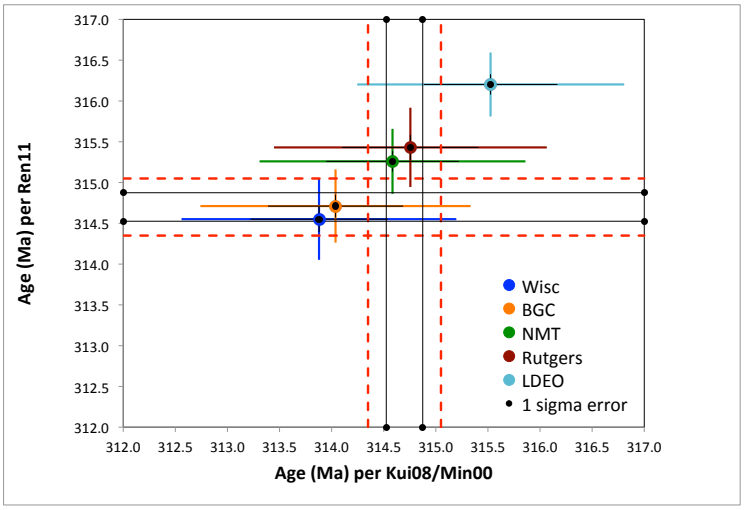
Inter-lab and inter-method comparison of the Fire Clay tonstein age

In 2004 Malka Machlus collected some samples of the Fire Clay tonstein and separated sanidine and zircon from it to test for homogeneity of the sanidine (inspired by the great replication over ~400 km distance reported by Kunk and Rice, 1994, in their GSA special paper).



As reported at the Goldschmidt in Montreal, we measured 223 individual crystals of Fire Clay sanidine and 125 individual crystals of Fish Canyon sanidine in eight populations from three different irradiations at LDEO. The LDEO results for the sanidines against Fish Canyon are RFC = 12.1169±0.0014 (1 sigma) and this yields an age relative to the Kuiper et al. (2008) estimate of 28.201Ma with decay constant estimate of Min et al. (2010) of 315.53±0.64 Ma (316.2±0.2 Ma using the Renne et al., 2011 optimization; both of these are 1σ estimates). Four other labs have requested aliquots and volunteered to run Fire Clay sanidine against Fish Canyon sanidine (Rutgers, U Wisconsin, New Mexico Tech, Berkeley Geochronology Center). Although each of the Ar labs obtained precise estimates of the age (analytical uncertainty ranged from 0.012-0.045%, 1σ), the range of apparent ages is ~0.5%. Additionally, some potential complexity in the Ar-Ar system is hinted by the highly precise multiple collector results from the ARGUS VI at NMT, and by saddle-shaped release spectra.

Although previous work on the Fireclay tonstein has revealed clearly inherited grains that are approximately 1 Ga, the selection of long skinny crystals with axial melt inclusions appears to eliminate this problem. At the time of Goldschmidt in Montreal, Erin Shea had made recent measurements using the EARTHTIME tracer at MIT and obtained a preliminary, result of 314.41±0.4 Ma (2σ with fully propagated uncertainty including analytical, tracer and decay constant). More recently with the new calibration of the EARTHTIME 202-205-233-235 tracer zircons from RH1 give 314.699±0.35 Ma (n=20, MSWD=1.5; 2σ with fully propagated uncertainty including analytical and tracer and decay constant). However, with these new measurements, there are a few grains that are in the 314.48 range that are inferred to reflect either residual Pb loss, protracted crystallization, or a complex mixture.

Comparing between chronometers, closer agreement was found between the U/Pb result and Ar-Ar results with the Kuiper/Min estimates, with values on either side of the estimate and with all five labs matching within 1σ limits. While promising, these results continue to point to the need for additional strategies for evaluation of ages biases among labs where great precision and accuracy is needed.

We feel this is a big improvement relative to the results from the Alder Creek (the extreme range of that experiment is represented by the labs that participated in this experiment), but acknowledge that at least partly it is because the Alder Creek is a great challenge because it is so young. We hope the pipette experiment, led by Brent Turrin, will be a positive step in that direction.