THE POPIGAI: UNUSUAL FEATURES OF LARGE SCALE IMPACT CRATERING.

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Introduction: The unique 100-km in diameter and young (35.7 Ma) Popigai astrobleme is described in details both in English and Russian papers [1–3 and refs. therein]. Its two-stage target included the supracrustal cover (a number of Protherozoic to Mesozoic lithologies up to 1700 m in thickness) and the Archean crystalline basement. The astrobleme exhibits a diversity of unusual impact structures, formations, and features, which are still unknown in other terrestrial impact sites. Some of these unusual properties and interpretation of their origin are presented below being of the interest for the current large-scale cratering models.

Impact diatremes and horsts [1–3]: Impact diatremes (IDs) are the pipe-like explosion structures in sedimentary terrains out of the tectonic rim of the crater **(Fig. 1).** They are filled up by klippen+megabreccia mixtures of target rocks. Impact horsts (IHs), of 0.3 to 2 km in length, are also present here, being the blocks of deep-seated target rocks tectonically-intruded into the upper members of non-shocked sedimentary cover. Both IDs and IHs target rocks bear traces of a weak shock metamorphism only ("gries breccia" and shatter cones).

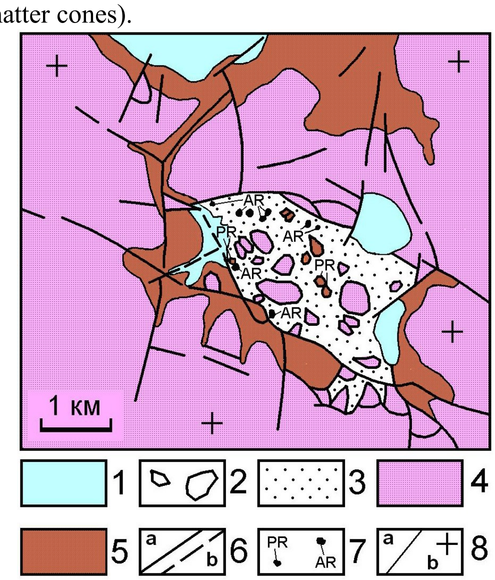

Fig. 1. An example of the Pastakh impact diatreme ~3 km off the west border of the Popigai astrobleme. Legend: 1 – Quarternary; 2 – klippen blocks; 3 – megabreccia; 4 – Cambrian; 5 – Protherozoic; 6 – traced (a) and supposed (b) faults; 7 – small klippen's lithology: Protherozoic (PR) and Archean (AR); 8 – geologic boundaries (a) and subhorizontal bedding (b).

Suevite megarbeccia: Suevite megabreccia (SMb) [1–3] is made up of large lumps, up to 80 m in size, of Mesozoic, mainly Cretaceous, rocks, which exhibit traces of weak shock metamorphism only. SMb occupies the top of the suevite column and is present within the annular trough around the inner ring of the crater.

On the origin of IDs, IHs and SMb: IDs and IHs are the evidence of deep sub-vertical impulses of the shock wave which was propagated here in a "buried" state already. As for the SMb, its spatial position and lithology also indicate the subvertical ejection of the subsurface part of the target and does not satisfy to any Z–models of cratering which suppose the monotonous centrifugal rizing-up excavation of ejecta and the "reversal stratigraphy" in the ejecta blanket. We can cite here the opinion by [4] and others that the geology of well-studied complex craters shows that neither excavation flow nor the shape of the excavation cavities are well-approximated by the Z–models. In order to explain the subvertical ejection for IDs, IHs and SMb, we proposed the hypothesis of the dynamic barrier **(Fig. 2),** based upon the vector interpretation of the cratering by [5]. Other unusual features of the Popigai cratering are presented in the papers [1–3 and refs. therein].

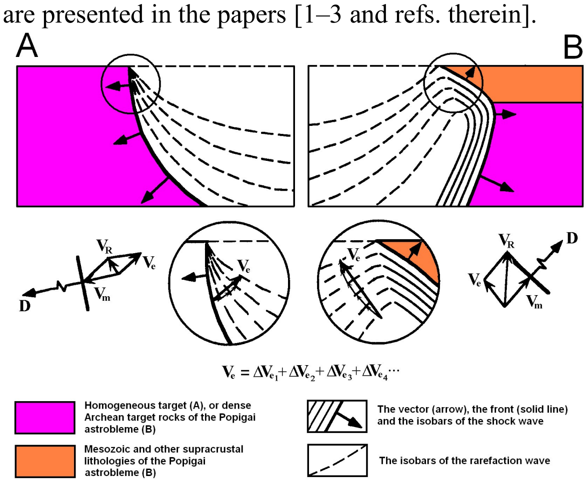

Fig. 2. Simple cratering ejection after [5] (A) and subvertical ejection of Popigai supracrustal lithologies due to subsurface delay of the shock wave after [1–3] (B).

References: [1] Vishnevsky S., Montanari A. (1999) *Geological Society of America Special Paper 339,* 19–59. [2] Vishnevsky S. (2007) *Astroblemes.* Novosibirsk, 288 pp. (in Russian). [3] Vishnevsky S. (2013) *Ural'sky Geologichesky Zhurnal, 93 (3),* 23–45 (in Russian). [4] Sharpton V. L., Dressler B. O. (2003) *Workshop on Impact Cratering*. LPI Contr. #1155. Abstract #8059. [5] Gault D. E., Quaide W. L., Oberbeck V. R. (1968) *Shock Metamorphism of Natural Materials*. Baltimore: Mono Book Corp., p. 87–99.