KIMBERLITE AND KIMBERLITE-LIKE ROCKS, THEIR COMPOSITIONS, TIME-SPACE RELATIONS, GENESIS AND TECTONIC CONTROL

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Rocks termed at present as kimberlites do not represent a united genetic group. According to the geological characteristics of their manifestations in the crust, their natural associations, chemical features and mineral compositions, they may be subdivided into five individual groups. They are (1) kimberlites from localised complexes, (2) kimberlite-like lamprophyres related to K-rich basalts, (3) kimberlite-like basanites associated with alkaline-ultramafic carbonatite-bearing complexes, (4) kimberlite-like mafic and ultramafic volcanites related to olivine-alkaline basalts, (5) kimberlite-like peridotitic breccias from alpine-type hyperbasic complexes.

Kimberlites from localised complexes (proper kimberlites) are discovered only on ancient platforms within their Archaean-Lower Proterozoic cratons, i.e. in those parts of the continents where the mantle substance was differentiated to great depths and the thick lithosphere was formed. In different epochs kimberlites penetrated into the crust, as a rule, at final stages of tectono-magmatic activity. Within individual cycles their intrusion was preceded or accompanied by intrusion of magmas of varying petrochemical types. They were tholeiite-basaltic magmas, or alkaline-ultramafic magmas, or alkaline-basaltic ones. In the kimberlite-productive cycles standard sets of magmatic rocks associations are absent. Within a tectono-magmatic cycle kimberlites may be associated with tholeiitic basalts, alkaline basalts and alkaline-ultramafic rocks. They also occur autonomously, without any connections with other types of magmatic rocks.

The nature of the time/space relations between kimberlite and other types of igneous rocks formed within the same tectonic cycle indicates a distinct genetic singularity of kimberlite magmatism. Thick tectonosphere, low-gradient thermal regime of primary magmatic chambers, low melting degree of the initial substance, high rates of the melts rising to the surface without delays in intermediate reservoirs beginning with 120 km depth are necessary for origination of kimberlites and their penetration into the upper portions of the crust. According to the current thermal and geodynamic models of continental and oceanic rifting, as well as to the models of island arc and continental margin formation, the above conditions are not realised. These conditions are in line with the geological data. Classic types of kimberlites are not found in the systems mentioned above.

The specific petrochemical and geochemical characteristics of kimberlite is well seen from the coefficients: Si/Mg, Ca/Ca+Mg, Ni/Co, Cr/V, Ni/V, Na/K, Li/Rb, K/Rb, Sc/V. In total they are ultramafic (not alkaline) rocks slightly oversaturated with alumina. To judge from their texture, structure and mineralogical features, they are holomelanocratic volcanites forming small bodies of pipe and vein facies. Direct transitions and connections with rocks of other genetic associations are not established. All the above-mentioned indicate genetic independence of kimberlite magmas.

All the kimberlite-like rocks cannot be identified with proper kimberlites. They converge with the latter according to some features.

The kimberlite-like basanites from alkaline-ultramafic complexes show maximum convergence with kimberlites in their texture and structure, rock-forming minerals, petrochemical and geochemical features. However, such high-pressure minerals as Cr-rich garnet, chromite, magnesian subcalcic endiopsides and diamonds are absent in them. Unlike kimberlites, they often contain phenocrysts of titanaugite, aegerine-augite, fassaite. In the matrix alkaline amphiboles and feldspathoids are present. Judging from the fact that deep-seated xenoliths are represented as spinel lherzolite and metamorphic eclogites (very rare), the primary magmas producing these associations were formed in the spinel-garnet mantle zone. These rock manifestations are controlled by continental rift zones, mobile belts and margins of platforms.

Kimberlite-like mafic and ultramafic volcanites from associations of alkaline olivine basalts strongly differ from kimberlites in their petrochemical, geochemical and mineralogical features, but they are rather close to them in deep-seated nodule composition. Among the nodules, together with prevailing spinel lherzolite, spinel-garnet and garnet varieties are present. Sometime, in their composition uvarovite-pyrope with knorringite minal admixture are present. High-chromic and at the same time low-calcic knorringite-pyropes do not occur in them. Unlike deep-seated nodules from kimberlites, garnet lherzolites and harzburgites from kimberlite-like rocks do not contain magnesian and ferromagnesian endiopsides, as well as diopsides with low aluminium content and at the same time with high Na_2O content. Phenocrysts of the above clinopyroxene varieties are absent in kimberlite-rocks. Ultramafic xenoliths are widely distributed in the kimberlite-like rocks of this series. They consist of minerals with high ferrugineity (augites, salite-augites, bronzites, chrysolites) and related typochemical phenocrysts. This type of kimberlite-like rocks is confined to continental rifts, subductive zones of median massifs and marginal platform structures.

The kimberlite-like rocks from associations with K-rich alkaline basalts are identical to kimberlites by suites of high-pressure minerals, but, as well as the above group of rocks, differ from them in their mineralogical, petrochemical and geochemical features.