Mineral processing

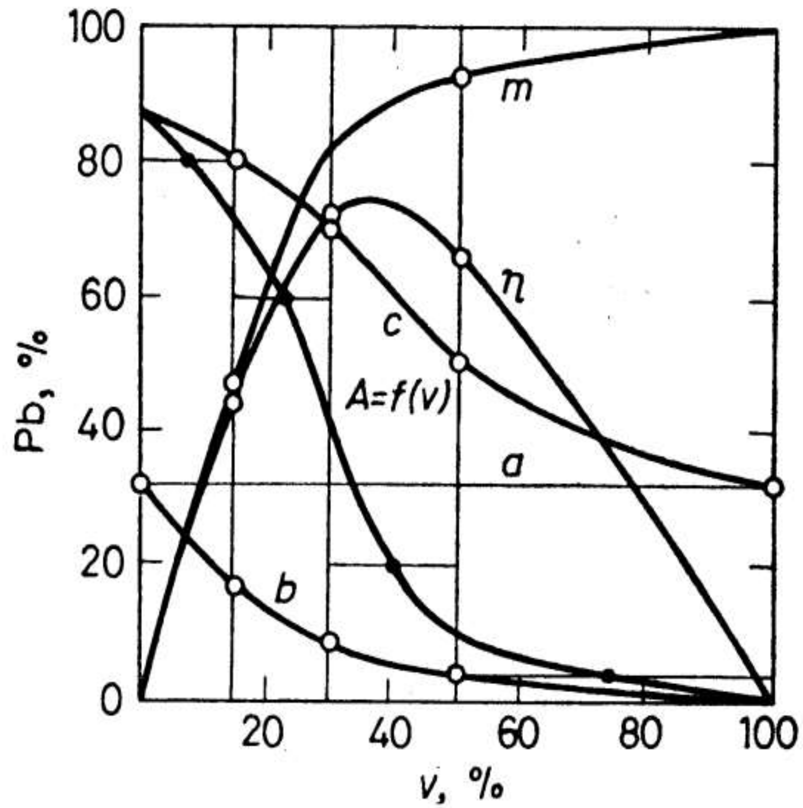


Fig. 2.13. Ore-dressing diagram. Basic curve $A = f(v)$ — metal content in r.o.m. ore vs. weight recovery v; a — average metal content of r.o.m. ore; b — metal-content curve of gangue; c — metal-content curve of concentrate; m — metal recovery curve; η — curve of the concentration operation's efficiency

[Tarján]

University of Göttingen
GÖochronology

Data reporting and alternative tools for the expression and interpretation of detrital zircon U-Pb data

(from the aspect of a fission trackker)

István DUNKL
http://www.sediment.uni-goettingen.de

Discordance criteria ?

DcPDP (= Discordance corrected PDP)

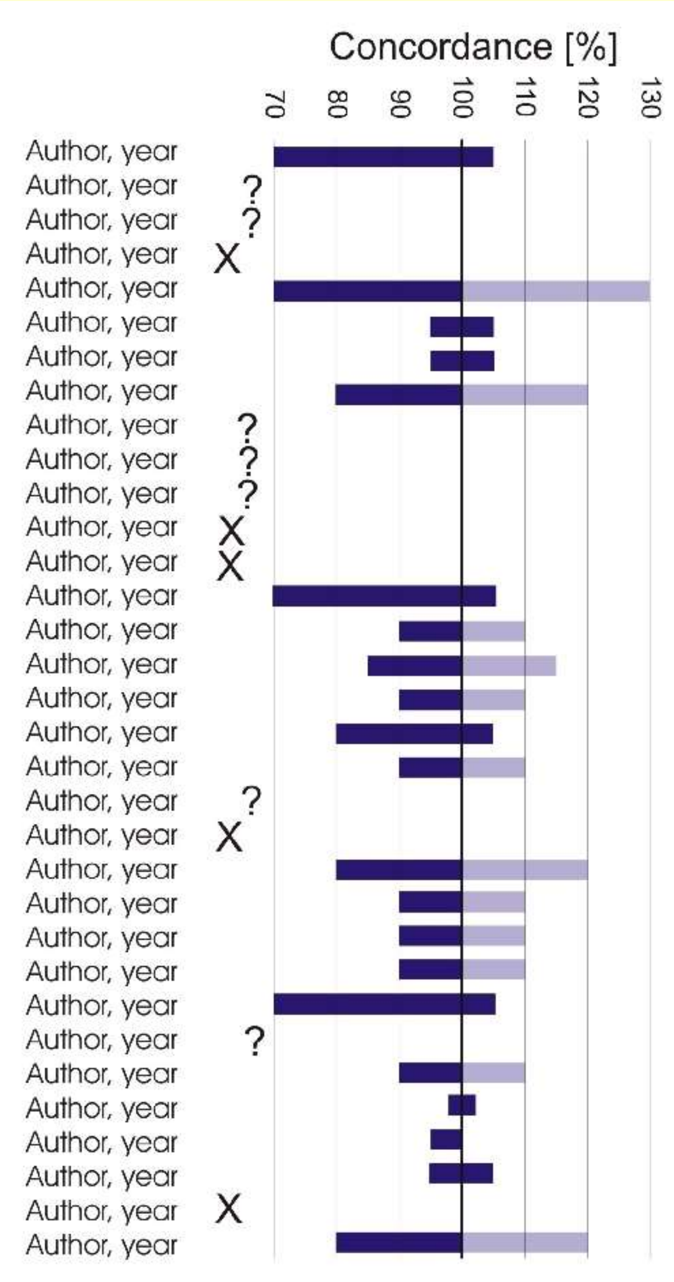
Type of distribution of age components

An unusual way to identify age componets

Residual error test for the youngest component

Minimum distance of components

Compilation of discordance criteria from randomly selected papers with detrital U/Pb ages



has 11 mildly discordant grains,

concordant and nearly concordant analyses

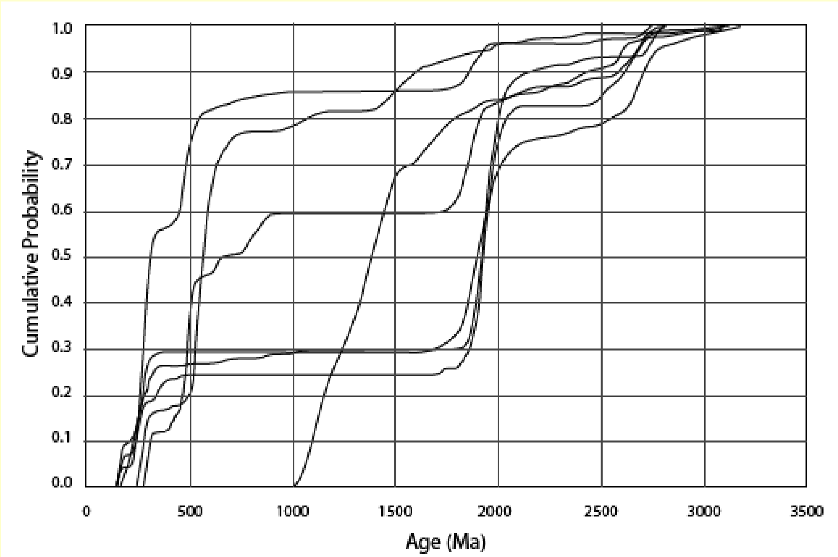
ages with acceptable concordance

high discordance

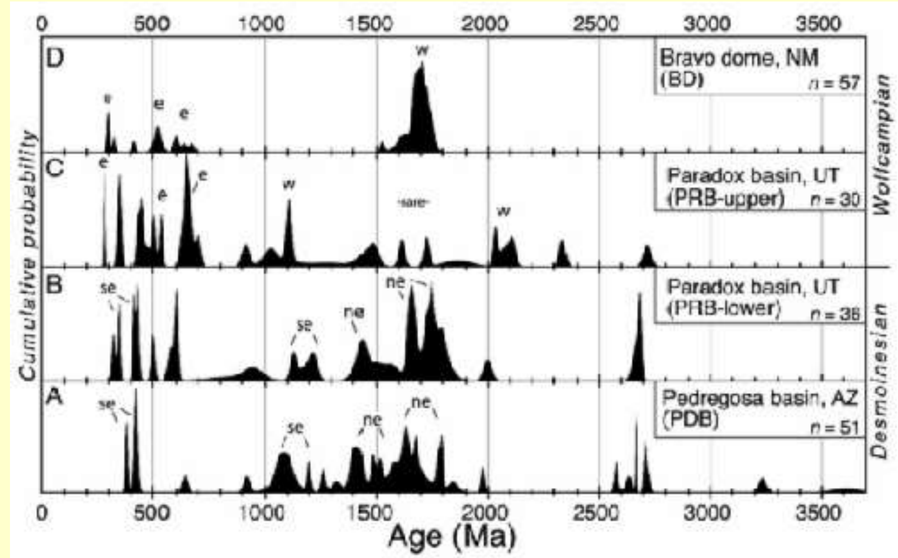
With several exceptions, the zircon ages are discordant.

X: concordance not mentioned
?: concordance not definied
light coloured: reverse side not mentioned

Cummulative vs. PDP



[Gehlers, 2006]



[Soreghan et al., 2002]

Houston, we have some problems:

THE TROUBLE WITH "PROBABILITY DENSITY" PLOTS
OF FISSION TRACK AGES

R. F. GALBRAITH

Statistical uncertainty associated with histograms in the Earth sciences

Pieter Vermeesch

Summary

- PDP is accepted, widely used
- discordant ages should be presented in a different way
- there is no accepted discordance cut off
- there is no reason to set a fix discordance cut off

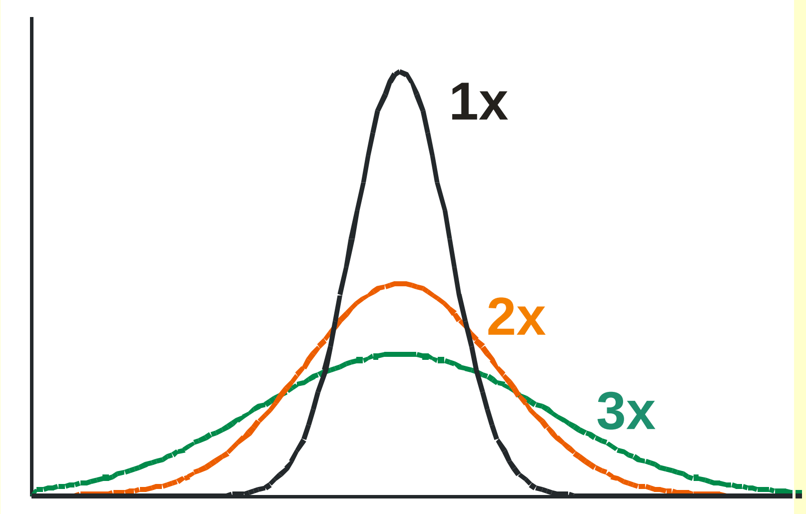
The suggestion: DcPDP (= Discordance corrected PDP)

... be pragmatical:

let's add a proportional 'punishment' to the calculated uncertainty according to the degree of discordance

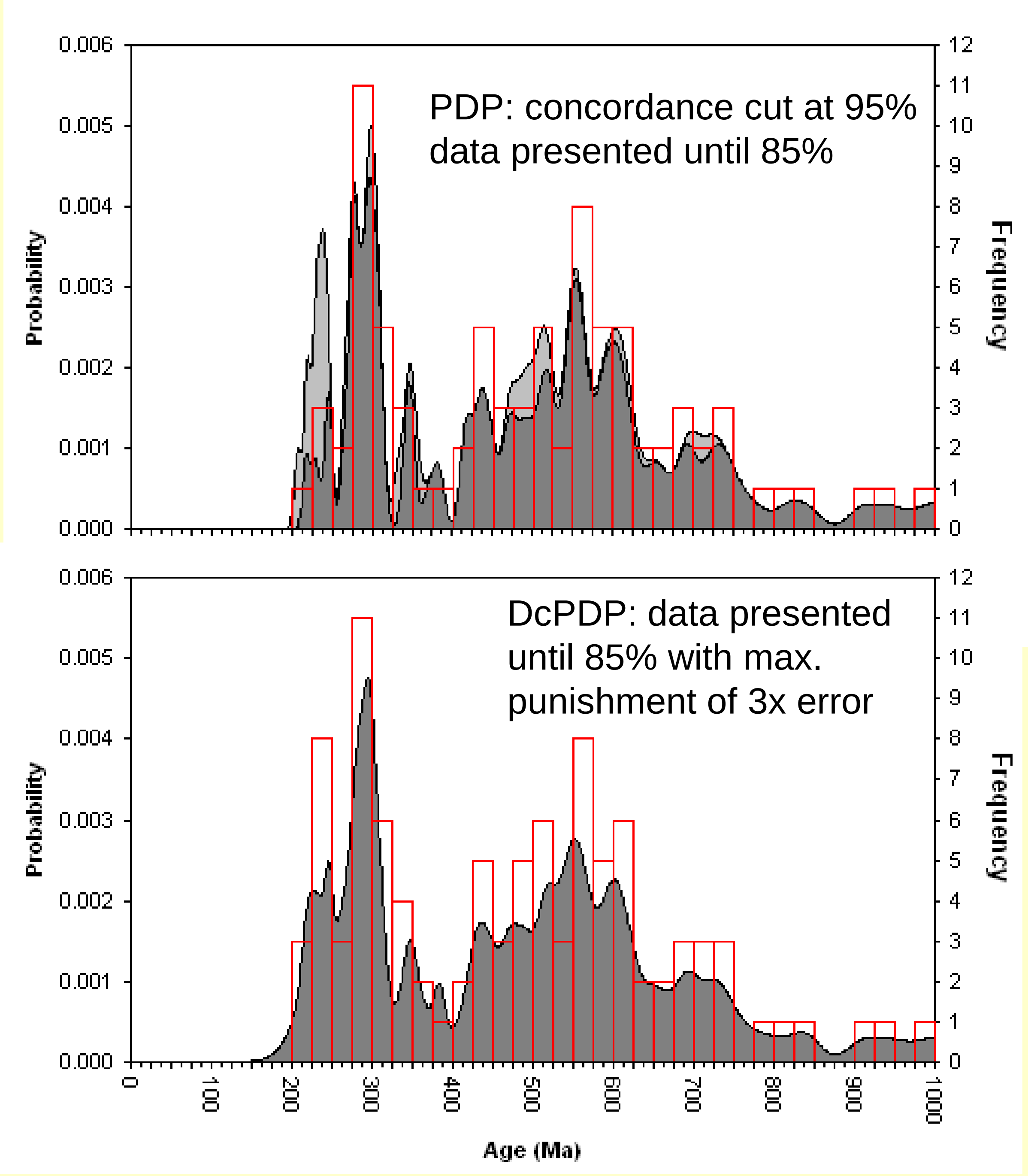
e.g.:

100% concordance ---> 1x unc.
85% concordance ---> 3x unc.



DcPDP
(Discordance corrected PDP)

an example



120 zircon 206/238 ages,
data from Mikes et al.

DcPDP (= Discordance corrected PDP)

POSSIBILITIES

limit of concordance: up to 90 ... 85% ?
punishment: 3x ...4x error ?
reverse side: up to 102 ...105% conc. ?

ADVANTAGES

- represents the actual differences between the reliability of data
- avoids the usage of an artificial discordance threshold
- reduces the 'hectic peaks' in the PDP
- the 'nearly concordant' data remains and contribute to the major age components *(important for sediment mass balance)*
- just one curve per sample *(clear-cut presentation in case of many data)*
- binned diagram can show all data in the background

Suggestions I.

Showing concordance in the data table

... and maybe propose a uniform format: 0.98 / 98% / +2%

Presenting the age of sedimentation in the graphics

- sieve fraction dated

- method of grain selection (if applied)

- number of data / number above 95 % concordance (*90% ? an issue for discussion*)

- which age presented: 206/238 or 207/206 or concordia or 'best age'?

- in case of 'combi' presentation at what age is the boundary of methods?

- which common-Pb correction used?

Identification of age components

The youngest and oldest ages ...

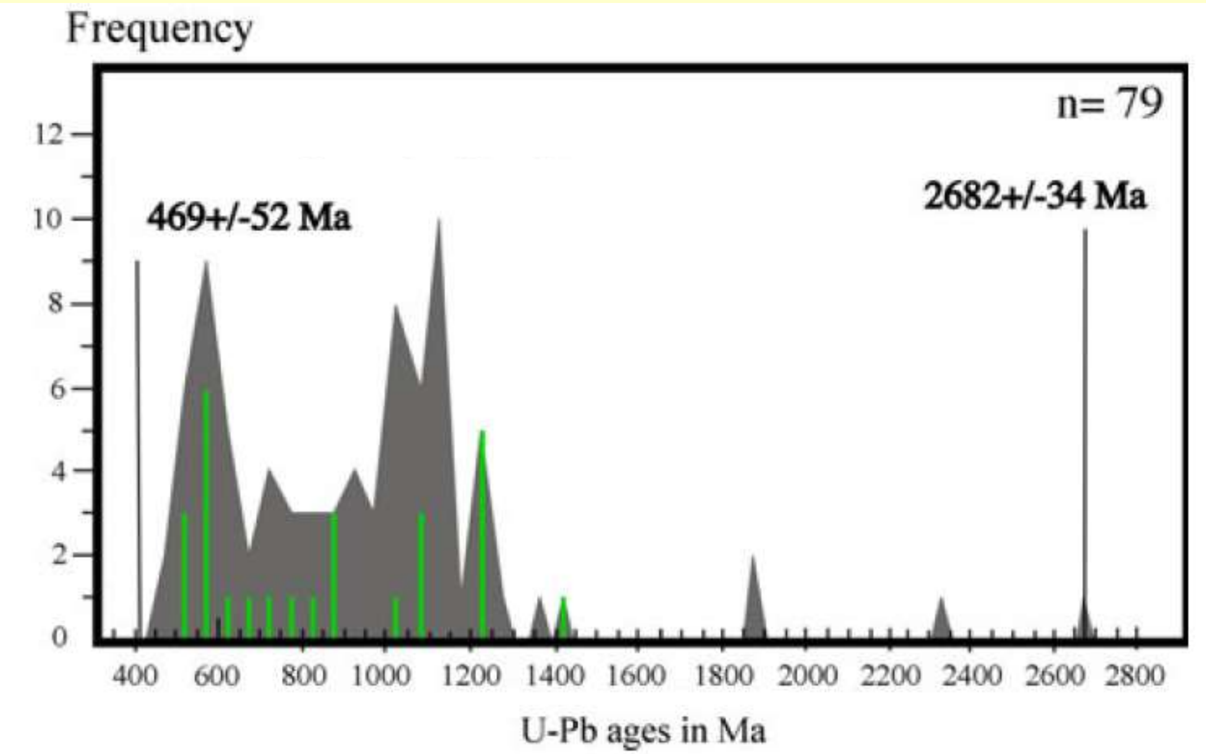
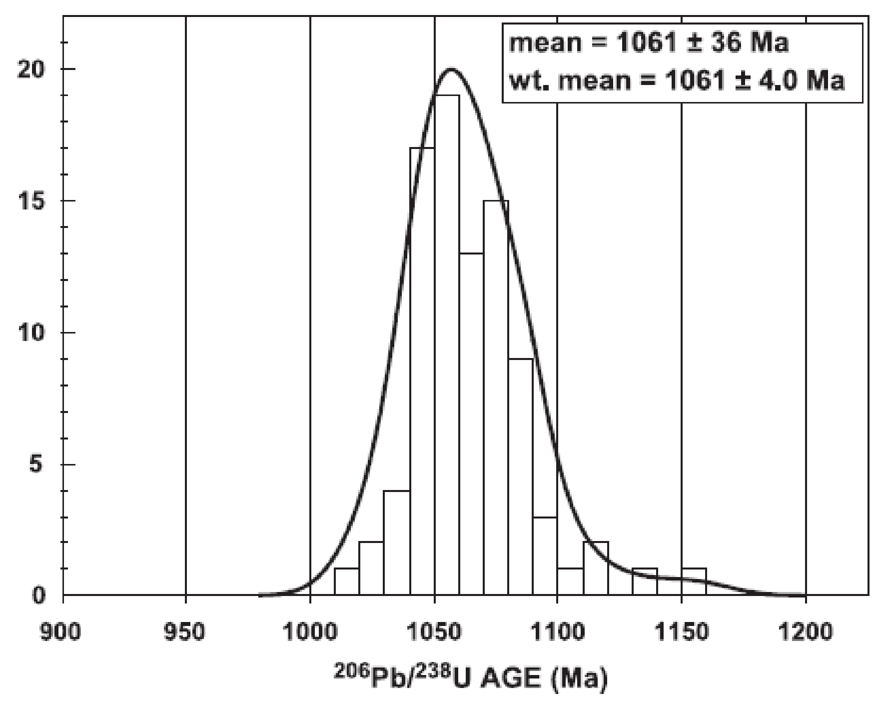


Fig. 6 **a** Schematic diagram for detrital zircons of the western basin of the according to data from Table 1 supplementary material. **b** Schematic diagram for detrital zircons of the eastern basin of the The oldest and youngest zircons are shown.

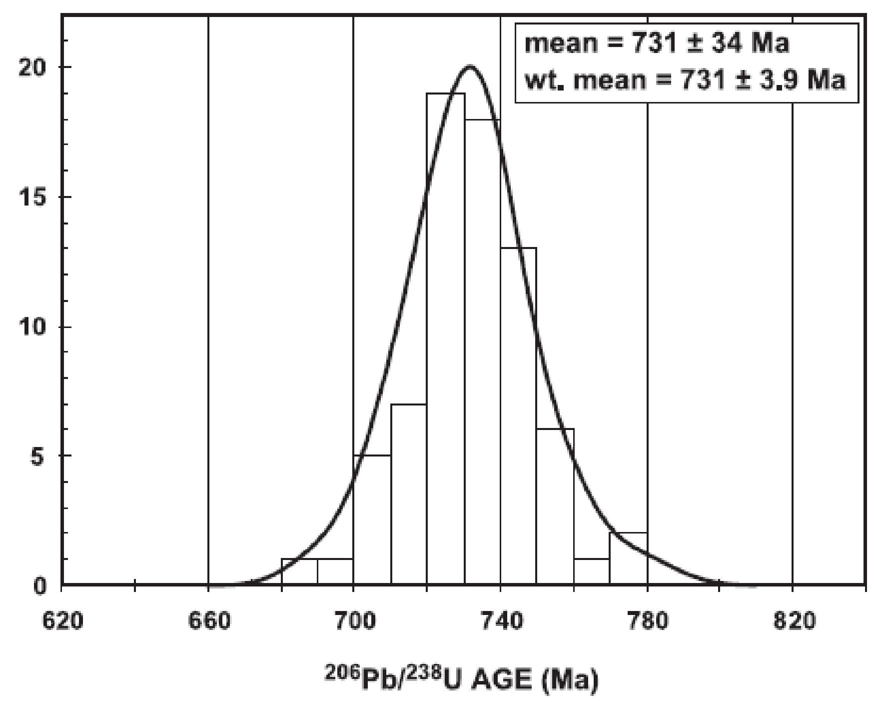
[Author, year]

Empirical distributions - what we need

91500



Mud Tank

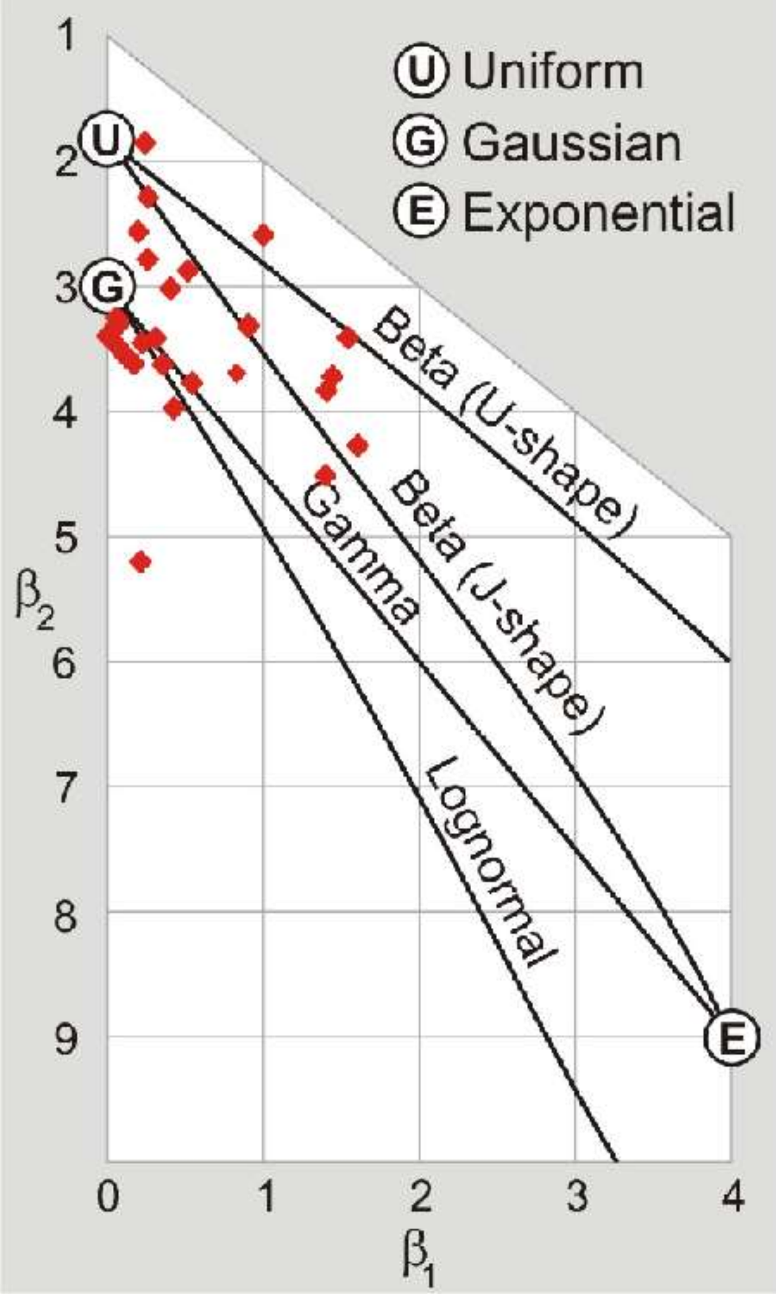


[Jackson et al., 2004]

1 single grain data : ... OK, it can be important, but it is an 'indication' and not an 'age component'

Empirical descriptions of grain-age distributions in standards and igneous samples help to determine the paremeters in detrital samples.

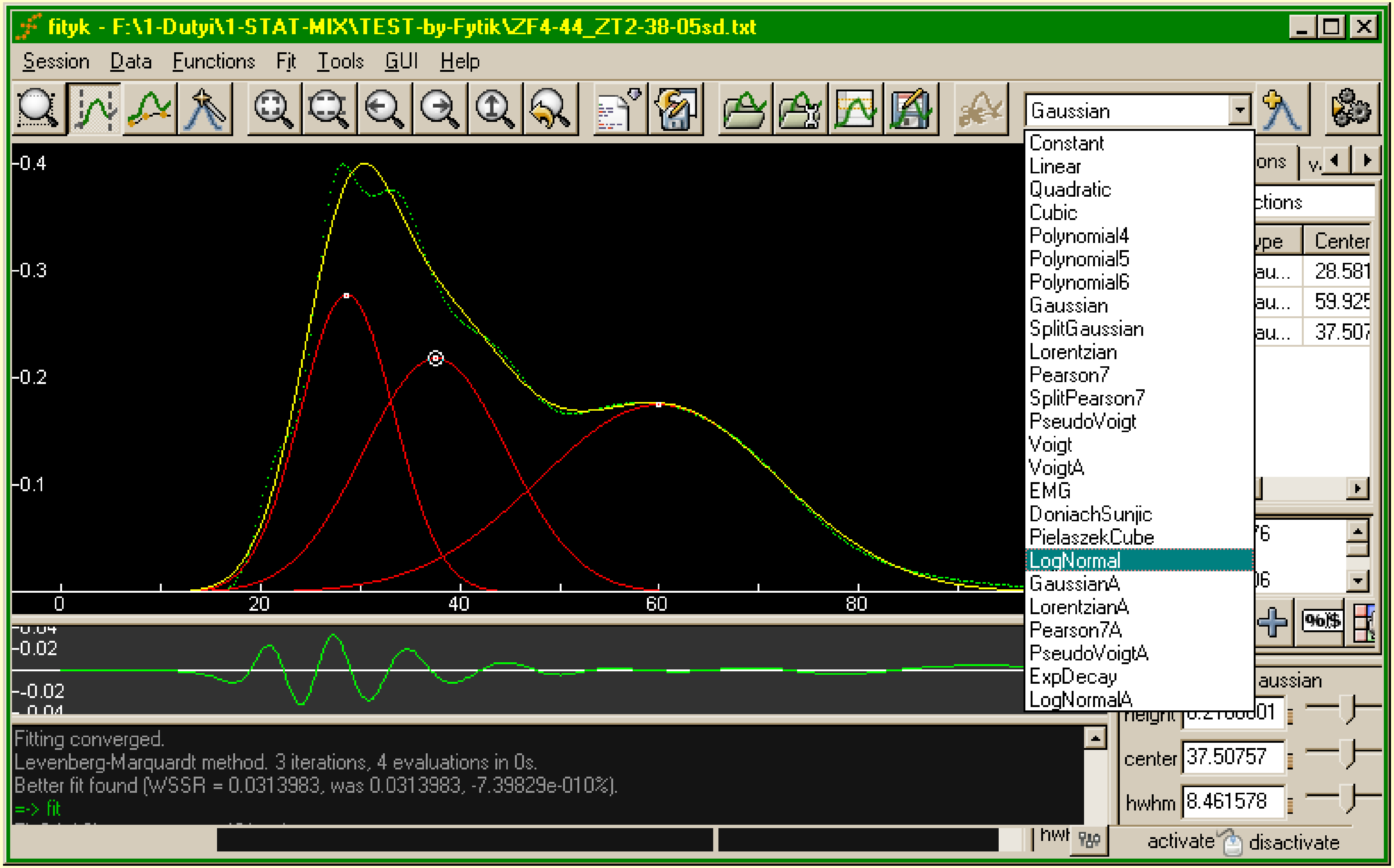
Parameters of single-grain age distributions of igneous samples on a Pearson family discrimination plot



mainly I-type granitoids, each sample composed of 25 single-grain ages

Age component isolation by curve fitting programs

(e.g. **Fityk** for Raman spectroscopy)



Fityk

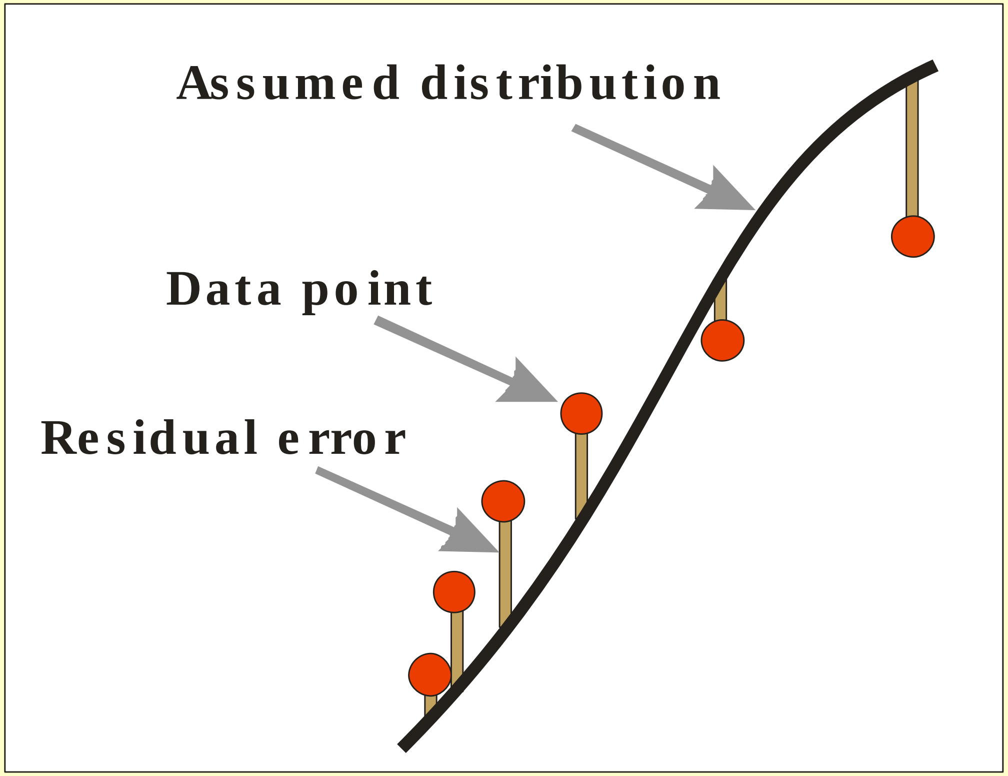
fityk y(x) curve fitting and data analysis

http://fityk.nieto.pl/

ADVANTAGES:
- quick
- transparent, well documented
- user can define the distribution type of components

DISADVANTAGE: it does not work with the primary data

Fitting of data and model by cummulative way



Fityk

http://fityk.nieto.pl/

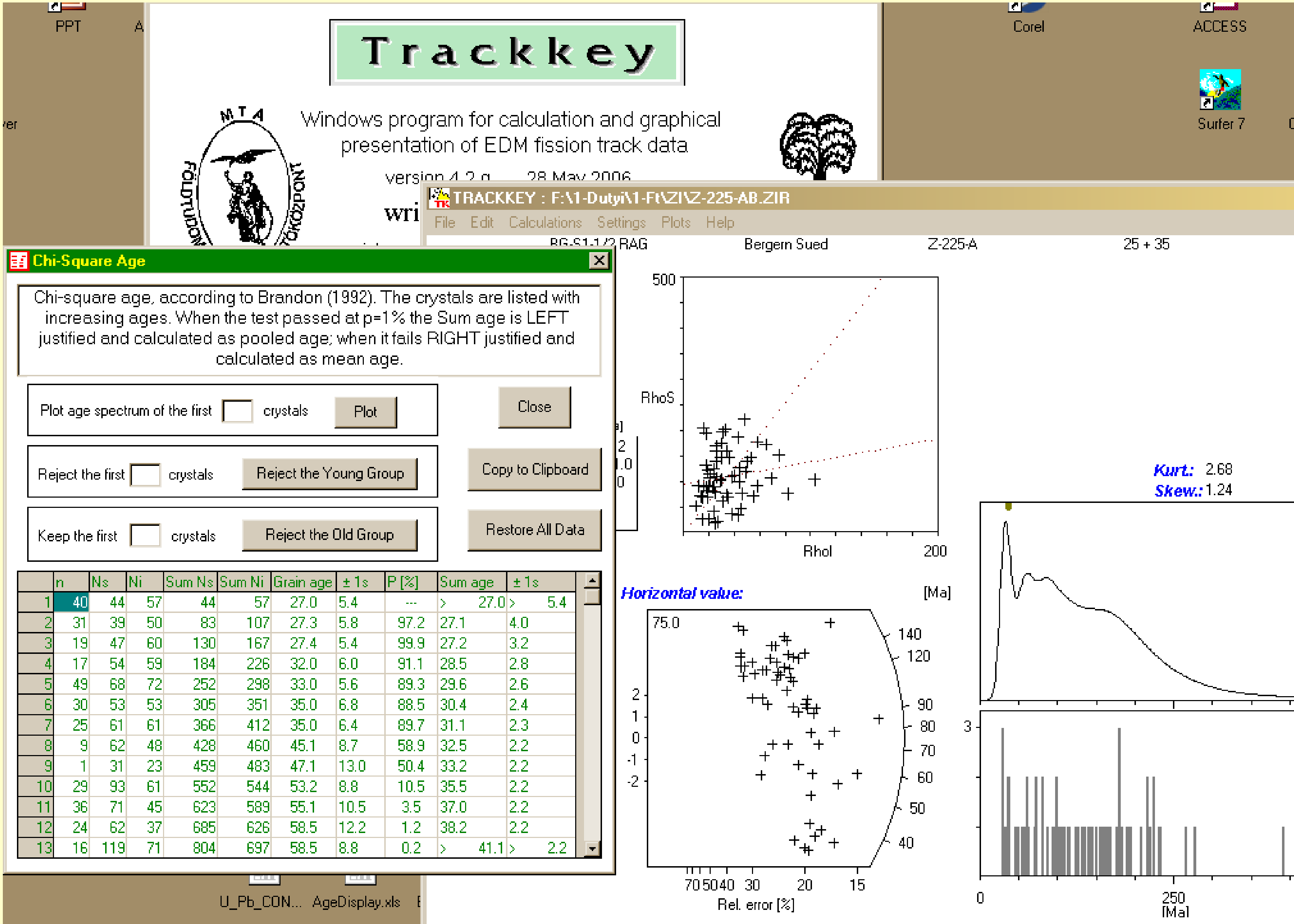
ADVANTAGES:
- quick
- transparent, well documented
- user can define the distribution type of components

DISADVANTAGE: it does not work with the primary data

BUT maybe fitting to a DcPDP generated curve is just an ADVANTAGE:

if DcPDP is a better approximation of the reliability of the data set, then in this way we can perform a more robust component identification

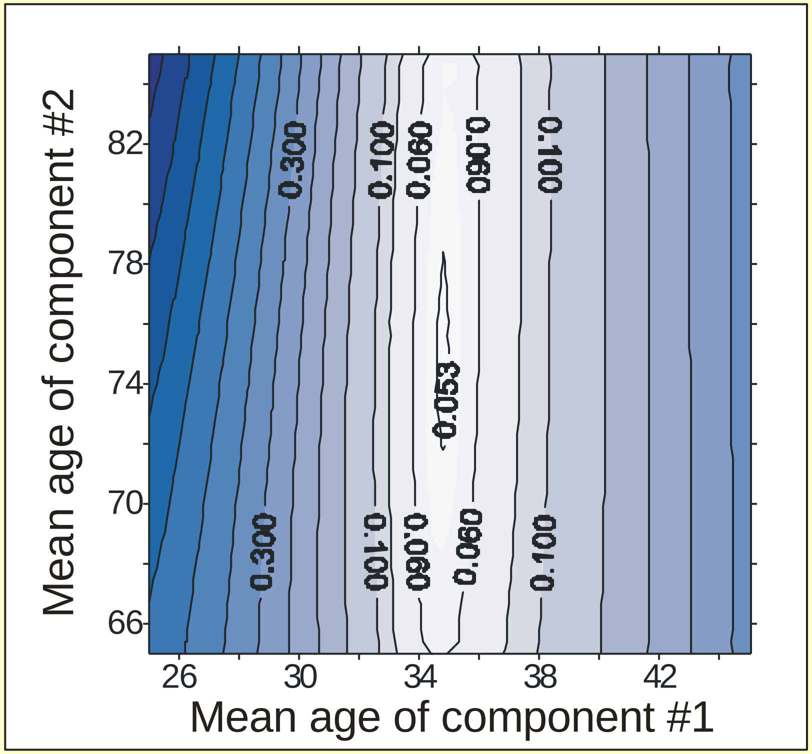
How the trackkers doing it ?

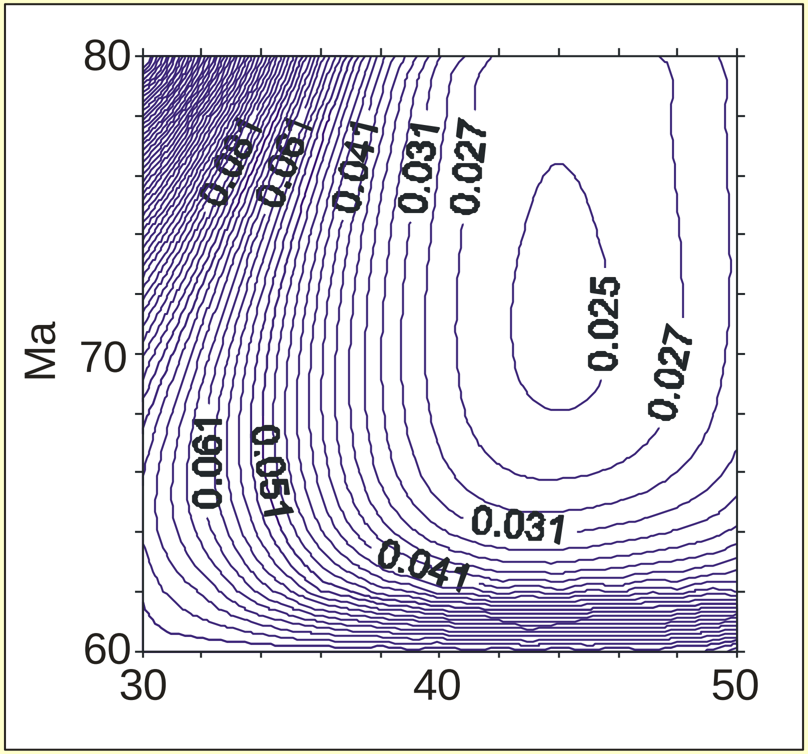


	n	Ns	Ni	Sum Ns	Sum Ni	Grain age	± 1s	P [%]	Sum age	± 1s
1	40	44	57	44	57	27.0	5.4	---	> 27.0	> 5.4
2	31	39	50	83	107	27.3	5.8	97.2	27.1	4.0
3	19	47	60	130	167	27.4	5.4	99.9	27.2	3.2
4	17	54	59	184	226	32.0	6.0	91.1	28.5	2.8
5	49	68	72	252	298	33.0	5.6	89.3	29.6	2.6
6	30	53	53	305	351	35.0	6.8	88.5	30.4	2.4
7	25	61	61	366	412	35.0	6.4	89.7	31.1	2.3
8	9	62	48	428	460	45.1	8.7	58.9	32.5	2.2
9	1	31	23	459	483	47.1	13.0	50.4	33.2	2.2
10	29	93	61	552	544	53.2	8.8	10.5	35.5	2.2
11	36	71	45	623	589	55.1	10.5	3.5	37.0	2.2
12	24	62	37	685	626	58.5	12.2	1.2	38.2	2.2
13	16	119	71	804	697	58.5	8.8	0.2	> 41.1	> 2.2

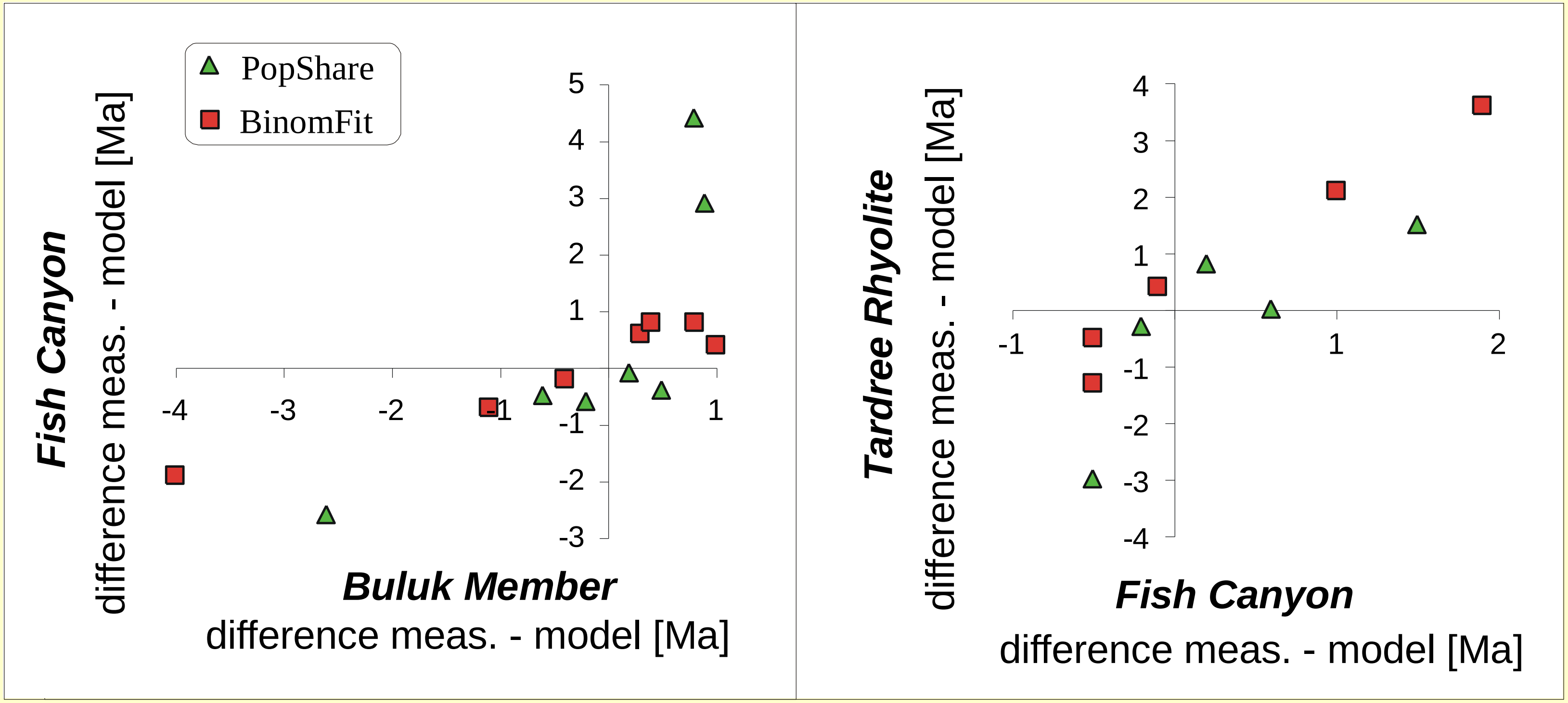
Residual error visualizes the reliability of the age components

Especially recommended for the youngest age component

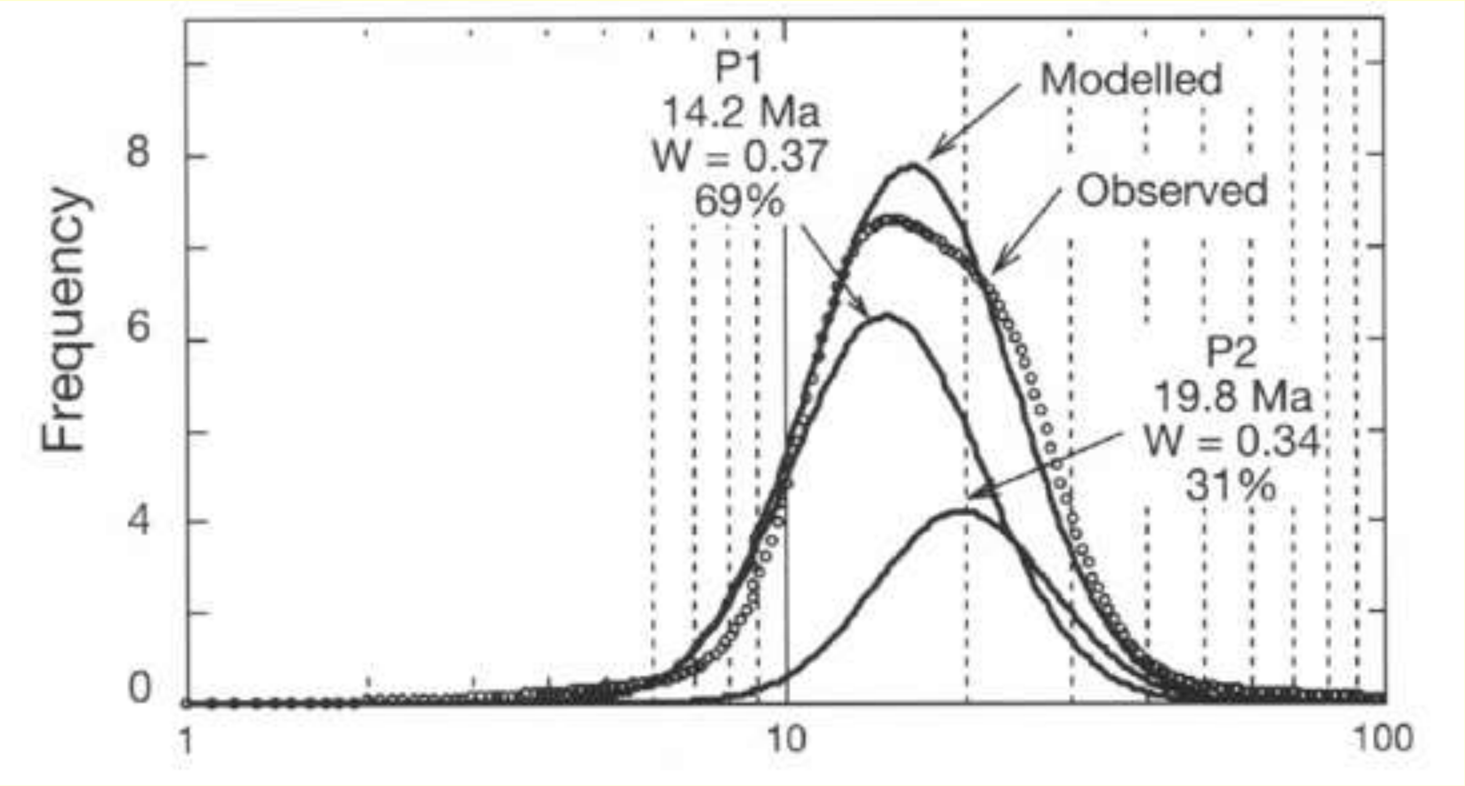




Test of component identification by mixed age standards

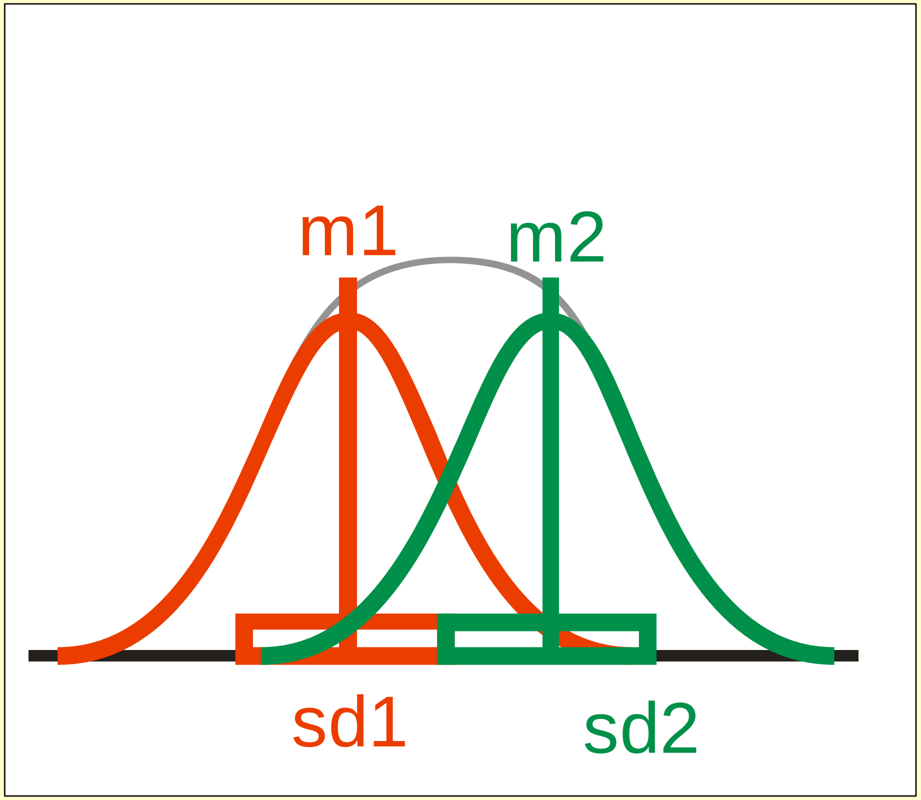


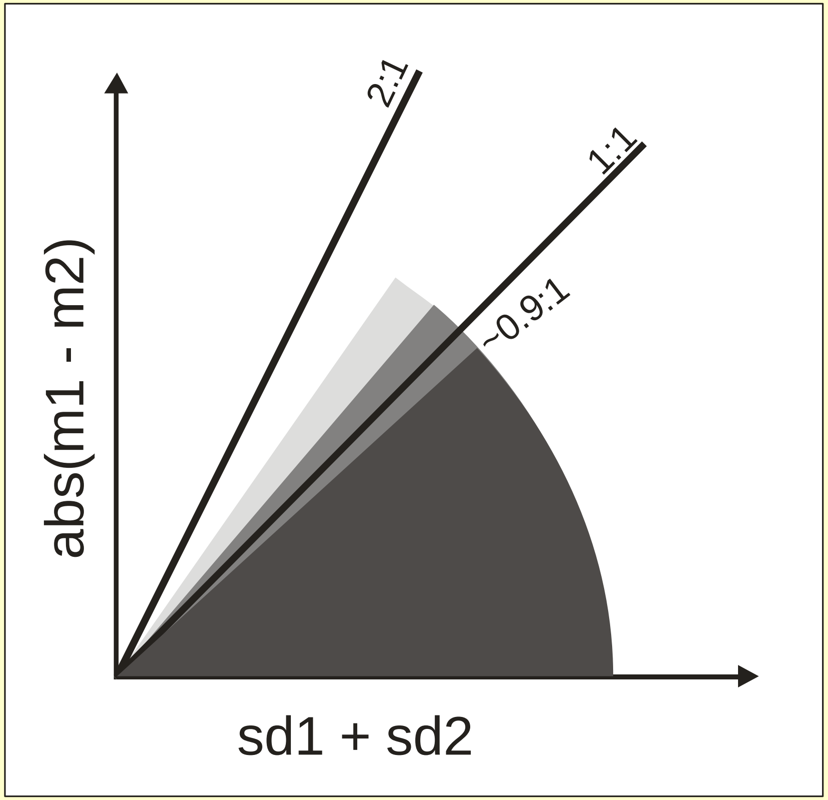
Fitted *"peaks"* method



[Author, year]

What is the signal-criterion?





Some hints to the number of age components

Evaluation scheme of a distribution

1. Assuming one component

1.1. Symmetric

Gaussian
Laplace .....

1.2. "Oblic" (~Pearson Gr.)

Gamma
Lognormal ......

2. More components

Component:
A distinguishable part of the whole data set that can be characterized by a distribution type, mean and scatter.

2.1. How many?
2.2. Distribution type?

Number of parameters: (No of comps * 3) - 1 = parameters

Components		Parameters		Data needed
2	-->	5	-->	~25
3	-->	8	-->	~40
4	-->	11	-->	~55
5	-->	14	-->	~70
6	-->	17	-->	~85

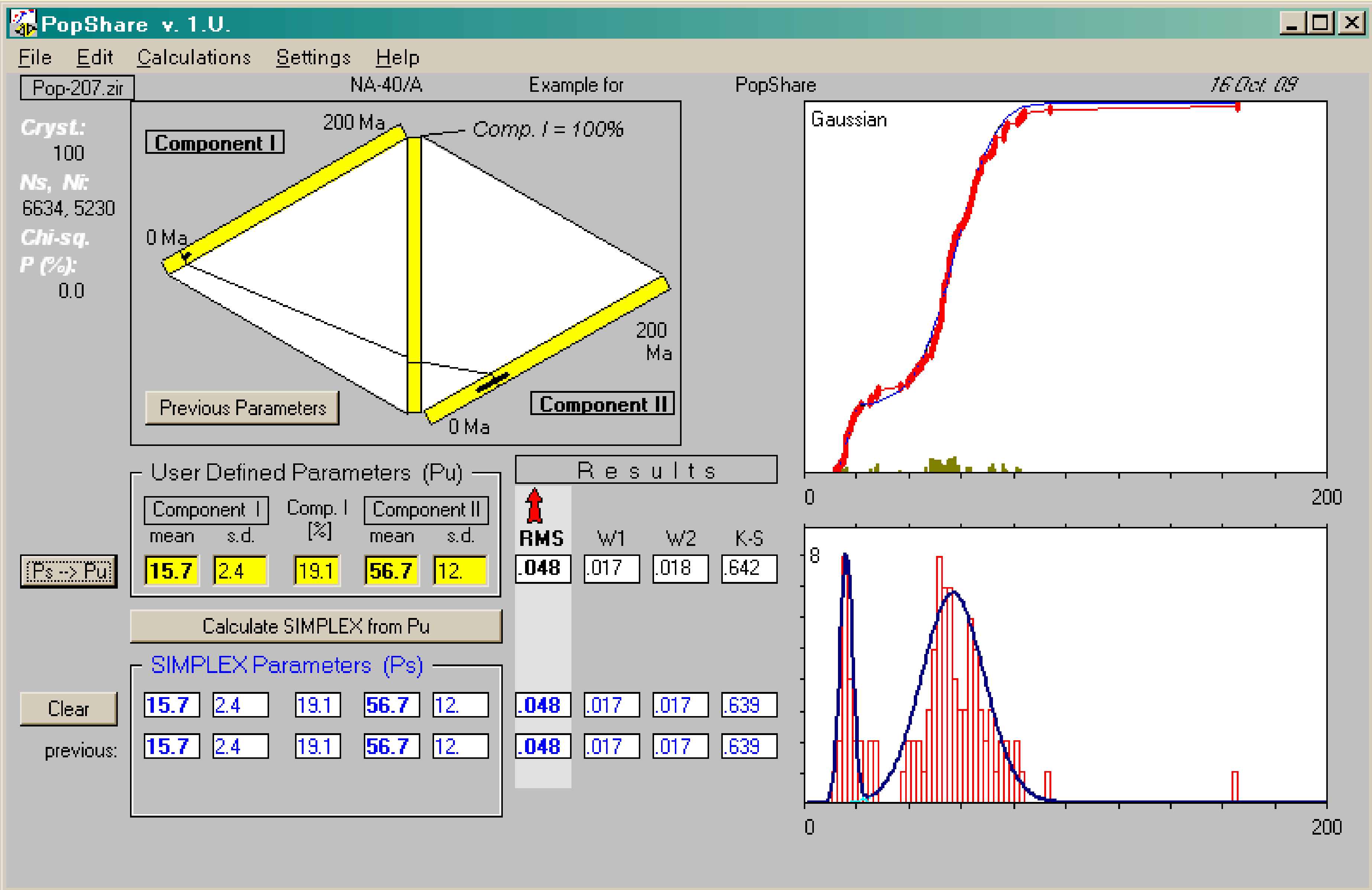
Suggestion for data presentation

- DcPDP (corrected curve + all data in binned diagram)

Suggestions for component analysis

- the youngest age has very limited meaning
- one data is not an age component
- empirical description of distribution type of igneous samples and their parameters for the identification of components in detrital samples
- we should consider some overlapping criterion in order to limit the number of age components
- the isolation of the youngest age component needs special care, consider residual error analysis for the estimation of the real uncertainty
- maybe the DcPDP generated (smoothed) curve is a useful base for component identification

Stop talking


PopShare v. 1.U.
File Edit Calculations Settings Help
Pop-207.zir
NA-40/A
Example for
PopShare
16 Oct. 08
Cryst.:
100
Ns, Ni:
6634, 5230
Chi-sq.
P (%):
0.0
Component I
200 Ma
Comp. I = 100%
0 Ma
200
Ma
Previous Parameters
Component II
0 Ma
Gaussian
0
200
8
0
200
User Defined Parameters (Pu)
Component I
mean
s.d.
Comp. I
[%]
Component II
mean
s.d.
15.7
2.4
19.1
56.7
12.
Ps --> Pu
Calculate SIMPLEX from Pu
Results
RMS
W1
W2
K-S
.048
.017
.018
.642
SIMPLEX Parameters (Ps)
Clear
15.7
2.4
19.1
56.7
12.
.048
.017
.017
.639
previous:
15.7
2.4
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56.7
12.
.048
.017
.017
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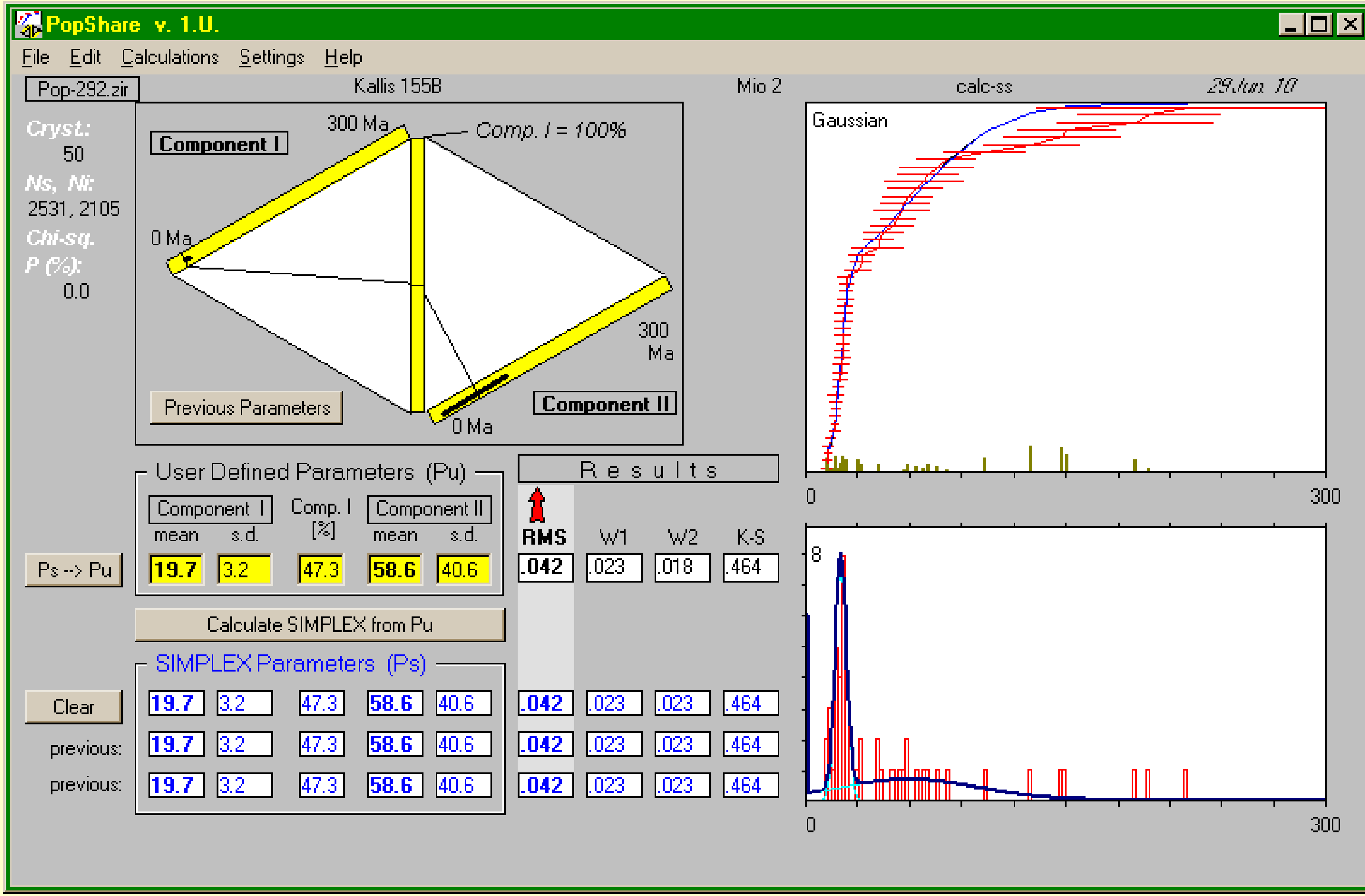
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Mio 2
calc-ss
29.Jun. 10
Cryst.:
50
Ns, Ni:
2531, 2105
Chi-sq.
P (%):
0.0
Component I
300 Ma
Comp. I = 100%
0 Ma
300
Ma
0 Ma
Component II
Previous Parameters
Gaussian
0
300
8
0
300
User Defined Parameters (Pu)
Component I
mean s.d.
Comp. I [%]
Component II
mean s.d.
Ps --> Pu
19.7 3.2 47.3 58.6 40.6
Results
RMS W1 W2 K-S
.042 .023 .018 .464
Calculate SIMPLEX from Pu
SIMPLEX Parameters (Ps)
Clear
19.7 3.2 47.3 58.6 40.6 .042 .023 .023 .464
previous: 19.7 3.2 47.3 58.6 40.6 .042 .023 .023 .464
previous: 19.7 3.2 47.3 58.6 40.6 .042 .023 .023 .464

N

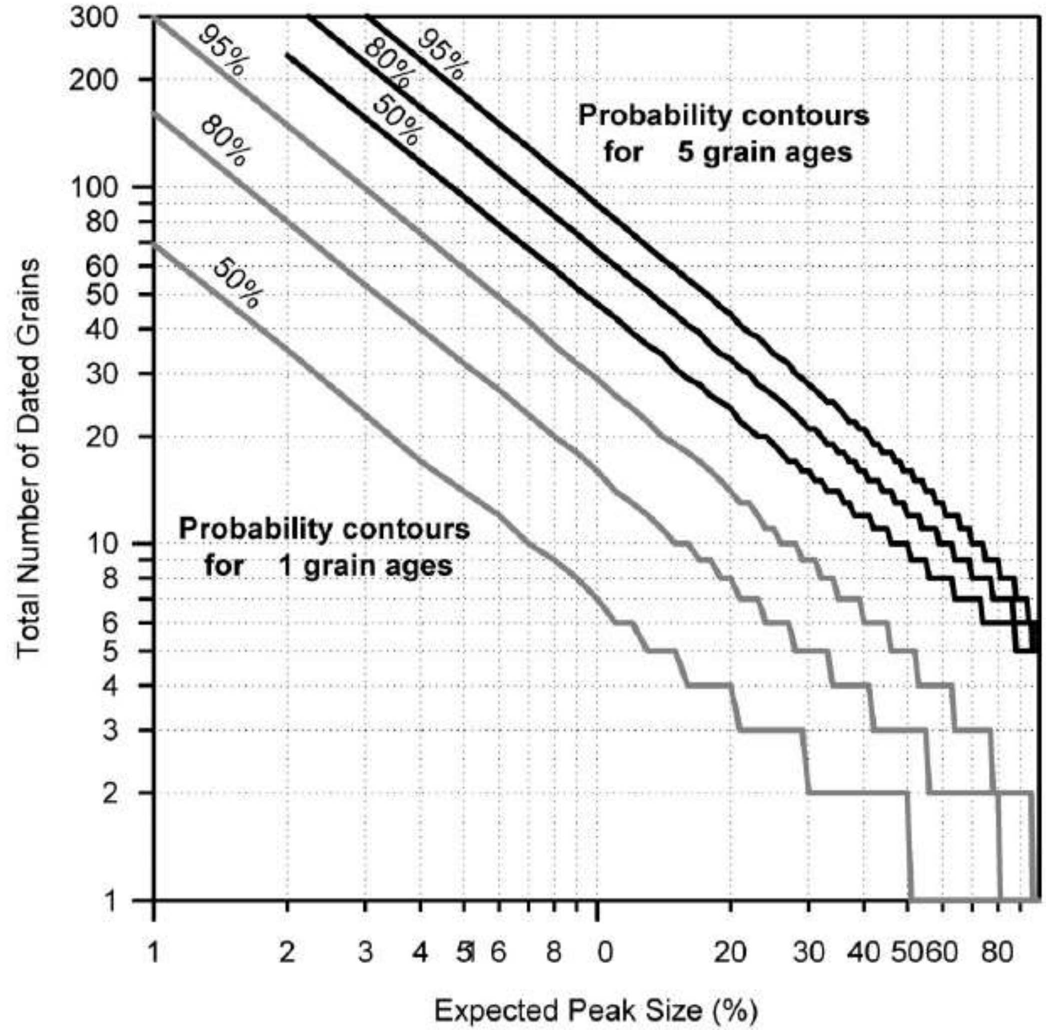
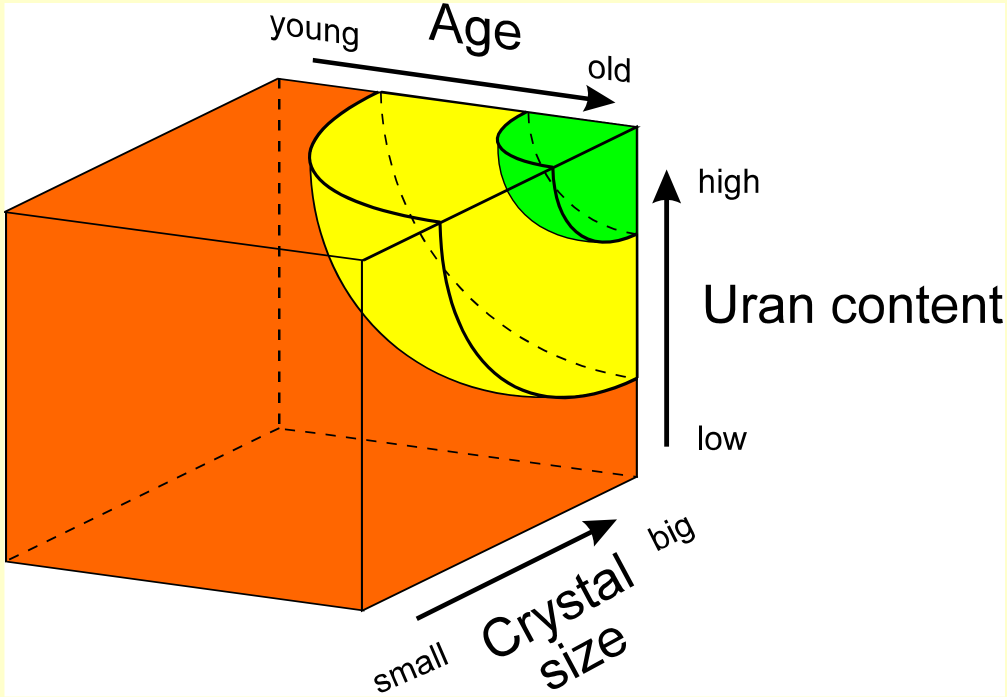


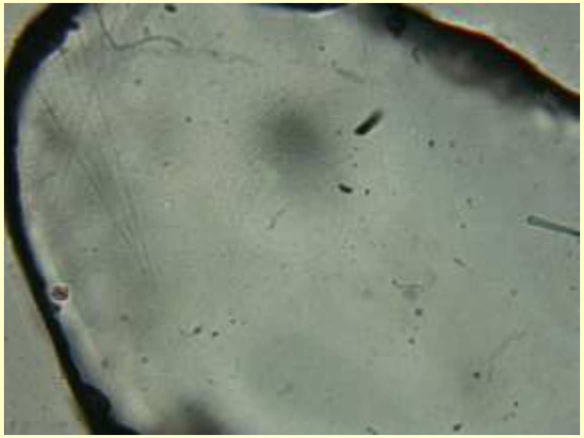
Figure 8. Graph showing probabilities that a sample grain-age distribution will contain at least one grain (gray contours) or at least five grains (black contours) from a component of that distribution. The probabilities are a function of the true size (i.e. expected size) of the component and the total number of grains dated. The calculated probabilities are based on the binomial distribution. See text for further discussion.

[Stewart and Brandon, 2004]

The crystals have different counts and thus different error

Number of tracks	FT age [Ma]	±	1s	
71	46	±	8	
45	34	±	7	
91	38	±	6	
45	28	±	6	
4	**13**	±	**7**	50 %
66	49	±	9	
46	45	±	9	
220	**42**	±	**6**	15 %
64	28	±	5	
18	21	±	6	

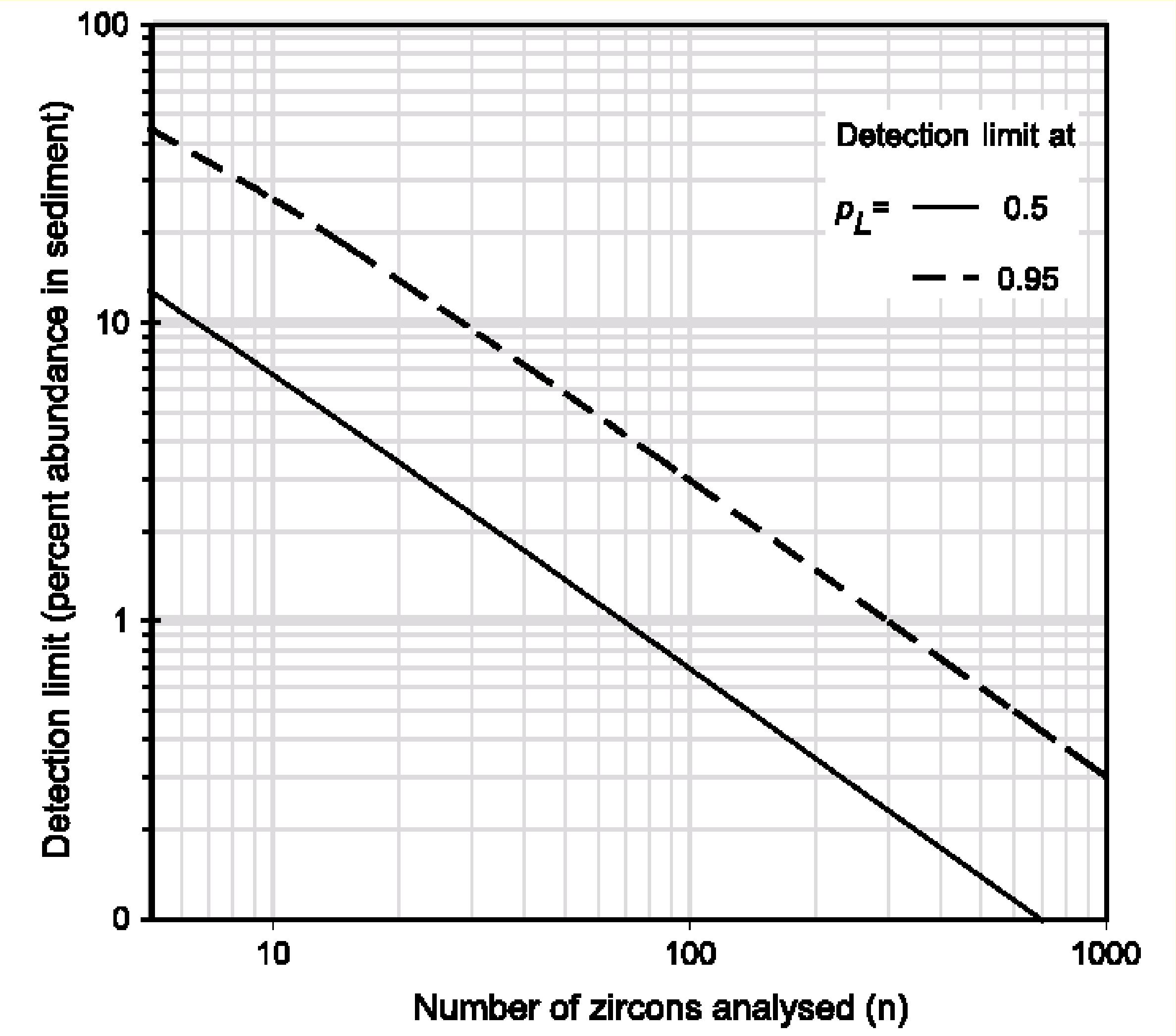




[Dunkl, 2001]

But how many grains?

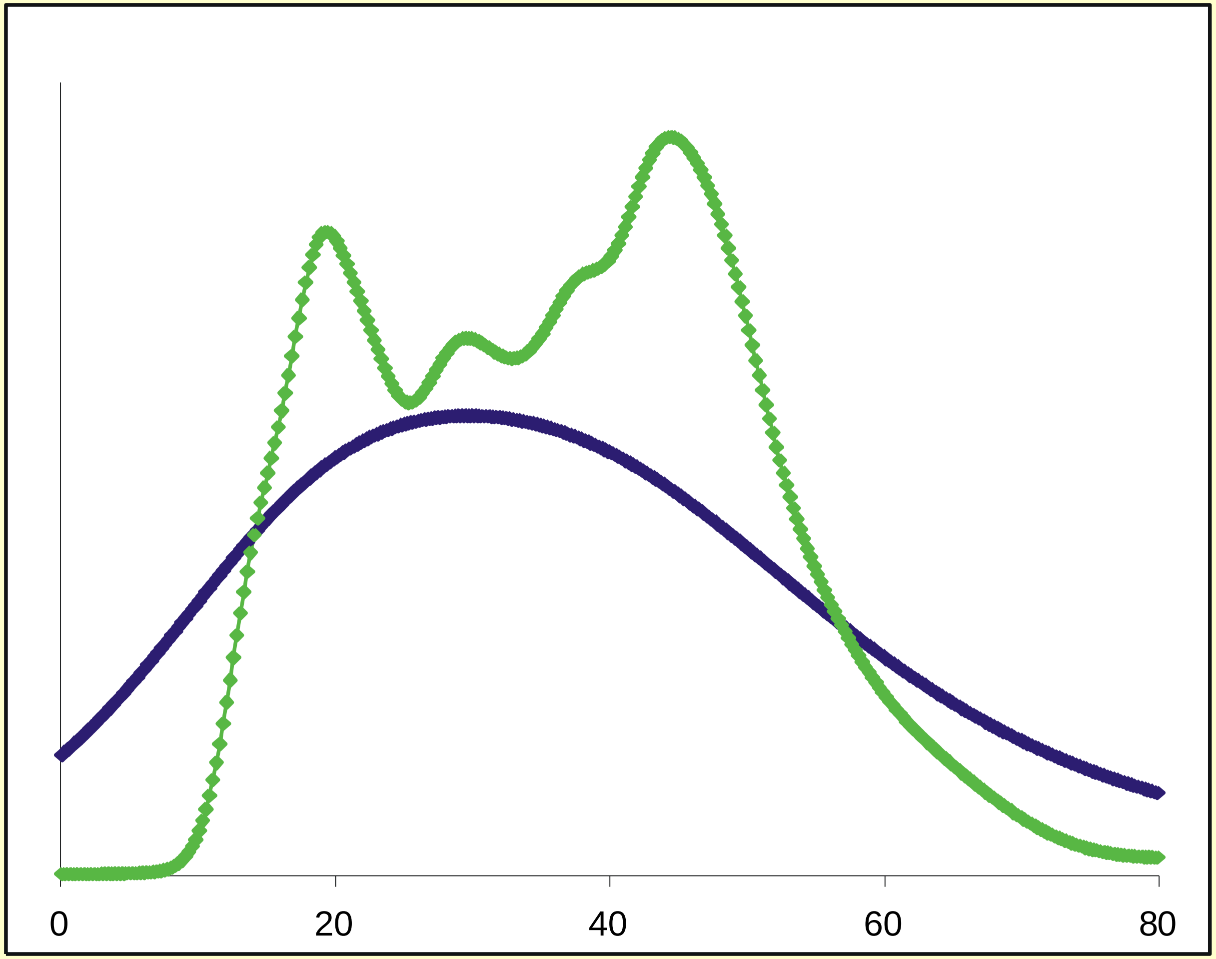
... how many grains for what?



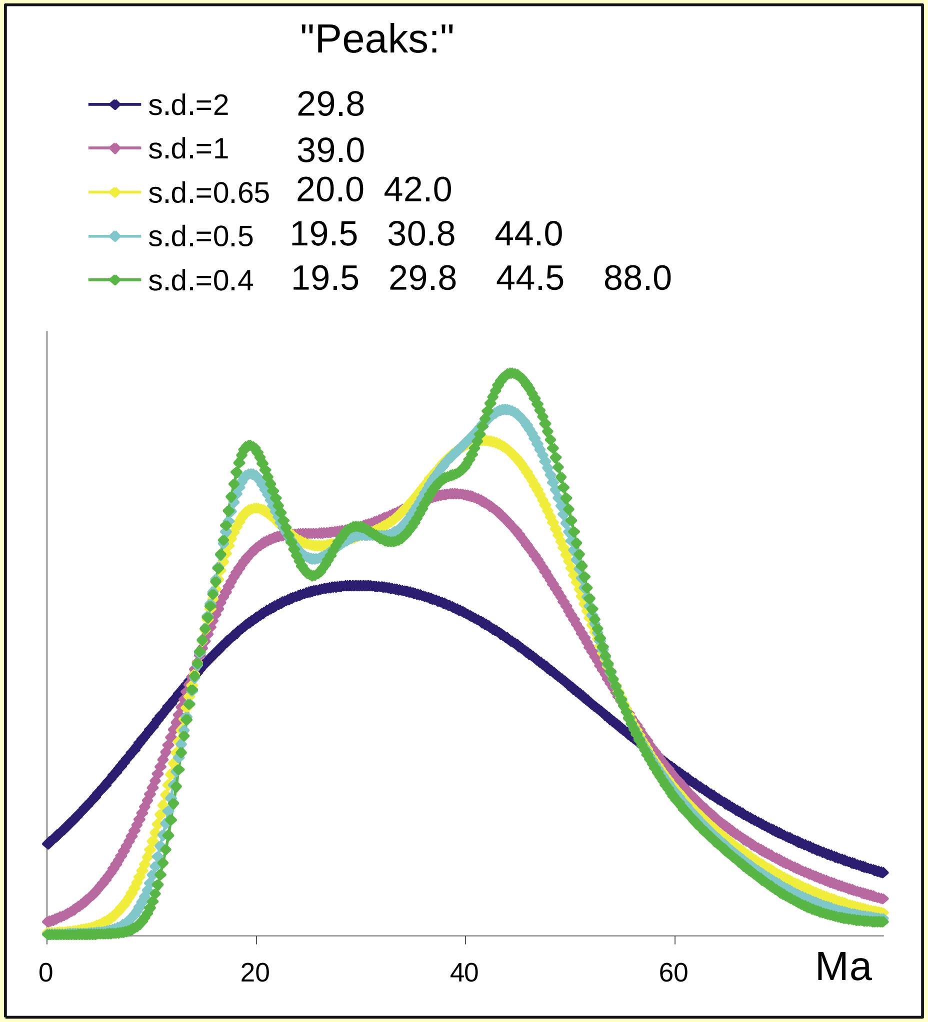
Theoretical detection limits for zircon populations in data sets of n analyses, derived from the binomial formula, at probability levels pL=0.5 and 0.95.

[Andersen, 2005]

Peaks are ...



Peaks are ...



a-343

some more about it in:

THE TROUBLE WITH "PROBABILITY DENSITY" PLOTS OF FISSION TRACK AGES

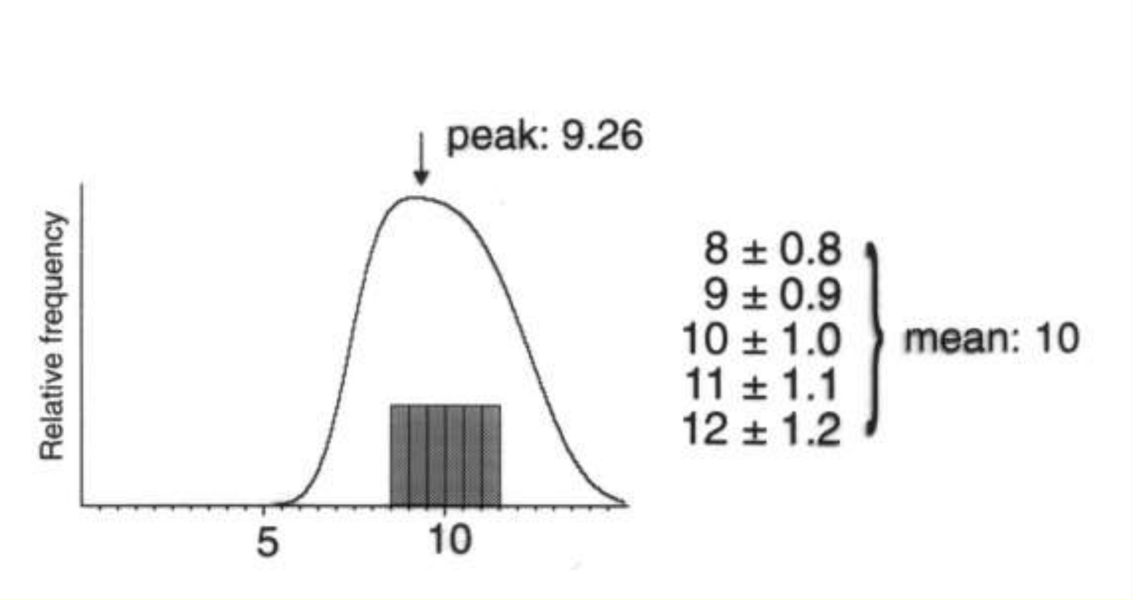
R. F. GALBRAITH

and in:

Statistical uncertainty associated with histograms in the Earth sciences

Pieter Vermeesch

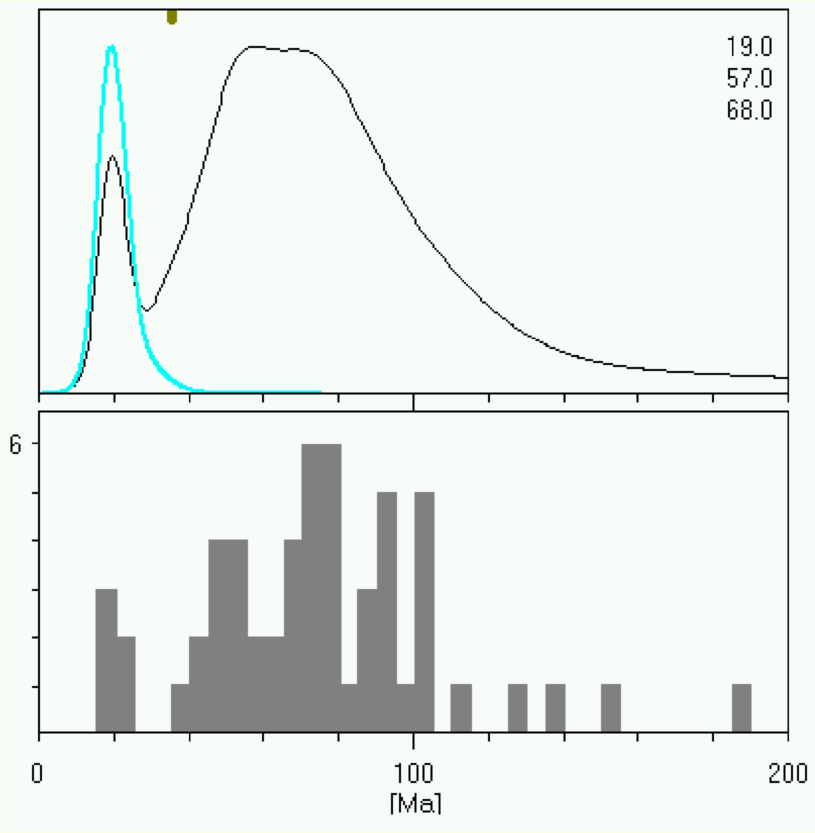
Peaks are in the mountains



Identification of the youngest population

(chi-square age concept , Brandon, 1992)

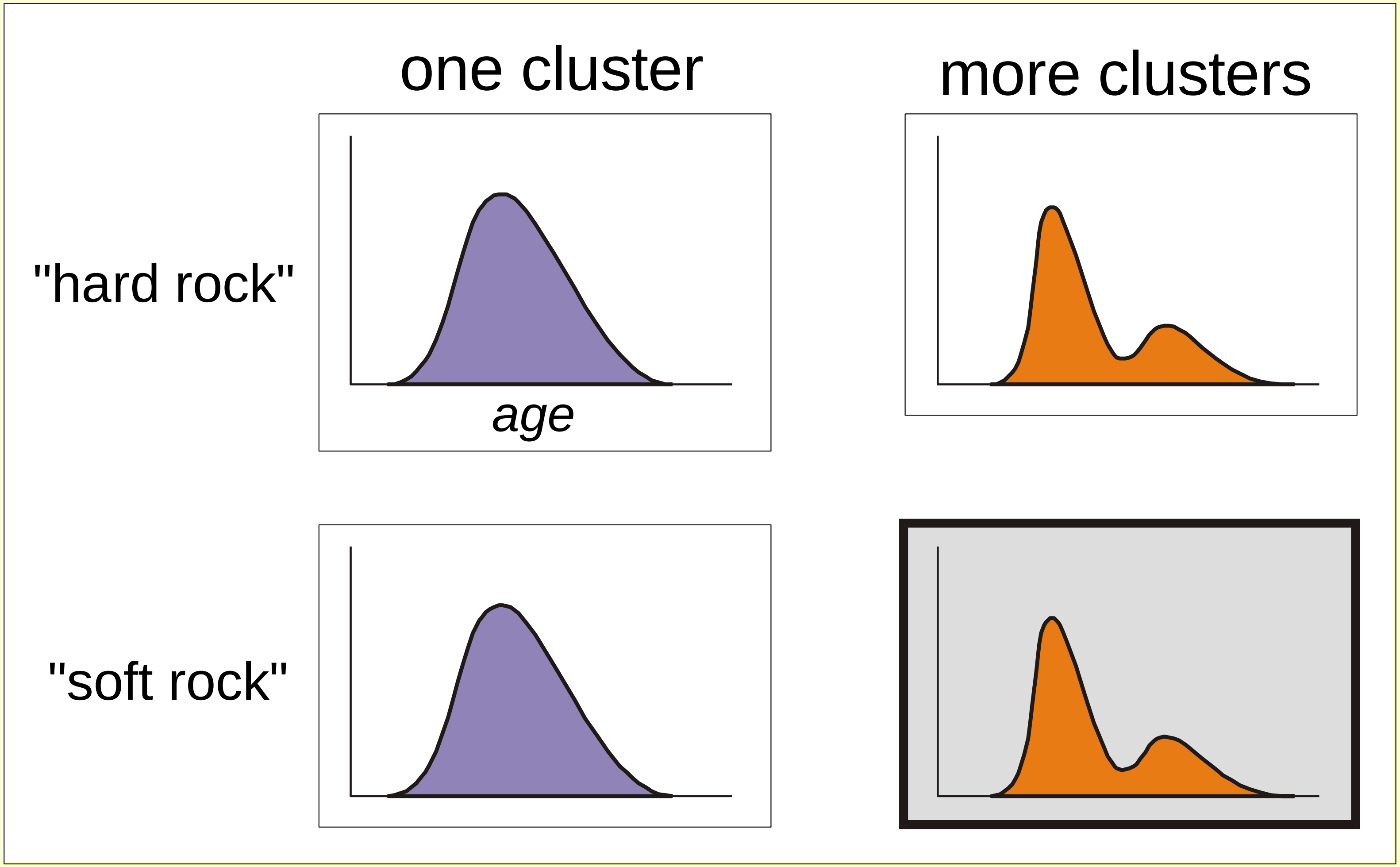
Z-249



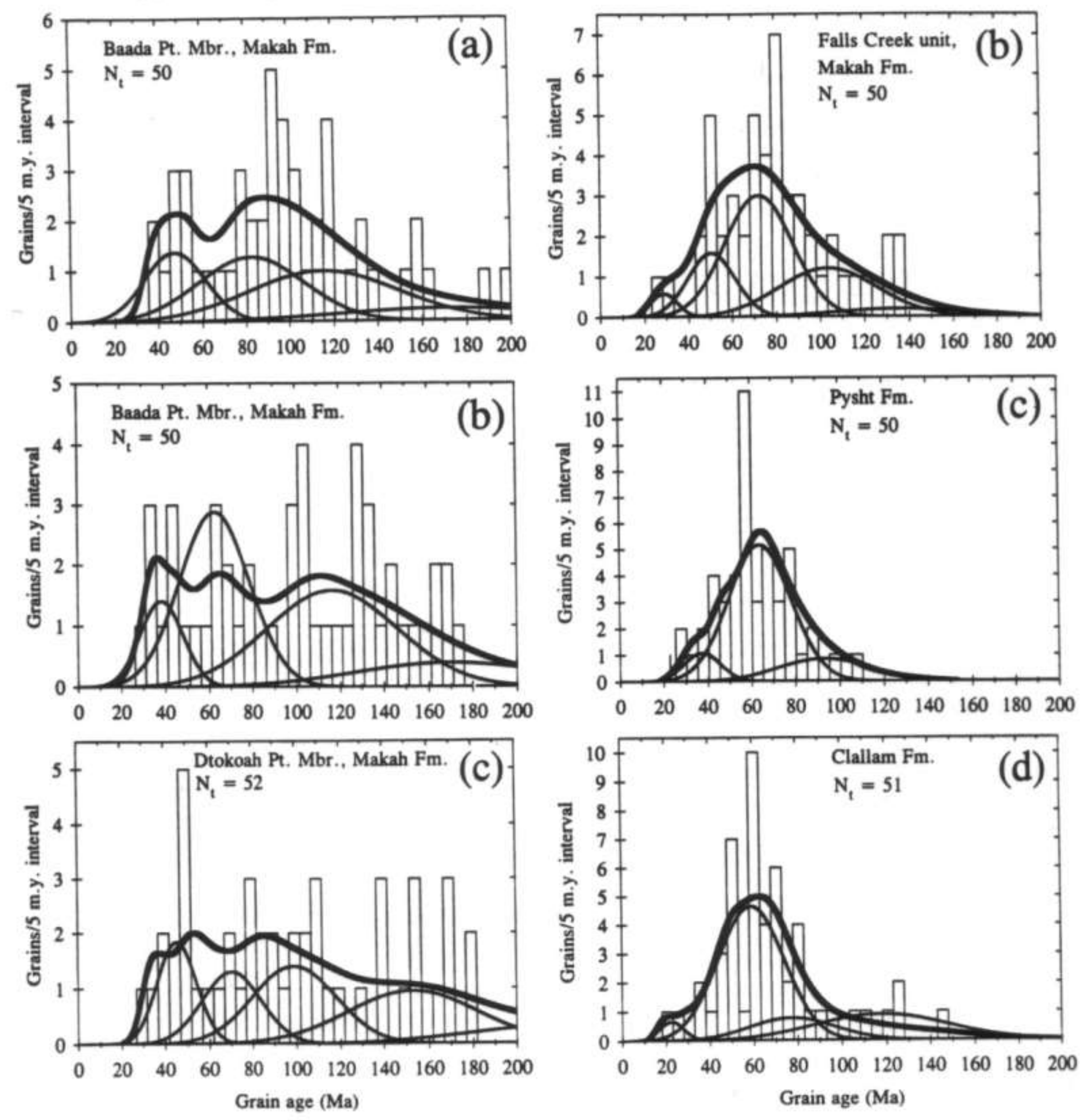
Option I: volcanic (age of youngest population =~ age of sedimentation)

Option II: cooling ages (age of pop1 > age of sedimentation)

“Soft rock” - more age clusters



What is the ... ?



[Garver and Brandon, 1994]