Mineral inclusions in diamonds from chemicaly heterogeneous eclogite xenolith

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The studied eclogite from Udachnaya kimberlite pipe (Yakutia), wich was primarily composed of omphacitic clinopyroxene (65%) and pyrope-almandine garnet (35%). By composition of major matrix minerals this eclogite fall in between group A and group B eclogites [1]. Accessory minerals are diamond and sulfide (MSS). In the xenolith there are simultaneous compositional variations of garnet and clinopyroxene. The content of CaO and FeO in garnets decrease with the increasing of Mg (Mg# 56.7-75.5). Jadeite component in clinopyroxene increase from 12 to 22% with the decreasing of Mg number (from 74% to 83%). The variation of diamond characteristics (size, morphology, nitrogen content and aggregation state, carbon isotope composition) reflects the diamond formation in two stages.

Mineral inclusions have mostly been recovered from diamonds of first generation. Inclusions generally differ from matrix minerals by chemistry. Clinopyroxene inclusions contain higher amount of Na_2O (6.0-7.3 wt% in inclusions and 4-6.8 wt% in matrix), Al_2O_3 (9.3-13.2 wt% and 5.8-10.4 wt% respectively) and K_2O (0.19-0.58 wt% and 0.1-0.17 wt% respectively) and have lower Mg#. Garnets in inclusions have higher CaO content (5.6- 8.6 wt%) and lower MgO content (10.0- 12.3 wt%) than garnets in matrix (3.2-4.5 wt% and 13.4-18.6 wt% respectively). Some inclusions of garnet and clinopyroxene are relatively enriched in MREE. The estimates of temperature by garnet-clinopyroxene pair [2] from three individual diamonds give the average value around 1220°C.

The compositional differences of inclusions and matrix minerals may be explained by the evolution of eclogites after diamond formation or by the diamond growth from fluid/melt, which were no in equilibria with the host rock. The evolution of composition of eclogite is possibly resulted either from partial melting or from metasomatism or from solid state diffusion of components. As the partial melting and metasomatism reasonably involve a significantly bigger volume than the studied sample is, we suggest the outflow/inflow of some components by diffusion in solid state in originally heterogeneous environments.

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References

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