# A lower age limit for the Archean based on $\delta^{18}O$ of detrital zircons

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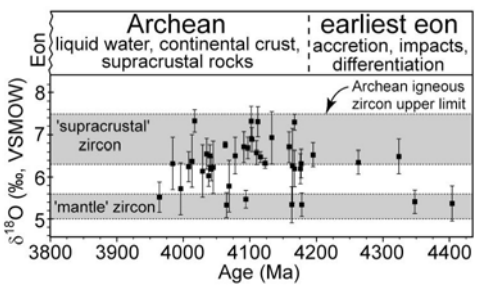
A lower boundary for the Archean Eon is proposed based on changes in magma chemistry due to interaction with liquid water at the Earth's surface. The $\delta^{18}O$ of detrital igneous zircons from Jack Hills, Western Australia, record the changing surface environment during the onset of 'cool early Earth' conditions. Mildly elevated $\delta^{18}O$ for igneous zircon occurs as far back as 4325 Ma, however a later rise of ~1‰ in $\delta^{18}O$ to 7.3‰ provides strong evidence for the recycling of supracrustal rocks into magmas, and the first evidence for the presence of liquid water on Earth (Cavosie et al., 2005). This boundary may also signify the stabilization of continental crust, as evidenced by the formation of supracrustal rocks. Rare and scattered geologic occurrences (e.g. 3850 Ma metasediments, 4030 Ma gneisses, or a 4400 Ma detrital zircon) are merely 'snapshots' in a fragmentary rock record, and do not define boundary conditions, as some have speculated. Such occurrences, no matter how significant, should not be used to define eon boundaries. The earliest eon (before Cool Earth conditions) encompasses accretion, differentiation, and the early meteorite bombardment of Earth (including Moon formation). The naming of the earliest eon (e.g. Hadean, Priscoan, etc.) requires further international discussion, as chronostratigraphic principles cannot be applied where superposition is unknown due to the lack of a preserved intact rock record. The published $\delta^{18}O$ of dated zircons suggest that the onset of cool Earth conditions was at ca. 4200 Ma, which is here proposed as the beginning of the Archean Eon.

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# Hf and Nd isotope evolution of lithologies from the 3.8 Ga Nuvvuagittuq Sequence, northern Superior Province, Canada

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The 3.8 Ga Nuvvuagittuq volcano-sedimentary sequence in the Inukjuak Domain of the Superior Province in northern Quebec lies on the coast of Hudson Bay. The Nuvvuagittuq sequence consists of volcanic and sedimentary units as well as tonalitic gneiss and pegmatites. The volcanic units include mafic amphibolites with associated intermediate volcanic horizons. The sedimentary rocks consist largely of iron formation that vary from iron oxide dominated facies to silicate (quartz-amphibole) dominated facie. One particular silicate facies forms a dominant and persistent horizon that can be followed throughout much of the sequence. The volcano-sedimentary units are intruded by layered ultramafic sills that vary from dunite and pyroxenite to gabbro compositions. The bulk of the surpacrustal sequence forms a semi-oval structure that is cored and enveloped by ca 3.6 Ga tonalitic gneisses.

The tonalitic gneisses range from granodiorite to tonalite and granite in composition and interleave with amphibolite and ultramafic units along the outer margin of the sequence. The TTG suite is characterised by heavy rare earth element (REE) depletion compared to light REE. Hf and Nd isotope analyses of the tonalites yield negative initial epsilon values suggesting that the tonalites have recycled significant amounts of older ca 3.8 Ga crust.

The volcanic units range from basaltic to dacitic in composition with the amphibolites yielding flat to slightly light REE enriched profiles and the dacitic compositions yielding light REE enriched and heavy REE depleted profiles. Hf and Nd isotope data from the volcanic lithologies range from slightly depleted initial epsilon values (+2 for Nd, +3 for Hf) to slightly negative values (-1 for Nd and –4 for Hf). Comparison with geochemical data suggests that the Hf isotope system has been perturbed in the volcanic lithologies whereas Nd has been more robust. Comparison of the Nuvvuagittuq Nd and Hf isotope data with that of West Greenland localities suggests that the mantle source for the Nuvvuagittuq lithologies was less depleted than that of West Greenland.