INFRARED AND CATHODOLUMINESCENCE STUDIES OF INCLUSION-BEARING DIAMONDS FROM BRAZIL.

Milledge[(1)], H.J.; Mendelssohn[(1)], M.J. and Meyer[(3)], H.O.A.

(1) Crystall. & Min. Phys. Unit, Dept. Geol. Sci., University College London, Gower Street, London WC1E 6BT, U.K.;
(2) Dept. Earth & Atmos. Sci., Purdue Univ., West Lafayette, IN 47907 USA.

Infrared spectra have been obtained for diamonds from five localities in the Precambrian Sopa conglomerate at Sampaio, Diamantina and Serro, Minas Gerais, and from the equivalent Lavras Formation, 675 km north at Adarai, Bahia as well as from the basal Taua conglomerate of the Cretaceous Bauru Formation at the Agua Suja Mine, Romaria, western Minas Gerais.

Although only small numbers of stones were tested, spectra from all localities showed a range of spectral types, and large variations in nitrogen concentration. Since the IaA - IaB aggregation process is a second-order process (see MJM, HJM, GIC & HOAM, this volume) it is concentration-dependent, so that diamonds which have all experienced the same P/T histories may show different degrees of aggregation if their nitrogen concentrations differ substantially, but in that case the higher degree of aggregation must correspond to higher concentrations. Accurate assessment of such spectra depends on the absolute values of the IaA and IaB absorption coefficients at 1282 cm^{-1}, but the effects can be demonstrated generally from the following pairs of spectra.

DIAMANTINA
HBDT1: Low degree of aggregation for quite a high N concentration, whereas HBAN7 from Andarai shows a similar aggregation state for a much lower nitrogen concentration. Platelet development is normal aggregation.

SERRO (Minas Gerais)
HBSE8: High N concentration, high degree of aggregation, platelet peak intact.

HBSE11: Aggregation varying with concentration within one stone, platelet peak intact.

SAMPAIO
HBSAP1: More complete aggregation for lower N concentration than HBSP8 but platelet peak intact.
HBSP4: Lower aggregation state for lower N concentration. Platelet peak intact.

ANDARAI
HBAN1: Shows a very unusual effect, where the platelet peak is absent for an intermediate aggregation state, as in HBSP4. The platelet peak is sometimes absent in specimens where the IaA - IaB aggregation is complete, but seldom at this stage.
HBAN5: Shows a similar N concentration and aggregation state, but with the platelet peak intact.

The existence of these well-aggregated defects in Precambrian diamonds is interesting, because all aggregation must have taken place before emplacement, so that the residence time in the mantle must have been much shorter than for diamonds emplaced in the Cretaceous, and the temperatures correspondingly higher. It is most important therefore to be able to correlate temperatures as implied by infrared spectra with temperatures estimated from inclusion geothermometry.

This comparison will only be reliable if diamond plates are polished so as to expose inclusions for microprobe analysis and to make it possible for infrared microspectroscopy to be carried out in the immediate vicinity of the inclusion, because spatial information is frequently lost when the diamond has to be broken to expose the inclusion for probe work. The importance of this spatial correlation was demonstrated for one specimen from Romaria where the spectral and inclusion temperatures were not in agreement, but subsequent spectral measurements on other fragments of the diamond indicated that it was very inhomogeneous.

Rather than fracture these specimens, many of which are inhomogeneous like HBSE11, polished plates are being prepared where possible in order to facilitate comparison of the two methods of estimating temperatures in addition to obtaining the inclusion geochemistry.

Cathodoluminescence studies of Brazilian diamonds have also revealed two interesting facts. As might have been anticipated, there is evidence of alpha-radiation damage of varying degrees of severity, but what is almost unique is the appearance of very well developed red haloes on the surface of a diamond from Romaria. Very slight traces of pink haloes have been detected on one of the Precambrian stones, but extensive and well-defined areas of red luminescence occurred on specimens from Serro and Andarai. In our experience, red cathodoluminescence is comparatively rare, and such discrete patches even more so.

The second observation of interest is that one specimen from Romaria showed very large platelets exposed on an external surface. Relatively large platelets (a few microns in diameter) have now been seen in several diamonds from the Finsch and Argyle mines, but they are usually only detected on polished sections exposing the interior of the stone, and do not extend to the exterior surface, for whatever reason. It is possible, therefore, that this specimen has been substantially resorbed at some stage.

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