MINERALOGY OF INCLUSION WITH SILICATE-NATROPHOSPHATE IMMISCIBILITY, METEORITE ELGA (IIE)

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Introduction: Iron meteorite Elga (group IIE) is a fine-grained octahedrite with silicate inclusions (up to 15 vol.%) and with clear features of local shock metamorphism melting [1-7]. The inclusions are rounded or oval; sizes – 1-5 mm, sometimes up to 10-15 mm. Their mineral composition strongly varies. Most inclusions are gray-green and consist of glass (45-70%), diopside (25-50%) and enstatite (1-5%), rarely phosphates (fluorapatite, merrillite, panethite), olivine, chromite and rutile. Spheric milky-white inclusions contain glass or quartz-feldspathic aggregate with minimal mafic silicates. Schreibersite and troilite commonly occurs around all inclusions. Inclusions with equal content of silicates and troilite as well as troilite-schreibersite segregations were also observed in Fe-Ni-metal.

Experimental: Polished samples of the Elga meteorite were examined using optical microscope Olympus BX51, scanning microscope TESCAN MIRA 3MLU SEM with EDS/WDS system, electron microprobe JEOL JXA-8100 (WDS) and LabRAM HR 800 mm spectrometer.

Results and Discussion: The studied silicate inclusion (3 mm) has a specific mineral composition and show silicate (≈90%) – natrophosphate (≈10%) liquid immiscibility due to meniscus-like isolation of Na-Ca-Mg-Fe phosphates (Fig. 1). Specific silicate-phosphate immiscible inclusions were previously decribed in the Elga meteorite, but their phosphate part contains merrillite and chladniite [6]. Silicate part of the studied immiscible inclusion is free in silicate glass; now it is fine-grained aggregate of feldspars and quartz.The relationships of feldspars indicate solid decay of initially homogenous K-Na-feldspar into albite and K-feldspar with temperature decreasing. Mafic minerals in silicate part are very specific: dominant phase is an obertiite–group oxyamphibole, "ferro-obertiite" $NaNa_2Mg_{2.5}Fe^{2+}Ti_{1.5}[Si_8O_{22}]O_2$; minor phases are aenigmatite $Na_2(Fe^{2+},Mg)_5TiSi_6O_{18}O_2$, clinopyroxene of the diopside $Ca(Mg,Fe)Si_2O_6$ – kosmochlor $NaCrSi_2O_6$ - $Na(Mg,Fe)_{0.5}Ti_{0.5}Si_2O_6$ series, enstatite and Fe-Zn-eskolaite. Three last minerals are commonly confined to the boundary between silicate and natrophosphate parts. The alteration phases are represented by Fe-chlorite and hydrated phosphate close to vivianite $Fe^{2+}_3(PO_4)_2•8H_2O$ and with Na_2O (2.3-3.3 wt.%). Natrophosphate part consists of aggregate of three orthophosphates (brianite, czochralskiite, maricite) and minor Na-Cr-Ti-clinopyroxene, pentlandite, rarely taenite (Fig. 1). Meteorite Elga is second occurrence of natural czochralskiite $Na_4Ca_3Mg(PO_4)_4$, in addition to the Morasko meteorite [5-7]. Unlike holotype mineral, the Elga czochralskiite are richer in FeO (2.3-4.8) and MnO (0.5-1.5 wt.%). Brianite $Na_2CaMg(PO_4)_2$ contains FeO (3.0-4.4) and MnO (0.3-0.7 wt.%) and maricite $NaFe(PO_4)$ - MnO (5.5-6.2), MgO (5.3-5.8) and CaO (0.5-1.5 wt.%). Chemical data for all minerals in the inclusion are supported by Raman spectroscopy.

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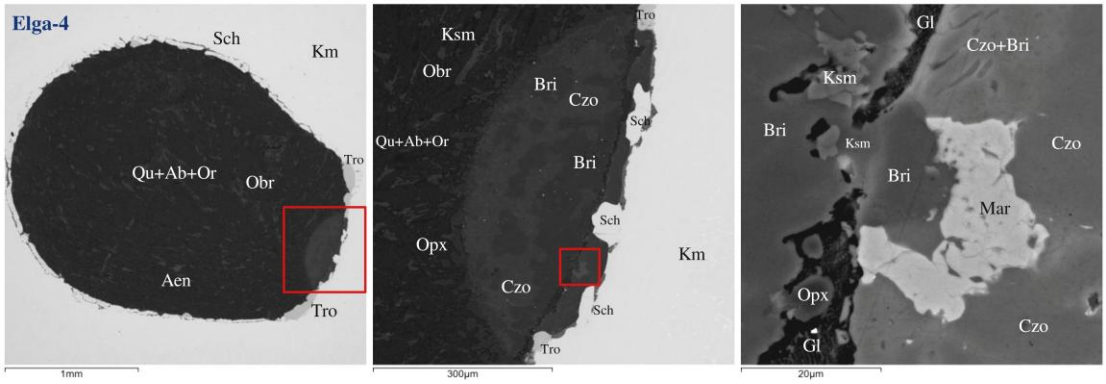

Figure 1. Silicate-natrophosphate immiscible inclusion in metal, meteorite Elga, BSE images. Tro – troilite, Km – Fe-Ni-metal; Sch – schreibersite; Aen – aenigmatite; Obr – «ferro-obertiite»; Qu+Ab+Or (Gl) – albite-K-feldspar-quartz aggregate (former glass); Opx – enstatite; Ksm – Na-Cr-Ti-clinopyroxene; Bri – brianite; Mar – maricite; Czo – czochralskiite.