UNUSUAL PHOSPHIDE, CARBIDE AND CARBONATE FROM THE MORASK0 IAB-MG IRON METEORITE

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We studied a sample of the Morasko iron meteorite IAB-MG with utilization a variety of the transmission electron microscopy (TEM) techniques [1]. The foils were cut from an interface region between the taenite and kamacite lamellae. The amorphous Fe-Ni-Ti carbon-rich matrix with irregularly-sized pores hosts 1.5–2 μm inclusions of phosphide and nanometre-sized inclusions of taenite, Ba-carbonate, and Fe-Ni carbide (Fig. 1).

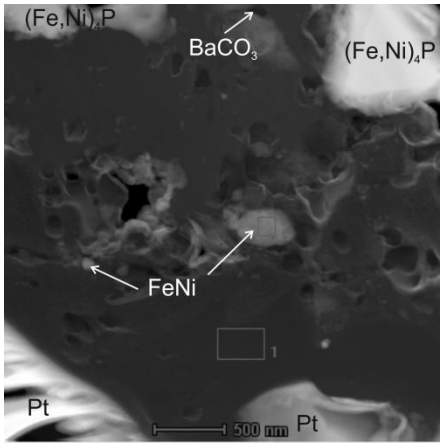

Fig. 1. Amorphous porous (irregular black areas) matrix with inclusions of phosphide, taenite and Ba-calcite. Pt is the platinum strip from the FIB sample preparation.

The irregular *phosphide* grains have irregular shape. They cannot be attributed as schreibersite because of their different stoichiometry which is $(Fe,Ni)_4P$: Fe = 52.8-53.1 at.%; Ni = 26.7-27.1 at.%; P = 20.1-20.2 at.%; (Fe+Ni)/P = 3.95-3.98. The variations in stoichiometry of meteoritic phosphides are not unusual. For example, Borodaev et al. [2] reported nickel-free variety of schreibersite Fe_2P, and Kvasnitsya et al. [3] found the "schreibersite" composition of the Tunguska cosmic body close to $(Fe,Ni)_5P$. This indicates that phosphides may form not a single mineral but a series of various stoichiometries.

Taenite forms irregular, drop-like grains, 50-750 nm in size, included in both amorphous matrix and schreibersite grains. They have very variable composition with Fe/(Fe+Ni) atomic ratios from 0.50 to 0.86, in contrast to kamacite from the meteorite matrix, where Fe comprises 94.4 at.%. No other admixtures were found in EDX and EELA spectra of taenite.

Ba-carbonate (witherite) was identified as a single, elongated, irregularly-shaped inclusion in amorphous matrix, ~65 nm in size. In its cation composition, Ba strongly predominates; minor admixture of Ca occurs. The identification of mineral is confirmed by diffractional data.

A single grain of *iron carbide* is irregularly-shaped, ~60 nm in size, surrounded by amorphous carbon. The chemical composition of metals (from the EDX data) is as following (in at.%): Fe = 94; Ni = 6; - exactly the same as in the kamacite matrix of the iron, which implies possible genetic relationship between these two phases. According to crystallographic data, the carbide is the "Hagg carbide" $(Fe,Ni)_5C_2$ [4], not reported earlier in the natural environment.

References:

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