MORPHOLOGY OF KIMBERLITE MINERALS: ITS USAGE FOR PREDICTING AND SEARCHING THE DIAMOND DEPOSITS

V.K.Garanin,G.P.Kudryavtseva,T.V.Posukhova and V.P.Afanasjev

Department of Geology, Moscow State University, USSR

The morphology of kimberlite minerals, is very diverse which is the to their formation under impacts of various abyssal and exogenous morphogenetic factors. Being easiby accessible to investigation, it provides ample information for predicting and searching the diamond deposits.

The morphological features of kimberlite minerals fall into two groups: I - those insignificantly varying during the formation of placer aureoles and permitting reconstruction of the original mineral, features specific for each individual source; 2 - those strongly and regularly varying during the formation and following existence of placer aureoles and functionally dependent upon the distance from their sources - for the placer aureoles formed in continental environments.

The first group of features allows typification of bedrock sources, i.e. referring the minerals of placer aureoles to specific kimberlite bodies. It comprises: the morphology of pyrope grains (oval-shaped, angular-oval,fragmentary,block-shaped,oval-shaped with scale-like, crescent-like and cirque-like gonges on the surfaces that are due to postmagmatic corrosive splitting); inclusions in pyropes and the total amount of grains with inclusions; pyrope colours; the morphology of picroilmenite grains (the presence or absence of fine-prained shells on their surface); the character of faceting of chromespinel grains. As a rule, kimberlite bodies are typified with respect to several above-listed features, specific to each of them.

The second group includes more stable primary features, as well as the specific exogenous ones, permitting the estimation of the relative remoteness of the bedrock sources: the proportion of pyropes with the dislocational and cuboidal type of hypergenous corrosion; the share of picroilmenite with the structures of solid solution decay and recrystallization; the presence of signs of mechanical wear, and the degree of its manifestation; the presence or absence of primary reactional formations, such as kelyphitic and subkelyphitic shells, chlorite incrustations on pyropes and kimberlite selvage in contrasting picroilmenite relief.

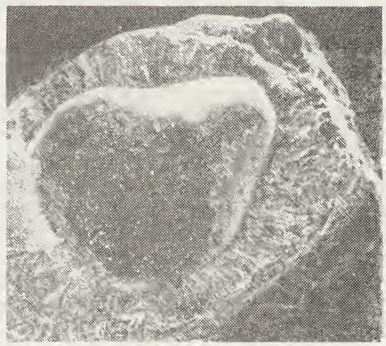
The morphology of kimberlite minerals is instrumental in deciphering the history of formation of placer aureoles and their development, permitting to establish their genesis: "primary" if they were formed by direct washing-out of kimberlites, and "redeposited" if the bedrock source was buried beneath younger deposits containing associated minerals of diamond.

The genetic approach to the morphology of kimberlite minerals is particularly important since it permits the estimation of the potentials of the placer-mineralogical technique and the facties of exploration work in different geological environments. For primary aureoles the discovery of the kimberlite body is secured by tracing direct-ablation minerals along the stray flux. For the aureoles of a redeposited character in the absence of confidently established stray fluxes of kimberlite washout products synchronous to sedimentation there is possible in principle only prognostication of more or less limited areas in which the search for buried deposits must be conducted by alternative methods (geophysical, drilling after a congested grid for possible direct undercutting). A particularly important sign of redeposited character of a concentrate aureole proves to be a mass manifestation on minerals of hypergenous alterations acquired during crust-forming epoche preceyding sedimentation. Furthermore, in certain cases there is observed a great incompatibility between mineralogical features of concentrate aureoles and the facial pattern of the enclosing deposits. Thus, for a number of aureoles occurring in the Upper Paleozoic continental deposits in the Tungusska syneclise eastern framing the morphological features of kimberlite minerals (in the first place, extreme mechanical wear), the composition of their association (predominantly diamond-pyrope with a far-reaching granulometric grading) point to the original formation of aureoles under the coastal-marine conditions in the Middle Paleozoic and thair redeposited character in the Upper Paleozoic deposits.

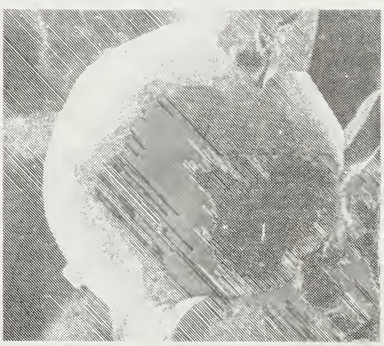
It shoned be emphasized that now the best instrument for morphological examination of kimberlite minerals is the scanning electron microscope (SEM) which makes possible the high-quality photography of minerals under a wide range of magnifications and with the sharpness that can not be achieved by optical instruments.

The secondary electron images of the grains of garnefs, ilmenites and sphineles, as shown in Figure I, illustrate the potentials of SEM-techniques for examination the minerals associated with diamonds.

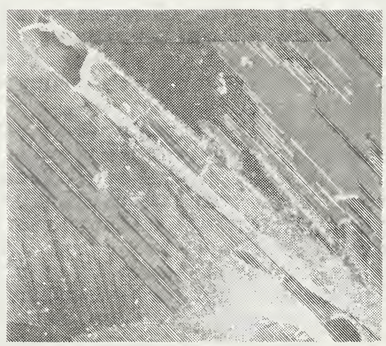
a, 75^x



b, 75^x

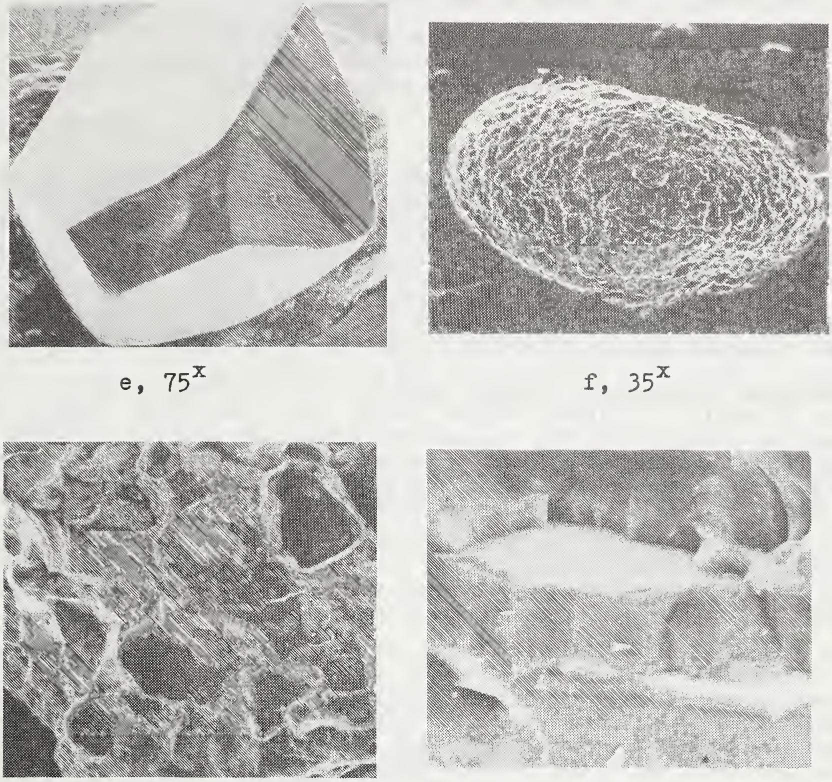


c, 350^x



d, 350^x

(Figure I)



e, 75^x f, 35^x

g, $I50^x$ h, $I500^x$

Fig.I. Morphological features of kimberlite minerals: a - oval-shaped pyrope grain with cirque-like gouges; b - kelyphitite shell on a pyrope grain and sub-kelyphitic surface of garnet; c - inclusion of chromespinel in pyrope; d - inclusion of rutile in pyrope; e - crystall-shaped chrome spinel grain; f - ilmenite with fine-grained shell on their surface; g - recrystallisation structures in ilmenite; h - exsolution texture with platy intergrowth of crome spinels in ilmenite