Diversity of martian sulfides in chassignites

J.-P. LORAND[1]

[1]LPG Nantes, UMR CNRS 6112, Université de Nantes, France.
jean-pierre.lorand@univ-nantes.fr

The Chassignite subclass of Martian meteorites (only three dunite cumulates from 1.3 Ga-old subaerial flow so far identified) shows a great diversity of Fe-Ni sulfides and metal phases that records quite well the polyphase petrogenetic history of chassignites on Mars.[1-3]. Igneous sulfides (nickeliferous pyrrhotite, pentlandite) occur in uniformly low amounts (0.010 ± 0.005 wt. %)[1-4]. The samples that escaped strong shock metamorphism (Chassigny, northwest Africa NWA 8694) preserved nickeliferous pyrrhotite phase in olivine-hosted melt inclusions and intercumulus spaces. The pyrrhotite Ni content (1.5-2.5 wt. % Ni) is within the range expected for equilibration with the coexisting olivine at igneous temperatures. By contrast, igneous pyrrhotite reequilibrated toward strongly metal-deficient compositions ($M_{0.88+/-0.01}S$ where M = Fe+Ni+Co+Cu) due to a late-magmatic oxidation event. Hydrothermal alteration produced nickeliferous pyrite (0–2.5 wt% Ni) and scarce millerite, which partly replaced intercumulus pyrrhotite. The shock that ejected Chassigny and NWA 8694 from Mars generated post-shock temperatures high enough to anneal and rehomogenize Ni inside pyrrhotite; hence the few pentlandite blebs observed in pyrrhotite exsolved during post-shock cooling. Much stronger shock metamorphism features were documented in the highly shocked chassignite NWA 2737. Both hydrothermal pyrite and igneous metal-deficient pyrrhotite were converted into Ni-poor troïlite (M⁄S = 1.0) sometimes Cr-bearing (up to 1 wt%), coexisting with micrometer-sized taenite⁄tetrataenite-type native Ni-Fe alloys (Ni⁄Fe =1) and Fe-Os-Ir-(Ru) alloys. The high shock pressure (55 GPa) coupled with post-shock temperature to perhaps 800 °C triggered sulfur degassing and metal exsolution.

1 Lorand et al. (2012) Meteor. & Planet. Sci. Lett., 47, 1830-1841. 2 Lorand, et al. (2018) Amer. Mineral., 103, 872-885; 3 Hewins et al. (2019) Geochim. Cosmochim. Acta (submitted).