TRACE ELEMENT COMPOSITION AND CLASSIFICATION OF Ni-RICH ATAXITE ONELLO.

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Introduction: Significant amount of iron meteorites remains poorly described and ungrouped. Some of them reveal anomalous composition, which do not allow classification to the specific known groups [1]. Here we provide new data on the unique Ni- and P-rich iron meteorite Onello, which contains rare high-pressure phosphide allabogdanite [2]. Onello was found in Yakutia (Russia) in 1997. Preliminary study did not allow its clear classification [3].

Methods: Several 0.5-2 cm fragments of meteorite were cut and polished for investigation by scanning electron microscope (Tescan MYRA 3 LMU) with energy-dispersive system X-Max-80 (Oxford Instr.). Trace elements composition was obtained by LA-ICP-MS (Thermo Scientific Element XR) method at University of Tokyo (Japan). We used homogenous piece of Campo del Cielo iron and synthetic FeNi-metal [4] as standards.

Results and discussion: Onello is fine-grained ataxite with matrix consisting of taenite with 23.0-25.4 wt% Ni. Taenite matrix contains numerous tiny inclusions of schreibersite (22-26 wt% Ni), nickelphosphide (44-52 wt% Ni) and allabogdanite (20.6-21.8 wt% Ni). Nickelphosphide and schreibersite are often surrounded by thin rim of kamacite (5.8-8.8 wt% Ni). Some phosphide grains (especially schreibersite) are large in size (up to 3-4 mm) and contain troilite inclusions. Pentlandite is also found as fine lamellae in troilite. In [3] P-bearing sulfide was reported; however, we could not confirm it from the available sample set. Awaruite-like mineral (75-81 wt% Ni) is also common and appears as cloudy aggregates in the taenite matrix (Fig.1). The stoichiometry is different from awaruite and correspond to 3.0-4.1 Ni per Fe atom. It also contains 1.0-2.5 wt% O. Awaruite is often surrounded by O-bearing alteration products (Fig.1), which show unusual stoichiometry, intermediate between awaruite metal and oxides. They form compositional trend toward trevorite.

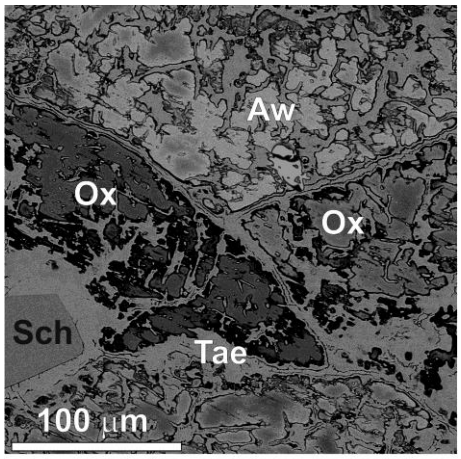

Figure 1. Awaruite (Aw) with oxide (Ox) products of alteration in taenite (Tae) matrix of Onello meteorite. Sch – schreibersite.

Metal composition was calculated using average of 16 LA-ICP-MS analyses in different samples. Important concentrations include Ni = 24.12 wt% and (in ppm): Cr = 0.32, Co = 6780, Cu = 1075, Ga = 7.21, Ge = 22.2, As = 30.4, Mo = 10.5, Ru = 2.71, Pd = 17.3, Sb = 1.36, W = 0.24, Re = 0.05, Os = 0.46, Ir = 0.58, Pt = 3.07, and Au = 3.03. Onello meteorite can be related to anomalous Ni-rich members of IAB group based on the Ni-Ga, Ni-Ge and Ni-Ir classification plots. Previous analyses failed determination of the correct Ga concentration. In the Au-Ni based classification inside IAB group [5] Onello falls into the sHH subgroup in all elemental plots versus Au, however, with slightly anomalous Ni-content. The members of sHH subgroup contain 14.6-18.4 wt% Ni.

An appearance of allabogdanite indicates crystallization from P-rich melt (>25 mol% P according to peritectics at the Fe-Ni-P phase diagram [6]) at high pressures above 8 GPa [7]. It may indicate that anomalous Ni-rich members of IAB group represent products of secondary impact events on IAB parent body, which affected Ni- and P-rich areas. Re-melting and re-crystallization of these zones caused formation of unusual minerals, such as allabogdanite and awaruite.

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