Geophysical Research Abstracts
Vol. 15, EGU2013-6329-1, 2013
EGU General Assembly 2013

Component geochronology of the ca. 3920 Ma Acasta Gneiss

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Compiled U-Pb zircon ages of the oldest parts of the Acasta Gneiss Complex (AGC) in the Northwest Territories (Canada) span about 4050-3850 Ma (Stern and Bleeker, 1998); yet older 4200 Ma xenocrystic U-Pb zircon ages have also been reported for this terrane (Iizuka et al., 2006). The AGC has at least 50 km^2 of outcrop exposure, but only a small subset has been documented in the detail required to investigate a complex history. To better understand this history, ion microprobe zircon geochronology was combined with whole-rock and zircon rare earth element compositions (+Y; [REE+Y]zirc) and Ti-in-zircon thermometry (Tixln) from a sub-divided $\sim$60 cm^2 slab of Acasta banded gneiss, and compared to other nearby variably deformed AGC granitoid gneiss samples. Micro-sampling by this method reveals components with distinctive [Th/U]zirc vs. Tixln and [REE+Y]zirc that are correlative with separate ^{235,238}U-^{207,206}Pb zircon age populations and whole-rock compositions, but not with ^{147}Sm-^{143}Nd isotope systematics. Lattice-strain theory used to model [REE+Y] reconciles U-Pb zircon geochronology for the individual components, which also preserve strong positive Eu* anomalies. Modeling shows that the magmas that gave rise to the oldest domains formed at contemporary oxygen fugacities. The AGC preserves a legacy older than about 4000 Ma, but this derives from incomplete assimilation of older crust. Magmatic emplacement at ca. 3920 Ma is contemporaneous with the Late Heavy Bombardment (LHB) of the Moon. Later superimposed Eoarchean events (3850-3720 Ma) are reminiscent of formation times for the Itsaq Gneiss Complex in West Greenland (Nutman et al., 1996), Nuvvuagittuq Supracrustal Belt in northern Québec (Cates et al. 2013), and Manfred Complex in Western Australia (Kinny et al., 1990). Equilibration of Sm-Nd occurred at the scale of individual components over the course of one or more of these events.