THE EXPERIENCE OF MINERALOGIC-PETROGRAPHIC MAPPING OF KIMBERLITE PIPES

N.N. Zinchuk, Z.V. Specyus, V.M. Zuev, N.N. Romanov

"Almazy Rossii–Sakha" Co. Ltd.

In spite of our detailed knowledge of kimberlite rocks from many regions, the variations of the concentration of minerals and major elements and the horizontal and vertical patterns for the diamond content distribution in kimberlite pipes were studied insufficiently.

At the example of mined diamond deposits we compared the composition and petrographic-mineralogic features of kimberlites, including the distribution of relict and new-formed minerals, major petrogenic oxides, and diamond morphological groups within the individual marking horizons and on the explored depth. Most complete evidence on these questions was obtained for the Udachnaya kimberlite pipe that is known to be characterized by a complex geological structure. The features of physical-mechanical kimberlite properties influence on technological processes. The distribution of xenoliths and major oxides are responsible for the properties of minerals. That is why the change of such features and distributions is studied basing on the mineralogic-petrographic mapping of marking horizons on the exploration grid 40×40 m, sampling and detailed study of kimberlite matter from drilling cores. Also, there is carried out the study of mineralogy and some physical properties of diamonds that were taken from exploration samples of the same drills using the chemical decomposition method.

The vertical and horizontal change of kimberlite compositional features and physical-chemical parameters was recorded due to the performed investigations. Thus, kimberlite rocks from the upper horizons of almost all the studied kimberlite pipes and especially those covered by weathering crusts or vent facies rock relics are characterized by lower density. With depth, rock density increases from 2.10-2.15 to 2.50-2.70 g/cm^3. The coefficient of kimberlite hardness was established to vary from 2.10 to 6.30 with depth and laterally. The coefficient of kimberlite breakage for the Udachnaya pipe ranges from 0.7 to 2.75 and rather depends on kimberlite hardness. Distribution trends for hardness and breakage coefficient in both pipe's bodies correlate.

The behaviour of major paragenetic indicator minerals (pyrope, picroilmenite, Cr-spinel, etc.) was reported in many papers. We obtained new data on the peculiarities of areal distribution of heavy minerals, such as magnetite, ilmenitė, pyrope, Cr-diopside, Cr-spinel, olivine, pyroxene, iron hydroxides, and pyrite within individual horizons of the Udachnaya pipe. Comparison of the content of minerals in different bodies and horizons of the Udachnaya pipe showed their uneven distribution.

For the first time, we studied the features of composition and distribution of major kimberlite secondary minerals in several Yakutian kimberlite pipes. In individual cases secondary minerals compose up to 90-95 % of the whole rock that is therefore considered as aporock. Our investigations recorded wide content variations and uneven distribution of new-formed minerals, such as serpentine, chlorite, calcite, dolomite, brusite, gypsum, etc. Most significant change in the ratio of secondary minerals is found in the lower part of pipes (below 400 m from the surface).

The petrographic mapping of the main marking horizons of the Udachnaya and Mir pipes suggests that compositional and structural features of pipes are illustrated by the petrochemical features of recognized kimberlite varieties.

Horizon-by-horizon study of diamond mineralogy in the Udachnaya pipe showed the similarity of diamond assemblages from separate horizons according to the ratio of crystals of different morphology (except for insignificant decrease of the portion of cubes, aggregates, and intergrowths with depth), amount of inclusion, surface sculptures, and crystal intactness. Those feature are close for diamond assemblages from the eastern and western bodies of the Udachnaya pipe. These results plus stable photo- and X-ray luminescence and persistent content of diamonds in different horizons prove the stable diamond content in the pipe rocks to the depth and support the mantle genesis of diamonds.

Thus, the mineralogic-petrographic mapping method that was developed in the "Almazy Rossii-Sakha" Company and applied to kimberlite rocks from the mined Yakutian kimberlite pipes allows to define the regular change of geology-technological characteristics of rocks, to predict their dressing to the depth, and to outline the features of their structure and evolution.