THEME 6: THE EARLY EARTH AND PLANETS

Session 6.2: Composition and evolution of the early Earth

CONVENED BY:

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INVITED SPEAKER:

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What do we really know about the composition and evolution of the early Earth? Participants in this session are invited to critically examine the known material record of early terrestrial processes and to explore the possibilities of extending and improving this record. Topics to be discussed include, but are not limited to: factors that controlled growth and survival of early terrestrial crust; possible ways of finding new, more extensive and less disturbed early Archean rocks and Hadean minerals; geological and geochemical diversity of early terrestrial and planetary crusts; preservation of chemical and structural information in Hadean minerals, and recovery of this information; analytical, methodological and conceptual advances necessary for progress of early Earth research.

6.2.11

Inclusion mineralogy of pre-4.0 Ga zircons from Jack Hills, Western Australia: A progress report

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Understanding the Hadean Eon (~4.5-4.0 Ga) of Earth's history is essential for developing models for the earliest atmosphere, appearance and survival of a hydrosphere, early crustal processes and conditions responsible for the origin of life. In the absence of a Hadean rock record, pre-4.0 Ga detrital zircons and their mineral inclusions from the fuchsitic quartz-pebble conglomeratic Jack Hills member of the Narryer Gneiss Complex (*NGC*) in Western Australia is an available resource [1,2]. Several studies have reported zircon ages in excess of 4 Ga in the *NGC*, but few have provided data bearing on inclusion mineralogy [3], which has direct consequence to interpretations of Hadean zircon petrogenesis. Polyphase inclusions reported from pre-4 Ga *NGC* zircons consist of quartz, "K-feldspar", biotite, chlorite, amphibole, albite, muscovite and biotite/chlorite. Small (~5 µm?) inclusions of quartz, apatite, Ca-Al-silicate (plagioclase?) and monazite from the Mt. Narryer zircon locality (also *NGC*) have been also described [3]. We report the results of an inclusion mineralogy study of 700 zircons from the original JH992 Jack Hills locality [1] and 400 more grains from an outcrop approximately 250 m west along strike. Of the ~50 grains identified that are >4.0 Ga, diverse inclusions of quartz, K-feldspar, FeOOH, Ni-rich pyrite, thorite (ThO_2) and monazite (Ce,La,Th)PO_4 have been documented. In our inclusion survey, grain edges or cracks were avoided and ion microprobe U-Th-Pb analyses were obtained in the vicinity of each inclusion; they are probably not derived from later fluid infiltration or envelopment by *e.g.* neoblastic overgrowths. Inclusion sizes vary from ~2 µm (all phases) to ~15µm (K-feldspar and quartz). Quartz, apatite, Ca-Al-silicate, K-Feldspar are typical of "wet" plutonic facies granitoids. Monazite is indicatative of peraluminous melts but could also be an exsolution product along with ThO_2 (~2 µm), apatite and minute quartz blebs. Due to the characteristically small nature (~2-3 µm) of FeOOH inclusions, a potential origin for these is transport via fluid infiltration from weathering. The limited number of pre-4.0 zircon inclusions reported so far are likely but a small subset of the true frequency and diversity of Hadean zircon mineral inclusions.

References

[1] Mojzsis, S.J. *et al.* (2001) *Nature* **409**, 178-180.
[2] Peck, W.H. *et al*. (2001) *GCA* **65**, 4215-4229.
[3] Maas, R. *et al*. (1992) *GCA* **56**, 1281-1300.