THE PHYSICAL CHARACTERISTICS AND SYNGENETIC INCLUSION GEOCHEMISTRY OF DIAMONDS FROM PIPE 50, LIAONING PROVINCE, PEOPLE'S REPUBLIC OF CHINA.

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Introduction:- Pipe 50 is located in the Toudaogou area, near Fuxian. The kimberlite has an irregular rhomboidal outline, trends east-west with a surface length of 275m and width of 55m, is believed to be of Devonian age (366 to 398Ma), and is intruded into Proterozoic sandstones, (Zhang et al 1989). In this study, the physical characteristics of 13,000 diamonds from this mine covering the whole production are presented, together with data on the nature and chemistry of the syngenetic inclusions, collected over a two-year period.

Diamond Characteristics:- Initial shape variations as a function of size, Harris et al (1975) are shown in Figure 1a. The proportion of **primary** diamond shapes is given in Figure 1b, after reassignment of broken diamonds (irregulars) to their sub-shapes. Octahedra (70%) and macles (10%) dominate

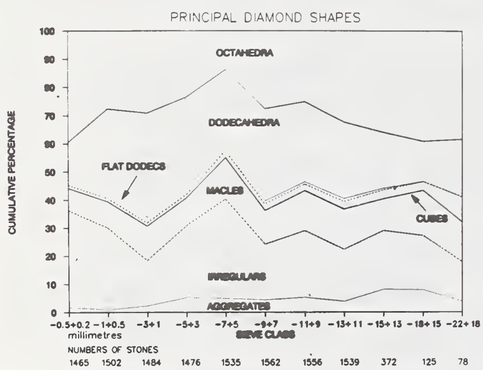

FIGURE 1a

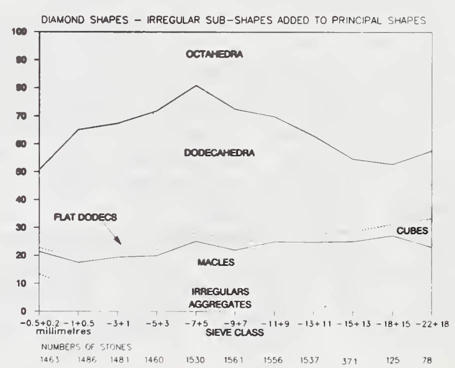

FIGURE 1b

the primary shapes, with about 5% each of cubes and aggregates, there being a small percentage of genuine irregulars. Figure 1b also clearly shows that the proportions of these crystals are independent of diamond size. In addition, from diamond size -7+5 to the very smallest stones, there is a pronounced reversal in the proportion of dodecahedra, (the resorbed form of primary octahedra). This change is also accompanied by a steady and marked increse in the proportion of both sharp-edged octahedra, from 25% to 75% and triangular macles, from 15% to 60%. Octahedral faces of both morphologies consist of triangular growth platelets giving crystal edges a distinct striated appearance.

With diamonds larger than -7+5, colour proportions are also largely independent of size, colourless (55%) and brown (30%) dominating over yellow (8%), the remaining few percent being grey-black or transparent green coated. In sizes smaller than -7+5, the steady increase in colourless stones at the expense of yellow and brown, is probably not real, but reflects the difficulty of determining true body colour in small diamonds.

Apart from the distinctive striated and terraced appearance of the smaller octahedra and macles, a noticeable surface feature on about 10% of dodecahedra are very shallow, irregular bounded, matt etched depressions, which may partially occur over an entire stone, or be confined to a few faces. This surface is considered to be incipient corrosion sculpture, a root zone diamond surface texture, (Robinson et al 1989). More rarely, dodecahedral surfaces exhibit imbrication, or non-alluvial scratch-like markings, the latter, having a very variable surface distribution. In the size range 0.5 to 3.0mm, 45% of diamonds are plastically deformed, but this value falls to 20%, both for the smallest diamonds, where identification is difficult because crystals are sharp-edged and for large diamonds where numbers are small. Plastic deformation is expectedly high among brown diamonds of all sizes (70%), but at Pipe 50, relatively high levels of deformation among colourless (average 30%) and yellows (average 45%), are also recorded.

Syngenetic Inclusions:- The diamond paragenesis at Pipe 50 is overwhelmingly peridotitic, only one eclogitic diamond being recovered during the examination period. Olivine and chromite dominate over all other minerals, but chrome diopside has an unusually high and equal occurrence with pyrope garnet, enstatite and sulphides. In all, 59 inclusions were recovered from 55 diamonds. Analysis of individual and co-existing inclusions indicate that the paragenesis is strongly lherzolitic, with a very minor harzburgitic component. Olivines average Fo = 92.40 (n=20), enstatites, En = 93.00, (n=2), and chromites have average Cr203 contents of 65.16 wt%, (n=21). Only two of the 5 pyropes are harzburgitic, but the lherzolitic ones have up to 13 wt% Cr203). Chrome-rich lherzolitic clinopyroxenes (n=3), (approx. 1.50 wt% Cr203) co-exist with the most chrome-rich olivines (0.06wt % Cr203), but a fourth clinopyroxene is distinctly chrome-poor (0.40 wt%, when coexisting with pyrope (1.75 wt% Cr203). Sulphide inclusions (n=4), are confined only to pyrrhotite with exsolved pentlandite. The single eclogitic diamond turned out to be lherzolitic, containing a pale-orange, relatively high titanium (0.41 wt% TiO_2) garnet, (4.30 wt% CaO, 1.48 wt% Cr203), associated with a pale-green bimineralic inclusion of chrome poor (0.64 wt% Cr203) clinopyroxene and an orthopyroxene with a Fe/Fe+Mg ratio of 88.60.

Discussion:- The constancy in the proportion of **primary** shapes with size for the overwhelmingly peridotitic diamond paragenesis at Pipe 50, implies a very constant nucleation rate and growth for these diamonds. This result may also be a general feature of such diamond populations, as similar graphs have been recorded for the peridotitic diamonds at Finsch and DeBeers Pool mines in Kimberley, (Harris et al 1984).

If upward moving magmas of kimberlite or lamproite release diamonds from disaggregating xenoliths, as proposed by Robinson et al (1989), then evidence from diamond size distribution characteristics, (Deakin and Boxer, 1989), suggests that very large numbers of small diamonds will be released in the final stages of this disaggregation. Whilst many of these diamonds may undergo resorption to extinction, the small proportion that remains is numerically substantial and hence, small sharp-edged crystals are easily recognised in a diamond population. At Pipe 50, diamond size distribution may play a part in accounting for the unresorbed smaller diamonds, but more probably the unresorbed larger diamonds, are protected either by the xenolith, or if released, because there is insufficient oxygen activity in the magma to cause resorption. Of these two proposals, the second is favoured for Pipe 50, because diamonds of such a wide range of sizes, are unlikely to be released from xenoliths all at once.

The proportional increase in sharp-edged octahedra with decreasing size is not thought to be caused by a new influx of diamonds, as considered by Haggerty (1986). The 30% increase in octahedra at Pipe 50, is not accompanied by any similar increase in the total octahedral content, nor is there any increase in the total macle proportion, both likely consequences if a second diamond population was present. Also, particular attention was paid to the recovery of inclusions from sharp-edged smaller crytals, and no obvious differences in mineralogy or chemistry were noted between them and inclusions recovered from larger more rounded crystals.

Inclusions belonging to the lherzolitic paragenesis, are usually, either rare, or if more substantially present in a specific diamond population, associated with a dominant eclogitic paragenesis, (see e.g. Otter and Gurney, 1989). At Pipe 50, not only are eclogitic inclusions absent, but lherzolitic diamonds constitute the major paragenesis.

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