SOME PHLOGOPITE FORMATION STAGES (ON THE EXAMPLE OF STUDY OF PHLOGOPITE FROM THE PIPE "MIR").

Babushkina,S.A.

National Research Center on Diamonds, Gemstones and Gold, 22 Lenin pr., Yakutsk, 677892, Russia

Phlogopite and crystal inclusions in it from the Mir kimberlite pipe have been analysed on an electron microprobe. The phlogopite, taken from both hand specimens and kimberlite monofractions, was represented by 1x1 to 1.5x1.5 mm grains. The latter were mostly isometric and molten, with the previous hexagonal facets of the platelets still discernible. All in all, 243 phlogopite grains were analyzed, of which 78 had inclusions in them. Diagnosed as crystal inclusions were chrome-spinellid (in 62 grains), picroilmenite (in 12 grains), garnet (in 6 grains), and chrome-diopside (in 3 grains).

The results revealed that:

1. Chrome-spinellid inclusions in the mica are represented by both irregular-shaped microinclusions epitaxially intergrown with the host mineral and well-formed crystals measuring from first tens of microns to 0.4x0.4 mm. Compositionally, the inclusions can be divided into six groups. Group 1 comprises high-Cr (Cr_2O_3=59.73%), low-Ti (TiO_2=0.48%) and low-Al (Al_2O_3=5.38%) ones. Group 2 is characterized by low Cr (Cr_2O_3=51.75%), high Ti (TiO_2=1.64%) and high Al (Al_2O_3=6.54%) contents. Group 3 has still lower Cr (47.44%) and still higher Ti and Al (1.93% and 8.63%, respectively) contents. Group 4 is characterized by the following composition: Cr_2O_3=44.33%, TiO_2=3.88% and Al_2O_3=3.64%. Group 5 has lower Cr (39.64%), moderate Al (3.73%) and maximum Ti (7.01%) contents. Group 6 is still lower in Cr (29.14%) and moderate in Al (6.17%) and Ti (4.07%).

In all compositional diagrams, these groups form stable areas with certain regularities. For example, in the TiO_2-Cr_2O_3 diagram for chrome-spinellid inclusions, spinels of Group 2 and Group 3 display a positive correlation between Ti and Cr, whereas for Group 5 and Group 6 the correlation is reversed.

In their major-element proportions, Group 1 chrome-spinellids correspond to those from ultrabasic xenoliths and fall into the field of diamond-associated chromites. Groups 2 and 3 correspond in composition to chrome-spinellids from sheared dunites. Groups 4,5 and 6 correspond to chrome-spinellids in high-Cr, zoned garnets and chrome-spinellids from xenoliths and concentrates of kimberlite pipes.

2. There are mostly single picroilmenite inclusions, although two inclusions in one mica grain are not unusual. They vary in size from first tens of microns to 0.4x0.4 mm. Most frequently, they are restricted to the peripheral parts of zoned

phlogopites. Where zoning is not visible, the inclusions still tend to occur at the periphery of the host grains. The average composition of the analyzed picroilmenites is: 10.00-15.91% MgO, 0.07-0.82% Al_2O_3, 46.06-54.53% TiO_2, 0.15-7.29% Cr_2O_3.

Comparison of these picroilmenites with those from kimberlite concentrates from the Mir pipe has led to the following conclusion: the inclusions in mica are have higher Mg and Ti contents relative to the ilmenites from kimberlite concentrates; picroilmenite inclusions in mica form an independent group of ilmenites on a MgO-Cr2O3 diagram.

By their $MgO+TiO_2$, $FeO+TiO_2$ and $Cr_2O_3+Al_2O_3$ ratios, the analysed samples plot onto the trend of picroilmenites from garnet-ilmenite peridotites and pyroxenites, ilmenite perodotites and pyroxenites and ilmenites of diamond association.

3. Garnet has been diagnosed in six phlogopite grains. In one grain, it occurs as an inclusion in a chrome-spinellid (the garnet size is 6x10 microns); in the others, it occurs as relatively large (0.2 mm and more) inclusions and intergrowths. They contain Cr within 3.01-8.94%, Ca within 4.81-10.58%, Ti within 0.01-1.01%.

Three of the analyzed garnets refer to knorringhite-pyropes, two to almandine-pyropes and one to uvarovite-pyrope. In their composition, the knorringhite-pyropes correspond to sheared lherzolites and inclusions in diamonds; the uvarovite-pyrope corresponds to garnets from wehrlite-paragenesis minerals-inclusions in diamonds; one of the almandine-pyropes plots in the field of the garnets in paragenesis with two pyroxenes and the intergrowths with polycrystalline diamond aggregates, whereas the other plots at the boundary between the garnets from lherzolites and wehrlites.

4. Clinopyroxene inclusions correspond in composition to the chrome-diopside with insignificant yreite component admixture (NaO=2.23%, Cr_2O_3=2.22%, Al_2O_3=1.88%). The Ca/Ca+Mg ratio is 0.51. These inclusions conform in composition to inclusions in diamonds or olivines.

5. The inclusions-bearing phlogopite form two clearly-defined populations in the Cr_2O_3-mg diagram, one characterized by 0.77% TiO_2 and 5.11% FeO and the other by 0.26% TiO_2 and 2.91 % FeO.

The first population of the phlogopites is divided into three groups which exhibit regular compositional variations with increasing Cr and Mg from earlier to later individuals. The three groups contain chrome-spinellid inclusions of Groups 1, 2, 3 and 4; phlogopites of the first group also contain garnet and chrome-dopside inclusions.

The second population is divided into two groups. The first group includes the most Cr-high and most Mg-high varieties

and contains chrome-spinellid inclusions of Group 4, as well as garnet and chrome-spinellid of Group 5. With further crystallisation, the composition of the phlogopites and the paragenesis of their inclusions changes. They contain chrome-spinellid of Group 6 and picroilmenite as inclusions.

Thus, the compositions of the studied crystalline inclusions and their host micas suggest that they originated in relation to deep processes. It appears that phlogopites of the first population and their crystalline inclusions come from ultrabasic mantle xenoliths and were liberated into kimberlite breccia upon their disintegration. The second population and its crystalline inclusions appear to have resulted from an independent process involving the already formed complex of the first population minerals that terminated in crystallization of phlogopite analogous in composition to that in peripheral zones of phlogopite phenocrysts from kimberlite breccias.