

Results of inter-laboratory comparison on U-Pb detrital zircon analysis

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with contributions from 8 LA ICP-MS
and 2 SIMS labs (anonymous)



Detrital zircon workshop, Prague, 13.-14.8. 2011

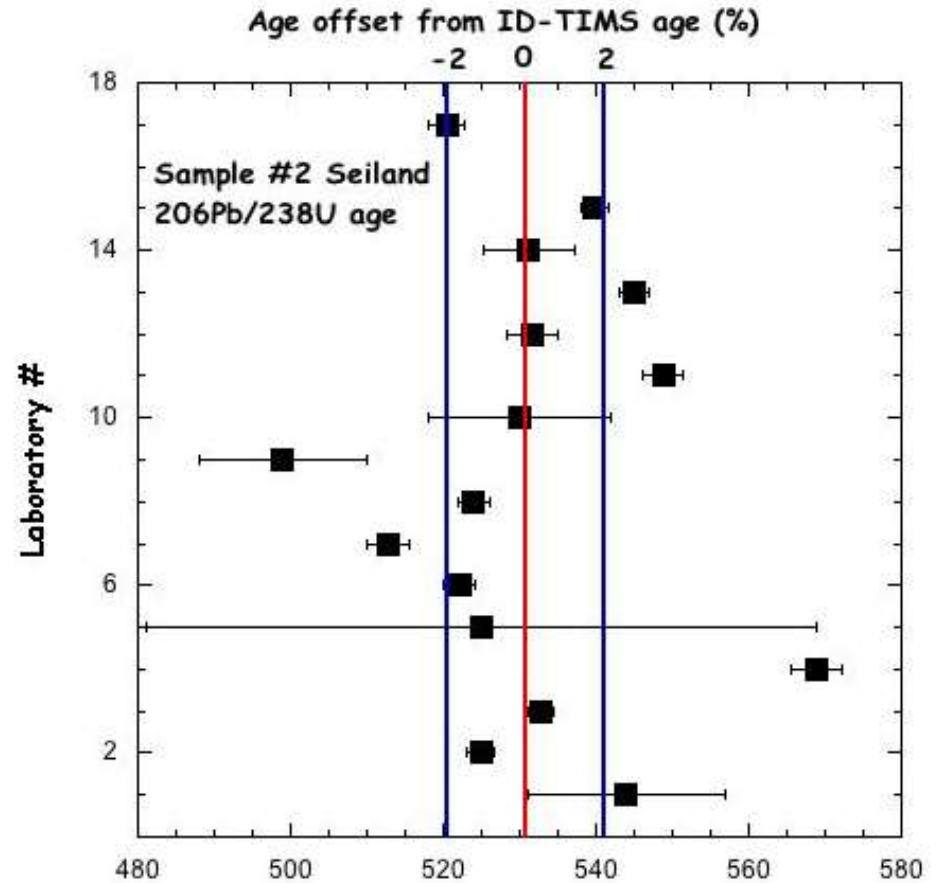
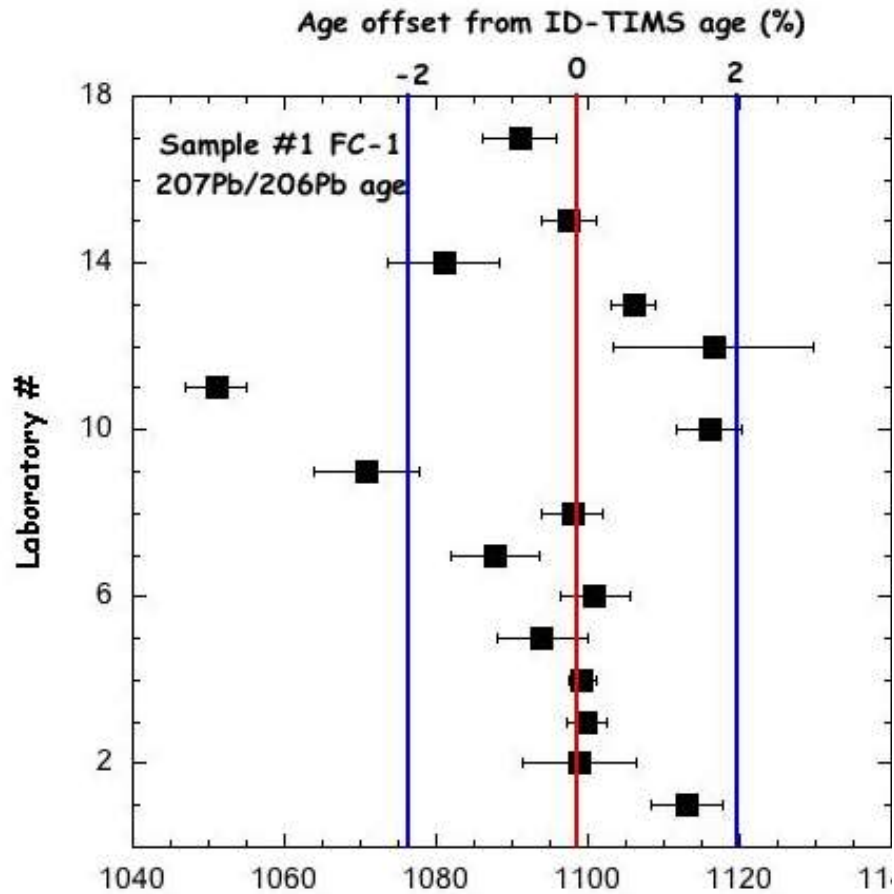
Goals

- To reflect the current state of the art in U-Pb analysis of detrital zircon.
- To illustrate the nature and extent of differences between labs with respect to the way the data are presented and the age spectra interpreted.
- The exercise is not intended to address sampling and sample preparation biases which need to be assessed separately. A coherent program of work on sampling biases could be devised as an outcome of the workshop and ILC.
- The results will be presented as blind tests (specific labs not linked to specific results), the results will be published in *Geostandards and Geoanalytical Research*.

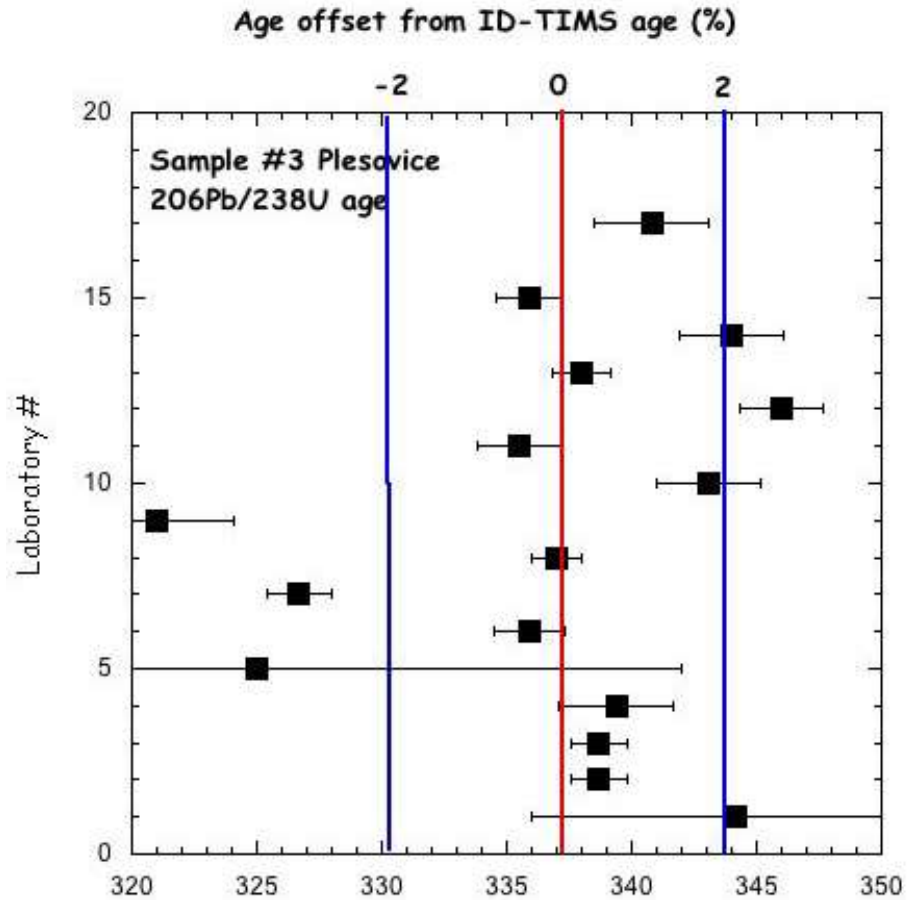
Previous inter-laboratory comparison

- Test of precision and accuracy of LA ICP-MS U-Pb zircon dating.
- 17 laser ablation ICP-MS labs involved, organized by J.M. Hanchar, Memorial University
- Three test samples (***FC-1*** 1098 Ma, ***Seiland*** 531 Ma and ***Plešovice*** 337 Ma).
- Most data within $\pm 2\%$ from the expected TIMS values.

Previous inter-laboratory comparison



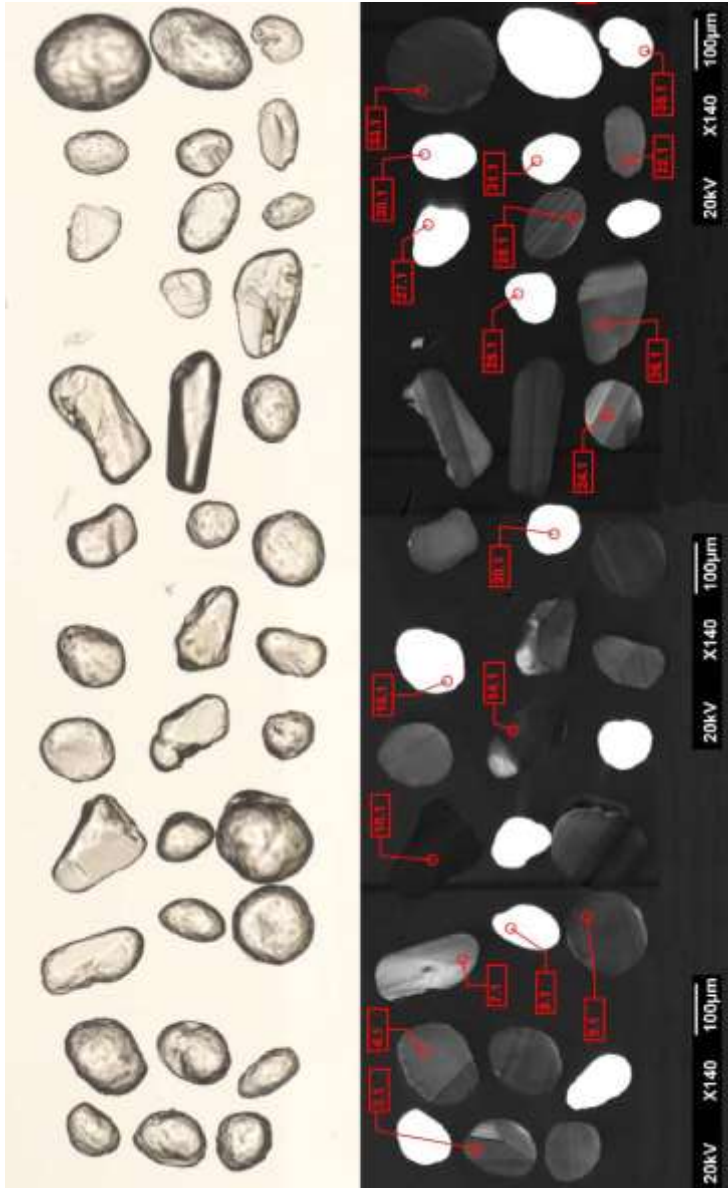
Previous inter-laboratory comparison



Preparation of synthetic detrital samples

- Six natural zircons (reference materials) were crushed and air-abraded to resemble detrital zircon population. The grains were sieved to >100 and $<100\mu\text{m}$ size fractions.
- The abraded grains were hand-picked into glass vials and mounted and polished at UoB to ensure that all samples were identical. The grains were sprinkled onto double sided tape and embedded in epoxy to avoid size separation during mounting. SIMS labs could do their own grain mounting and polishing.
- Sample mounts were imaged before and after polishing/cleaning to ensure that no grains were liberated from the epoxy.
- Each sample mount contained 208 zircon grains. The mounts were distributed to 12 labs, 8 LA ICP-MS and 2 SIMS labs reported back the results.
- The labs were asked to analyze 100 grains using their usual procedures for detrital zircon dating and report the results in the order of analysis.

Preparation of synthetic detrital samples

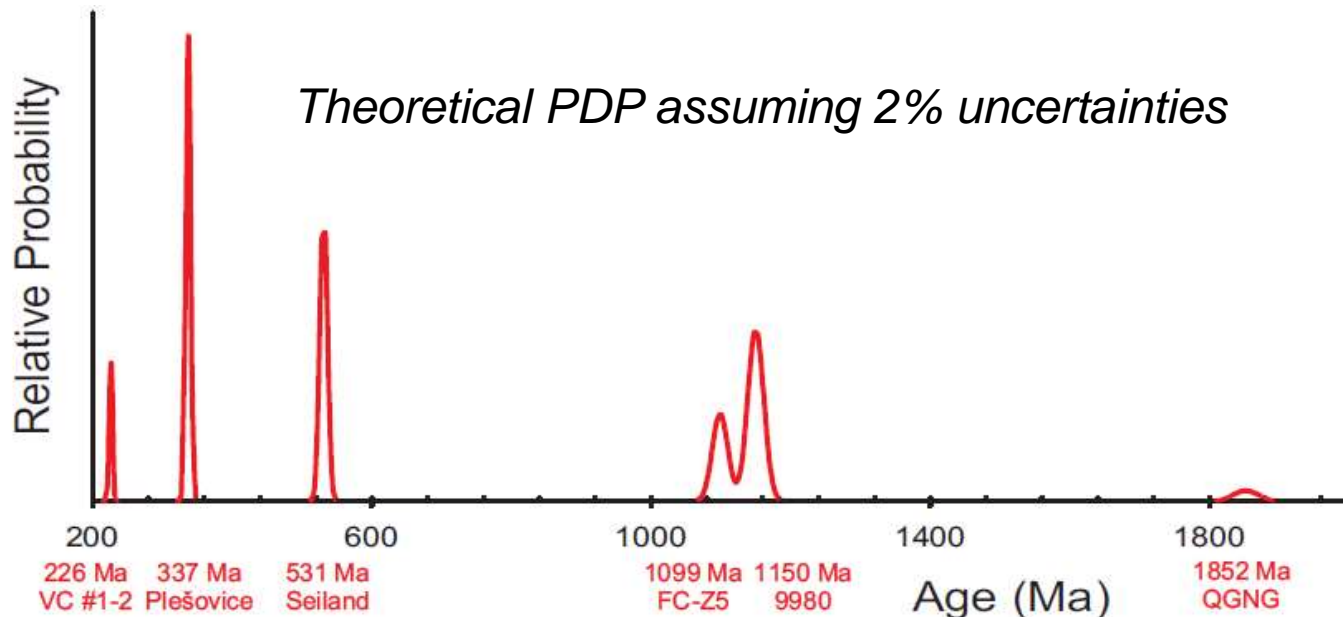


Courtesy of ILC participant

Reference zircons used in synthetic detrital samples

	<100 μm	>100 μm	Total
	% [n]	% [n]	% [n]
<i>VC #1-2</i> (226 \pm 2 Ma, <i>Kloetzli et al. 2009</i>)	2.4% [5]	2.4% [5]	4.8% [10]
<i>Plešovice</i> (337 \pm 1 Ma, <i>Slama et al. 2008</i>)	12% [25]	12% [25]	24% [50]
<i>Seiland</i> (531 \pm 2 Ma, <i>Pedersen et al. 1989</i>)	24% [50]	0% [0]	24% [50]
<i>FC-Z5</i> (1099.3 \pm 0.3 Ma, <i>Paces&Miller 1993</i>)	7.2% [15]	7.2% [15]	14.4% [30]
<i>9980</i> (1150 \pm 2 Ma, <i>Corfu unpubl.</i>)	14.9% [31]	14.9% [31]	29.8% [62]
<i>QGNG</i> (1852 \pm 1 Ma, <i>Black et al. 2003</i>)	1.4% [3]	1.4% [3]	2.9% [6]

All samples are near concordant and do not normally require significant common Pb correction



Evaluated parameters so far

- U-Pb age accuracy for individual samples (relative to TIMS)
- Reproducibility of age spectra (comparison between the labs)
- U-Pb age resolution (separation of age peaks for FC-Z5 & 9980)
- How many grains are needed (first appearance of population)
- Grain size preference during analysis

Note: Results are referred to by lab #

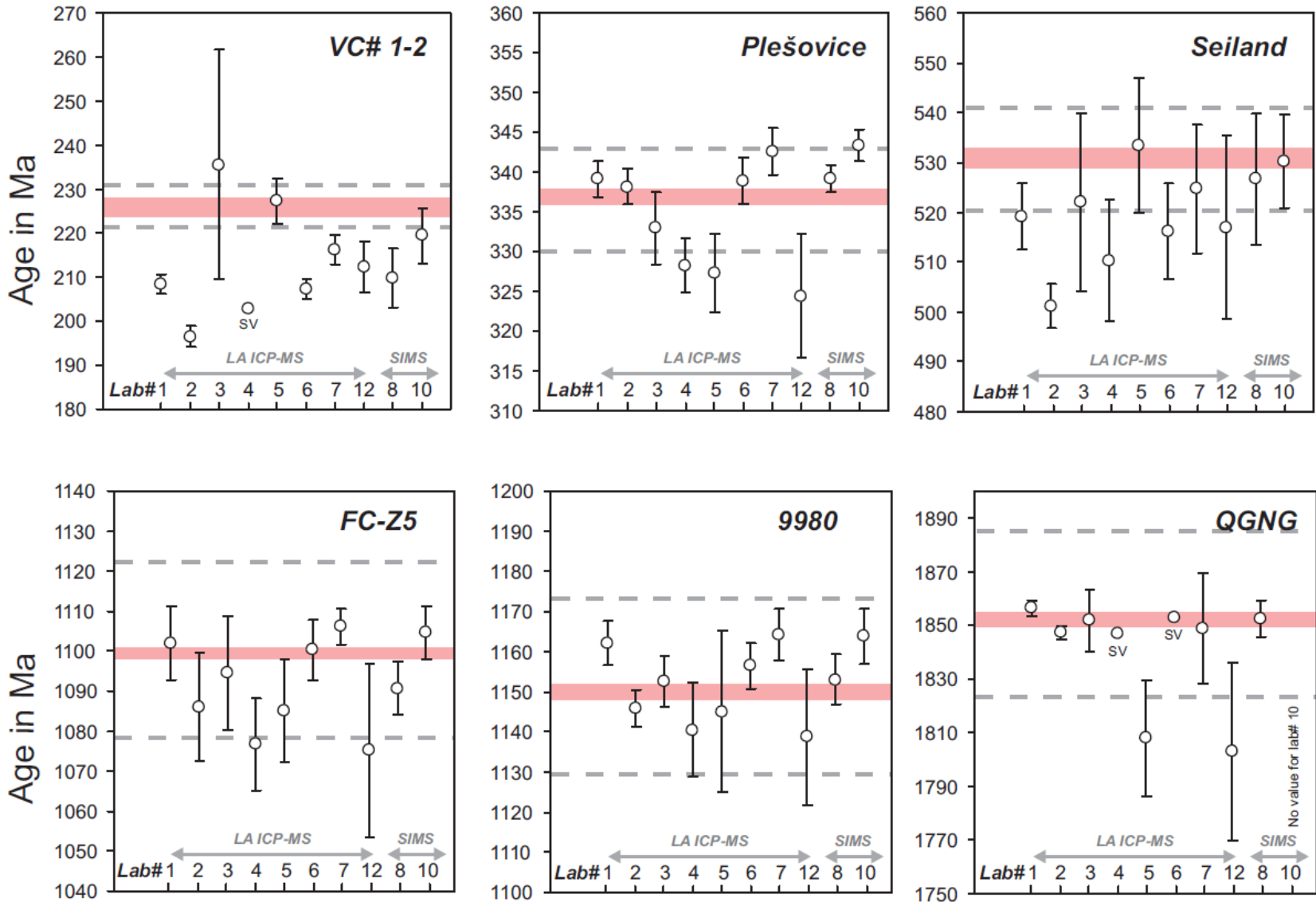
Data are U-Pb concordia ages calculated by Isoplot v.2.45

Uncertainties are 1 sigma unless stated otherwise

Some labs filtered their data

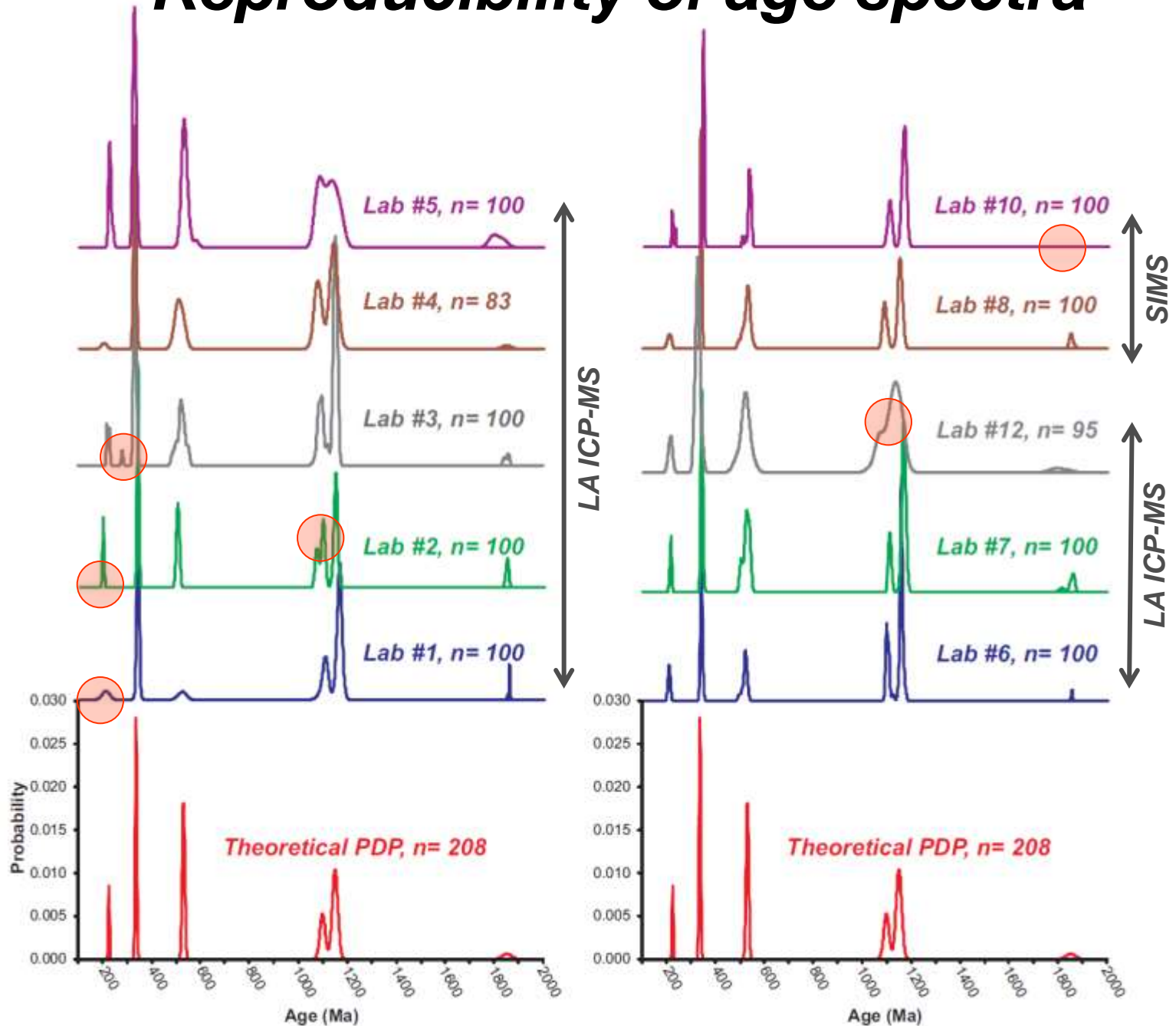
Some labs reported preliminary results

U-Pb age accuracy

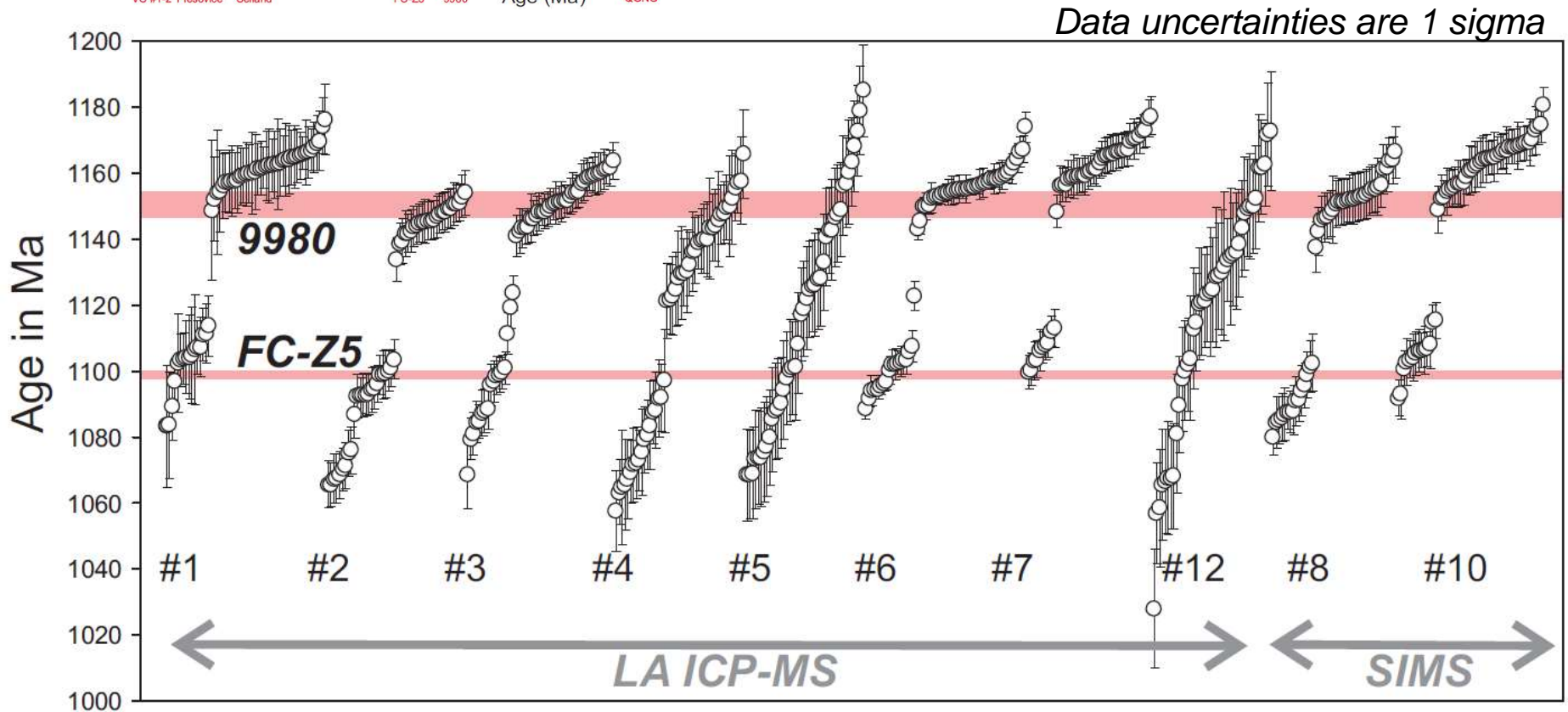
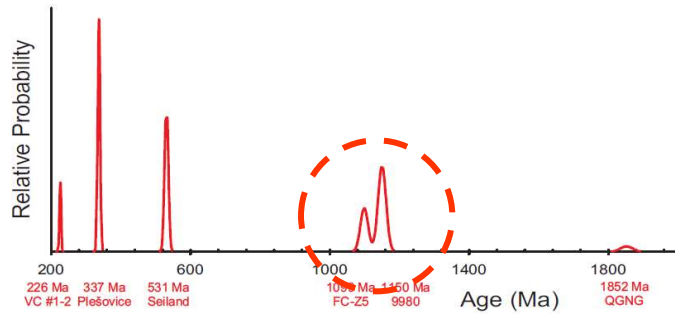


Note: mean U-Pb concordia ages, data uncertainties are 1SD, reference TIMS ages are $\pm 2\sigma$, dashed lines – $\pm 2\%$ limits, sv – single value

Reproducibility of age spectra

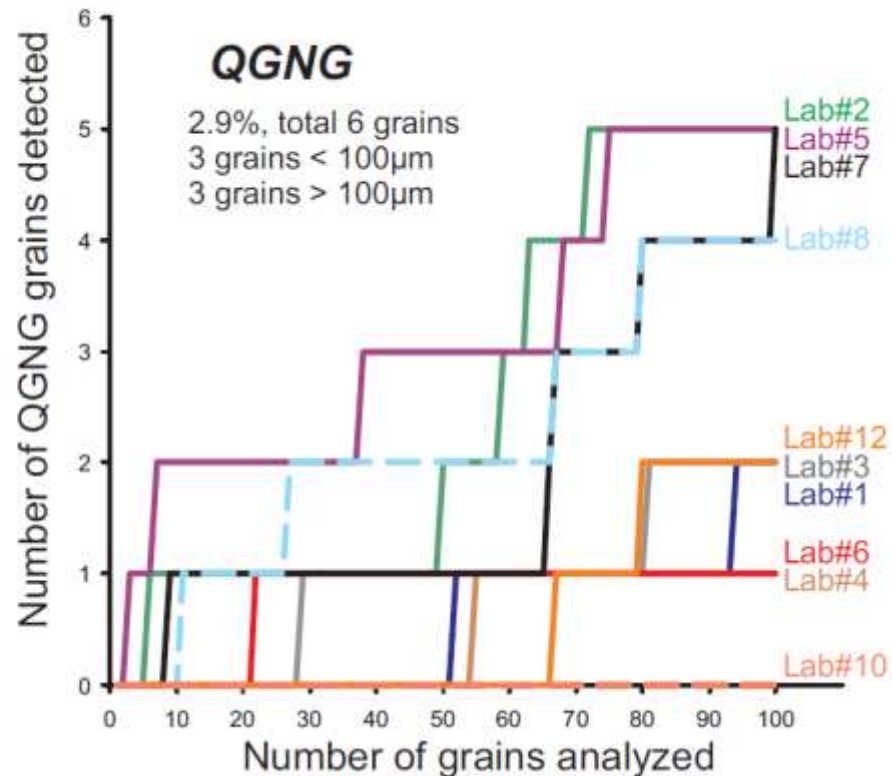
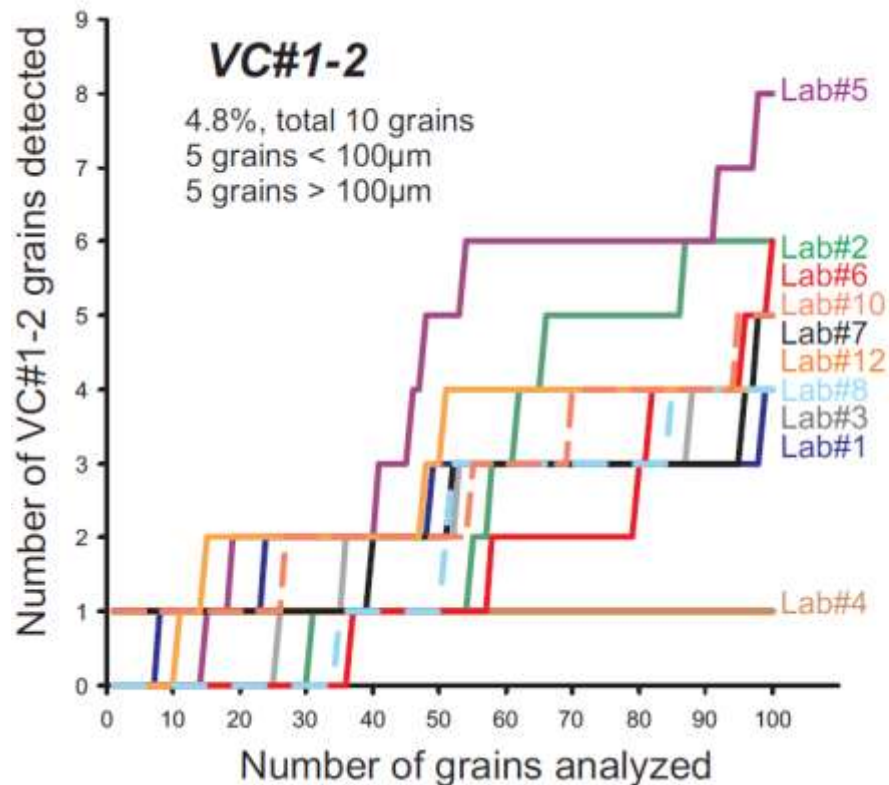


U-Pb age resolution

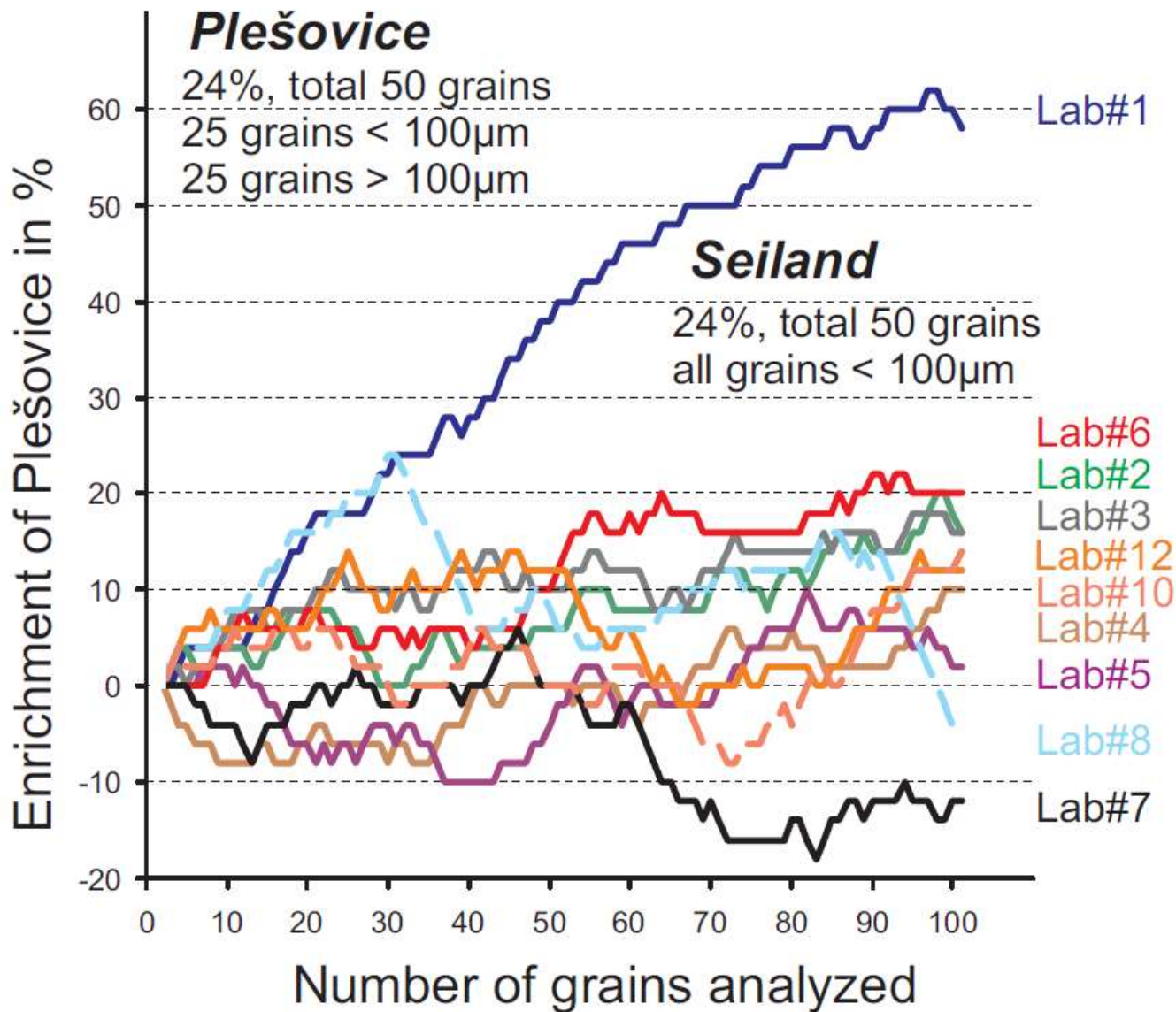


Note: U-Pb concordia ages, some labs filtered their data, different instruments (SC vs. MC), reference TIMS ages are $\pm 2\sigma$

First appearance of 5% and 3% populations



Grain size preference during analysis



Summary

- Accuracy of dating was comparable to the previous RR study by JMH (mostly within 2%) for all samples except for sample VC#1-2 (mostly within 10%).
- The age spectra (PDPs) obtained by all labs were similar but there were variations in peak intensities and age resolution.
- Some labs could not clearly separate two adjacent age peaks at ca. 1100 and 1150 Ma (5% apart) at 1 sigma uncertainty level. Even more overlap is expected at 2 sigma level uncertainty.
- Zircon 5% population was detected by all labs within 40 analyses, 3% population required almost twice as many analyses and 1 lab did not detect it within 100 analyses. Large grains are preferentially analyzed by most labs.

Thanks to

John Hanchar for the previous round robin data

Fernando Corfu for providing 9980 TIMS data

Jiri Slama for making the ILC sample mounts

Matt Horstwood for advising on ILC strategy

All ILC participants for contributing the data

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