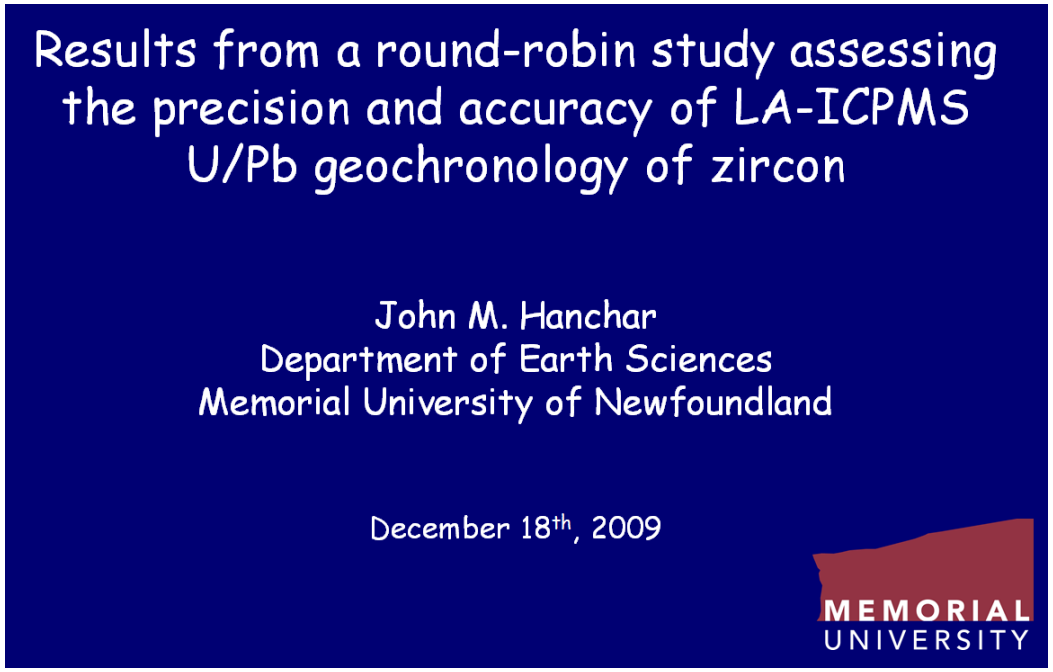
LA-ICP-MS U-Th-Pb Network
Zircon Standard Analyses (Round #3)

George Gehrels & Matt Horstwood

Data from:

Willy Amidon (Middlebury College)
David Barbeau (Univ South Carolina)
George Gehrels (Univ of Arizona)
Chris Holm-Denoma (USGS/Denver)
Matt Horstwood (British Geological Survey)
Ellen Kooijman (Swedish Museum of Natural History)
Ming-Chang Liu (UCLA)
Kate Souders (Texas Tech Univ)
Jay Thompson (Univ of Tasmania)
Renjie Zhou (Univ of Queensland)

Thanks to Sam Bowring & Anne Bauer (MIT) for ID/CA-TIMS analyses



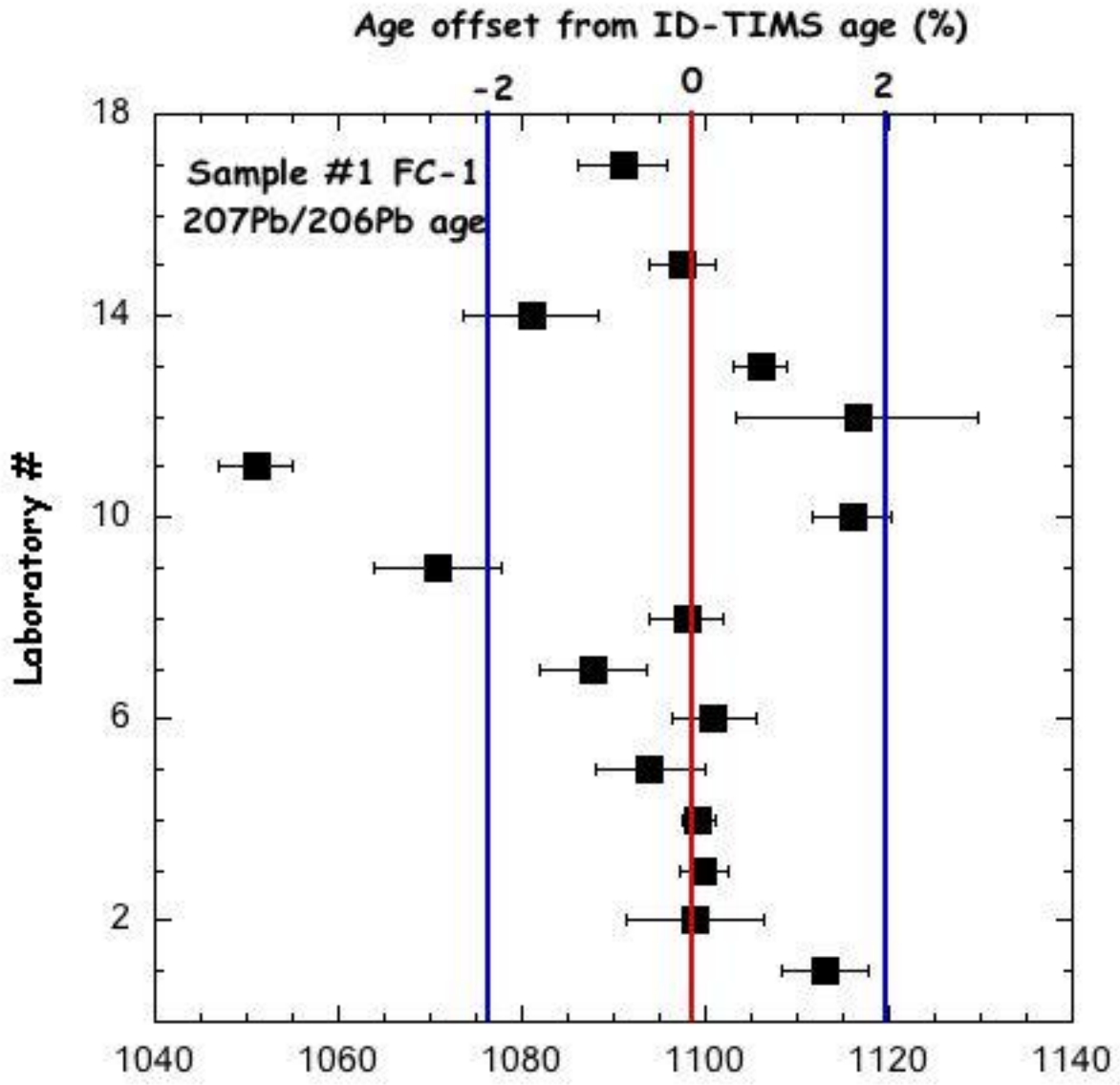
Plesovice = 337 Ma
Seiland (Sri Lanka) = 531 Ma
FC-1 = 1099 Ma

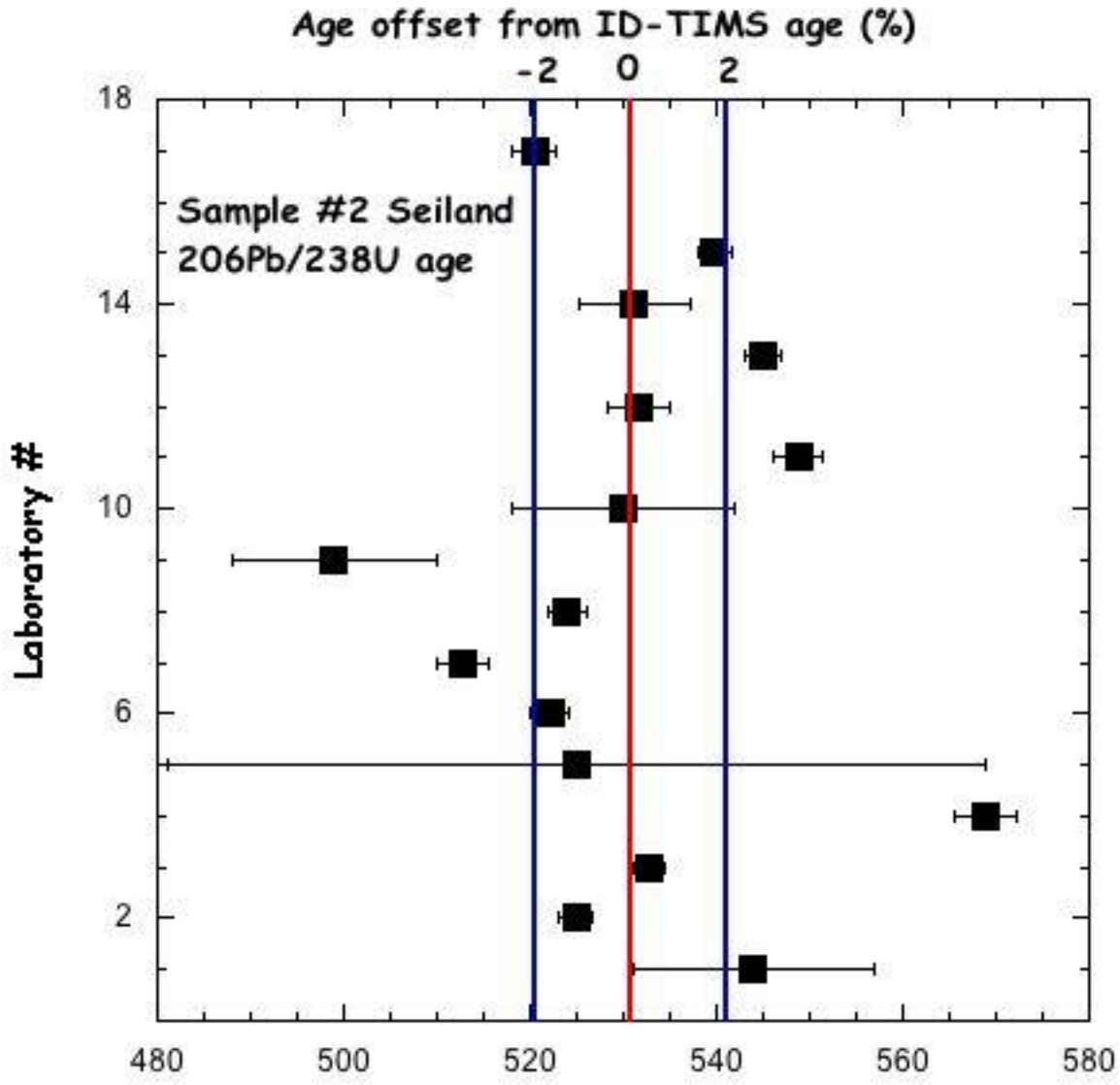
Sample were blind, grains were mixed

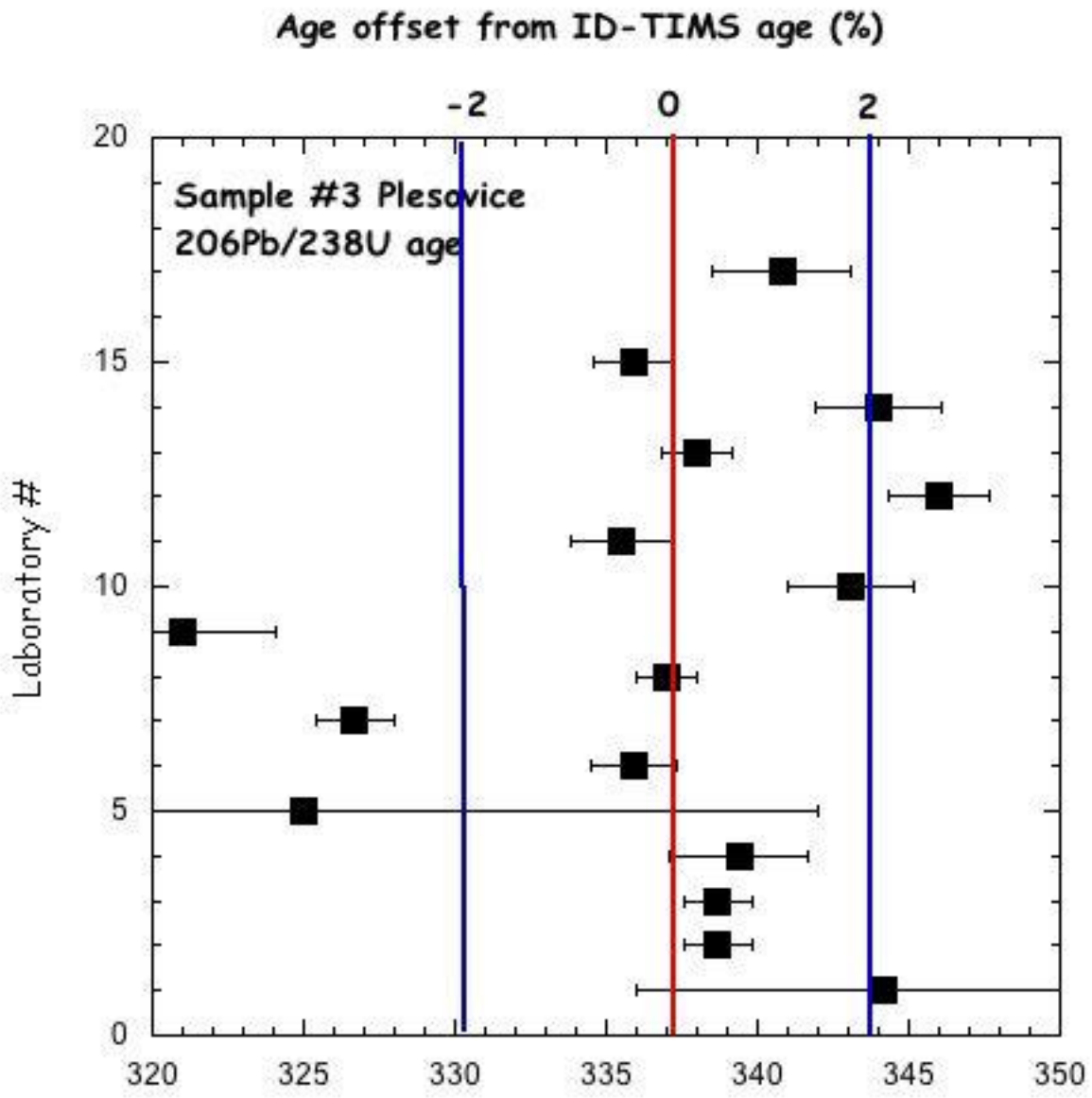
17 labs submitted data (Lab names not reported)

==> Most 206/238 & 206/207 ages reliable to ~2%

Presented at AGU and 2009 Workshop, manuscript not submitted


Age offset from ID-TIMS age (%)
-2
0
2
Sample #1 FC-1
207Pb/206Pb age
Laboratory #
18
14
10
6
2
1040
1060
1080
1100
1120
1140


Age offset from ID-TIMS age (%)
-2
0
2
Sample #2 Seiland
206Pb/238U age
Laboratory #
18
14
10
6
2
480
500
520
540
560
580


Age offset from ID-TIMS age (%)
-2
0
2
Sample #3 Plesovice
206Pb/238U age
Laboratory #
20
15
10
5
0
320
325
330
335
340
345
350

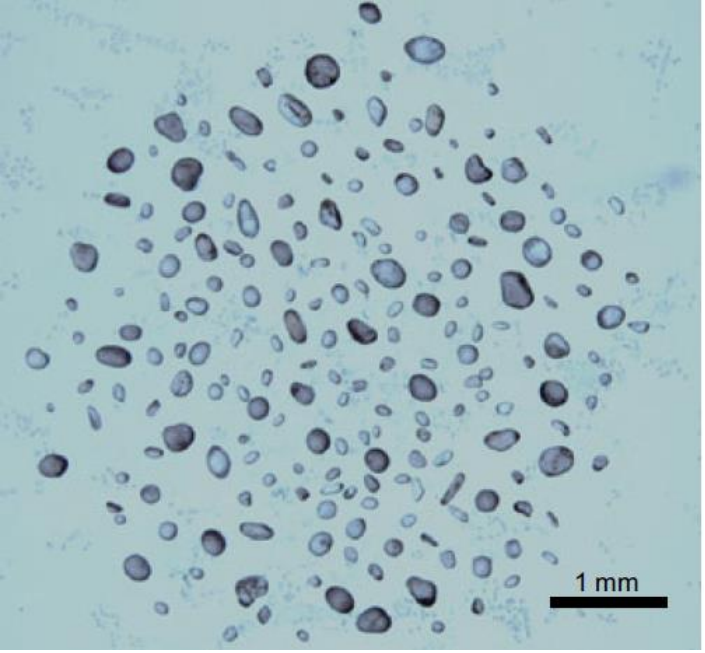
Round #2: Interlab Comparison (2011-2013)

Vol. 37 – N° 3 09 13 P. 243–259

GEOSTANDARDS and GEOANALYTICAL RESEARCH

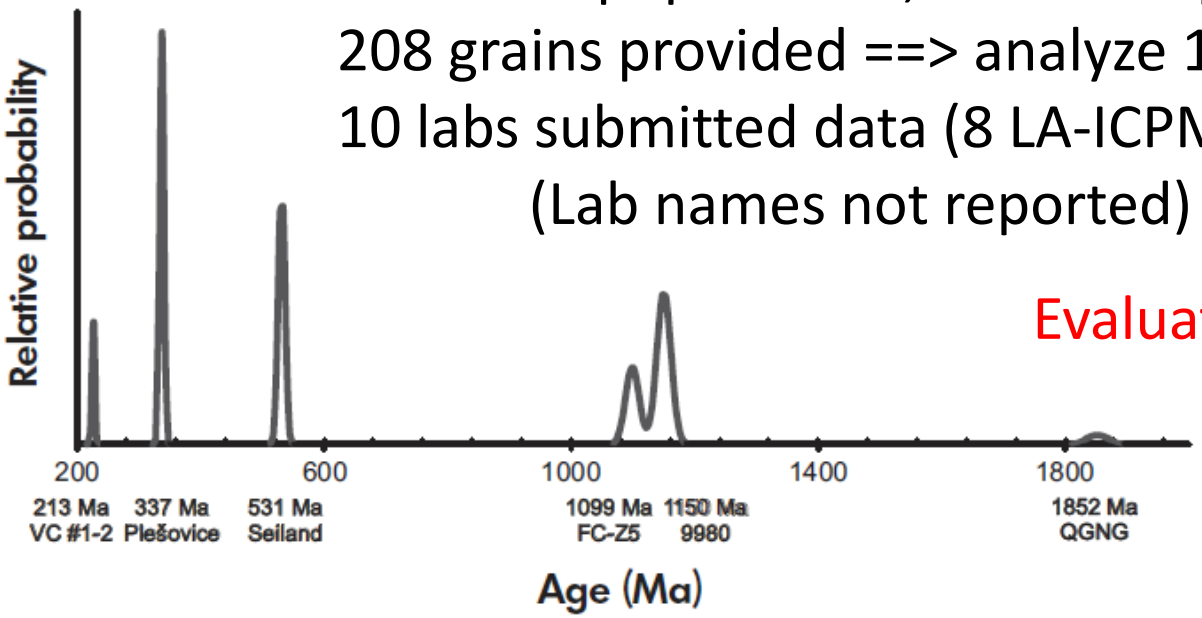
U-Pb Detrital Zircon Analysis – Results of an Inter-laboratory Comparison

Jan **Košler** (1)*, Jiří **Sláma** (1), Elena **Belousova** (2), Fernando **Corfu** (3), George E. **Gehrels** (4), Axel **Gerdes** (5), Matthew S. A. **Horstwood** (6), Keith N. **Sircombe** (7), Paul J. **Sylvester** (8), Massimo **Tiepolo** (9), Martin J. **Whitehouse** (10) and Jon D. **Woodhead** (11)

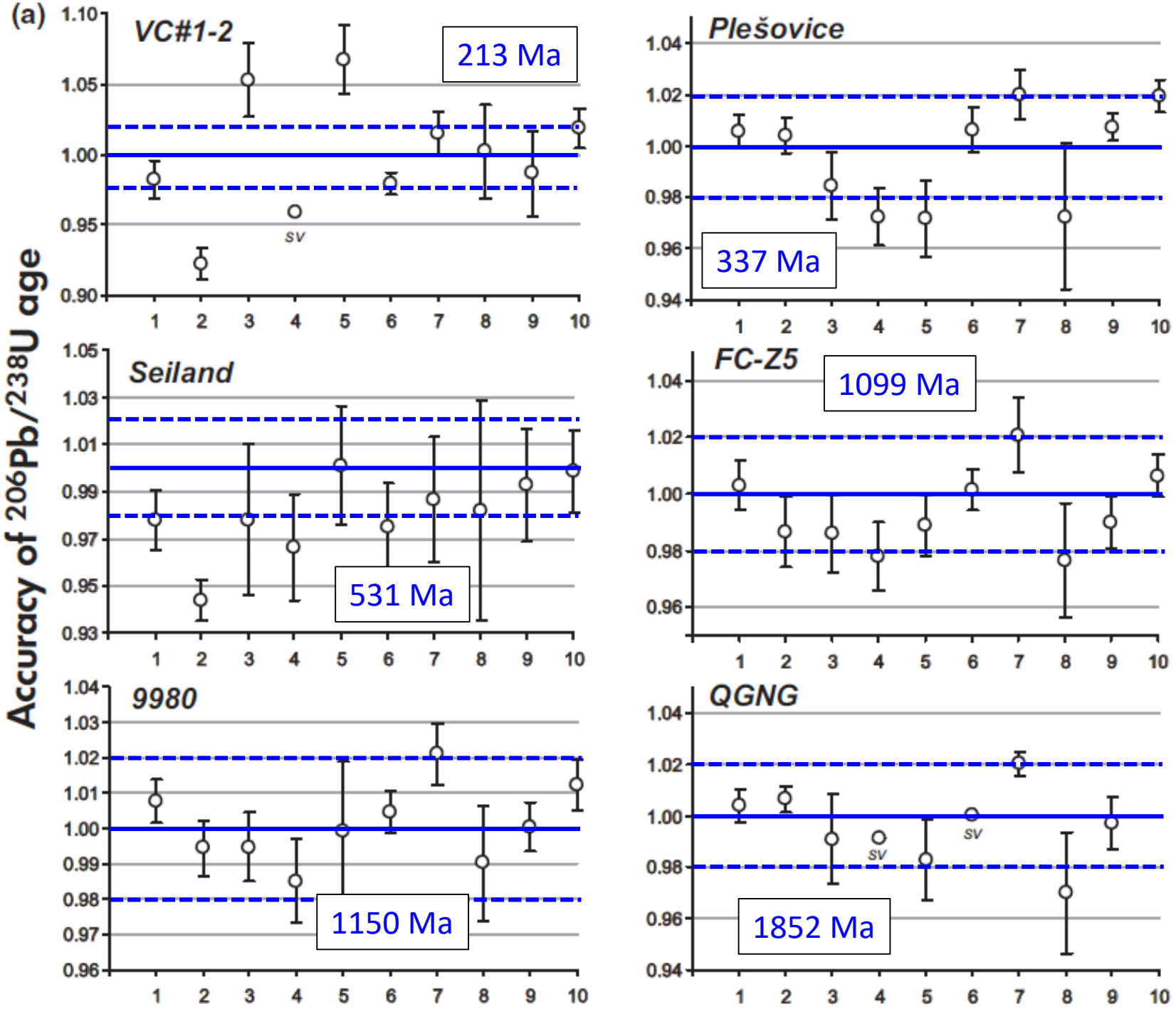


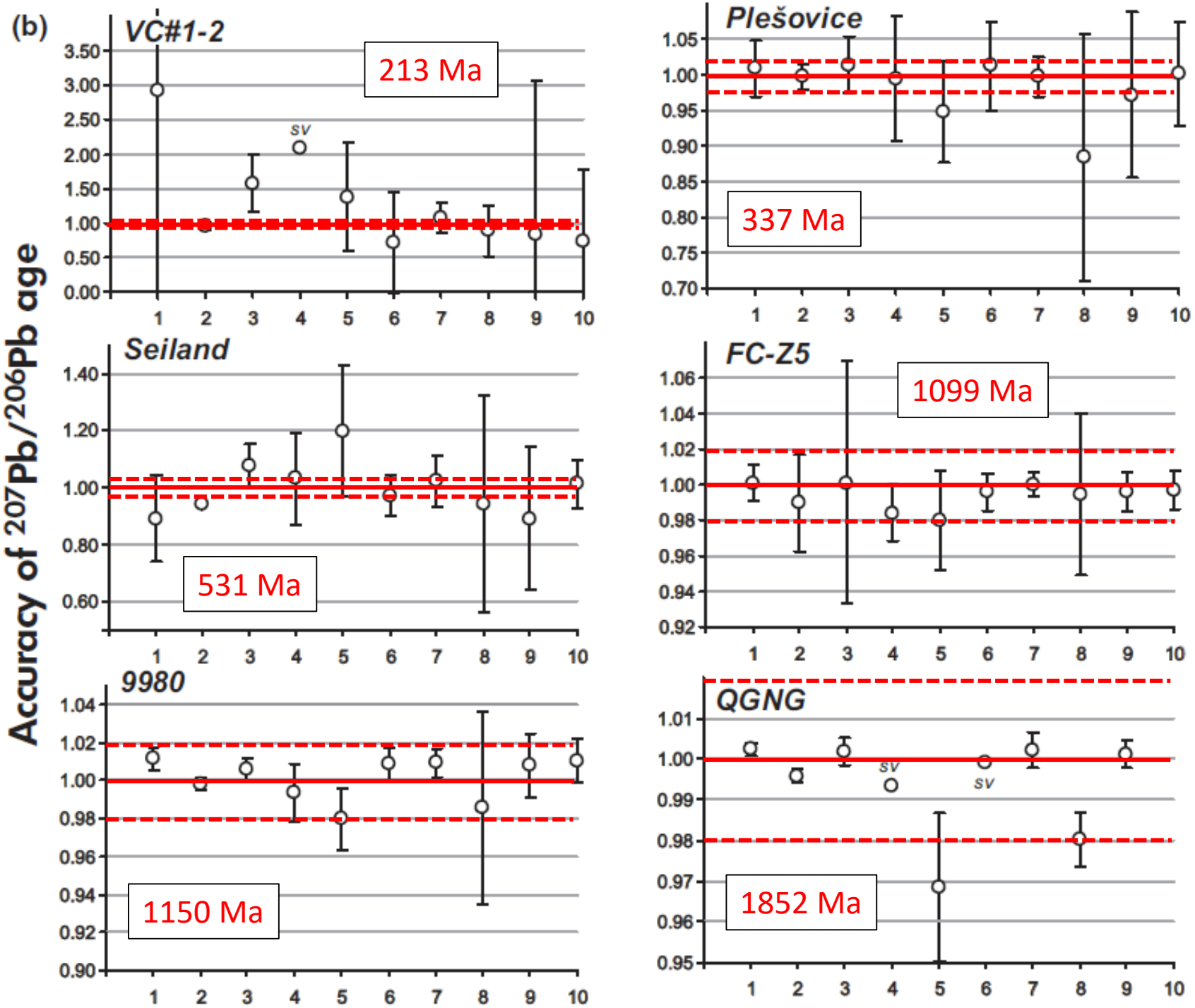
VC 1-2 = 213 Ma
Plesovice = 337 Ma
Seiland (Sri Lanka) = 531 Ma
FC-Z5 = 1099 Ma
9980 = 1150 Ma
QGNG = 1852 Ma

Blind samples, abraded grains, uncertain # of populations, uncertain proportions
208 grains provided ==> analyze 100 grains at random
10 labs submitted data (8 LA-ICPMS, 2 SIMS)
(Lab names not reported)



Evaluate ages & proportions


(a)
VC#1-2
213 Ma
SV
Plešovice
337 Ma
Seiland
531 Ma
FC-Z5
1099 Ma
9980
1150 Ma
QGNG
SV
SV
1852 Ma
Accuracy of 206Pb/238U age


(b)
VC#1-2
213 Ma
SV
Plešovice
337 Ma
Seiland
531 Ma
FC-Z5
1099 Ma
9980
1150 Ma
QGNG
1852 Ma
SV
SV
Accuracy of 207Pb/206Pb age

LA-ICP-MS U-Th-Pb Network Meeting in 2013
➔ decided to do another comparison:
more standards, expanded age range, more labs

Sample	$^{206}Pb^*/^{238}U$ Age (Ma, ± 2σ)	$^{206}Pb^*/^{207}Pb^*$ Age (Ma, ± 2σ)	Technique (ID-TIMS, CA-TIMS)	Material	Publication for age	Contact Information	Status
Fish Canyon	28.478 ± 0.024	NA	ID-TIMS	small crystals	Schmitz and Bowring (2001) Geochimica et Cosmochimica Acta, v. 65, no. 15, p. 2571-2587	George Gehrels (ggehrels@gmail.com) & Matt Heizler (matt@nmt.edu)	Available
Fish Canyon	28.61 ± 0.08	NA	CA-TIMS	small crystals	Bachman et al. (2007) Chemical Geology, v. 236, p. 134-166	George Gehrels (ggehrels@gmail.com) & Matt Heizler (matt@nmt.edu)	Available
GHR1	48.105 ± 0.023 Ma	NA	CA-TIMS	small to large crystals	Eddy et al. (2018) Geostandards and Geoanalytical Research, in press	Mike Eddy (meddy@princeton.edu) George Gehrels (ggehrels@gmail.com)	Available
94-35	55.5 ± 1.5	NA	ID-TIMS	small to large crystals	Klepeis et al. (1998) Journal of Structural Geology, v. 20, p. 883-904. CA-TIMS analyses in progress at MIT....	George Gehrels (ggehrels@gmail.com)	Available
Ecstall	91.5 ± 1.0 Ma	NA	ID-TIMS	small crystals	Butler et al. (2002) Journal of Geophysical Research, v. 107, no. B1, 10.1029/2001JB000270.	George Gehrels (ggehrels@gmail.com)	Not Available
49127	136.89 ± 0.7 Ma	139.3 ± 4.8 Ma	ID-TIMS	small crystals	D. Kimbrough (written communication)	David Kimbrough (dkimbrough@geology.sdsu.edu)	Uncertain
Plesovice	337.16 ± 0.11 Ma	337.96 ± 0.61 Ma	ID-TIMS	moderate-size	Slama et al. (2008) Chem. Geol., v. 249, p. 1-35.	Jiri Slama (Jiri.Slama@uib.no)	Available

				crystals			
Plesovice	337.1 ± 0.2 Ma	339.3 ± 0.3 Ma	ID-TIMS	moderate-size crystals	Slama et al. (2008) ages recalculated by Horstwood et al. (2016) Geostandards and Geoanalytical Research, v. 40 (3), p. 311-332,	Jiri Slama (Jiri.Slama@uib.no)	Available
Temora-2	416.78 ± 0.33 Ma	419.5 ± 1.1 Ma	ID-TIMS	small crystals	Black et al. (2004) Chem. Geol., v. 205, p. 115-140.	Geochronology Staff (geochronology@ga.gov.au)	Available
Temora-2	418.37 ± 0.14 Ma	420.13 ± 0.30 Ma	CA-TIMS	small crystals	Mattinson (2010) Chem. Geol., v. 275, p. 186-198.	Geochronology Staff (geochronology@ga.gov.au)	Available
R33	419.3 ± 0.4 Ma	NA	ID-TIMS	small crystals	Black et al. (2004) Chem. Geol., v. 205, p. 115-140.	John Aleinikoff (jaleinikoff@usgs.gov) & Bill McClelland (bill-mcclelland@uiowa.edu)	Available
R33	420.53 ± 0.16 Ma	422.37 ± 0.36 Ma	CA-TIMS	small crystals	Mattinson (2010) Chem. Geol., v. 275, p. 186-198.	John Aleinikoff (jaleinikoff@usgs.gov) & Bill McClelland (bill-mcclelland@uiowa.edu)	Available
SL2	563.2 ± 4.8 Ma	568 ± 16 Ma	ID-TIMS	single crystal	Gehrels et al. (2008) Geochemistry, Geophysics, Geosystems, v. 9, Q03017, doi:10.1029/2007GC001805.	George Gehrels (ggehrels@gmail.com)	Not Available
CZ3							
BR66							
Peixe	564 ± 4 Ma	564 ± 4 Ma	ID-TIMS	single crystal	Gehrels (unpublished)	George Gehrels (ggehrels@gmail.com)	Not available
GJ1	~609 Ma	NA	ID-TIMS	single crystals	Jackson et al. (2004) Chem. Geol., v. 211, p. 47–69.	Elena Belousova (ebelouso@els.mq.edu.au)	Uncertain
Mud Tank	734 ± 32 Ma	NA	ID-TIMS	single crystals	Black and Gulson (1978) Australia Geology & Geophysics, v. 3, p. 227–232.	Commonly available from gem dealers	Available
Mud Tank	731.66 ± 0.49 Ma	734.4 ± 1.0 Ma	CA-TIMS	single crystals	Horstwood et al. (2016) Geostandards and Geoanalytical Research, v. 40	Commonly available from gem dealers	Available

					(3), p. 311-332,		
91500	1062.4 ± 1.9 Ma	1065.4 ± 0.5 Ma	ID-TIMS	single crystal	Wiedenbeck et al. (1995) Geostandards Newsletter v. 19 (1), p. 1-23	IA Geo Limited (iageo.ltd@ntlworld.com)	Available
91500	1063.51 ± 0.39 Ma	1066.0 ± 0.6 Ma	ID-TIMS	single crystal	Wiedenbeck et al. ages recalculated by Horstwood et al. (2016) Geostandards and Geoanalytical Research, v. 40 (3), p. 311-332.	IA Geo Limited (iageo.ltd@ntlworld.com)	Available
91500	1063.6 ± 1.4 Ma	1066.4 ± 5.0 Ma	ID-TIMS	single crystal	Schoene et al. (2006) Geochimica et Cosmochimica Acta, v. 70, p. 426-445.	IA Geo Limited (iageo.ltd@ntlworld.com)	Available
FC-1	1099.5 ± 0.5 Ma	1099.0 ± 0.6 Ma	ID-TIMS	small crystals	Paces and Miller (1999) Journal of Geophysical Research, v. 98, no. B8, 13997-14013.	George Gehrels (ggehrels@gmail.com)	Available
FC-1	1095.32 ± 0.33 Ma	1098.47 ± 0.16 Ma	CA-TIMS	small crystals	Mattinson (2010) Chem. Geol., v. 275, p. 186-198.	George Gehrels (ggehrels@gmail.com)	Available
Oracle	1436.2 ± 1.3 Ma	1437.05 ± 0.77 Ma	CA-TIMS	small crystals	S. Bowring (written communication)	George Gehrels (ggehrels@gmail.com)	Available
QGNG	NA	1849.8 ± 1.1 Ma	ID-TIMS	small crystals	Compston (1999) Mineralogical Magazine, v. 63 (3), p. 297-311.	Geochronology Staff (geochronology@ga.gov.au)	Not Available
QGNG	1842.0 ± 3.1 Ma	1851.6 ± 0.6 Ma	ID-TIMS	small crystals	Black et al. (2004) Chem. Geol., v. 205, p. 115-140.	Geochronology Staff (geochronology@ga.gov.au)	Not Available
QGNG	1848.7 ± 2.7 Ma	1851.5 ± 5.8 Ma	CA-TIMS	small crystals	Schoene et al. (2006) Geochimica et Cosmochimica Acta, v. 70, p. 426-445.	Geochronology Staff (geochronology@ga.gov.au)	Not Available
Tan Brown	2507.8 ± 1.5 Ma	2512.24 ± 0.71 Ma	ID-TIMS	small to large crystals	ID-TIMS analyses in progress by Ann Bauer at MIT....	Mark Pecha (mpecha@email.arizona.edu) Peninsular Gneiss (Dharwar craton) near Karimnagar	Available

Tan Brown	2508.9 ± 1.2 Ma	2511.95 ± 0.86 Ma	CA-TIMS	small to large crystals	ID-TIMS analyses in progress by Ann Bauer at MIT….	Mark Pecha (mpecha@email.arizona.edu) Peninsular Gneiss (Dharwar craton) near Karimnagar	Available
OG-1	3440.7 ± 3.2 Ma	3465.4 ± 0.6 Ma	ID-TIMS	small crystals	Stern et al. (2009) Geostandards and Geoanalytical Research, v. 33 (2), p. 145-168.	Geochronology Staff (geochronology@ga.gov.au)	Uncertain
OG-1	3463.3 ± 3.6 Ma	3467.1 ± 0.6 Ma	CA-TIMS	small crystals	Bodorkos et al. (2009) AGU abstract #V33B-2044	Geochronology Staff (geochronology@ga.gov.au)	Uncertain

10 different standards from 28 Ma to 3.5 Ga

Hired UA undergraduate students to pick grains from each standard:

- 10 different standards
- 100 grains of each
- 100 sets

==> 100,000 grains picked!

Have distributed sets to 68 different labs (some up to four sets!!)
Have so far received data from 11 labs…..

1. Alyssa Abbey (University of Michigan; alabbey@umich.edu)
2. Willy Amidon (Middlebury College; wamidon@middlebury.edu)
3. Alexis Ault (University of Washington; alexis.ault@gmail.com)
4. Fernando Barra (Universidad de Chile)
5. Ian Bowen (NU Instruments)
6. Molon Buyartuev (Russian Academy of Sciences; modibu@gmail.com)
7. Alan Chapman (Macalester College; chapman@macalester.edu)
8. Drew Coleman (University of North Carolina; dcoleman@unc.edu)
9. John Cottle (UC Santa Barbara; cottle@geol.ucsb.edu)
10. Andy Dufrane (University of Alberta; dufrane@ualberta.ca)
11. Istvan Dunkl (University of Goettingen; istvan.dunkl@geo.uni-goettingen.de)
12. Chris Fisher (Washington State University)
13. Dirk Frei (Stellenbosch University; dirkfrei@sun.ac.za)
14. Mayuko Fukuyama (Akita University, Japan; mayuko@gipc.akita-u.ac.jp)
15. Carlos Garrido (University of Granada, Spain)
16. John Garver (Union College; garverj@union.edu)
17. Richard Gaschnig (University of Massachusetts; Richard_Gaschnig@umi.edu)
18. Axel Gerdes (Goethe University Frankfurt; gerdes@em.uni-frankfurt.de)
19. Achim Hermann (Louisiana State University; ahermann@lsu.edu)
20. Chris Holm-Denoma (USGS Denver; cholm-denoma@usgs.gov)
21. Matt Horstwood (NIGL; msah@bgs.ac.uk)
22. Forrest Horton (Woods Hole Institute of Oceanography; Horton@caltech.edu)

23. Jeremy Hourigan (UC. Santa Cruz; hourigan@ucsc.edu)
24. Ryan Ickert (Berkeley Geochronology Center; risckert@gbc.org)
25. Simon Jackson (Natural Resources Canada; Simon.Jackson@nrcan-rncan.gc.ca)
26. Jan Kosler (University of Bergen)
27. Andrew Kylander Clark (UC Santa Barbara; kylander@geol.ucsb.edu)
28. Jade Star Lackey (Pomona College; jadestar.lackey@pomona.edu)
29. Antonio Langone (University of Pavia)
30. Tom Lapen (University of Houston; tjlapen@central.uh.edu)
31. Jeff Marsh (Laurentian University; jhmarsh00@gmail.com)
32. Dave Moecher (University of Kentucky)
33. Hadi Moghadam (Macquarie University)
34. Paul Mueller (University of Florida; pamueller@ufl.edu)
35. Norm Pearson (Macquarie University; norman.pearson@mq.edu.au)
36. Axel Schmitt (UC Los Angeles)
37. Saurabh Singhal (Wadia Institute, India; ssinghal121@gmail.com)
38. Keith Sircombe (Geoscience Australia; Keith.Sircombe@ga.gov.au)
39. Luigi Solari (University of Mexico; solari@unam.mx)
40. Kate Souders (UC Davis; souders@ucdavis.edu)
41. Alex Steely (UC Santa Cruz; asteely@ucsc.edu)
42. Lisa Stockli (University of Texas, Austin; lstockli@jsg.utexas.edu)
43. Paul Sylvester (Texas Tech University; paul.sylvester@ttu.edu)
44. Victor Valencia (Washington State University; vicvalencia1@gmail.com)
45. Chris Yakumchuck (University of Waterloo, Canada; chris.yakymchuk@uwaterloo.ca)

46. Renjie Zhou (University of Queensland; renjie.zhou@uq.edu.au)
47. Alex Zirkparvar (Oak Ridge National Lab; zirakparvana@ornl.gov)
48. Will Powell (Rio Tinto; William.Powell@riotinto.com)
49. Jeff Vervoort (Washington State University; vervoort@wsu.edu)
50. Alexis Licht (University of Washington; licht@u.washington.edu)
51. Robinson Cecil (Cal State University Northridge; robinson.cecil@csun.edu)
52. Ellen Kooijman (Swedish Museum of Natural History; ellen.kooijman@nrm.se)
53. Andreas Moller (University of Kansas; amoller@ku.edu)
54. Kip Hodges (Arizona State University; kvhodges@asu.edu)
55. Randy Irmis (University of Utah; irms@umnh.utah.edu)
56. Nathan Niemi (University of Michigan; naniemi@umich.edu)
57. Dave Barbeau (University of South Carolina; dbarbeau@geol.sc.edu)
58. Greg Dumond (University of Arkansas; gdumond@uark.edu)
59. Willy Guenthner (University of Illinois; wrg@illinois.edu)
60. Mauricio Ibanez-Mejia (University of Rochester; ibanezm@rochester.edu)
61. Matt Coble (Stanford University/USGS SIMS; coblem@stanford.edu)
62. Ming-Chang Liu (UCLA SIMS; mcliu@ucla.edu)
63. Will Matthews (University of Calgary; wamatthe@uclagary.ca)
64. Andy DuFrane; University of Alberta; dufrane@ualberta.ca)
65. Luke Beranek (Memorial University; lberanek@mun.ca)
66. Laura Bracciali (Stellenbosch University; bracciali@sun.ac.za)
67. Mark Schmitz (Boise State University; markschmitz@boisestate.edu)
68. Chris Daniel (Bucknell University; cdaniel@bucknell.edu)

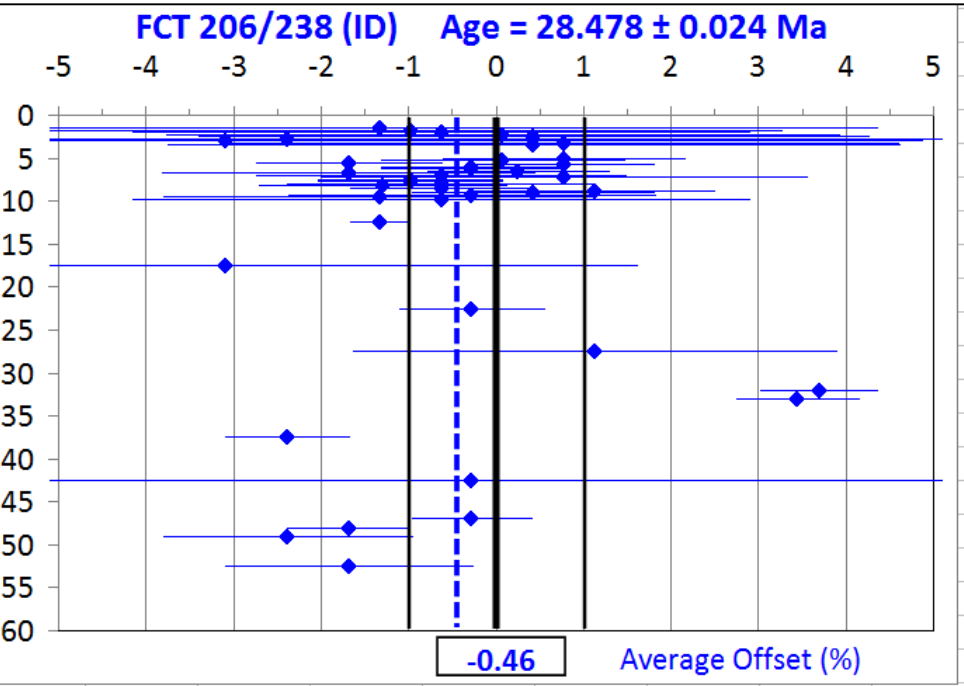
Matt's Instructions:

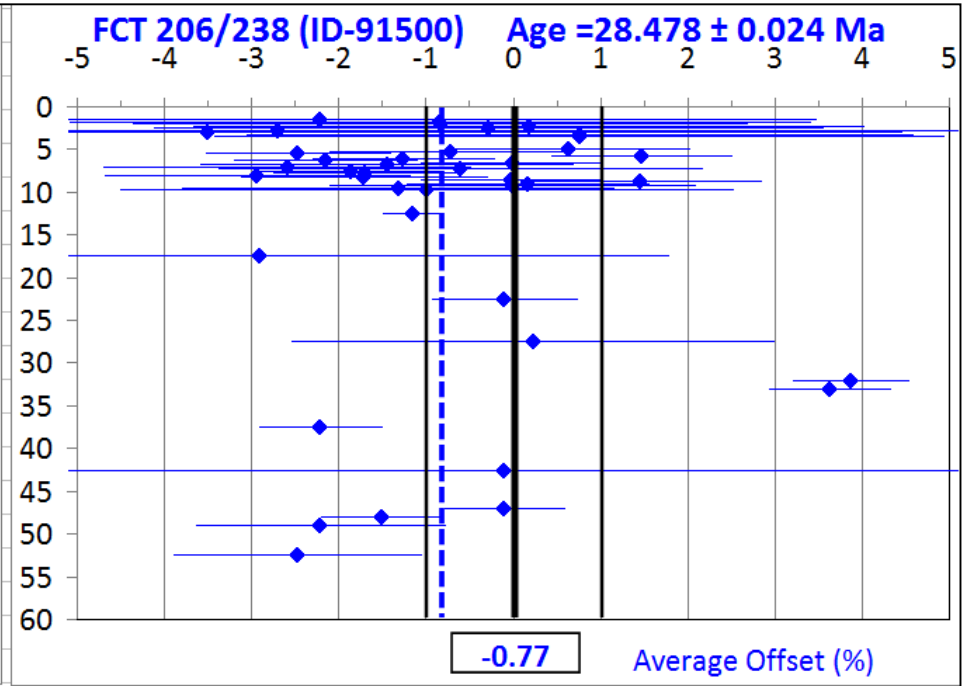
- 10 analyses of each standard (cycle thru 10 times, not in sets)
- Use 91500 as primary (or provide 91500 results for re-calculation)*
- Report weighted mean ratios and ages (no rejection)*
- Report systematic (external) uncertainties (2σ)*

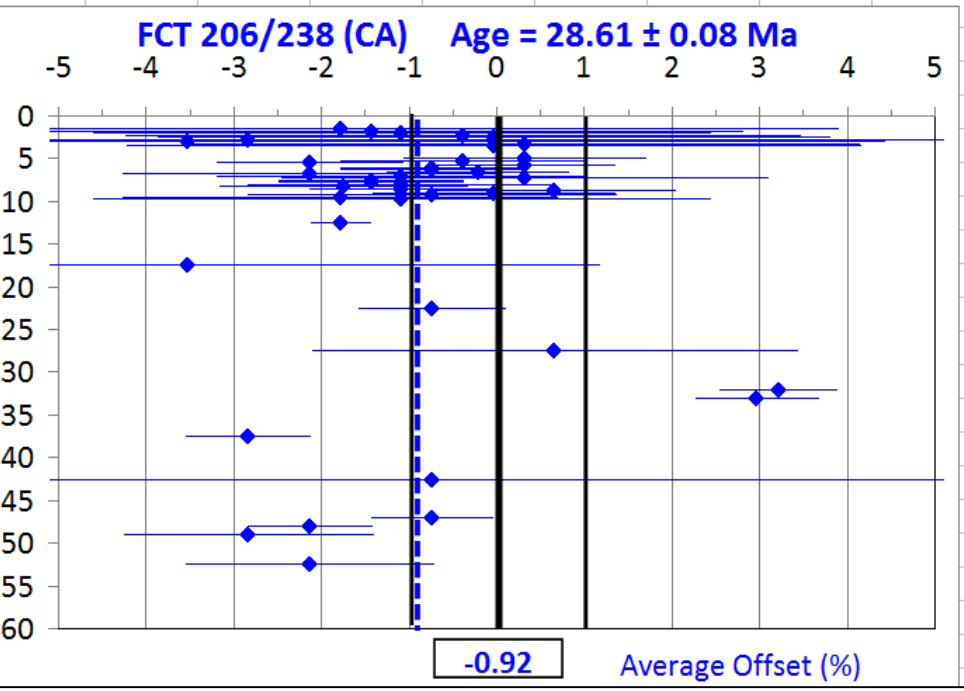
Lab #	Instrument	Primary Standard	Standard Mount	Common Pb Correction	Data Reduction
1	NU Plasma I	SL	Together	204-based	Agecalc
2	Element2	SL	Together	204-based	Agecalc
3	Thermo iCAP-RQ	91500	Separate	none	Iolite
4	Thermo ICAP-Q	91500	Separate	none	Iolite
5	Agilent 7900	91500	Separate	none	LADR
6	Cameca 1280	FC-1	??	??	In-house
7	NU Plasma II	91500	Separate	204-based	Iolite
8	?	91500	??	??	??
9	NU AttoM	91500	Separate	none	Iolite
10	NU Plasma I	91500	??	none	Iolite
11	NU AttoM	Tem-FC1	??	none	Iolite

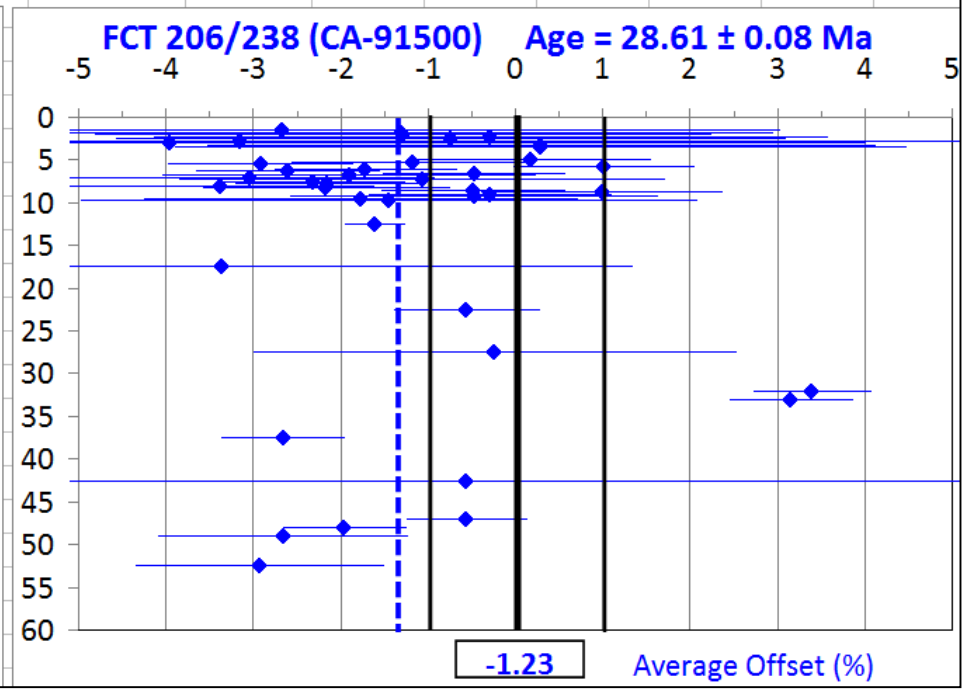
Decisions about data analysis & display

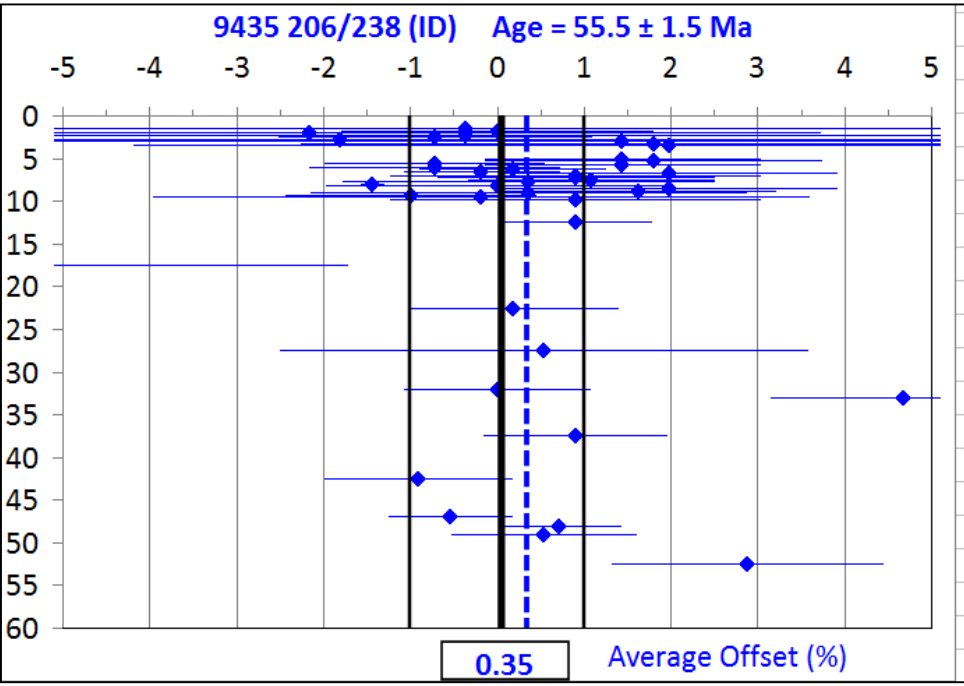
- Which of the above are important variables?
- Focus on ages or ratios?
- Compare results with ID-TIMS or CA-TIMS data?
- Report Internal (measurement) or Internal + External (systematic) uncertainties?
- Show all sessions from each lab or average of sessions if more than one?

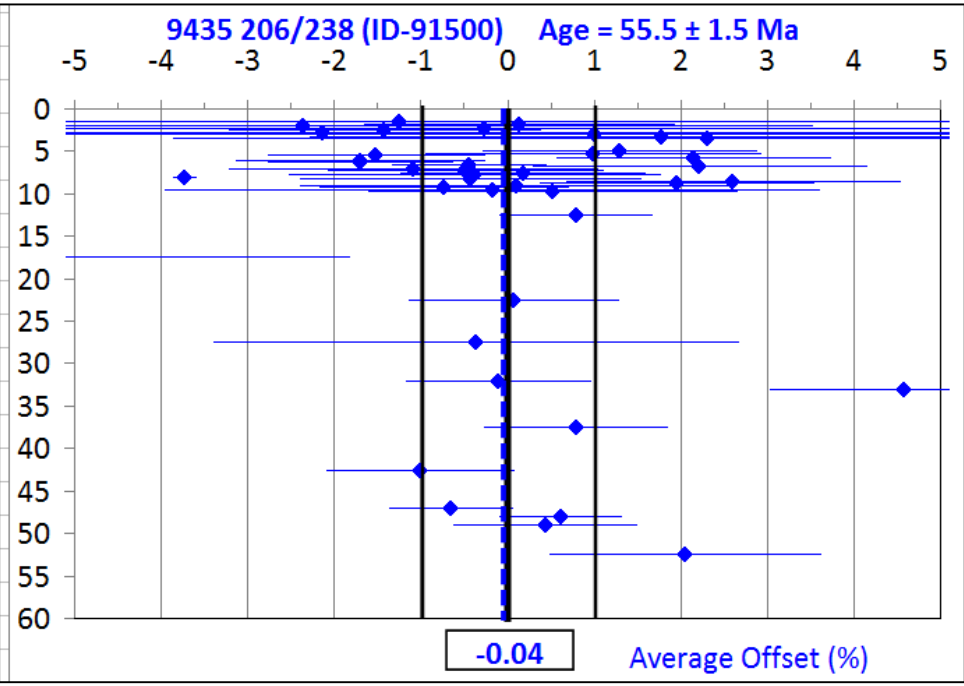

FCT 206/238 (ID) Age = 28.478 ± 0.024 Ma
-0.46
Average Offset (%)

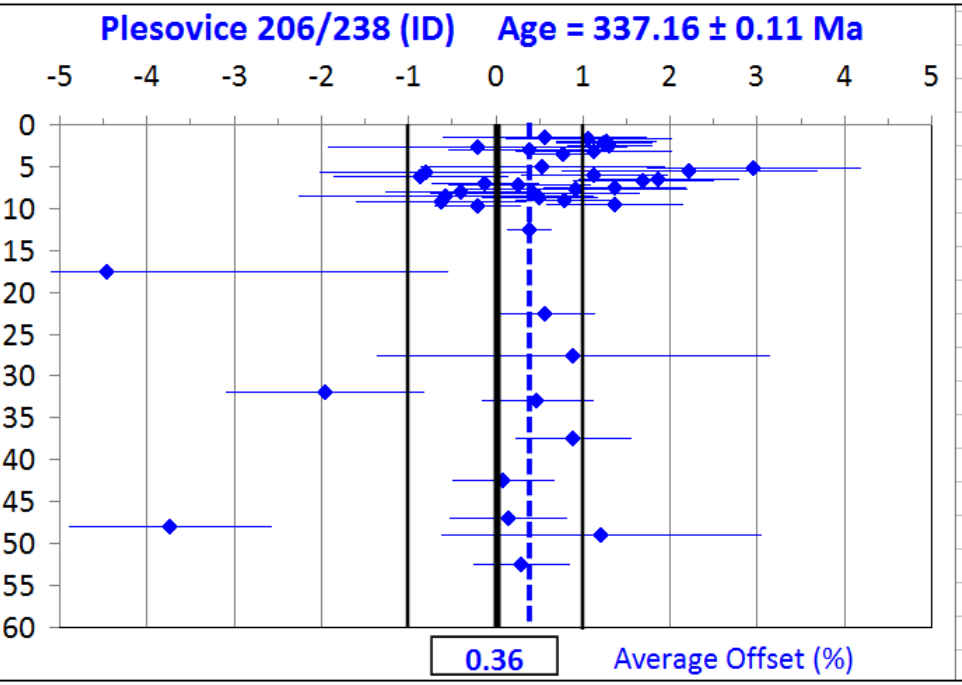

FCT 206/238 (ID-91500) Age =28.478 ± 0.024 Ma
-0.77
Average Offset (%)

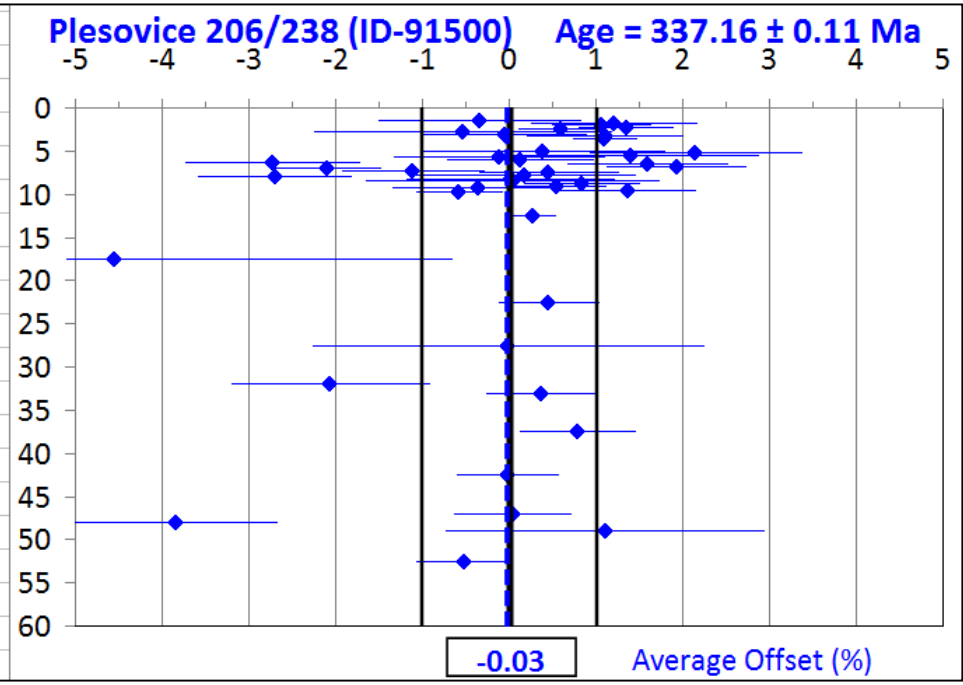

FCT 206/238 (CA) Age = 28.61 ± 0.08 Ma
-0.92
Average Offset (%)

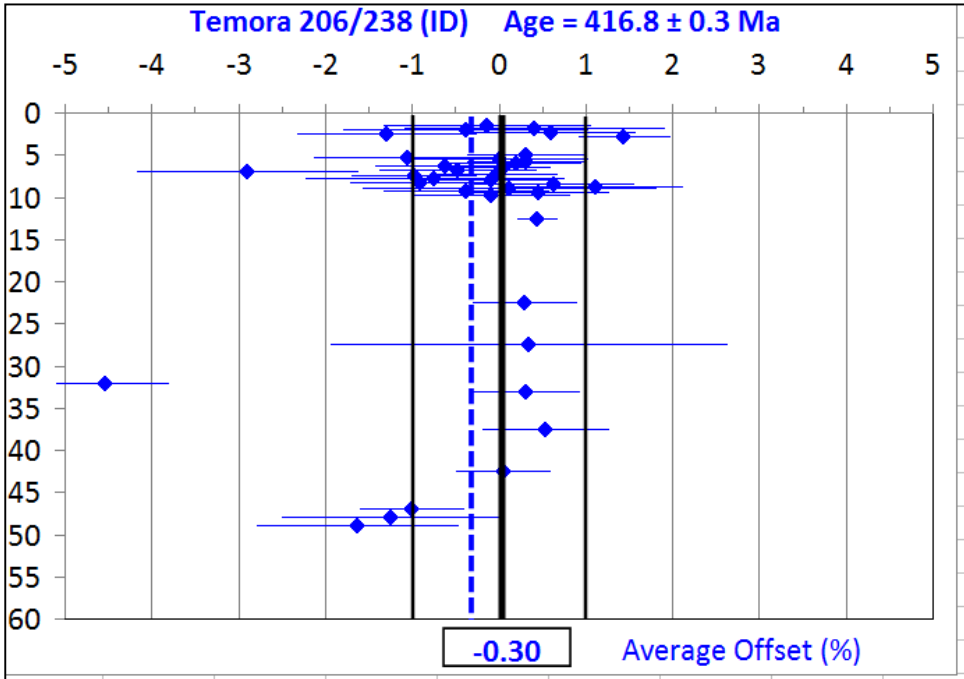

FCT 206/238 (CA-91500) Age = 28.61 ± 0.08 Ma
-1.23
Average Offset (%)

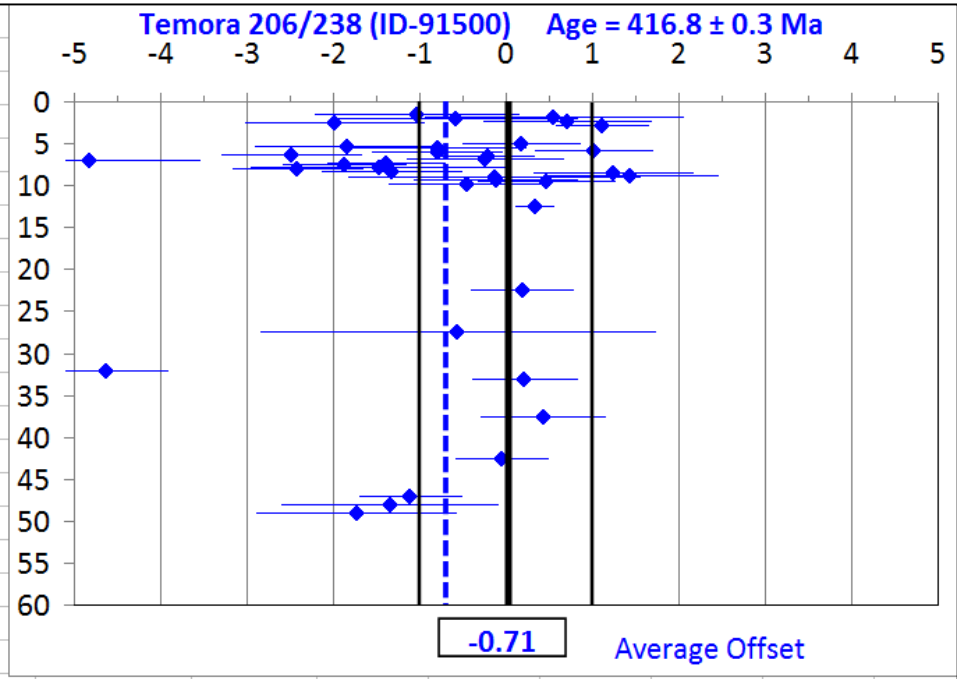

9435 206/238 (ID) Age = 55.5 ± 1.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.35
Average Offset (%)

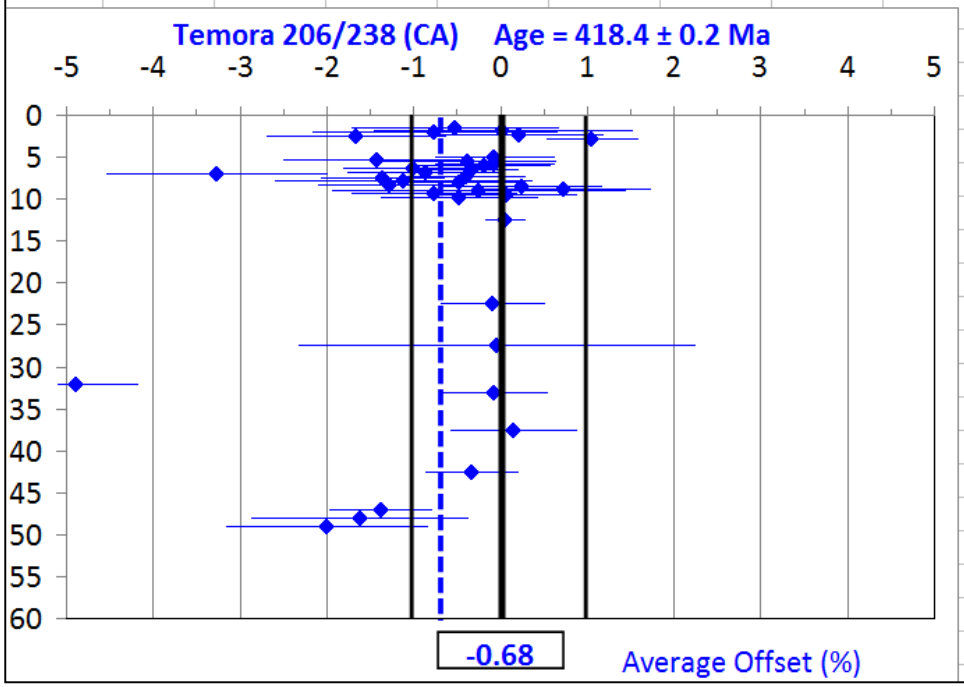

9435 206/238 (ID-91500) Age = 55.5 ± 1.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.04
Average Offset (%)

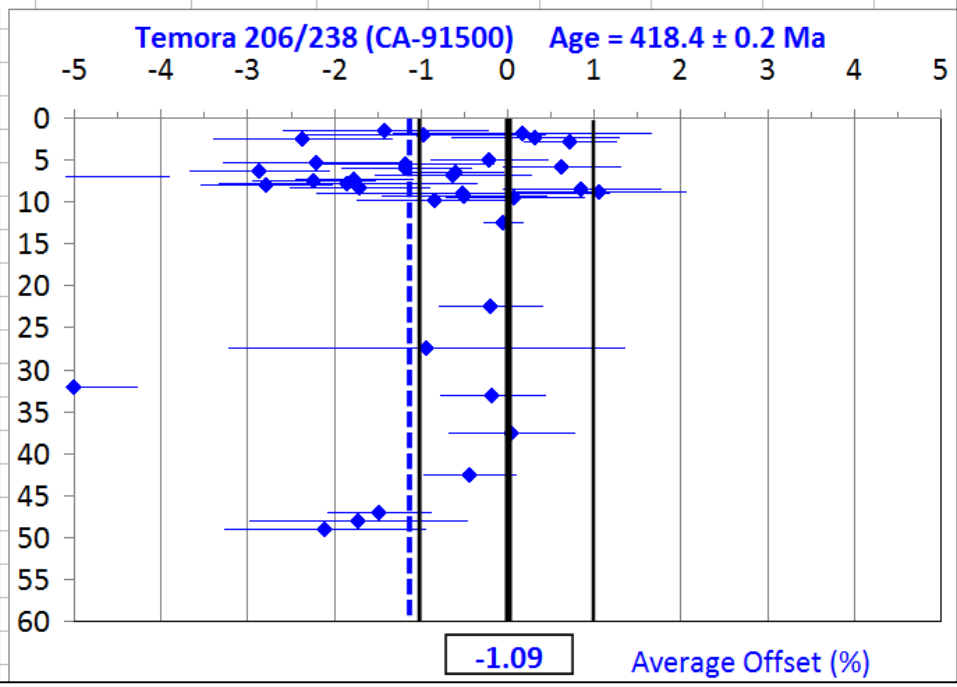

Plesovice 206/238 (ID)
Age = 337.16 ± 0.11 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.36
Average Offset (%)

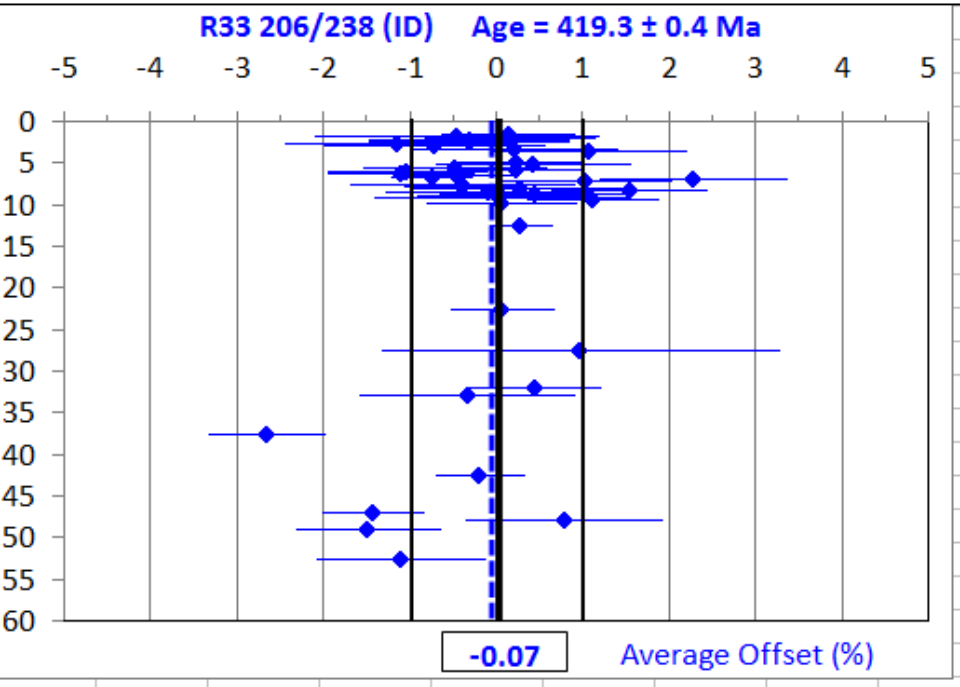

Plesovice 206/238 (ID-91500)
Age = 337.16 ± 0.11 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.03
Average Offset (%)

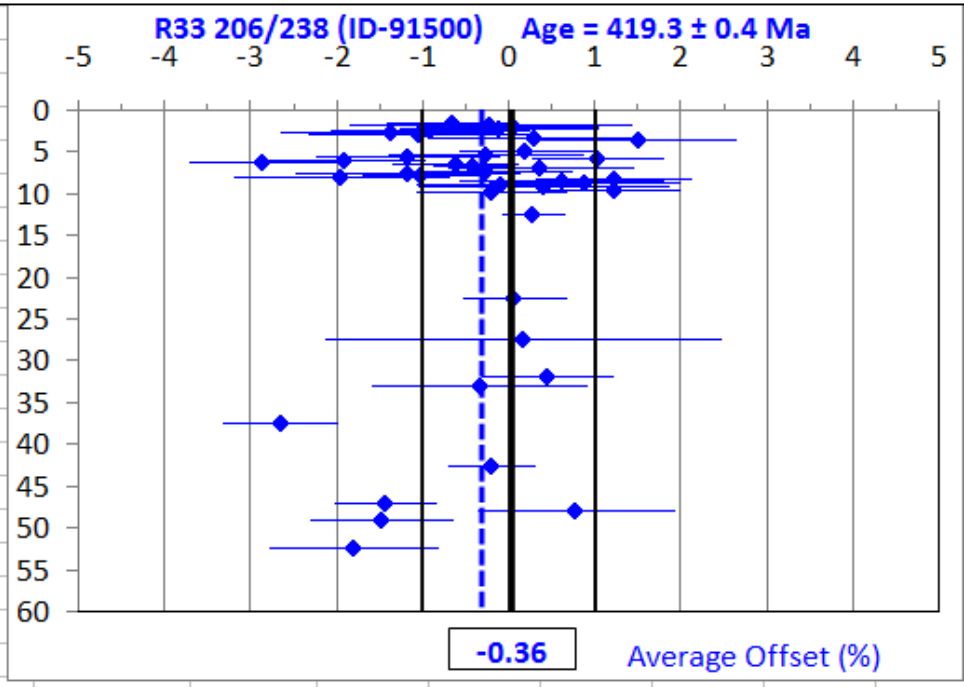

Temora 206/238 (ID) Age = 416.8 ± 0.3 Ma
-0.30
Average Offset (%)

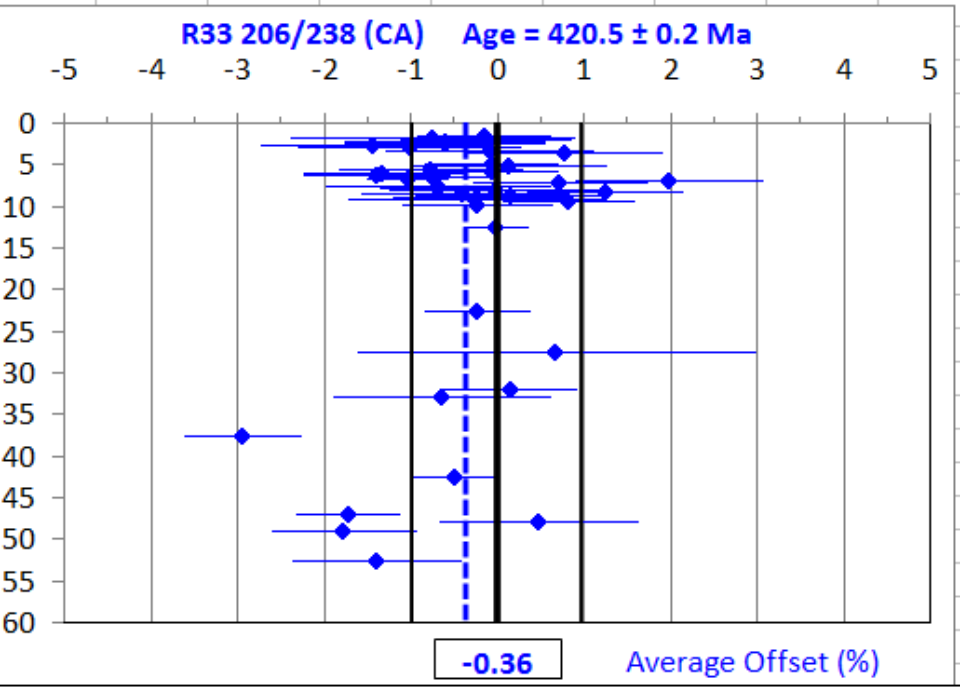

Temora 206/238 (ID-91500) Age = 416.8 ± 0.3 Ma
-0.71
Average Offset

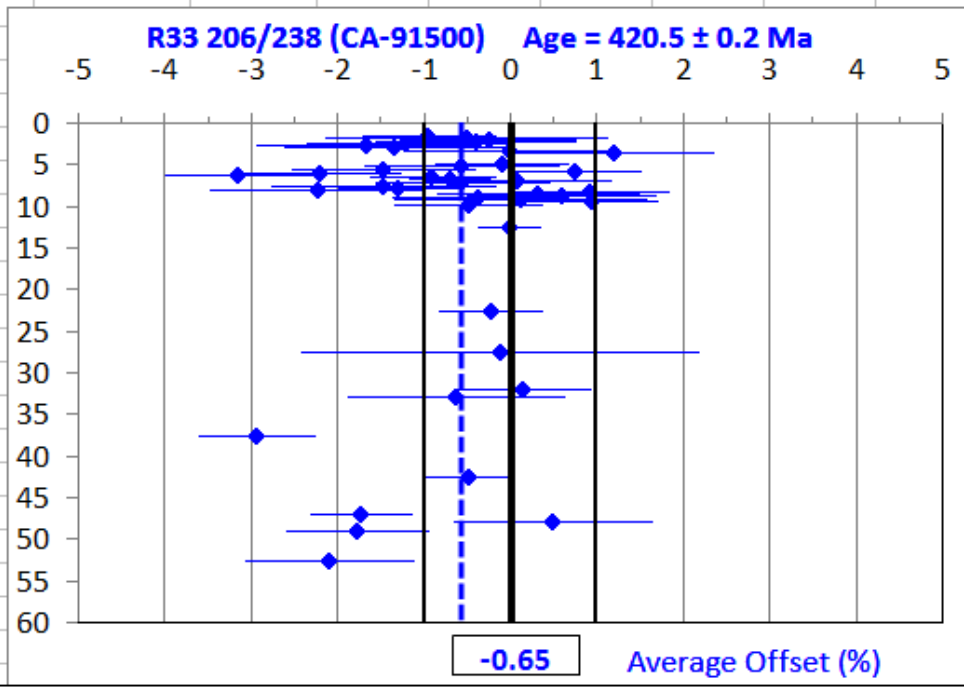

Temora 206/238 (CA) Age = 418.4 ± 0.2 Ma
-0.68
Average Offset (%)

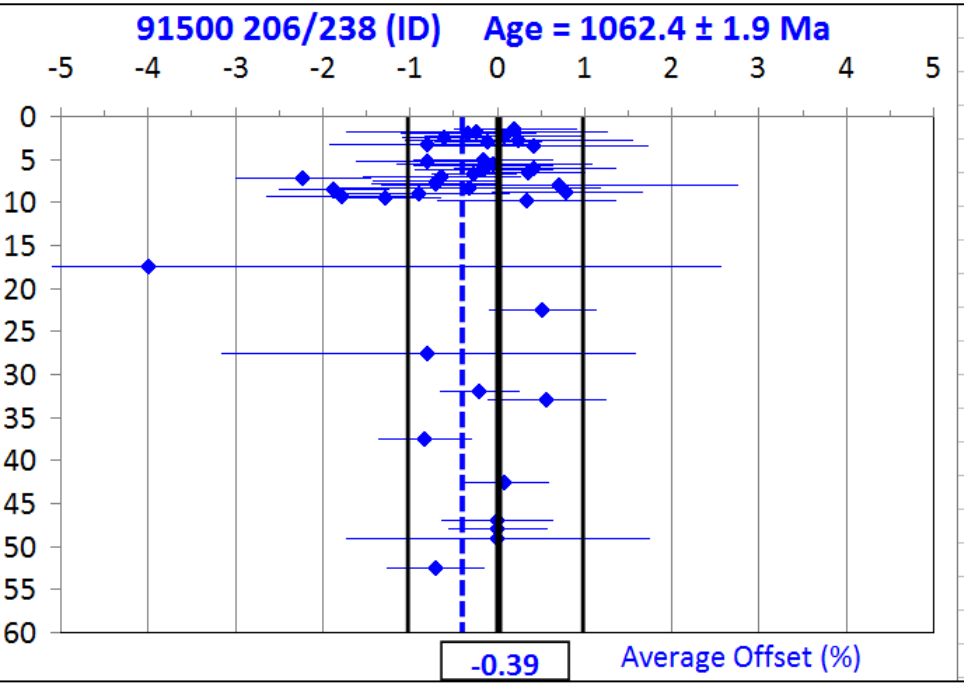

Temora 206/238 (CA-91500) Age = 418.4 ± 0.2 Ma
-1.09
Average Offset (%)

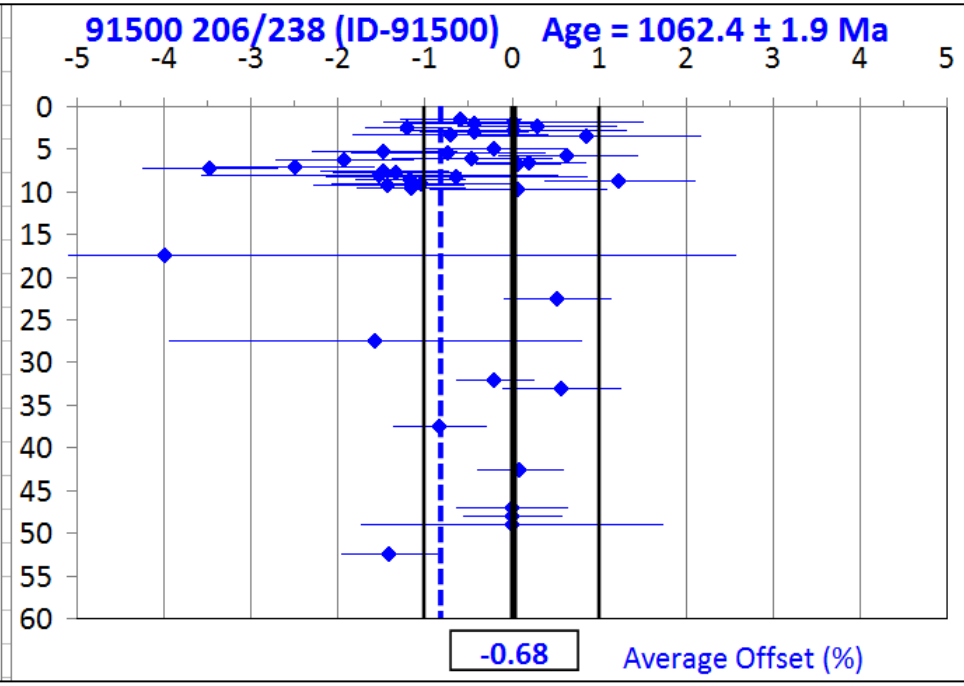

R33 206/238 (ID) Age = 419.3 ± 0.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.07
Average Offset (%)

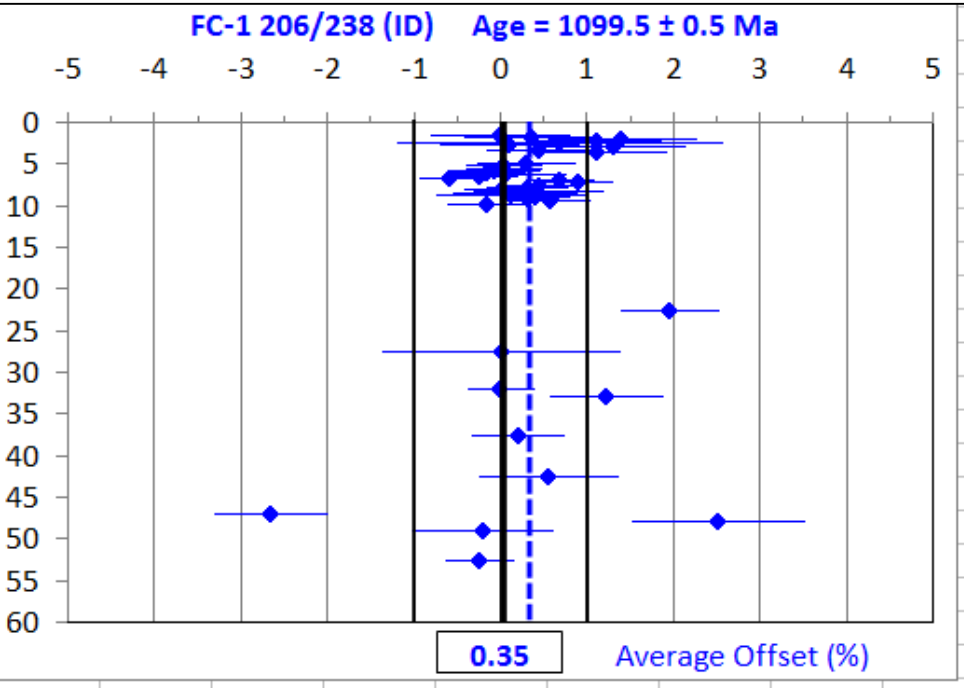

R33 206/238 (ID-91500) Age = 419.3 ± 0.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.36
Average Offset (%)

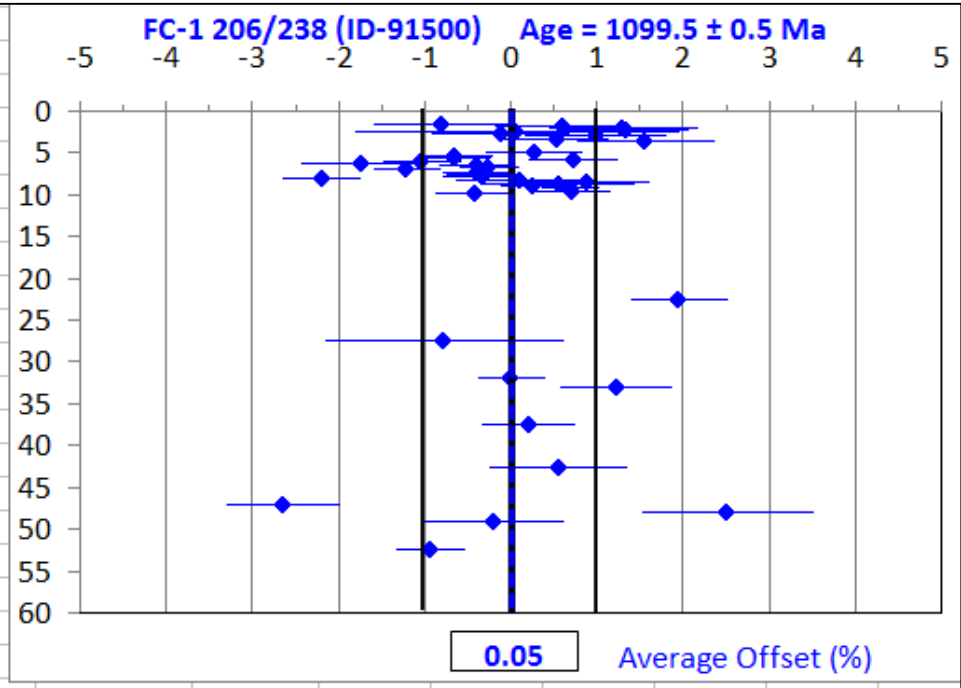

R33 206/238 (CA) Age = 420.5 ± 0.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.36
Average Offset (%)

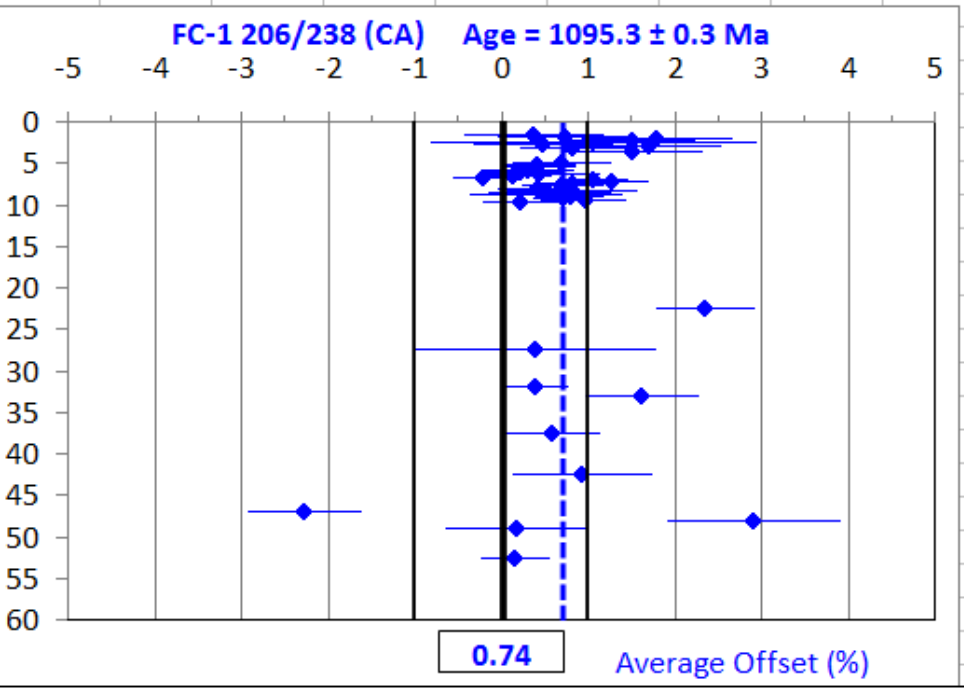

R33 206/238 (CA-91500) Age = 420.5 ± 0.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.65
Average Offset (%)

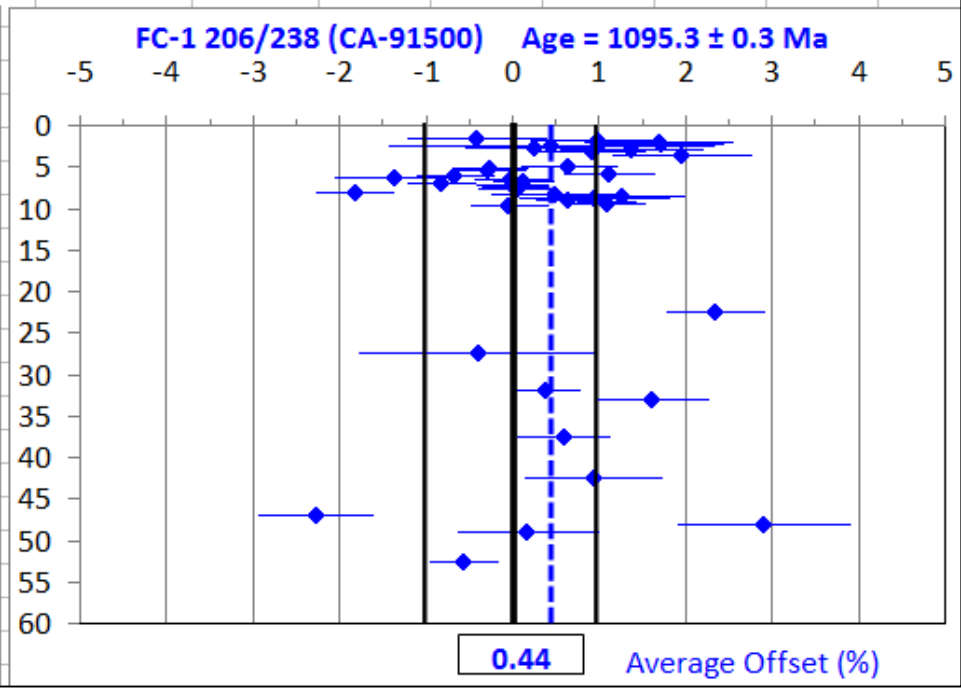

91500 206/238 (ID)
Age = 1062.4 ± 1.9 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.39
Average Offset (%)

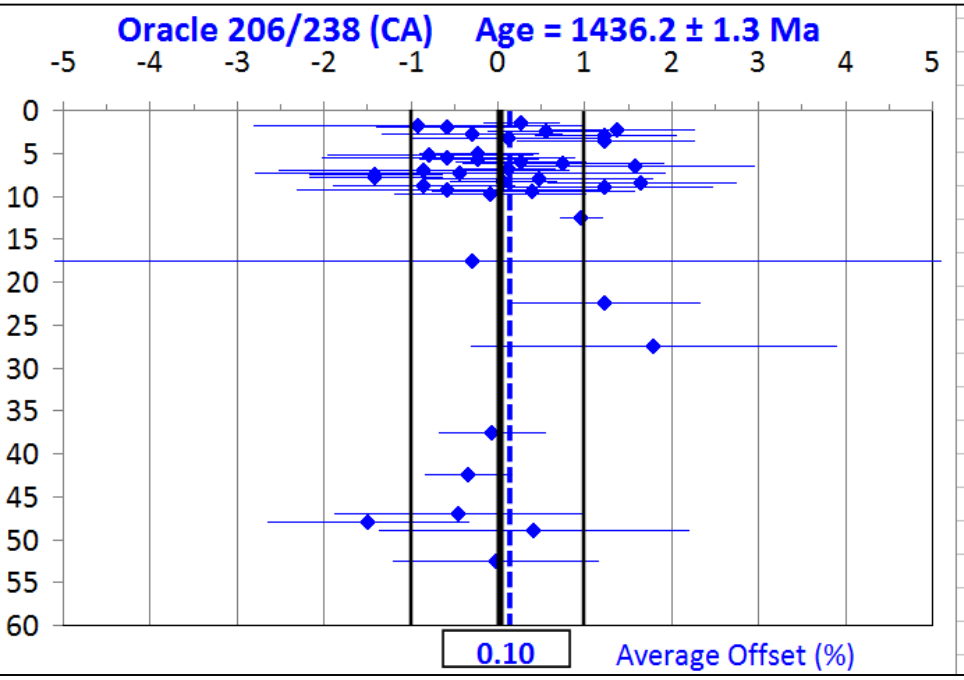

91500 206/238 (ID-91500)
Age = 1062.4 ± 1.9 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.68
Average Offset (%)

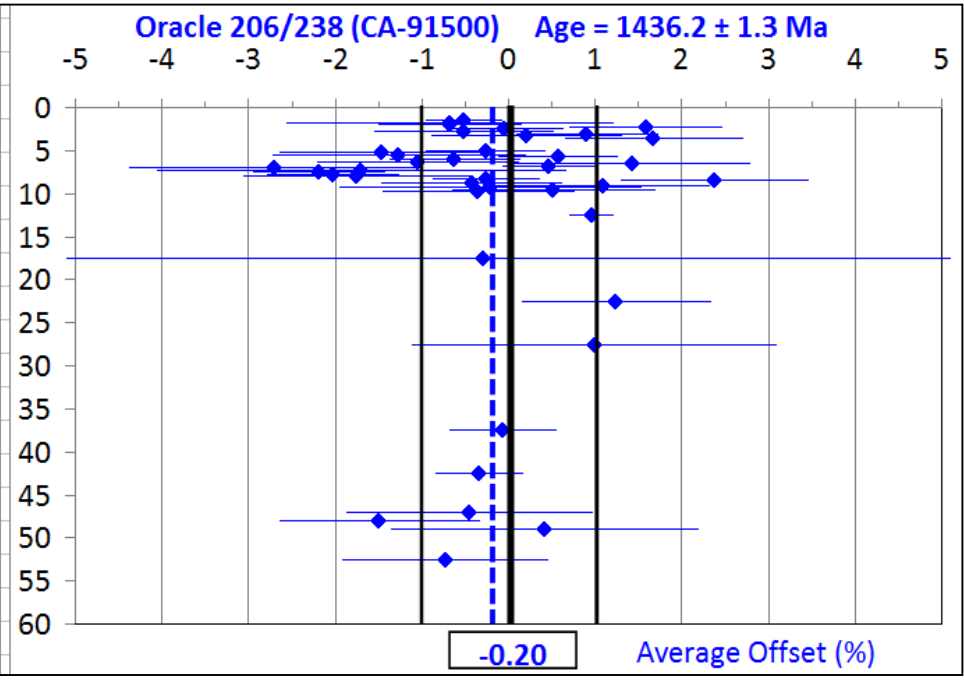

FC-1 206/238 (ID) Age = 1099.5 ± 0.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.35
Average Offset (%)

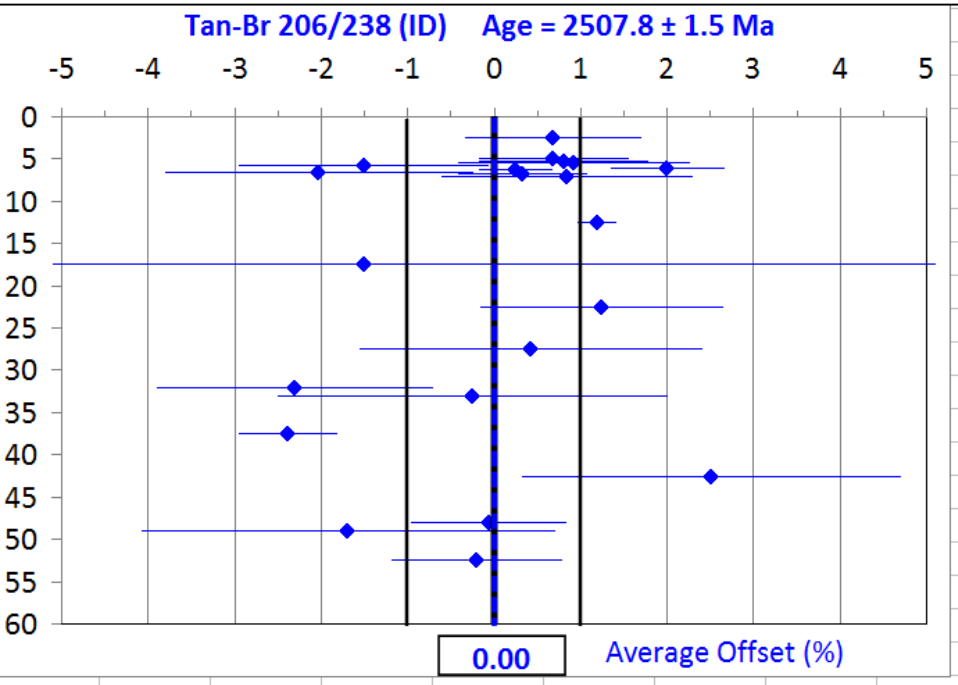

FC-1 206/238 (ID-91500) Age = 1099.5 ± 0.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.05
Average Offset (%)

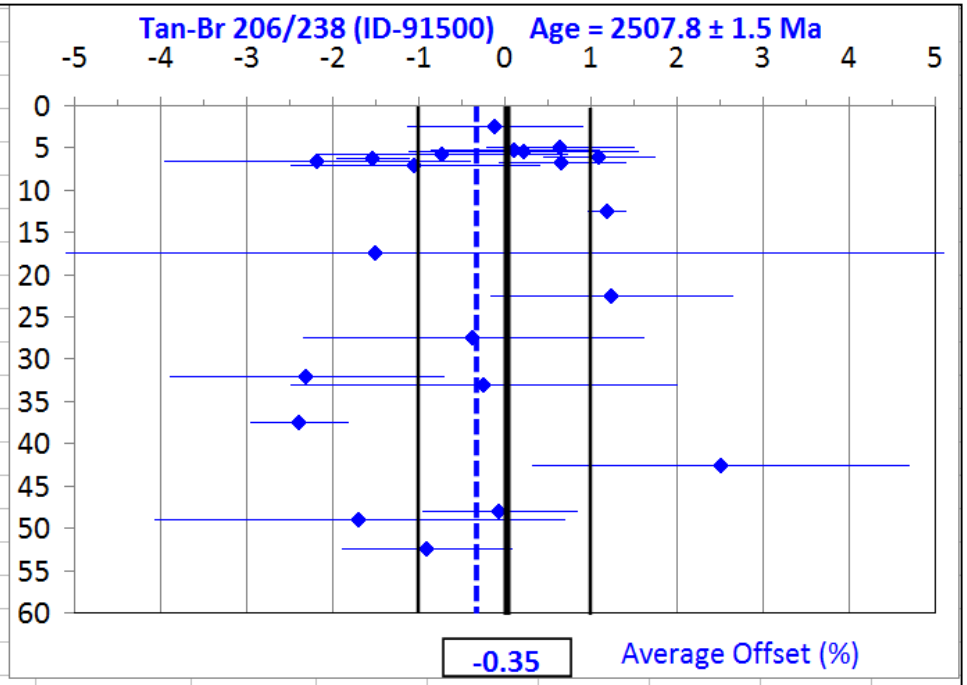

FC-1 206/238 (CA) Age = 1095.3 ± 0.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.74
Average Offset (%)

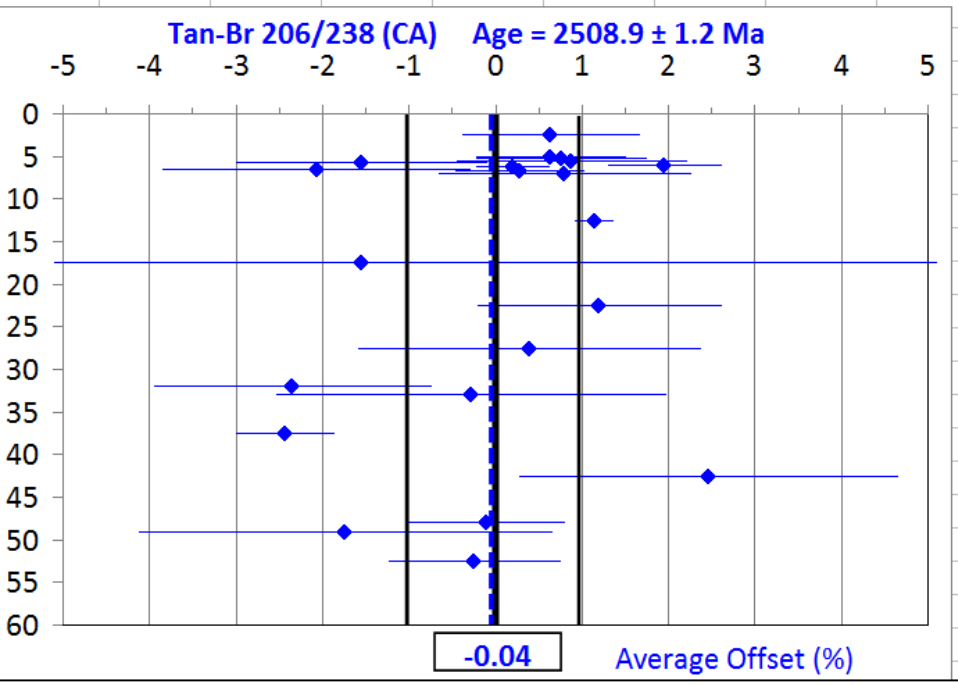

FC-1 206/238 (CA-91500) Age = 1095.3 ± 0.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.44
Average Offset (%)

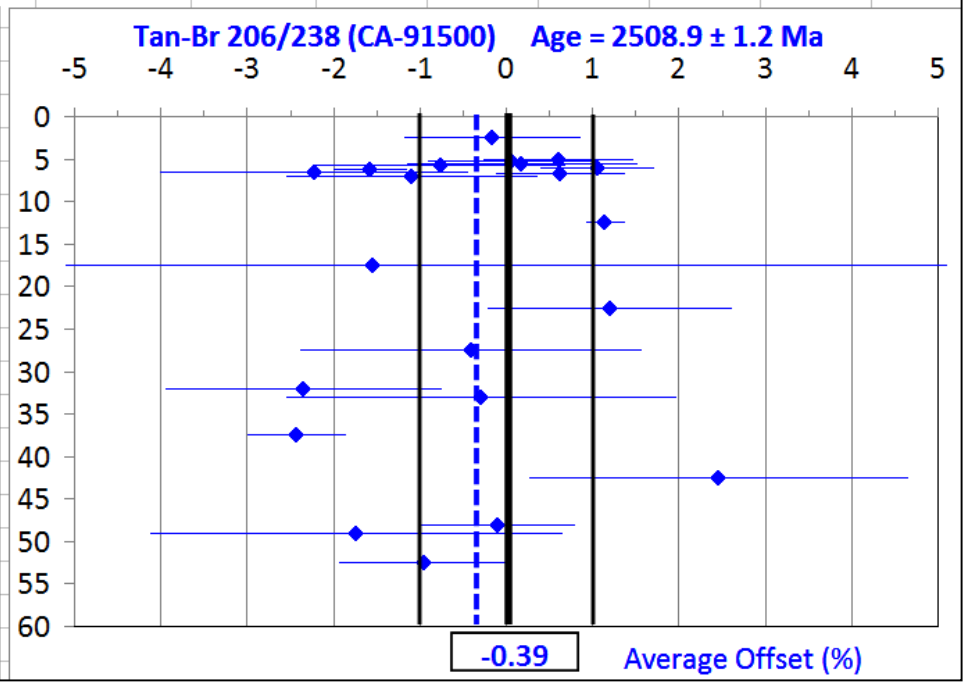

Oracle 206/238 (CA) Age = 1436.2 ± 1.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.10
Average Offset (%)

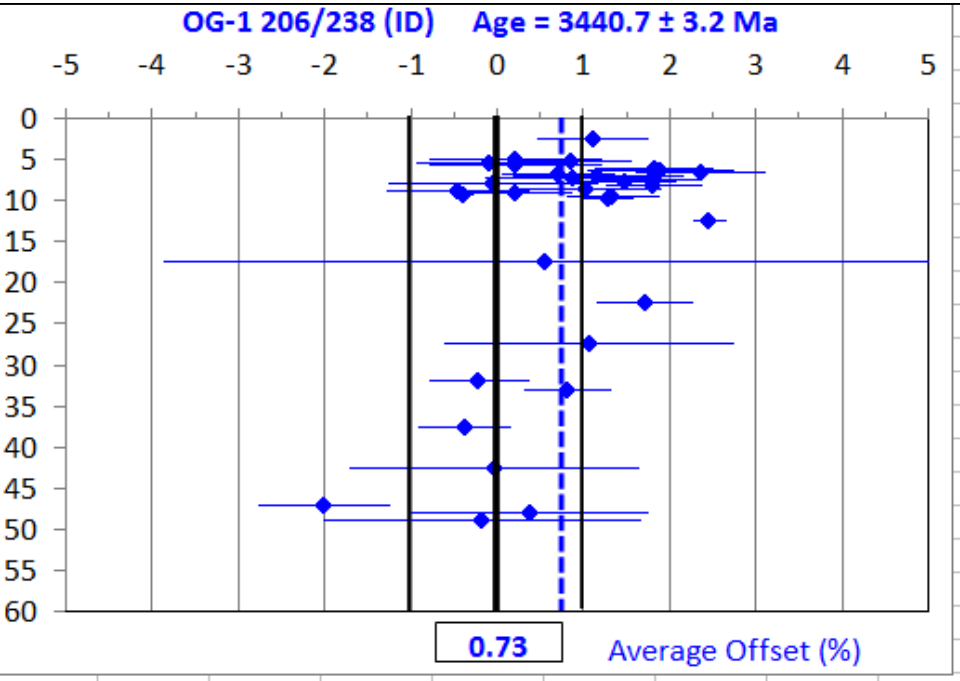

Oracle 206/238 (CA-91500) Age = 1436.2 ± 1.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.20
Average Offset (%)

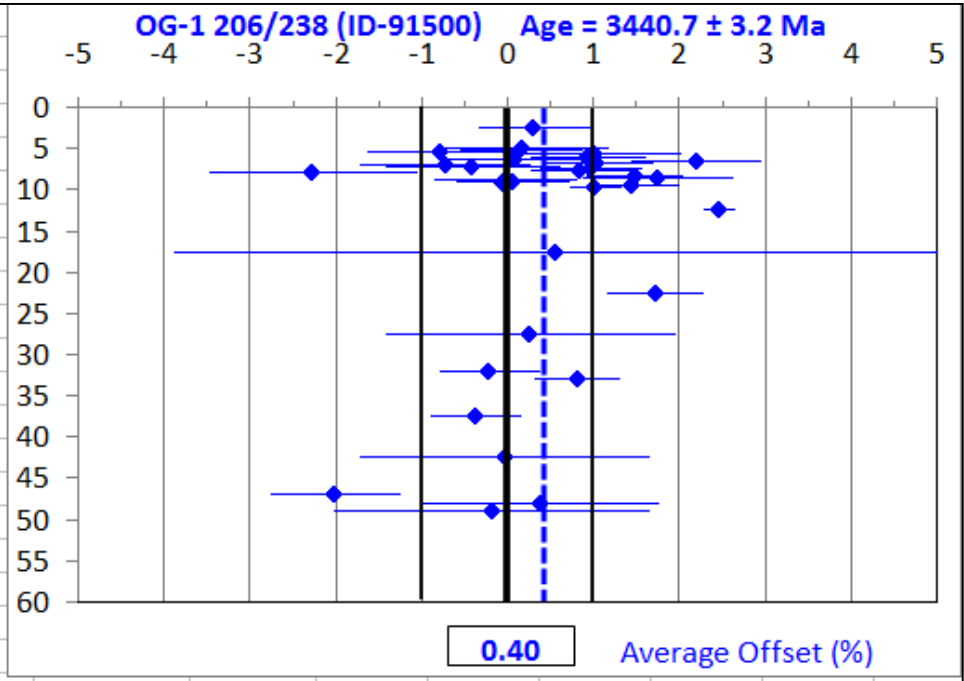

Tan-Br 206/238 (ID) Age = 2507.8 ± 1.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.00
Average Offset (%)

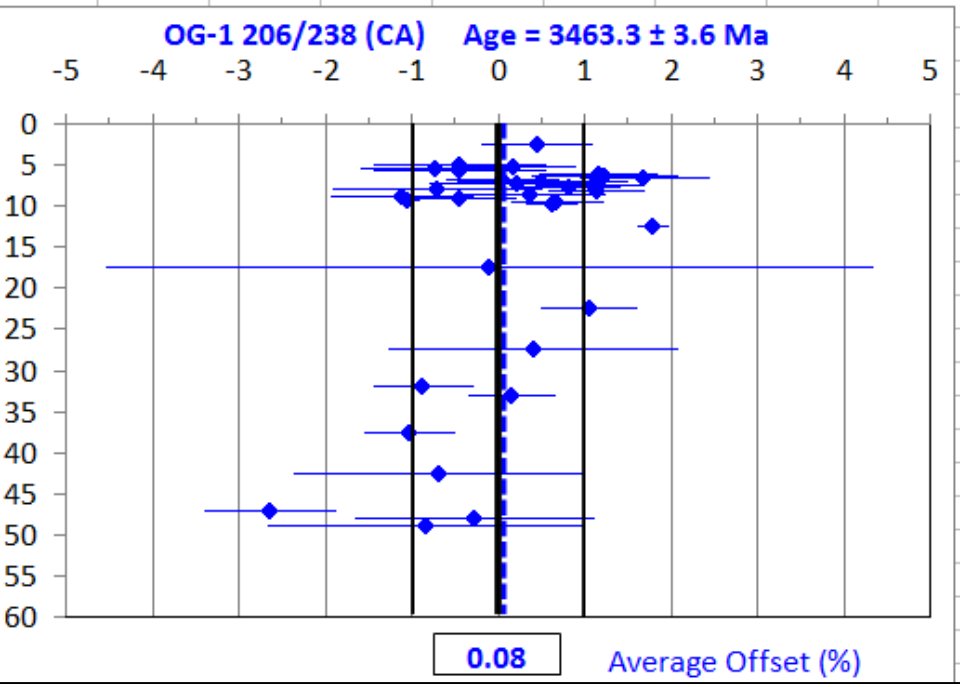

Tan-Br 206/238 (ID-91500) Age = 2507.8 ± 1.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.35
Average Offset (%)

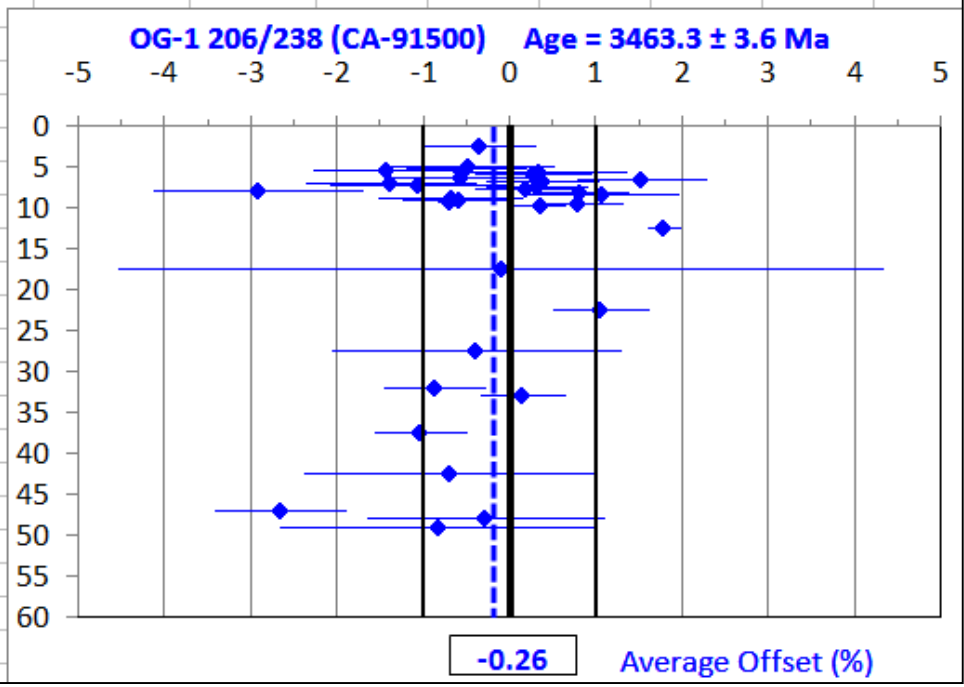

Tan-Br 206/238 (CA) Age = 2508.9 ± 1.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.04
Average Offset (%)

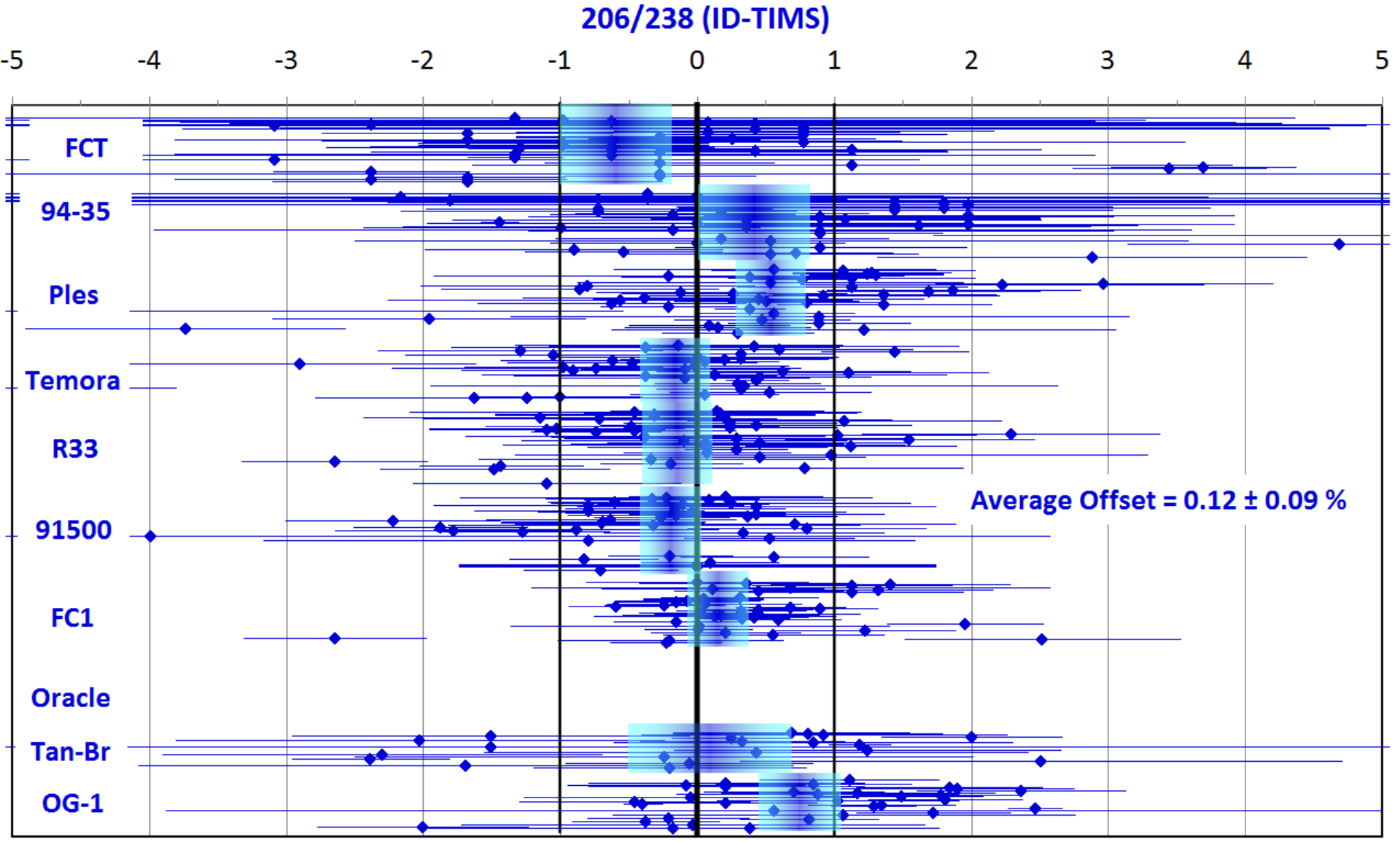

Tan-Br 206/238 (CA-91500) Age = 2508.9 ± 1.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.39
Average Offset (%)

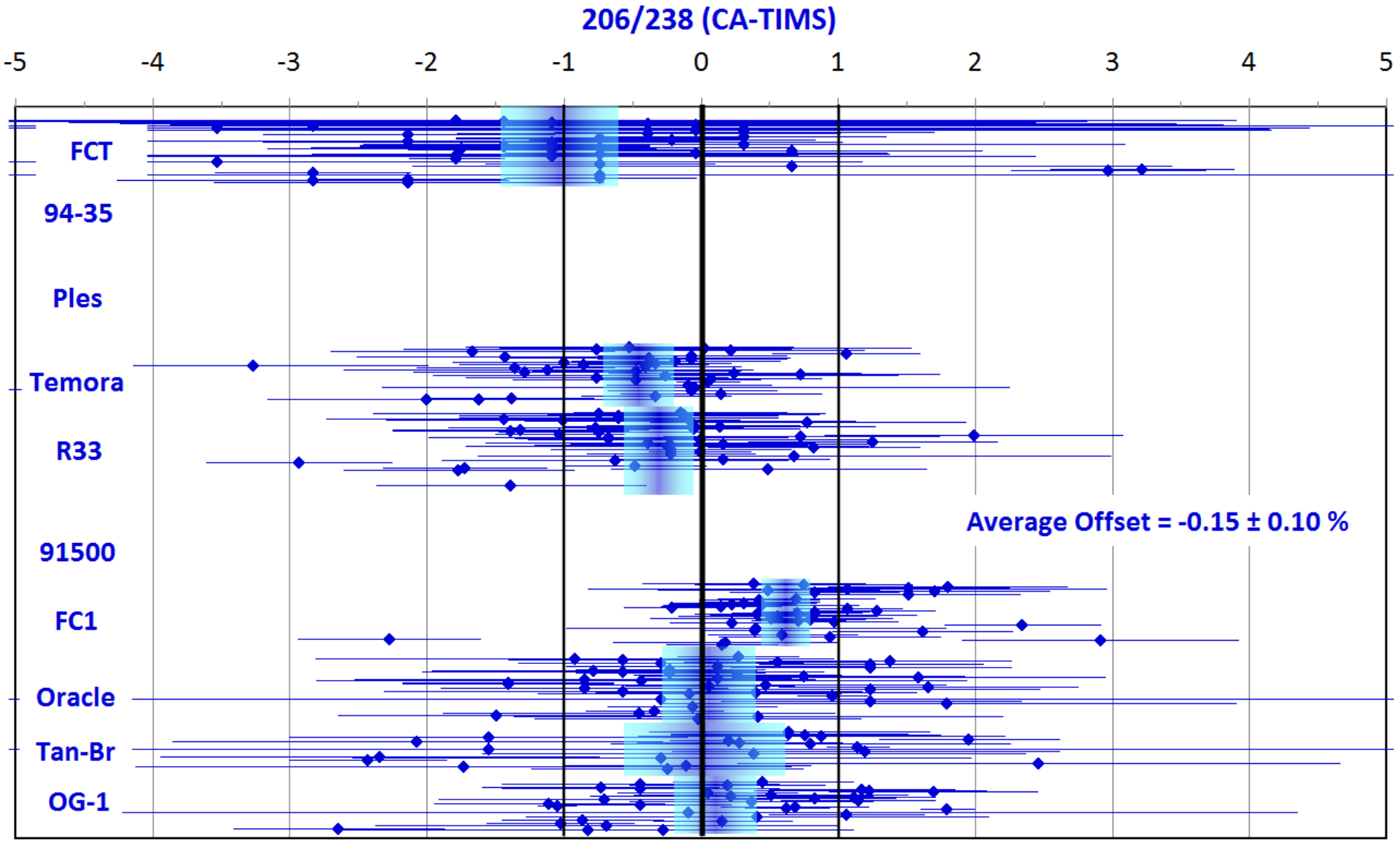

OG-1 206/238 (ID) Age = 3440.7 ± 3.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.73
Average Offset (%)

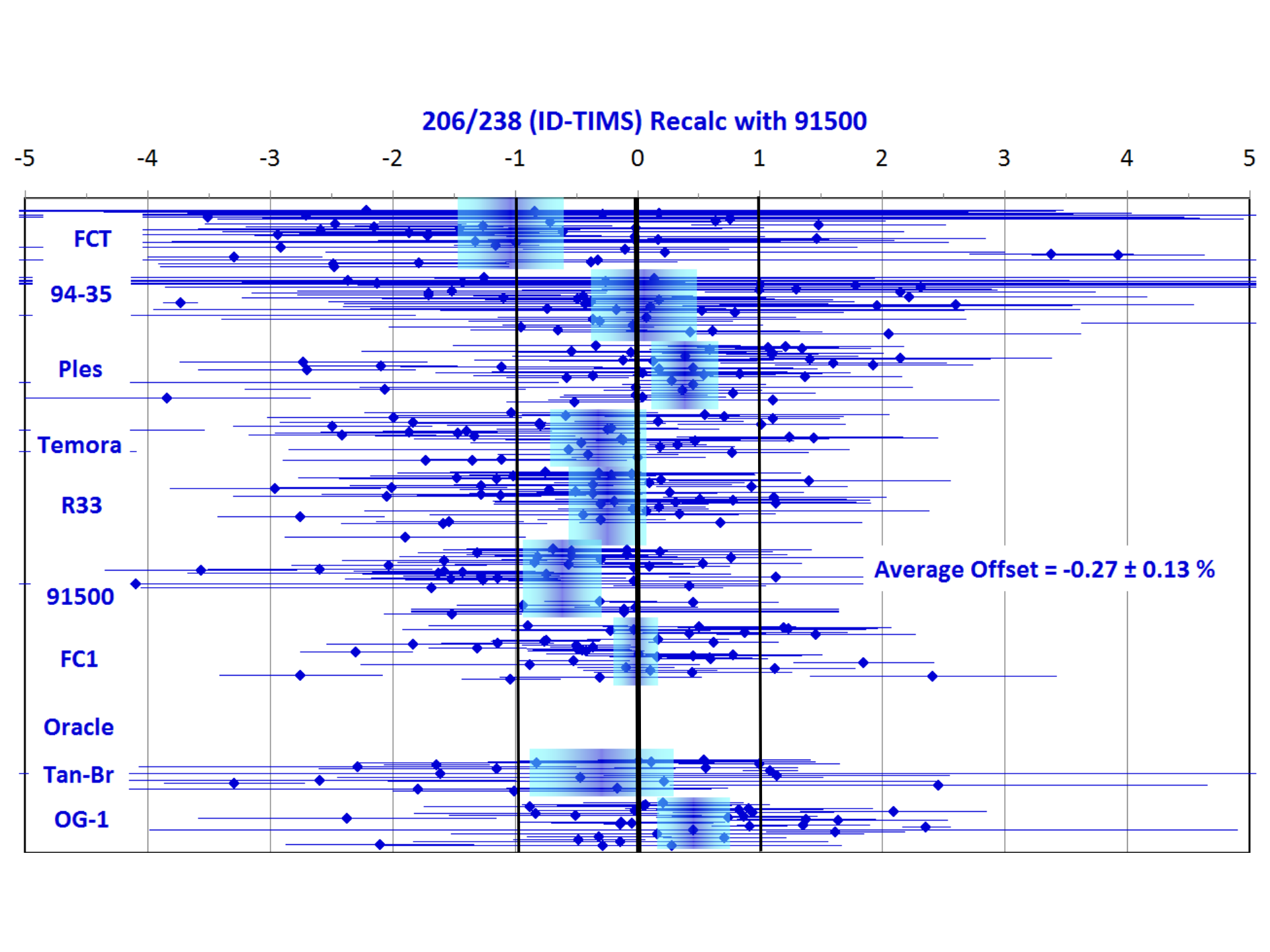

OG-1 206/238 (ID-91500) Age = 3440.7 ± 3.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.40
Average Offset (%)

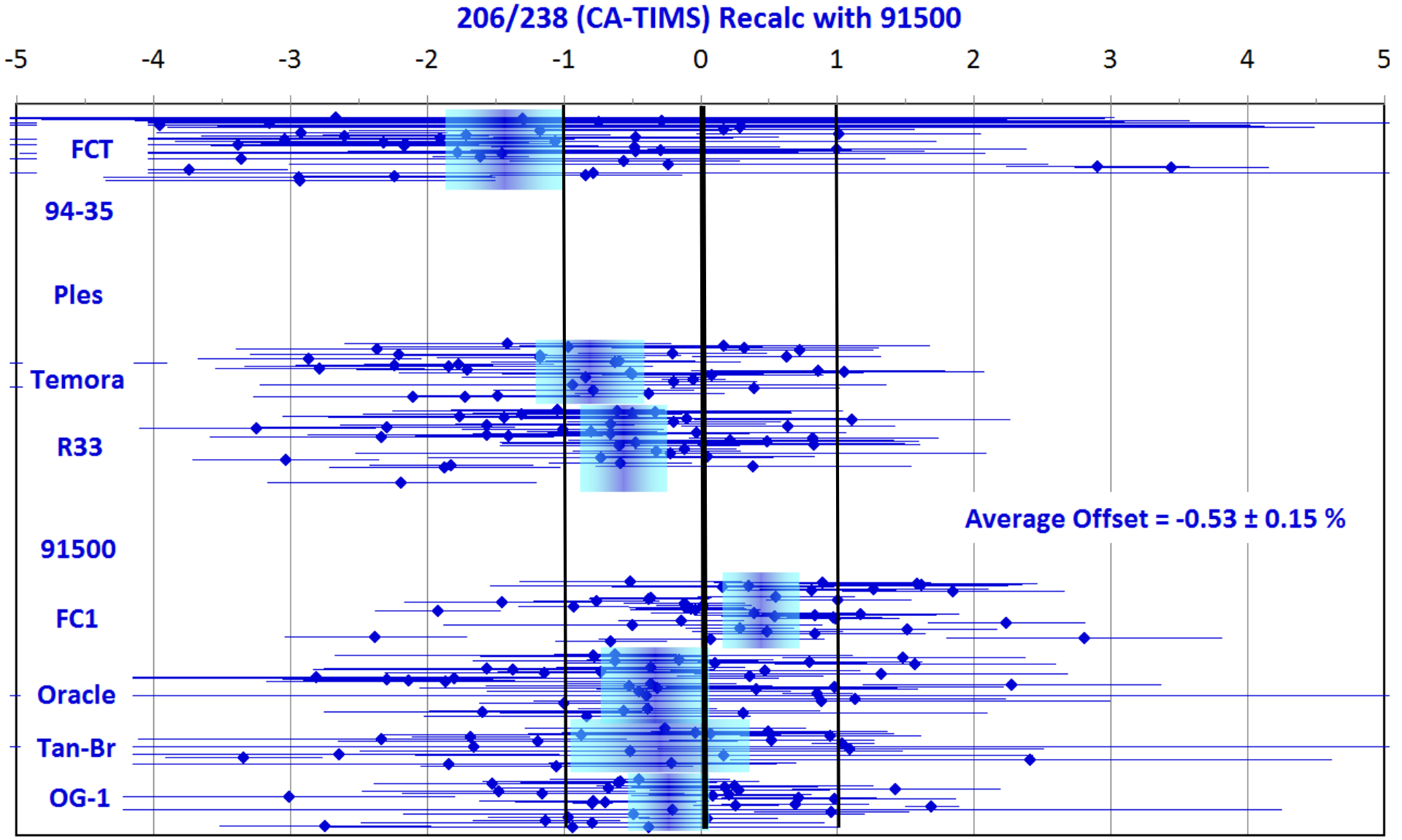

OG-1 206/238 (CA) Age = 3463.3 ± 3.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.08
Average Offset (%)

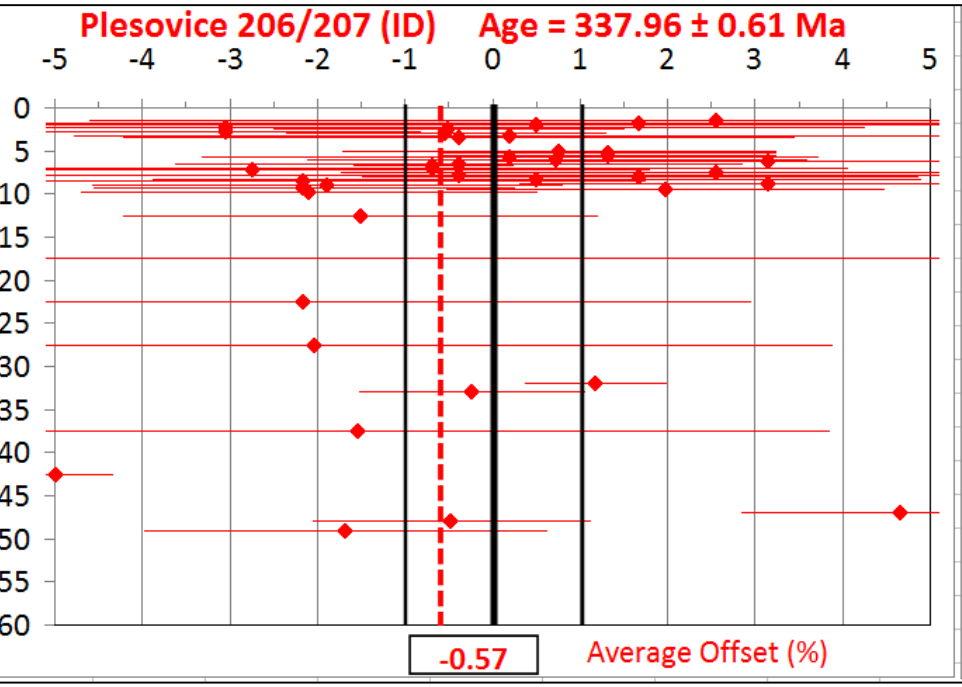

OG-1 206/238 (CA-91500) Age = 3463.3 ± 3.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.26
Average Offset (%)

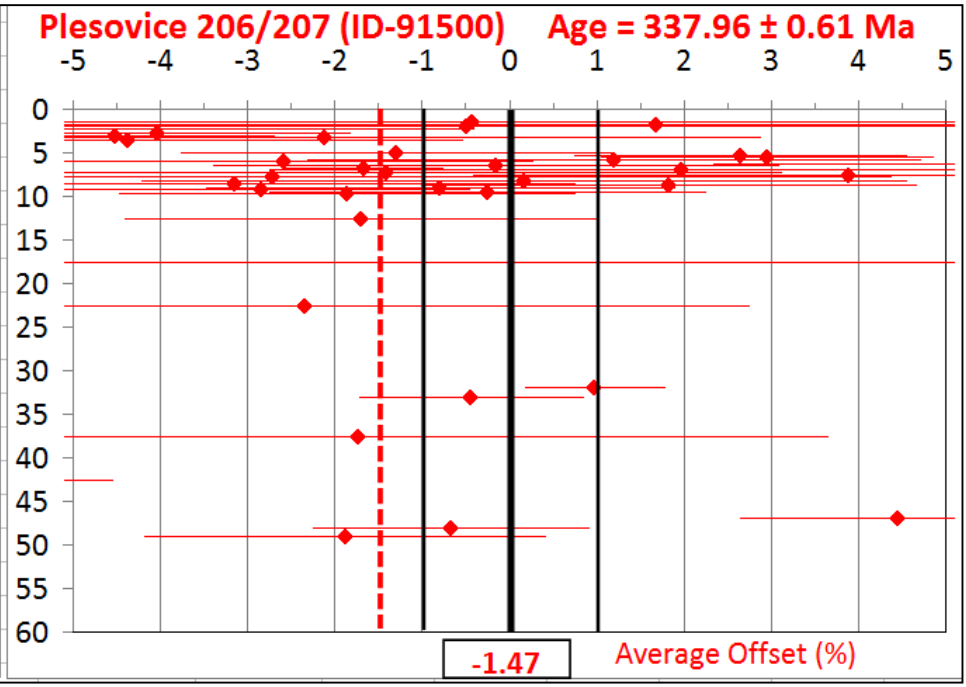

206/238 (ID-TIMS)
-5
-4
-3
-2
-1
0
1
2
3
4
5
FCT
94-35
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = 0.12 ± 0.09 %

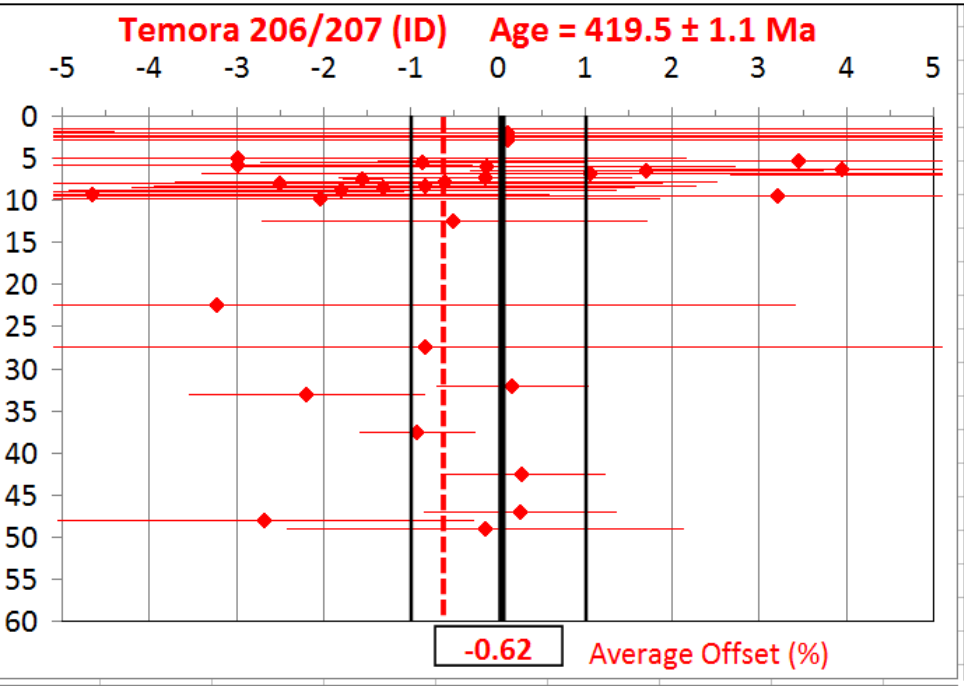

206/238 (CA-TIMS)
-5
-4
-3
-2
-1
0
1
2
3
4
5
FCT
94-35
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.15 ± 0.10 %

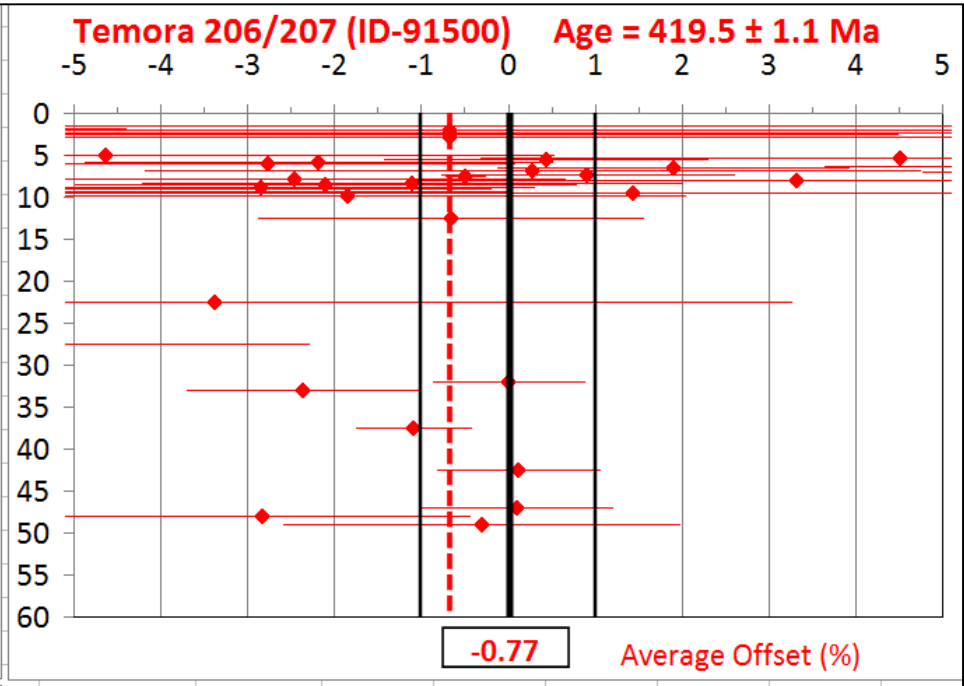

206/238 (ID-TIMS) Recalc with 91500
-5
-4
-3
-2
-1
0
1
2
3
4
5
FCT
94-35
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.27 ± 0.13 %

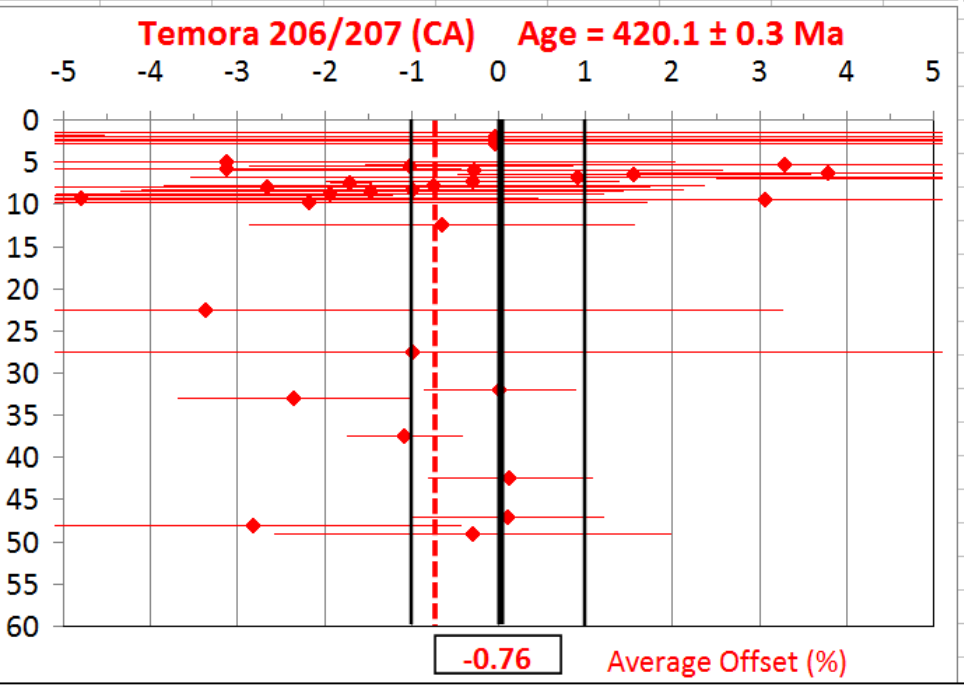

206/238 (CA-TIMS) Recalc with 91500
-5
-4
-3
-2
-1
0
1
2
3
4
5
FCT
94-35
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.53 ± 0.15 %

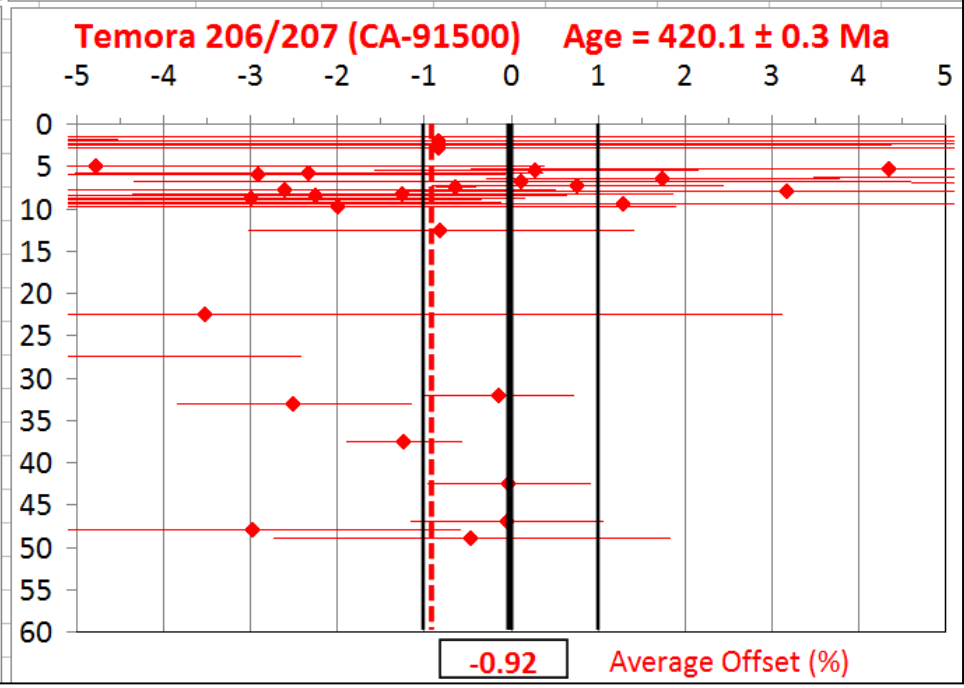

Plesovice 206/207 (ID)
Age = 337.96 ± 0.61 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.57
Average Offset (%)

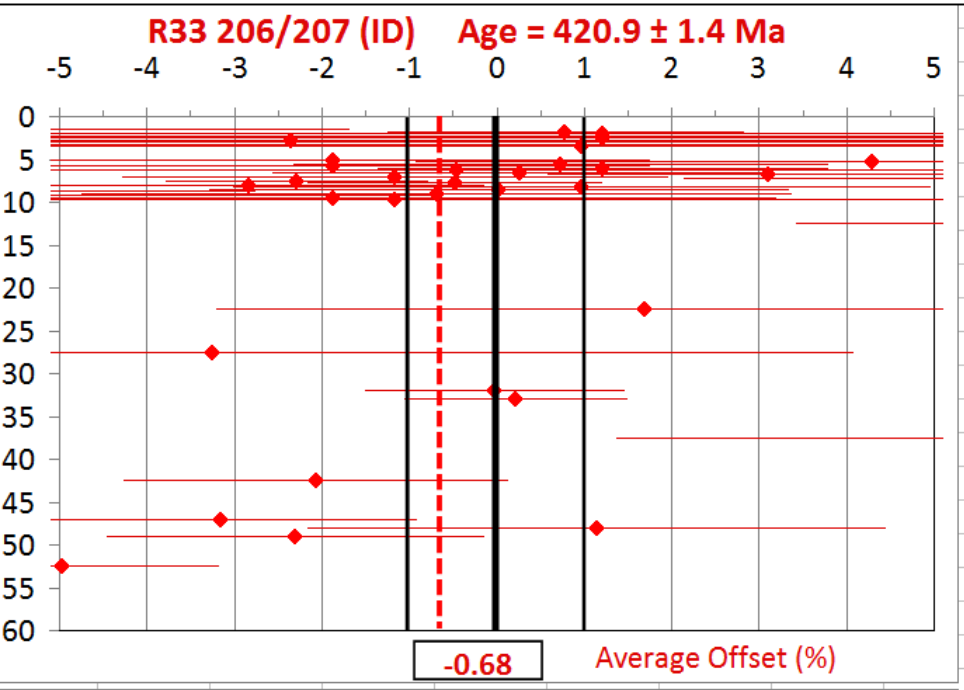

Plesovice 206/207 (ID-91500)
Age = 337.96 ± 0.61 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-1.47
Average Offset (%)

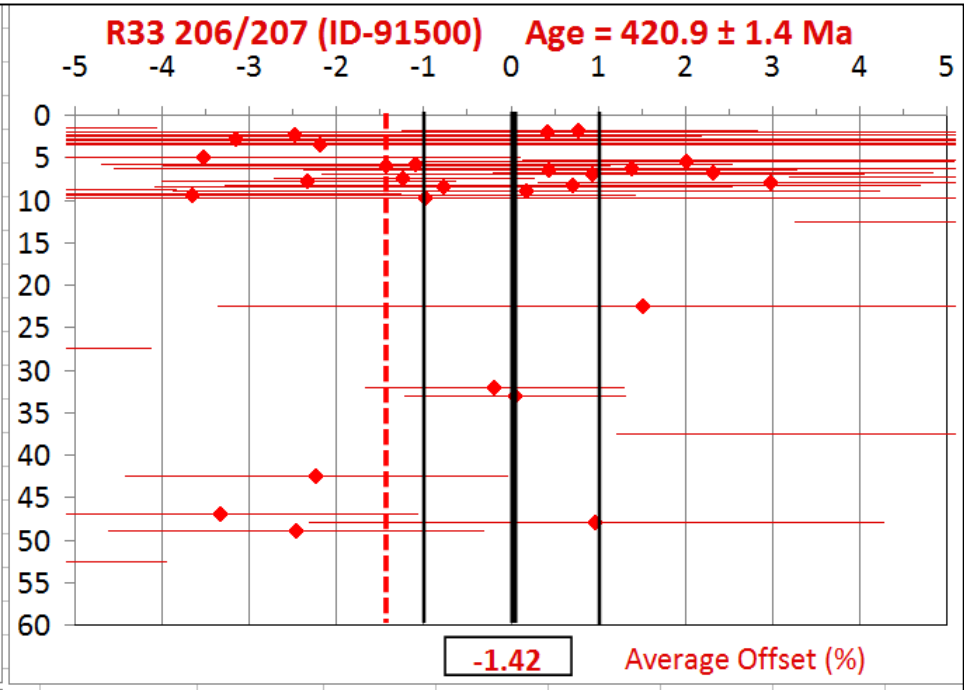

Temora 206/207 (ID) Age = 419.5 ± 1.1 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.62
Average Offset (%)

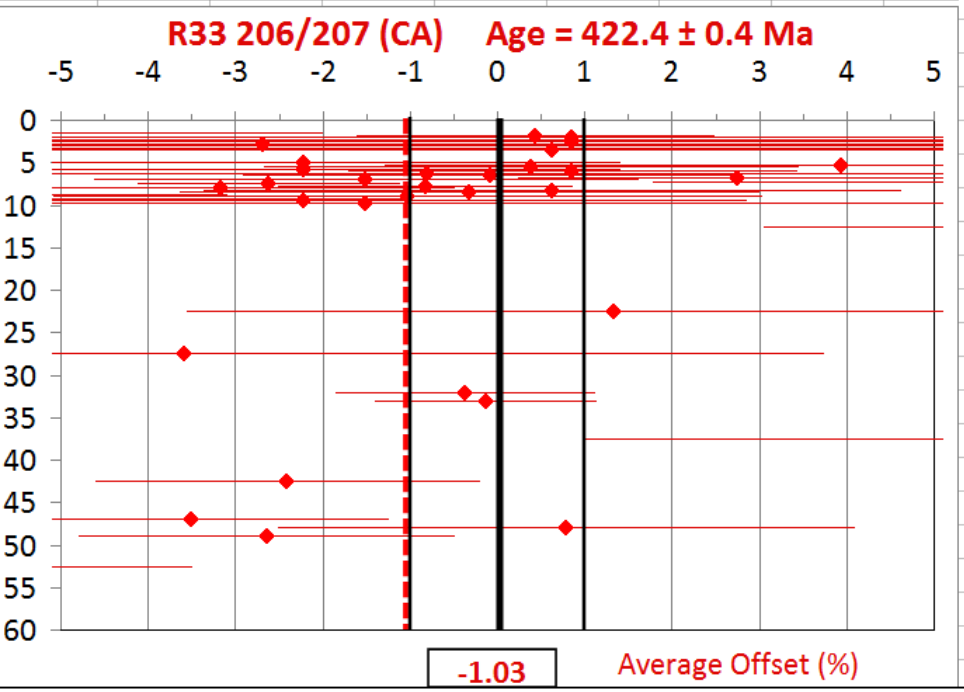

Temora 206/207 (ID-91500) Age = 419.5 ± 1.1 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.77
Average Offset (%)

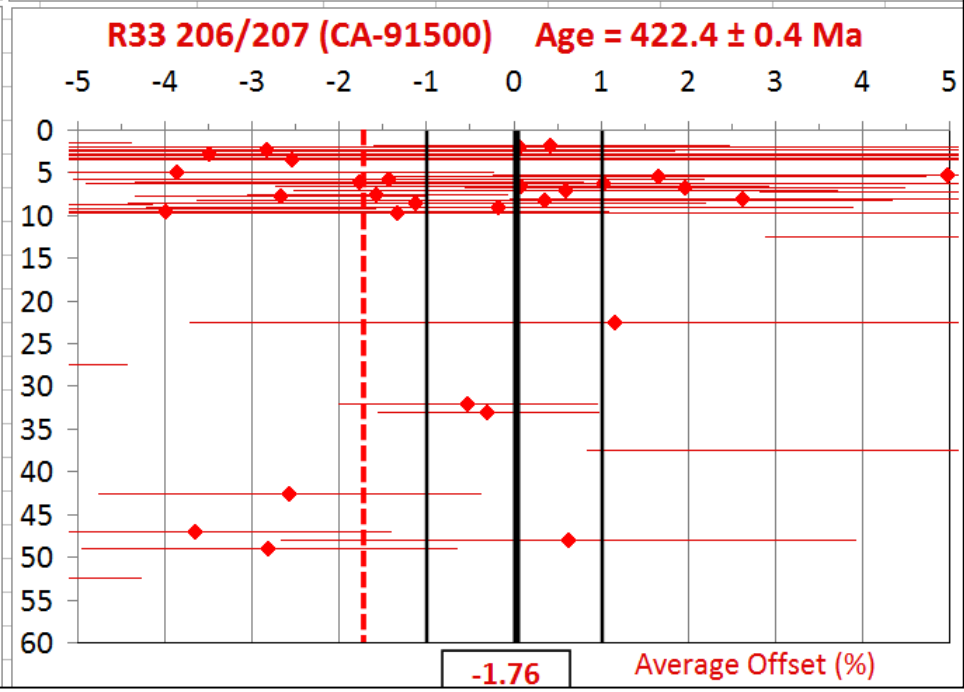

Temora 206/207 (CA) Age = 420.1 ± 0.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.76
Average Offset (%)

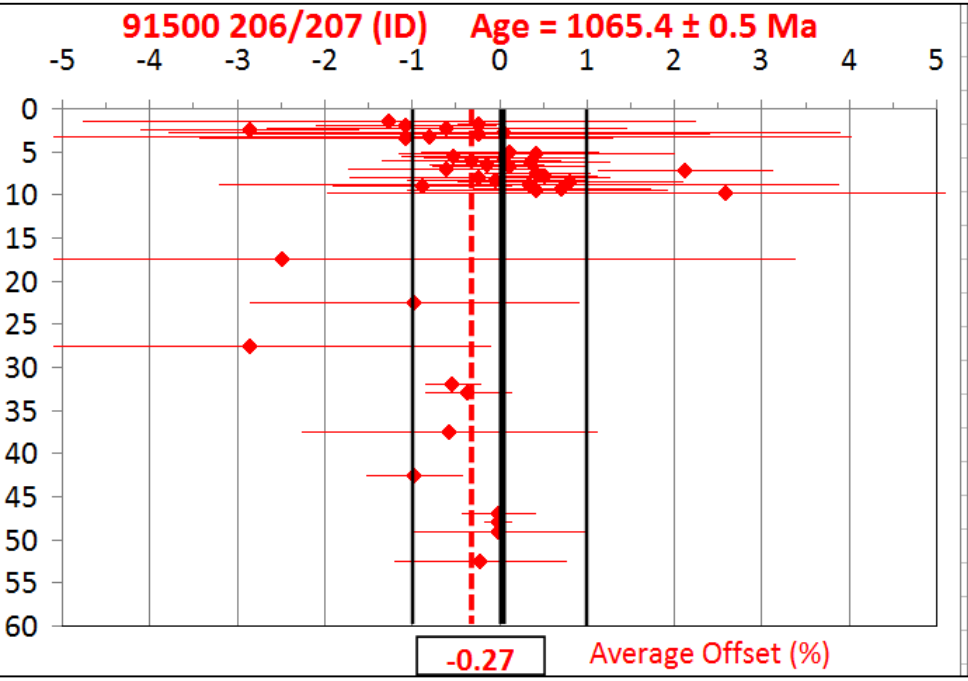

Temora 206/207 (CA-91500) Age = 420.1 ± 0.3 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.92
Average Offset (%)

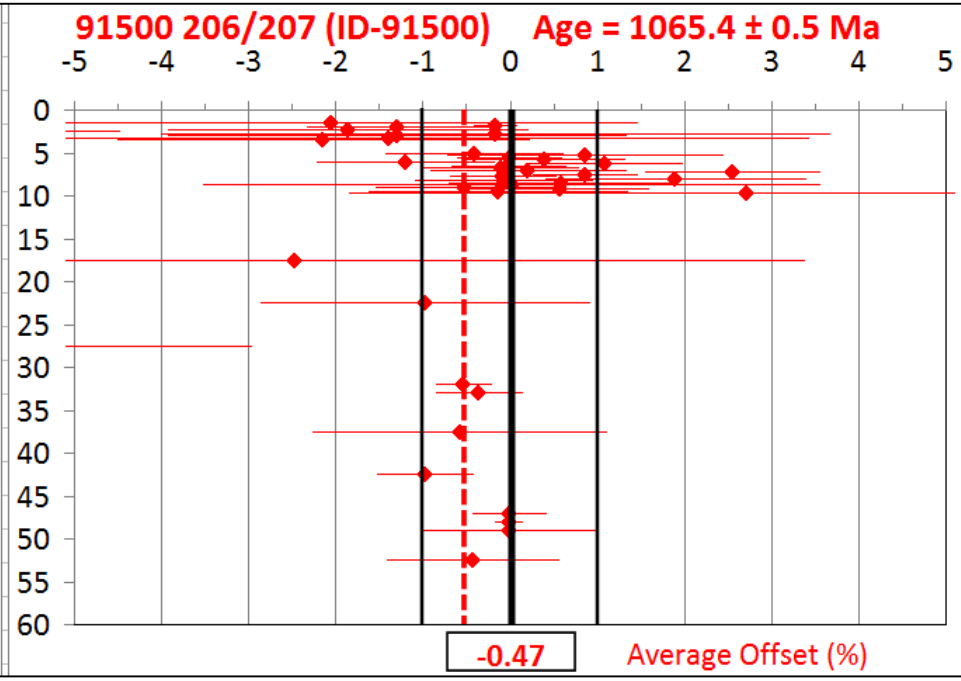

R33 206/207 (ID) Age = 420.9 ± 1.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.68
Average Offset (%)

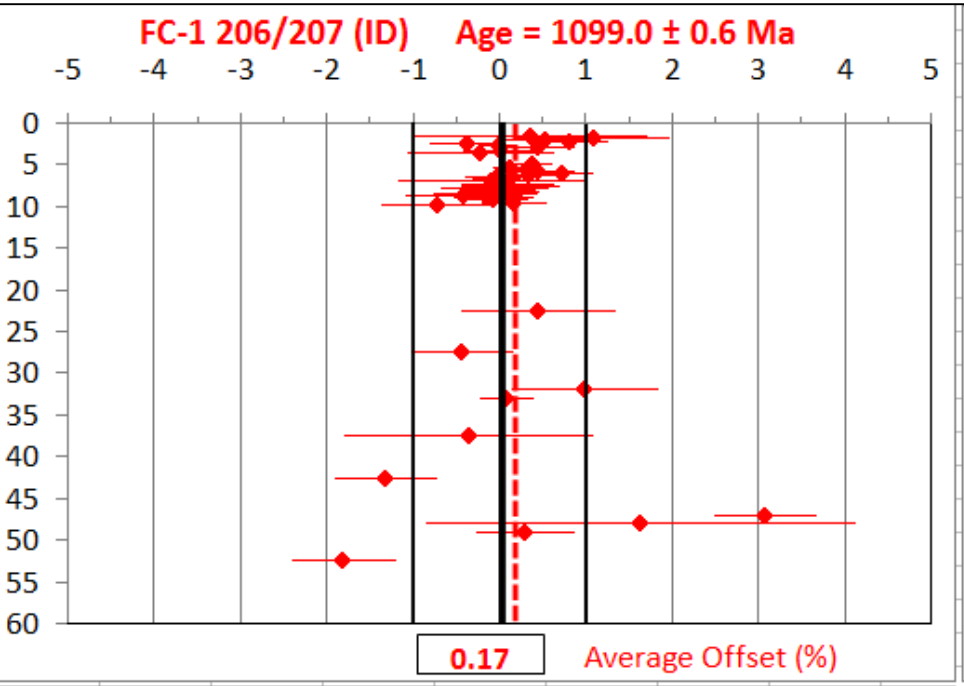

R33 206/207 (ID-91500) Age = 420.9 ± 1.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-1.42
Average Offset (%)

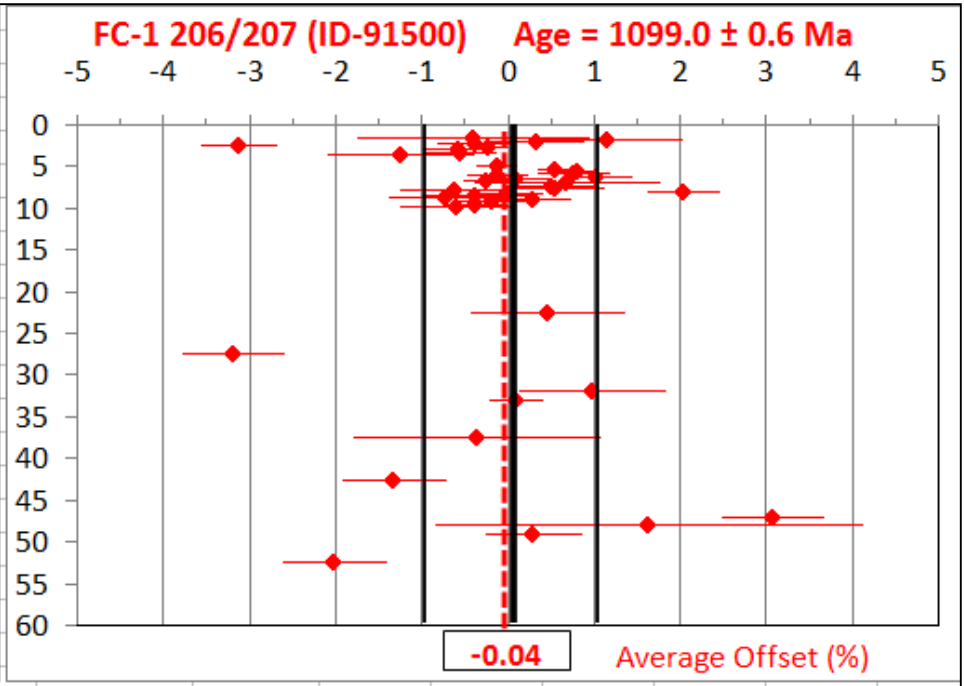

R33 206/207 (CA) Age = 422.4 ± 0.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-1.03
Average Offset (%)

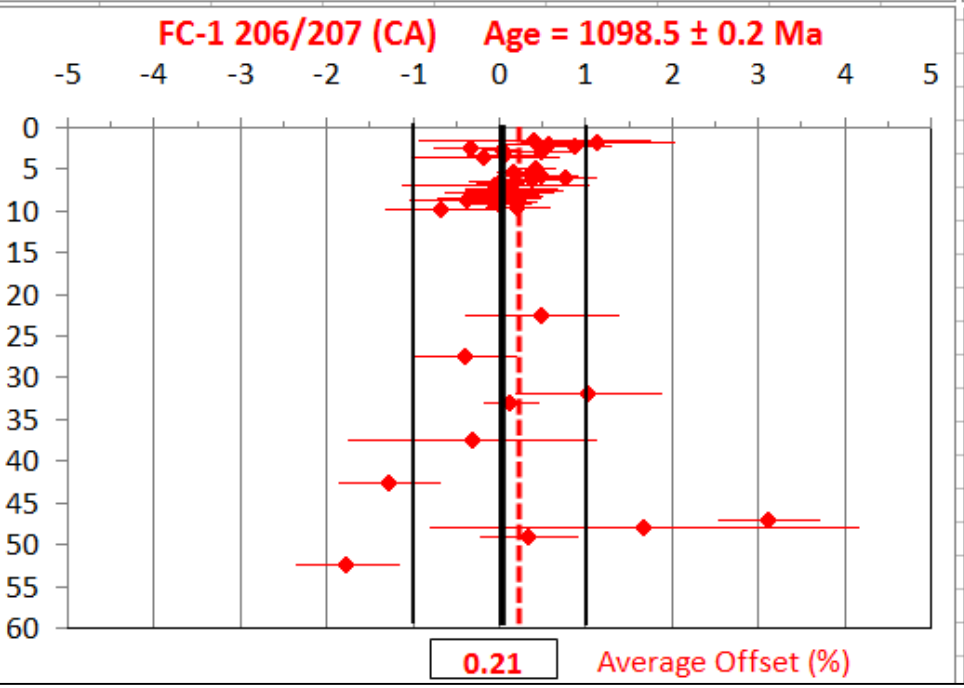

R33 206/207 (CA-91500) Age = 422.4 ± 0.4 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-1.76
Average Offset (%)

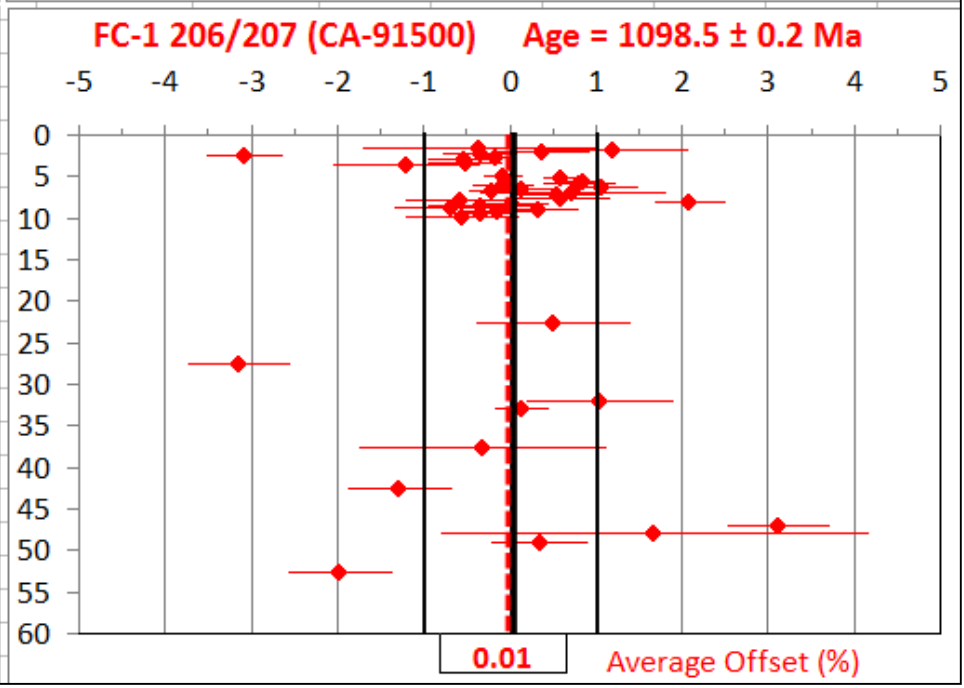

91500 206/207 (ID)
Age = 1065.4 ± 0.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.27
Average Offset (%)

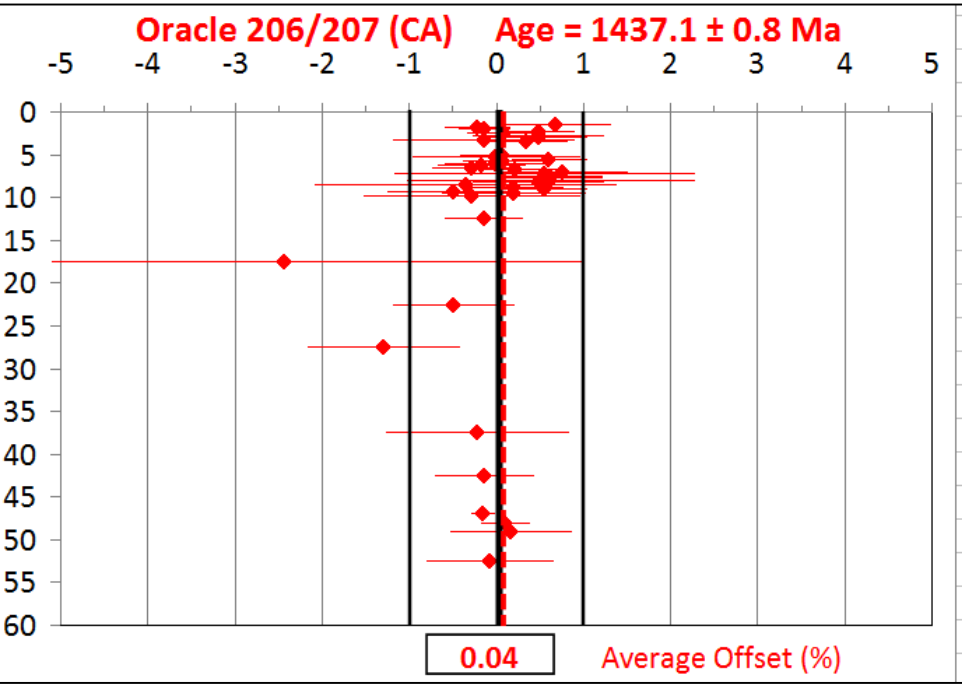

91500 206/207 (ID-91500)
Age = 1065.4 ± 0.5 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.47
Average Offset (%)

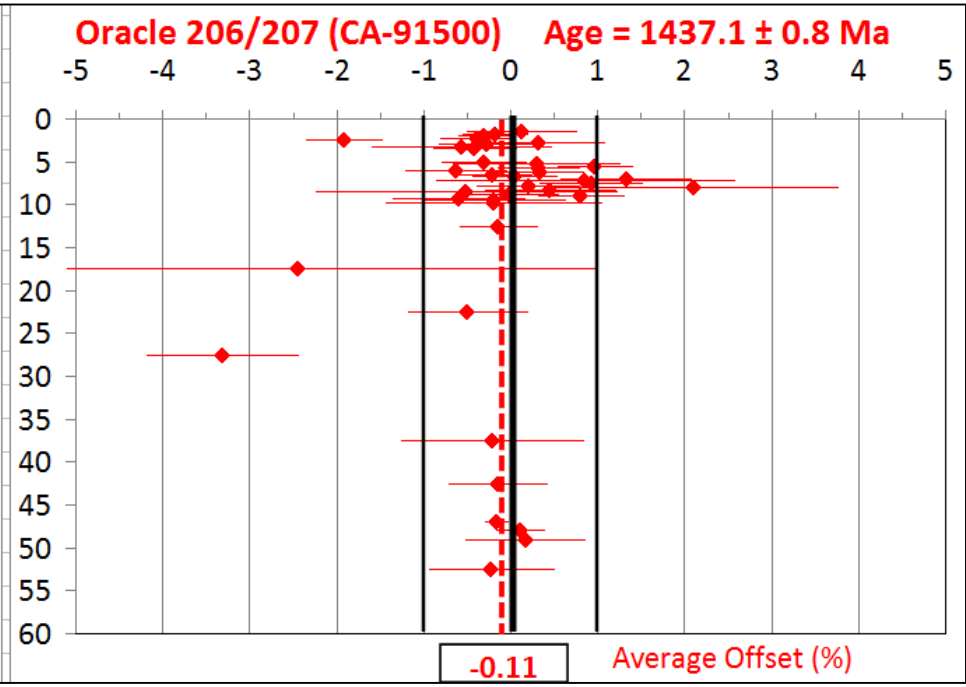

FC-1 206/207 (ID) Age = 1099.0 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.17
Average Offset (%)

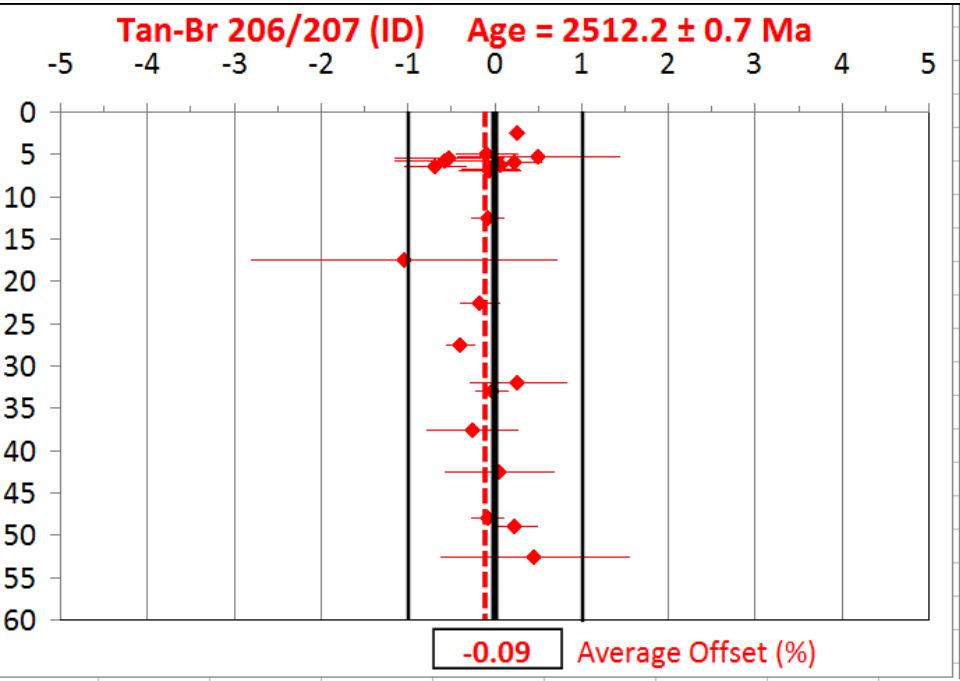

FC-1 206/207 (ID-91500) Age = 1099.0 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.04
Average Offset (%)

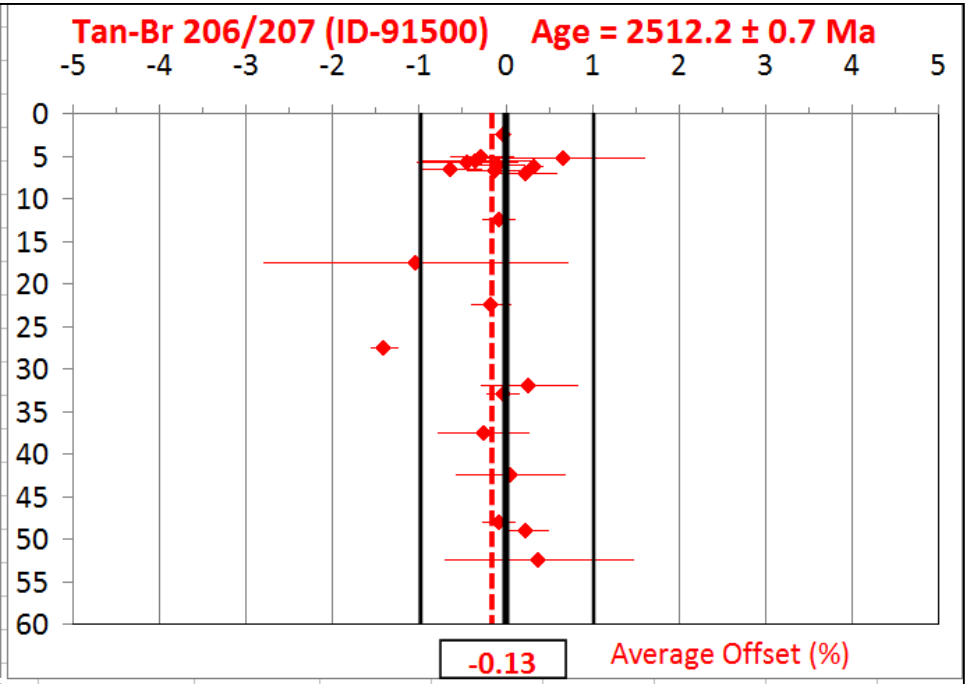

FC-1 206/207 (CA) Age = 1098.5 ± 0.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.21
Average Offset (%)

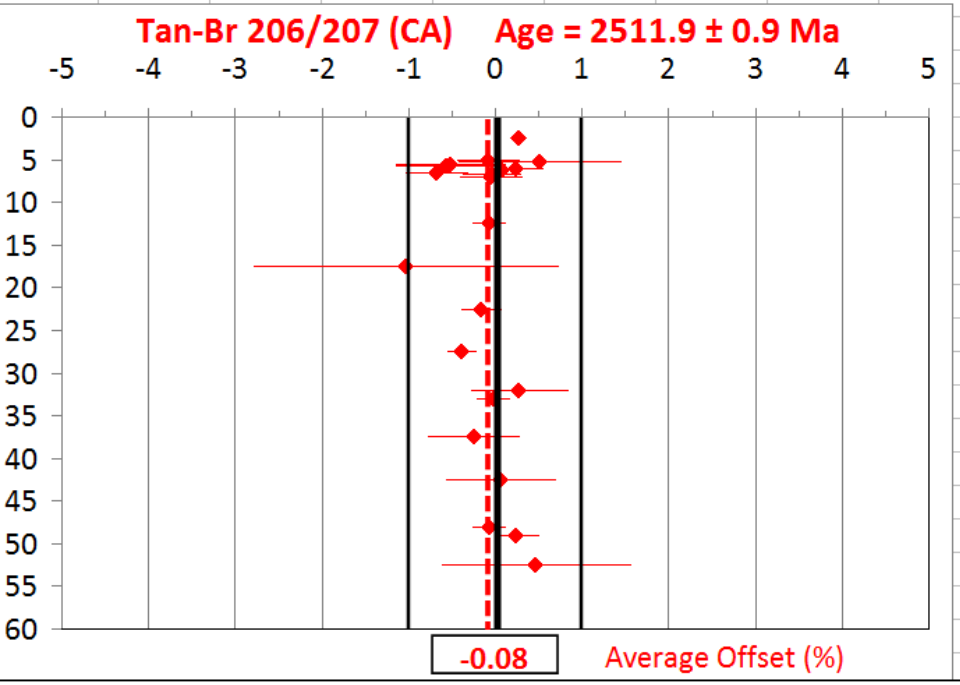

FC-1 206/207 (CA-91500) Age = 1098.5 ± 0.2 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.01
Average Offset (%)

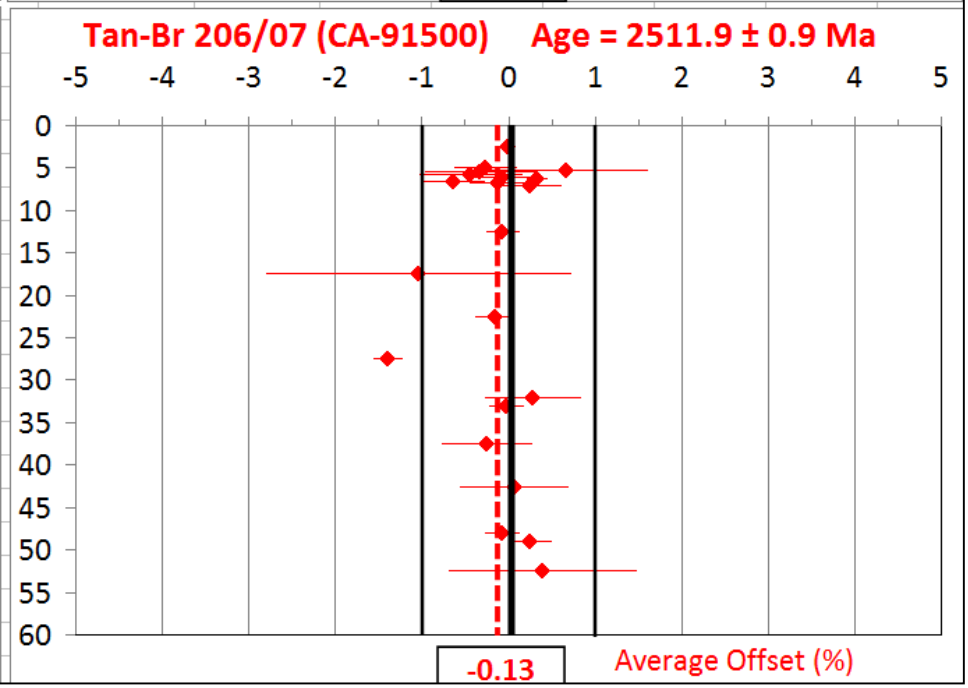

Oracle 206/207 (CA)
Age = 1437.1 ± 0.8 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.04
Average Offset (%)

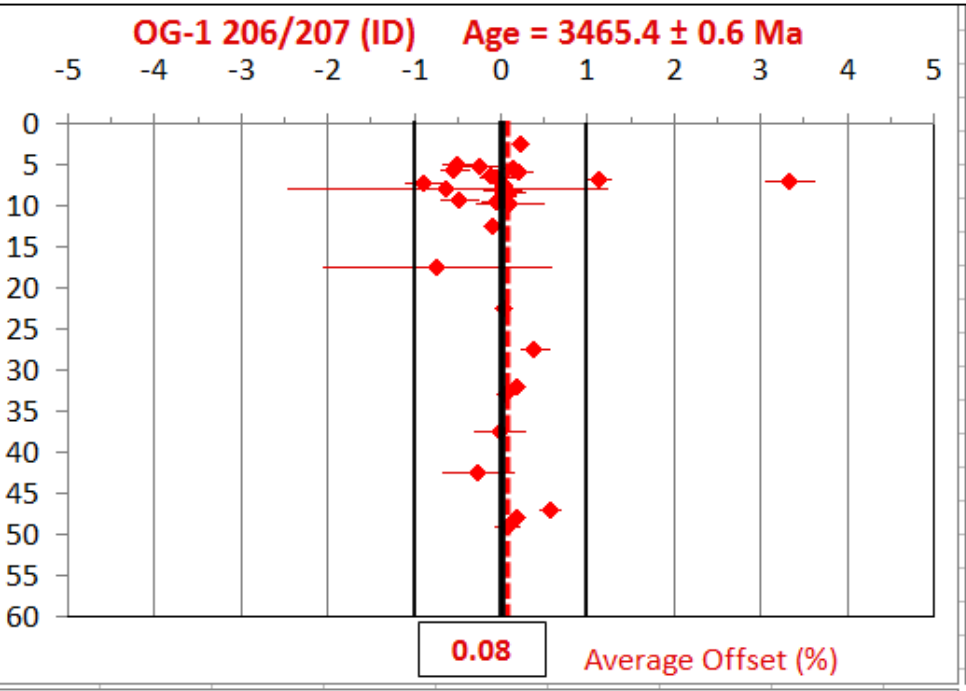

Oracle 206/207 (CA-91500)
Age = 1437.1 ± 0.8 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.11
Average Offset (%)

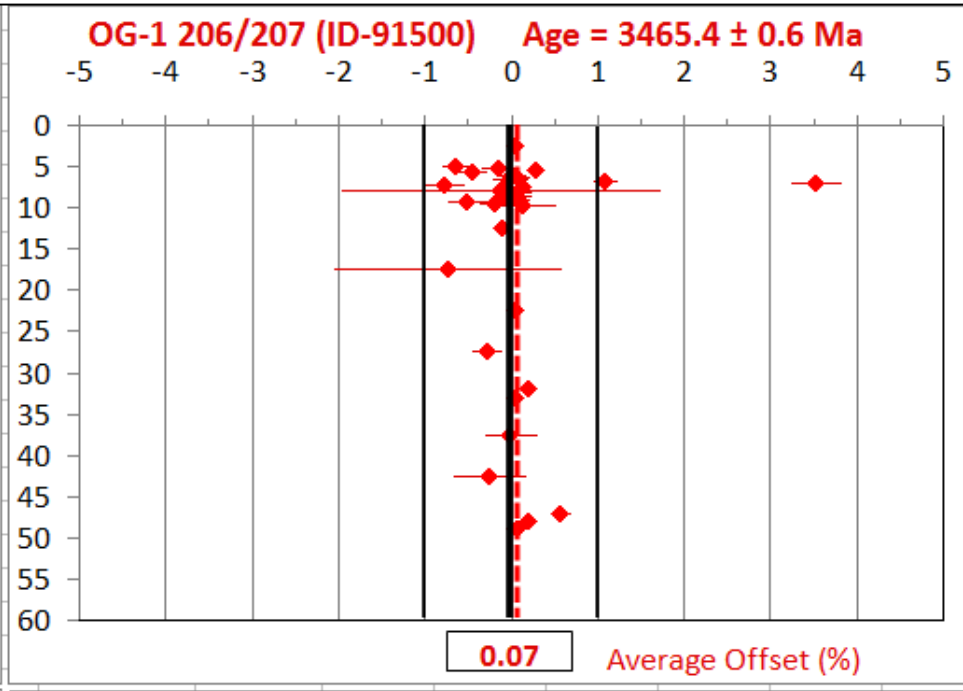

Tan-Br 206/207 (ID) Age = 2512.2 ± 0.7 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.09
Average Offset (%)

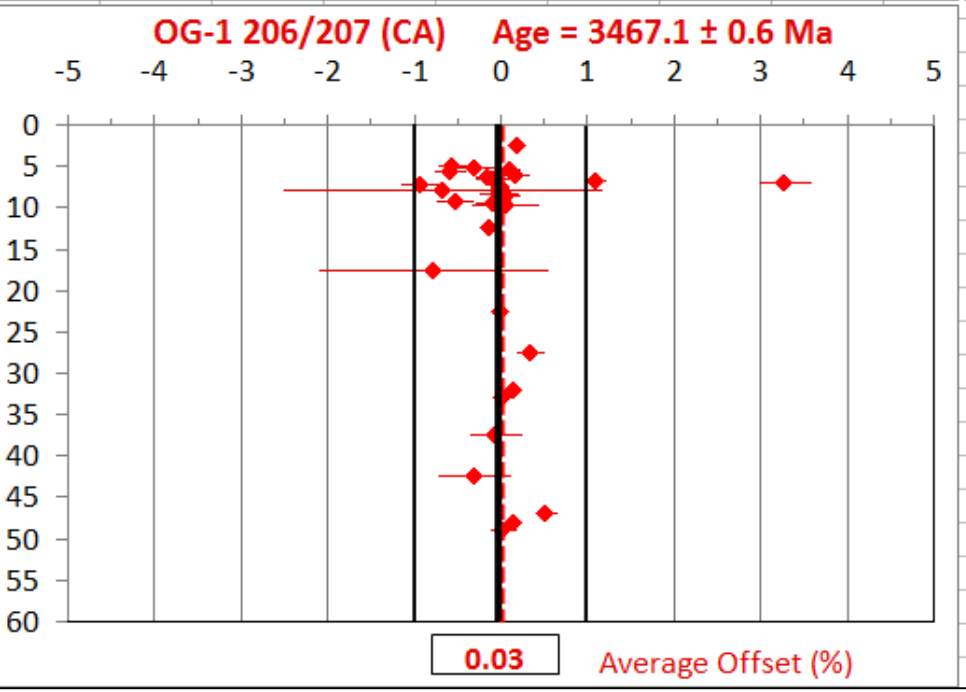

Tan-Br 206/207 (ID-91500) Age = 2512.2 ± 0.7 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.13
Average Offset (%)

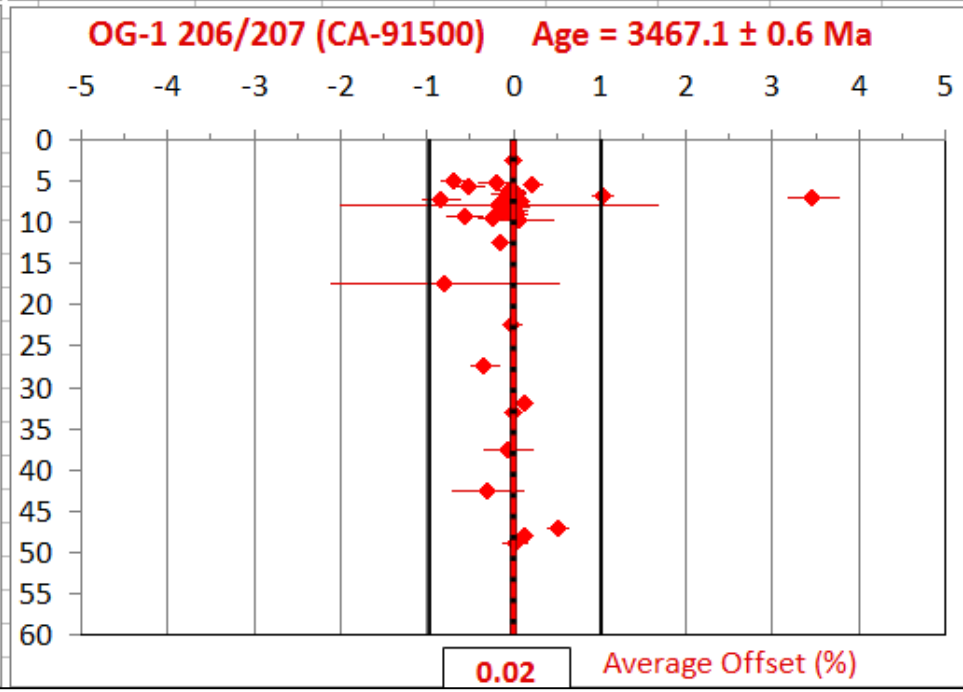

Tan-Br 206/207 (CA) Age = 2511.9 ± 0.9 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.08
Average Offset (%)

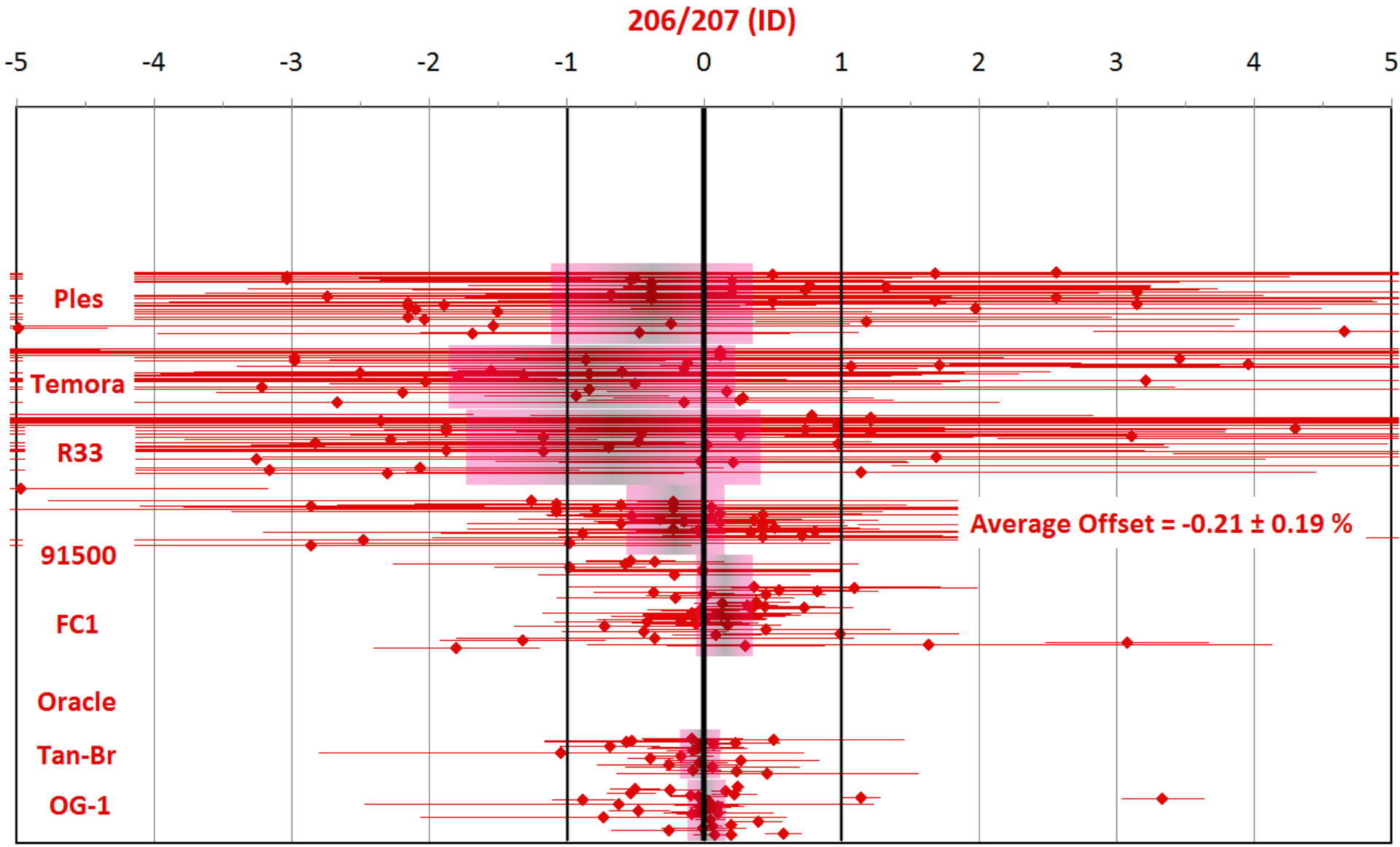

Tan-Br 206/07 (CA-91500) Age = 2511.9 ± 0.9 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
-0.13
Average Offset (%)

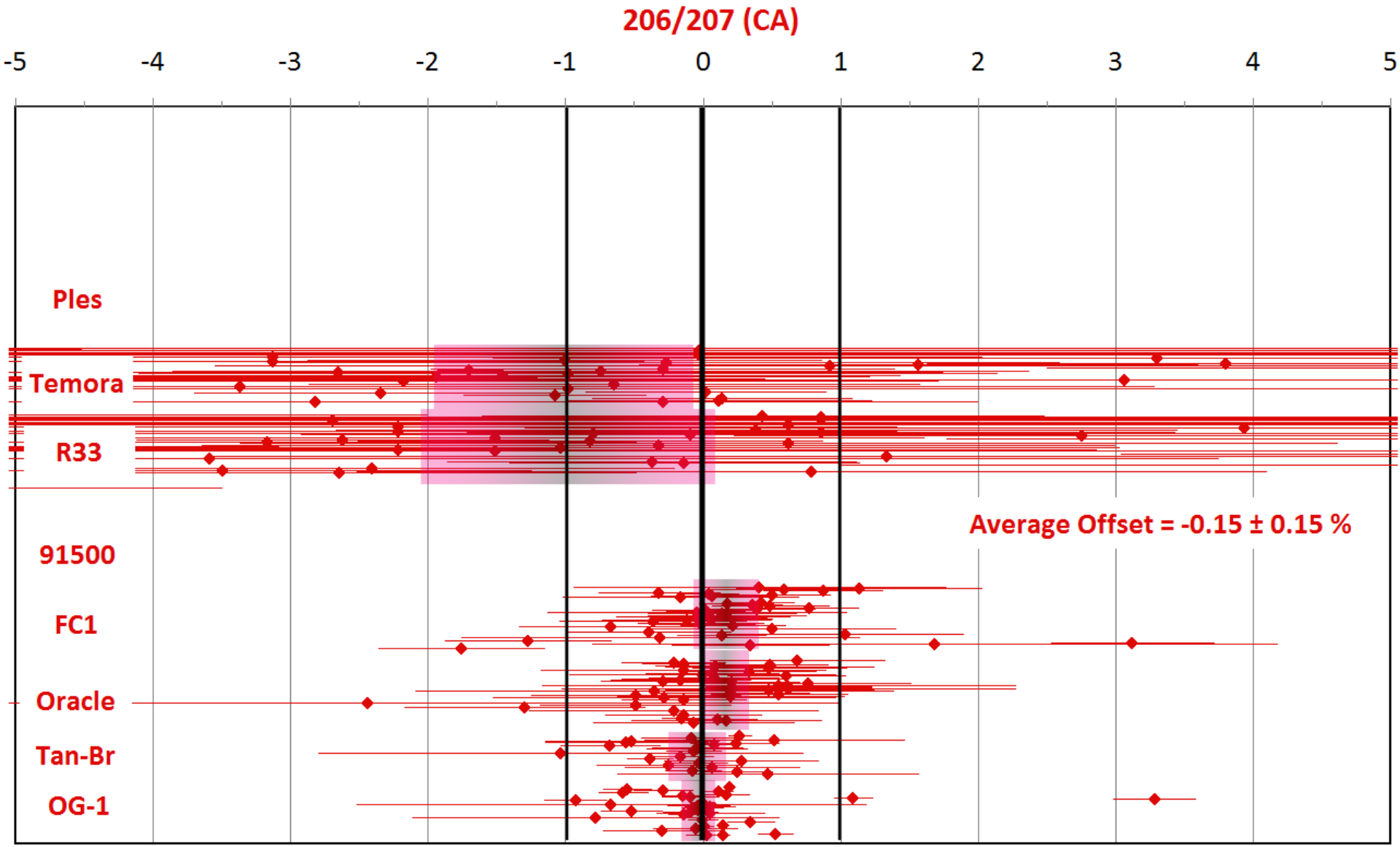

OG-1 206/207 (ID) Age = 3465.4 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.08
Average Offset (%)

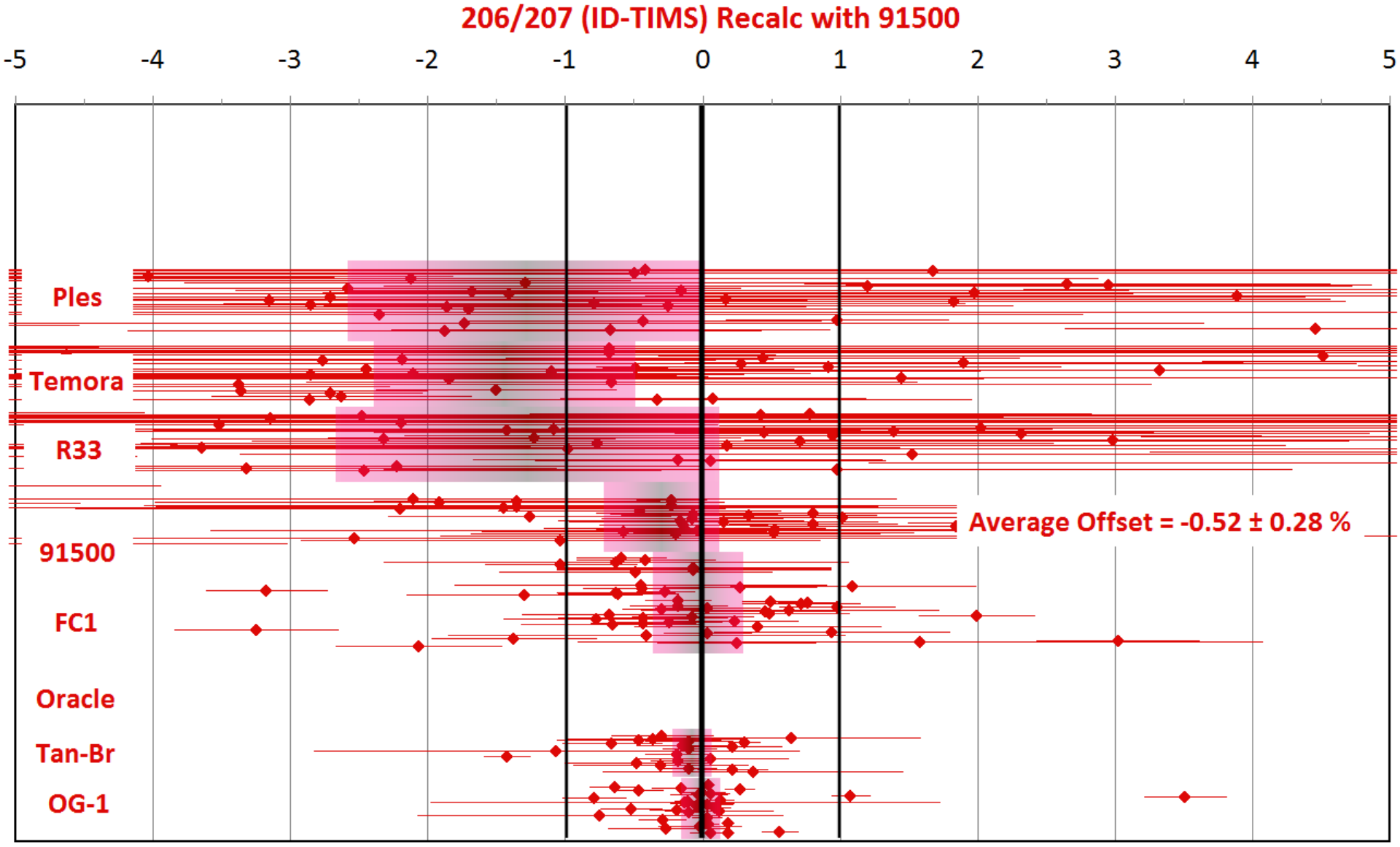

OG-1 206/207 (ID-91500) Age = 3465.4 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.07
Average Offset (%)

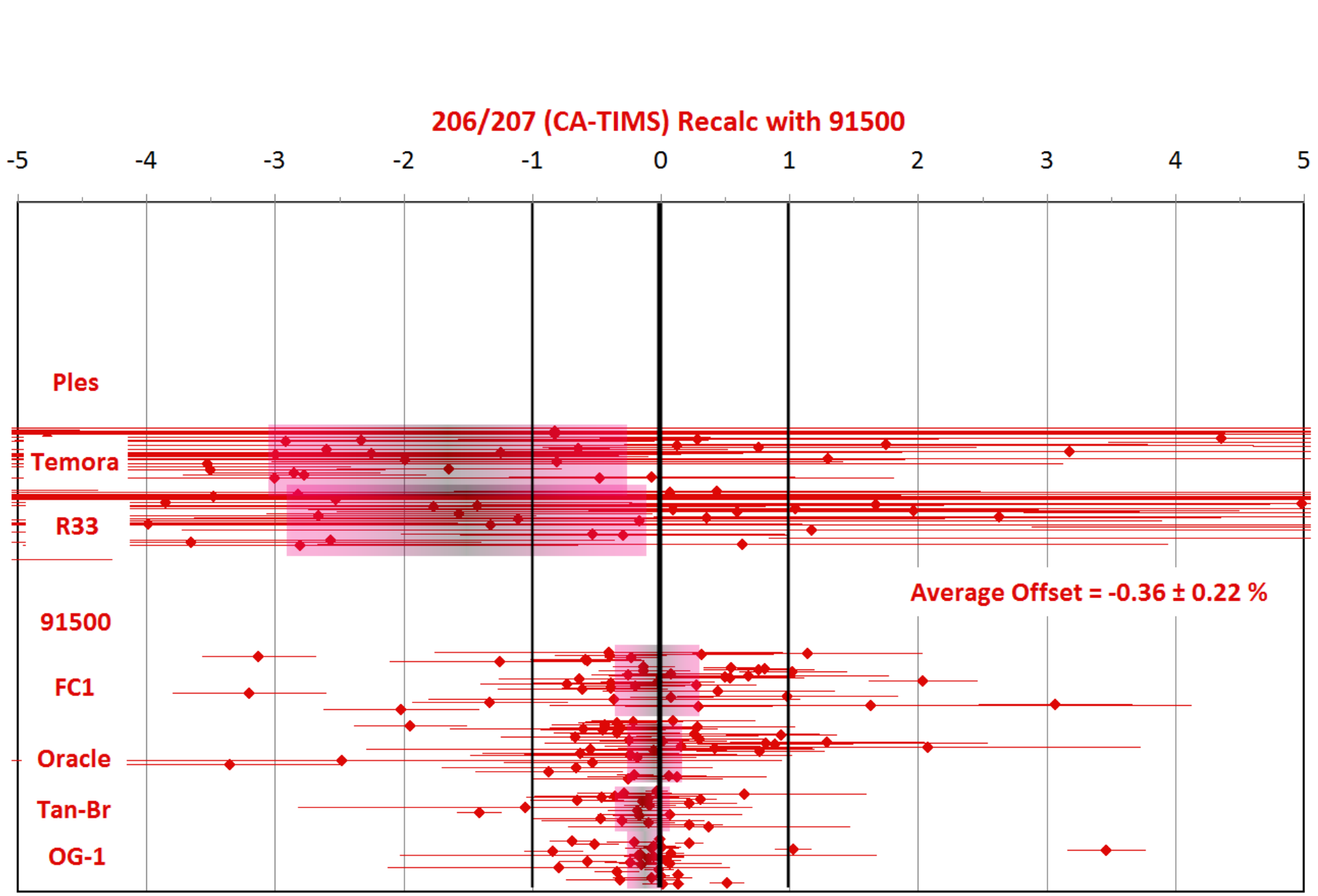

OG-1 206/207 (CA) Age = 3467.1 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.03
Average Offset (%)


OG-1 206/207 (CA-91500) Age = 3467.1 ± 0.6 Ma
-5 -4 -3 -2 -1 0 1 2 3 4 5
0 5 10 15 20 25 30 35 40 45 50 55 60
0.02
Average Offset (%)

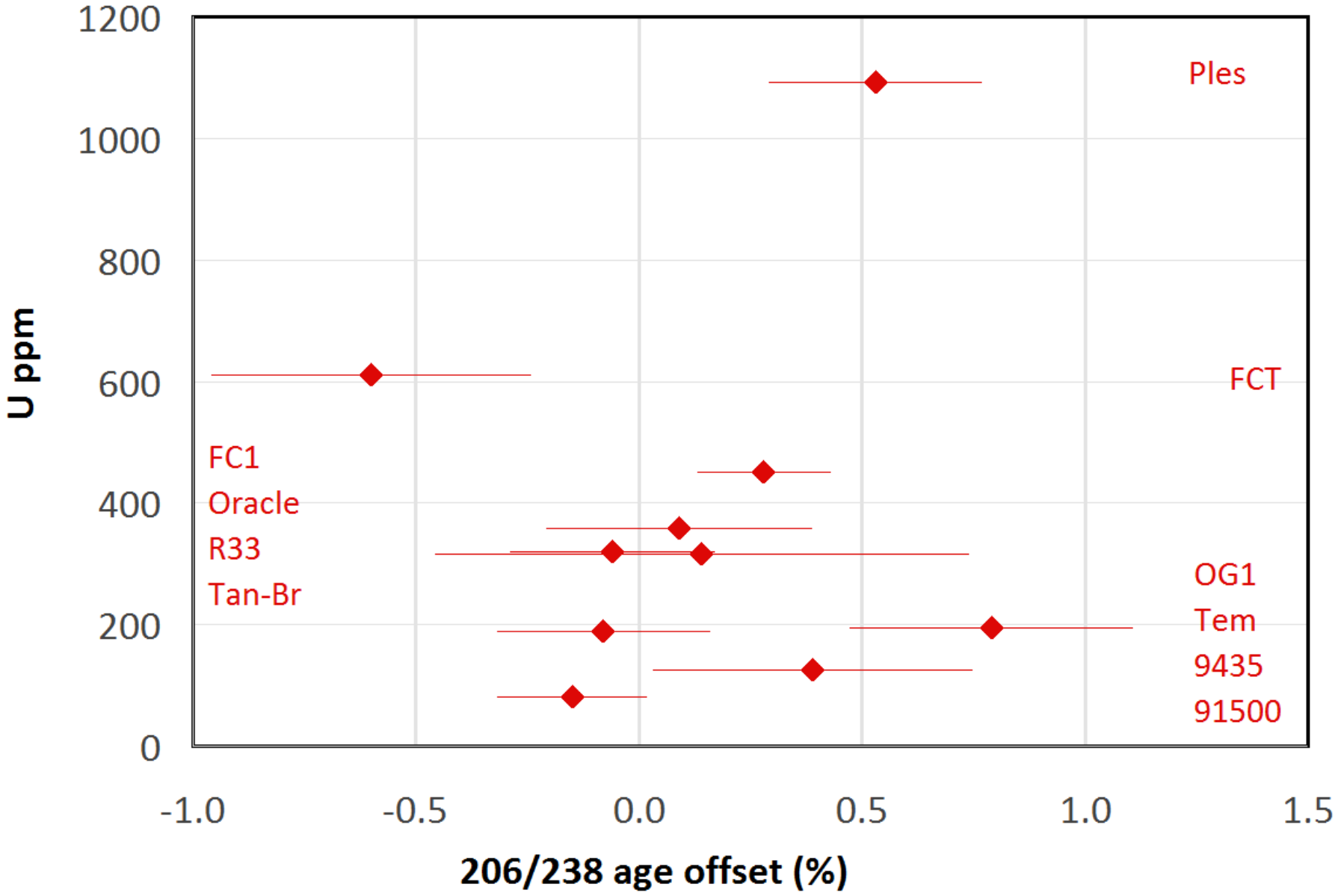

206/207 (ID)
-5
-4
-3
-2
-1
0
1
2
3
4
5
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.21 ± 0.19 %


206/207 (CA)
-5
-4
-3
-2
-1
0
1
2
3
4
5
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.15 ± 0.15 %

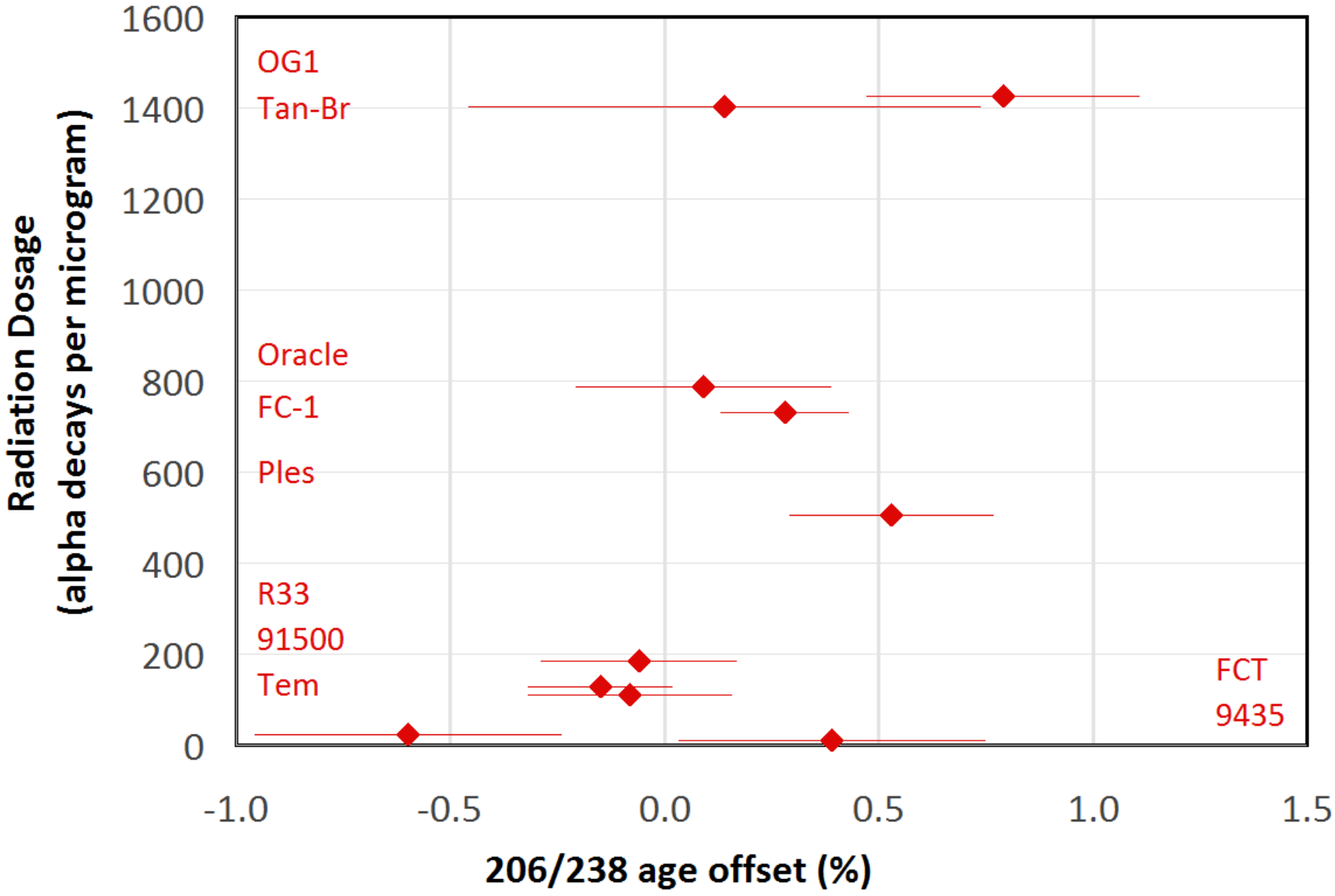

206/207 (ID-TIMS) Recalc with 91500
-5
-4
-3
-2
-1
0
1
2
3
4
5
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.52 ± 0.28 %


206/207 (CA-TIMS) Recalc with 91500
-5
-4
-3
-2
-1
0
1
2
3
4
5
Ples
Temora
R33
91500
FC1
Oracle
Tan-Br
OG-1
Average Offset = -0.36 ± 0.22 %

Look at correlations with Uconc & Radiation Dosage



Look at correlations with Uconc & Radiation Dosage



Chemical Geology 332–333 (2012) 157–165

Contents lists available at SciVerse ScienceDirect

Chemical Geology

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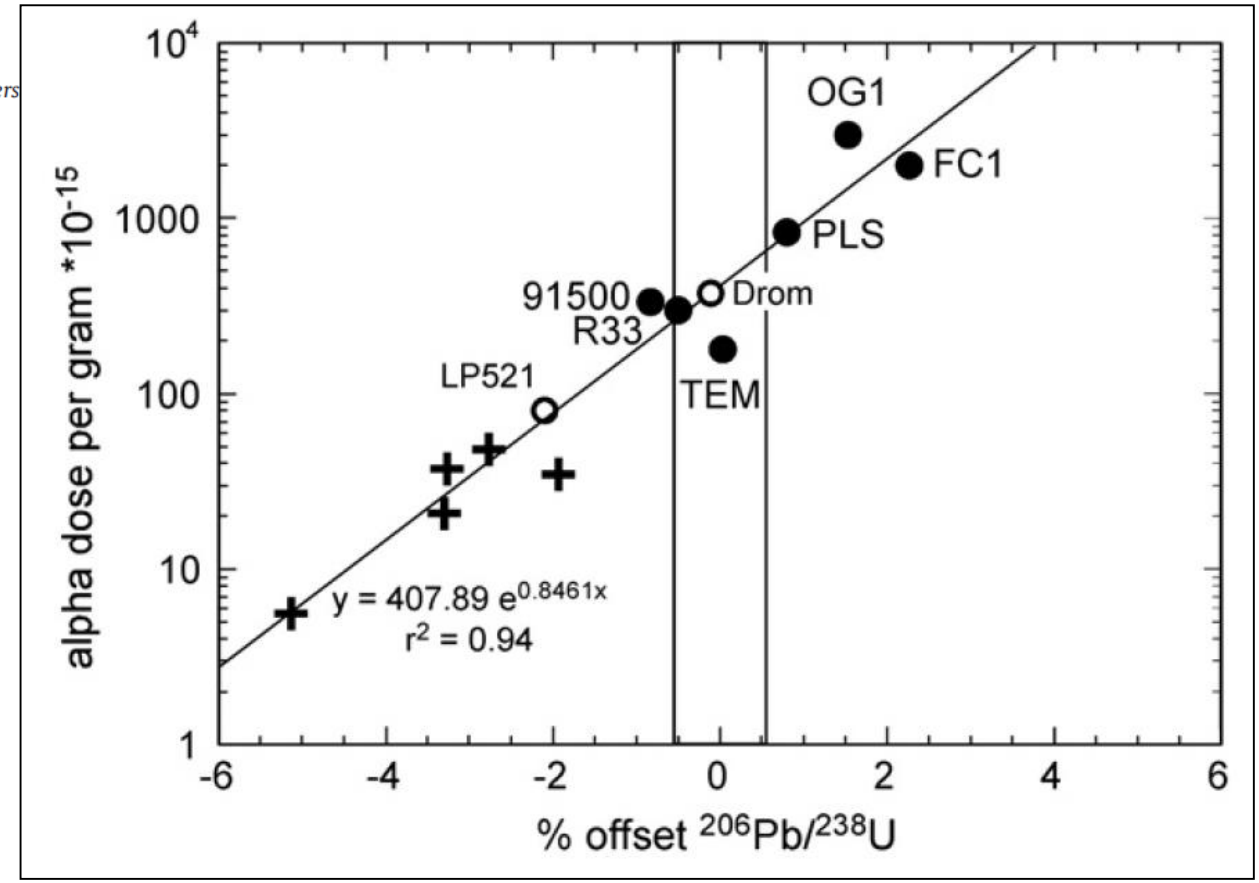
Identification and elimination of a matrix-induced systematic error in LA–ICP–MS $^{206}Pb/^{238}U$ dating of zircon

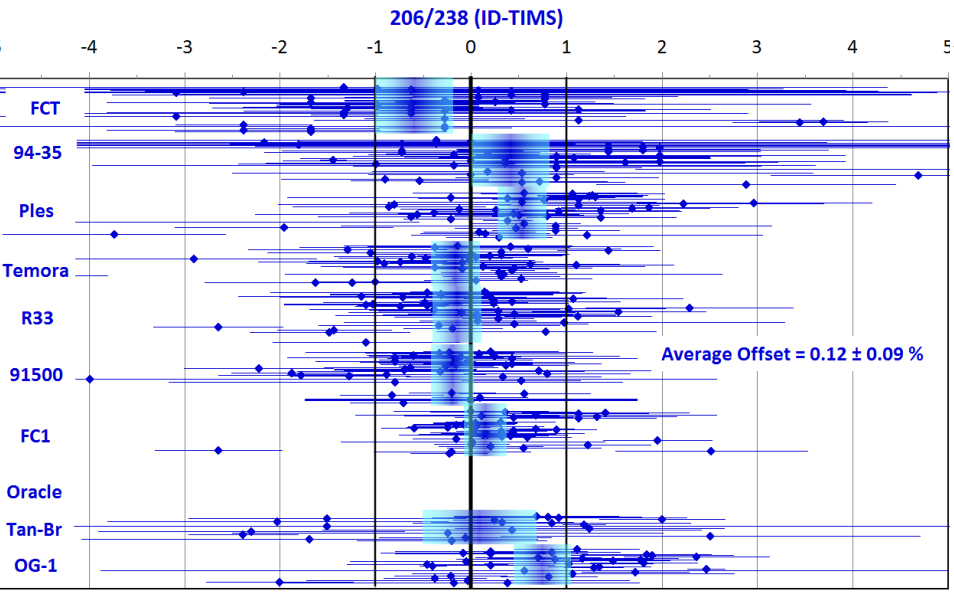
Charlotte M. Allen *, Ian H. Campbell

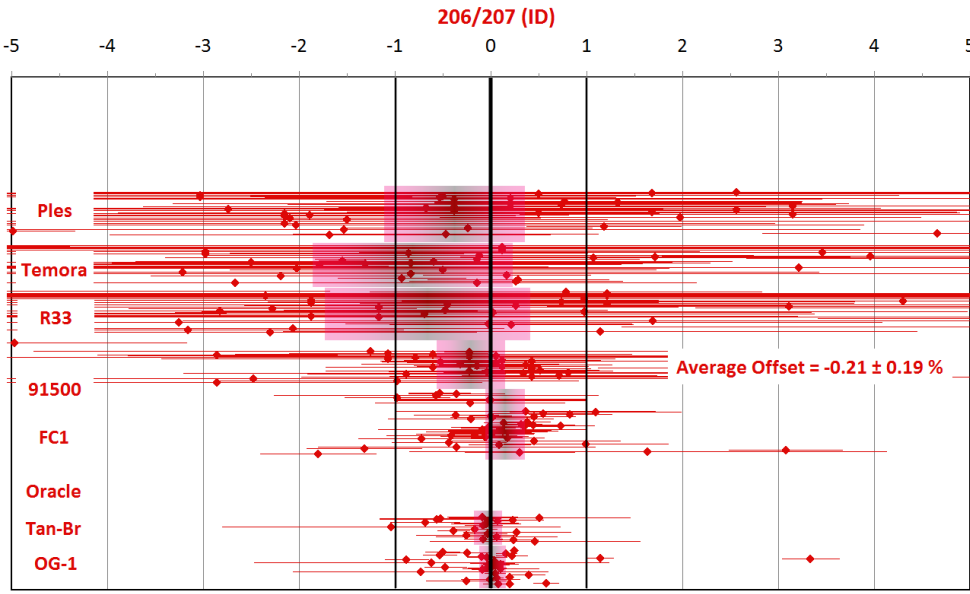
Research School of Earth Sciences, The Australian National Univers



Conclusions:

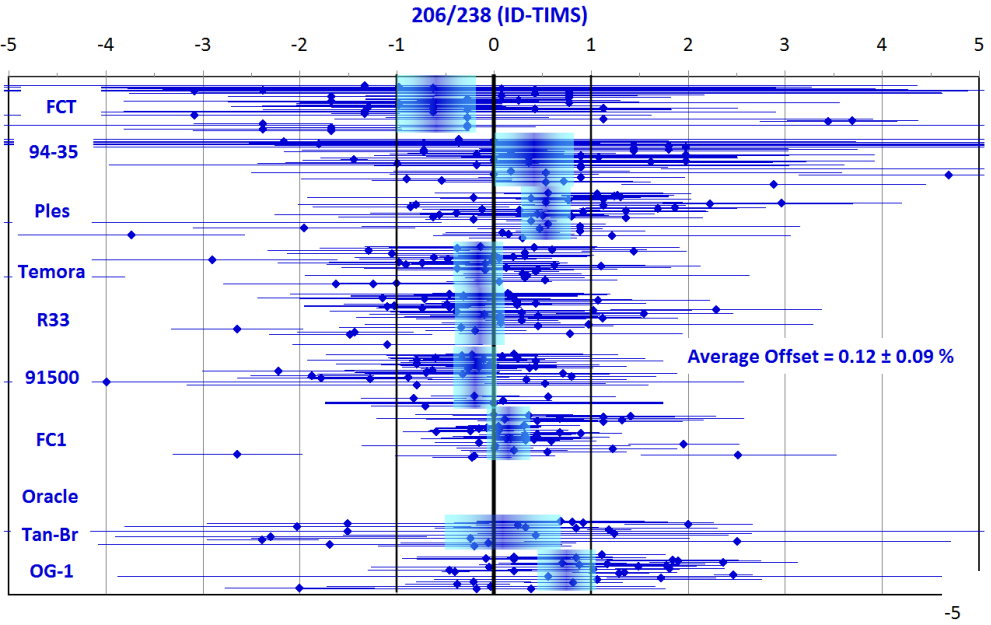
1. Need more data to reach firm conclusions...
2. Doing better than 2% for 206/238? for 206/207?

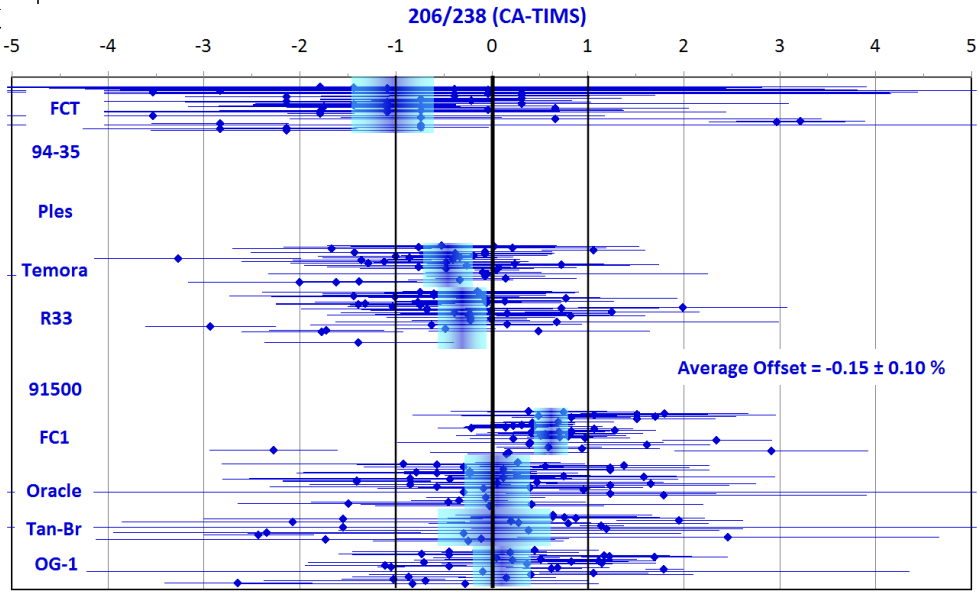




Conclusions:

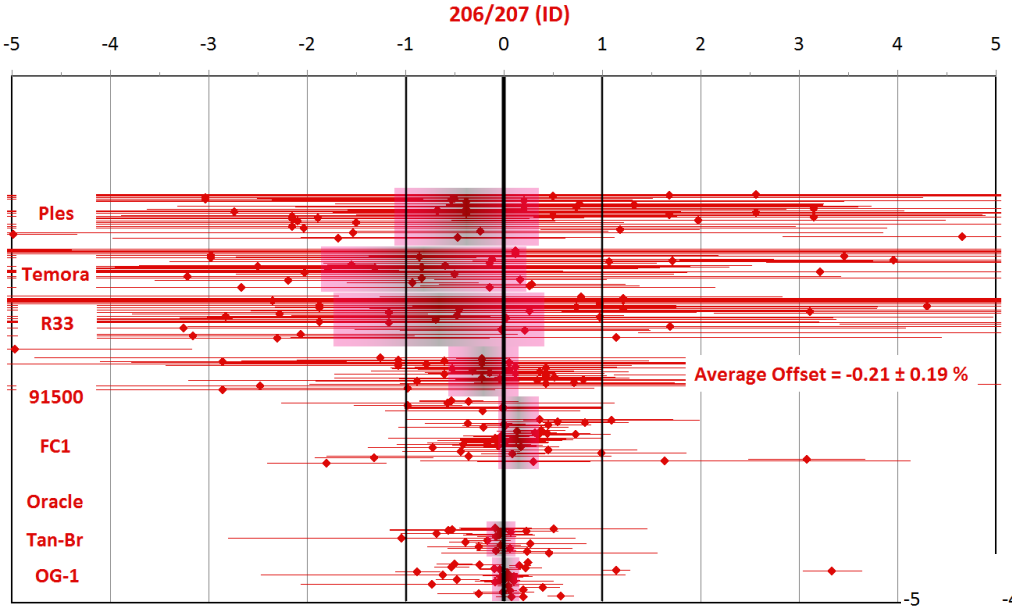
3. Better match with ID-TIMS or CA-TIMS?

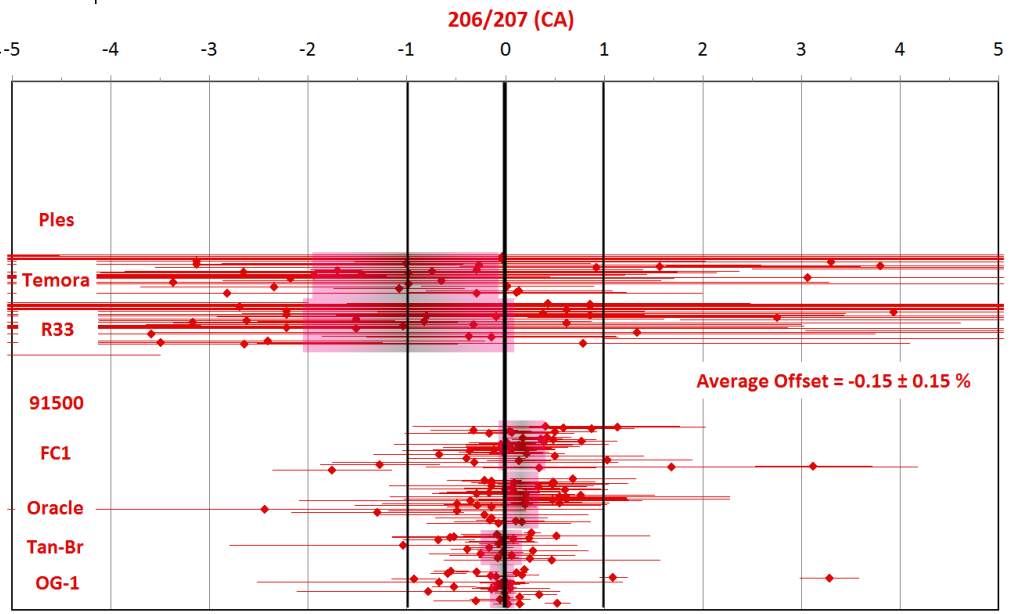




Conclusions:

3. Better match with ID-TIMS or CA-TIMS?

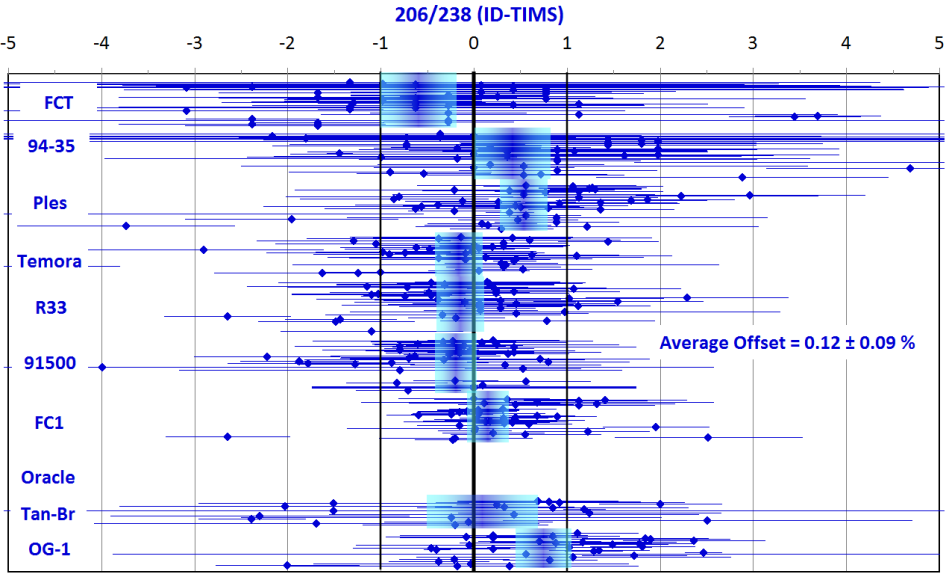


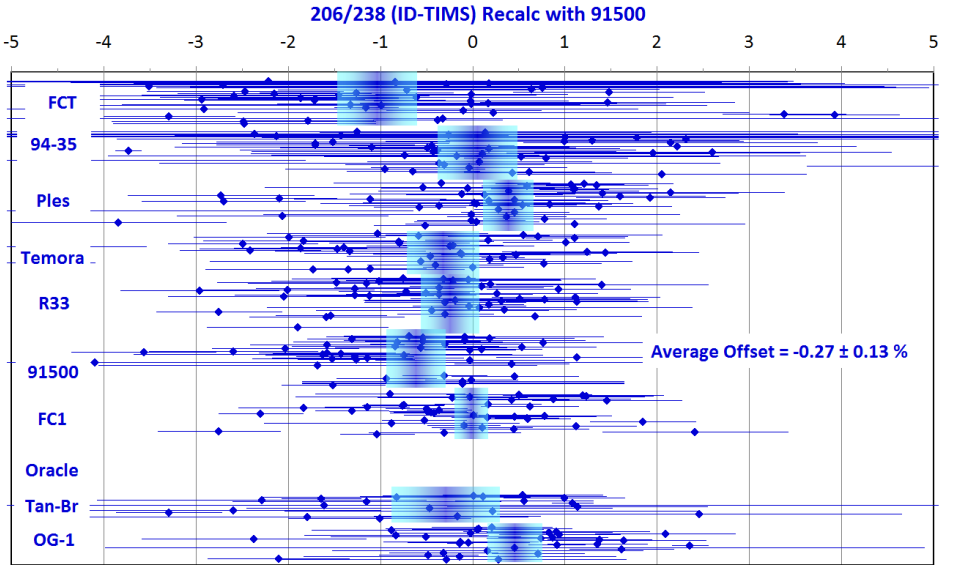


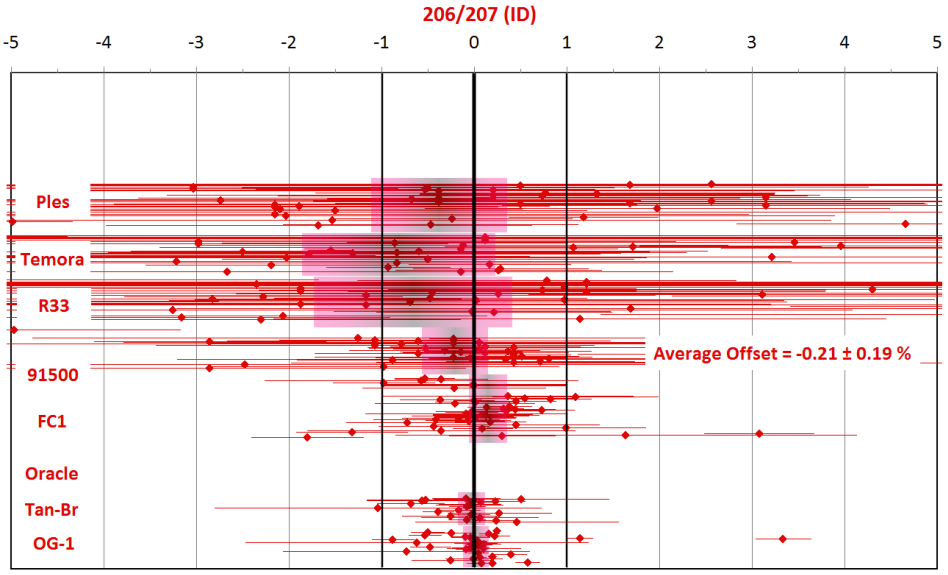
==> Need more samples analyzed with ID-TIMS & CA-TIMS!

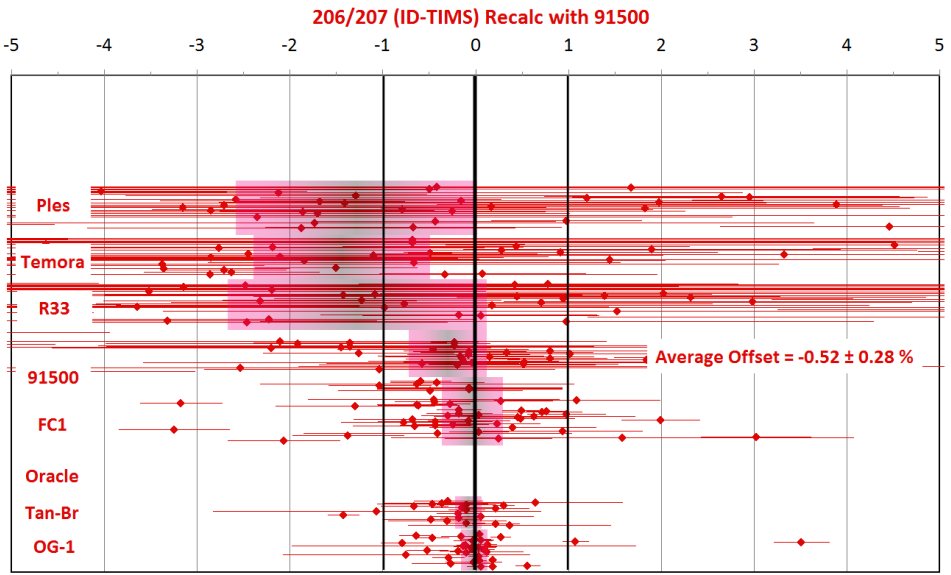
Conclusions:

4. Calibration with 91500 or other primary standards?





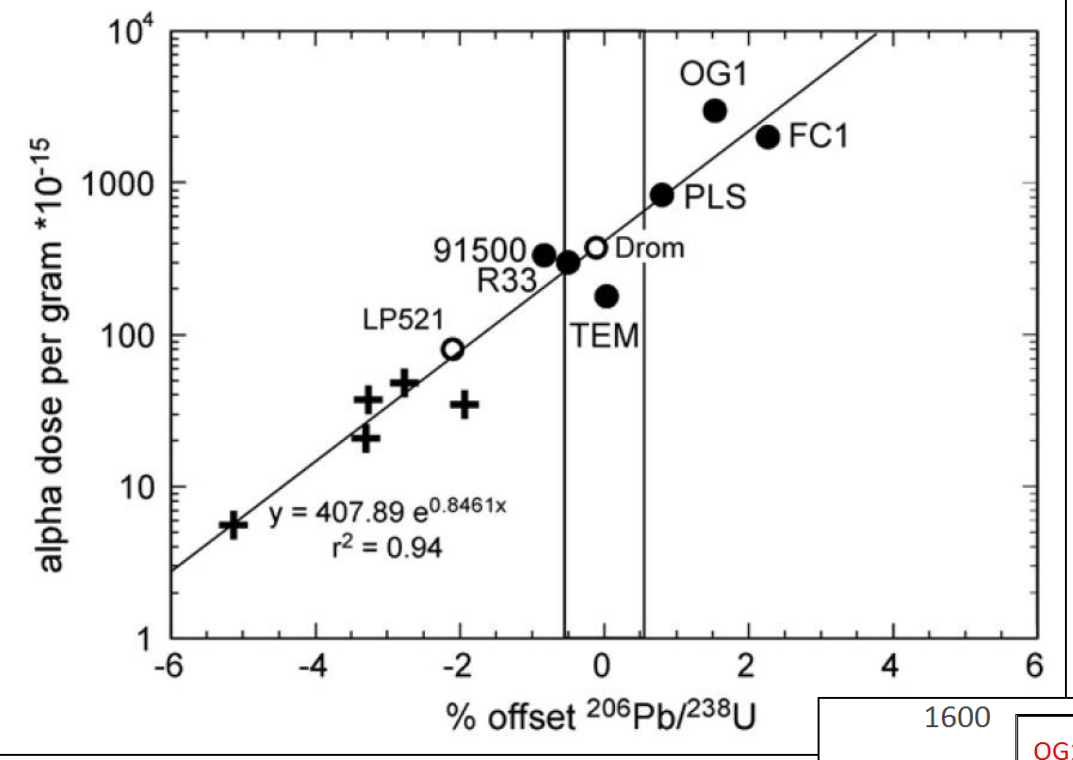




Conclusions:

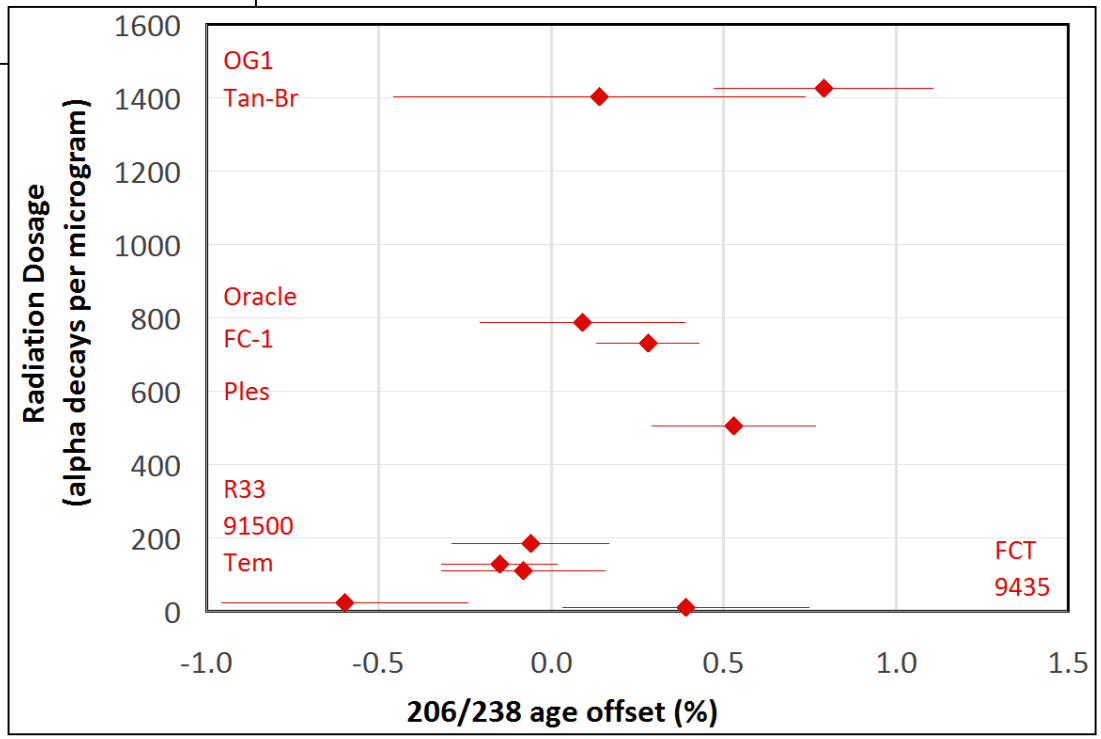
5. Impact of instruments & protocols?

Lab #	Instrument	Primary Standard	Standard Mount	Common Pb Correction	Data Reduction
1	NU Plasma I	SL	Together	204-based	Agecalc
2	Element2	SL	Together	204-based	Agecalc
3	Thermo iCAP-RQ	91500	Separate	none	Iolite
4	Thermo ICAP-Q	91500	Separate	none	Iolite
5	Agilent 7900	91500	Separate	none	LADR
6	Cameca 1280	FC-1	??	??	In-house
7	NU Plasma II	91500	Separate	204-based	Iolite
8	?	91500	??	??	??
9	NU AttoM	91500	Separate	none	Iolite
10	NU Plasma I	91500	??	none	Iolite
11	NU AttoM	Tem-FC1	??	none	Iolite



Conclusions:

6. Correction for radiation dosage and/or thermal annealing should improve precision & accuracy...



Next Steps:

1. Publish this data set as-is, with more lab responses, or not at all?

2. Should we find a TIMS lab willing to complete ID-TIMS & CA-TIMS analyses on current standards?

3. Continue distributing current standard sets, or are there better samples?

4. Should future comparisons be blind?

5. Should future studies focus on specific aspects, e.g., radiation damage?