RAMAN MAPPING OF MINERAL PHASES WITHIN UHPHT VEIN IMPACT GLASS OF THE GIANT KARA METEORITE CRATER. S.I.Isaenko[1], T. G. Shumilova[1], [1]Institute of Geology FRC Komi SC UB RAS, Pervomayskaya st. 54., Syktyvkar, 167982, Russia; shumilova@geo.komisc.ru; s.i.isaenko@gmail.com.

Introduction: The method of two-dimensional Raman mapping allow observe distribution and relationship of mineral phases and some spectroscopic features "in situ" of the studied sample that is especially useful for studying of polished thin sections and polished tabs. The latter looks especially perspective for microscopic objects of the products of impact metamorphism. The method allows to provide visualization of mineral phases spatial distribution, features of their morphology, grain sizes and relationship of minerals, degrees of their crystallinity, orientation of crystallites and their size, different structural parameters and defects, such as residual tension within minerals and other mineralogical features [1-3]. Thus, the method is an important modern instrument for extraterrestrial material and other different impact processes products.

In this work we present the Raman mapping in application to multi-component stockwork-like vein-type UHPHT impact melt glasses with coesite crystals within inhomogeneous tight aggregates of different crystallinity level.

Material and instrumental: The sampling of the ultrahigh pressure high temperature (UHPHT) was provided in 2015 and 2017 at the Southern rim zone of the Kara impact crater (Pay-Khoy ridge, Russia). The UHPHT impact glasses are presented by the vein complex within the host suevite first time discovered at the Kara astrobleme in 2015 [1-3]. The preliminary studies have been provided with scanning electron microscopy (SEM), electron probe microanalysis (EPMA), elemental mapping, high resolution transmission electron microscopy (HRTEM), electron diffraction (ED). The Raman spectra were registered with use a Raman spectrometer LabRam HR 800 (Horiba, Jobin Ivon) in the mode of two-dimensional Raman mapping for XY axes by use of a He-Ne laser (λ= 633 nm) with the power of 20 mW, in the spectral region 100–4000 cm^{-1}, a spectrometer grating – 600g/mm, the laser spot locality – about 1.5 μm^2, the analysis square – about 5 μm^2. The mapping was provided by the net 50×50 points with a step about 1.6-1.8 μm, the spectra were processed with LabSpec 5.39 software.

Results: The UHPHT impact glasses of the vein type described in detail in [4-7] have multi-component composition with presence of coesite crystals. They are presented by tight aggregates of aluminosilicate and silica glasses, being with liquation structural relations, with inclusions of microcrystals of pyroxene (within aluminosilicate glass) and coesite (silica glass). The elemental composition of the phases has been studied with electron microprobe analysis and electron diffraction patterns [4, 7]. The phase boundaries relations has been visualized with SEM and elemental mapping. It was preliminary found that the general matrix of the UHPHT vein glass consists of aluminosilicate content of the feldspar composition and includes single crystalline augite microcrystallites. The host matrix includes UHPHT silica "drops" of glass with coesite microcrystals.

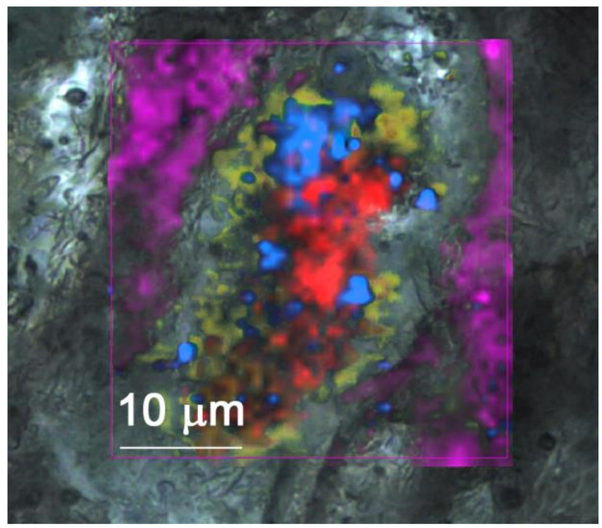

Figure 1. Combined optical image of the UHPHT vein impact glass from the Kara meteorite crater in transmitted light with Raman mapping by mineral phases within: red – coesite, yellow – silica glass, violet – alimino-silicate glass, blue – region of the high luminescence (smectite region).

After the detailed SEM and elemental mapping studies by use of individual Raman spectra studies for the detail phase analysis we have selected regions with silica drops containing coesite crystals with the aim to analyze the features of the phase relations supported with spectroscopic data. By typical individual spectra of optically visible mineral phases we have collected the massifs of the individual spectra with the following map reconstruction for different phases and their structural features spatial distribution.

Following to the received data we have described the spatial relationships of amorphous substances - aluminosilicate and silica glasses and crystalline phases - coesite, pyroxene and smectite. The latter has very high lumeniscence, its phase state was proven with high resolution transmission electron microscopy (HRTEM) with electron diffraction (ED) and distribution hare was constructed by luminescence indicator in the collected Raman spectra.

The provided mapping allows to see that the coesite crystals are set close set together within the central parts of the silica "drops". The latter also contains the large number of smectite inclusions set within the next zone from the "drops" center to its edge. The tight spatial co-existence of smectite and coesite crystals allow conclude that the smectite was formed under UHPHT conditions. Some earlier the possibility of smectite crystallization from impact melt has been described by G.R.Osinski [8] for the impactites of the Ries crater (Bavaria, Germany).

Conclusion: The Raman mapping of the UHPHT mineral associations allowed to describe an unusual tight co-existence of coesite and smectite within pure amorphous silica glass of the Kara melt impactites. The produced data demonstrate that Raman mapping is useful for analyzing of complicated aggregates consisting of amorphous and crystalline phases within impact products.

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