

Erosional Section of Kimberlite Bodies and the Scales of Placer Diamondiferousness

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Diamondiferousness of terrigenous sedimentations of any age depends on conditions of their formation and availability of placer and primary sources of diamonds in the areas of erosion. The decisive significance therewith has the size of the erosional section of diamond-bearing rocks and the development of intensive crust-formation, preceding accumulation of sedimentations under discussion, as well as their undamaged state in the subsequent stages of history of the discussed territory's geological development. A classical example in this plan is the region of massive development of kimberlite pipes and dikes on constantly rising Caapvaal craton in South Africa, extended and intensive erosion of which reached from 1000 m (the Premier pipe) and 1400 m (pipes of kimberlite field Kimberley) to 2000 m and more (Postmasburg field, where dike bodies of root parts of pipes are already outcropping) and diamonds were carried to the Atlantic ocean by watercourses (Houtorn, D.B.). In the result of it and also due to constant sea currents along the coast there has been formed beach-submarine placer of diamonds extending for more than 400 km with large stones of high quality and resources about a milliard and a half carat (according to the data of south african geologists). Similar significant erosional section (Koval'sky, V.V., et al.) of kimberlite bodies is noted in north-eastern part of the Siberian Platform, within also constantly rising Anabar antecline and Olenek uplift. On such blocks of the platform subjecting to constant rising, therewith, there are individual areas which are distinguished by some lag in this uplift. It is the Abelyakh diamondiferous region, where rich in all parameters modern alluvial diamond placers have been formed, which is considered to be such an area here.

By analysis of quantitative correlations of diamonds and eroded parts of kimberlite pipes and explored placers, Malo-Botuobinsky diamondiferous region, located within Botuobinsky craton (central part of the Siberian Platform), is considered to be as a standard. Here diamondiferous kimberlite pipes of Middle-Paleozoic age have been found and three large epochs of denudation and accumulation: Late-Paleozoic, Mesozoic and Cainozoic are allocated. By estimating the volume of diamonds, carried out from the eroded kimberlite pipes in terrigenous sedimentations, and comparing it with the quantity of diamonds available in placers, we establish the scales of primary and placer diamondiferousness of a definite region under investigation. Thus, direct geological data testify that the deepest erosional section (300 m) of all kimberlite bodies of the region and country rocks took place in pre-Middle Carboniferous time. It was at that time that the main mass of kimberlitic minerals, including diamonds, was set free, which then got into productive levels of Upper Paleozoic. In Mesozoic epoch of denudation (in Middle-Late Triassic) kimberlite bodies were eroded to the depth nearly an order less than in Late

Paleozoic - only to 40 m, and in Kainozoic - to approximately the same value less - about 5 m.

Malo-Botuobinsky region is one of few diamondiferous regions of the Siberian province where both primary and placer diamond deposits are available. In the result of explorational works on these deposits the main parameters (grade of diamonds, thickness, etc.) were revealed, as well as resources of diamonds were estimated. Taken together this made it possible to assess quantitatively the scales of primary and placer diamondiferousness, so that we could determine whether so far undiscovered diamondiferous kimberlite pipes and diamond placers are available in the region. Thus, determination of possible scales of primary and placer diamondiferousness was carried out by way of comparison of diamond resources available in all ancient and modern placers and placer occurrences of the region, with estimated quantity of diamonds which were set free from eroded to the present time parts of known kimberlite bodies. At first the balance of diamond resources in placers and placer occurrences was determined. Then the quantity of diamonds released in the course of three denudational cycles (pre-Middle Carboniferous, pre-Lower Jurassic and Kainozoic) from each kimberlite pipe of the region was estimated. For this purpose in the first turn their main parameters and thickness of the eroded part of each pipe according to the cycles of denudation (according to direct geological data) were determined. Volumetric weight of kimberlites and average grade of diamonds in a unit of volume were conditionally accepted as equal to the same ones in upper explored blocks of pipes and with taking into account the data of exploitation. The areas of cross sections of kimberlite pipes within their eroded parts were determined with the help of average coefficients accounting for the expansion of the funnel. It is necessary to emphasize that estimation of diamonds released from eroded parts in pre-Middle Carboniferous time carries a somewhat approximate character on account of impossibility to determine exact estimational parameters, especially the area of the pipes' cross section. It is really not easy to determine the degree of expansion of the funnel of pipes to the day surface in the period of their intrusion and to what depth the upper (crater) part of pipes was filled by non-diamondiferous bolder material from country rocks, that is not by kimberlite. Such facts are determined in poorly eroded kimberlite bodies of South Africa and Yakutia. Paleogeographic constructions substantiate that in the process of territory's erosion eroded diamondiferous material was both carried beyond the region's boundaries in western and north-western directions and localized within its boundaries. The resources of diamonds in the discovered placers of Late Paleozoic age are much less than the quantity carried out from eroded parts of pipes. This proves the possibility of discovering diamond placers of close and distant drift in sedimentations of Upper Paleozoic. In connection with this it is necessary to emphasize that considerable concentrations of diamond indicator-minerals and diamonds have not been revealed in these sedimentations near known kimberlite bodies of the region. With getting away from these bodies in north-western direction (direction of drift of terrigenous material in Late Paleozoic time) only their background contamination by minerals of kimberlite is revealed, that is, "the path" of indicator-minerals and diamonds from kimberlite bodies in the direction of terrigenous material's transportation into Late

Paleozoic basins of sedimentation is not fixed. This situation can be explained by the location of known kimberlite bodies in the discussed period of time in the vaulted part of Mirny consedimentational paleouplift, within which at present practically there are no Upper Paleozoic sedimentations, and to their slopes from north-west there adjoin only upper non-diamondiferous levels of these sedimentations, under which occur proper productive layers where diamond placers of industrial significance (Kyuelyakhskaya trough) is allocated. Thus, there was no such a "trap" (local depression) near the pipes in the period of erosion of kimberlites and Upper Paleozoic accumulation of sediments, the trap which was earmarked for the Mir pipe in Early Jurassic time and where considerable in size and grade of diamonds placer Watershed pebble-bed (Vodorazdel'nye galechniki) was formed.

Conditions of erosion and accumulation of sediments, similar to the same in Late Paleozoic time existed also in Early Jurassic time on the area of Western group of kimberlite bodies (pipes Internatsional'naya, XXIIIrd Party Congress, etc.). Here these bodies are also located on Mirny uplift, but at the very slope of Mesozoic trough (central part of Angaro-Vilyuysky sagging). The material of denudation was carried beyond the limits of the site practically leaving no traces of indicator-minerals and diamonds' transportation, for, at present high-diamondiferous pipes Internatsional'naya and XXIIIrd Party Congress are overlaid by thin-granular sediments (aleurolites, clays) of Lower Jurassic containing only background quantity of small and in poor state indicator-minerals. And only during detailed prospecting works a small part of rich placer of diamonds of diluvial-proluvial genesis, which preserved from erosion, (placer Novinka) was discovered on a terracette of Jurassic trough (1,5 km south of pipe Internatsional'naya). Resources of diamonds in this placer constitute about one fourth part of diamonds carried out from the eroded part of the Internatsional'naya pipe only. Later, during explorational and exploitational works "the path" of kimberlite minerals from the Internatsional'naya pipe till the Novinka placer was discovered, which represents linear placer of diamonds Geophysicheskaya, attributed to the bottom of a very shallow paleowatercourse. Thus, volume estimation analysis of diamonds carried out from different parts of known kimberlite pipes of the region in pre- and Late Paleozoic time, and for the Western group of kimberlite bodies - in pre- and Early Jurassic time, serves as a basis for forecasting of diamond placers of close and distant drift.

Determination of scales of primary and placer diamondiferousness by the volume of carried out diamonds from Mirny group of kimberlite bodies (Mir, Sputnik, Dachnaya) in Mesozoic and Kainozoic time has special significance in this plan. Here the resources of diamonds in Lower Jurassic and Quaternary placers exceed the volume of diamonds carried out from the eroded kimberlites, in the time of formation of these placers, for about one third. And this is even without taking into account the quantity of diamonds available in poor placers and in the form of dispersed diamondiferousness in Jurassic and Quaternary sedimentations, as well as those ones which were carried out at the same time beyond the boundaries of the region. Such situation testifies that there are still undiscovered kimberlite bodies with sufficient content of diamonds. This conclusion is

supported by availability of a number of local perspective sites for new primary sources of diamonds to be discovered within Mirny kimberlite field.

It is nearly impossible to carry out similar analysis of scales of primary and placer diamondiferousness in other industrial-diamondiferous regions (Daldyno-Alakitsky and Middle-Markhinsky) of the Siberian Platform, for there are practically no placers of diamonds. In the first region it is because of relatively small erosional section of the pipes (on some of them crater formations have preserved) and intensive release of kimberlite material beyond its boundaries, and in the second region - kimberlite bodies are located on the upper curve of north-western border of Middle Paleozoic Ygyatinskaya trough and overlayed on it Vilyuyskaya Mesozoic syncline, where denudated kimberlite material was carried out, and then the pipes were overburdened by thin-granular sediments of Lower Jurassic. The conditions are similar to those of the Internatsional'naya pipe region. Here availability of placers of Novinka and Geophysicheskaya type is also possible.