A COMPARISON OF CHARACTERISTICS OF DIAMONDS FROM THE ORAPA AND JWANENG KIMBERLITE PIPES IN BOTSWANA

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INTRODUCTION

As part of a continuing research programme to define diamond populations from kimberlites and lamproites, the physical characteristics of the diamonds from the Jwaneng and Orapa mines in southwest and northeast Botswana, respectively, have been classified. As with previous investigations, the procedures used are those outlined by Harris *et al.* (1975) with additional physical properties discussed in Harris *et al.* (1984) also being applied. With one exception, the results are determined as a function of diamond size. In all, five characteristics are used to define the two diamond populations: crystal form, colour, ultraviolet fluorescence, levels of plastic deformation and, specifically in the -7+5 diamond sieve size classes (maximum circular sieve diameter ranging from 2.16 to 1.83mm), the syngenetic inclusion abundances.

CRYSTAL FORM

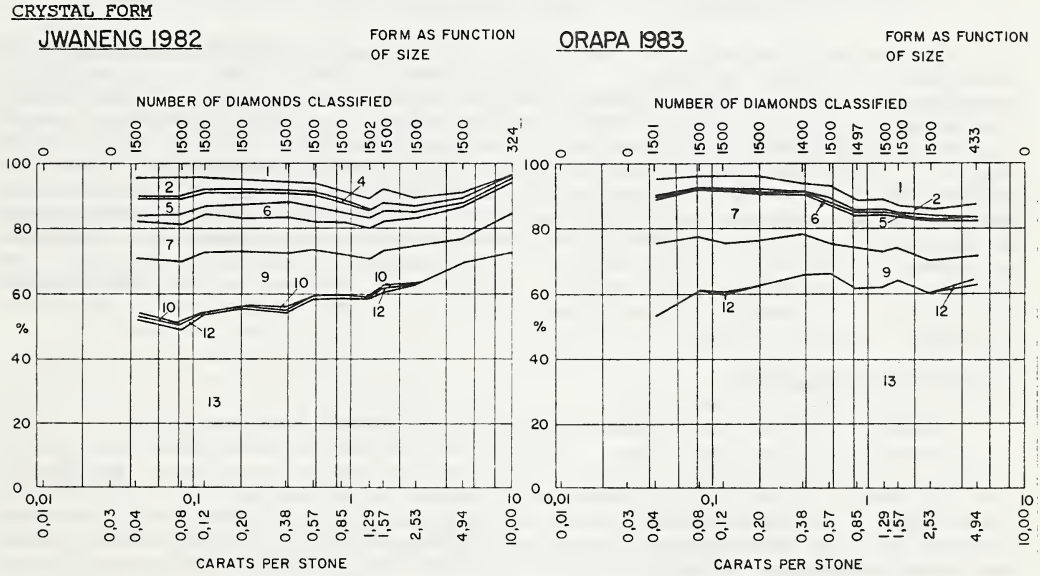

Fig. 1

1. octahedra; 2. dodecahedra; 4. cubo-octahedra; 5. cubo-dodecahedra; 6. cubes; 7. macles; 9. irregulars; 10. cubo-octa-dodecahedra; 12. tetrahexahedra; 13. polycrystalline aggregates. (For a full listing see Harris *et al.* (1984)).

At both mines aggregated diamonds comprise about 60% of the productions with cube or cube-related shapes constituting a significant minor form. The latter are

minor form. The latter are approximately four times more common (8%) at Jwaneng than Orapa. Other shape characteristics differ overall by less than 5%. A notable absence from both productions are flattened dodecahedra (see Fig. 1).

COLOUR

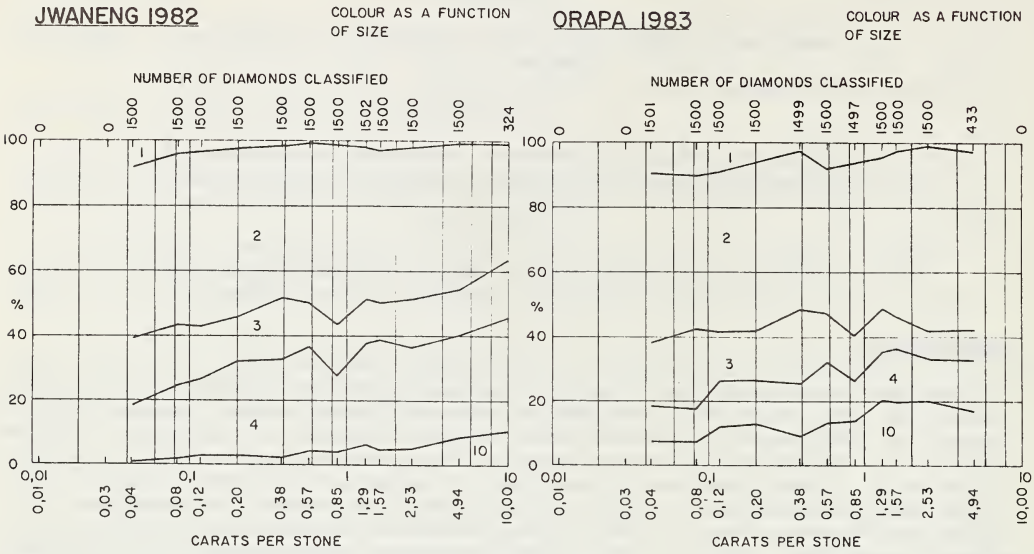

Fig. 2

1. colourless; 2. yellow; 3. brown; 4. transparent green-coated; 10. steel grey or grey. (For a full listing see Harris *et al.* 1984)).

The similarity between the proportions of colourless yellow and brown diamonds at both mines is evident in Figure 2. With increasing diamond size, the proportion of colourless diamonds steadily decreases from just under 10% to about 2%. Yellow diamonds have an equal overall average of 50%. The 17% proportion of brown diamonds at Jwaneng varies insignificantly with diamond size but a steady decrease is seen at Orapa from 25% to 9%. Principal colour variations are the 10% overall differences between the proportions of transparent green coated and grey diamonds. With the former, levels are constant at Jwaneng but slightly increase with increasing diamond size at Orapa. These proportional differences reflect local variations in the movement of radioactive groundwaters through the epiclastic sediments above the diatremes from which the diamonds were recovered. The distinct proportional increase in steel grey and grey diamonds with increasing diamond size corresponds to the higher levels of bort or industrial diamonds at Orapa than Jwaneng.

ULTRAVIOLET FLUORESCENCE

Figure 3 shows distinct characteristics with diamonds from Jwaneng being 40% less fluorescent than those from Orapa. Light blue fluorescence predominates with yellow, orange and green fluorescence constituting less than 10% for both mines (see Fig. 3). The dominance of light blue fluorescence is related to the dominance of yellow diamonds (see before). The marked differences in fluorescence levels, however, suggests that at Jwaneng, nitrogen impurities in N3 centres (which mostly give rise to yellow diamonds) are also accompanied by high levels of nitrogen in A-centres, because the latter, quenchs blue luminescence and thereby makes a stone non-fluorescent (Davies and Thomaz, 1979).

PLASTIC DEFORMATION

Over the major part of both productions plastic deformation levels are independent, of diamond size, averaging 8.05% (σ 1.19) at Jwaneng and 11.73% (σ 1.99) at Orapa. For both mines no specific relationship between diamond colour and plastic deformation was

found. The present values are the lowest so far recorded and, as elsewhere, show that deformation largely post-dates diamond formation (see Harris *et al.* (1984)).

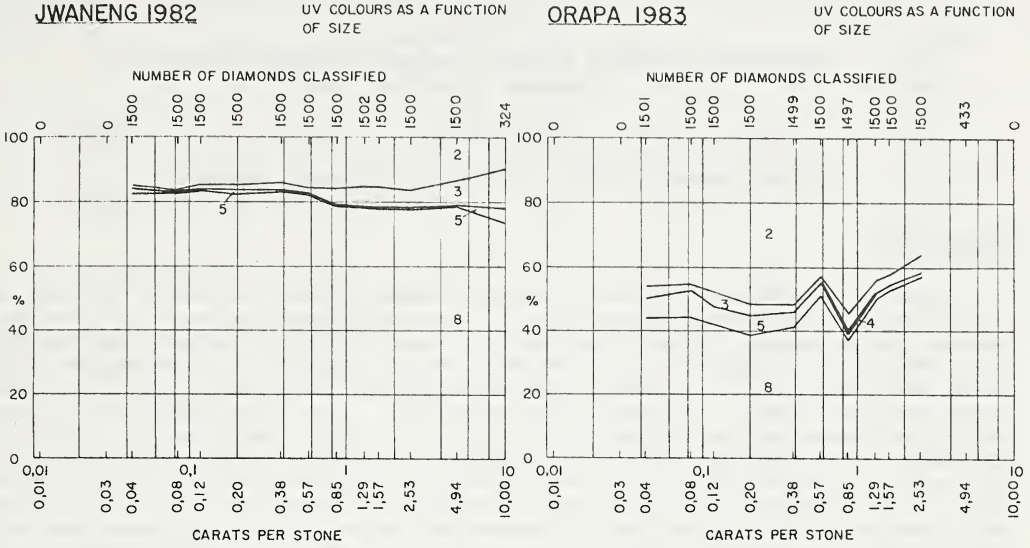

Fig. 3

2. light blue; 3. yellow; 4. green; 5. orange; 8. non-fluorescent.
(For a full listing see Harris *et al.* (1983)).

SYNGENETIC INCLUSION ABUNDANCES

A visual evaluation of tens of thousands of diamonds from both mines shows a distinct difference in inclusion abundance as follows:-

Jwaneng: eclogitic 38.5%; peridotitic 41.9%; sulphides 19.8%
Orapa: eclogitic 65.4%; peridotitic 19.6%; sulphides 15.0%

For Orapa, the proportions have been slightly modified after analysis of the inclusions (Gurney *et al.* (1984)) and in view of the high 'eclogitic' content of Jwaneng similar changes may also occur when these inclusions are analysed.

CONCLUSIONS

Compared to diamond production in other parts of southern Africa, distinctive characters at Jwaneng and Orapa are; 1) high levels of a) aggregated and cube-shaped diamonds, b) transparent green coated stones and c) light blue fluorescent diamonds; 2) the low levels of plastic deformation; and 3) a dominant eclogitic inclusion suite at Orapa and equally high eclogitic and peridotitic paragenesis at Jwaneng.

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