Stable isotope fractionation of Sn during planetary and nebular processes

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A major unresolved issue in cosmochemistry is the widespread depletion of volatile elements that is observed in the terrestrial planets and in meteorites [1,2]. At first order, the abundance of moderately volatile elements is correlated with their condensation temperature, and the CV chondrites are depleted in volatile elements when compared to the CI chondrites, the Earth is more depleted, and the Moon even more so. Carbonaceous chondrites also exhibit a volatile depletion trend in the order CI > CM > CO > CV. Several scenarios have been proposed to explain these volatile element depletions, including incomplete condensation from solar nebula or evaporation on the parent body. Isotopes are known to fractionate during kinetic processes process related to volatility, and therefore stable isotopic variations of moderately volatile elements have the potential to differentiate between these different mechanisms.

Tin has a 50% condensation temperature of 704 K [3], intermediate between Zn (723 K) and Se (697 K), and is strongly chalcophile. It therefore has the potential to investigate the origin of the difference of behaviour between Zn and Se isotopes [4]. In addition, volatility-related stable isotope fractionation of Sn may give insights into the compositions and source regions of accreting bodies and the relative timing of their accretion to Earth and provide a means to trace volatilisation during thermal events such as impacts or planetary magmatism. Furthermore, Sn is also moderately siderophile, and metal–silicate partitioning of Sn has been shown to vary significantly with changing metal compositions and oxygen fugacity [5]. Thus, Sn stable isotopes may also provide insights into planetary accretion and differentiation.

Using our recent method for measurement of Sn stable isotopes by double-spike MC-ICPMS [6], we have analysed a suite of chondrite and achondrite meteorites. Using these data we explore the possibility of Sn stable isotope fractionation during nebular and planetary processes.

[1] Halliday and Porcelli (2001) *EPSL* **192**, 545–559. [2] O'Neill and Palme (2008) *Phil. Trans. A.* **366**, 4205–38. [3] Lodders (2003) Ap. J. 591, 1220-1247. [4] Vollstaedt et al. (2016) EPSL 450, 372–80 [5] Capobianco et al. (1999) *GCA* **63**, 2667–77. [6] Creech, et al. (2017) Chem. Geol. doi:10.1016/j.chemgeo.2017.03.013.