Precise Determination of Ca Isotopic Compositions in Bulk Meteorites by Thermo Ionization Mass Spectrometry (TIMS)

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Introduction: We had improved the TIMS measurement of minor Ca isotopes using a large Ca ion current around 1.5nA. The 2 sigma precision isotope ratios of $^{43}Ca/^{44}Ca$, $^{46}Ca/^{44}Ca$, and $^{48}Ca/^{44}Ca$ were 0.3, 7.5, 0.6 epsilon units (ε) respectively for 1~2μg of Ca loaded [1]. We then determined isotopic compositions of several bulk meteorites, including of achondrites (SNCs, angrites, HEDs, and ureilites) and ordinary chondrites (H, L, and LL), and surprised discovered planetary scale of ^{48}Ca heterogeneities. It revealed that relative to the earth, urelites showed negative ^{48}Ca anomaly as low as -2ε (i.e. a 7 sigma effect) [2] whereas 1 ordinary chondrite had a positive anomaly. These anomalies are only a bit smaller than those found in CAIs. However, the achondrites presumably solidified from large scale melting on planetary bodies hundreds of km in size thus should not have retained any detectable heterogeneities due to rare carrier grains. Similar anomalies in ^{54}Cr and ^{50}Ti had also been discovered by Trinquier et al. (2007, 2009) [3-4] and showed a correlation with our discovery of ^{48}Ca anomaly. In additional to well-known O isotope heterogeneity, these neutron-rich iron group isotopes heterogeneities among different groups of meteorites could be another potential tracers to understand the homogenization processes of solar materials, especially refractory elements, in the early Solar System.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, journal names should be spelled in full. Please, use the following style:

[1] Chen H. W. et al. 2010. 41st Lunar and Planetary Science Conference. #2088. [2] Chen H. W. et al. 2011. ApJ 745, L23. [3] Trinquier A. 2007. ApJ 655, 1179-1185. [4] Trinquier A. et al. 2009. Science 324, 374-376.