**MASSIVE IMPACT MELT ROCK FROM THE PUCHEZH-KATUNKI IMPACT STRUCTURE: A CASE STUDY OF AN INHOMOGENEOUS IMPACT MELT.** M. V. Naumov, Karpinsky All-Russia Geological Research Institute, 199106 Sredny pr., 74, St.Petersburg, Russia, m_naumov@mail.ru

**Geological setting**. The Puchezh-Katunki impact structure of 80 km in diameter is located in the center of the East European Platform. The structure is buried beneath Mesozoic-Cenozoic deposits; however, it is well exposed by numerous drillholes. The detailed geology of the impact structure is given in a special monograph [1 and references therein].

The target consisted of Pre-Cambrian crystalline rocks overlain by the sedimentary cover up to 2200 m thick. The crystalline basement is composed mostly of leucocratic and mesocratic gneisses, migmatite, and granite, with subordinate amphibolite and minor mafics and ultramafics. Impact rocks in the Puchezh-Katunki crater are represented mostly by lithic breccias, which fill in annular depression and overlie ring terrace and, in parts, central uplift. Impact melt rocks (predominantly suevites) develop mainly on the slopes of the central uplift and contribute as few as 0.2% to the total volume of impact rocks. The preserved volume of the impact melt is estimated to don't exceed 3.5 km$^3$ [2].

**Impact melt rocks**. Massive impact melt rocks (so called "tagamite") occur at two environments: (1) thin (no thicker than 3 m) injections within shocked crystalline rocks of the central uplift ("auithigenic breccia") and (2) irregular bodies up to 10 m thick within polymict allogenic breccia at the southwestern slope of the uplift. Two tagamite groups differ significantly by both morphology of bodies, texture, and chemical composition. Tagamites from allogenic breccia are filled with fragments of sedimentary rocks and fused gneisses, they show massive and aphanitic texture, while thin veins in authigenic breccia are more variable: tagamites with holohyaline, cryptocrystalline, hyalopilitic, and hemicrystalline textures are distinguished [1]. Commonly, all tagamites are altered to a variable degree. Fe-Mg saponite, chlorite and zeolite are common alteration minerals.

**Geochemistry of massive impact melt rocks**. XRF, ICP-MS, and ICP-OES analyses of both impact melt and target lithologies from the PK show that chemical compositions of impact melt bodies differ significantly (Table 1), an averaged composition of tagamite corresponds to a mixture of amphibole-biotite gneisses and amphibolites in the ratio of 4:1 [1], though. Tagamite bodies occurring within allogenic lithic breccia are more basic than tagamite injected to the authigenic breccia. Moreover, compositions of certain tagamite veins differ considerably as well; this is clearly shown by standard deviation values. In addition, the compositional differentiation of vein tagamites is displayed by REE distribution curves (Fig. 1). The variation of REE distribution in tagamite is a little less than in host shocked and cataclased gneiss and amphibolite.

**Conclusion.** Although the Puchezh-Katunki crater is relatively large (diameter of the annular depression is 42 km), no extensive and homogeneous impact melt was generated there. From both petrographic and geochemical data, only local, small melts were arisen. They inherited chemical composition of local target lithologies (mostly high-Ca plagioclasic gneiss) and injected into either disturbed target crystalline rocks or allogenic lithic breccia. In this aspect, the PK crater differs from the most of large impact structure such as Popigai crater in Northern Siberia. The latter host a vast impact melt (1750 km$^3$); nevertheless, the melt is highly homogeneous both in the section and through the area.

Formation of numerous local small melts in the PK could be caused by two factors: (1) target features, e.g., a thick sedimentary cover (>2 km thick) overlying crystalline basement, and presence of a water layer at the impact site; (2) parameters of the event, including the oblique impact.

**References.** [1] Masaitis V.L. and Pevzner L.A., eds. (1999). Deep drilling in the Puchezh-Katunki impact structure (in Russian). *VSEGEI Press*, 399 p. [2] Masaitis V.L. et al. (1996). *Solar System Research 30*, 5-13.

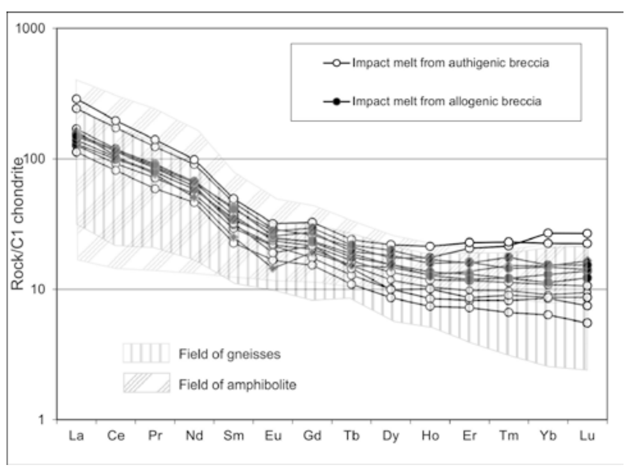


Fig. 1. REE distribution in massive impact melt rocks from the Puchezh-Katunki impact structure

Table 1. Average chemical composition of impact melt and main target lithologies from the Puchezh-Katunki impact structure

| Lithology | 1 | | 2 | |
|---|---|---|---|---|
| | X | S | X | S |
| *wt.%* | | | | |
| $SiO_2$ | 58,14 | 3,29 | 54,90 | 2,60 |
| $Al_2O_3$ | 15,26 | 0,78 | 16,70 | 1,31 |
| $TiO_2$ | 0,84 | 0,16 | 0,92 | 0,07 |
| $Fe_2O_3$ | 4,43 | 1,31 | 6,75 | 1,14 |
| FeO | 3,01 | 0,62 | 2,90 | 1,90 |
| MnO | 0,12 | 0,03 | 0,20 | 0,08 |
| MgO | 4,32 | 1,24 | 4,08 | 1,16 |
| CaO | 5,44 | 1,29 | 5,66 | 2,54 |
| $Na_2O$ | 3,58 | 0,70 | 2,61 | 0,55 |
| $K_2O$ | 1,93 | 0,69 | 0,91 | 0,71 |
| $P_2O_5$ | 0,15 | 0,03 | 0,17 | 0,00 |
| L.O.I. | 2,29 | 1,09 | 3,95 | 1,41 |
| Sum | 99,51 | | 99,76 | |
| *ppm* | | | | |
| Ag | 0,24 | 0,135 | 0,37 | 0,13 |
| Co | 26 | 8 | 24 | 8 |
| Cu | 40 | 22 | 147 | 237 |
| Ni | 52 | 17 | 39 | 10 |
| Mo | 2,9 | 6,3 | 0,2 | 0,5 |
| Zn | 97 | 28 | 163 | 116 |
| Cr | 121 | 29 | 94 | 26 |
| V | 120 | 36 | 125 | 34 |
| Sr | 388 | 100 | 447 | 124 |
| Y | 17,7 | 7,6 | 21,5 | 3,0 |
| Zr | 161,9 | 44,2 | 172,4 | 13,8 |
| Nb | 14,5 | 5,6 | 15,1 | 2,0 |
| La | 43,7 | 15,6 | 35,9 | 3,1 |
| Be | 1,09 | 0,29 | 1,57 | 0,85 |
| Ba | 835 | 399 | 550 | 162 |
| Pb | 11 | 5 | 13 | 9 |
| Rb | 48 | 17 | 19 | 23 |
| Number of analyses | 7 | | 5 | |

| Lithology | 3 | 4 | 5 | 6 |
|---|---|---|---|---|
| | X | X | X | X |
| *wt.%* | | | | |
| $SiO_2$ | 64,46 | 58,07 | 48,95 | 45,59 |
| $Al_2O_3$ | 15,02 | 15,53 | 12,98 | 11,89 |
| $TiO_2$ | 0,61 | 0,70 | 1,26 | 2,61 |
| $Fe_2O_3$ | 2,11 | 2,39 | 4,43 | 5,72 |
| FeO | 2,72 | 4,65 | 8,09 | 9,94 |
| MnO | 0,06 | 0,11 | 0,22 | 0,23 |
| MgO | 2,21 | 4,16 | 8,21 | 6,94 |
| CaO | 4,34 | 6,40 | 9,51 | 11,75 |
| $Na_2O$ | 4,22 | 3,73 | 2,37 | 2,39 |
| $K_2O$ | 2,02 | 1,77 | 1,29 | 1,05 |
| $P_2O_5$ | 0,19 | 0,12 | 0,23 | 0,34 |
| L.O.I. | 2,47 | 2,46 | 2,59 | 2,18 |
| Sum | 100,44 | 100,08 | 100,12 | 100,66 |
| *ppm* | | | | |
| Ag | 0,22 | 0,25 | 0,19 | 0,52 |
| Co | 14 | 23 | 44 | 64 |
| Cu | 26 | 35 | 106 | 283 |
| Ni | 18 | 50 | 97 | 105 |
| Mo | 0,5 | 0,9 | 0,3 | <1 |
| Zn | 127 | 92 | 135 | 222 |
| Cr | 34 | 127 | 265 | 150 |
| V | 61 | 109 | 220 | 290 |
| Sr | 504 | 436 | 215 | 248 |
| Y | 9,0 | 12,1 | 18,2 | 19,9 |
| Zr | 185,8 | 96,9 | 70,9 | 108,8 |
| Nb | 11,4 | 8,7 | 10,9 | 18,2 |
| La | 36,8 | 27,1 | 25,3 | 17,7 |
| Be | 1,37 | 0,92 | 1,14 | 0,51 |
| Ba | 1127 | 646 | 345 | 346 |
| Pb | 13 | 8 | 7 | <1 |
| Rb | 66 | 39 | 15 | 15 |
| Number of analyses | 17 | 15 | 12 | 5 |