MORPHOLOGICAL, RESORPTION AND ETCH FEATURE TRENDS OF DIAMONDS FROM KIMBERLITES WITHIN THE COLORADO-WYOMING STATE LINE DISTRICT, USA.

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Nearly 1700 carats of diamonds were recovered during company bulk testing of kimberlite occurrences in the State Line District of the Colorado-Wyoming Kimberlite Province. Representative splits of parcels from each locality are being evaluated both physically and chemically along with mineral inclusions, but physical properties are emphasized in this study. Morphological and surface texture characteristics are being described in detail to generate data that may provide insight into the genesis and resorption history of this unique North American diamond suite. Parcels from seven occurrences (Aultman, Maxwell, Schaffer, Chicken Park, George Creek, Sloan 1 & 2, Sloan 5 & 6) (Fig. 1) are included in the evaluation (includes all stones in small parcels and several thousand stones overall). The classification system established by D.N. Robinson (1979) was utilized with modifications.

Degree of stone resorption was established by the method devised by D.N. Robinson to determine the relative percentage of resorption or preservation (Otter and Gurney, 1989). Stones are divided into six classes on the basis of transitional forms between non-resorbed octahedra or cubes (Class 6) and fully developed tetrahexahedra (Class 1) which reflect minimum mass loss of 45% (Robinson, pers. commun., 1984) (Fig. 2, Table 1). Transitional (Class 2-5, 55-99% preserved) and tetrahexahedroid (THH: Class 1, < 55% preserved) forms predominate over octahedra (Class 6, 99-100% preserved) and all occur as single crystals, macles, interpenetrants, and simple and multicrystalline aggregates. Some cubo-octahedra and very rare cubes also were recognized. Single crystal forms dominate all parcels but aggregates and macles are least abundant at the Maxwell and Chicken Park sites and most abundant at George Creek and Sloan. The majority of the diamonds originated as octahedra but differential resorption between kimberlite localities is reflected by the greater proportion of Class 1 and 2 stones (< 70% preservation) at the Maxwell, Aultman, Schaffer, Sloan and Chicken Park sites than at George Creek (> 37% versus ca. 10% in single crystals). Diamonds at all localities exhibit a decrease in degree of resorption with increase in stone size.

A very small proportion of the diamonds district-wide are regularly shaped and more than half of all stones are chipped or broken. Both larger and brown crystals appear to have a greater tendency to breakage, but this property is not exclusive. Although brown crystal color commonly is considered a result of diamond deformation (Robinson, 1979; Robinson et al., 1989), which would favor breakage, many of the best developed deformation textures present in State Line stones occur in colorless crystals that comprise a much smaller proportion of the population (brown > 50% at most localities, colorless < 10%). More than 50% of the Maxwell, Schaffer, Sloan and George Creek diamonds are brown; 70-80% of the Maxwell and Schaffer stones exhibit deformation features, whereas only about 15% of the George Creek stones and 2% of Sloan stones show such features. Strain features in George Creek stones most typically occur as wide deformation lamellae in large colorless crystals. Furthermore, deformation features are present in 75% of the Aultman stones, only 27% of which are brown. Brown colors range from very pale to dark cognac and tend to be more prevalent in smaller stones. Other colors recorded include various shades of gray, amber, yellow and rare pink and green.

In addition to deformation features, more than 40 surface textures are described and these are principally products of resorption and secondary etching (corrosion) processes. Most are rather uniformly represented throughout the diamond parcels, but a few have very restricted distribution. Corrosion sculpture is significant only at the Sloan 2 and Chicken Park sites where it is present on 20% and > 50% of the stones respectively. This apparently is a late phase etch feature that was generated by shallow corrosive root zone activity in a dike and blind diatreme system respectively. However, no corrosion sculpture was observed in diamonds from the George Creek dikes that clearly reflect a root zone environment. The lower degree of resorption (mostly class 4 and 5) thus more limited development of textrahexahedroid (THH) surfaces would have retarded development of corrosion sculpture on the George Creek stones. Instead, most George Creek diamonds are characterized by well developed etch sculpture (mosaic of deep trigonal and hexagonal etch pits that generally range from 30 to > 100 microns and cover stone surfaces) which apparently also formed in the dike system. Formation of this feature is favored by larger octahedral surfaces (low resorption) and any minor corrosion sculpture that may have been present would have been obliterated. The etch sculpture probably was initiated in a high T (> 950°C) steam-CO_2 rich melt which was progressively enriched in O_2 with decreasing temperature.

Correlation of mineral inclusion and diamond chemistry data, as they become available, with the physical properties of the respective stones will permit us to interpret the relationships between diamond source and genesis with morphology, resorption and etch features. This should provide information regarding processes that were active deep under North America prior to the late Devonian eruption of the State Line kimberlites.

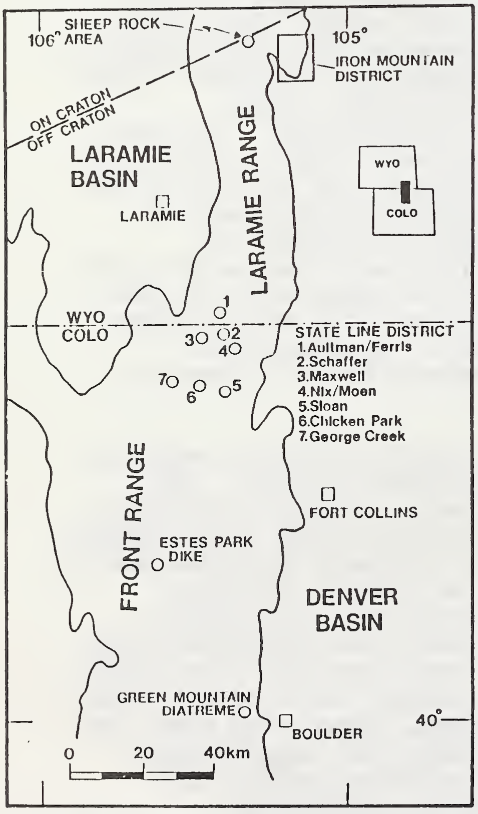

FIGURE 1. Location map of kimberlite occurrences in the Colorado-Wyoming Kimberlite Province. Front and Laramie Range area underlain by Precambrian crystalline rocks, Basin areas underlain by post-Devonian sedimentary rocks. On craton-off craton line marks boundary between Archean and Proterozoic crustal rocks.

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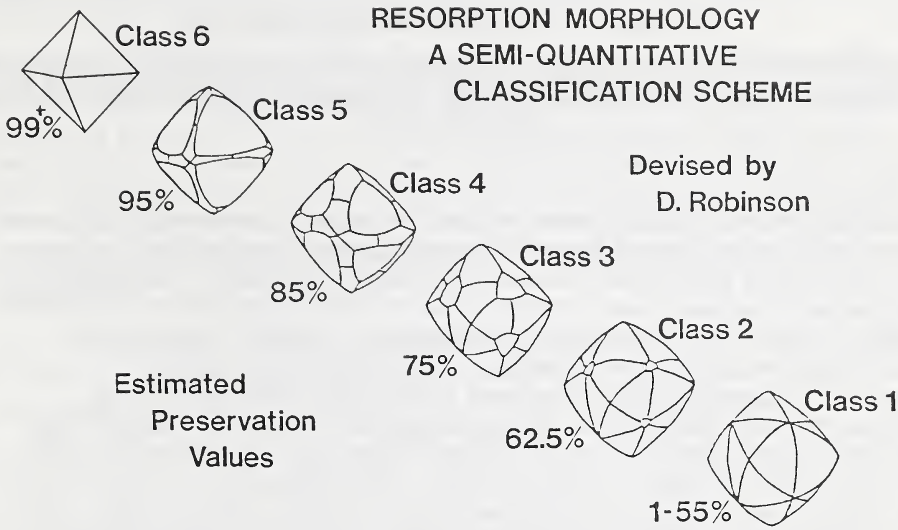

FIGURE 2. Estimated preservation values of progressively more resorbed octahedra (Modified from D.N. Robinson, pers. commun., 1984, and Otter and Gurney, 1989).

TABLE 1. Resorption morphology classification (Modified from D.N. Robinson, pers. commun., 1984, and Otter and Gurney, 1989). Based on relative percentage of preservation of stones converted by resorption from octahedra (or cubes) to tetrahexahedra.

Class	Percent Preservation	Form
1	1-55	Tetrahexahedra*
2	55-70	"Rounded-dodecahedra"
3	70-80	"Octahedra-dodecahedra"
4	80-90	"Rounded-octahedra"
5	90-99	Octahedra
6	99-100	Planar octahedra

*May include spheres