

**ISOTOPIC COMPOSITIONS AND SYSTEMATICS OF EARLY SOLAR SYSTEM AND PRESOLAR MATERIALS: AN EVALUATION OF MATRIX EFFECTS AND MASS INTERFERENCES.**

S. J. McKibbin<sup>1</sup>, J. N. Avila<sup>1</sup>, T. R. Ireland<sup>1</sup>, P. Holden<sup>1</sup> and H. St. C. O'Neill<sup>1</sup>. <sup>1</sup>Research School of Earth Sciences and Planetary Science Institute, Australian National University, Canberra ACT 0200. E-mail: seann.mckibbin@anu.edu.au, janaina.avila@anu.edu.au

**Introduction:** The precision and accuracy of SIMS data is extremely dependent on the selection of suitable calibration standards. It is well recognised that SIMS analysis ideally requires standards that are compositionally and structurally similar to the analytical target (here referred to as matrix-matched) [1, 2], but it is common for this to go unaddressed. In order to analyse early solar system [3] and presolar materials using SHRIMP-RG, matrix-matched mineral standards have been used to monitor instrumental mass fractionation, determine elemental yields and delineate possible mass interferences.

**Cr isotopes in silicates:** Measurements of Cr isotopic ratios in mafic silicate minerals indicate that instrument-induced mass-fractionation is strongly dependent on the crystal lattice. Olivine-structure minerals return  $^{53}\text{Cr}^+ / ^{52}\text{Cr}^+$  ratios that are typically fractionated by 10-30 ‰ in favour of the light isotope. Fractionation is even more pronounced in pyroxenes, with the  $^{53}\text{Cr}^+ / ^{52}\text{Cr}^+$  40-50 ‰ enriched in the light isotope.

Inter-element ratios such as  $^{55}\text{Mn}^+ / ^{52}\text{Cr}^+$  are invariably fractionated by many tens of percent during sputtering of olivine, and this is extremely dependent on the bulk major oxide matrix composition (Mg, Fe and Ca content). Correction factors have been calculated by measurement of  $^{55}\text{Mn}^+ / ^{52}\text{Cr}^+$  in synthetic olivine [(Mg,Fe)<sub>2</sub>SiO<sub>4</sub>; Mg# ~60], high-Ca fayalite and low-Ca kirschsteinite [(Fe,Ca)<sub>2</sub>SiO<sub>4</sub>] using SIMS followed by LA-ICP-MS. The measured  $^{55}\text{Mn}^+ / ^{52}\text{Cr}^+$  increases with decreasing Fe-content; for high-Ca fayalite the two techniques give similar results, but for olivine the SIMS ratio is 40% higher than the LA-ICP-MS result. Downhole ion yields also change during sputtering depending on matrix composition. Olivine gives increasing Cr<sup>+</sup> and decreasing Mn<sup>+</sup> within each spot over several minutes, resulting in decreasing  $^{55}\text{Mn}^+ / ^{52}\text{Cr}^+$  with time. High-Ca fayalite and low-Ca kirschsteinite show either no net change or the opposite trend. Notably, we have not observed any effect on the  $^{53}\text{Cr}^+ / ^{52}\text{Cr}^+$  ratio due to Mg, Fe and Ca content of olivine-structure minerals.

**Ba isotopes in silicon carbide:** Experiments involving measurement of Ba isotopes in SiC grains indicate the presence of molecular interferences on all Ba isotopes. However, the interferences observed in SiC are not present in silicates, as evidenced by the analysis of several NIST glasses and USGS basaltic reference materials. Contributions from interferences are particularly large for <sup>134</sup>Ba and <sup>136</sup>Ba. SHRIMP RG was operated at mass resolving power of  $m/\Delta m = 9000$  (at 1% peak), which was not enough to resolve the molecular interferences. These interferences were suppressed with the use of energy filtering which reduced the intensity of the secondary ion beam, resulting in isotope ratios with lower precision but improved accuracy.

**References:** [1] Shimizu N. and Hart S. R. 1987. *Annual Review of Earth and Planetary Sciences* 10:483-526. [2] Ireland T. R. 1995. *Advances in Analytical Geochemistry* 2, pp. 1-118. [3] McKibbin S. J. et al. 2008. *This Meeting*.