Package: georefdatar (via r-universe)

October 11, 2024

Title Geosciences Reference Datasets

Version 0.6.5.9005

Description Reference datasets commonly used in the geosciences. These include standard atomic weights of the elements, a periodic table, a list of minerals including their abbreviations and chemistry, geochemical data of reservoirs (primitive mantle, continental crust, mantle, basalts, etc.), decay constants and isotopic ratios frequently used in geochronology, color codes of the chronostratigraphic chart. In addition, the package provides functions for basic queries of atomic weights, the list of minerals, and chronostratigraphic chart colors. All datasets are fully referenced, and a BibTeX file containing the references is included.

License MIT + file LICENSE

URL https://github.com/abuseki/georefdatar

BugReports https://github.com/abuseki/georefdatar/issues

Encoding UTF-8

Roxygen list(markdown = TRUE)

RoxygenNote 7.3.1

Depends R (>= 2.10)

LazyData true

Imports Rdpack

RdMacros Rdpack

Suggests spelling, testthat (>= 3.0.0), readxl, dplyr, tidyr

Config/testthat/edition 3

Language en-US

Repository https://abuseki.r-universe.dev

RemoteUrl https://github.com/abuseki/georefdatar

RemoteRef HEAD

RemoteSha 2439383944295cdf32f72862c9dfb1f4a5d36094

Contents

`ALL_MORB__GALE__2013` *ALL_MORB*

Description

A data set containing the composition of mid-ocean ridge basalts (MORB) as given and defined by Gale et al. (2013)

Usage

```
ALL_MORB__GALE__2013
```

Format

A data frame with 1 row and 70 element concentrations:
MgO, SiO2, FeO, CaO, Na2O, Al2O3, TiO2, K2O, P2O5, MnO, Ba, Be, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Ga, Gd, Hf, Ho, La, Li, Lu, Mo, Nb, Nd, Ni, Pb, Pr, Rb, Sc, Sm, Sn, Sr, Ta, Tb, Th, Tl, U, V, W, Y, Yb, Zn, Zr, Sr87_Sr86, Nd143_Nd144, Pb206_Pb204, Pb207_Pb204, Pb208_Pb204, Hf176_Hf177, Sm_Nd, Zr_Hf, Ba_Th, Nb_U, Ce_Pb, Nb_Ta, Th_U, Ba_Rb, Ba_Cs, Rb_Cs, K_U, Y_Ho, Zr_Sm, Hf_Nd, Y_Yb

Details

This data contains he composition of MORB defined as *ALL MORB* which is "the total composition of the crust apart from back-arc basins".

References

Gale A, Dalton CA, Langmuir CH, Su Y, Schilling J (2013). "The mean composition of ocean ridge basalts." *Geochemistry, Geophysics, Geosystems*, **14**(3), 489–518. doi:10.1029/2012GC004334.

`aw` *Get the atomic weight of an element*

Description

Get the atomic weight of an element

Usage

```
aw(sym, dataSource = "IUPAC")
```

Arguments

`sym`	symbol of the element as a string
`dataSource`	the data source for the atomic weight, either `IUPAC` (default) or `PubChem`. This is case insensitive ("IUPAC" is the same as e.g. "IuPaC")

Value

Atomic weight of element with the given symbol

See Also

IUPAC_StdAW for the table of standard atomic weights by IUPAC and pte for a full periodic table of elements

Examples

```
aw('H')
aw('H')*2+aw('O')

aw('Li', dataSource= "pubchem")
```

BAB__GALE__2013 *BAB*

Description

A data set containing the composition of back-arc basin basalts as given by Gale et al. (2013)

Usage

```
BAB__GALE__2013
```

Format

A data frame with 1 row and 70 element concentrations:
MgO, SiO2, FeO, CaO, Na2O, Al2O3, TiO2, K2O, P2O5, MnO, Ba, Be, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Ga, Gd, Hf, Ho, La, Li, Lu, Mo, Nb, Nd, Ni, Pb, Pr, Rb, Sc, Sm, Sn, Sr, Ta, Tb, Th, Tl, U, V, W, Y, Yb, Zn, Zr, Sr87_Sr86, Nd143_Nd144, Pb206_Pb204, Pb207_Pb204, Pb208_Pb204, Hf176_Hf177, Sm_Nd, Zr_Hf, Ba_Th, Nb_U, Ce_Pb, Nb_Ta, Th_U, Ba_Rb, Ba_Cs, Rb_Cs, K_U, Y_Ho, Zr_Sm, Hf_Nd, Y_Yb

In the article the concentrations ...

References

Gale A, Dalton CA, Langmuir CH, Su Y, Schilling J (2013). "The mean composition of ocean ridge basalts." *Geochemistry, Geophysics, Geosystems*, **14**(3), 489–518. doi:10.1029/2012GC004334.

CC_Bulk__Rudnick_Gao__2014
Bulk Continental Crust

Description

A data set containing the composition of the *Bulk Continental Crust* as recommended by Rudnick and Gao (2014). This article is a revision of the previous work Rudnick and Gao (2003).

Usage

```
CC_Bulk__Rudnick_Gao__2014
```

Format

A data frame with 1 row and 84 element concentrations. These elements are:
SiO2, TiO2, Al2O3, FeO*, MnO, MgO, CaO, Na2O, K2O, P2O5, Li, Be, B, N, F, S, Cl, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ru, Pd, Ag, Cd, In, Sn, Sb, I, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, U, Nb/Ta, Zr/Hf, Th/U, K/U, La/Yb, Rb/Cs, K/Rb, La/Ta, Mg#, Eu/Eu*, Heat production

Details

In this work the concentrations of the major elements (as oxides) are given in wt%. The concentrations of all other elements are given in ug/g (ppm) or ng/g (ppb). For the sake of unity the values given in ppb where converted to ppm using `ppm= ppb/1000`.
The listed values for the major elements (oxides) are in wt% and all other elements are given in ppm. Heat production is given in mW/m^3.

References

Rudnick RL, Gao S (2014). "Composition of the Continental Crust." In Holland HD, Turekian KK (eds.), *Treatise on Geochemistry*, Second Edition edition, 1–51. Elsevier, Oxford. ISBN 978-0-08-098300-4, doi:10.1016/B9780080959757.003016. Rudnick RL, Gao S (2003). "Composition of the Continental Crust." In *Treatise on Geochemistry*, 1–64. Elsevier. doi:10.1016/b0080437516/030164.

`CC_Bulk__Taylor_McLennan__1995`
Bulk Continental Crust

Description

A data set containing the composition of the *Bulk Continental Crust* as given by Taylor and McLennan (1995)

Usage

```
CC_Bulk__Taylor_McLennan__1995
```

Format

A data frame with 1 row and 63 element concentrations in ppm. These elements are:
Li, Be, B, Na, Mg, Al, Si, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, In, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Au, Tl, Pb, Bi, Th, U

Details

In this work the concentrations of most elements are given in ppm and some concentrations are given in wt% or ppb.
For the sake of unity the values given in either wt% or ppb where converted to ppm. So all listed values are in ppm.
This conversion was done using:

- `ppm= wt% * 10000`
- `ppm= ppb / 1000`

References

Taylor SR, McLennan SM (1995). "The geochemical evolution of the continental crust." *Reviews of geophysics*, **33**(2), 241–265. doi:10.1029/95rg00262.

`CC_Lower__Rudnick_Gao__2014`
Lower Continental Crust

Description

A data set containing the composition of the *Lower Continental Crust* as recommended by Rudnick and Gao (2014). This article is a revision of the previous work Rudnick and Gao (2003).

Usage

```
CC_Lower__Rudnick_Gao__2014
```

Format

A data frame with 1 row and 84 element concentrations. These elements are:
SiO2, TiO2, Al2O3, FeO*, MnO, MgO, CaO, Na2O, K2O, P2O5, Li, Be, B, N, F, S, Cl, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ru, Pd, Ag, Cd, In, Sn, Sb, I, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, U, Nb/Ta, Zr/Hf, Th/U, K/U, La/Yb, Rb/Cs, K/Rb, La/Ta, Mg#, Eu/Eu*, Heat production

Details

In this work the concentrations of the major elements (as oxides) are given in wt%. The concentrations of all other elements are given in ug/g (ppm) or ng/g (ppb). For the sake of unity the values given in ppb where converted to ppm using `ppm= ppb/1000`.
The listed values for the major elements (oxides) are in wt% and all other elements are given in ppm. Heat production is given in mW/m^3.

References

Rudnick RL, Gao S (2014). "Composition of the Continental Crust." In Holland HD, Turekian KK (eds.), *Treatise on Geochemistry*, Second Edition edition, 1–51. Elsevier, Oxford. ISBN 978-0-08-098300-4, doi:10.1016/B9780080959757.003016. Rudnick RL, Gao S (2003). "Composition of the Continental Crust." In *Treatise on Geochemistry*, 1–64. Elsevier. doi:10.1016/b0080437516/030164.

`CC_Lower__Taylor_McLennan__1995`

Lower Continental Crust

Description

A data set containing the composition of the *Lower Continental Crust* as given by Taylor and McLennan (1995)

Usage

```
CC_Lower__Taylor_McLennan__1995
```

Format

A data frame with 1 row and 63 element concentrations in ppm. These elements are:
Li, Be, B, Na, Mg, Al, Si, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, In, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Au, Tl, Pb, Bi, Th, U

Details

In this work the concentrations of most elements are given in ppm and some concentrations are given in wt% or ppb.
For the sake of unity the values given in either wt% or ppb where converted to ppm. So all listed values are in ppm.
This conversion was done using:

- `ppm= wt% * 10000`
- `ppm= ppb / 1000`

References

Taylor SR, McLennan SM (1995). "The geochemical evolution of the continental crust." *Reviews of geophysics*, **33**(2), 241–265. doi:10.1029/95rg00262.

`CC_Middle__Rudnick_Gao__2014`

Middle Continental Crust

Description

A data set containing the composition of the *Middle Continental Crust* as recommended by Rudnick and Gao (2014). This article is a revision of the previous work Rudnick and Gao (2003).

Usage

```
CC_Middle__Rudnick_Gao__2014
```

Format

A data frame with 1 row and 76 element concentrations. These elements are:
SiO2, TiO2, Al2O3, FeO*, MnO, MgO, CaO, Na2O, K2O, P2O5, Li, Be, B, F, S, Cl, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Pt, Au, Hg, Tl, Pb, Bi, Th, U, Nb/Ta, Zr/Hf, Th/U, K/U, La/Yb, Rb/Cs, K/Rb, La/Ta, Mg#, Eu/Eu*, Heat production

Details

In this work the concentrations of the major elements (as oxides) are given in wt%. The concentrations of all other elements are given in ug/g (ppm) or ng/g (ppb). For the sake of unity the values given in ppb where converted to ppm using `ppm= ppb/1000`.
The listed values for the major elements (oxides) are in wt% and all other elements are given in ppm. Heat production is given in mW/m^3.

References

Rudnick RL, Gao S (2014). "Composition of the Continental Crust." In Holland HD, Turekian KK (eds.), *Treatise on Geochemistry*, Second Edition edition, 1–51. Elsevier, Oxford. ISBN 978-0-08-098300-4, doi:10.1016/B9780080959757.003016. Rudnick RL, Gao S (2003). "Composition of the Continental Crust." In *Treatise on Geochemistry*, 1–64. Elsevier. doi:10.1016/b0080437516/030164.

`CC_Upper__Rudnick_Gao__2014`

Upper Continental Crust

Description

A data set containing the composition of the *Upper Continental Crust* as recommended by Rudnick and Gao (2014). This article is a revision of the previous work Rudnick and Gao (2003).

Usage

```
CC_Upper__Rudnick_Gao__2014
```

Format

A data frame with 1 row and 84 element concentrations. These elements are:
SiO2, TiO2, Al2O3, FeO*, MnO, MgO, CaO, Na2O, K2O, P2O5, Li, Be, B, N, F, S, Cl, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ru, Pd, Ag, Cd, In, Sn, Sb, I, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, U, Nb/Ta, Zr/Hf, Th/U, K/U, La/Yb, Rb/Cs, K/Rb, La/Ta, Mg#, Eu/Eu*, Heat production

Details

In this work the concentrations of the major elements (as oxides) are given in wt%. The concentrations of all other elements are given in ug/g (ppm) or ng/g (ppb). For the sake of unity the values given in ppb where converted to ppm using `ppm= ppb/1000`.
The listed values for the major elements (oxides) are in wt% and all other elements are given in ppm. Heat production is given in mW/m^3.

References

Rudnick RL, Gao S (2014). "Composition of the Continental Crust." In Holland HD, Turekian KK (eds.), *Treatise on Geochemistry*, Second Edition edition, 1–51. Elsevier, Oxford. ISBN 978-0-08-098300-4, doi:10.1016/B9780080959757.003016.

Rudnick RL, Gao S (2003). "Composition of the Continental Crust." In *Treatise on Geochemistry*, 1–64. Elsevier. doi:10.1016/b0080437516/030164.

`CC_Upper__Taylor_McLennan__1995`
Upper Continental Crust

Description

A data set containing the composition of the *Upper Continental Crust* as given by Taylor and McLennan (1995)

Usage

```
CC_Upper__Taylor_McLennan__1995
```

Format

A data frame with 1 row and 64 element concentrations in ppm. These elements are:
Li, Be, B, Na, Mg, Al, Si, P, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, In, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Au, Tl, Pb, Bi, Th, U

Details

In this work the concentrations of most elements are given in ppm and some concentrations are given in wt% or ppb.
For the sake of unity the values given in either wt% or ppb where converted to ppm. So all listed values are in ppm.
This conversion was done using:

- `ppm= wt% * 10000`
- `ppm= ppb / 1000`

References

Taylor SR, McLennan SM (1995). "The geochemical evolution of the continental crust." *Reviews of geophysics*, **33**(2), 241–265. doi:10.1029/95rg00262.

`CI__McDonough_Sun__1995`

Chondrite

Description

A data set containing the composition of the *CI* chondrite as given by McDonough and Sun (1995)

Usage

```
CI__McDonough_Sun__1995
```

Format

A data frame with 1 row and 76 element concentrations in ppm:
Li, Be, B, C, N, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, U

Details

In the original work the concentrations of most of the major elements are given in wt% and the concentrations of Nb and following are given in ppb.
For the sake of clarity these values where converted to ppm. So all values given here are in ppm.
This conversion was done using:

- `ppm= wt% * 10000`
- `ppm= ppb / 1000`

References

McDonough WF, Sun SS (1995). "The composition of the Earth." *Chemical Geology*, **120**(3-4), 223–253. doi:10.1016/00092541(94)001404.

`decayConstants` *Decay constants*

Description

A data set containing some decay constants regular used in earth science and geochronology.

Usage

```
decayConstants
```

Format

A data frame with 6 rows and the following 5 columns:

1. `name` of the radioactive isotope – element symbol and mass number
2. `value` it's value and
3. `err` uncertainty as given by the reference. Uncertainty may be `NA` if not stated.
4. `unit` of the decay – usually per year (y), in some cases per day (d)
5. `refkey` key to reference. Also makes the entry in this table unique if there is more than one decay constant per isotope

The following decay constants are included:

- Ar37
- Ar39
- K40
- Rb87

Some of them are included more than once in this table because their values changed over time.

References

Stoenner RW, Schaeffer OA, Katcoff S (1965). "Half-lives of argon-37, argon-39, and argon-42." *Science*, **148**(3675), 1325–1328. doi:10.1126/science.148.3675.1325.

Steiger RH, Jäger E (1977). "Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology." *Earth and Planetary Science Letters*, **36**(3), 359–362. doi:10.1016/0012821x(77)900607.

Renne PR, Norman EB (2001). "Determination of the half-life of 37Ar by mass spectrometry." *Physical Review C*, **63**(4), 047302. doi:10.1103/PhysRevC.63.047302, https://link.aps.org/doi/10.1103/PhysRevC.63.047302.

Renne PR, Balco G, Ludwig KR, Mundil R, Min K (2011). "Response to the comment by W.H. Schwarz et al. on "Joint determination of 40K decay constants and 40Ar*/40K for the Fish Canyon

sanidine standard, and improved accuracy for 40Ar/39Ar geochronology" by P.R. Renne et al. (2010)." *Geochimica et Cosmochimica Acta*, **75**(17), 5097–5100. doi:10.1016/j.gca.2011.06.021.

Villa IM, De Bièvre P, Holden NE, Renne PR (2015). "IUPAC-IUGS recommendation on the half life of 87Rb." *Geochimica et Cosmochimica Acta*, **164**, 382–385. ISSN 0016-7037, doi:10.1016/j.gca.2015.05.025.

`EMORB__Sun_McDounough__1989` *E-type MORB*

Description

A data set containing the element concentrations in the E-type MORB as given by Sun and McDonough (1989).

Usage

```
EMORB__Sun_McDounough__1989
```

Format

A data frame with 1 row and 36 element concentrations in ppm:
Cs, Tl, Rb, Ba, W, Th, U, Nb, Ta, K, La, Ce, Pb, Pr, Mo, Sr, P, Nd, F, Sm, Zr, Hf, Eu, Sn, Sb, Ti, Gd, Tb, Dy, Li, Y, Ho, Er, Tm, Yb, Lu

References

Sun SS, McDonough WF (1989). "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications*, **42**(1), 313–345. doi:10.1144/gsl.sp.1989.042.01.19.

`georefdatar_package` *Geosciences Reference Data Sets in R*

Description

The package includes reference data sets commonly used in geosciences, such as the standard atomic weights of elements, a periodic table, a mineral list, reservoir reference datasets (continental crust, mantle, basalts, etc.), decay constants, and isotopic ratios frequently used in geochronology. Additionally, the package provides functions for basic queries of atomic weights and mineral lists. All datasets have complete references, making them citable.

Author(s)

Gerald Schuberth-Hlavač

References

Cohen KM, Finney SC, Gibbard PL, Fan J (2013). "The ICS International Chronostratigraphic Chart." *Episodes*, **36**(3), 199–204. doi:10.18814/epiiugs/2013/v36i3/002, Updated, https://stratigraphy.org/.

Connelly NG, Damhus T, Hartshorn RM, Hutton AT (eds.) (2005). *Nomenclature of Inorganic Chemistry: IUPAC recommendations 2005*. Royal Society of Chemistry, Cambridge. ISBN 0854044388, https://iupac.org/what-we-do/books/redbook/.

Gale A, Dalton CA, Langmuir CH, Su Y, Schilling J (2013). "The mean composition of ocean ridge basalts." *Geochemistry, Geophysics, Geosystems*, **14**(3), 489–518. doi:10.1029/2012GC004334.

Hiess J, Condon DJ, McLean N, Noble SR (2012). "238U/235U systematics in terrestrial uranium-bearing minerals." *Science*, **335**(6076), 1610–1614. doi:10.1126/science.1215507.

Kim S, Chen J, Cheng T, Gindulyte A, He J, He S, Li Q, Shoemaker BA, Thiessen PA, Yu B, Zaslavsky L, Zhang J, Bolton EE (2020). "PubChem in 2021: new data content and improved web interfaces." *Nucleic Acids Research*, **49**(D1), D1388–D1395. doi:10.1093/nar/gkaa971.

Lafuente B, Downs RT, Yang H, Stone N (2015). "The power of databases: The RRUFF project." In Armbruster T, Danisi RM (eds.), *Highlights in Mineralogical Crystallography*, 1–30. Walter de Gruyter GmbH. doi:10.1515/9783110417104003.

Lee J, Marti K, Severinghaus JP, Kawamura K, Yoo H, Lee JB, Kim JS (2006). "A redetermination of the isotopic abundances of atmospheric Ar." *Geochimica et Cosmochimica Acta*, **70**(17), 4507–4512. ISSN 0016-7037, doi:10.1016/j.gca.2006.06.1563.

Marshall CP, Fairbridge RW (eds.) (1999). *Encyclopedia of Geochemistry*, Kluwer Academic Encyclopedia of earth sciences series. Kluwer Academic Publ., Dordrecht, Bosten, London. ISBN 9780412755002.

McDonough WF, Sun SS (1995). "The composition of the Earth." *Chemical Geology*, **120**(3-4), 223–253. doi:10.1016/00092541(94)001404.

National Center for Biotechnology Information (2022). "PubChem Periodic Table of Elements." https://pubchem.ncbi.nlm.nih.gov/periodic-table/. Retrieved February 28, 2022, https://pubchem.ncbi.nlm.nih.gov/periodic-table/.

Prohaska T, Irrgeher J, Benefield J, Böhlke JK, Chesson LA, Coplen TB, Ding T, Dunn PJH, Gröning M, Holden NE, Meijer HAJ, Moossen H, Possolo A, Takahashi Y, Vogl J, Walczyk T, Wang J, Wieser ME, Yoneda S, Zhu X, Meija J (2022). "Standard atomic weights of the elements 2021 (IUPAC Technical Report)." Technical Report 5, IUPAC. doi:10.1515/pac20190603.

Renne PR, Balco G, Ludwig KR, Mundil R, Min K (2011). "Response to the comment by W.H. Schwarz et al. on "Joint determination of 40K decay constants and 40Ar*/40K for the Fish Canyon sanidine standard, and improved accuracy for 40Ar/39Ar geochronology" by P.R. Renne et al. (2010)." *Geochimica et Cosmochimica Acta*, **75**(17), 5097–5100. doi:10.1016/j.gca.2011.06.021.

Renne PR, Norman EB (2001). "Determination of the half-life of 37Ar by mass spectrometry." *Physical Review C*, **63**(4), 047302. doi:10.1103/PhysRevC.63.047302, https://link.aps.org/doi/10.1103/PhysRevC.63.047302.

Rollinson HR (1993). *Using Geochemical Data: Evaluation, Presentation, Interpretation*. Longman Group UK.

Rudnick RL, Gao S (2003). "Composition of the Continental Crust." In *Treatise on Geochemistry*, 1–64. Elsevier. doi:10.1016/b0080437516/030164.

Rudnick RL, Gao S (2014). "Composition of the Continental Crust." In Holland HD, Turekian KK (eds.), *Treatise on Geochemistry*, Second Edition edition, 1–51. Elsevier, Oxford. ISBN 978-0-08-098300-4, doi:10.1016/B9780080959757.003016.

Steiger RH, Jäger E (1977). "Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology." *Earth and Planetary Science Letters*, **36**(3), 359–362. doi:10.1016/0012821x(77)900607.

Stoenner RW, Schaeffer OA, Katcoff S (1965). "Half-lives of argon-37, argon-39, and argon-42." *Science*, **148**(3675), 1325–1328. doi:10.1126/science.148.3675.1325.

Sun SS, McDonough WF (1989). "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications*, **42**(1), 313–345. doi:10.1144/gsl.sp.1989.042.01.19.

Taylor SR, McLennan SM (1995). "The geochemical evolution of the continental crust." *Reviews of geophysics*, **33**(2), 241–265. doi:10.1029/95rg00262.

Villa IM, De Bièvre P, Holden NE, Renne PR (2015). "IUPAC-IUGS recommendation on the half life of 87Rb." *Geochimica et Cosmochimica Acta*, **164**, 382–385. ISSN 0016-7037, doi:10.1016/j.gca.2015.05.025.

Vrielynck B (2022). "Colour Code according to the Commission for the Geological Map of the World (CGMW)." doi:10.14682/2022ICCCOLCODE, https://ccgm.org/.

Warr LN (2021). "IMA-CNMNC approved mineral symbols." *Mineralogical Magazine*, 1–30. doi:10.1180/mgm.2021.43.

`icsColor` *Get ICS Color for a unit name found in the International Chronostratigraphic Chart.*

Description

Retrieve the color code for a given name of an eontheme, eratheme, system, ... from the color codes of the International Chronostratigraphic Chart.

Usage

```
icsColor(name, colorModel = "RGB")
```

Arguments

name	character. The name of a unit: eontheme to stage
colorModel	character. The color model to get the color codes in – either 'RGB' (default) or 'CMYK'.

Value

list of the color code in the chosen color model

See Also

ICS_Colors for the full color code table

Examples

```
# Color codes of the Permian in RGB
icsColor("Permian")
```

ICS_Colors *The CGMW ICS color codes*

Description

A data set containing the color codes used by the International Chronostratigraphic Chart by the International Commission on Stratigraphy (ICS) (Cohen et al. 2013).

Usage

```
ICS_Colors
```

Format

A data frame with 194 rows and the following 11 columns:

standard sorting order ICS' ordering of this entry

Long List (isc:) Entries name prefixed by `ics:`

Long List (formatted) The (common) name of entry, e.g. 'Holocene'

Rank Is the entry a System, Series, Stage, ...

Cyan, Magenta, Yellow, Black Color's values in the CMYK color model

Red, Green, Blue Color's values in the RGB color model

Details

The coloring in this chart follows the Commission for the Geological Map of the World (CGMW) (Vrielynck 2022).

References

Cohen KM, Finney SC, Gibbard PL, Fan J (2013). "The ICS International Chronostratigraphic Chart." *Episodes*, **36**(3), 199–204. doi:10.18814/epiiugs/2013/v36i3/002, Updated, https://stratigraphy.org/.

Vrielynck B (2022). "Colour Code according to the Commission for the Geological Map of the World (CGMW)." doi:10.14682/2022ICCCOLCODE, https://ccgm.org/.

See Also

`icsColor()` a convenience function to get a specific color.

`isoRatios` *Isotopic rations*

Description

A data set containing some isotopic ratios regular used in earth science

Usage

```
isoRatios
```

Format

A data frame with 3 rows and the following 4 columns:

1. `name` of the isotopic ratio – twice the element symbol and mass number
2. `value` it's value and
3. `err` uncertainty as given by the reference. Uncertainty may be `NA` if not stated.
4. `refkey` key to reference. Also makes the entry in this table unique if there is more than one ratio for the isotopes

The following isotopic ratios are included:

- Ar40Ar36
- U238U235

Some of them are included more than once in this table because their values changed over time or are still under discussion.

References

Steiger RH, Jäger E (1977). "Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology." *Earth and Planetary Science Letters*, **36**(3), 359–362. doi:10.1016/0012821x(77)900607.

Lee J, Marti K, Severinghaus JP, Kawamura K, Yoo H, Lee JB, Kim JS (2006). "A redetermination of the isotopic abundances of atmospheric Ar." *Geochimica et Cosmochimica Acta*, **70**(17), 4507–4512. ISSN 0016-7037, doi:10.1016/j.gca.2006.06.1563.

Hiess J, Condon DJ, McLean N, Noble SR (2012). "238U/235U systematics in terrestrial uranium-bearing minerals." *Science*, **335**(6076), 1610–1614. doi:10.1126/science.1215507.

`IUPAC_StdAW` *IUPAC Standard atomic weights of the elements*

Description

A data set containing the standard atomic weights of the elements as recommended by the International Union of Pure and Applied Chemistry (IUPAC) and Commission on Isotopic Abundances and Atomic Weights (CIAAW).

Usage

```
IUPAC_StdAW
```

Format

A data frame with 118 rows and the following 8 columns:

Element Element's name

Symbol Element's symbol

Atomic number Element's atomic number. Elements are listed in increasing atomic number

stdAW::Value Values of standard atomic weights are given as single values with uncertainties (column stdAW::Uncertainty) or as intervals.

stdAW::Uncertainty of the Value of the standard atomic weight

abrStdAW::Value Abridged atomic weights quoted to five significant figures. Unless such precision cannot be attained due to the variability of isotopic composition in normal materials or due to the limitations of the measurement capability.

abrStdAW::± A plus-minus-value as a simplified measure of the reliability of the abridged values.

Note The collected footnotes of the table. Notes are resolved to the sentences associated with them. If there is more than one note, the notes are separated by an newline (`\n`).

Details

This is table 1 of (Prohaska et al. 2022). The (foot)notes in the table have been collected in a new column (Notes) and their abbreviations resolved into sentences.

References

(Prohaska et al. 2022)

See Also

`aw()` for a function to get the standard atomic weights of the elements found in this table by their symbols

IUPAC periodic table of elements online

CIAAW also a periodic table of elements online

CIAAW standard atomic weights online

`Lanthanides` *Rare earth elements – REE, LREE, MREE, HREE, REM, Lanthanides*

Description

List of rare earth elements and subsets thereof.

Usage

```
Lanthanides

REE

LREE

MREE

HREE

REM
```

Format

`Lanthanides`: character vector with 15 elements.

`REE`: character vector with 15 elements.

`LREE`: character vector with 4 elements.

`MREE`: character vector with 6 elements.

`HREE`: character vector with 4 elements.

`REM`: character vector with 17 elements.

Details

The "Red Book" ( ) defines the rare earth metals (REM) as Sc, Y and the lanthanides (La – Lu). In geochemistry, the term "rare earth elements" is generally limited to the lanthanides – e.g. (Rollinson 1993, 1999). Therefore, it is crucial to consider the context in which this term is used.
A distinction is made here between rare earth metals (REM) and rare earth elements (REE). The latter are the lanthanides as they are commonly used in geochemistry. Speaking in sets, the REE are a subset of the REM. And all subsets of the REE are also limited to the lanthanides.

1. **Lanthanides** La–Lu ( ).
2. **REE** Same as Lanthanides. The term rare earth elements as used in geochemistry – e.g (Rollinson 1993, 1999).
3. **LREE** Light REE, La–Nd
4. **MREE** Intermediate REE, Sm–Ho
5. **HREE** Heavy REE, Er–Lu
6. **REM** Rare earth metals. Sc, Y and the lanthanides ( )

References

Rollinson HR (1993). *Using Geochemical Data: Evaluation, Presentation, Interpretation*. Longman Group UK.

Marshall CP, Fairbridge RW (eds.) (1999). *Encyclopedia of Geochemistry*, Kluwer Academic Encyclopedia of earth sciences series. Kluwer Academic Publ., Dordrecht, Bosten, London. ISBN 9780412755002.

Connelly NG, Damhus T, Hartshorn RM, Hutton AT (eds.) (2005). *Nomenclature of Inorganic Chemistry: IUPAC recommendations 2005*. Royal Society of Chemistry, Cambridge. ISBN 0854044388, https://iupac.org/what-we-do/books/redbook/.

Examples

```
# get information from the periodic table of elements
subset(pte, Symbol %in% REE)
```

Lithophile *Goldschmidt's classification of the elements*

Description

Sets containing the elements classified after Goldschmidt.

Usage

```
Lithophile

Chalcophile

Siderophile

Atmophile
```

Format

`Lithophile`: character vector with 46 elements.

`Chalcophile`: character vector with 15 elements.

`Siderophile`: character vector with 15 elements.

`Atmophile`: character vector with 10 elements.

Details

The geochemical behavior of the elements is controlled by many factors (e.g. ionic radius, volatility, redox, ...). Therefore, the elements can be classified in several ways. A common classification scheme is that developed by *V. M. Goldschmidt*, which is based on the affinity of elements to form different types of compounds. The Elements are characterized as:

1. **lithophile** (rock-loving): elements with a strong affinity for forming oxides and silicate minerals.
2. **chalcophile** (copper-loving): elements with a strong affinity for forming sulfides.
3. **siderophile** (iron-loving): elements with a strong affinity to form metals or solid solutions in metals.
4. **atmophile** (air-loving): elements that exist either uncombined or as highly volatile compounds.

References

Marshall CP, Fairbridge RW (eds.) (1999). *Encyclopedia of Geochemistry*, Kluwer Academic Encyclopedia of earth sciences series. Kluwer Academic Publ., Dordrecht, Bosten, London. ISBN 9780412755002.

Examples

```
# List the atmophile elements
Atmophile

# Show the electron configuration of the atmophile elements
pte[pte$Symbol %in% Atmophile, c("Symbol", "ElectronConfiguration")]
```

`mins` *List of Minerals*

Description

International Mineralogical Association (IMA) Commission on New Minerals, Nomenclature and Classification (CNMNC) approved list of minerals, names and abbreviations (Warr 2021).

Usage

```
mins
```

Format

A data frame with 5744 minerals with the following columns: Symbol, Name, Formula, IMA Status.

Details

This list is based on the supplementary material of Warr (2021). Some minor harmonizations have been made in this list as some inconsistencies were found. In addition to minerals, this list also includes groups such as amphibole, biotite, pyroxene ... and their abbreviations.
The list has the following attributes:

- `Symbol`: IMA symbol/abbreviation
- `Name`: IMA name of the mineral
- `Formula`: IMA mineral formula
- `IMA Status`:
  - *A*: Approved
  - *G*: Grandfathered
  - *GROUP*: Name of a group of mineral species
  - *Rd*: Redefined
  - *Rn*: Renamed
  - *Q*: Questioned
  - *I*: Informal
  - *NL*: Not listed

An up-to-date list of IMA approved minerals can be downloaded from RRUFF (Lafuente et al. 2015). However, this list only includes minerals and not groups.

References

Warr LN (2021). "IMA-CNMNC approved mineral symbols." *Mineralogical Magazine*, 1–30. doi:10.1180/mgm.2021.43.

Lafuente B, Downs RT, Yang H, Stone N (2015). "The power of databases: The RRUFF project." In Armbruster T, Danisi RM (eds.), *Highlights in Mineralogical Crystallography*, 1–30. Walter de Gruyter GmbH. doi:10.1515/9783110417104003.

See Also

IMA–CNMNC approved mineral symbols: Paper and supplementary material, (Warr 2021)

IMA approved minerals on RRUFF

`minSearch()`

`minSearch` *Find minerals by their names or symbols*

Description

Searches for minerals by their names and symbols using a regular expression. By default cases are ignored.

Usage

```
minSearch(pattern, ignore.case = TRUE)
```

Arguments

`pattern`	regular expression for the mineral to search
`ignore.case`	switch case insensitivity on (default) or off

Value

data.frame of minerals where the given pattern matches.

See Also

List of minerals, `minsForChemistry()`

Examples

```
minSearch('alm')
minSearch('Pyh$', ignore.case = FALSE)
```

minsForChemistry *Find minerals by their chemistry*

Description

Searches for minerals by their chemistry using a regular expression.

Usage

```
minsForChemistry(pattern, ignore.case = FALSE)
```

Arguments

pattern	regular expression for the chemistry
ignore.case	switch case insensitivity on or off (default)

Value

data.frame of minerals where the given pattern matches.

See Also

List of minerals, `minSearch()`

Examples

```
minsForChemistry('Mn.*\\(SiO4\\)$')
```

NMORB__Sun_McDounough__1989 *N-type MORB*

Description

A data set containing the element concentrations in the N-type MORB as given by Sun and McDonough (1989).

Usage

```
NMORB__Sun_McDounough__1989
```

Format

A data frame with 1 row and 36 element concentrations in ppm:
Cs, Tl, Rb, Ba, W, Th, U, Nb, Ta, K, La, Ce, Pb, Pr, Mo, Sr, P, Nd, F, Sm, Zr, Hf, Eu, Sn, Sb, Ti, Gd, Tb, Dy, Li, Y, Ho, Er, Tm, Yb, Lu

References

Sun SS, McDonough WF (1989). "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications*, **42**(1), 313–345. doi:10.1144/gsl.sp.1989.042.01.19.

`OIB__Sun_McDounough__1989` *Ocean Island Basalts – OIB*

Description

A data set containing the element concentrations in the OIB as given by Sun and McDonough (1989).

Usage

```
OIB__Sun_McDounough__1989
```

Format

A data frame with 1 row and 36 element concentrations in ppm:
Cs, Tl, Rb, Ba, W, Th, U, Nb, Ta, K, La, Ce, Pb, Pr, Mo, Sr, P, Nd, F, Sm, Zr, Hf, Eu, Sn, Sb, Ti, Gd, Tb, Dy, Li, Y, Ho, Er, Tm, Yb, Lu

References

Sun SS, McDonough WF (1989). "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications*, **42**(1), 313–345. doi:10.1144/gsl.sp.1989.042.01.19.

`PGE` *Platinum-group elements – PGE*

Description

List of platinum group elements and subsets thereof.

Usage

```
PGE

IPGE

PPGE
```

Format

PGE: character vector with 6 elements.

IPGE: character vector with 3 elements.

PPGE: character vector with 3 elements.

Details

Ru-Pd and Os-Pt: in chemistry, this group is referred to as the platinum metals. Since the 1960 geologists are using the term "platinum-group elements" (PGE) ( ). In geochemistry, this group is further divided into two subgroups: Ir-PGE and Pd-PGE ( ) with Au often added to the latter (Rollinson 1993).

- PGE Platinum-group elements – e.g. ( ).
- IPGE, PPGE Ir-PGE and Pd-PGE – (Rollinson 1993, 1999);

References

Rollinson HR (1993). *Using Geochemical Data: Evaluation, Presentation, Interpretation*. Longman Group UK.

Marshall CP, Fairbridge RW (eds.) (1999). *Encyclopedia of Geochemistry*, Kluwer Academic Encyclopedia of earth sciences series. Kluwer Academic Publ., Dordrecht, Bosten, London. ISBN 9780412755002.

Connelly NG, Damhus T, Hartshorn RM, Hutton AT (eds.) (2005). *Nomenclature of Inorganic Chemistry: IUPAC recommendations 2005*. Royal Society of Chemistry, Cambridge. ISBN 0854044388, https://iupac.org/what-we-do/books/redbook/.

Examples

```
# get information from the periodic table of elements
subset(pte, Symbol %in% PGE)
```

PM__Sun_McDounough__1989

Primitive mantle

Description

A data set containing the element concentrations in the primitive mantle as given by Sun and McDonough (1989).

Usage

```
PM__Sun_McDounough__1989
```

Format

A data frame with 1 row and 36 element concentrations in ppm:
Cs, Tl, Rb, Ba, W, Th, U, Nb, Ta, K, La, Ce, Pb, Pr, Mo, Sr, P, Nd, F, Sm, Zr, Hf, Eu, Sn, Sb, Ti, Gd, Tb, Dy, Li, Y, Ho, Er, Tm, Yb, Lu

Details

For lead and cesium the recommended (in this work) values for mantel-normalizing diagrams where used. The original values that where given in Tbl.1 are (Cs, 0.032) and (Pb, 0.185).

References

Sun SS, McDonough WF (1989). "Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes." *Geological Society, London, Special Publications*, **42**(1), 313–345. doi:10.1144/gsl.sp.1989.042.01.19.

---

pte *Periodic Table of Elements*

Description

The periodic table of elements as given by PubChem National Center for Biotechnology Information (2022).

Usage

```
pte
```

Format

A data frame with 118 rows and 17 columns.
For each element the following attributes are reported: AtomicNumber, Symbol, Name, AtomicMass, CPKHexColor, ElectronConfiguration, Electronegativity, AtomicRadius, IonizationEnergy, ElectronAffinity, OxidationStates, StandardState, MeltingPoint, BoilingPoint, Density, GroupBlock, YearDiscovered

References

National Center for Biotechnology Information (2022). "PubChem Periodic Table of Elements." https://pubchem.ncbi.nlm.nih.gov/periodic-table/. Retrieved February 28, 2022, https://pubchem.ncbi.nlm.nih.gov/periodic-table/.

Kim S, Chen J, Cheng T, Gindulyte A, He J, He S, Li Q, Shoemaker BA, Thiessen PA, Yu B, Zaslavsky L, Zhang J, Bolton EE (2020). "PubChem in 2021: new data content and improved web interfaces." *Nucleic Acids Research*, **49**(D1), D1388–D1395. doi:10.1093/nar/gkaa971.

See Also

IUPAC_StdAW for the standard atomic weights of the elements recommended by IUPAC

`Pyrolite__McDonough_Sun__1995`
Pyrolite

Description

A data set containing the *recommended chemical composition of the of the Silicate Earth-"Pyrolite"* as given by McDonough and Sun (1995)

Usage

```
Pyrolite__McDonough_Sun__1995
```

Format

A data frame with 1 row and 76 element concentrations in ppm:
Li, Be, B, C, N, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Th, U

In the article the concentrations of most of the major elements are given in wt% and the concentrations of Nb and following are given in ppb.
For the sake of clarity these values where converted to ppm: So all values given here are in ppm.
This conversion was done using:

- `ppm= wt% * 10000`
- `ppm= ppb / 1000`

References

McDonough WF, Sun SS (1995). "The composition of the Earth." *Chemical Geology*, **120**(3-4), 223–253. doi:10.1016/00092541(94)001404.

Index