

The abanico plot

visualising chronometric data with individual standard errors

Michael Dietze¹, Sebastian Kreutzer², Christoph Burow³, Margret C. Fuchs⁴, Manfred Fischer⁵, Christoph Schmidt⁵

1 - GFZ German Research Centre for Geosciences, Section 5.1 Geomorphology

2 - IRAMAT-CRP2A, Université Bordeaux Montaigne

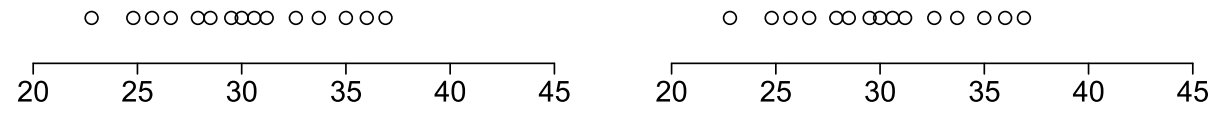
3 - Institute for Geography, University of Cologne

4 - Helmholtz-Zentrum Dresden-Rossendorf, Helmholtz Institute Freiberg for Resource Technology, Remote Sensing Group

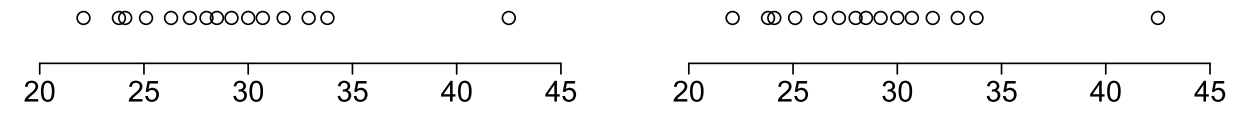
5 - Geographical Institute, Geomorphology, University of Bayreuth

The relevance of errors And the need to explicitly show them

homogeneous distribution?



homogeneous distribution with an outlier?

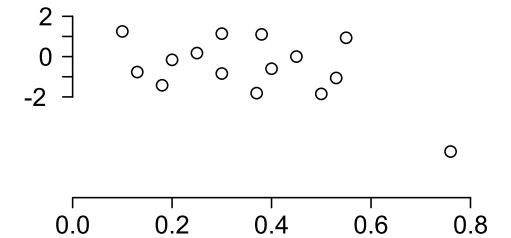
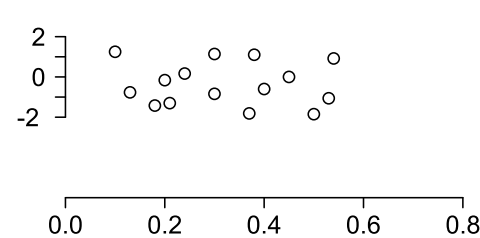
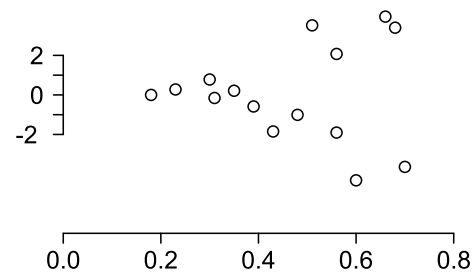
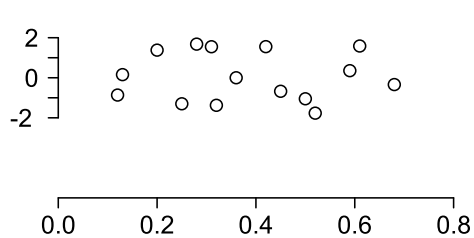
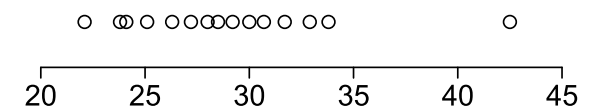
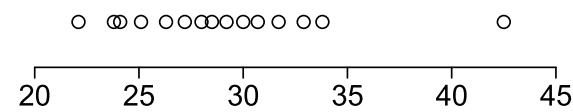
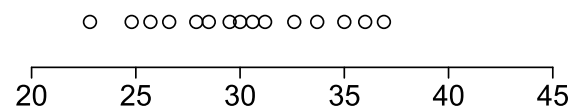
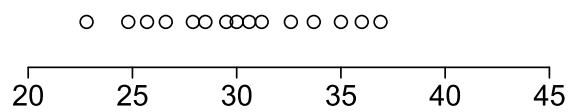


Graphs courtesy of Rex Galbraith

The relevance of errors And the need to explicitly show them

homogeneous distribution?

homogeneous distribution with an outlier?



Yes, of course

No, two populations

No, just homogeneity

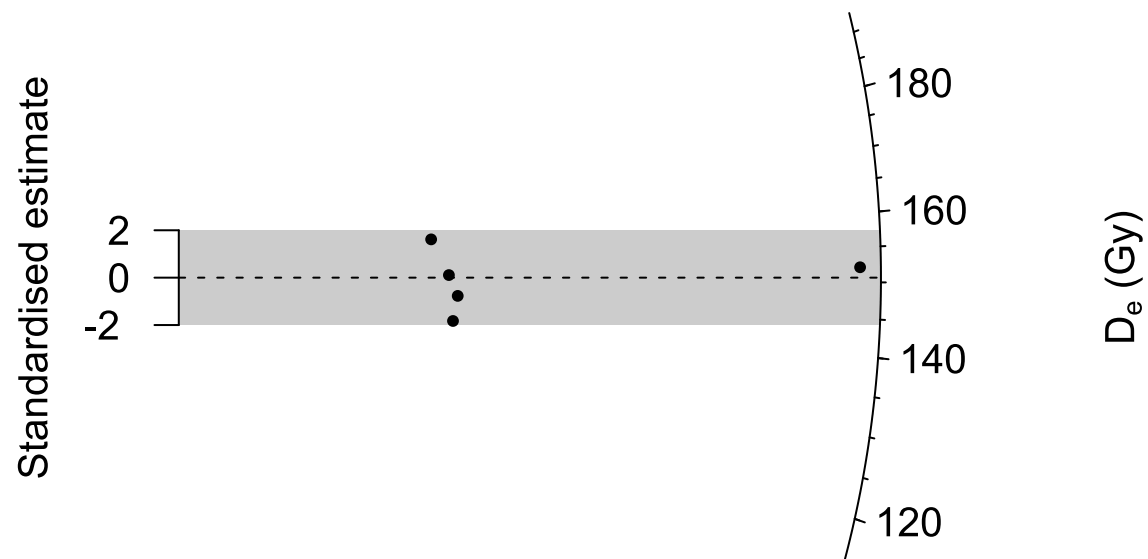
Yes, but not the obvious

Graphs courtesy of Rex Galbraith

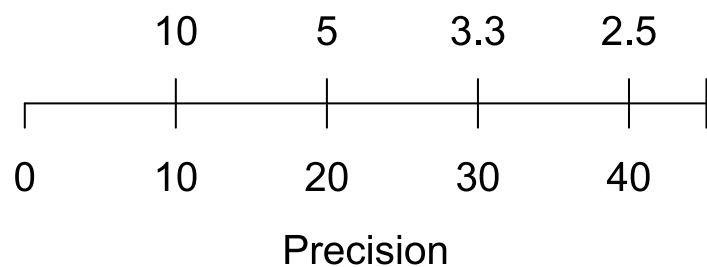
What the radial plot does really well And what is does not so well

D_e distribution

n = 5 | in 2 sigma = 100 %



Relative standard error (%)

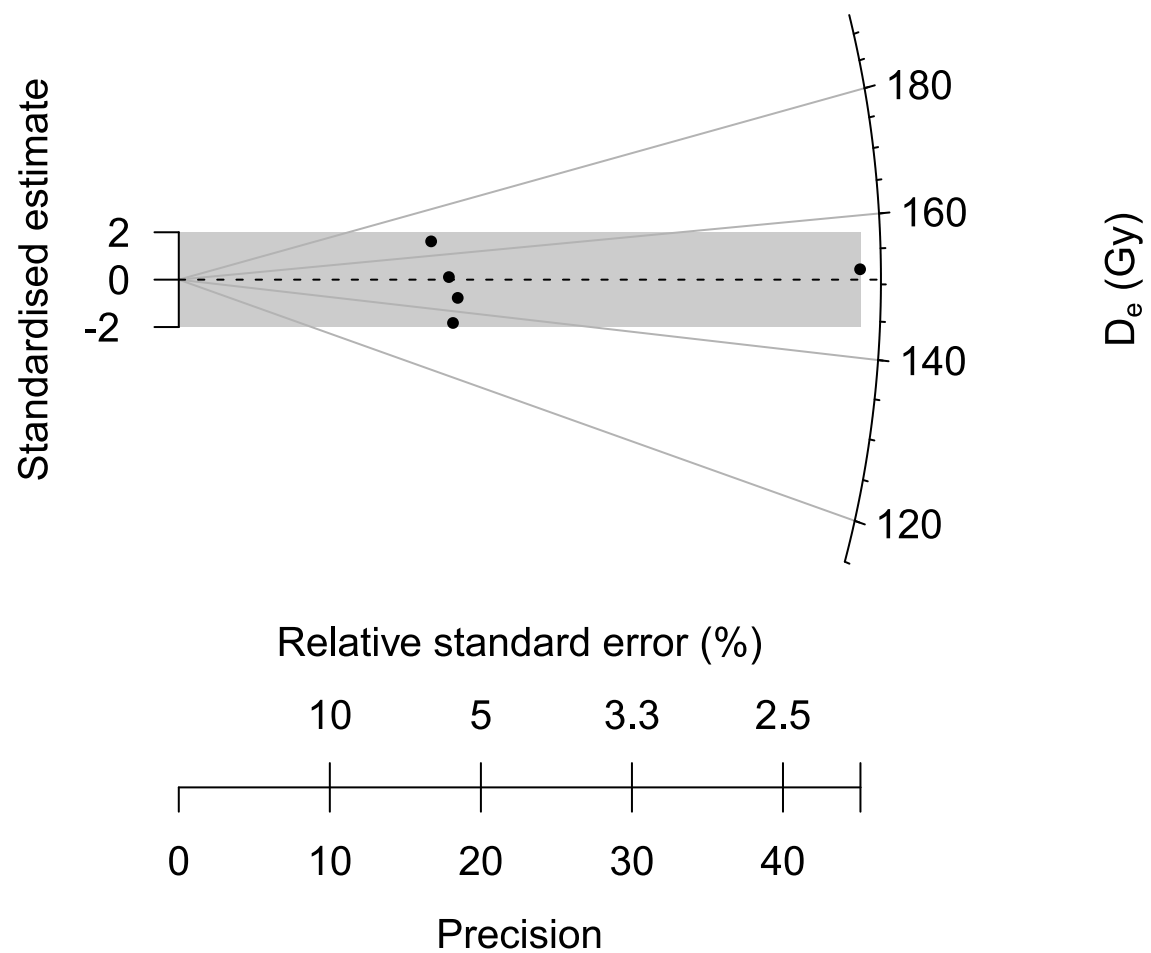


```
plot_RadialPlot(data = data.frame(z, s),  
                plot.ratio = 0.15, pch = 20, grid.col = "none")
```

What the radial plot does really well And what is does not so well

D_e distribution

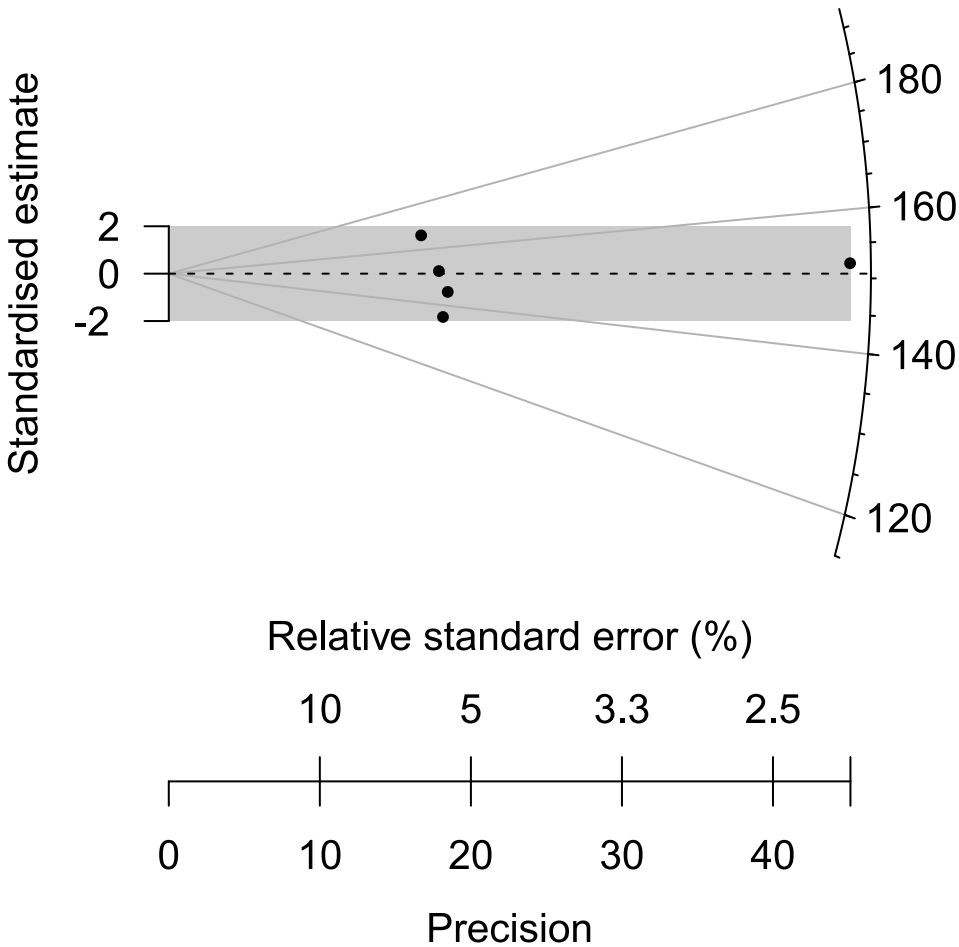
n = 5 | in 2 sigma = 100 %



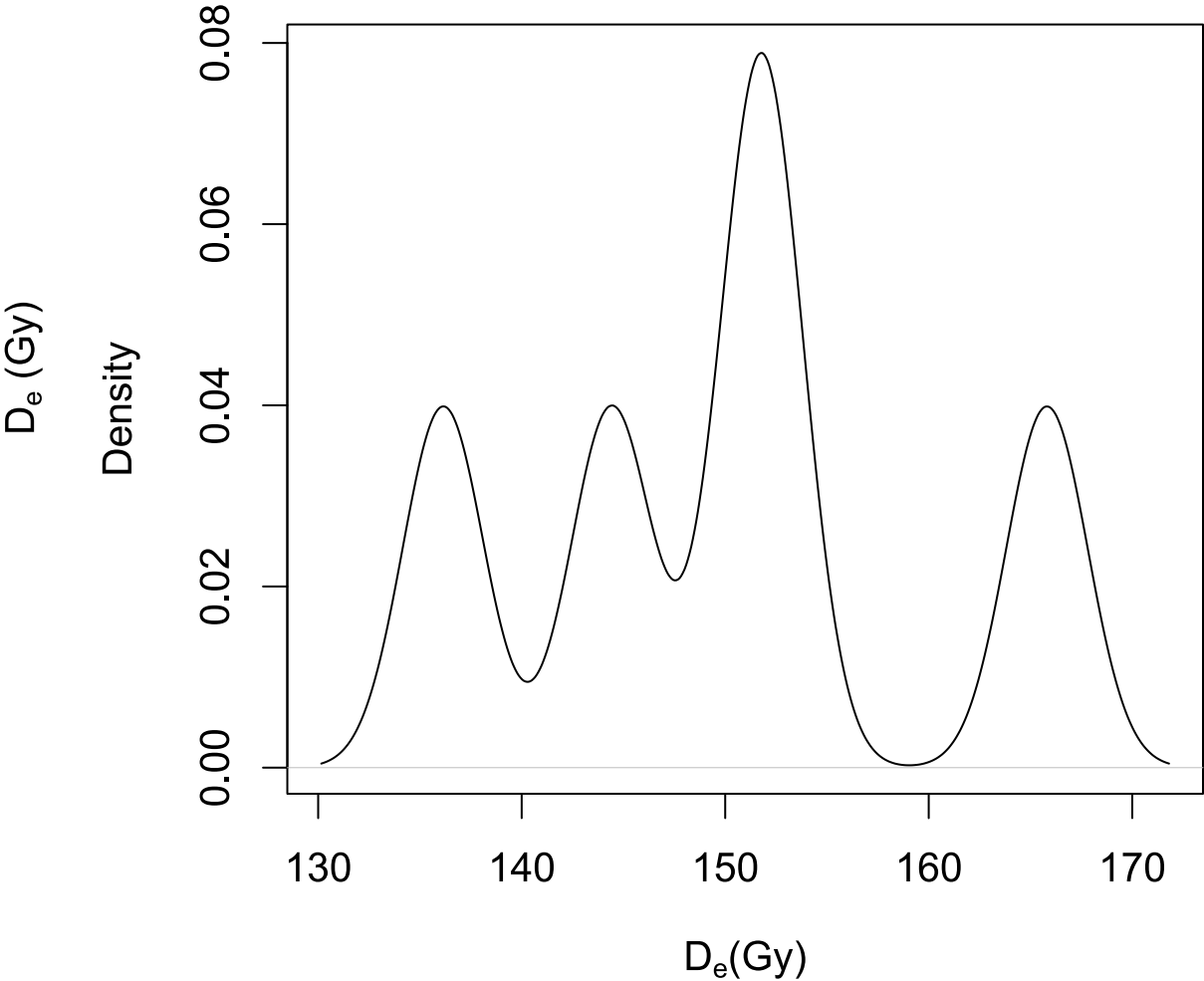
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D_e distribution

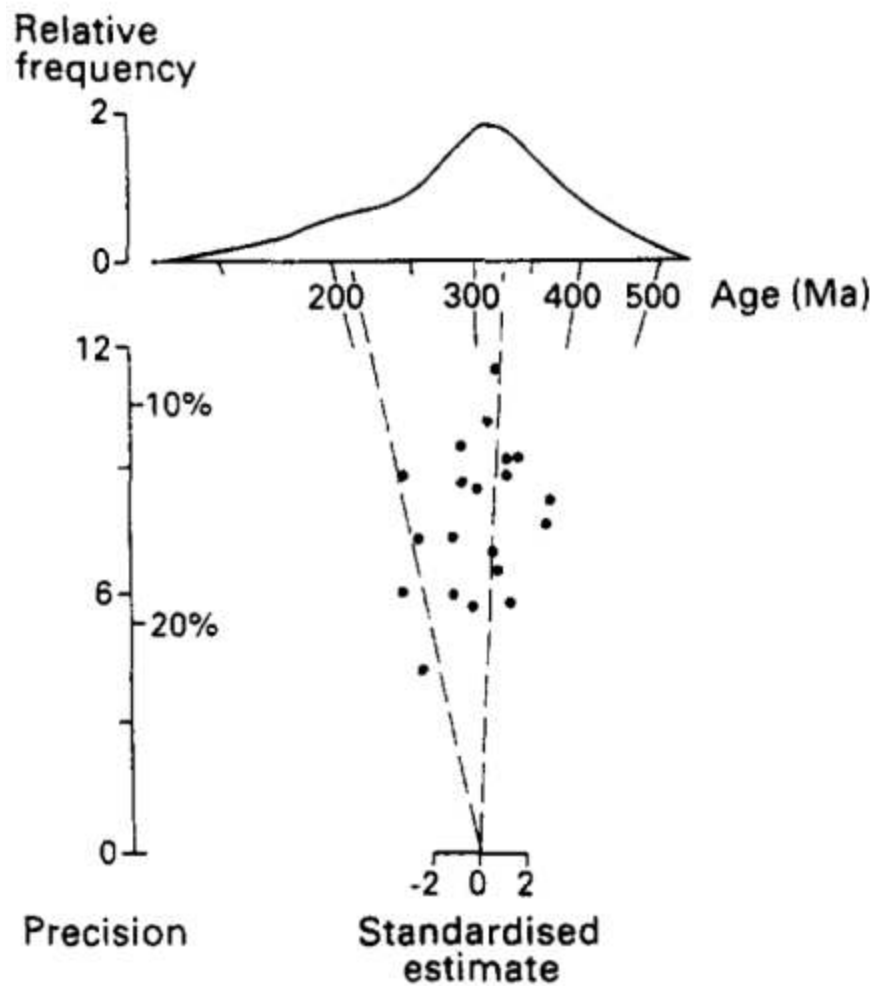
n = 5 | in 2 sigma = 100 %



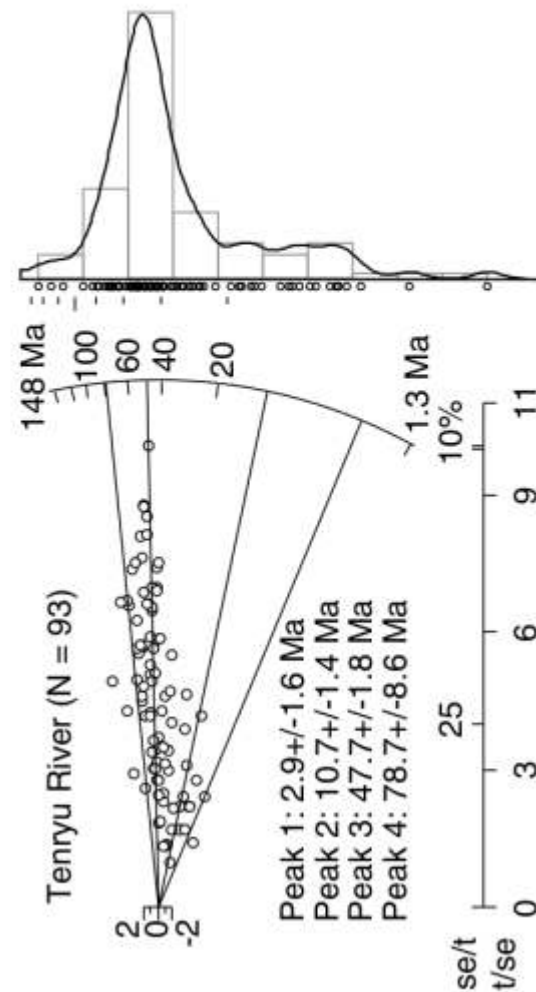
KDE (bandwidth = 2)



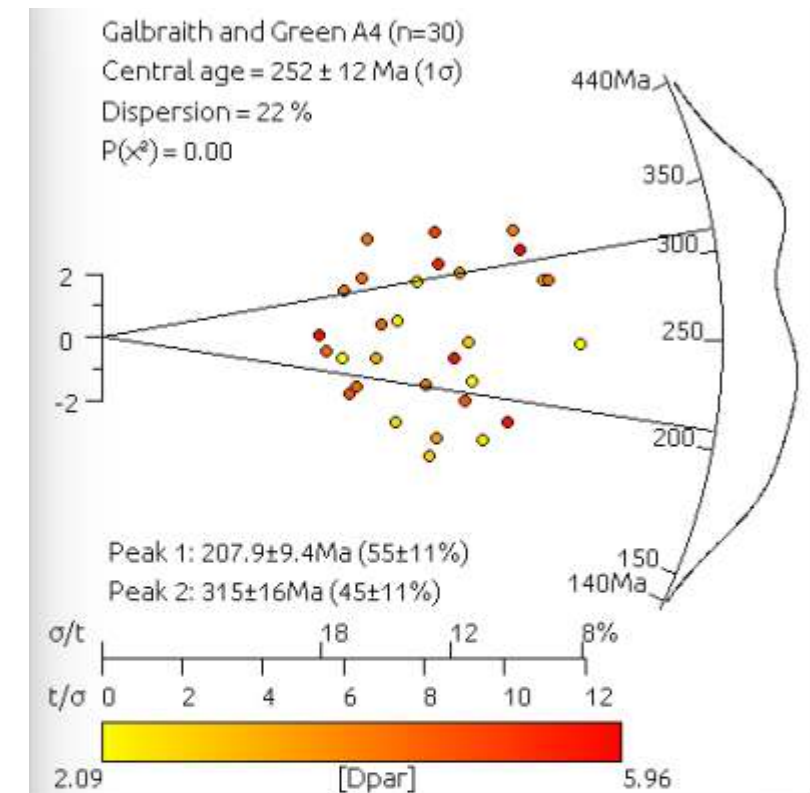
A glimpse back and aside Alternative ways to merge two plots



Galbraith & Green (1990)

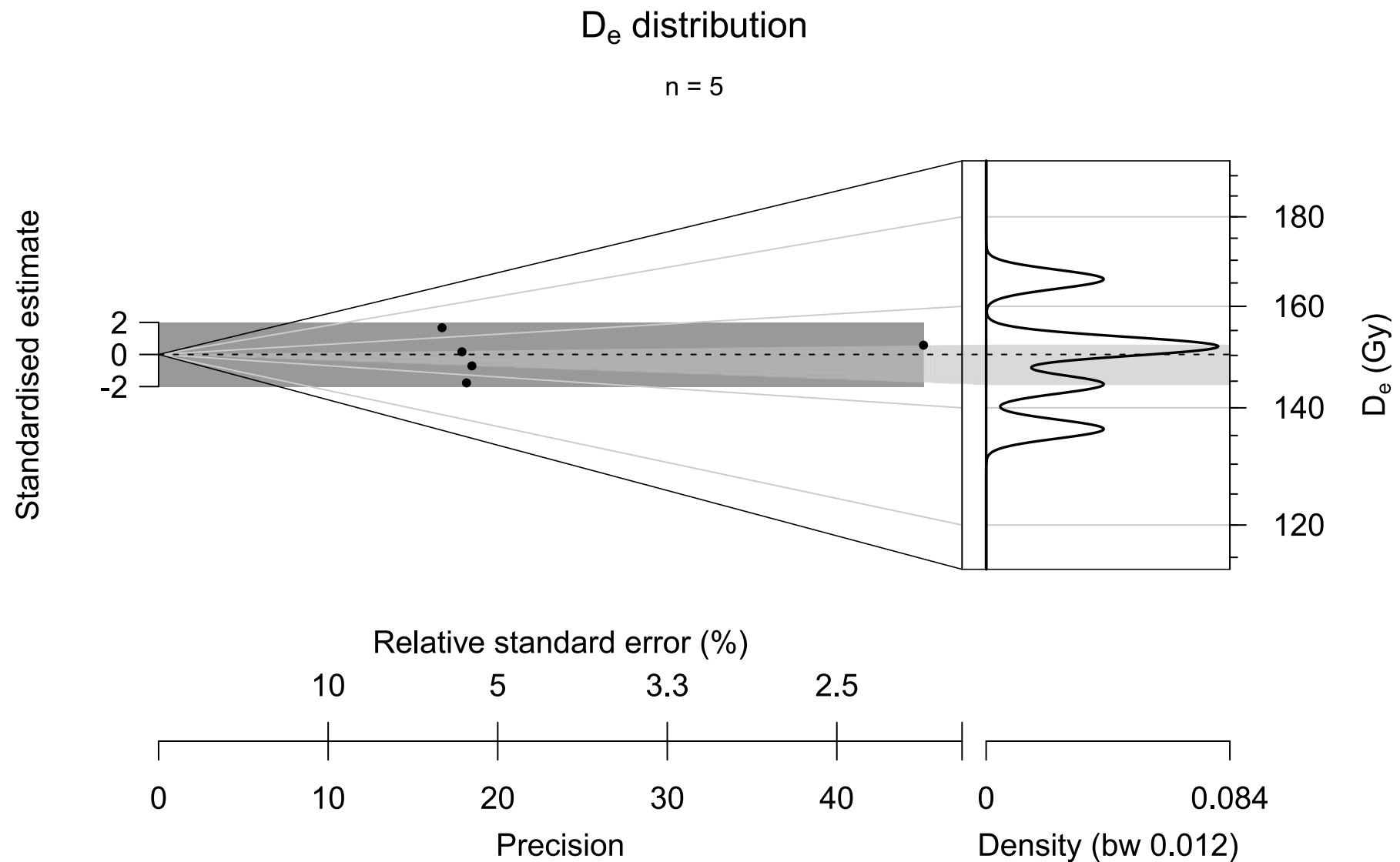


Clift et al. (2013)

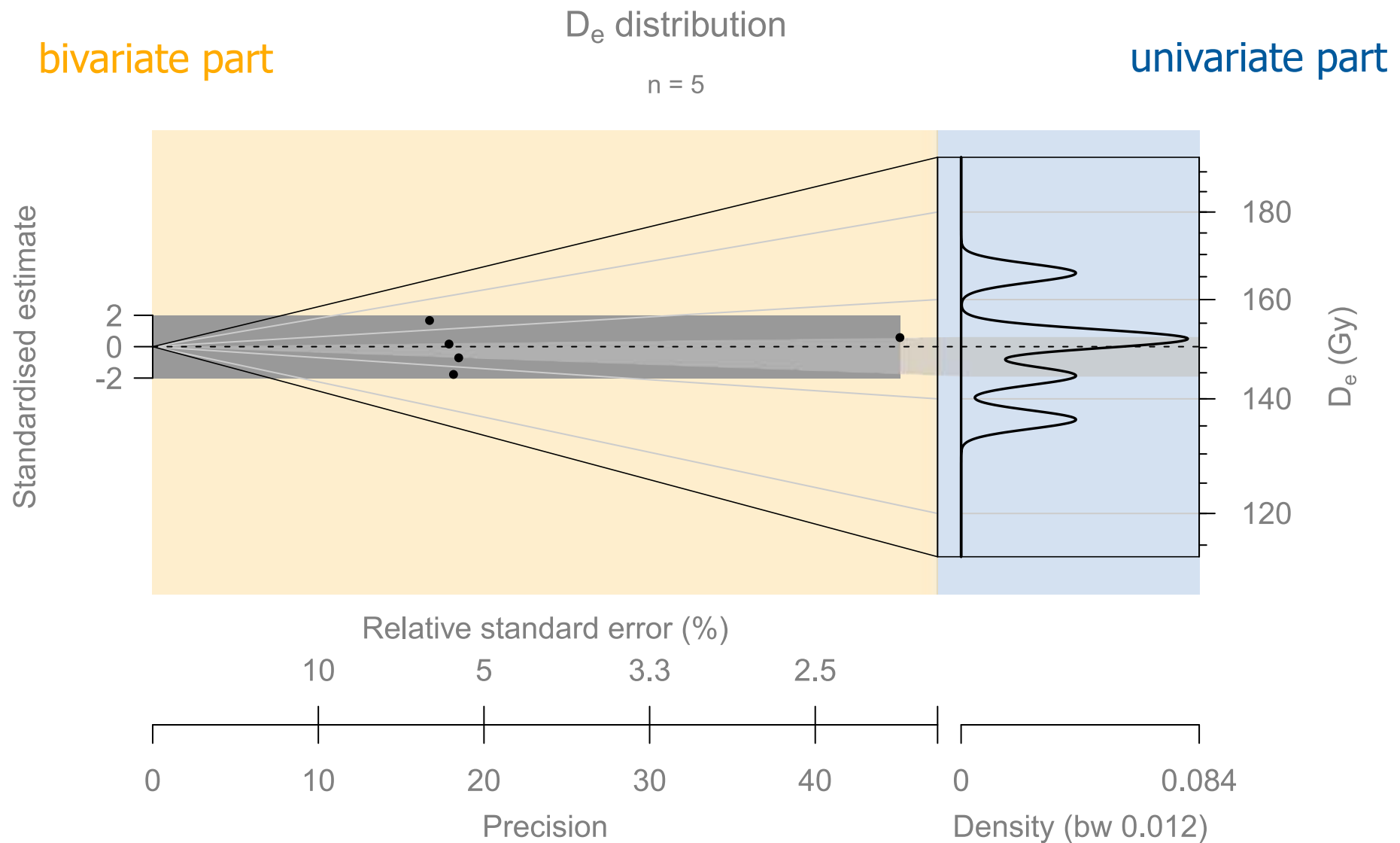


Vermeesch et al. (2009)*

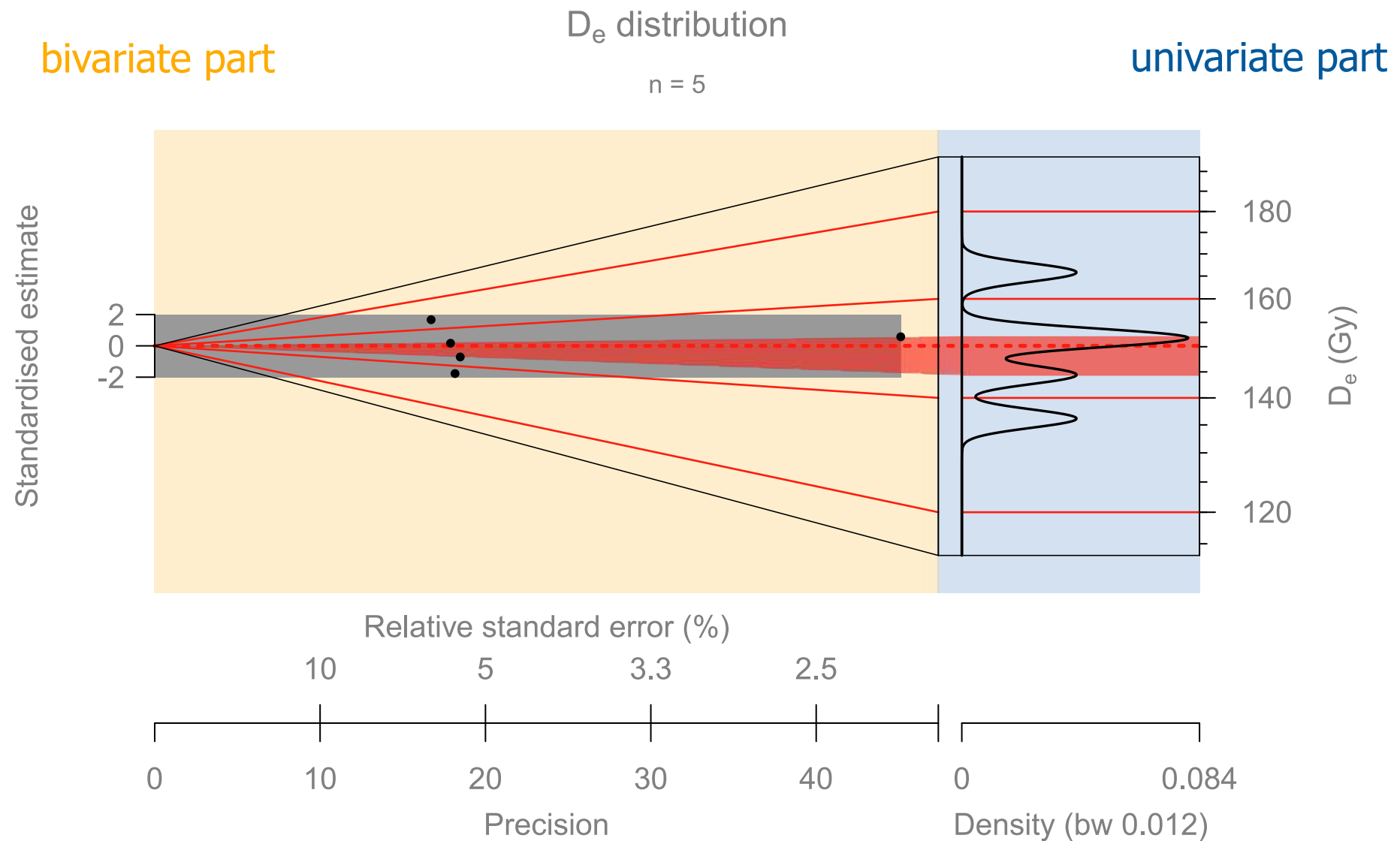
A step beyond The structure of the abanico plot



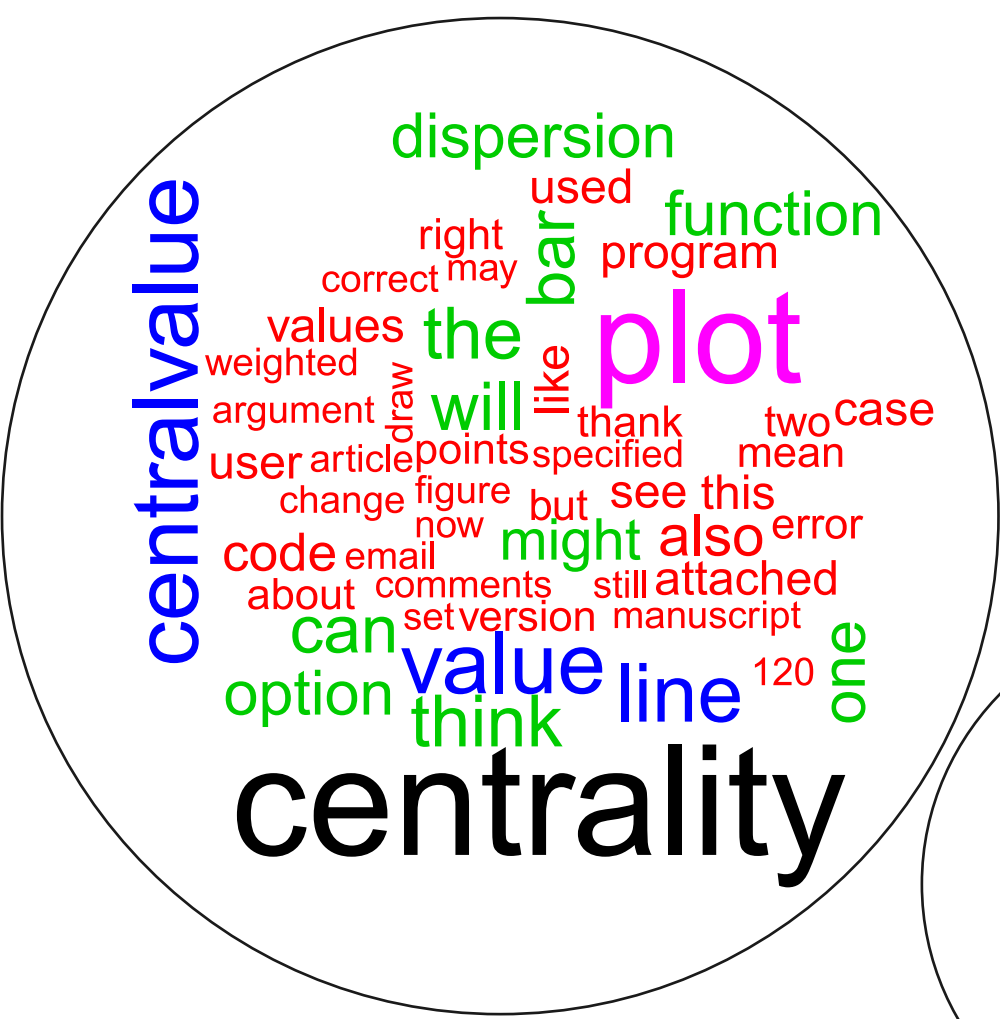
A step beyond The structure of the abanico plot



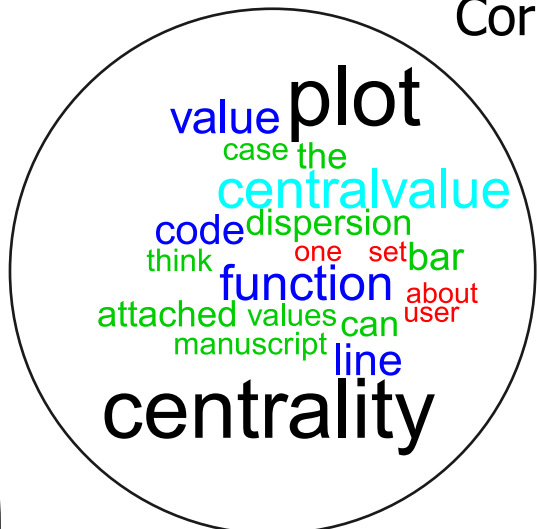
A step beyond The structure of the abanico plot



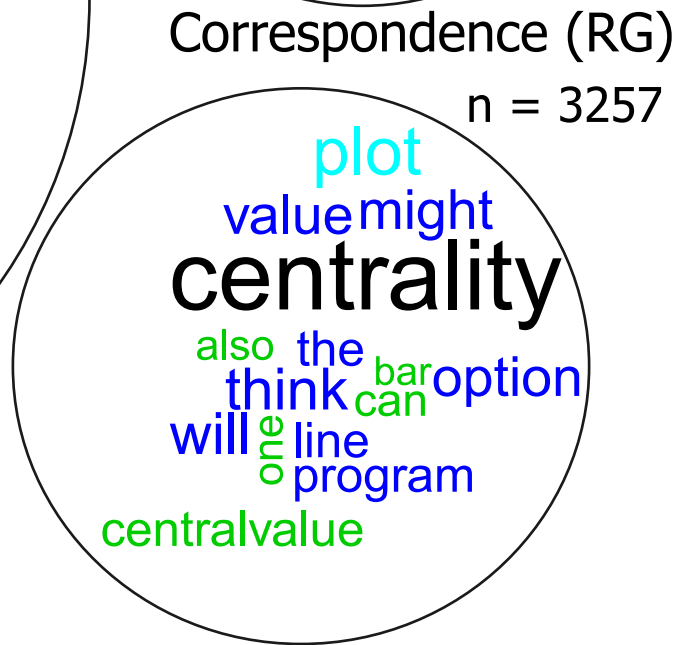
A summary The most important keywords during preparation of the article



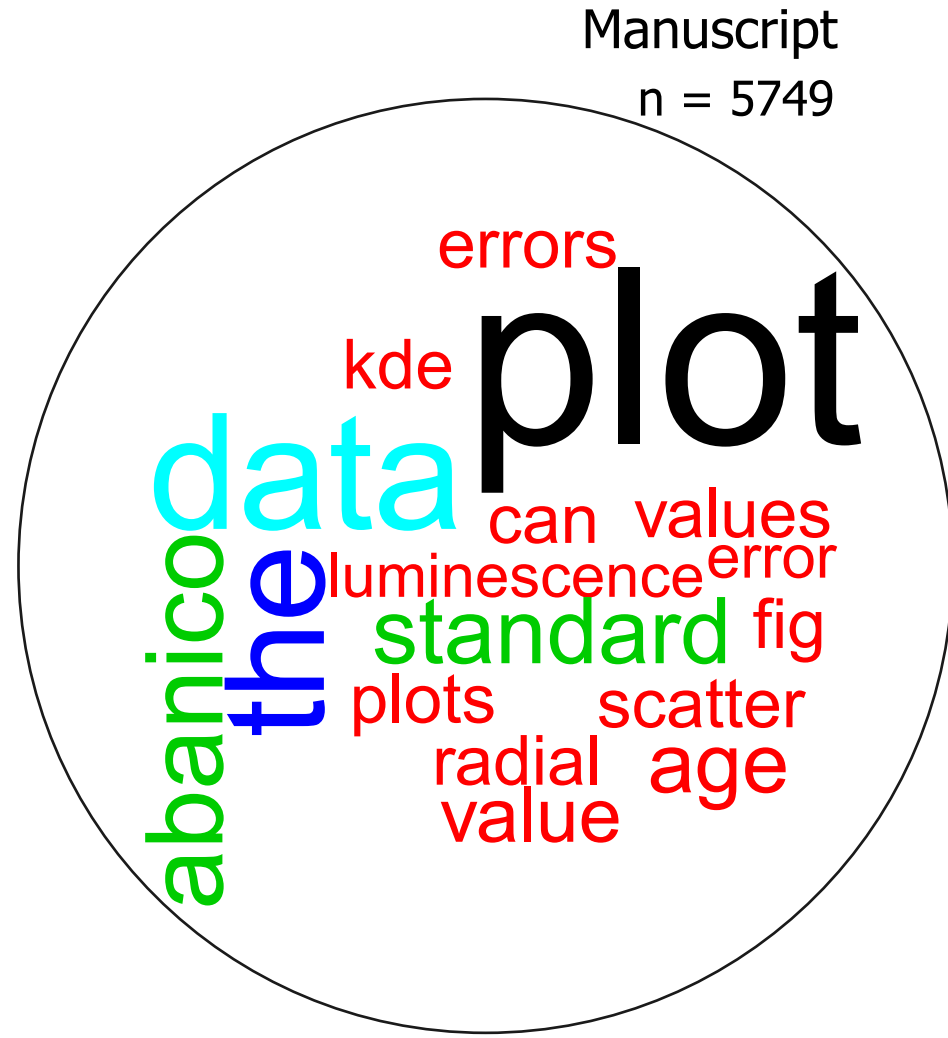
Correspondence (total)
n = 6156



Correspondence (MD)
n = 2899

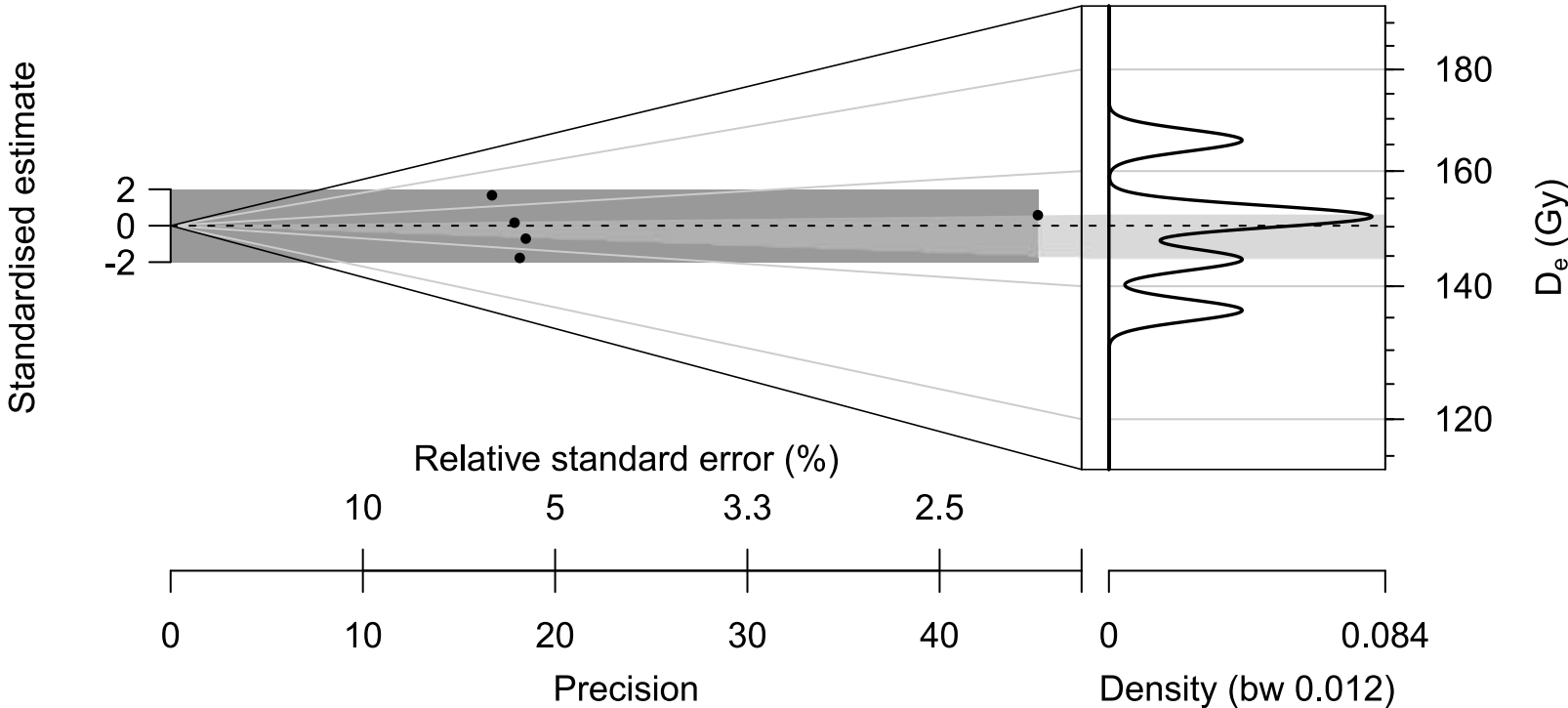


Correspondence (RG)
n = 3257



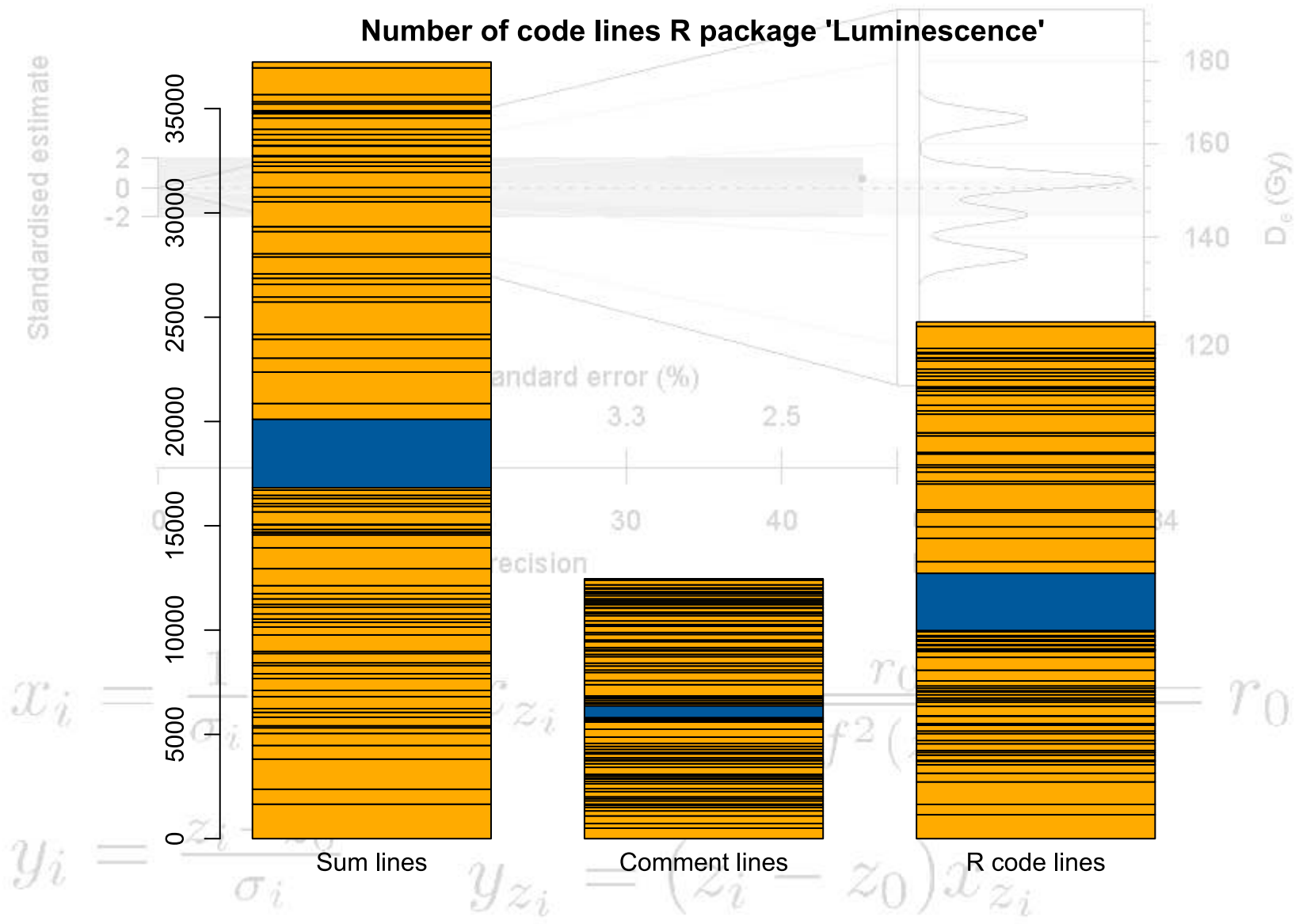
Manuscript
n = 5749

The geometric foundations Just four equations to construct the plot

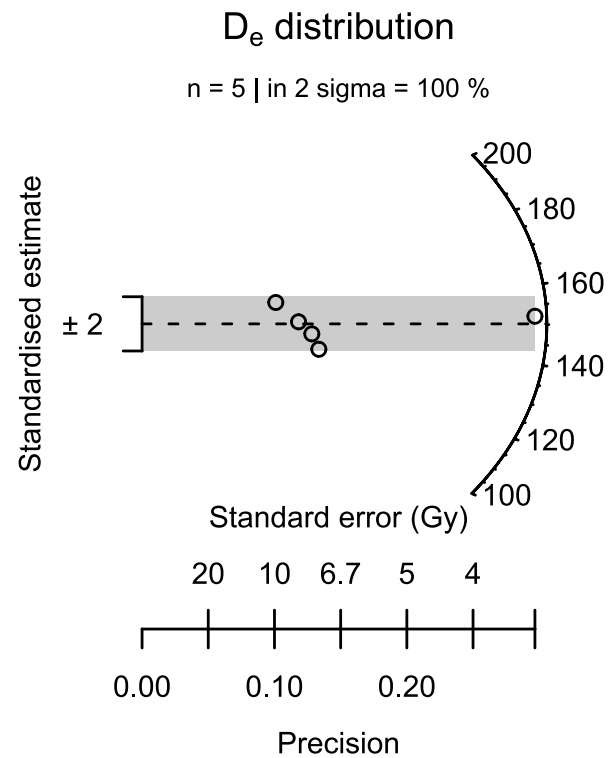


$$\begin{aligned}
 x_i &= \frac{1}{\sigma_i} & x_{z_i} &= \frac{r_0}{\sqrt{1+f^2(z_i-z_0)^2}} = r_0 \\
 y_i &= \frac{z_i-z_0}{\sigma_i} & y_{z_i} &= (z_i-z_0)x_{z_i}
 \end{aligned}$$

The geometric foundations Just four equations to construct the plot



The geometric foundations From radial to abanico plot



$$x_i = \frac{1}{\sigma_i}$$

$$x_{z_i} = \frac{r_0}{\sqrt{1 + f^2 (z_i - z_0)^2}} = r_0$$

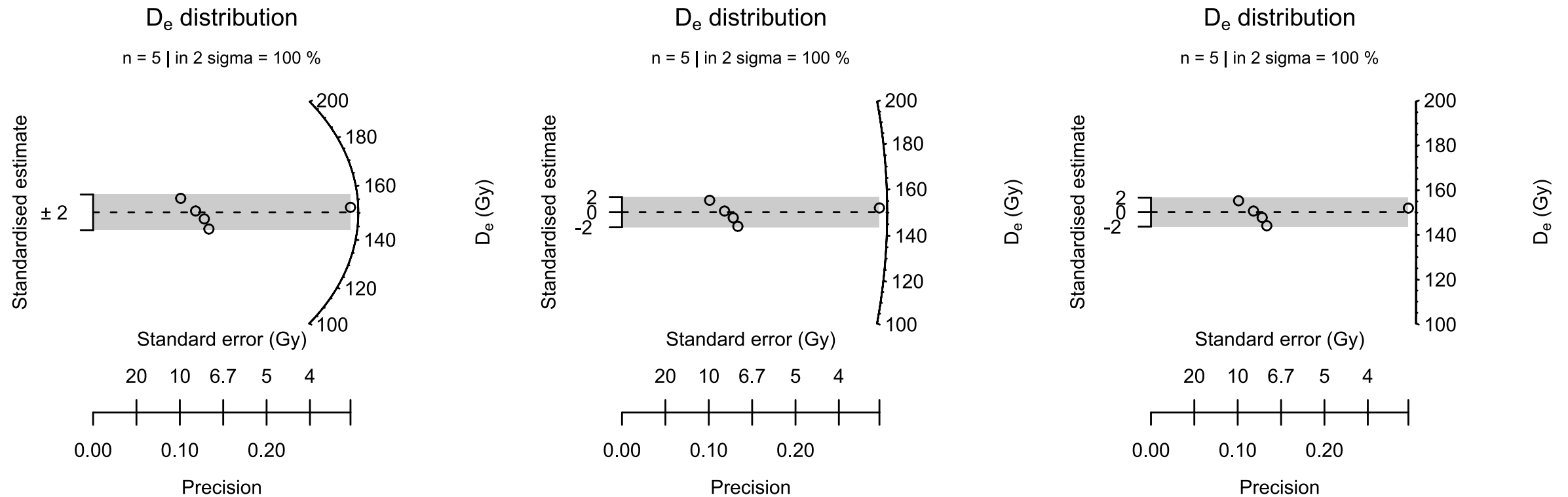
$$y_i = \frac{z_i - z_0}{\sigma_i}$$

$$y_{z_i} = (z_i - z_0) x_{z_i}$$

Galbraith (1988)

```
plot_RadialPlot(data = data.frame(z, s), plot.ratio = 0.25)
```

The geometric foundations From radial to abanico plot



$$x_i = \frac{1}{\sigma_i}$$

$$y_i = \frac{z_i - z_0}{\sigma_i}$$

$$x_{z_i} = \frac{r_0}{\sqrt{1 + f^2 (z_i - z_0)^2}} = r_0$$

$$y_{z_i} = (z_i - z_0) x_{z_i}$$

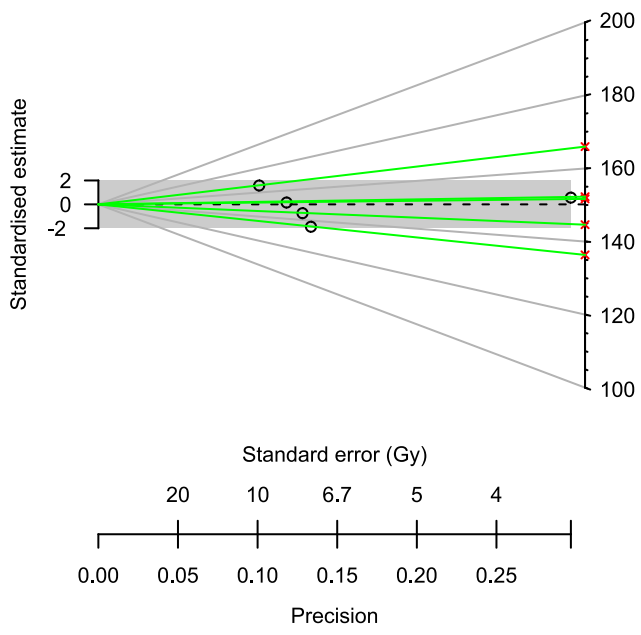
Galbraith (1988)

```

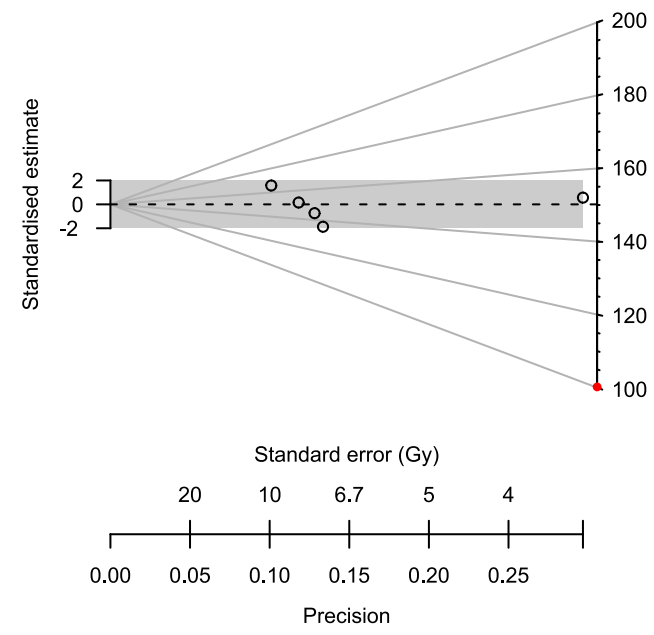
plot_RadialPlot(data = data.frame(z, s), plot.ratio = 0.25)
plot_RadialPlot(data = data.frame(z, s), plot.ratio = 0.1)
plot_RadialPlot(data = data.frame(z, s), plot.ratio = 0.01)
    
```


The geometric foundations From radial to abanico plot

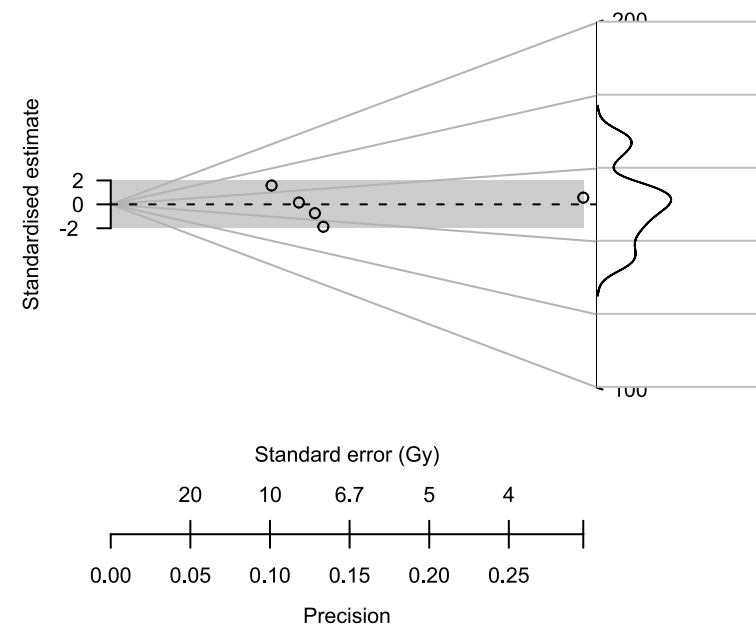
D_e distribution
n = 5 | in 2 sigma = 100 %



D_e distribution
n = 5 | in 2 sigma = 100 %



D_e distribution
n = 5 | in 2 sigma = 100 %



$$x_i = \frac{1}{\sigma_i}$$

$$y_i = \frac{z_i - z_0}{\sigma_i}$$

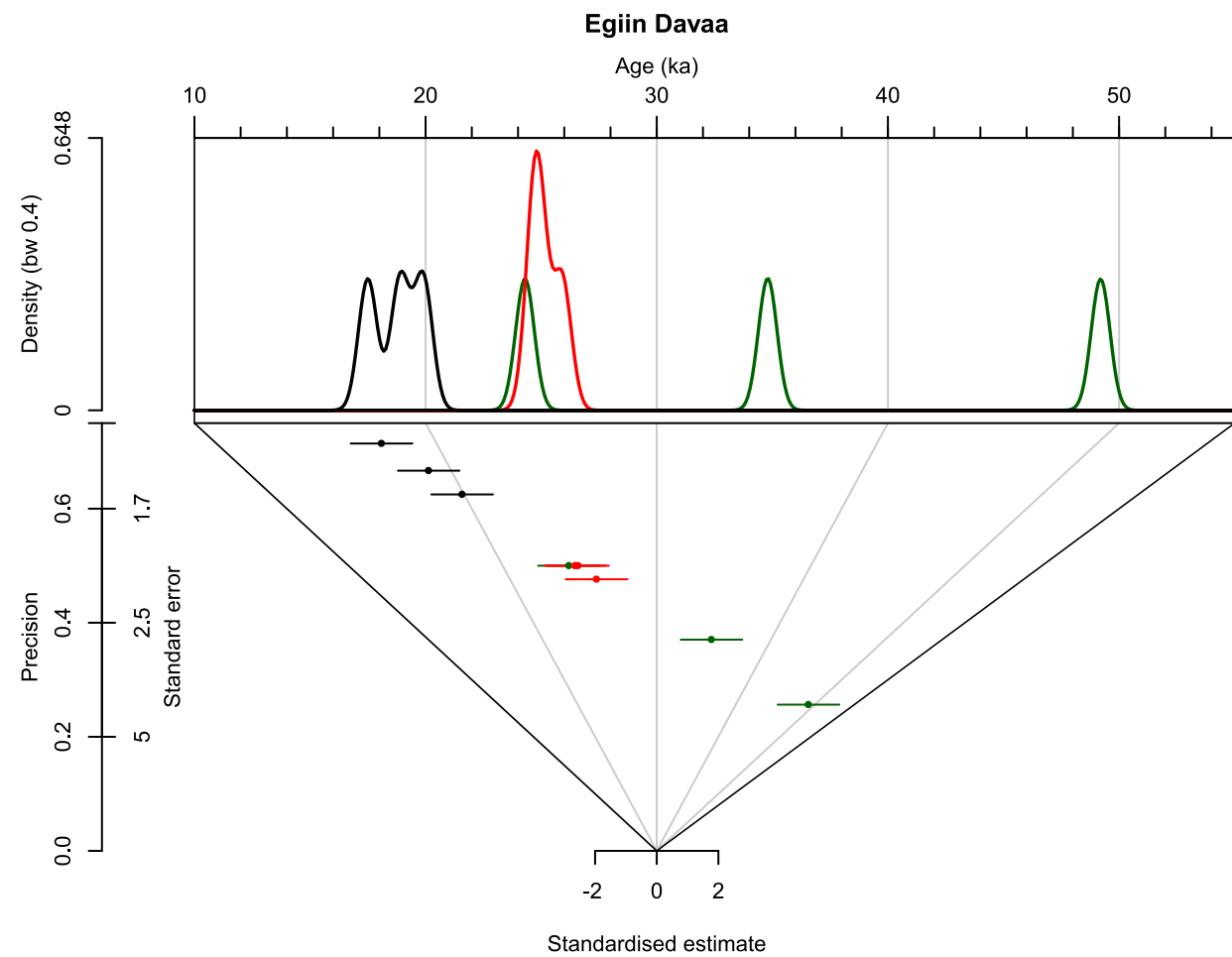
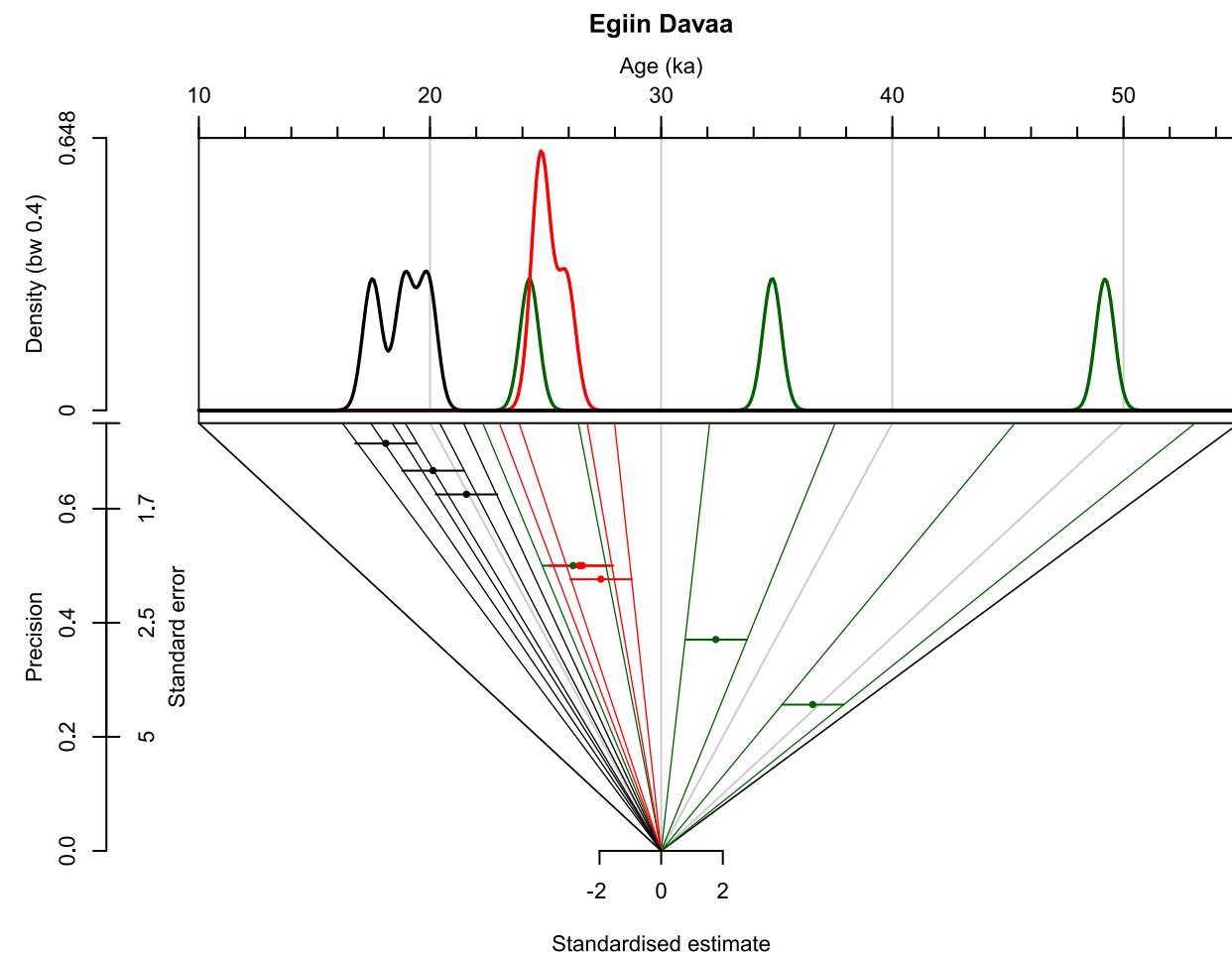
$$x_{z_i} = \frac{r_0}{\sqrt{1 + f^2 (z_i - z_0)^2}} = r_0$$

$$y_{z_i} = (z_i - z_0) x_{z_i}$$

Galbraith (1988)

Galbraith (1990)

Cosmogenic nuclides

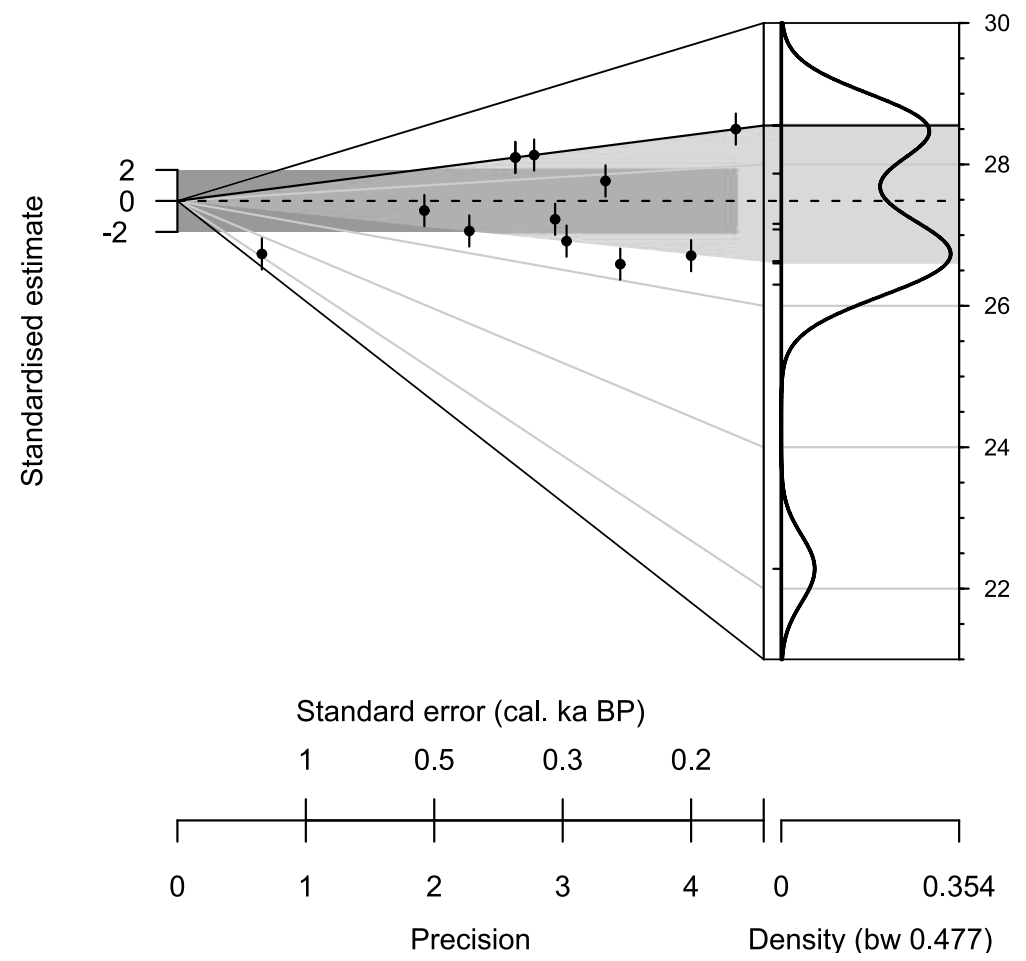


Data courtesy of Steffen Pötsch

Cosmogenic nuclides

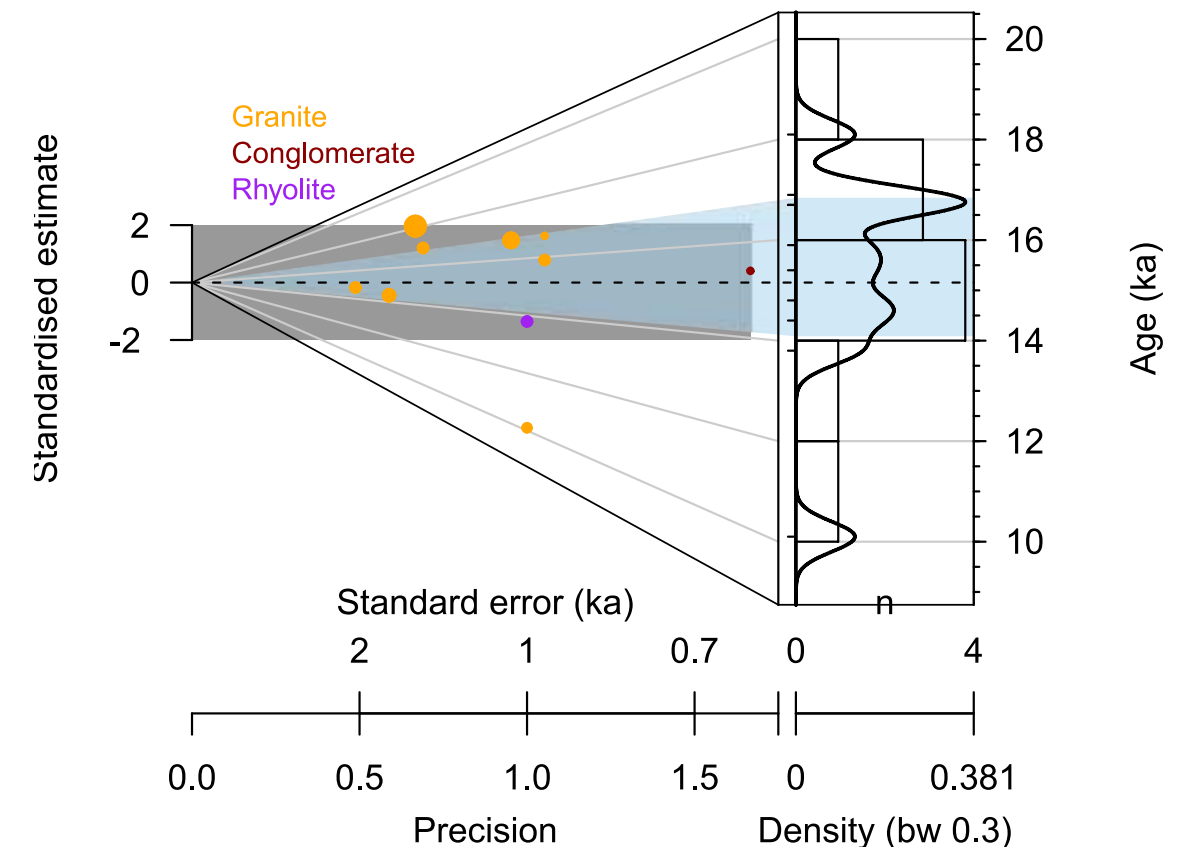
Radiocarbon ages, Gozha

n = 12 | mean = 27.06 | weighted mean = 27.48 | median = 27.12



Exposure ages Fenix I

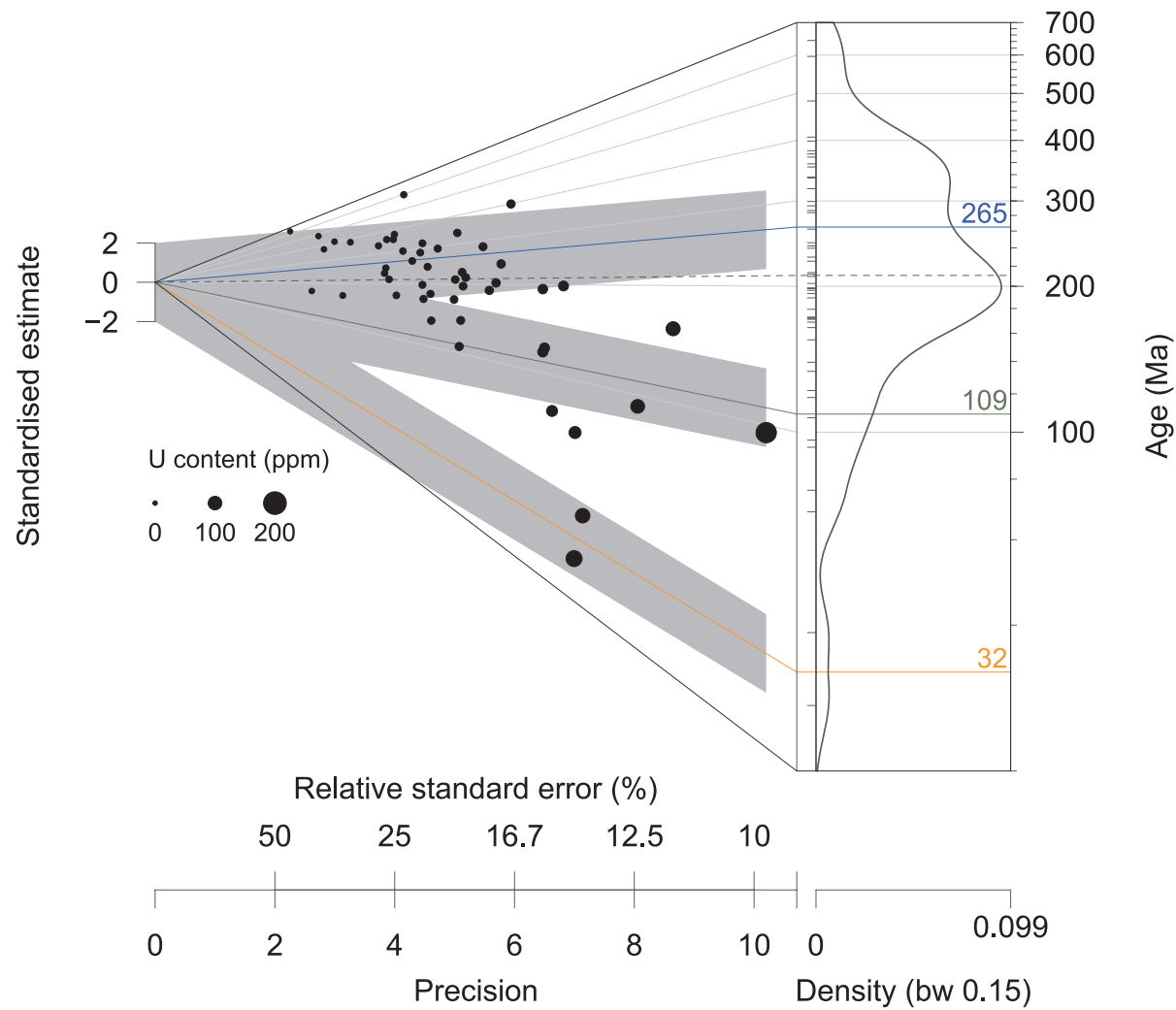
n = 10 | in 2 sigma = 90 % | median = 15.65 | weighted mean = 15.16



Plots from Dietze et al. (accepted), data from Rinterknecht et al. (2006) and Douglass et al. (2006).

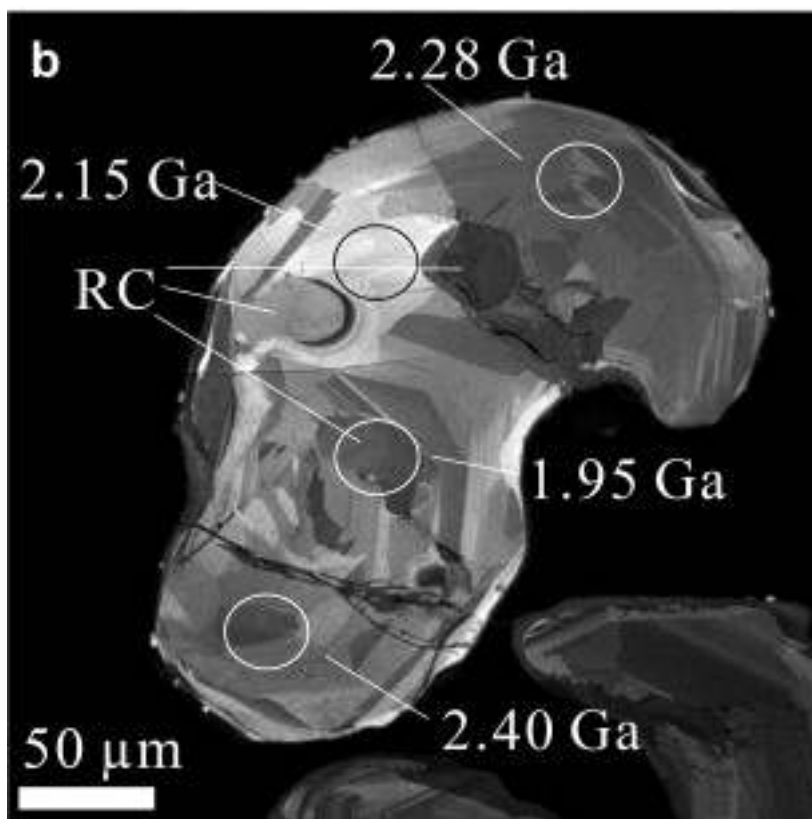
Fission track ages

Zircon fission track ages

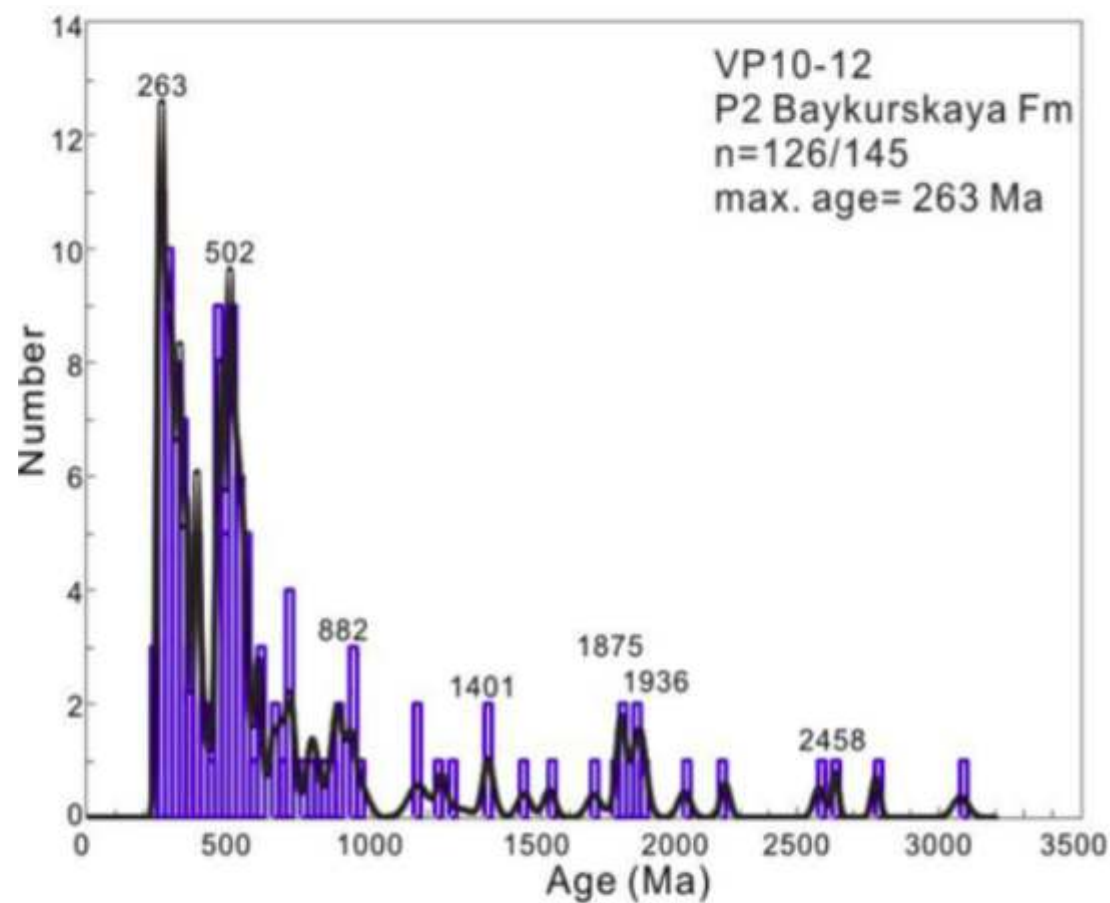


Plot from Dietze et al. (accepted), data from Kirstein et al. (2009)

Beyond OSL/FT/CN...

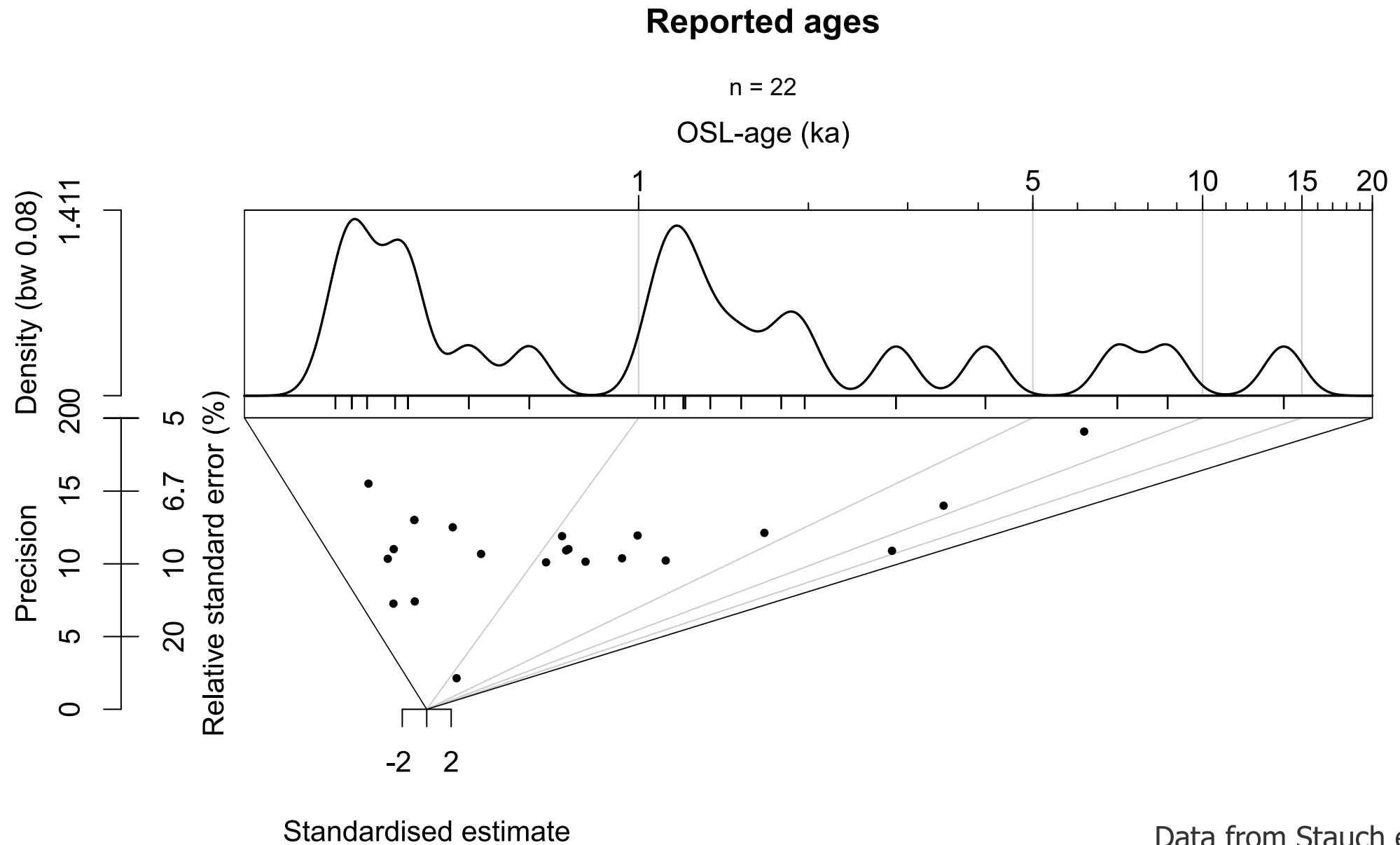


From Kröner et al. (2014)



From somewhere out of the internet...

An alternative to probability density functions of pooled ages?



Data from Stauch et al. (2014)

A summary The most important keywords during preparation of the article

NEW PACKAGE: RLumShiny
 24-03-2015
 A new R package called *RLumShiny* is now available at GitHub, which bundles all shiny apps in an easy-to-use fashion. Please visit [this site](#) for a quick guide on how to install and use the *RLumShiny* package. A release on the CRAN is planned for April.

[Contact](#)

Report a bug

If you encounter a bug please send a short message using the text area below. This is completely anonymous. For further enquiries, however, it may be useful to leave an e-mail address so I can contact you.

Reported bugs

KDE: 'sum' not meaningful for factors
 cannot coerce class "try-error" to a data.frame

R.Luminescence Advanced Plotting

This page features [RStudio Shiny Apps](#) hosted on [Uberspace](#) providing a graphical user interface for functions of the R package 'Luminescence'.

[Abanico Plot](#) |
 [Histogram](#) |
 [RadialPlot](#) |
 [Kernel density estimate](#) |
 [Dose Recovery Test](#) |
 [Cosmic Dose Rate](#) |
 [CW Curve Transformation](#)

The Abanico Plot is a combination of the classic Radial Plot and a kernel density estimate plot. It allows straightforward visualisation of data precision, error scatter around a user-defined central value and the combined distribution of the values, on the actual scale of the measured data (e.g. seconds, equivalent dose, years). The principle of the plot is shown in *Galbraith & Green (1990)*.

Data | Login | Statistics | Plot | Axis | Datapoints | Lines

Bars & Grid | Legend | Filter | Layout | Export | About

Data upload

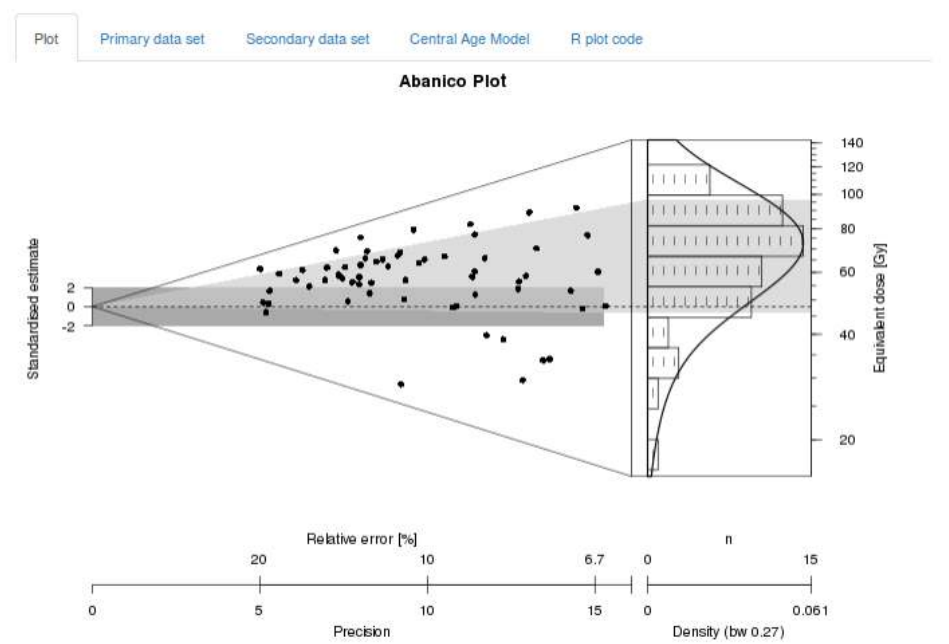
Primary data set
 No file selected.

Secondary data set
 No file selected.

Settings

Exclude NA values File contains headers

Separator
 Tab Space Comma Semicolon



- Git version history**
- RLumShiny**
Thu Jun 18 17:23:58 2015 +0200
add reactivity and data validation
 - Tue May 19 18:53:01 2015 +0200
respect changes in Luminescence 0.4.4
+ add 'frame' input to specify plot border
+ rename 'na.exclude' to 'na.rm'
 - remove text input for KDE axis label
 - Tue May 19 18:49:46 2015 +0200
arg 'na.exclude' renamed to 'na.rm'
 - Mon May 4 15:37:51 2015 +0200
add appveyor.yml
 - Mon May 4 15:35:49 2015 +0200
use appveyor CI & add status badge
 - Mon Apr 27 18:52:03 2015 +0200
add R.Lum Team as contributors
 - Mon Apr 27 18:51:27 2015 +0200
ignore .travis.yml
 - Mon Apr 27 17:33:45 2015 +0200
Update README.md
 - Mon Apr 27 17:17:23 2015 +0200
Add twitter link
 - Sun Apr 26 22:17:34 2015 +0200
travis-CI link is case sensitive

<http://zerk.canopus.uberspace.de/R.Lum/>

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Data | Login | Statistics | Plot | Avs | Datapoints | Lines

Bars & Grid | Legend | Filter | Layout | Export | About

Data upload

Primary data set
[Browse...](#) No file selected.

Secondary data set
[Browse...](#) No file selected.

Settings

Exclude NA values File contains headers

Separator
 Tab Space Comma Semicolon

[Refresh](#) [Exit](#)

Plot | Primary data set | Secondary data set | Central Age Model | **R plot code**

```
# To reproduce the plot in your local R environment
# copy and run the following code to your R console.
library(Luminescence)
file<- file.choose()
data <- read.delim(file, header = FALSE, sep= '\t')

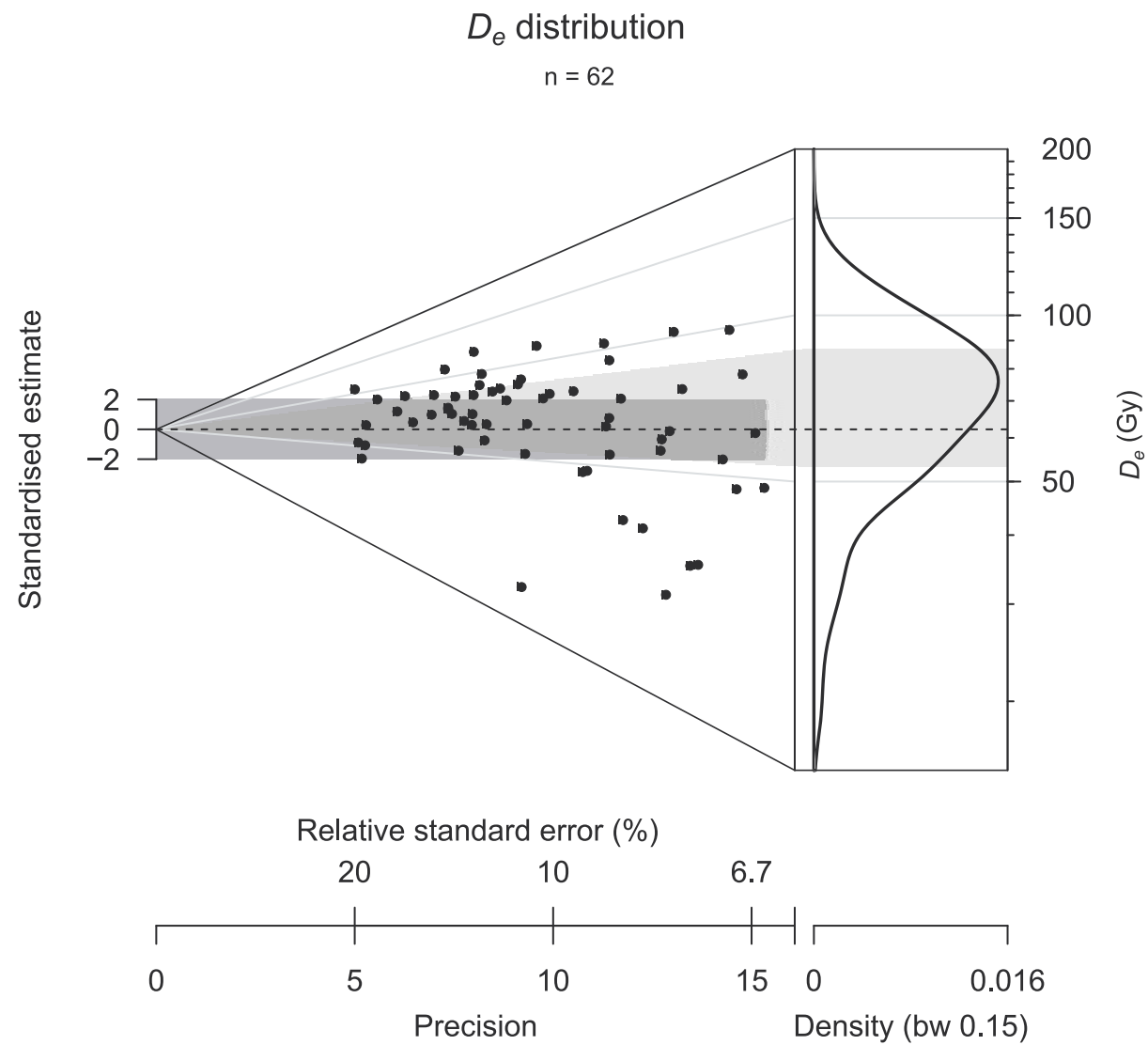
plot_AbanicoPlot(data = data,
  summary.pos = 'topleft',
  y.axis = TRUE,
  centrality = 'mean',
  bw = 0.269717338633411,
  dispersion = 'sd',
  plot.ratio = 0.75,
  central.value = 69.3256451612903,
  log.z = TRUE,
  summary = c('NA'),
  col = c('black', '#FFFFFF00'),
  pch = c(16,16),
  slab = 'Equivalent dose [Gy]',
  main = 'Abanico Plot',
  xlim = c(15.76,142.872),
  cex = 1,
  mtext = '',
  stats = ,
  error.bars = FALSE,
  line = c(NA,NA,NA,NA,NA,NA,NA,NA),
  line.col = c('#000000','#000000','#000000','#000000','#000000','#000000','#000000','#000000'),
  line.label = c('','','','','',''),
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  grid.col = 'none',
```

Git version history

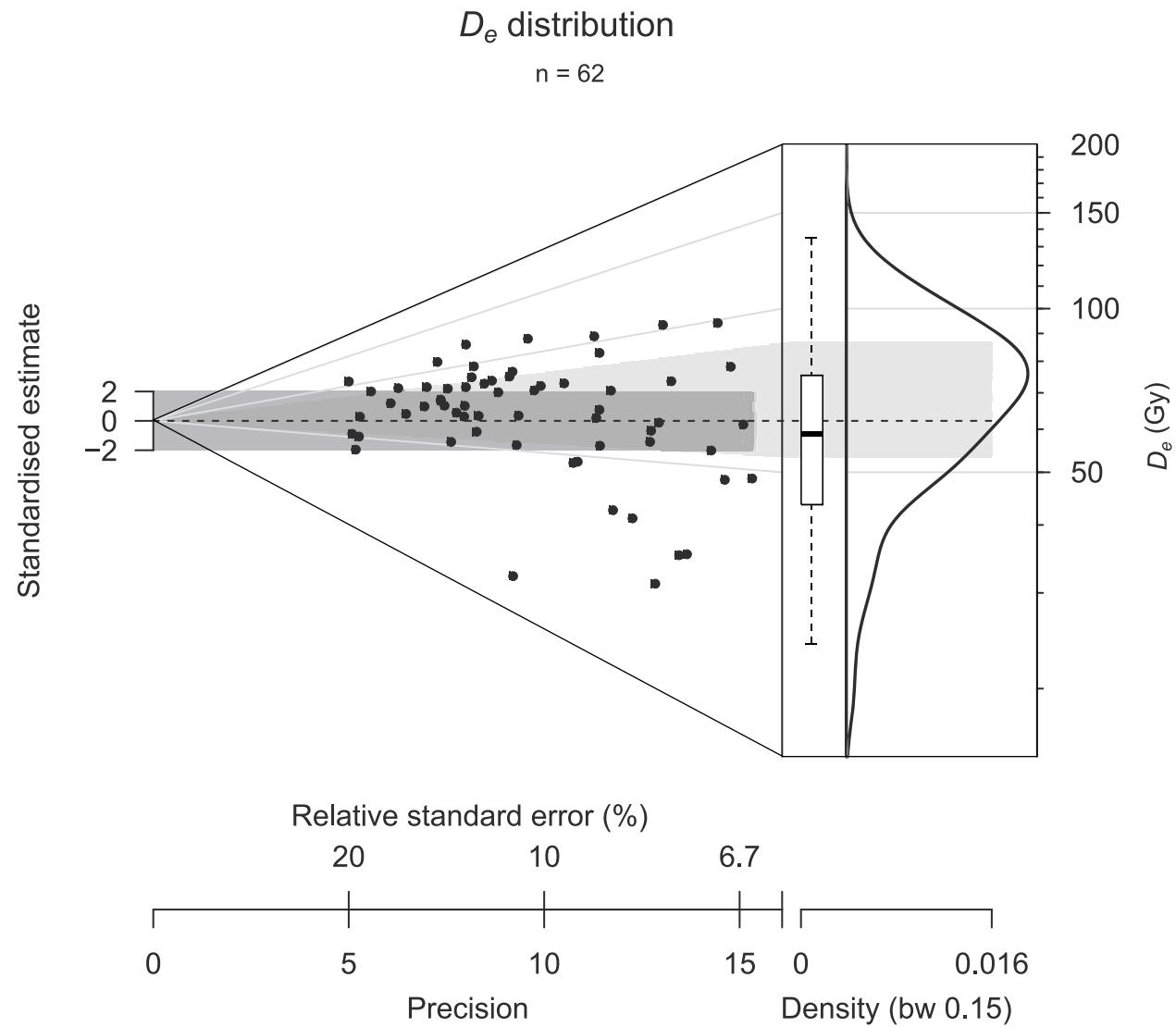
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<http://zerk.canopus.uberspace.de/R.Lum/>

Where to go next Some future improvements, tweaks, generalisations

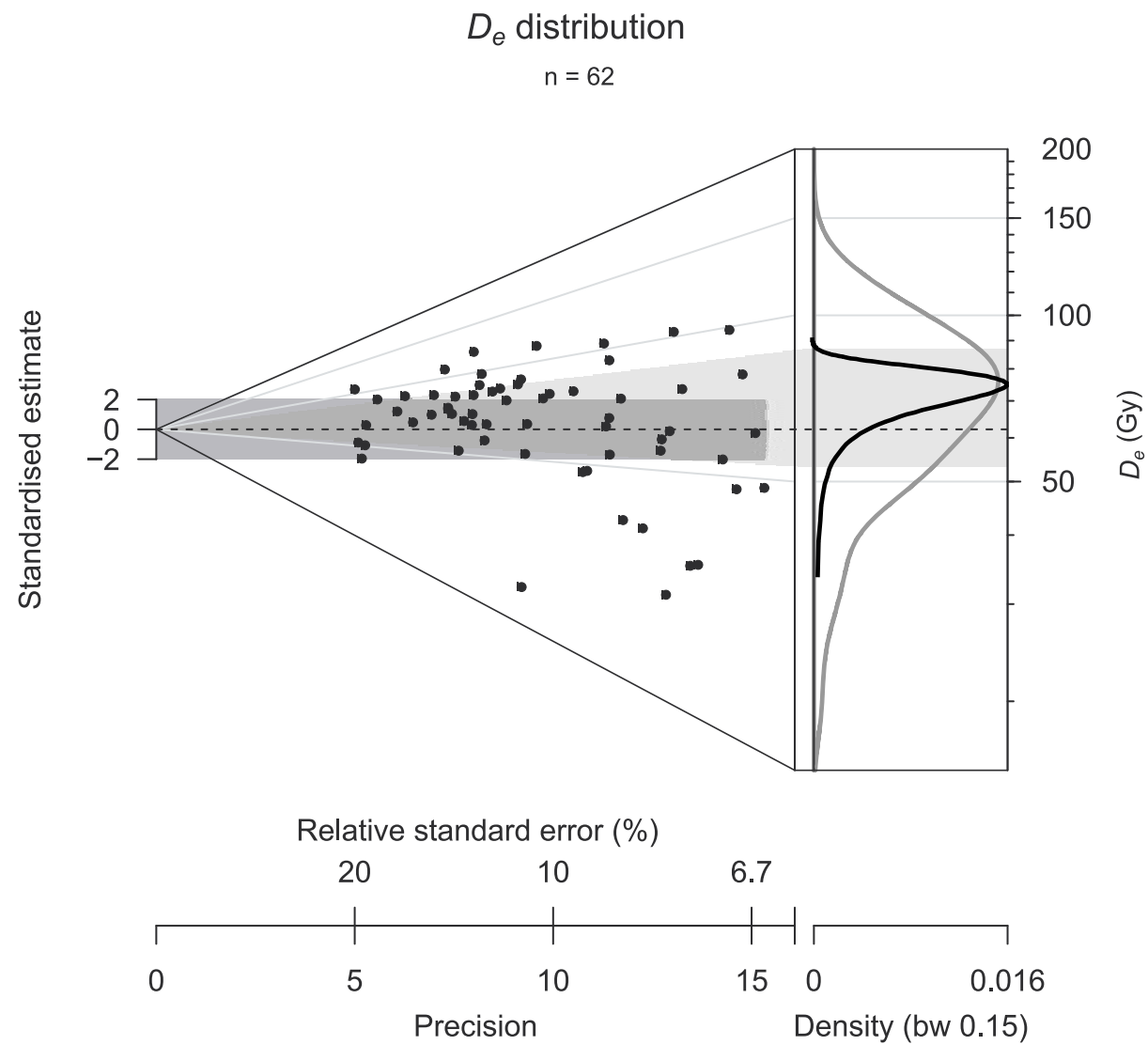


Where to go next Some future improvements, tweaks, generalisations

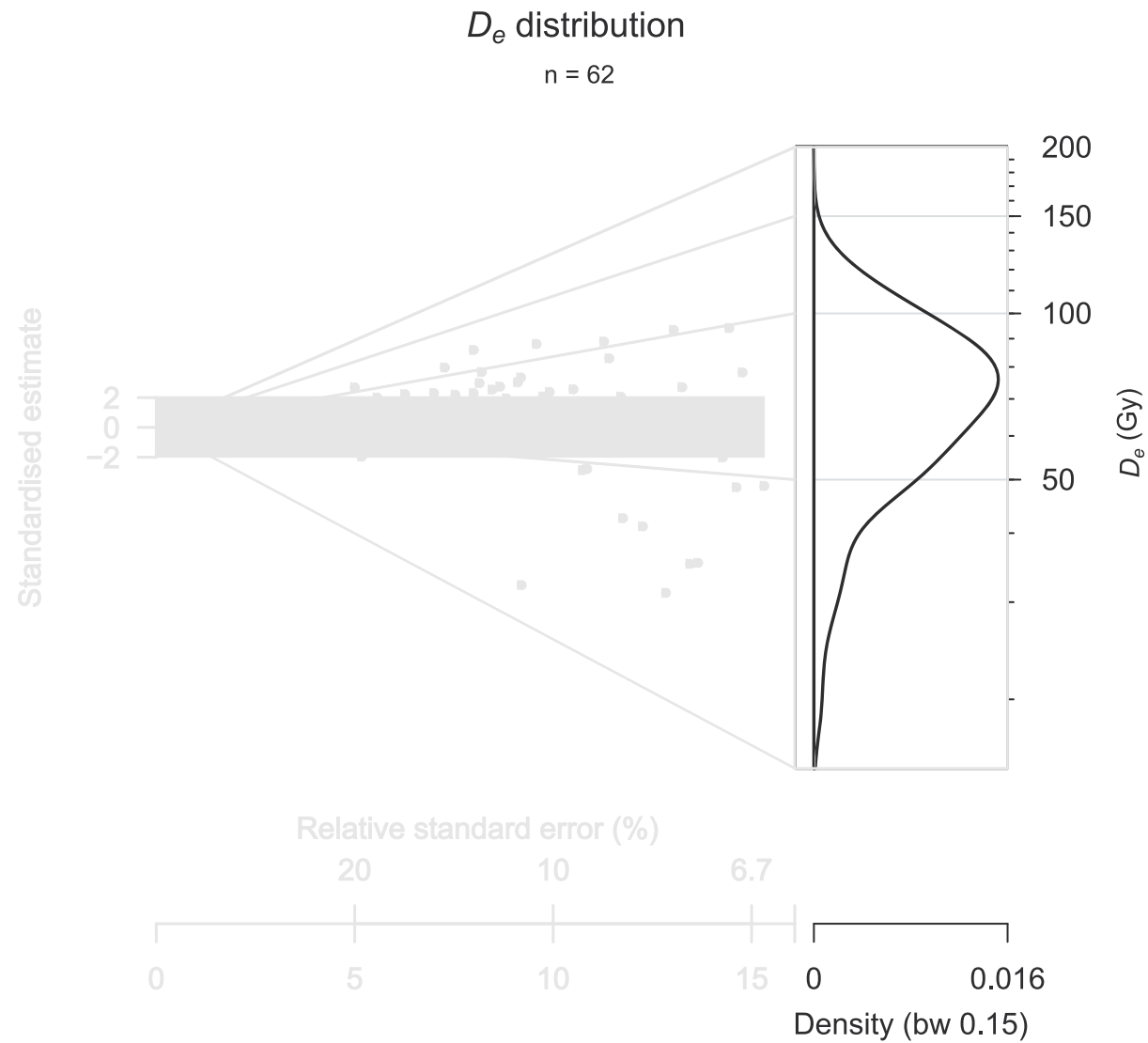


Where to go next

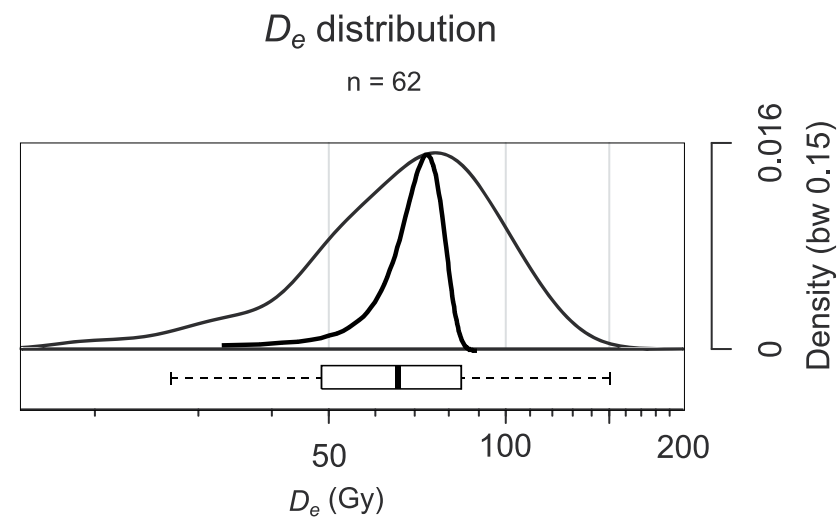
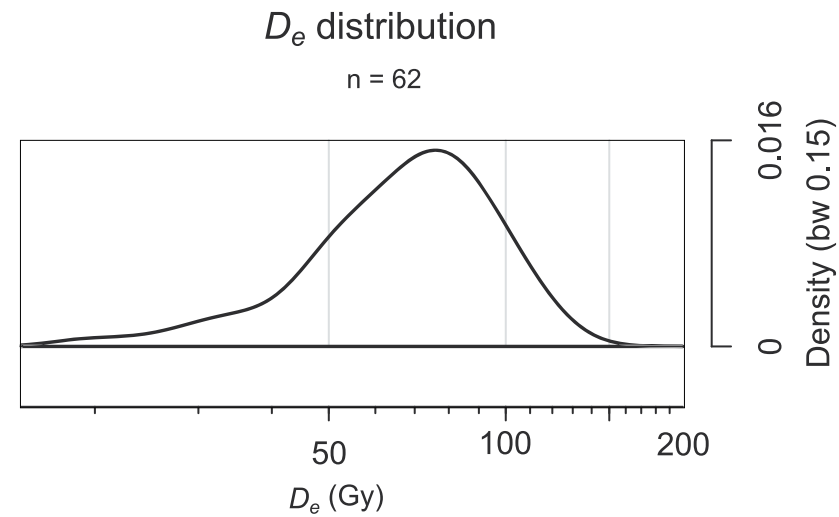
Some future improvements, tweaks, generalisations



Where to go next Some future improvements, tweaks, generalisations



Where to go next Some future improvements, tweaks, generalisations



WHY? |

FOUR EQUATIONS |

APPLICATIONS |

AP @ R.LUM & SHINY |

TOWARDS INNOVATIONS

Where to go next ...



Let the users decide...
...implying they get involved!

A photograph of a black sand beach. The sand is dark and fine-grained, extending from the foreground towards the water. The water is dark blue with white foam from waves crashing onto the shore. In the foreground, there is a patch of yellowish-green, mossy or lichen-covered ground, possibly a dune or a rocky outcrop. The overall scene is a natural coastal landscape.

Thank you!