AENIGMATITE MINERALIZATION IN THE FRAGMENT OF THE DAG 1064 POLYMICT UREILITE.

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Introduction: Aenigmatite is triclinic inosilicate with a formulae $Na_2Fe^{2+}{}_5TiSi_6O_{20}$, commonly found in the terrestrial alcaline rosks. Extraterrestrial aenigmatite was discovered in the Kaidun CR2 breccia [1] and aenigmatite-like phase was described in the Adzhi-Bogdo (stone) LL3-6 chondritic breccia [2]. Among the ureilites, only a mineral of aenigmatite group – rhoenite, was discovered in the monomict ureilite EET 96001 [3]. We report here the texture and composition of aenigmatite-bearing fragment found in the DAG 1064 polymict ureilite.

Results: DAG 1064 is a breccia composed by angular fragments of olivine $Fa_{6.8\text{-}24.2}$, pyroxene $Fs_{16.7}Wo_{9.1}$, graphite, minor quenched melt rocks, carbonaceous chondrite fragments, rare feldspar-bearing rocks, accessory feldspar, sulfides, FeNi metal, suessite and diamond.

One tetragonal fragment, 50x100 µm in size, consists of pyroxene $En_{18.8}Wo_{44.9}$ (Na_2O 1.78; Al_2O_3 0.17; TiO_2 1.35 in wt%, here and below, Fe/Mn=32). Pyroxene contains graphic-like glassy inclusions, too small for quantitative analysis, enriched in K_2O and Al_2O_3. The fragment is crossed by a veinlet of glassy or cryptocrystalline material with aenigmatite mineralization. Vein-forming material comprises two types: 1) Si-rich Ca-Mg poor material with 97 wt% of the analytical total (SiO_2 68.3; CaO 1.3, MgO 0.7); 2) Si-poor Ca-Mg rich material with the total of 89% (SiO_2 46.4; CaO 7.7, MgO 8.8). Both materials contain ~19.3 FeO, 2.3 K_2O, 2.0 Al_2O_3 and noticeable (0.7-1.0) amounts of Ti, Cl, P. The host pyroxene is zoned by Na_2O content that varies from 2.54 to 1.28 wt% toward the veinlet. Aenigmatite forms perfect elongated lath-shaped crystals with trigonal tops. The crystals are growing from the pyroxene of one side of the veinlet across the veinlet but do not rich the opposite side. The largest aenigmatite crystal is 2.5 x 15 µm. The best fit formula is $Na_{1.97}(Fe^{2+}{}_{4.53}Mg_{0.46}Mn_{0.09}Ca_{0.07})Ti_{1.02}(Si_{5.87}Al_{0.02})O_{20}$.

Discussion: Pyroxene of the aenigmatite-bearing fragment has a Fe/Mn ratio in a range of that of ureilitic pyroxenes but it is exotic, and probably, non-chondritic due to the high FeO content. The veinlet could be formed by injection of a melt from some unknown fractionated alcaline-rich source. Aenigmatite indicates conditions of formation similar to that established for the terrestrial aenigmatite: T<900°C and high fO_2 [4]. Habitus of the aenigmatite crystals could be an evidence of crystal growth in empty fracture space and indicate possible pneumatolytic origin of the aenigmatite. Pyroxene zoning and the absence of reducing rim on the contacts with ureilite breccia suggest that the fragment experienced insignificant thermal metamorphism after the veinlet formation and after the fragment admixture into the breccia. The fragment is different in paragenesis and mineral compositions from the aenigmatite-bearing fragments, described in [1, 2], and has his own genetic history.

References: [1] Ivanov A. et al. 2003. *Meteoritics & Planetary Science* 38:725-737. [2] Bischoff A. et al. 1993. *Meteoritics* 28: 570-578. [3] Warren P. et al. 2006. *Meteoritics & Planetary Science 41*:797-813. [4] Marsh J. S. 1975. *Contrib. Mineral. Petrol.* 50:135-144.