~3.46 Ga-old meteorite fragments suggest the Earth's core is rich in Ti, Si and Ca

USCHI M. GRAHAM[1], ZI-KUI LIU[2], AND HIROSHI OHMOTO[3]

[1]Univ. of Kenntucky, Lexington, KY 40511 USA. graham@topasol.com

[2]Penn State Univ., University Park, PA 16802 USA. prof.zikui.liu@gmail.com

[3]Penn State Univ., University Park, PA 16802 USA. hqo@psu.edu

Previous researchers have estimated elemental abundances of the solar system and Earth's interior mostly from the compositions of various meteorites that have fallen recently on Earth. In the ABDP #1 drill core from Western Australia, we have discovered numerous meteorite fragments (MFs), <1 µm to ~2 mm in size, throughout a ~40 m section of the ~3.46 Ga Apex Basalt that overlies the thick (~20-200m) Marble Bar Chert/Jasper (MBC) beds. Contrasting to modern iron meteorites (Fe-Ni type), the MFs are mostly made of oxidized forms of Ti-Si-Ca alloys with lesser amounts of Fe, Al, Mg, Mn, V, Cr, Co and Cu; Ni is only a very minor component. Initial oxidation of the alloys may have occurred through reactions with the atmospheric O_2 in the "impact clouds." The fO_2 conditions for the core of the parental planet for these MFs were estimated at ~10 log units below the Fe/FeO buffer at ~1,500°C. Our findings suggest that: (1) Asteroids that seeded the early Earth may have had very different origins, ages and compositions than meteorites that have fallen recently on Earth and, consequently, the early-Earth materials may have come from different parts of the asteroid belt than modern meteorites; (2) Elemental abundances of the solar system and of the Earth are possibly much higher in Ti and lower in Fe and Ni than those estimated by previous researchers; and (3) The Earth's core may contain appreciable amounts of Ti, Si and Ca in addition to Fe.