The University of Oxford Department of Earth Sciences

EARTHSCIENCES

Volatile loss from planets and asteroids

Supervisory Team	• **Dr J Barling** www.earth.ox.ac.uk/people/jane-barling • **Professor B Wood** www.earth.ox.ac.uk/people/bernie-wood

Mercury, the moon, Earth, Mars and Vesta are all known to be depleted in volatile elements relative to the solar system reference, CI chondrite meteorites. Conventionally, the volatile contents of meteorites, the moon and planets are thought to be a result of mixing together, in varying proportion, volatile rich CI-chondrite-like material with volatile poor material. The result is a general depletion trend reflecting the volatility of the element. Volatility is related to the temperature at which the element would condense from a solar gas with elements condensing at low temperatures being most volatile.

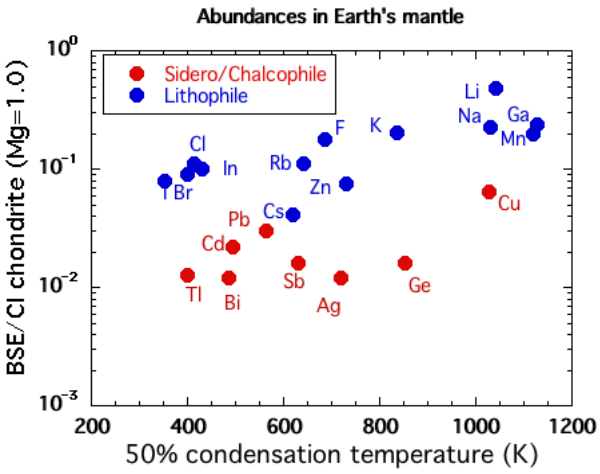

Figure 1

Depletions below the rough trend are generally assumed to be due to partitioning of "siderophile" elements into the core (Figure 1).

A recent D.Phil student in Oxford (Ashley Norris) has questioned the conventional interpretation by showing that abundances in the Earth correlate extremely well with measured volatilities from molten silicate liquid. This has led to the idea that Earth lost its volatile elements by vaporisation either on precursor bodies or during the Moon-forming giant impact (Norris and Wood 2017) (Figure 2) and that these elements were not accreted in the "conventional" way.

If volatile loss by vaporisation from molten bodies was an important process in the early solar system then we should, in principle, observe isotopic fractionation of volatile elements with lighter isotopes being lost more readily than heavier isotopes. The aim of this project is to investigate the effects of volatile loss on the isotopic compositions of several elements. We will start with Zn and Cd, two of the elements in Figure 2 and progress to Pb and Cu.

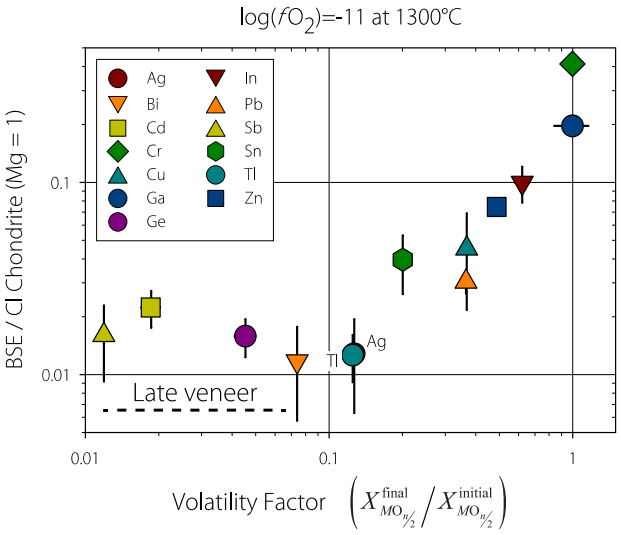

Figure 2

The project will involve performing experiments at controlled conditions at high temperatures for relatively short times (typically 60 mins) then performing isotopic analyses of the product melts. Because variations in isotope compositions are known for these elements in different meteroite classes, on Earth and on Mars and Vesta, the results will enable us to test and improve on the model initially proposed for establishing Earth's volatile element composition.

References & Further Reading

C.A. Norris and B.J. Wood, Earth's volatile contents established by melting and vaporization. *Nature* 549(7673) (2017) 507-+

Further Information

Jane Barling (jane.barling@earth.ox.ac.uk) and Bernie Wood (bernie.wood@earth.ox.ac.uk)