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Testing the accuracy of recent revisions to the age of Fish Canyon sanidine and the K-Ar decay constants using high-precision U-Pb and Ar/Ar ages for the Manicouagan impact event

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Compared with the U-Pb chronometer the Ar/Ar system still retains relatively large systematic uncertainties. This is highlighted when U-Pb and Ar/Ar ages (negating issues of zircon residence) for minerals from the same rock are compared (Min et al., 2000). Typically there is bias with respect to the U-Pb ages, the magnitude of which depends on the constants used but is up to 1%, hence comparison of timescales becomes problematic. Recent studies have attempted to improve the accuracy of the Ar/Ar method by determination of an accurate age for Fish Canyon sanidine independent of the K-Ar decay constants (Kuiper et al., 2008; Channell et al., 2010). Renne et al. (2010) went a step further and used statistical optimization models derived in part from U-Pb – Ar/Ar data couplets to derive new decay constants and an age for Fish Canyon sanidine. The results of the various efforts to determine the age of Fish Canyon sanidine vary by $\sim$1%, beyond what is expected from uncertainty in precision alone. Although magnitude of this geological uncertainty is difficult to assess in single experiment, one could ask whether the amount of variation in the three latest revisions to the FCs age represents true external reproducibility and thus reflects these geological uncertainties? Although there is no general consensus about the age dispersion, it is evident that inter-laboratory calibration issues, real geological differences, and bias between different radioisotopic systems are contributing factors.
Inter-comparison of one Ar/Ar (sanidine) age with one U-Pb (zircon) age is problematic. It is known that both sanidine and zircon have markedly different closure temperatures for the retention of daughter products in the U-Pb and K-Ar systems respectively (zircon U-Pb, ca. 1000 ˚C; sanidine K-Ar ca. < 300 ˚C) so that the equivalence of mineral ages is dependent upon the thermal history of the magma/rock. One approach to minimize this effect is to focus inter-calibration efforts on rocks that have undergone rapid cooling (i.e. extrusive volcanics); however these may still be complicated by the fact that U-Pb zircon ages will record a pre-eruptive history (zircon residence). Thus we are commonly faced with the question: what are these minerals dating and at what level can we assume equivalence?
Melt rocks from large terrestrial impact events are an ideal target for an Ar/Ar – U-Pb inter-comparison study as they have a somewhat simple crystallization and cooling history, they do not suffer the protracted crystallization histories that typify magma-chamber process in convergent/divergent plate tectonic settings thus a zircon U-Pb age is likely to constrain the timing of crystallization. Ramezani et al. (2005) was the first to test this and presented a high-precision ID-TIMS 206U-238Pb age (215.56 $\pm$ 0.05 Ma, 2σ) for zircon for the Manicouagan impact event. We present new high-precision Ar/Ar data obtained by in situ UV laserprobe and laser step-heating for the sanidine from the Manicouagan melt rocks. Using the high-precision Ar/Ar and U-Pb ages for the impact event we will discuss revisions for the age of Fish Canyon sanidine as well as re-determinations of the K-Ar decay constants. The approach should allow us to get beyond the question of 'what are we dating?' and assess the inter-calibration of these two chronometers at a level approaching analytical precision.

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