A COMBINED SILICON, MAGNESIUM AND CALCIUM ISOTOPIC STUDY OF BULK METEORITES AND THE EARTH

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Introduction: Variations in the isotopic compositions between Earth and other Solar System bodies has been well documented. While there are large and well documented variations in Oxygen isotopes between Earth and meteorites and their components [1], smaller variations in ^{26}Mg, ^{53}Cr, ^{129}Xe, ^{182}W and ^{142}Nd are due to decay of extinct radionuclides. With recent developments in mass spectrometry techniques, extremely small isotopic differences, as low as a few ppm, have been discovered between bulk meteorites and the Earth for ^{54}Cr [2], ^{50}Ti [3], ^{95,97}Mo [4], ^{96}Zr [5], ^{135,138}Ba [6,7], ^{142}Nd [8] and ^{144}Sm [9]. Several isotopic anomalies have also been identified in pre-solar SiC grains.

Si, Mg and Ca isotopic variations: Very recently, it has been shown that the Silicon isotopic compositions (δ^{30}Si) of bulk meteorites (both differentiated and undifferentiated) are lighter (by ~0.3‰) than the Bulk Silicate Earth (BSE) and the Moon [10]. The heavier Si-isotopic composition of the Earth compared to bulk meteorites has been attributed to core formation on Earth. There is, however, a very limited dataset available for the Si-isotopic composition of terrestrial samples and meteorites owing to the analytical difficulties in measuring Si isotopes.

Mg isotopic compositions (δ^{25}Mg) of most meteorites do not show much variability and it is debatable whether the BSE has a slightly heavier isotopic composition compared to chondrites [11] or is chondritic [12]. Ca isotopic compositions of chondritic meteorites are also distinctly lighter than terrestrial igneous rocks [13].

What causes the isotopic variability? The isotopic differences between Earth and bulk meteorites can broadly be attributed to the following processes: (1) Terrestrial fractionation, (2) Fractionation and incomplete mixing in the solar nebula prior to accretion and (3) Late injection of pre-solar material and its inhomogeneous distribution.

Goals of the present study: We have undertaken a recent study to perform Si, Mg and Ca isotopic measurements in the same samples of chondritic meteorites and silicate terrestrial samples. Si and Mg isotopes are analyzed by MC-ICPMS. Measurement of standards have yielded an external reproducibility of less than 0.2‰ for δ^{30}Si and ~ 0.1‰ for δ^{26}Mg. Ca isotopes are analyzed by TIMS. By analyzing the isotopes of Si, Mg and Ca, which are major chemical constituents of meteorites and the bulk silicate Earth, we wish to understand the processes leading to differences in isotopic compositions of undifferentiated meteorites and the Earth.

References: [1] Clayton R. et al. (1973) *Science,* 182, 485. [2] Trinquirer A. et al. (2007) *Ap. J.,* 655, 1179. [3] Trinquirer A. et al. (2007) *Workshop on Chronology of meteorites,* Abstract#4054. [4] Yin Q. Z. et al. (2002) *Nature,* 415, 881-883. [5] Yin Q. Z. et al. (2001) *LPS XXXII,* Abstract#2128. [6] Carlson R. W. et al. (2007) *Science,* 316, 1175-1178. [7] Ranen M. C. and Jacobsen S. B. (2006) *Science,* 314, 809-812. [8] Boyet M. and Carlson R. W. (2005) *Science,* 309, 576-581. [9] Andreasen R. and Sharma M. (2006) *Science,* 314, 806-809. [10] Bastian Georg R. (2007) *Nature,* 447, 1102-1106. [11] Wiechert U. and Halliday A. N (2007) *EPSL,* 256, 360-371. [12] Teng F-Z et al. (2007) *EPSL,* 261, 84-92. [13] Simon J. I. and DePaolo D. J. (2007) *LPS XXXVII,* Abstract#1752.