Geochronology and microstructural studies of zircons from Mt. Alfred and the Maynard Hills, Western Australia

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1 Abstract

Recent research into the early Earth (>4000 Ma ago) has been stimulated by the recent finds of >4000 Ma detrital zircons from Western Australia. These zircons older than >4000 Ma have been found in Mt. Narryer [Froude et al., 1983], Jack Hills [Compston et al., 1986] and the Maynard Hills [Wyche et al., 2004]. Zircons older than 4300 Ma have been identified from the Jack Hills (Narryer Terrane) [Wilde et al., 2001, Peck et al., 2001, Cavosie et al., 2004] and Maynard Hills (Barlee Terrane) [Nelson, 2002, Wyche et al., 2004].

Initial investigations of these >4300 Ma grains strongly imply an igneous origin based on their oscillatory zoning, Th/U ratios and REE abundances [Wilde et al., 2001, Peck et al., 2001, Nelson, 2002, Cavosie et al., 2004]. Further evidence for the formation of evolved continental crust felsic rocks (granites) earlier than 4400 Ma in the Earth's history is made in Wilde et al. (2001), Peck et al. (2001), Valley et al. (2002) and Cavosie et al (2004). Oxygen isotopic evidence of elevated $\delta^{18}O$ in a 4404 Ma zircon from the Jack Hills [Wilde et al., 2001, Peck et al., 2001, Valley et al., 2002] was interpreted to indicate that the igneous source was derived from crustal material that had interacted with a liquid phase hydrosphere. The proposal of Hadean era subduction with a liquid phase hydrosphere has also been proposed by recent research involving titanium concentrations being used to surmise a zircons formation temperature [Watson and Harrison, 2005, Harrison and Schmitt, 2007] and more recently the findings of diamond inclusions within 4.250 Ga zircons [Menneken et al., 2007].

Detailed studies of >4000 Ma zircons have discovered that a number of these have a surprisingly large range of $^{207}Pb/^{206}Pb$ dates [Nelson, 2000, Wilde et al., 2001, Peck et al., 2001]. The range of dates do not correspond with obvious structural features within the grains and even lie on what should be isochemical cathodoluminescence zones. The dates are also significantly larger than can be attributable to analytical uncertainty, which strongly suggests real variations exist. There have been no studies to date that conclusively determine the cause of these variations, and other anomalous behaviors shown within these zircons.

These >4000 Ma zircons are the only known surviving terrestrial material from the early Earth's history (from 4404 Ma to 4030 Ma), and as such are

scientifically pertinent to ancient earth studies.

Additional old zircons (>4000 Ma) have recently been found 45km south of the Maynard Hills (Kohler Bore) Location, near Mt. Alfred. These new finds may help elucidate the evolution of the early Earth and further constrain the depositional environment and provenance of these old grains.

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