MINERAL PARAGENESES OF NATURAL DIAMONDS

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Minerals coexisting with natural diamonds are specified by different relations with the latter. They are represented by isolated syngenetic crystalline inclusions, mainly as single grains, sometimes by two-, three- or even four-phase inclusions.

Intergrowths with polycrystalline diamond aggregates and monocrystals are also typical of diamond-mineral relations. Moreover, the diamonds sometimes containing inclusions are part of xenoliths of diamondiferous peridotites and eclogites. The octahedral faces established in inclusions of a majority of Yakutian samples may serve as one of the most sound indications in favour of the syngenetic nature of crystalline inclusions and diamonds.

Generalization of the results of examination of the composition of over 600 samples of olivines, pyroxenes, garnets, chromespinelides and some other minerals coexisting with diamonds as inclusions, intergrowths and contained in xenoliths, most of which are from Yakutian occurence reveals two main types of diamond parageneses (Sobolev et al., 1969; Sobolev, 1971, 1974): ultramafic (1) and eclogitic (2).

The characteristic features relevant to Type-1 paragenesis are: presence of olivine, Mg-composition of garnets and pyroxenes, variable Cr-content in garnets, pyroxenes and spinel.

Some distinct criterions established for the mineral composition and their associations have been established permitting one to reveal a series of parageneses within Type-1 including various ultramafic rock compositions. A typomorphic nature of Mg-garnets has been recognized as one of the main criterions. The Ca-contents of these garnets are essentially a function of the nature of their parageneses. A positive correlation established for Ca- and Cr-contens in garnets typical of two-pyroxene para-

geneses (Sobolev et al., 1969) in addition to unambiguous position of the compositional field of these garnets permits one to separate the compositional field of garnets coexisting with enstatite without clinopyroxene (Ca-Cr diagram) belonging to harzburgite (dunite) paragenesis (Sobolev et al., 1969,1973). Extremely low Na_2O contents in Ca-poor chrome pyropes (usually below 0.03 wt %) may serve as additional indication that clinopyroxene is absent in this type of paragenesis.

The finds of trimineral inclusions represented by inter - growths of Ca-poor chrome pyrope, enstatite and chromite (Sobolev et al.,1976) and even tetramineral intergrowths, such as pyrope + enstatite + chromite + olivine show an independent nature of parageneses of these garnets.

The identification of inclusions of Mg-garnets coexisting with two pyroxenes in one diamond, among them several tetramineral associations: garnet + enstatite + diopside + olivine (Sobolev et al.,1976) and five-mineral associations (+ilmenite) typical of diamondiferous lherzolite (Pokhilenko et al., 1976) permitted one to reveal websterite-lherzolite paragenesis. The garnet of this paragenesis contains moderate CaO (up to 4-6 wt%) and some Na_2O (about 0.1%).

The paragenesis of Ca-rich pyrope, olivine and clinopyroxene (wehrlite) is based on identification of trimineral association in a single diamond (Sobolev et al.,1970).

The eclogite-type paragenesis (2) is specified by a wide series of compositions from common two-mineral eclogites with rutile, coesite eclogites (Sobolev et al., 1976) to kyanite,corundum eclogites and grospydites (Ponomarenko et al., 1976).

Type 1 generally predominates over the Type 2 in most of the diamond occurences. Harzburgite-dunite paragenesis is most typical of Type 1, while wehrlite paragenesis is most uncommon. Coesite eclogites have been recently identified to belong to Type 2, though their distribution is still unknown. Common eclogites greatly predominate in this type.

The obtained thermobarometric data for numerous equilibrated mineral associations, such as inclusions, intergrowths and

xenoliths permit one to suggest a wide T-range for the crystallization of natural diamonds (1100-1500°C) and 50-60 kbar pressure, sometimes attaining 80 kbar.

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