UAKITITE VN, A NEW NITRIDE IN IRON METEORITES

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Introduction: Uakitite VN (IMA 2018-003) was discovered in iron meteorite Uakit (IIAB, 3.96 kg), which was found in 2016 in the Baunt Evenk district, Republic of Buryatia, Russia (approved 28 June 2017 by the Meteorite Nomenclature Committee). Kamacite is the main mineral of the meteorite (>98 vol.%). Minor and accessory primary minerals are represented by schreibersite (rhabdite), nickelphosphide, taenite, plessite (taenite + kamacite + tetrataenite), cohenite, tetrataenite, daubreelite, kalininite, troilite, carlsbergite, sphalerite, uakitite, cooper and the potentially new mineral $CuCrS_2$. The presence of large sulfide nodules (up to 1 cm) of troilite-daubreelite composition is common of the Uakit meteorite. The appearance of Ni-rich magnetite, pentlandite, heazlewoodite, awaruite-nickel as well as Ni-rich goethite, akageneite, Ni-rich siderite, Ca-Fe-carbonates, gypsum, and unidentified hydrated Fe-rich phosphate and Ca-Fe-sulfate is related to different stages of the terrestrial alteration [1-2].

Experimental: Polished samples of the Uakit meteorite were examined using optical microscope Olympus BX51, scanning microscopes TESCAN MIRA 3MLU SEM with EDS/WDS system and FE-SEM ZEISS SIGMA VP with EDS and EBSD systems, electron microprobe JEOL JXA-8100 and LabRAM HR 800 mm spectrometer.

Results and Discussion: Uakitite was observed in small troilite-daubreelite (±schreibersite) inclusions (up to 100 μm) in kamacite and in large troilite-daubreelite nodules (up to 1 cm). Most inclusions represent alternation of layers of troilite and daubreelite, which are formed due to solid decay of an initial Fe-Cr-sulfide. These inclusions are partially resorbed and located in impact-derived fissures of the meteorite, which is now filled with magnetite, rarely other secondary minerals.The troilite-daubreelite associations in the Uakit meteorite formed due to high-temperature (> 1000°C) separation of Fe-Cr-rich sulfide liquid from Fe-metal melt. Phase relations indicate that uakitite is one of early minerals in these associations. It forms isometric (cubic) crystals (in daubreelite) or rounded grains (in schreibersite). The size of uakitite grains is usually less than 5 μm (Fig. 1). It is associated with sulfides (daubreelite, troilite, $CuCrS_2$), schreibersite and magnetite. No assemblages with carlsbergite CrN were found. Unfortunately, we failed to obtain all physical and optical propertites of uakitite because of the very small sizes of the grains, but they are known for synthetic VN: yellow and transparent phase with metallic lustre; Mohs hardness - 9-10; light gray colour with a pinky tint in reflected light; density (calc.) = 6.128 g/cm^3. Uakitite is structurally related to carlsbergite CrN and osbornite TiN. Single-crystal X-ray studies for uakitite could not be carried out because of the small size. Structural data were obtained for three uakitite crystals using the EBSD technique (Fig. 1) and fitted to the structural model of synthetic VN (cubic, *Fm*-3*m*, *a* = 4.1328(3) Å; *V* = 70.588(9) Å^3; Z = 4) [3]. Fitting of the EBSD patterns for a VN model resulted in the parameter MAD = 0.14-0.37° (best-good fit). Analytical data for uakitite (in wt.%, n=53) are: V – 71.33; Cr – 5.58; Fe – 1.56; N - 21.41; Ti – 0.00. The empirical formula $(V_{0.91}Cr_{0.07}Fe_{0.02})_{1.00}N_{1.00}$ indicates that chromium incorporates in the structure according to the scheme $V^{3+} \rightarrow Cr^{3+}$ (up to 7 mol.% of the carlsbergite end-member).

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References: [1] Ripp G. S. et al. 2017. *200th Anniversary Meeting of the Russian Mineralogical Society*, Saint-Petersburg. v. 2. pp. 311-313. [2] Sharygin V. V. et al. 2018. *Mineralogical Magazine.* CNMNC Newsletter No.42. [3] Kubel F. et al. 1988. *Physical Review B: Condensed Matter* 38:12908-12912.

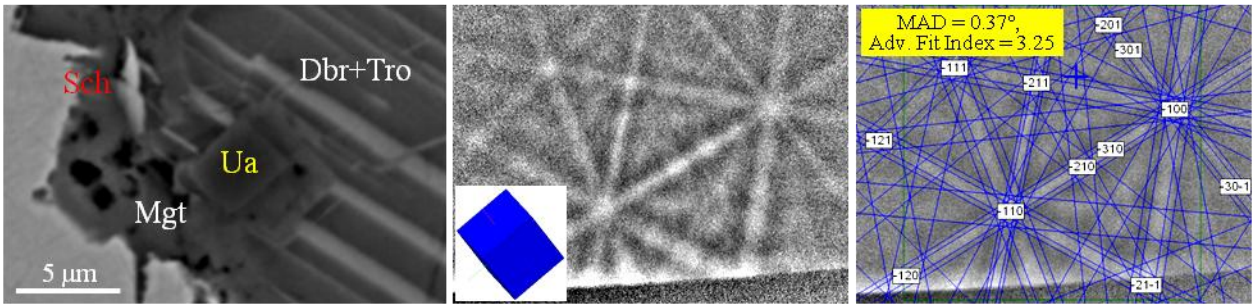

Figure 1. BSE image of a uakitite-containing phosphide-sulfide inclusion in kamacite, the Kikuchi patterns (initial and indexed) and orientation for uakitite grain, Uakit meteorite. Symbols: Ua – uakitite; Mgt – magnetite; Sch – schreibersite; Dbr+Tro – daubreelite + troilite; MAD – mean angular deviation in comparison with synthetic VN.