TOPOGRAPHIC VIEW THROUGH DRONE OBSERVATIONS AT THE GIANT KARA METEORITE CRATER, PAY-KHOY, RUSSIA. T. G. Shumilova[1], S. I. Isaenko [1] and A. A. Zubov [1], [1]Institute of Geology FRC Komi SC UB RAS (Pervomayskaya st 54, Syktyvkar, 167982, Russia; shumilova@geo.komisc.ru; tg_shumilova@mail.ru).

Introduction: The Kara meteorite crater formed about 70.3 ± 2.2 Ma ago [1] is one of the largest impact structures on the landscape of the Earth having the diameter about 65 km with the proposed twitted Ust`-Kara co-crater of 25 km in diameter [2, 3] and many others), but some scientists suppose a single large astrobleme with initial rim-to-rim size up to 120 km [4-6]. According to geological and geophysical data, the Kara crater corresponds well to a large astrobleme with a central uplift [2, 7]. By the deep geophysical study the depression does not have any mantle roots [8]. In spite on the provided numerous studies till present it is unclear the original size of the Kara crater.

Subject and methods: Here we demonstrate the results of our study of the “in situ” observations of the impactites of the Kara astrobleme at the rim around the present erosion level in different parts of the meteorite crater – the basins of Saayakha, Kara, Anaroga, B. and M. Vonuyta rivers in the Western, Sauthern and Eastern sectors of the crater. And, our especial attention had been provided to the Ust`-Kara sector at the Arctic Ocean coast (Baydaratskaya Bay).

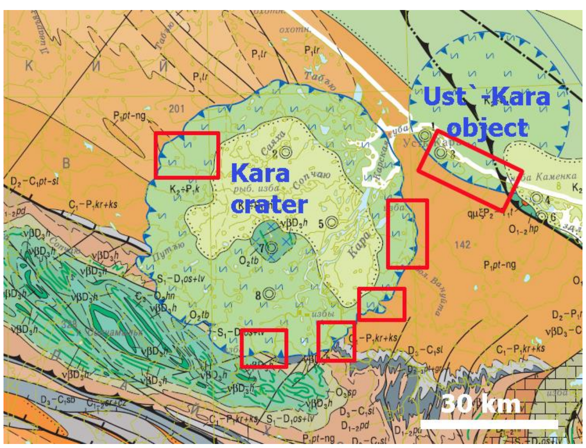

Figure 1. The Kara meteorite crater and Ust`-Kara region with impactites on the part of the Geological map of Shishkin et al. (2012) [3].The studied points are marked by red squares.

The field observations have been provided in 2017 and 2019 with a mini-drone for «air-bird high» observations of the topographic features of the impact object. The drone was equipped with the Cinema 4K resolution camera and 3-axial gimbal stabilizer allowed to get high quality photo- and video-documentation – 4096 × 2160 pixels, the frequency of 24 frames/s. The overage wind velocity was about 8 m/s at the limit for the wind conditions – 10 m/s. The field video records have been evaluated with PIX4DMapper. The evidence of the impactites state has been proven with independent special studies by a complex of modern methods described in our works [9-11] and by our most recent new studies on the Ust`-Kara region (2019-2020) demonstrating similar impactites facies and ultra high pressure high temperature (UHPHT) features of the impactites formation.

The impactites of the Kara astrobleme are presented mostly by suevites and by rare melt rocks. Melt impactites form rare layer-like bodies present on the surface generally in the Anaroga River basin. They are characterized by 7-8 m visible thickness and with either clear or unclear contacts with the co-existing suevites. Suevites have very wide distribution at the astrobleme, form natural outcrops with up to km in extention and thickness up to 30 m in high. The impactites have several varieties in dependence on their target precursor and formation features [9].

Results. By our field observations in a complex of detail lab analysis of the studies of the impact products we have found an unusual features of the Kara and Ust`-Kara impactites. The especial effect have been produced by «air-bird high» observations followed by 3D modeling allowed to watch impactites massifs morphology and their varieties contacts and contacts with target rocks in different projections.

Injected injected stockwork-like UHPHT complex. During our studies we have found at the Kara astrobleme an intrusive melt complex presented by different portions of upper-going impact melt intruding breccia and suevites**.** One of the most impressive points is the discovery of UHPHT impact melt glasses forming injected stockwork-like system of thin veins within suevite massif (Figure 2). The glasses are characterized by presence of melt-crystallized coesite that have been described in detail in [10, 11].

Intrusive impact melt batholith. Another interesting find is an intrusive impact melt batholith 100 m in prolongation and up to 8 m in at the left bank of the Kara River. The unusual feature of the batholith is macroscopically recognized immissibility of impact melt components forming unusual vein-like texture [11].

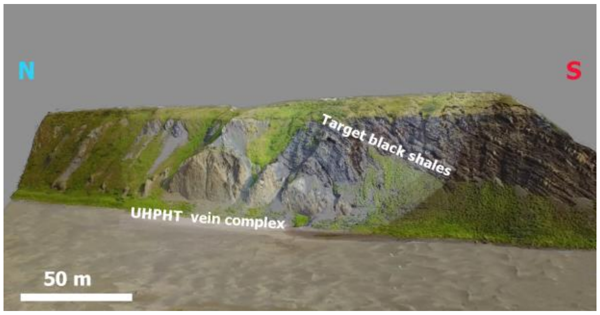

Figure 2. Suevite massif injected by UHPHT impact melt glasses. 3D modeling image.

*Ust`-Kara impactites.* Ust`-Kara impactites are presented generally by suevitic layer-like bodies well recognized on the ocean coast at the present erosion level. The specific feature of our observations is the stream-like morphology recognized on the 3D modeling images (Figure 3). Following to the topographic features and the directions of the streams we can conclude that the observed suevites have the topological signs pointing to their movement during formation in the direction from the center of the Kara astrobleme. Following to the analytical data we can conclude that the bottom variety of the Ust`-Kara suevites is characterized with abundance of melt-crystallized coesite.

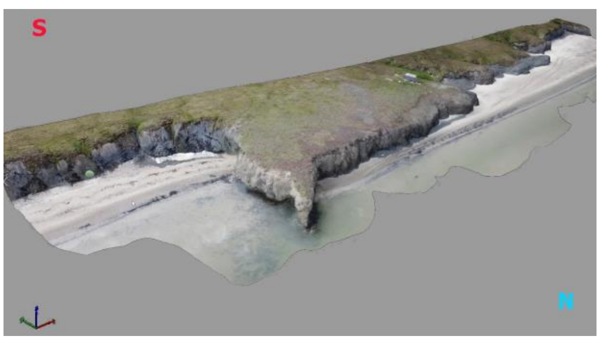

Figure 3. The stream-like morphology of the suevite massif with UHPHT impact melt glasses. 3D modeling image.

Conclusion. Here we present for the first time the «air-bird high» observations of the Kara and Ust`-Kara impactites followed by 3D modeling. The data allowed to recognize stream-like topology of the Ust`-Kara impactites pointing to their moving from the Kara crater center. According to the received complex data on the present state of the provided study we can propose that the described UHPHT melt impactites of the Kara and the Ust`-Kara objects belong to the bottom facies. The Ust`-Kara impactites belong rather to the Kara crater being the bottom facies of the single Kara impact which origin diameter will be the subject for our study for the future.

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