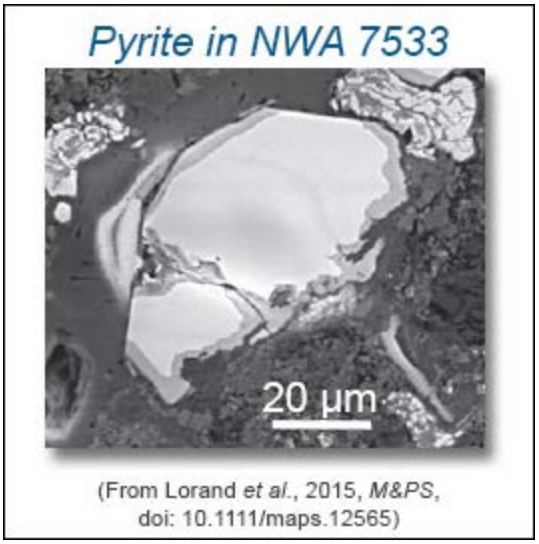
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks

Quick Views of Big Advances

Early Martian Crust as Recorded by NWA 7533



The chemistry of the early Martian crust and various effects of hydrothermal alteration can be evaluated through laboratory analyses of Martian meteorites. ***Polymict breccias*** are particularly good for this task because they contain an assortment of rock and mineral fragments, including clasts of basalt, impact melt, and sedimentary rocks. Jean-Pierre Lorand (CNRS UMR, Université de Nantes, France) and colleagues from France and the US report new ***chalcophile-siderophile*** element data for pyrite (FeS_2) crystals from the 4.43-billion-year-old Martian meteorite NWA 7533 [***Datalink*** from Meteoritical Database]. This meteorite and its paired stones, such as NWA 7034 [***Datalink*** from Meteoritical Database] are spectacular, polymict regolith breccias made of pieces of ancient Mars (see **PSRD** article: ***The Importance of When***). Pyrite, which precipitated out of sulfur-rich hydrothermal fluids during a thermal event on Mars dated at 1.4 billion years ago, is found in all of the different clasts of NWA 7533.

Lorand and coauthors obtained data for 25 chalcophile-siderophile trace elements in NWA 7533 pyrite using LA-ICPMS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry), which provided higher-sensitivity analyses to what had been collected previously by electron microprobe. Pyrite is by far the most abundant hydrothermal sulfide in the rock and is the major contributor of sulfur, selenium, and tellurium to the whole-rock budget of chalcophile elements. Yet pyrite appears to be a minor contributor of the other chalcophile and siderophile elements to the whole-rock budget. The research paper contains detailed results for the suite of trace element concentrations from the highly siderophile to the most volatile chalcophiles, and discussion of the origins of these elements. In the end, Lorand and coauthors suggest the chalcophile-siderophile element concentrations in NWA 7533 from the early Martian crust (except for the previously mentioned S, Se, and Te) were not modified significantly by secondary processes, including the 1.4-billion-year-old thermal event. This work contributes to the broad research efforts to tease out the chemical connections among impactor debris, hydrothermal fluids, and suflide cycling in the early Martian crust.

See Reference:

· Lorand, J.-P., Hewins, R. H., Humayun, M., Remusat, L., Zanda, B., La, C., and Pont, S. (2018) Chalcophile-siderophile Element Systematics of Hydrothermal Pyrite from Martian Regolith Breccia NWA 7533, *Geochimica et Cosmochimica Acta,* v. 241, p. 134-149, doi: 10.1016/j.gca.2018.08.041. [***abstract***]

See also:

· Davenport, J. D. (January 2014) ICP-MS and Planetary Geosciences. *PSRD*, ***www.psrd.hawaii.edu/Jan14/ICP-MS-HowItWorks.html***.

· Lorand, J.-P., Hewins, R. H., Reemusat, L., Zanda, B., Pont, S., Lerous, H., Marinova, M., Jacob, D., Humayun, M., Nemchin, A., Grange, M., Kennedy, A., and Göpel, C. (2015) Nickeliferous Pyrite Tracks Pervasive Hydrothermal Alteration in Martian Regolith Breccia: A Study in NWA 7533, *Meteoritics & Planetary Science,* v. 50, p. 2099-2120, doi: 10.1111/maps.12565. [***abstract***]

· Taylor, G. J. (June 2014) The Importance of When. *PSRD*, ***www.psrd.hawaii.edu/June14/Mars-meteorite-ages.html***.

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