THE POPIGAI ASTROBLEME (ARCTIC SIBERIA, RUSSIA): UNIQUE TEST SITE FOR STUDY OF VARIOUS ASPECTS OF LARGE-SCALE IMPACT CRATERING AND FIRST CLASS OBJECT OF UNESCO GEOLOGICAL HERITAGE. S. A. Vishnevsky[1] [1]Inst. of Geology & Mineralogy, SB RAS, Novosibirsk-90, 630090, RUSSIA. <svish@igm.nsc.ru>

Introduction: The Popigai astrobleme up to 100 km in diameter is present in the Arctic Siberia (**Fig. 1**), was originated 35.7 Ma ago and is beyond compare with any other terrestrial impact structures on the complex of Its features. Among the Popigai features there are its large size, young age, good preservation and exposure, as well as the diversity of impact formations (some of them are not known in other astroblemes). To this one can add an unprecedented volume of deep drilling studies (~450 boring holes, some deep, up to 1.5 km, and ~1000 t of unique boring cores). All these features are described in [1-3 and refs. therein].

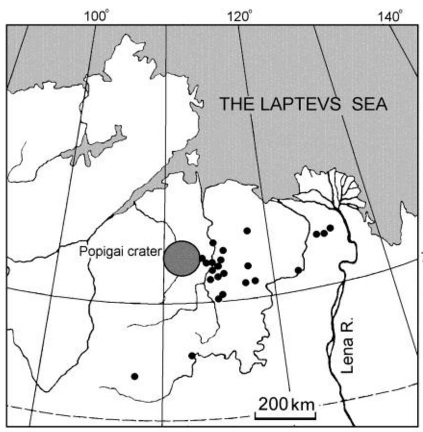

Fig. 1. General location of the Popigai astrobleme. Black circles are the impact diamond findings from the Popigai distal and proximal ejecta strewn field [2].

Popigai as a large-scale impact structure: Following to its features, the astrobleme is a unique test site for studying a broad number of unusual large-scale impact cratering features.

Geologic features. General geology of the astrobleme is presented on **Fig. 2**. Following to the general specificity of the impact cratering, the Popigai impact complex is clearly divided into three main groups reflecting excavation, transportation and deposition stages of the process: suevitic, bottom centrifugal and para-authigenic formations. In general, most of the formations satisfy to the current models of the impact cratering after [4, 5].

However, some of the formations do not satisfy to the current Z–models of cratering and their origin needs another explanation. There are impact diatremes (IDs), impact horsts (IHs) and suevite megabreccia (SMb). In order to explain their origin, the dynamic

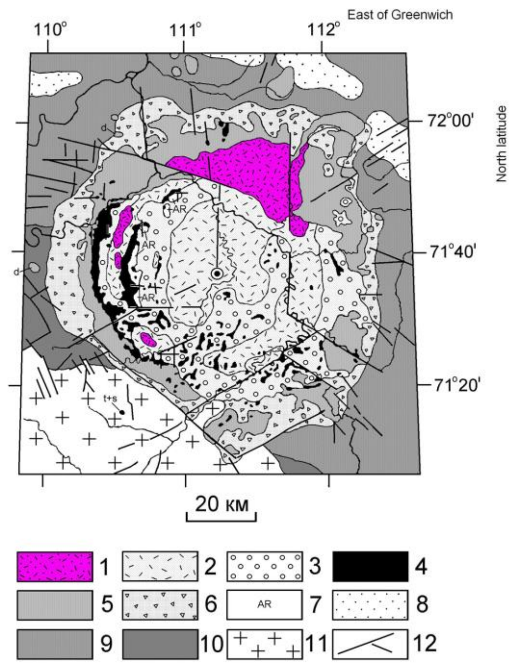

Fig. 2. General geology of the Popigai astrobleme after [3]. Legend: *Suevite formations:* 1 – suevite megabreccia; 2 – Daldyn type suevites; 3 – Parchanai type suevites. *Bottom centrifugal formations:* 4 – tagamites; 5 – megabreccia; 6 – klippen breccia. *Para-authigenic formations of plastic flow zone:* 7 – shocked gneisses of inner ring. *Target rocks:* 8 – Mesozoic; 9 – Paleozoic; 10 – Protherozoic; 11 – Archean. 12 – faults.

barrier hypothesis was proposed [2, 3, 6]. Among the formations, the SMb is the most paradoxical one. It occupies the top of the suevite column inside the crater, is made up mainly of the loose Mesozoic rocks (derived from the upper part of the target sequence) and was deposited without any reversal stratigraphy, which is required by Z–models of cratering. No other occurrences of the impactites similar to the Popigai SMB are known among the terrestrial impact sites. The origin of the IDs, IHs and SMB also needs the special studies, and the nature of these impact formations may be a good contribution to the large-scale impact cratering. To this one can add that similar objection against the Z-models of cratering was recently presented by [7].

Mineralogical and geochemical features. These features include established shock-induced separation of chemical components, origin of high-pressure water fluid inclusions and occurrences of impact diamonds.

Fig. 3. "The Motley Rocks": an outstanding outcrop of various impact formations (megabreccia with inclusions of suevite masses was overlapped by impact melt rocks) in the western border of the Popigai astrobleme.

Shock-induced separation of chemical components is represented by manifestations of "early" impact anatexis of the target gneisses. As a result, a number of "asid" (72–77 wt. % SiO_2) enriched with K_2O and H_2O glasses and even "high-silica" (up to 98 wt. % SiO_2) glasses were extracted from the parental gneisses during the shock compression to form so-called "bi-melt" tagamites of Popigai [2, 3]. Some of these "granite" glasses are similar to those "asid" globules found in the Moon basalts. The separation phenomenon confirmed in the shock experiments and can be explained by the theory of strongly-excited crystalline structures, when the speed of the component diffusion can be grown up to 15 orders of magnitude [see 7 and refs. therein].

High-pressure water fluid inclusions trapped at near surface conditions in some Popigai impact glasses exhibit paradoxically high, up to 3.3 GPa, conservation pressures and can be served as a specific geochemical evidence of the shock load [see 8 for the details].

Impact diamond potential of the Popigai impactites is unprecedented [3, 7, 9]. It is still unknown whether the diamonds will have an economic interest, but their total amounts exceed all the currently known worldwide manifestations of this mineral. To this I can add that there are gold manifestations in the Popigai impactites. They are still not studied in details at present, but may be of impact origin, and the problem is attractive.

Popigai as unique object of geological heritage: Being included into UNESCO Global List of our geological heritage as a first-class object [3, 7, 10, 11], the Astrobleme attracted attention in order to organize here the Popigai National Park (PNP) with a number of scientific, natural conservation and tourism activities. The idea of PNP meets a broad support from the side of scientific society, local authorities (Khatanga village), Taymyr Biosphere Reserve (Dr. Karbainov Ju. M. and colleagues), and – what is especially important – from

Fig. 4. One of the "storages" of the unique Popigai boring cores "protected" for decades only by the severe Arctic climate and a lack of the population on the area.

the side of the Polar Geological Expedition, who was a producer of geological prospecting works (Kirichenko V. T., Martyshking M. A. and colleagues). The PNP project meets also a support from the colleagues of VSEGEI (Mastchak M. S., Danilin A. N. and colleagues). All the problems and aspects of this project are briefly summarized in [3]. Beauty landscapes of the wild Arctic nature, unique outcrops of the Popigai impactites (**Fig. 3**) as well as a general cognitive interest are able to make undoubtedly the astrobleme as a very attractive site both for scientific and public audience. It's no doubt that at once the PNP will come into the life as a world-class touristic and scientific prestigious "pearl" of Russia. However, currently the PNP project meets a number of the problems as far as support from the side of the Central Russian Authorities is concerned. One of the most pressing things here is the problem of urgent conservation of the unique boring cores (**Fig. 4**). Undoubtedly, the well-organized storages of the cores will be very attractive from the side of the broad scientific community for decades.

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