POPIGAI ASTROBLEME (RUSSIA), WATER & DIAMOND POTENTIAL OF THE IMPACTITES-TAGAMITES: DATA ON GAS CHROMATOGRAPHY. S. A. Vishnevsky[1] [1]Institute of Geology & Mineralogy, SB RAS, Novosibirsk-90, 630090, 3 Koptug prospect, RUSSIA, <svish@igm.nsc.ru>

Introduction: In addition to a number of its features, the famous Popigai astrobleme [1] is known as the unique diamond deposit [2, 3]. At this, the massive impact melt rocks – tagamites are found to be the main diamond-bearing units of the Popigai impact complex. It was also found that the diamond potential of the tagamites varies strongly, and both the diamond-rich (type I) and diamond-poor (type II) species are known for this group of the rocks. Below the discussion on the possible H_2O role in the diamond potential of the rocks is continued based upon our previous investigations and the current contribution.

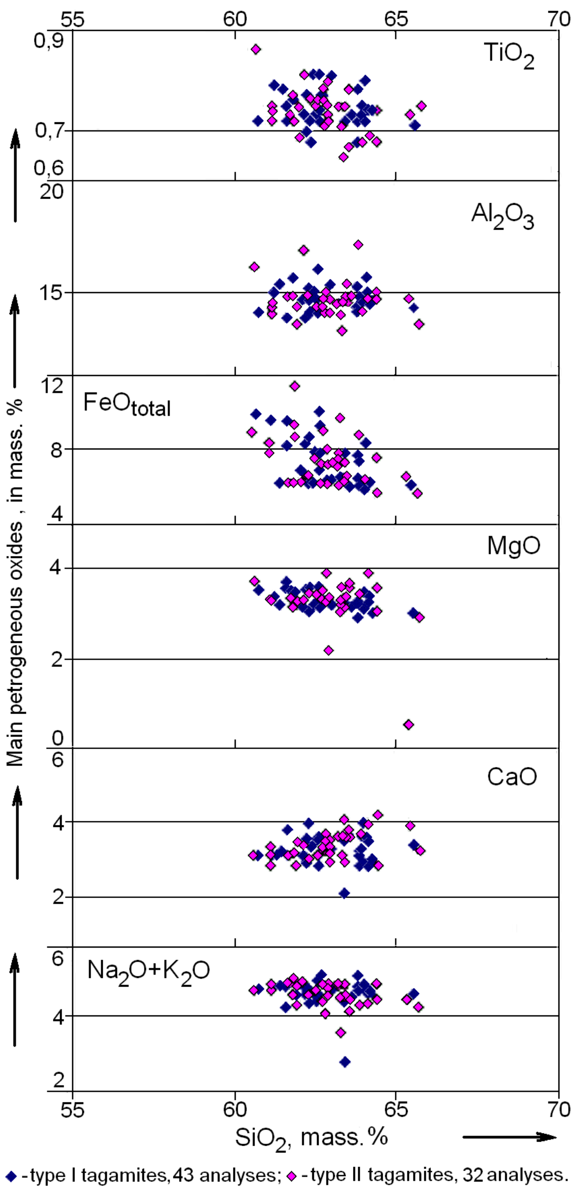

Fig. 1. Bulk geochemistry of the Popigai tagamites.

The bulk geochemistry and general petrology of the tagamites; the source and amount of H_2O in these rocks: Earlier it was found [1, 4, and refs. therein], that all the Popigai tagamites were derived from the target Archean gneisses as a result of a shock melting, and both the types I and II tagamites are characterized by the similar bulk geochemistry (Fig. 1), which is one to one equal to the bulk geochemistry of the target gneisses. The petrologic nature of both the tagamite types is still a matter of debates. Following to [3, 5], these types are attributed to low- (type I) and high-temperature (type I) state of initial impact melts. This hypothesis has a number of contradictions summarized in [4, 6]. Following to [1, 7], the nature of both the types was related to their different post-impact evolution due to a various initial water amount in the parental melts ("dry" and "wet" ones, respectively). At this, the "dry" melts were solidified into the cryptocrystalline type I tagamites, whereas the "wet" ones – into microcrystalline type II rocks. Following to [1, 7], the "dry" type I tagamites are characterized by 0,74±0,18 mass % of H_2O, whereas the "wet" type II rocks have 2,23±0,48 mass % of H_2O. Comparative ion probe and other studies on the amounts of H_2O, REE, minor and trace elements [4, 8–10] show that the ordinary Khapchan gneisses were served as the parental source for the "dry" tagamites, whereas the diaphthorites along the Khapchan gneisses could serve as the parental source for the "wet" tagamite varieties.

H_2O and diamond potential of the tagamites: a result of post-impact evolution of the melts: Summarized in [4, 6], the diamond potential of the type I and type II tagamites is strongly different. Following to these data, based upon 138 quantitative analyses for type I, and 32 analyses for type II rocks (all the diamond amounts are given in the conventional units), the bimodal distribution of the diamonds was found for both the tagamite types. At this, a part of types I and II tagamites show a small, down to zero, diamond content: type I – 47,5 %, and type II – ~80 % of the samples, with the average diamond amounts equal to 1,42 for the type I, and 1,05 for the type II rocks. For the samples with the higher diamond contents, the data are the next: type I – 42,5 %, and type II – 15,5 % of the samples, with the average diamond amounts such as 9,43±2,30 for the type I tagamites, and 6,88±1,52 for the type II tagamites. The bi-modal distribution of diamonds in both the tagamite types is attributed to the various initial graphite contents in the parental target rocks, for which graphite-rich and graphite-poor species are common. Once originated as a result of a shock compression of the initial graphite from the target gneisses, the impact diamond paramorphs than were subjected to dissolving during the post-impact evolution of the tagamite melts. It is evident from the traces of etching, which are very common for the Popigai impact diamonds. Following to [11, 12], K and Na combined with the action of H_2O, are the main agents of diamond etching in high-temperature silicate melts. Of course, the time scale of the post-impact evolution of the tagamite melts (quenching or long-time cooling) was also a very important factor as far as the final diamond potential of the tagamites is concerned. However, in a whole, at all the equal initial conditions, the preservation of diamonds in the "dry" melts was always higher than in the "wet" ones. We supposed [4, 6] the empirical fact of the higher diamond potential for the "dry" type I Popigai tagamites meets an explanation within the hypothesis mentioned above.

Data on gas chromatography: In order to check up the role of water in the diamond potential of the tagamites, the gas chromatographic analyses on H_2O was carried out for the types I and II tagamites with the known amounts of diamond **(Fig. 2).** The data obtained

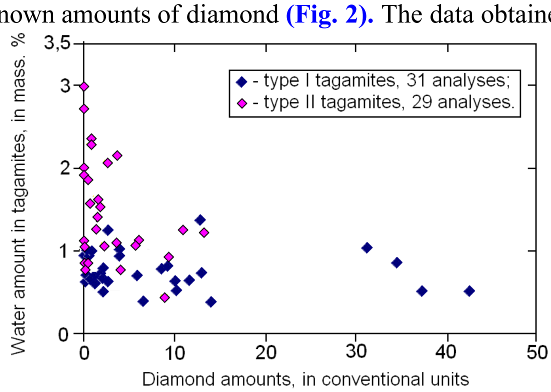

Fig. 2. Water vs. diamond amount plots for the types I and II tagamites of the Popigai.

confirm the hypothesis on the important role of H_2O in the diamond potential of the tagamites and show that there is a clear inverse proportion between the diamond and H_2O amounts for the "wet" type II tagamites. As for the "dry" type I tagamites, the results show there is no relation between the constantly low amount of H_2O and the broad spectra of the diamond potential of the rocks. It is also evident from the corresponding trend for the type I tagamites shown on **Fig. 3.** This trend, which is equal to the almost straight line both in the polynomial and exponential versions, shows that the final diamond potential of the type I tagamites (at all other equal evolution conditions such as quenching or

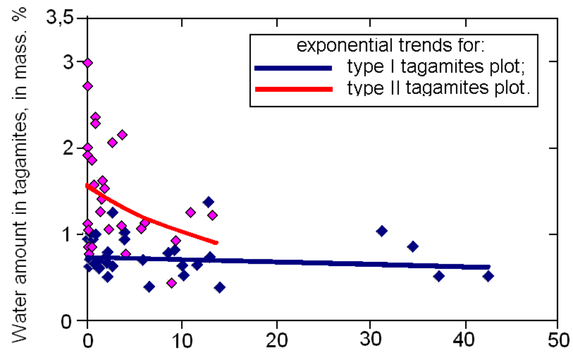

Fig. 3. Exponential trends for the data from the **Fig. 2.**

long-time cooling of the melts) was controlled by the initial graphite amount of the ordinary gneisses. The inverse trend for the type II "wet" tagamites show that H_2O was a powerful agent controlling the final diamond potential of the rocks no matter what was the initial graphite amount of the parental diaphthorites.

Conclusion: The data presented is in good agreement with the petrologic interpretations on the nature for the types I and II of the Popigai tagamites and their diamond potential after [1, 4, 6, 7]. So, it can be used as a guiding tool in the quest, investigation and geologic prospecting of the diamond-bearing Popigai rocks with the economic potential.

References: [1] Vishnevsky S., Montanari A. (1999) *Popigai impact structure (Arctic Siberia, Russia): Geology, Petrology, & Geochronology of glass-bearing impactites.* In *GSA Special Paper 339*, pp. 19–59. [2] Vishnevsky S. A., et al. (1997) *Impact diamonds: their features, origin & significance*. Novosibirsk, SB RAS Press, 110 pp. (both Russian and English). [3] Masaitis V. L., et al. (1998) *Diamond-bearing impactites of the Popigai astrobleme.* Sankt-Petersburg, VSEGEI Press, 179 pp. (in Russian). [4] Vishnevsky S. A. (2010) Water and diamond potential of the Popigai tagamites, In *Magmatism and Metamorphism in the History of Earth, XI All-Russian Petrographic Conf., Collection of Abstracts. Vol. 1.* Ekaterinburg, IGG UB RAN, pp. 120–121. (in Russian). [5] Masaitis V. L., et al. (1980) Geology of astroblemes. Leningrad, Nedra Press, 231 pp. (in Russian). [6] Vishnevsky S. A. (2011) *LPSC 42,* Abstract #1666. [7] Vishnevsky S. A. (1996) *Chemie der Erde, 56,* 493–497. [8] Vishnevsky S. A., et al. (2005) *Meteoritics & Planet. Sci., 40,* A162. [9] Vishnevsky S. A., Simakin S. G. (2006), *Meteoritics & Planet. Sci., 41,* A182. [10] Vishnevsky S. A., Simakin S. G. (2006), *Meteoritics & Planet. Sci., 41,* A183. [11] Karklina M. I., Maslakovets Yu. P. (1968) *Doklady Akademii Nauk SSSR, 186 (6),* 1311–1312 (in Russian). [12] Valter A. A., et al. (1992) *Shock metamorphic carbon minerals,* Kiev, Naukova Dumka Press, 172 pp. (in Russian).