Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17823

On the origins of iron and glassy spherules in ophiolitic chromitites

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Millimetric to (sub)-microscopic metallic-silicate-oxide spherules have been documented in ophiolitic mantle rocks such as peridotites and associated chromitites. They spherules may consists of: (1) native iron having variable amounts of Ni with/without inclusions of silicate glass or oxides (wüstite or magnetite), (2) dendritic intergrowth of oxides (magnetite, wüstite and hematite) with/without silicate glass and, (3) silicate glass only. Most authors agree that these spherules are indigenous to the mantle rocks and related with high-temperature processes operating in the Earth's upper mantle. Pioneering hypothesess suggested a formation related to fluids/melts of very high temperature (>1400-1500 ºC) and low fO_2 (well below IW buffer) operating inthe lower mantle or the Mantle Transition Zone (i.e., MTZ > 610 km). More recent works have suggested an origin related with slab-derived CH4 ± H2 fluids, or mantle melts that were supplied with such component. Some other authors, based on laboratory experimental tests only, argued that they could are the solid products of molten droplets originated by ligthning strikes affecting mantle rocks exposed to the Earth's surface. The un-natural athropogenetic origin of the spherules has also been suggested but not firmily proven.

This communication provides the first-ever micron-to-nanoscale characterization of a suite of spherules found in chromitites from the Rhodopean ophiolites in Bulgaria. A comparison of our studied spherules with other reported in the literature reveal that chromitite-hosted spherules shear similarities with those cosmic and volcanic-related spherules found in the geological record. We propose that the shperules could represent part of oceanic sediments that were incorporated into the upper mantle via subduction.