Was there voluminous ancient (>4.0 Ga) sialic crust? Implications from the Hf composition of detrital zircons

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We report LA-MC-ICPMS Hf isotope results of ancient detrital zircon from two locations in the Canadian Shield. Quartzite, deposited prior to 2.3 Ga in the Beaverlodge Belt, Rae Province, contains zircon entirely >3.6 Ga old. Meta-greywacke from the Assean Lake Area, western Superior Province, was deposited ca. 3.2 Ga and contains predominantly Paleoarchean zircon. The U-Pb and Lu-Hf isotope characteristics from these locations indicate that significant Paleoarchean crust was exposed at the time of sediment deposition, and crustal growth/reworking occurred between 3.7 and 3.86 Ga (Figure 1). Do to the extremely negative εHf of much of the zircon, some of the reworked crust must have been ≥4.0 Ga. However, the only presently known location of ≥4.0 Ga crust, the Acasta Gneiss, Canada, does not have a significant 3.7 to 3.86 Ga component.

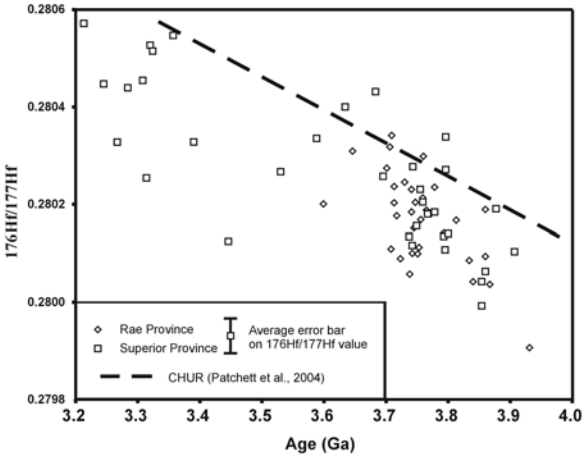

Figure 1: $^{176}Hf/^{177}Hf$ vs Age plot of ancient detrital zircons.

Occurrence of a 4.2 Gyr old zircon in the Acasta Gneiss Complex of northwestern Canada

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The recognized terrestrial materials more than 4.1 Gyr old have been restricted to detrital zircons within metasediments and a xenocrystic zircon within granitic gneiss in the Narryer Gneiss Complex of Western Australia. Consequently, knowledge of crustal evolution and surface environment in the early Earth is based on mainly the chemical and isotopic signatures of the zircons. However, it is essential for better understanding of them to obtain additional information from other regions. Here we report a further occurrence of a very old zircon grain in the Acasta Gneiss Complex of northwestern Canada, a locality which contains the oldest crustal rocks as old as 4.03 Gyr. The zircon grain was separated from 3.9-Gyr-old tonalitic gneiss and has a xenocrystic core with an U-Pb age of 4,203 ± 58 Myr (Fig. 1). The trace element composition of the core shows that it crystallized from granitoid magma. These data therefore indicates wide presence of continental crust on the Earth by 4.2 Gyr ago and subsequent reworking of them in the early crustal evolution.

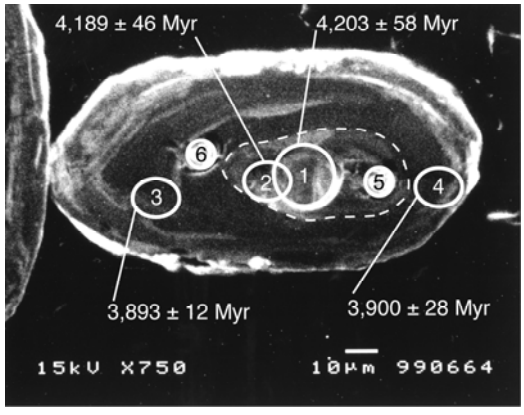

Fig.1 Cathodoluminescence image of zircon crystal AC012/ 1-12.