Conception of Formation of Magmatogene and Terrigenous Diamondiferous Formations of Ancient Platforms as the basis of deposits' forecast

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Sufficiently extended in time period of ancient platforms' diamondiferous provinces' formation may be divided, analyzing available actual material, into three main stages:
- cratonization of lithosphere blocks with crystallization of diamonds in partially exhausted mantle and granulite-eclogite crust in AR-PR_1 time (formation of protoplatforms);
- release of diamondiferous mantle material by deep-seated saturated with fluids magmas onto upper levels of the crust in various epochs of tectono-magmatic platforms' activization and formation of kimberlite-lamprophyric rocks with inherited diamondiferousness;
- weathering, denudation of mantle and crust primary sources at various stages of cover's evolution, formation of terrigenous diamondiferous formations.

When discussing the questions of diamond crystallization conditions in the process of Archean-Proterozoic lithosphere cratonization one should take into consideration the known fact that Prephanerozoic stage in the development of the Earth was characterized by special regime, which did not repeat itself in subsequent epochs. Its specific nature lay in high energetic potential of the earlier Earth and, consequently, regional metamorphism of diamond-pyrope, eclogite, granulite facies took place on relatively small depths (Salop, 1982; Milanovsky, Mal'kov, 1983; Rezanov, 1988). The decline of pressure gradient in the process of the Earth's evolution is fixed by occurrences of retrograde metamorphism observed in mantle inclusions (nodules) and lower crust xenoliths from kimberlites; initial specific features of mineral paragenesis preserved only inside diamond crystals.

Generation and separation of melts in the plots of diamondiferous lithosphere and their fast transfer into the crust space with fast cooling off and consolidation is the condition of formation of magmatogene type diamondiferous rocks in the Earth's crust. The delivery of "mantle" diamonds into upper parts of the crust was performed by the most deep-seated magmas of lamprophyric or alkaline-basaltoid type able in turbulent regime to carry mantle xenoliths, including diamondiferous ones, onto the surface and to form peculiar hybrid rocks with inherited diamondiferousness. Consequently the "draft" criteria of potential diamondiferousness of rocks are: a) indications of large depths of melts' generation (mineralogical, isotope-geochemical) and b) indications of their fast intrusion and cooling off (petrographical, structure-textural and others).

Fragments of mantle rocks, including diamondiferous ones, present in kimberlites and lamproites in the form of xenoliths, the depth of formation of which by composition of co-existing minerals is assessed at present in 150-350 km and more, were captured by melts and transfered to the surface, probably, from much smaller depths. The maximum level of carture of xenoliths corresponded, evidently, to the level of melts' separation (80-100 km). Occurrence on moderate depths of mantle rocks, having been formed at very high PT parameters, may be explained by much higher gradients in the moment of their formation, by a definite value of the section of ancient crust in Precambrian time, as well as by tectonic and convective transfer of blocks of mantle substrate of reduced density onto higher levels of lithosphere.

The character of magmatism, material composition and diamondiferousness of deep-seated subalkalic rocks are determined by their position in relation to these or those structures of lithosphere, and allocation of terrigenous formations - by the location of primary sources in relation to the basement structures and the platform's cover.

Diamondiferous magmatism in all the regions is associated with the dynamics of outlying areas of the largest platform depressions and is closely connected with basaltoid occurrences. Heated up asthenolenses, developing in root zones adjoining the cratons of intra-platform or pericraton volcanogenic-sedimentary basins could be the source of energy which caused tectono-magmatic activization of stable structures.

In the process of formation and evolution of platform's cover, due to weathering and denudation of mantle and crust diamondiferous sources, diamond placers of two main landscape-dynamic types were formed - peneplain placers (of denudation and denudation-accumulative plains) and placers of sags (close to edge parts of saggings and syneclises). Each age and genetic type of a placer occupies a definite position in platform structures with the forming of which specific epoch of placer formation is associated. In the vertical section of the platforms' cover placer deposits coincide with the initial stages of cycles of sediments' accumulation.

The appearance of diamonds from terrigenous sedimentations is determined by conditions of their crystallization (initial typomorphic signs) and by the character of subsequent hypergene (chemical and physical) transformations (secondary typomorphic signs). "Crust" diamonds, crystallized under reduced and less stable P-T parameters sufficiently differ from "mantle" ones by habit (mechanism of growth by cube, aggregates, splices, cyclical twins), by character of mineral inclusions (pyrope-almandine-grossular garnet, omphacite, disthene, coesite), by isotopy of carbon ($\sigma^{13}C$ in the interval from -10 to -23%), by genetic indicator minerals (complex of metamorphic minerals). Owing to intensive metamorphogenic and hypergenic influence they carry the most obvious signs of alterations - fritting, graphitization, shaping of oval (mechanical processing) crystals.

In the process of platforms' evolution the following hierarchical row of ore-placer diamondiferous targets is formed: province (subprovince) - zone (area) - region (field) - primary deposit (placer). Province (subprovince) - is the frontier of ancient cratons' distribution with the system of lineaments (belts), with "cold" depleted mantle underlayer, within which there existed thermodynamic conditions for crystallization of diamonds and their long preservation in metastable conditions. Diamondiferous regions

(fields), gravitating toward the systems of transcraton fractures of mantle blocking up (zones), may be determined as local blocks of cratons having suffered tectonomagmatic activization in the sites of increased penetrability of the Earth's crust under the effect of deep-seated mantle fluid flows (plumes). Allocation of diamondiferous rocks' denudation products monitors positive and negative platform structures of this or that type and rank. Thus, diamondiferous objects of different rank are different in age. Cropping up of provinces and subprovinces was predetermined at the earliest stage of protoplatforms' formation, and zones - at much later aulacogenic (riftogenic) stage of their evolution. Formation of diamondiferous regions and fields was performed at the platform stage in various epochs of tectonomagmatic activization.

Basing on the above stated a number of diamondiferous formations and potentially diamondiferous deep-seated volcanites of stable areas is earmarked for forecast-prospecting purposes. Taking into account available data on diamond occurrences in various types of rocks (F. Kaminsky) and in works of Y. Kuznetsov, N. Kheraskov, et al., the following below groups of formations will be included into that number.

The group of alkaline-ultrabasic formations: 1) of kimberlites; 2) olivine lamproites; 3) central intrusions of alkaline-ultrabasic rocks (?).

The group of alkaline-basaltoid formations: 1) of leucitic and sanidine lamproites and lamprophyres; 2) autonomous explosion' pipes of alkaline basaltoids and picrites.

Methodology of forecast and the method of prospecting of primary magmatogene sources of diamonds should take into account material (especially mineralogical), physical, structure-textural and other features of the broad spectrum of rocks and various geodynamic situations of their occurrence. Forecast evaluation of separate large parts of platforms at the regional stage is recommended to be performed according to the following basic directions: a) establishment of the type, structure-tectonical and geodynamic features of the lithosphere with the help of a complex of geologic-geophysical (including remote) methods; b) determinatiuon in terrigenous formations of correlation of "mantle" and "crust" diamonds according to a set of typomorphic indications - sharp predominance of the latter makes prospecting of magmatogene primary sources imperspective.

References

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