Trace element chemistry of sulphides in the Shergottite meteorites: Insights into the behaviour of siderophile-chalcophile elements in Martian magmas

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The Shergottite meteorites are plume-related Martian magmatic rocks that provide detailed insights into element partitioning processes between the Martian core, mantle and crust [1]. They contain various proportions of igneous sulphides, predominately associated with mesostasis interstitial to silicate cumulates, and dominated by Ni and Cu bearing pyrrhotite solid solutions that rarely contain (sub-) micron-scale pentlandite and Cu-sulphide exsolutions [2]. We report preliminary results of the first in-situ LA-ICP-MS and high-precision EPMA trace element (including PGE) analyses on unaltered sulphide assemblages in several specimens of the olivine-phyric (Y980459, Tissint, DAG476, Dhofar019) and basaltic (Zagami, Shergotty, Los Angeles) Shergottite sub-group, and show how these data may aid to further constrain the metal and sulphur inventory of Martian magmas.

The sulphide analyses show subtle to strong correlations/ anticorrelations between Ni/Cu, Ni/Co and Pt/Pd sulphide ratios, as well as the evolving nature [2] and estimated sulphur inventory [3] of the mesostasis they are associated with. Our findings show that sulphides in the Shergottites, although potentially modified from their igneous state by various post-magmatic processes (e.g. impact-induced shock heating), inherit base and trace element signatures that can be reconciled with a magmatic origin. The observed variations in Ni/Cu, Ni/Co and Pt/Pd sulphide ratios may be explained by Ni and Pt sequestration through crystallising olivine and Pt-rich nuggets, as well as the incompatibility of Cu, Co and Pd in fractionating silicates and oxides.

[1] Baumgartner et al. (2015), Ore Geol Rev, **65**, 400-412; [2] Lorand et al. (2005), Met Planet Sci, **40**, 1257-1273, Ding et al. (2015), **409**, 157-167