroup(xlab="")
```

## Arguments

xlab	variable name
------	---------------

## Details

The statistical summary involves number of observations, missing values, mean, standard deviation, minimum, 25% quartile, median (= 50% quartile), 75% quartile and maximum. The function also plots a summary boxplot and histogram.

If no variable is specified as an argument 'xlab', the user can enter it using the function '[selectColumnLabel](#)'. In the specification of the variable can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

## Value

results	numeric matrix with the results
---------	---------------------------------

## Author(s)

Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

## See Also

[boxplot](#) [summarySingle](#) [statistics](#) [summaryAll](#) [summaryByGroup](#)

## Examples

```
summarySingleByGroup("(Na2O+K2O)/Al2O3")
```

---

Sylvester	<i>Sylvester (1989)</i>
-----------	-------------------------

---

**Description**

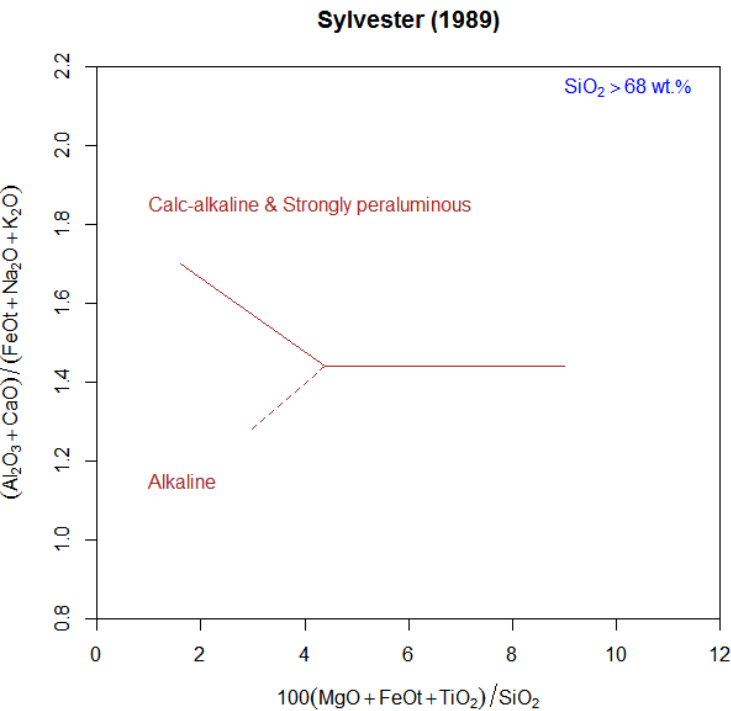
Assigns data for a binary plot  $(Al_2O_3 + CaO)/(FeOt + Na_2O + K_2O)$  vs.  $100 * (MgO + FeOt + TiO_2)/SiO_2$ , proposed by *Sylvester (1989)* to distinguish the alkaline collision-related alkaline granites into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

**Usage**

Sylvester()

**Details**

In the plot  $(Al_2O_3 + CaO)/(FeOt + Na_2O + K_2O)$  vs.  $100 * (MgO + FeOt + TiO_2)/SiO_2$  of *Sylvester (1989)* can be distinguished 'Alkaline' collision-related granites, from 'Calc-alkaline & Strongly peraluminous' types (solid line). The strongly fractionated calc-alkaline varieties are separated by the dashed line.



Note that only samples with  $SiO_2 > 68$  wt. % are plotted.

**Value**

sheet	list with Figaro Style Sheet data
x.data	$(Al_2O_3 + CaO)/(FeOt + Na_2O + K_2O)$ [wt. %]
y.data	$100 * (MgO + FeOt + TiO_2)/SiO_2$ [wt. %]



**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Sylvester P J (1989) Post-collisional alkaline granites. J Geol 97: 261-280. doi: [10.1086/629302](https://doi.org/10.1086/629302)

**See Also**

[figaro plotDiagram](#)

**Examples**

```
#plot the diagram
plotDiagram("Sylvester", FALSE)
```

---

TAS	<i>IUGS recommended TAS (Le Bas et al. 1986)</i>
-----	--

---

**Description**

Assigns data for IUGS recommended TAS diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'

**Usage**

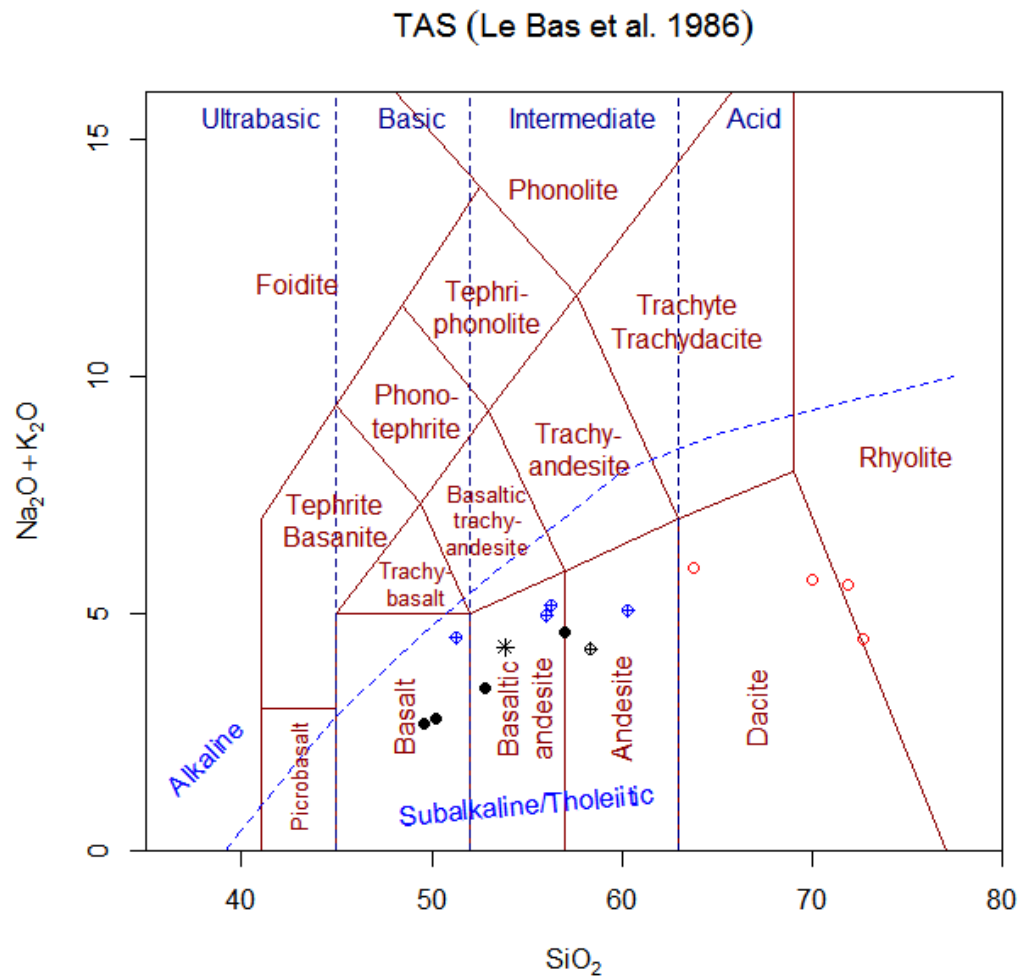
```
TAS(cutoff=95)
```

**Arguments**

cutoff	numeric; the minimal sum of the analysis to be considered for classification
--------	--

**Details**

TAS diagram, as proposed by *Le Bas et al. (1986)*, codified by *Le Maitre et al. (1989)* and slightly modified by *Le Bas (2000)*.



The diagram (in its basic form) defines following fields:

*foidite*  
*picrobasalt*  
*basalt*  
*basaltic andesite*  
*andesite*  
*dacite*  
*rhyolite*  
*trachybasalt*  
*basaltic trachyandesite*  
*trachyandesite*  
*trachyte/trachydacite*  
*tephrite/basanite*  
*phonotephrite*  
*tephriphonolite*  
*phonolite*

This primary division is further enhanced by the 'TASadd' routine (called automatically by 'classify').

Following actions are carried out:

- Analyses with  $H_2O > 2$  and  $CO_2 > 0.5$  (weight percent) are filtered out
- *Trachybasalt* is subdivided into *hawaiiite* and *potassic trachybasalt*
- *Basaltic trachyandesite* is subdivided into *mugearite* and *shoshonite*
- *Trachyandesite* is subdivided into *benmoreite* and *latite*
- High-Mg rocks are split into *picrite*, *komatiite*, *meimechite* and *boninite*

Note that systematics of high-Mg rocks follows revised IUGS Recommendations (*Le Bas et al., 2000; Le Maitre et al. 2002*) which differ from their 1st edition (*Le Maitre et al., 1989*). Further subdivisions recommended by *Le Maitre et al. (1989)* are not implemented in GCDkit, mainly for poorly defined CIPW version used by the Subcommittee.

### Value

x.data	SiO <sub>2</sub> data recast to anhydrous sum (matrix 'WRanh')
y.data	Na <sub>2</sub> O+K <sub>2</sub> O data recast to anhydrous sum (matrix 'WRanh')
sheet	list with Figaro Style Sheet data
results	matrix with classification results
groups	vector with classification results
grouping	set to -1

### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

- Le Bas M J, Le Maitre R W, Streckeisen A & Zanettin B (1986) A chemical classification of volcanic rocks based on the total alkali-silica diagram. *J Petrology* 27: 745-750 doi: [10.1093/petrology/27.3.745](https://doi.org/10.1093/petrology/27.3.745)
- Le Bas M J (2000) IUGS Reclassification of the High-Mg and Picritic Volcanic Rocks. *J Petrology* 41: 1467-1470 doi: [10.1093/petrology/41.10.1467](https://doi.org/10.1093/petrology/41.10.1467)
- Le Maitre R W et al (1989) *Igneous Rocks: A Classification and Glossary of Terms*, 1st edition. Cambridge University Press
- Le Maitre R W et al (2002) *A Classification and Glossary of Terms*, 1st edition. Cambridge University Press

### See Also

[classify figaro plotDiagram](#)

### Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("TAS")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("TAS", FALSE)
```

---

TASMiddlemost

*Middlemost's modification of TAS diagram*

---

## Description

Assigns data for Middlemost's modification of the TAS diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

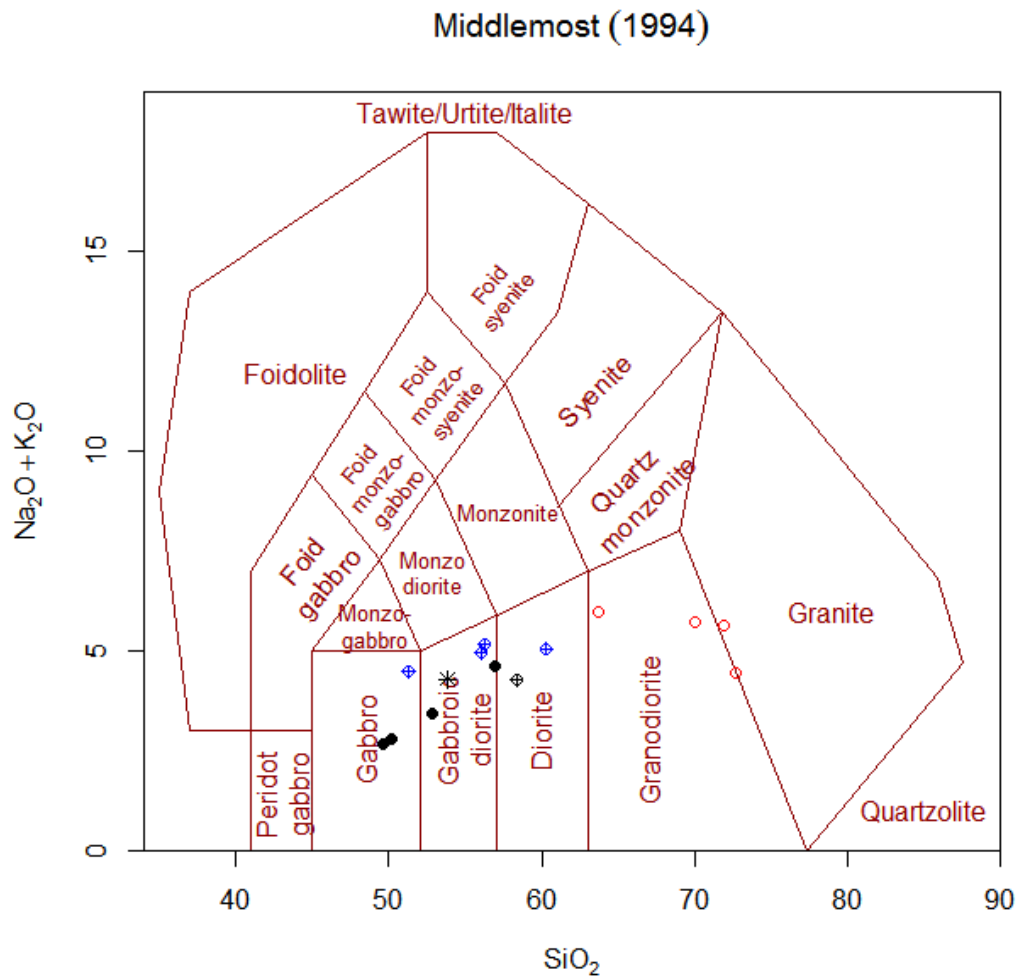
## Usage

TASMiddlemostVolc()

TASMiddlemostPlut()

## Details

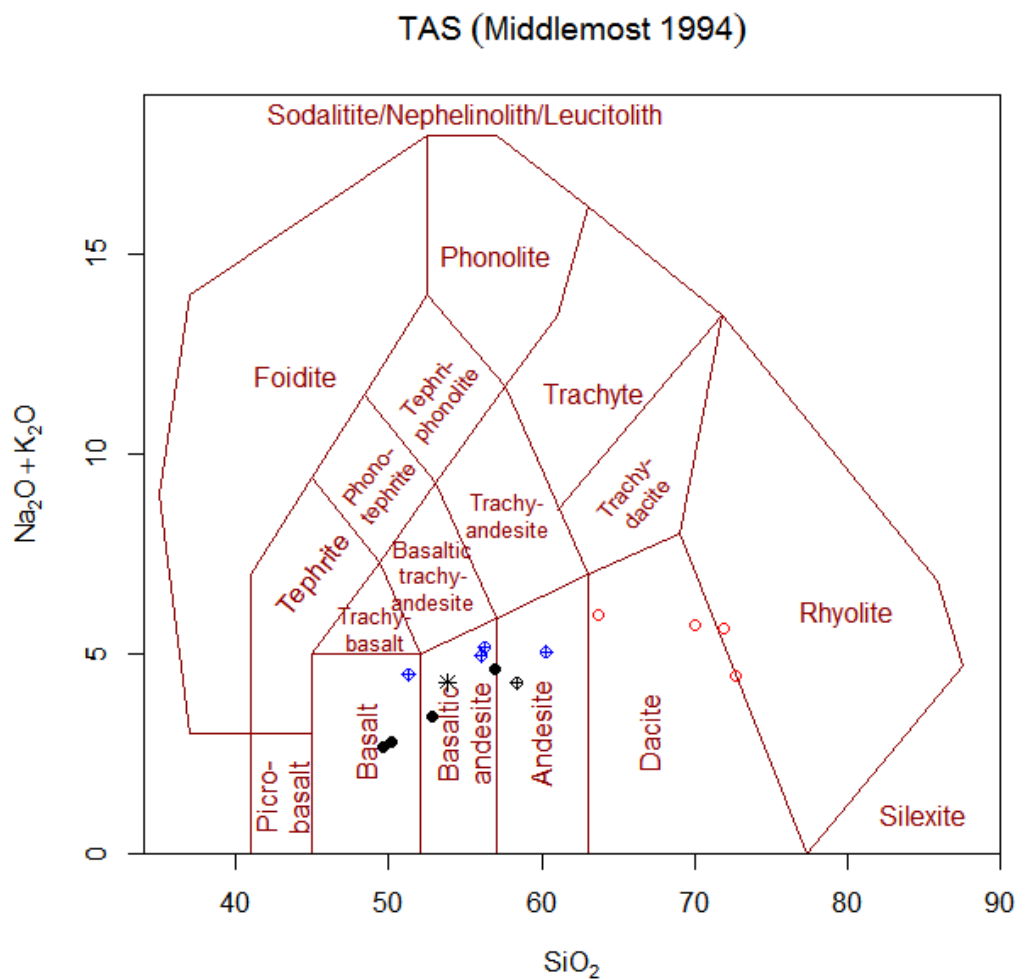
Middlemost's variation of classic IUGS-recommended TAS diagram, originally proposed by *Le Bas et al. (1986)*. Boundaries of foidite, phonolite, trachyte, trachydacite and rhyolite fields are defined, as inferred from the phase relations in the TAS system. Moreover, the trachyte + trachydacite field is split into trachyte and trachydacite fields, sillexite and sodalitite + nephelinolith + leucitolith fields are defined.



The same diagram layout is applied also to plutonic rocks as follows:

plutonic rocks	volcanic rocks
<i>Peridotgabbro</i>	<i>Picrobasalt</i>
<i>Gabbro</i>	<i>Basalt</i>
<i>Gabbroic Diorite</i>	<i>Basaltic Andesite</i>
<i>Diorite</i>	<i>Andesite</i>
<i>Granodiorite</i>	<i>Dacite</i>
<i>Granite</i>	<i>Rhyolite</i>
<i>Quartzolite</i>	<i>Silexite</i>
<i>Monzogabbro</i>	<i>Trachybasalt</i>
<i>Monzodiorite</i>	<i>basaltic Trachyandesite</i>
<i>Monzonite</i>	<i>Trachyandesite</i>
<i>Quartzmonzonite</i>	<i>Trachydacite</i>
<i>Syenite</i>	<i>Trachyte</i>
<i>Foid Gabbro</i>	<i>Tephrite</i>
<i>Foid Monzodiorite</i>	<i>Phonotephrite</i>
<i>Foid Monzosyenite</i>	<i>Tephriphonolite</i>
<i>Foid Syenite</i>	<i>Phonolite</i>

*Foidolite*                      *Foidite*  
*Tawite/Urtite/Italite*      *sodalite/nephelinolith/leucitolith*



### Value

sheet                      list with Figaro Style Sheet data  
x.data                      SiO<sub>2</sub> weight percent  
y.data                      Na<sub>2</sub>O+K<sub>2</sub>O weight percent

### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>

### References

Le Bas M J, Le Maitre R W, Streckeisen A & Zanettin B (1986) A chemical classification of volcanic rocks based on the total alkali-silica diagram. *J Petrology* 27: 745-750

Middlemost E A K (1994) Naming materials in the magma/igneous rock system. Earth Sci Rev 37: 215-224 doi: [10.1016/0012-8252\(94\)90029-9](https://doi.org/10.1016/0012-8252(94)90029-9)

## See Also

[classify TAS Cox figaro plotDiagram](#)

## Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("TASMiddlemostVolc")
# or
classify("TASMiddlemostPlut")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("TASMiddlemostVolc", FALSE)
# or
plotDiagram("TASMiddlemostPlut", FALSE)
```

---

ternary

*Ternary plot*

---

## Description

These functions plot/add data to a ternary plot.

## Usage

```
ternary(x = NULL, y = NULL, z = NULL, samples = rownames(WR),
        new = TRUE, grid = FALSE, ticks = TRUE, ...)

triplot(aa, bb, cc, alab, blab, clab, title = "", grid.int = 0,
        tick.int = 0, label.axes = FALSE, line = FALSE,
        pch = labels[names(aa), "Symbol"],
        col = labels[names(aa), "Colour"], identify = getOption("gcd.ident"),
        new = TRUE, ...)

triplotadd(aa, bb, cc,
           pch=labels[names(aa),"Symbol"],
           col=labels[names(aa),"Colour"],
           identify = FALSE, lines = FALSE, lty = "solid")
```

## Arguments

x	character; specification of the plotting variable for the bottom left apex (formulae OK).
y	character; specification of the plotting variable for the top apex (formulae OK).
z	character; specification of the plotting variables for the bottom right apex (formulae OK).
grid	logical; should be grid plotted?

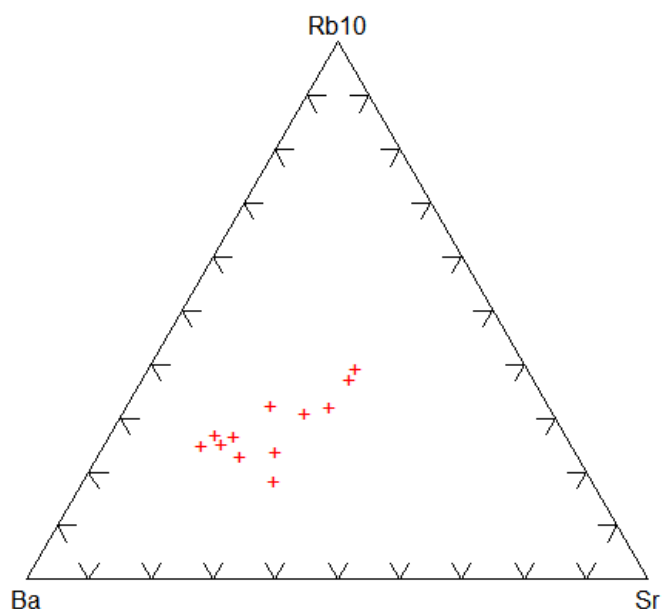
ticks	logical; should be ticks plotted?
samples	character or numeric vector; specification of the samples to be plotted.
new	logical; should be opened a new plotting window?
...	Further parameters to the functions 'ternary' and 'triplot'.
aa	a numerical vector, bottom left apex.
bb	a numerical vector, top apex.
cc	a numerical vector, bottom right apex.
alab,blab,clab	labels for the apices.
title	title for the whole diagram.
grid.int	interval of grid lines (0-1); if set to zero (default value), no grid is drawn.
tick.int	interval of ticks on axes (0-1); if set to zero (default value), no ticks are drawn.
label.axes	logical; if set to TRUE, axes are labeled by percentages of the components.
line, lines	logical; if set to TRUE, lines are drawn instead of plotting points.
lty	line type.
pch	plotting symbols.
col	plotting colours.
identify	logical; should be samples identified?

## Details

The function 'ternary' is the user interface to 'triplot'. The latter sets up the axes, labels the apices, plots the data and, if desired, enables the user to identify the data points interactively.

If 'new=TRUE', new plot window is opened.





The values for 'label.axes' are chosen according to 'tick.int' or 'grid.int'; if these are not available, labels are drawn by 10%.

'triplotadd' adds data points/lines to pre-existing ternary plot.

The variables to be plotted are selected using the function '[selectColumnLabel](#)'.

In the specification of the apices can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

The functions are Figaro-compatible.

### Value

A numeric matrix with coordinates of the data points recast to a sum of 1.

### Author(s)

Jakub Smid <[smid@prfdec.natur.cuni.cz](mailto:smid@prfdec.natur.cuni.cz)> & Vojtech Janousek, <[vojtech.janousek@geology.cz](mailto:vojtech.janousek@geology.cz)>

### See Also

[plot](#)

### Examples

```
ternary("Ba", "Rb*10", "Sr", col="red", pch="+")

ternary("SiO2/10", "2*FeO", "K2O*5", samples=1:10, grid=TRUE)

triplot(WR[, "SiO2"]/10, WR[, "Na2O"]+WR[, "K2O"], WR[, "MgO"], "SiO2", "A", "MgO",
tick.int=0.1)

triplot(WR[, "Rb"]*10, WR[, "Sr"], WR[, "Ba"], "Rb", "Sr", "Ba", tick.int=0.05,
grid.int=0.1, pch="+", col="darkblue", label.axes=TRUE)
```

---

tetrad	<i>Lanthanide tetrad effect</i>
--------	---------------------------------

---

### Description

Calculates lanthanide tetrad effect following the method of *Irber (1999)*.

### Usage

```
tetrad(method=NULL)
```

### Arguments

method                      Normalization scheme.

### Details

The method indicates which normalization scheme is to be used. It can be either 'Boynton' or 'Nakamura'. If not specified, the user is prompted to choose it interactively by the function [spider](#).

The anomalies of individual elements are calculated as follows for the first tetrad:

$$Ce/Cet = \frac{Ce_N}{La_N^{\frac{2}{3}} * Nd_N^{\frac{1}{3}}}$$

$$Pr/Prt = \frac{Pr_N}{La_N^{\frac{1}{3}} * Nd_N^{\frac{2}{3}}}$$

$$t1 = \sqrt{Ce/Cet * Pr/Prt}$$

By analogy, one can define for the third tetrad:

$$Tb/Tbt = \frac{Tb_N}{Gd_N^{\frac{2}{3}} * Ho_N^{\frac{1}{3}}}$$

$$Dy/Dyt = \frac{Dy_N}{Gd_N^{\frac{1}{3}} * Ho_N^{\frac{2}{3}}}$$

$$t3 = \sqrt{Tb/Tbt * Dy/Dyt}$$

The magnitude of the tetrad effect is then calculated as a geometric mean:

$$t3 = \sqrt{t1 * t3}$$

**Value**

Returns a matrix 'results' with the following columns:

Ce/Cet	Ce anomaly
Pr/Prt	Pr anomaly
t1	first tetrad
Tb/Tbt	Tb anomaly
Dy/Dyt	Dy anomaly
t3	third tetrad
TE1-3	degree of lanthanide tetrad effect, geometric mean of t1 and t3

**Plugin**

tetrad.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Irber W (1999) The lanthanide tetrad effect and its correlation with K/Rb, Eu/Eu\*, Sr/Eu, Y/Ho, and Zr/Hf of evolving peraluminous granite suites. *Geochim Cosmochim Acta* 63: 489-508

**See Also**

[spider](#)

**Examples**

```
tetrad("Boynton")
```

---

threeD

*3D plot*

---

**Description**

Plots a 3-D plot of three specified variables.

**Usage**

```
threeD(xlab="", ylab="", zlab="")
```

**Arguments**

xlab	Name of the data column to be used as x axis.
ylab	Name of the data column to be used as y axis.
zlab	Name of the data column to be used as z axis.

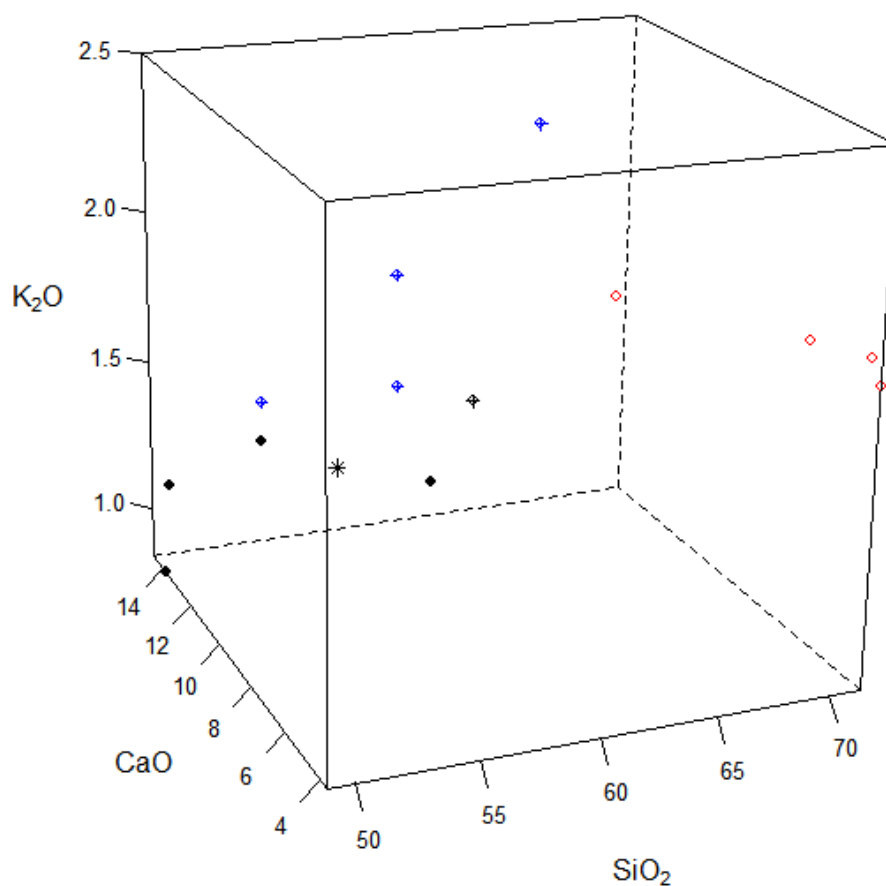
## Details

This function displays three variables in a form of 3D plot. The plot can be rotated interactively, if required so.

The samples to be plotted can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSubset](#) for details.

If no parameters 'xlab', 'ylab' and 'zlab' are given, the user is prompted to specify them.

The variables are selected using the function '[selectColumnLabel](#)'.



In the specification of the apices can be used also arithmetic expressions, see [calcCore](#) for the correct syntax.

See manual entry for '[cloud](#)' for further details.

## Value

None.

## Warning

This function IS NOT Figaro-compatible.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz> & Vojtech Erban, <vojtech.erban@geology.cz>

**Examples**

```
threeD("SiO2", "Na2O+K2O", "MgO+FeOt")
```

---

tkSelectVariable

*Tcl/Tk GUI: Select a single variable*


---

**Description**

Function to select a single variable using the Tcl/Tk-based Graphical User Interface (GUI).

**Usage**

```
tkSelectVariable(top.frame = NULL, where = colnames(WR), preselect = 2,
pack = FALSE, message = "Select a variable", background = "wheat",
variable = "x", on.leave = function() {}, row = 0, column = 0, height = 15,
width = 50, buttons = FALSE, state = "normal")
```

**Arguments**

top.frame	name of the parental frame
where	character; names of variables to be chosen from
preselect	numeric; which item is to be preselected
pack	logical; pack the frame?
message	character; textual prompt
background	colour for the frame background
variable	character; variable name with the output
on.leave	function to be invoked upon leave
row, column	coordinates within the parental frame
height, width	size of the frame
buttons	logical; should the frame have also buttons?
state	???

**Details**

The buttons are: Reset, SortUp, SortDown, OK, Cancel.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[tcltk-package](#)

---

trendTicks	<i>Petrogenetic trends</i>
------------	----------------------------

---

## Description

Adding a trend with arrow and tick marks to a pre-existing GCDkit plot.

## Usage

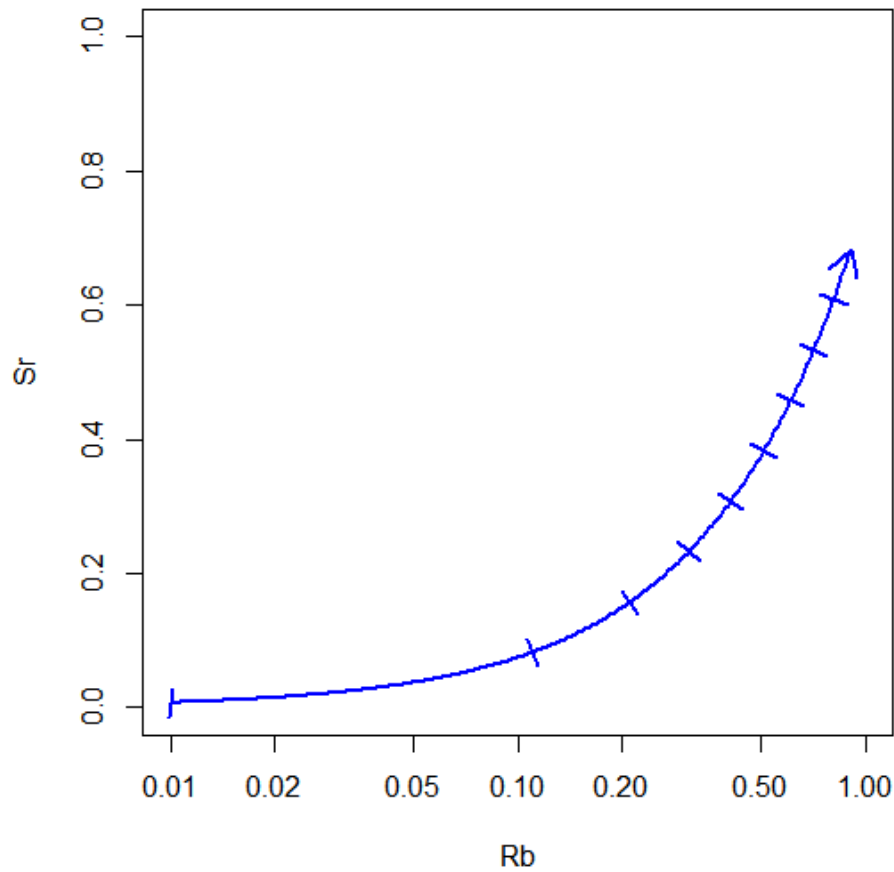
```
trendTicks(equation, x, xmin = par("usr")[1], xmax = par("usr")[2],
           text = FALSE, col = "blue", lty = "solid", lwd = 1, arrow = FALSE,
           autoscale = TRUE)
```

## Arguments

equation	character; a string with a valid formula expressed as a function of x.
x	numeric; x values where the ticks are to be drawn.
xmin	numeric; beginning of the trend.
xmax	numeric; end of the trend.
text	logical; should the tick marks be annotated by text?
col	text or numeric; plotting colour specification.
lty	text or numeric; the line type.
lwd	numeric; the line width, a positive number, defaulting to 1.
arrow	logical; should an arrow head be shown?
autoscale	logical; should the plot be autosized in order to accommodate the whole trend as well as all data points?

## Details

Using the function [curve](#), the function trendTicks adds to an existing GCDkit plot a linear or curved trend with tick marks and (optionally) arrow head. It is required that the trend is defined as a function of x. The slope of the individual tick marks is then determined using a derivation of the main function at the respective points.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**See Also**

[par](#)

**Examples**

```
plot(1,1,type="n",xlim=c(200,2000),ylim=c(10,400),xlab="Rb",ylab="Sr",log="")
equation<-"x/8"
x<-seq(2000,500,by=-100)
trendTicks(equation,x,1,min(x),max(x),col="darkred",lty="solid",lwd=2,arrow=T,text=F)

plot(1,1,type="n",xlim=c(0.01,1),ylim=c(0,1),xlab="Rb",ylab="Sr",log="x")
equation<-"6*x/8"
x<-seq(0.01,1,by=0.1)
trendTicks(equation,x,1,min(x),max(x),col=2,lwd=2,arrow=F,text=F)
```

Verma

*Major-element based discrimination plots for (ultra-)basic rocks  
(Verma et al. 2006)*

## Description

Plots data stored in 'WR' (or its subset) into discrimination plots proposed by *Verma et al. (2006)* for (ultra-) basic rocks ( $SiO_2 < 52$  wt. %).

## Usage

```
Verma(FeMiddlemost=NULL)
```

## Arguments

FeMiddlemost     logical, should be iron adjusted according to Middlemost (1989)?

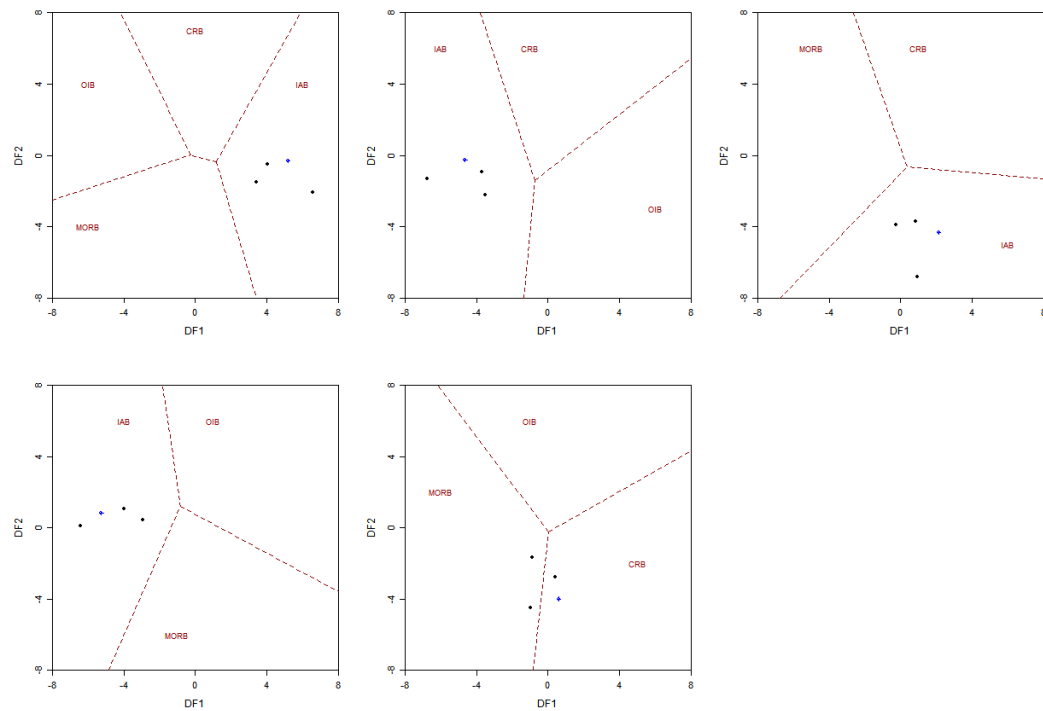
## Details

Suite of five diagrams for discrimination of geotectonic environment of ultrabasic and basic rocks ( $SiO_2 < 52$  wt. %), proposed by *Verma et al. (2006)*. It is based on log-transformed concentration ratios of major-element oxides. Note that prior to the transformation, the analyses are recast to 100% anhydrous basis. Each diagram is a plot of two discriminant functions, DF1 and DF2, respectively in x- and y-axes. Only samples with  $SiO_2 < 52$  wt. % are plotted. To work properly, the major element analysis should be complete ( $SiO_2, TiO_2, Al_2O_3, Fe_2O_3, FeO, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5$ ). Following the recommendation by *Verma et al. (2006)*, prior to the plotting can be performed an adjustment of the iron-oxidation ratio as proposed by *Middlemost (1989)* (see '[FeMiddlemost](#)').

For the  $Fe_2O_3/FeO$  ratios implemented for individual rock types (based on TAS classification), see *Verma et al. (2002)* (Fig. 1).



Geotectonic diagrams for (ultra-)basic rocks of Verma et al. (2006)



Following geotectonic settings may be deduced:

Abbreviation used	Environment
IAB	<i>island arc basic rocks</i>
CRB	<i>continental rift basic rocks</i>
OIB	<i>ocean-island basic rocks</i>
MORB	<i>mid-ocean ridge basic rocks</i>

## Value

None.

## Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

Middlemost E A K (1989) Iron oxidation ratios, norms and the classification of volcanic rocks. *Chem Geol* 77: 19-26. doi: [10.1016/0009-2541\(89\)90011-9](https://doi.org/10.1016/0009-2541(89)90011-9)

Verma S P, Torres-Alvarado I S, Sotelo-Rodriguez Z T (2002) SINCLAS: standard igneous norm and volcanic rock classification system. *Comput and Geosci* 28: 711-715. doi: [10.1016/S0098-3004\(01\)00087-5](https://doi.org/10.1016/S0098-3004(01)00087-5)

Verma S P, Guevara M, Agrawal S (2006) Discriminating four tectonic settings: Five new geochemical diagrams for basic and ultrabasic volcanic rocks based on log-ratio transformation of major-element data. *Journal of Earth System Science* 115: 485-528. doi: [10.1007/BF02702907](https://doi.org/10.1007/BF02702907)

## See Also

[FeMiddlemost Agrawal Plate](#) [Plate editing plotPlate](#) [figaro](#)

## Examples

```
#plot the diagrams
plotPlate("Verma")
```

---

Villaseca

*B-A plot (modified by Villaseca et al. 1998)*

---

## Description

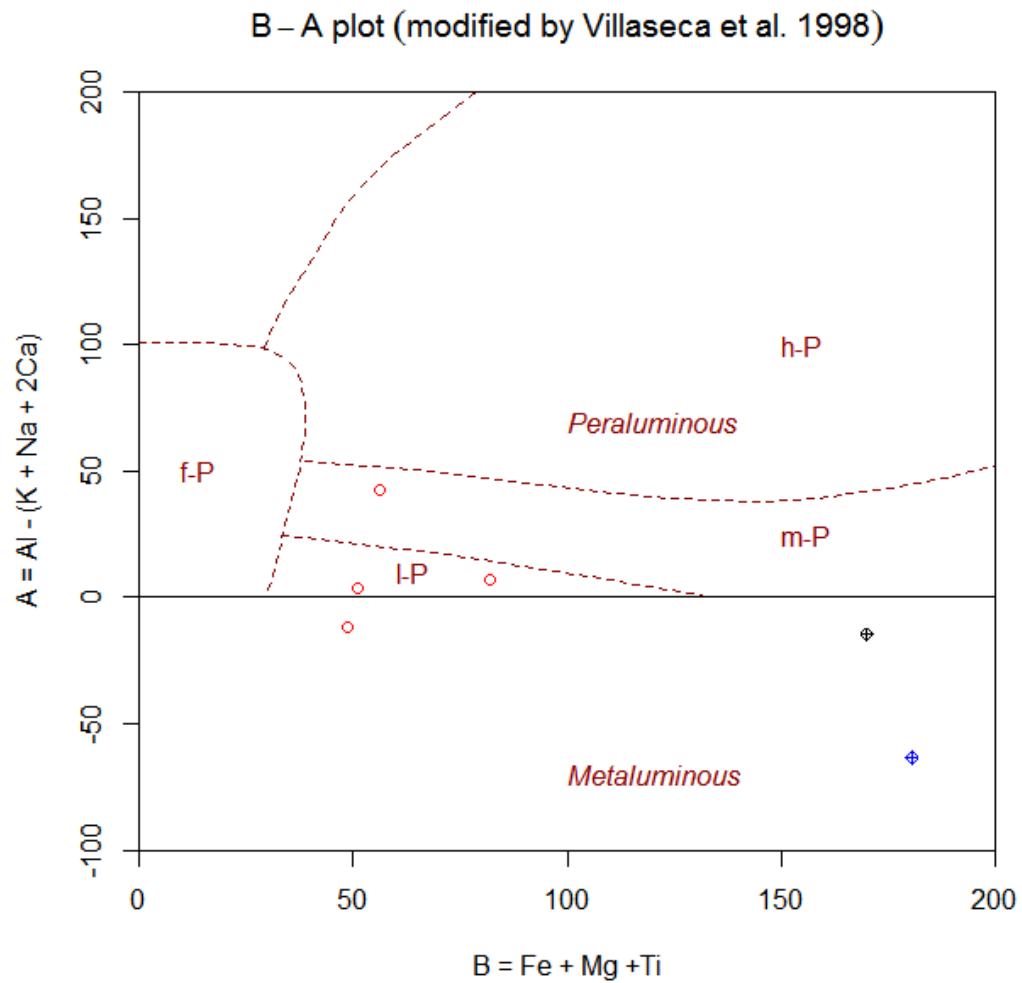
The B-A diagram as proposed by *Debon and Le Fort (1983)* with classification fields for various types of peraluminous rocks designed by *Villaseca et al. (1998)*.

## Usage

```
Villaseca()
```

## Details

Plots modified B-A diagram (designed originally by *Debon and Le Fort 1983*) with fields for various peraluminous rock types after *Villaseca et al. (1998)*. Assigns data for the B-A diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.



The following fields are defined:

l-P	low peraluminous
m-P	moderately peraluminous
h-P	highly peraluminous
f-P	felsic peraluminous
metaluminous	

Rocks with composition falling beyond defined boundaries are labeled '*undefined*' by the 'classify' function.

Parameters for the diagram are calculated by the function 'DebonCalc'. All of them are based on millications (1000 gram-atoms per 100 grams).

$$A = \text{Al} - (\text{K} + \text{Na} + 2 \text{Ca})$$

$$B = \text{Fe} + \text{Mg} + \text{Ti}$$

For details, see *Debon & Le Fort (1983)* or *(1988)*.

**Value**

sheet	list with Figaro Style Sheet data
x.data	B value. See details.
y.data	A value. See details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Debon F & Le Fort P (1983) A chemical-mineralogical classification of common plutonic rocks and associations. *Trans Roy Soc Edinb; Earth Sci* 73: 135-149
- Debon F & Le Fort P (1988) A cationic classification of common plutonic rocks and their magmatic associations: principles, method, applications. *Bull. Mineral* 111: 493-511
- Villaseca C, Barbero L, Herreros V (1998) A re-examination of the typology of peraluminous granite types in intracontinental orogenic belts. *Trans Roy Soc Edinb, Earth Sci* 89: 113-119

**See Also**

[classify figaro plotDiagram DebonCalc Debon](#)

**Examples**

```
#plot the diagram
plotDiagram("Villaseca",FALSE)
```

---

Wedge	<i>Wedge diagrams (Ague 1994)</i>
-------	-----------------------------------

---

**Description**

Implementation of Wedge diagrams after *Ague (1994)* and *Bucholz and Ague (2010)* used for judging the mobility of elements or oxides in course of various geochemically open-system processes such as alteration or partial melting.

**Usage**

```
Wedge(x = "Ti", y = NULL, protolith = NULL,
      outline = "chull", precision = 10, plotAltered = TRUE,
      xmin = 0, ymin = 0, xmax = NULL, ymax = NULL, fun = NULL)
```

**Arguments**

x	a single geochemical species presumably immobile during the given rock transformation.
y	list of elements/oxides for plotting, separated by commas.
protolith	Boolean search pattern to specify the protolith samples in the data file.
outline	method for contouring the clusters of protolith and product compositions, see Details.

precision	precision of contours drawn, if 'outline'="contour", see Details.
plotAltered	logical; should be the altered analyses plotted or just contoured?
xmin, xmax	(optional) limits for shared x axes of the individual plots.
ymin	(optional) minimum for all of the y axes of the plots.
ymax	(optional) upper limits for each of the y axes of the plots.
fun	panel function to be applied to each of the individual plots.

## Details

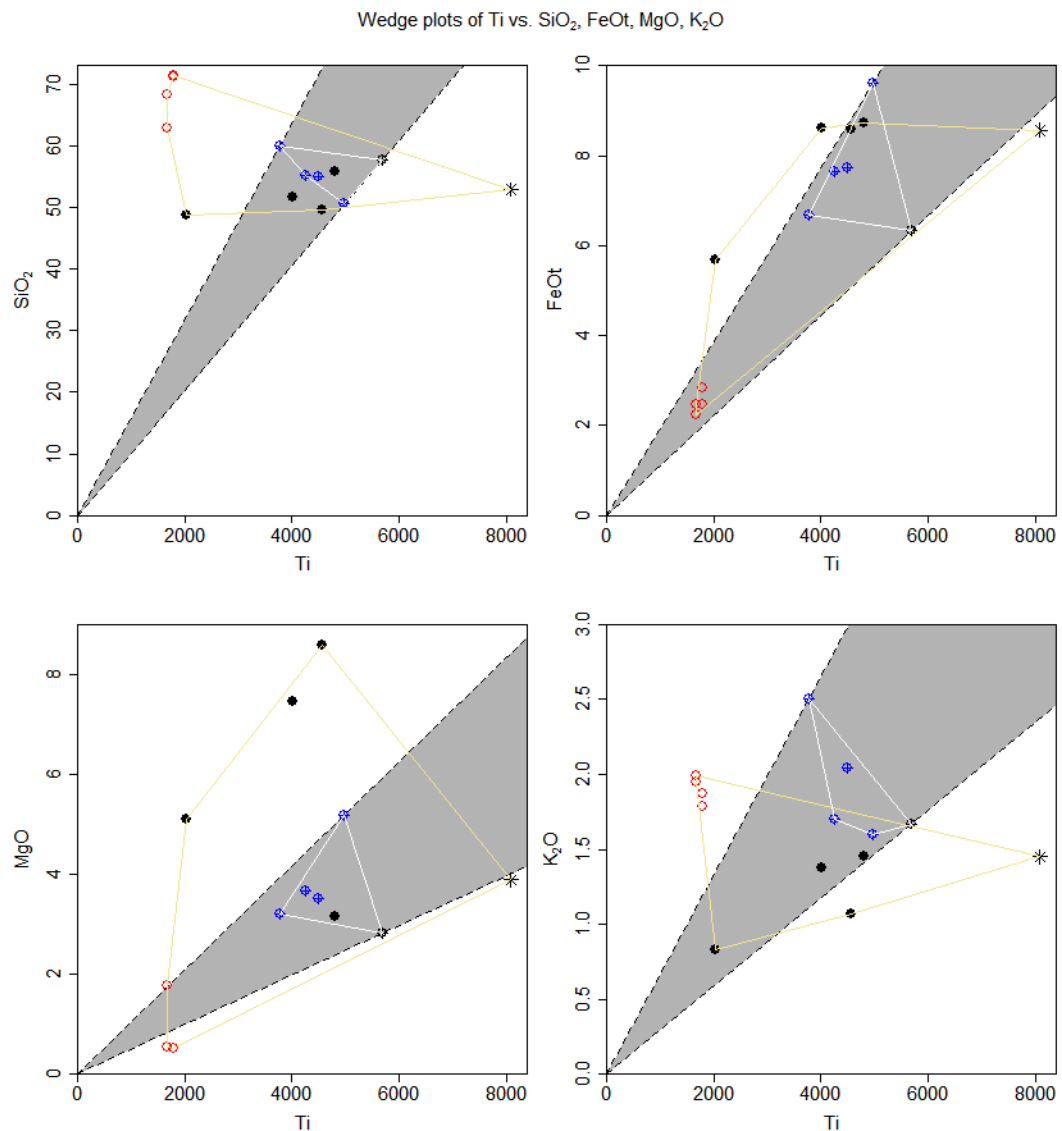
Wedge diagrams (*Ague 1994*) enable qualitative treatment of losses/gains of geochemical species (elements or oxides) during open-system geological processes, such as alteration, metamorphism or partial melting. As such they represent a viable alternative to the isocon plots (*Grant 1986, 2005*) or concentration ratio diagrams (*Ague 1994*). However, the Wedge diagrams have an advantage in that they take into account the overall variability of the whole dataset (both of the putative protolith and the altered product) and not just a selected whole-rock pair.

Wedge diagrams are simple binary plots of a potentially mobile element  $j$  versus a reference (immobile) element  $i$ . The compositionally heterogeneous protolith samples yield a cloud of points. The outer edges of this cloud define a wedge-shaped region that converges towards the origin.

As shown by *Bucholz and Ague (2010)*, the altered samples that plot above and to the left of this wedge are thought to have gained the mobile species  $j$ , whereas those falling below and to the right suffered its loss. The samples that remain in the wedge but moved upwards are thought to record residual enrichment, and those shifted downwards to have undergone a residual dilution.

The samples defining the protolith variation can be selected based on combination of three searching mechanisms (by sample name/label, range or a Boolean condition) - see [selectSamples](#) for details.

Implemented are two methods for outlining the clusters of the protolith and altered compositions (as specified by the argument 'outline'), convex hull (*chull*) and contour (*contour*). For the latter, the shape of the contours drawn can be controlled using the parameter (*precision*). The higher it is, the smoother contours result. See [contourGroups](#) and [chullGroups](#) for further details.



Optionally, the individual data points for the altered samples may be replaced by contours portraying their density, if *plotAltered* = *FALSE*.

Parameters *xmin*, *xmax*, *ymin* and *ymax* are passed to the function `plotWithLimits` used for the actual data plotting.

Optionally, panel function specified by *fun* with two arguments, *xlab* and *ylab*, is applied to each of the plots.

## Value

Returns a matrix 'results' of slopes of tie-lines from individual protolith samples to the origin (with a component for each diagram, i.e. for each species evaluated). Lines of maximum and minimum slopes are those which are plotted as dashed lines, thus defining the wedge of the protolith variation (see Details).

**Plugin**

Isocon.r

**Note**

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

- Ague J J (1994) Mass transfer during Barrovian metamorphism of pelites, south-central Connecticut; I, Evidence for changes in composition and volume. *Amer J Sci* 294: 989-1057 doi: [10.2475/ajs.294.8.989](#)
- Bucholz C E, Ague J J (2010) Fluid flow and Al transport during quartz-kyanite vein formation, Unst, Shetland Islands, Scotland. *J Metamorph Geol* 28: 19-39 doi: [10.1016/0009-2541\(67\)90004-6](#)
- Grant J A (1986) The isocon diagram - a simple solution to Gresens equation for metasomatic alteration. *Econ Geol* 81: 1976-1982 doi: [doi:10.2113/gsecongeo.81.8.1976](#)
- Grant J A (2005) Isocon analysis: a brief review of the method and applications. *Phys Chem Earth (A)* 30: 997-1004 doi: [10.1016/j.pce.2004.11.003](#)
- Gresens R L (1967) Composition-volume relationships of metasomatism. *Chem Geol* 2: 47-55 doi: [10.1016/0009-2541\(67\)90004-6](#)

**See Also**

[Ague](#), [isocon](#), [Plate](#), [Plate editing](#), [chull](#), [contour](#) [contourGroups](#) [chullGroups](#), [plotWithLimits](#)

**Examples**

```
data<-loadData("sazava.data",sep="\t")
Wedge("Ti","SiO2,FeOt,MgO,CaO,Na2O,K2O",
      protolith="Intrusion=\"Sazava\"", "chull")

# Using the default precision of 10
Wedge("Ti","Zr,Nb,Sr,Rb,Ba",protolith="Intrusion=\"Sazava\"", "contour")

Wedge("Ti","Zr,Nb,Sr,Rb,Ba",protolith="Intrusion=\"Sazava\"", "contour",precision=100)
```

Whalen

*A type granitoids (Whalen et al. 1987)*

## Description

Set of discrimination plots to distinguish A-type granitoids as defined by *Whalen et al. (1987)*.

## Usage

```
Whalen(plot.txt = getOption("gcd.plot.text"))
```

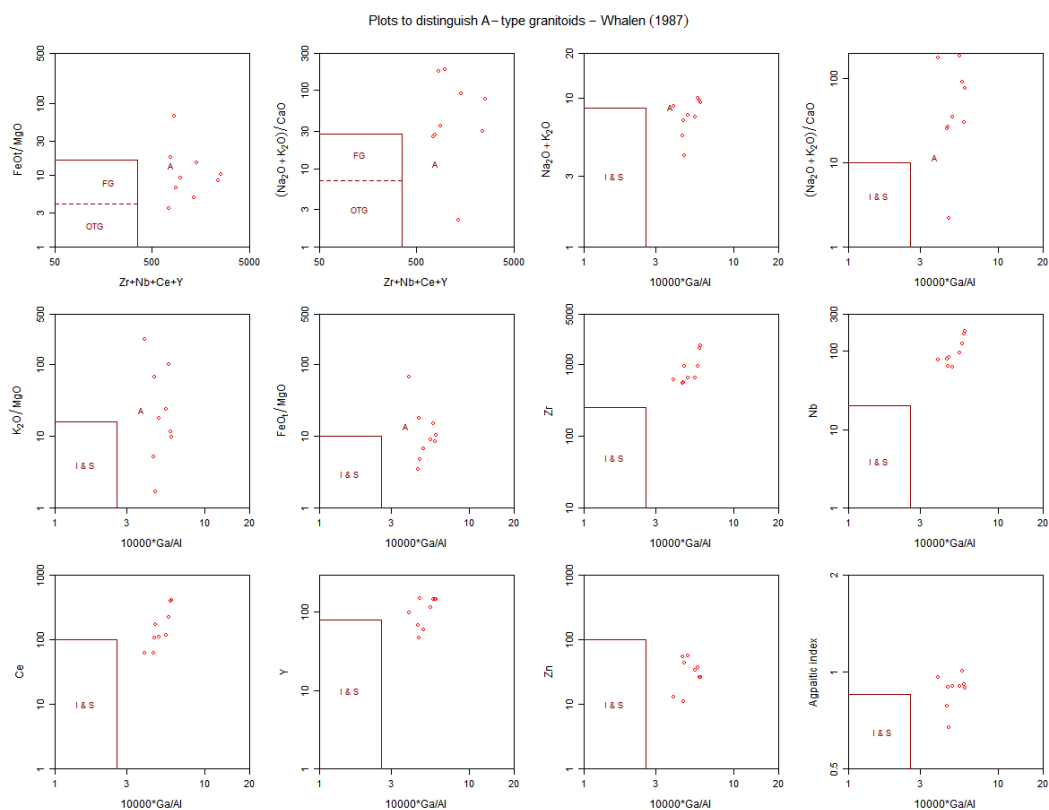
## Arguments

plot.txt            logical, annotate fields by their names?

## Details

Set of binary plots proposed by *Whalen et al. (1987)* to distinguish A-type granitoids on the one hand from ordinary/fractionated I- and S-types on the other.

In total 12 diagrams are plotted split into two pages. Apart from fields for I and S type granites ('I' & 'S'), sometimes split into ordinary ('OTG') and fractionated ('FG') domains, average composition of the A type granites (labeled 'A') are shown. See Figs 1, 2 and 5 in the original paper (*Whalen et al. 1987*) for comparison.





The following diagrams are plotted:  $Zr+Nb+Ce+Y$  vs.  $FeOt/MgO$  and  $(K_2O+Na_2O)/CaO$ ;  $10000Ga/Al$  vs.  $K_2O+Na_2O$ ,  $(K_2O+Na_2O)/CaO$ ,  $K_2O/MgO$  and  $FeOt/MgO$ ;  $10000Ga/Al$  vs.  $Zr, Nb, Ce, Y, Zn$  and Agpaitic Index.

### Value

To the matrix 'WR' are appended two columns, with Ga/Al ratios and values of the Agpaitic Index (labeled 'A.I.').

### Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

### Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Whalen J B, Currie K L, Chappell B W (1987) A-type granites: geochemical characteristics, discrimination and petrogenesis. Contrib Mineral Petrol 95: 407-419. doi: [10.1007/BF00402202](https://doi.org/10.1007/BF00402202)

### See Also

[Plate](#) [Plate editing](#) [plot](#) [Plate figaro](#)

### Examples

```
#plot the diagrams
plotPlate("Whalen")
```

---

WinFloyd1

*Nb/Y - Zr/TiO<sub>2</sub> diagram (Winchester + Floyd 1977)*


---

### Description

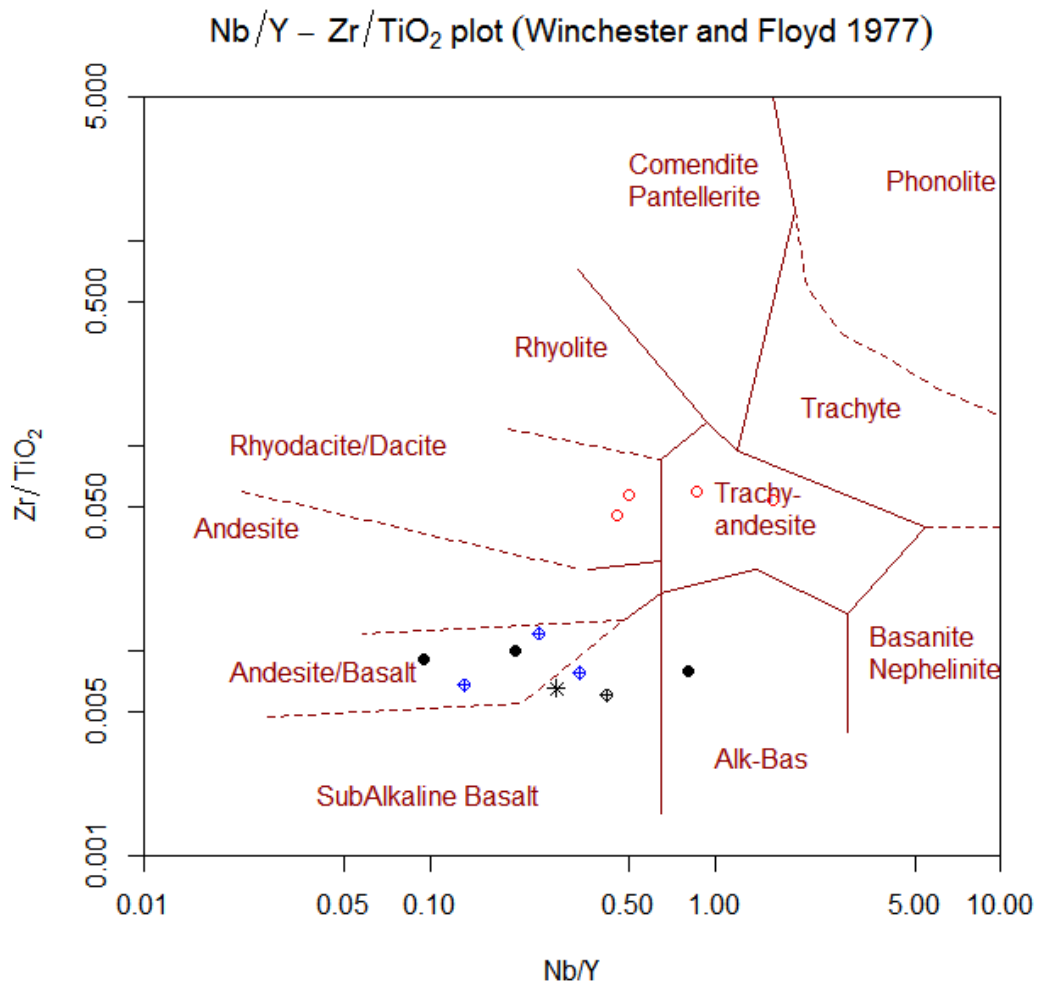
Assigns data for Nb/Y vs.  $Zr/TiO_2$  diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'.

### Usage

```
WinFloyd1()
```

## Details

Classification diagram proposed by *Winchester & Floyd (1977)*.



Using incompatible element ratios (Nb/Y vs. Zr/TiO<sub>2</sub>), following fields are defined:

*Trachyandesite*  
*Alkali basalt*  
*Basanite/Nephelinite*  
*Trachyte*  
*Phonolite*  
*Comendite/Pantellerite*  
*Rhyolite*  
*Rhyodacite/Dacite*  
*Andesite*  
*Andesite/Basalt*  
*Subalkaline basalt*

## Value

sheet

list with Figaro Style Sheet data

x.data            Nb/Y wt. % ratio  
y.data            (Zr/TiO<sub>2</sub>)\*0.0001 wt. % ratio

### Author(s)

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

### References

Winchester J A & Floyd P A (1977) Geochemical discrimination of different magma series and their differentiation products using immobile elements. Chem Geol 20: 325-343 doi: [10.1016/0009-2541\(77\)90057-2](https://doi.org/10.1016/0009-2541(77)90057-2)

### See Also

[classify figaro plotDiagram](#)

### Examples

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("WinFloyd1")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("WinFloyd1", FALSE)
```

---

WinFloyd2

Zr/TiO<sub>2</sub> - SiO<sub>2</sub> (Winchester + Floyd 1977)

---

### Description

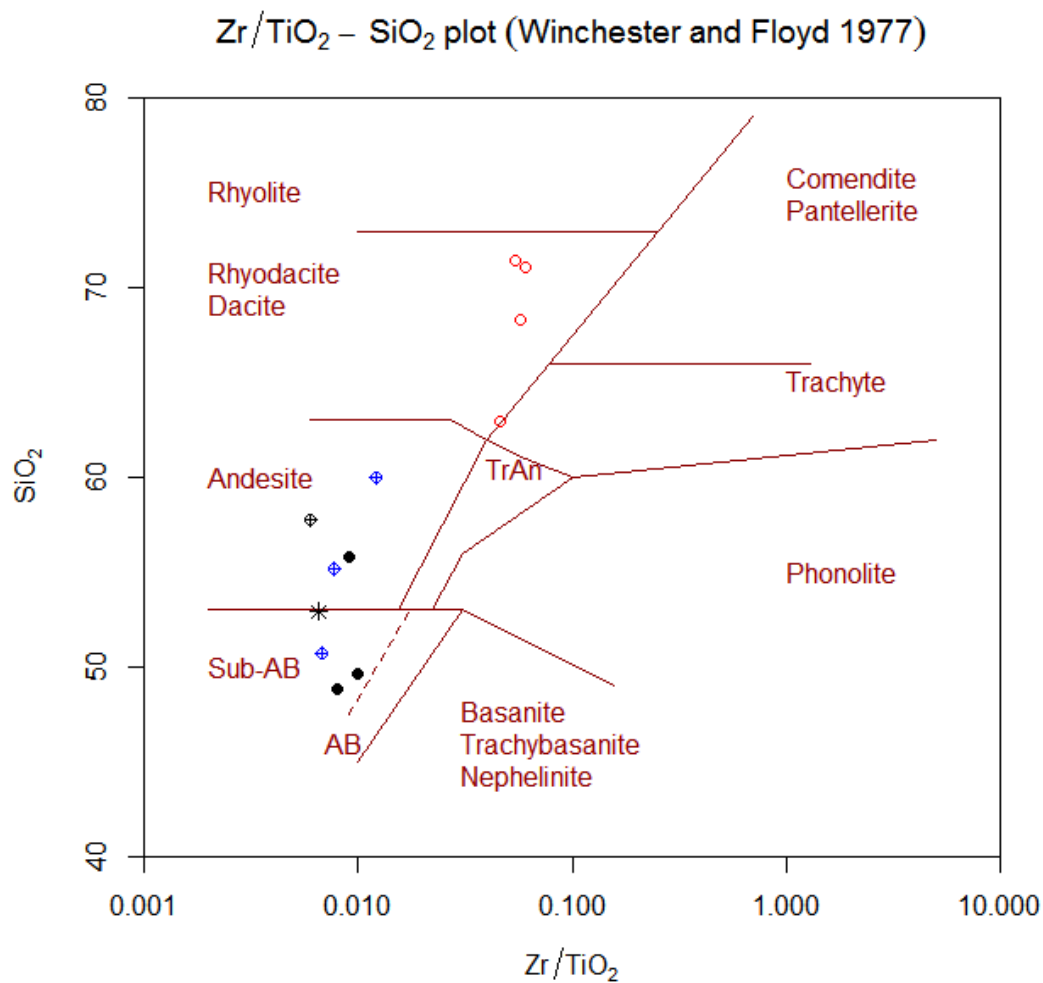
Assigns data for Zr/TiO<sub>2</sub> vs. SiO<sub>2</sub> diagram into Figaro template (list 'sheet') and appropriate values into 'x.data' and 'y.data'

### Usage

```
WinFloyd2()
```

### Details

Classification diagram proposed by *Winchester & Floyd (1977)*.



Using incompatible element ratio and silica (Zr/TiO<sub>2</sub> vs. SiO<sub>2</sub>), following fields are defined:

*Trachyandesite*  
*Basanite/Trachyte/Nephelinite*  
*Phonolite*  
*Trachyte*  
*Comendite/Pantellerite*  
*Rhyolite/Dacite*  
*Rhyodacite/Dacite*  
*Andesite*  
*Subalkaline basalt*  
*Alkaline basalt*

#### Value

sheet	list with Figaro Style Sheet data
y.data	SiO <sub>2</sub> wt. %
x.data	(Zr/TiO <sub>2</sub> )*0.001 wt. % ratio

**Author(s)**

Vojtech Erban, <vojtech.erban@geology.cz>  
& Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Winchester J A & Floyd P A (1977) Geochemical discrimination of different magma series and their differentiation products using immobile elements. *Chem Geol* 20: 325-343 doi: [10.1016/0009-2541\(77\)90057-2](https://doi.org/10.1016/0009-2541(77)90057-2)

**See Also**

[classify figaro plotDiagram](#)

**Examples**

```
#Within GCDkit, the plot is called using following auxiliary functions:
#To Classify data stored in WR (Groups by diagram)
classify("WinFloyd2")

#To plot data stored in WR or its subset (menu Classification)
plotDiagram("WinFloyd2", FALSE)
```

---

Wood	<i>Wood (1980)</i>
------	--------------------

---

**Description**

Assigns Figaro templates to Wood's geotectonic diagrams for basaltoids into the list 'plate' and appropriate values into the list 'plate.data' for subsequent plotting.

**Usage**

```
Wood(ident = getOption("gcd.ident"),
      plot.txt = getOption("gcd.plot.text"))
```

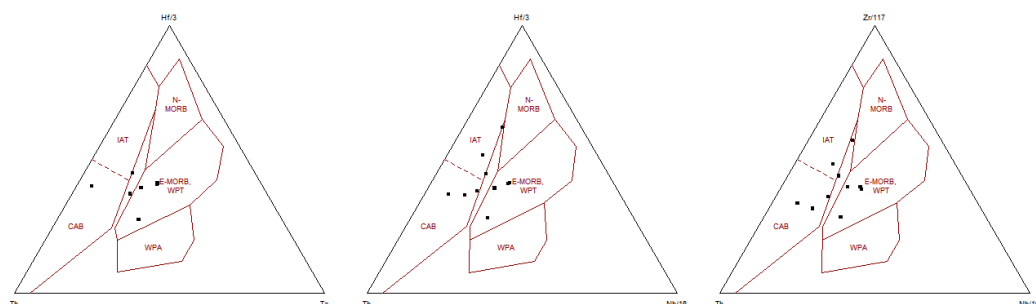
**Arguments**

ident	logical, identify?
plot.txt	logical, annotate fields by their names?

**Details**

A series of triangular diagrams with apices Th-Hf/3-Ta, Th-Hf/3-Ta and Th-Zr/117-Nb/16, proposed by *Wood (1980)*.

Triangular diagrams of the Th-Hf-Ta-Zr-Nb system, Wood 1980



Following fields are defined:

IAT	<i>Island-arc Tholeiites</i>
CAB	<i>Calc-alkaline Basalts</i>
N-MORB	<i>N-type Mid-ocean Ridge Basalts</i>
E-MORB	<i>E-type Mid-ocean Ridge Basalts</i>
WPT	<i>Within-plate Tholeiites</i>
WPA	<i>Alkaline Within-plate Basalts</i>

## Value

sheet                      list with Figaro Style Sheet data  
 x.data, y.data    Th, Hf/3 and Ta in ppm recalculated into two dimensions

## Note

This function uses the plates concept. The individual plots can be selected and their properties/appearance changed as if they were stand alone Figaro-compatible plots. See [Plate](#), [Plate editing](#) and [figaro](#) for details.

## Author(s)

Vojtech Janousek, <vojtech.janousek@geology.cz>

## References

- Pearce J A (1996) A User's Guide to Basalt Discrimination Diagrams. In Wyman D A (ed) Trace Element Geochemistry of Volcanic Rocks: Applications for Massive Sulphide Exploration. Geological Association of Canada, Short Course Notes 12, pp 79-113
- Wood D A (1980) The application of a Th-Hf-Ta diagram to problems of tectonomagmatic classification and to establishing the nature of crustal contamination of basaltic lavas of the British Tertiary volcanic province. Earth Planet Sci Lett 50: 11-30 doi:[10.1016/0012-821X\(80\)90116-8](https://doi.org/10.1016/0012-821X(80)90116-8)

## See Also

[Plate](#), [Plate editing](#), [plotPlate](#), [figaro](#)

## Examples

```
#plot the diagrams
plotPlate("Wood")
```

---

zrSaturation	<i>Zircon saturation (Watson + Harrison 1983)</i>
--------------	---

---

## Description

Calculates zircon saturation temperatures for the observed major-element data and Zr concentrations. Returns also Zr saturation levels for the given major-element compositions and assumed magma temperature.

## Usage

```
zrSaturation(cats = milli, T = 0, Zr = filterOut(WR, "Zr", 1))
```

## Arguments

cats	numeric matrix; whole-rock data recast to millications
T	assumed temperature of the magma in C
Zr	numeric vector with Zr concentrations

## Details

Calculates Zr saturation concentration at a given temperature. Given 'T' is the estimated absolute temperature (K) of the magma and 'M' is a cationic ratio:

$$M = 100 \frac{Na + K + 2Ca}{Al.Si}$$

it can be written *Watson & Harrison 1983*):

$$D_{Zr} = e^{(-3.8 - 0.85(M-1) + \frac{12900}{T})}$$

The Zr saturation level is then given by:

$$Zr.sat = \frac{497644}{D_{Zr}}$$

On the other hand, the saturation temperature can be obtained from the observed Zr concentration and magma composition (assuming no zircon inheritance)

$$D_{Zr} = \frac{497644}{Zr}$$

$$TZr.sat.C = \frac{12900}{\ln(D_{Zr}) + 3.8 + 0.85(M-1)} - 273.15$$

**Value**

Returns a matrix 'results' with the following columns:

M	cationic ratios
Zr	observed Zr concentrations
Zr.sat	saturation levels of Zr for assumed temperature
TZr.sat.C	zircon saturation temperatures in C

**Plugin**

Saturation.r

**Author(s)**

Vojtech Janousek, <vojtech.janousek@geology.cz>

**References**

Watson E B & Harrison M (1983) Zircon saturation revisited: temperature and composition effects in a variety of crustal magma types. *Earth Planet Sci Lett* 64: 295-304 doi: [10.1016/0012-821X\(83\)90211-X](https://doi.org/10.1016/0012-821X(83)90211-X)