

A STUDY OF UNUSUAL DIAMONDS
FROM THE GEORGE CREEK K1 KIMBERLITE DYKE, COLORADO.

VOLUME II
FIGURES, TABLES AND APPENDICES

by
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DOCTOR OF PHILOSOPHY

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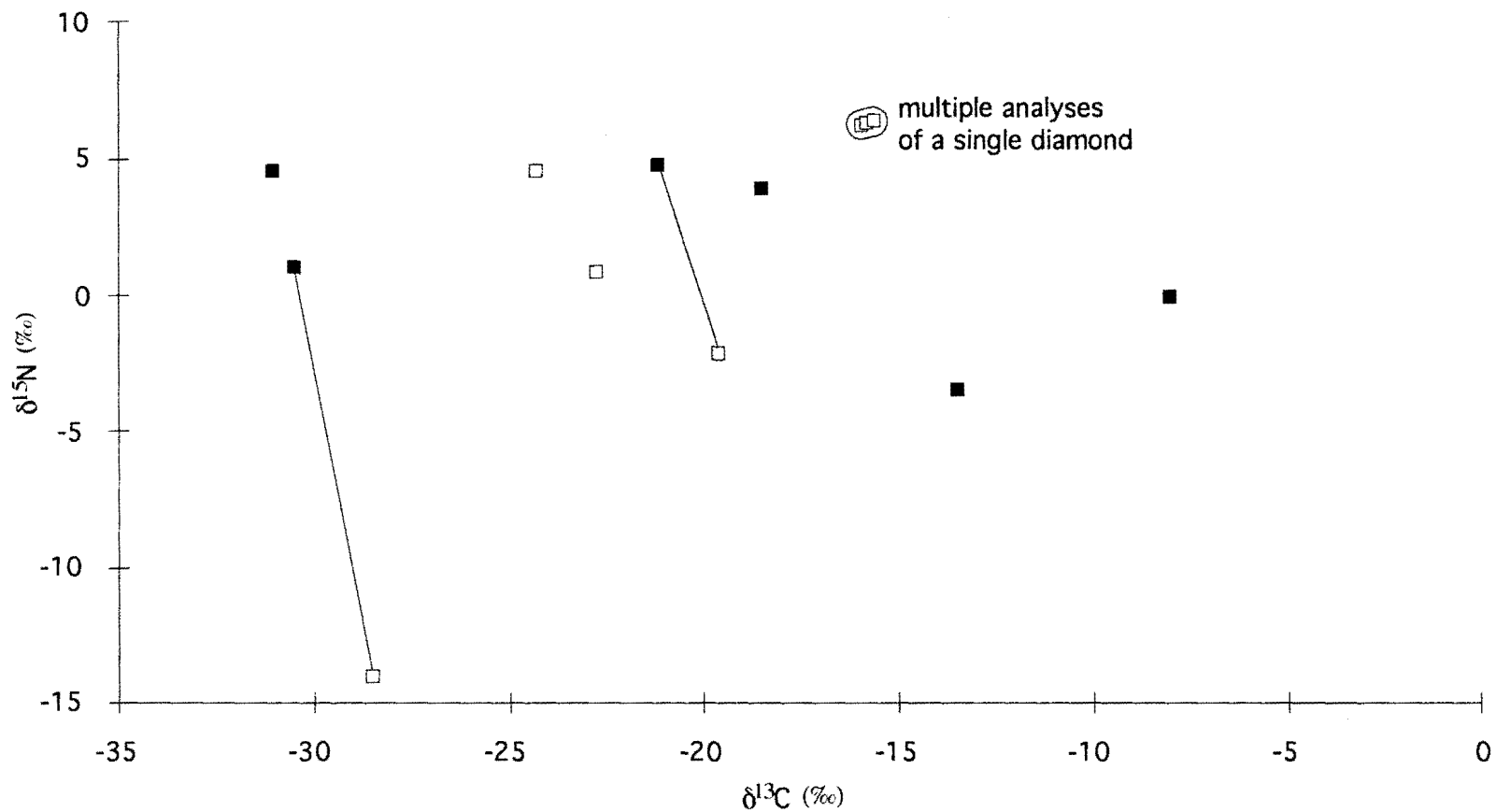


Fig. 1.1. Distribution of the stable isotope compositions of selected diamonds from the George Creek kimberlite. Carbon and nitrogen isotope compositions are presented in the customary $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ notation versus PDB and atmosphere standards respectively. Solid symbols denote CO_2 -bearing diamonds, and tie lines connect CO_2 -bearing and CO_2 -free fractions of the same diamond. Analyses were performed by J. M. Gibson at the Open University. Errors are smaller than the plot symbols.

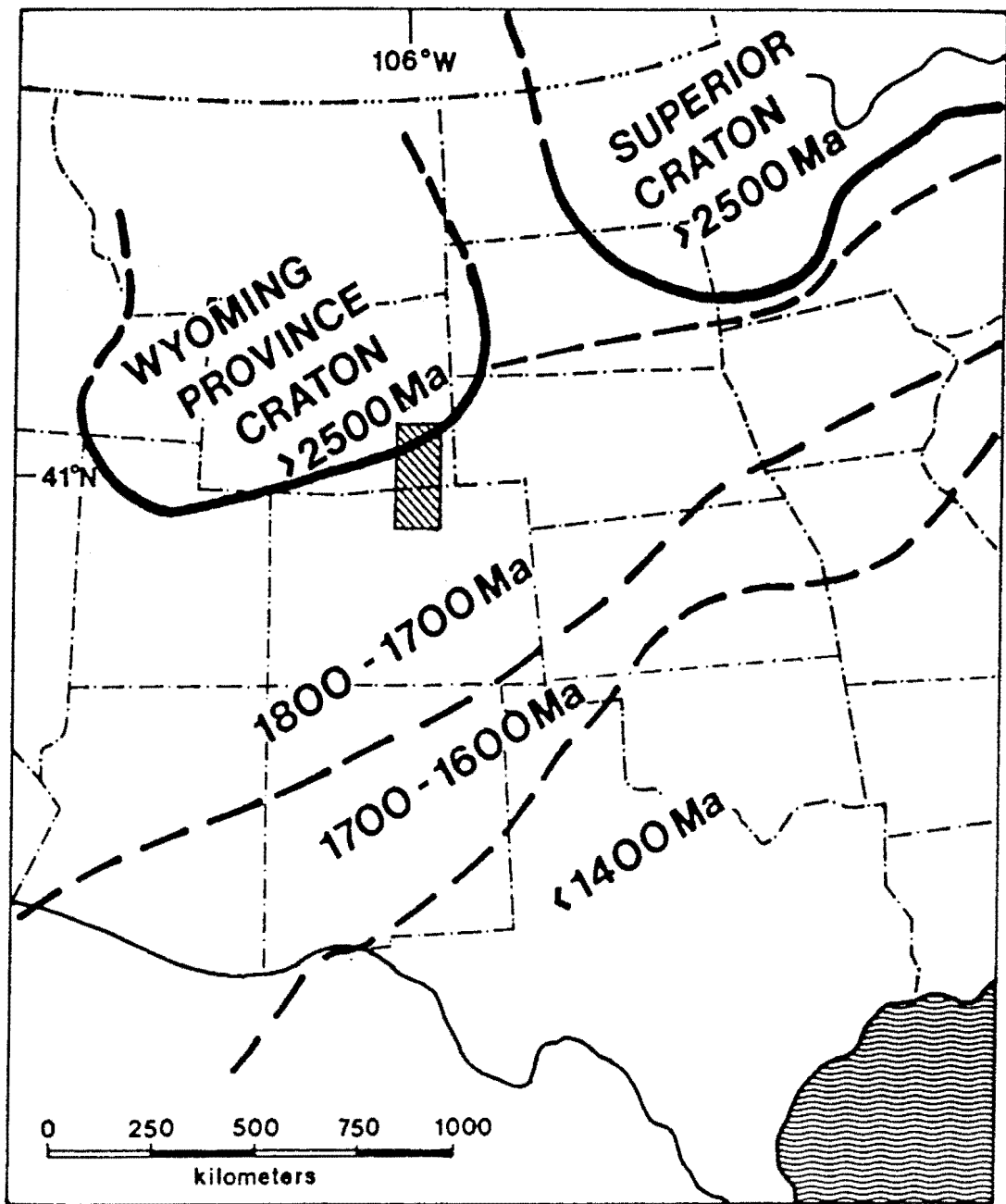


Fig. 2.1. Generalized sketch map showing the setting of the Colorado-Wyoming Kimberlite Province.

Proterozoic rocks accreted during collision with the Archaean Wyoming Province decrease in age to the southeast, away from the suture zone.

The hatched area marks the approximate position of the Colorado-Wyoming kimberlite province.

Modified from Karlstrom and Houston (1984) by Otter (1990).

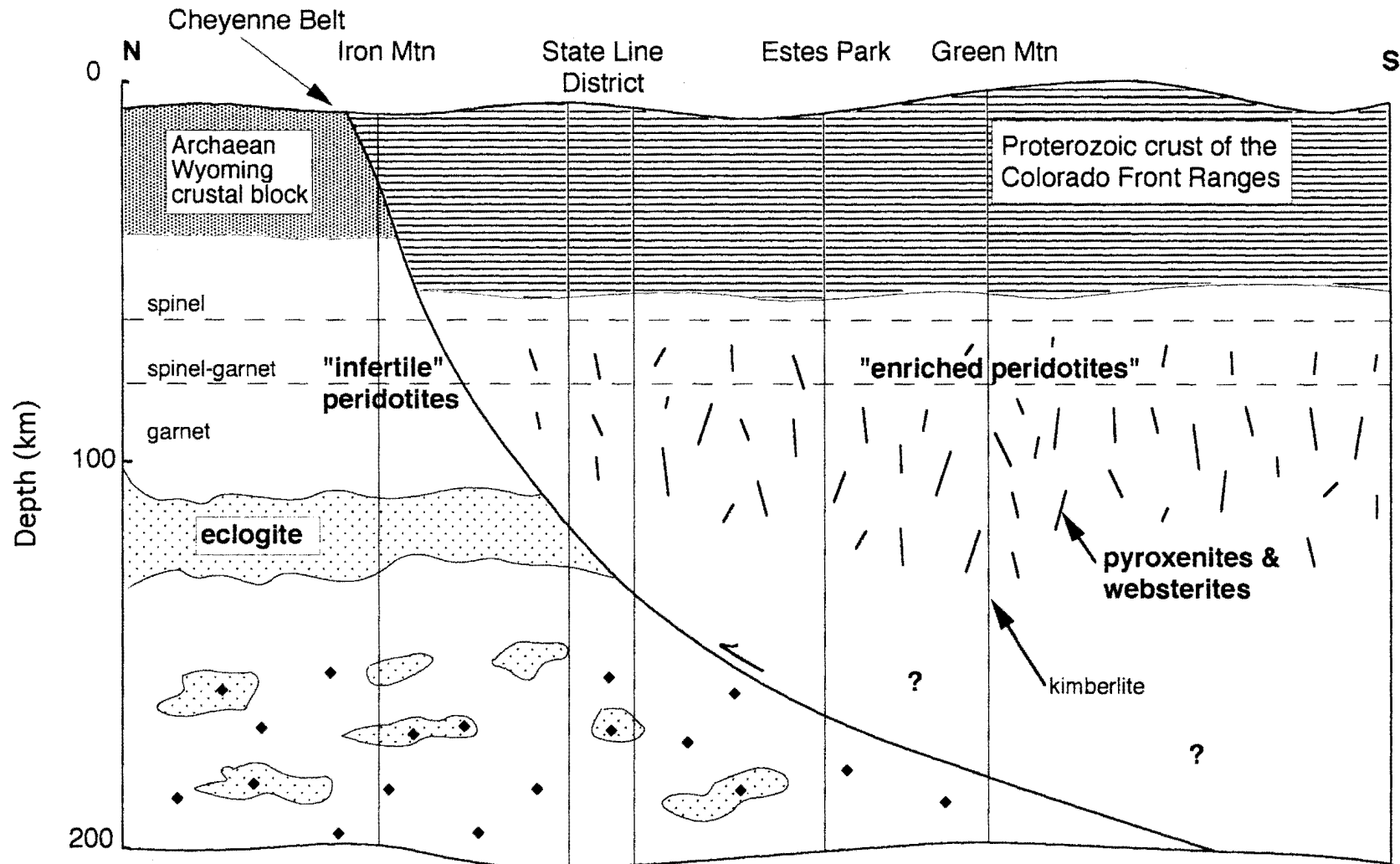


Fig. 2.2. Simplified cross-section of the Colorado-Wyoming lithospheric mantle during the Devonian period. Modified after Egger *et al.* (1988). The approximate positions of the spinel-, spinel-garnet - and garnet peridotite stability fields are illustrated by dashed lines. The tectonic juxtaposition of Archaean and Proterozoic lithologies is clearly evident. The model of Egger *et al.* (1988) does not show any eclogite bodies in the Proterozoic terrane, although this is considered unlikely because of the abundance of eclogite xenoliths and eclogitic diamonds recovered from the State Line kimberlites.

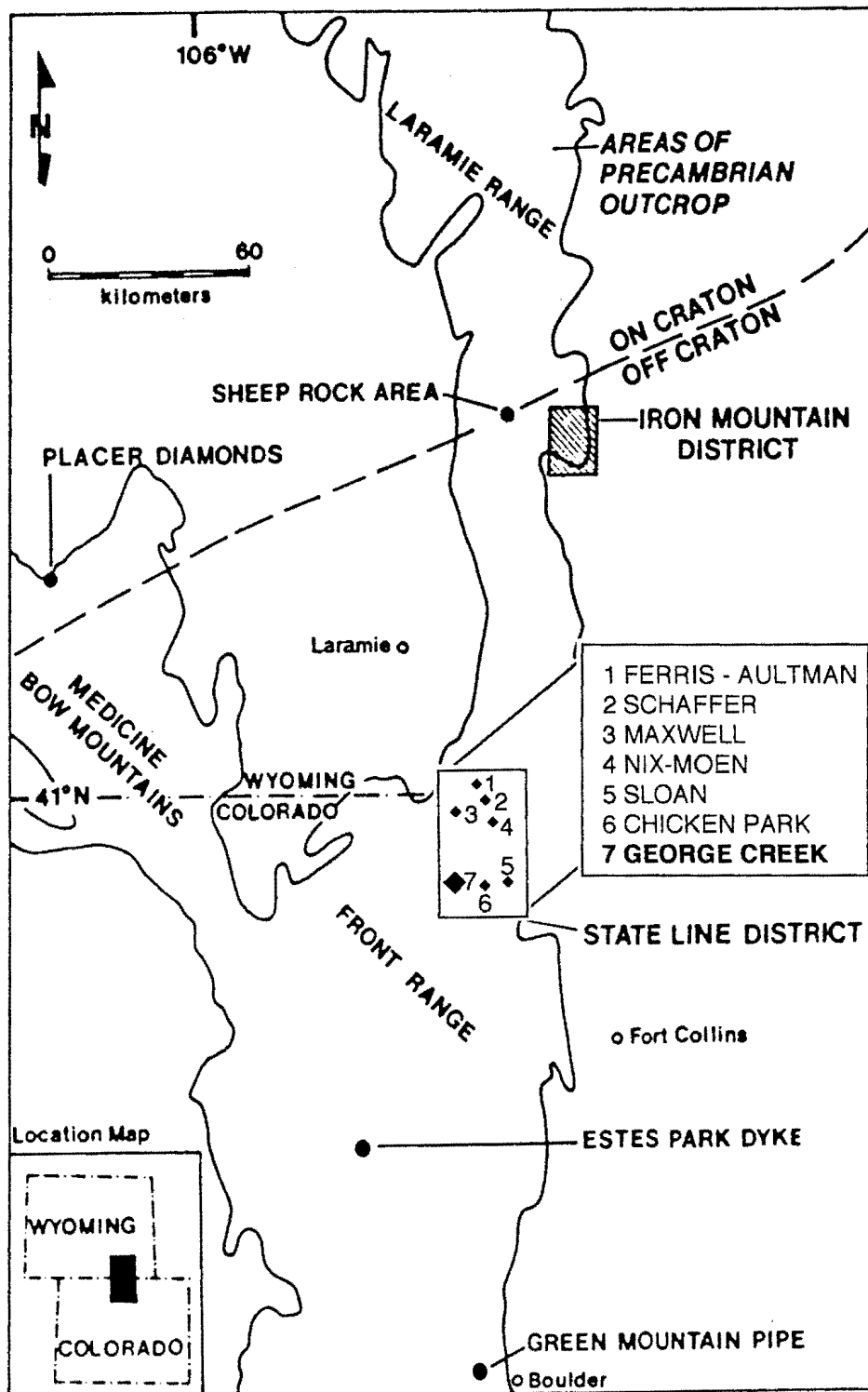


Fig. 2.3. Simplified sketch map showing the location of the George Creek dyke system in relation to other kimberlite occurrences in the Colorado-Wyoming Kimberlite Province.
 The tectonic suture between rocks of the Archaean Wyoming Province and Proterozoic rocks which were accreted during continent-island arc collision is shown as a dashed line marked "on craton-off craton".
 Modified from Otter (1990) and McCallum (1991).

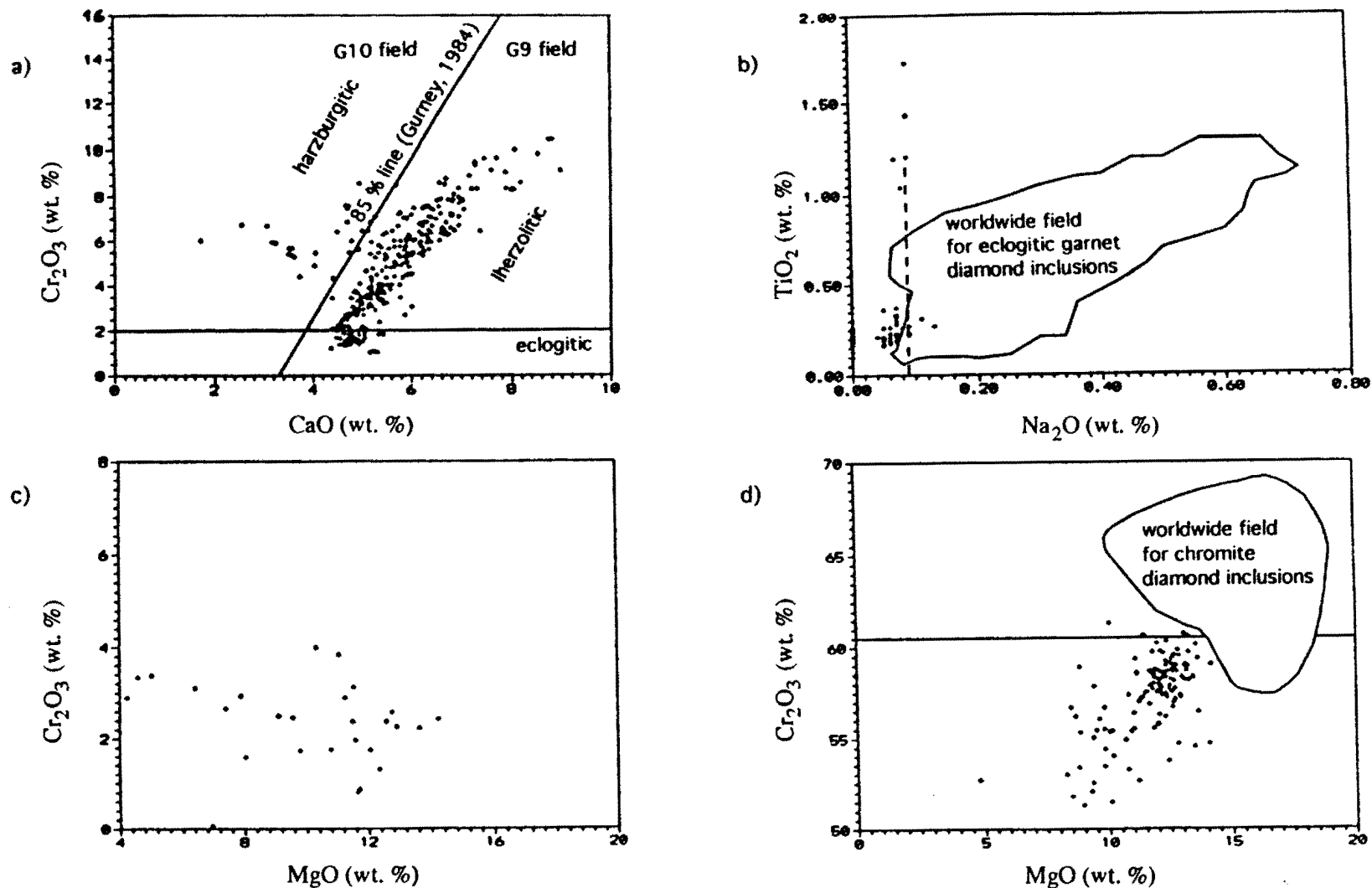


Fig. 2.4. Compositional variations of heavy minerals recovered from the George Creek dyke system, as an indication of potential diamond grade. a) A significant number of peridotitic garnets have Cr and Ca contents which fall within the sub-calcic G10 field of Gurney (1984), implying the existence of diamonds of the harzburgitic sub-paragenesis. b) The presence of diamonds of the eclogitic paragenesis is indicated by six garnets which plot within the worldwide field for eclogitic diamond inclusions, in terms of Ti and Na content. c) Ilmenite compositions rich in both Cr and Mg imply low oxygen fugacity conditions conducive to diamond preservation, whereas Cr-rich, Mg-poor compositions imply higher oxygen fugacity conditions which would have resulted in diamond resorption. d) None of the chromites recovered from the George Creek kimberlite system plots within the worldwide field for chromite diamond inclusions, indicating a low potential for diamonds of the peridotitic paragenesis. Plots are modified from McCallum and Waldman (1991).

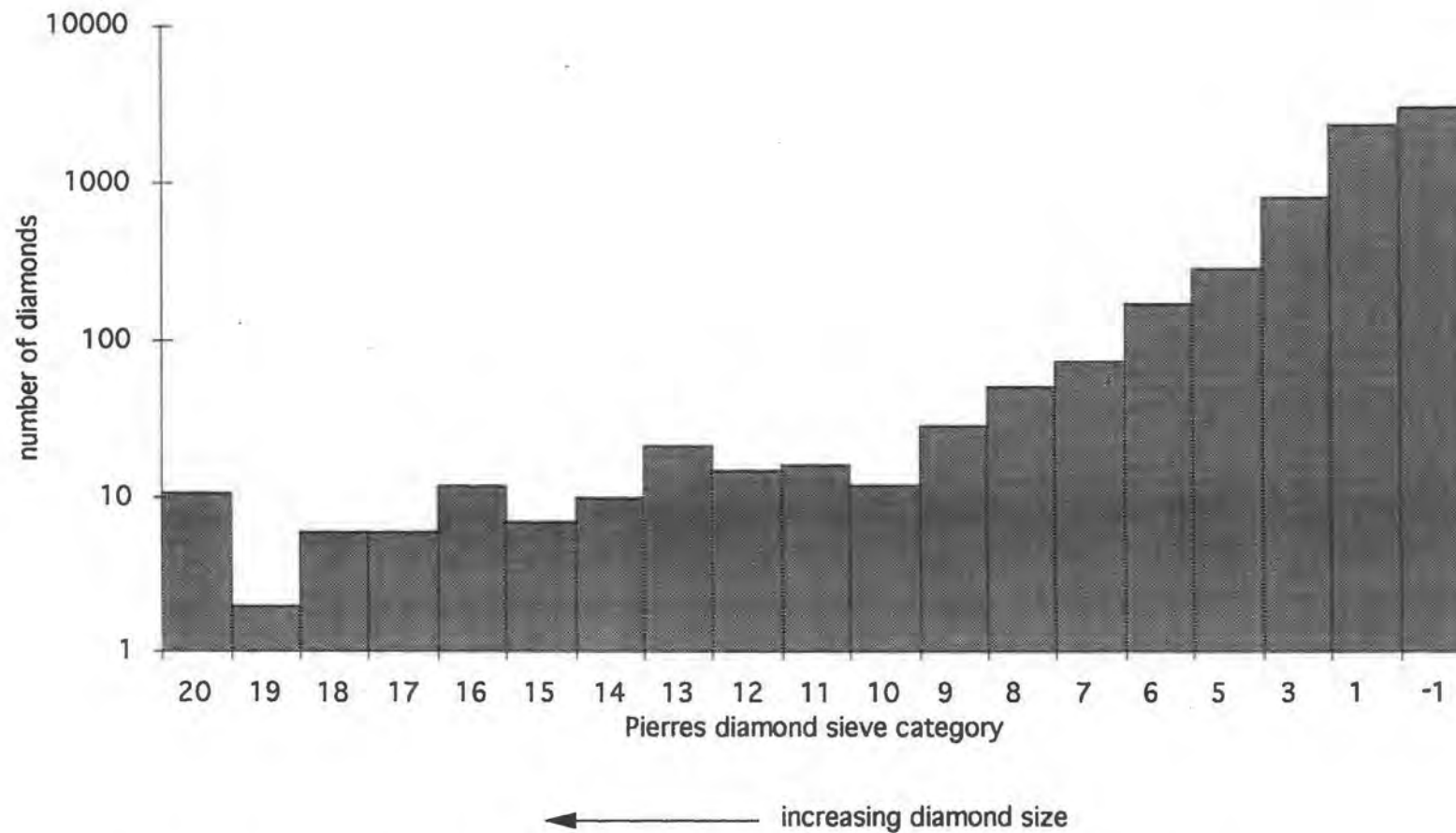


Fig. 3.1. Size distribution of the total study sample of 99.79 carats of diamonds from the George Creek K1 kimberlite. This plot includes diamonds not described from the -6 to -1 sieve categories, in order to show the approximately lognormal size distribution. Deviation from a lognormal distribution is due to the preferential incorporation of large, inclusion-bearing diamonds (generally larger than sieve category 10) in the study sample.

facing page:

Fig. 3.2. SEM photomicrographs of George Creek diamonds.

representative morphologies

- a) Unresorbed and unetched octahedron with smooth faces and sharp edges.
- b) Heavily-etched simple aggregate comprising two interpenetrant octahedra.
- c) Triangular macle with coarse trigonal etch pits (trigons) and pitted hemispherical cavities.
- d) Diamond aggregate comprising macle twins separated by deep ruts.
- e) High magnification photomicrograph of a macle twin plane distinguished by a "herring-bone" pattern of intersecting octahedral growth layers.
- f) CO₂-bearing diamond of modified cubic form with tetragonal etch pits and a deep rut. The cubic region contains sub-microscopic CO₂ inclusions, whereas the uppermost region of uncertain resorbed morphology lacks CO₂ inclusions.
- g) Well-resorbed and lightly-etched diamond aggregate.
- h) Resorbed CO₂-bearing diamond of unusual morphology similar to that of a diamond from Sloan kimberlite which was described as a pseudo-rhombic dodecahedron by Otter (1990). The morphology of this diamond was classified as uncertain.

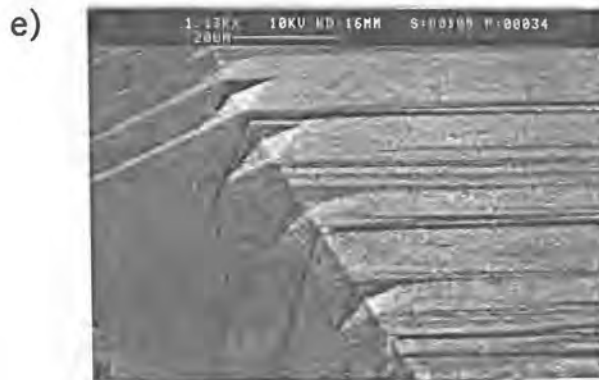
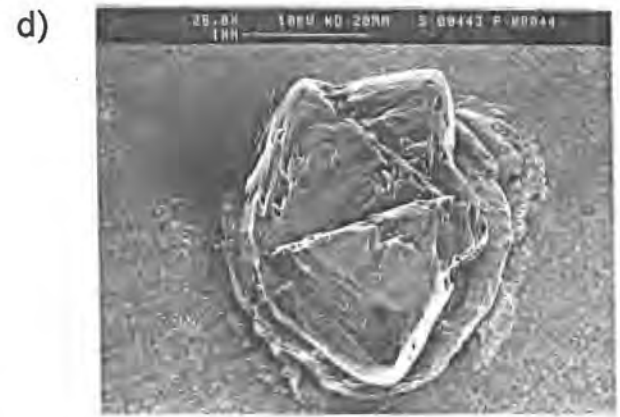
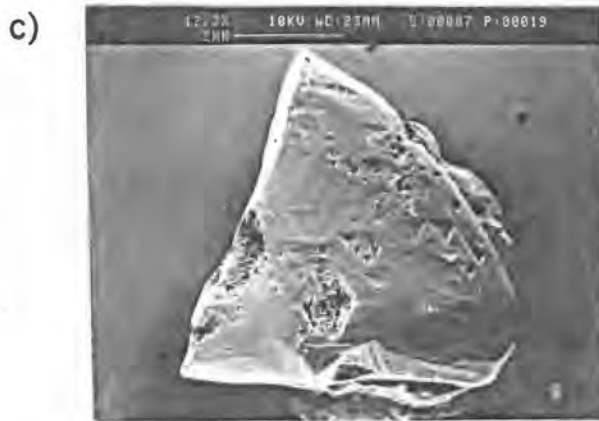
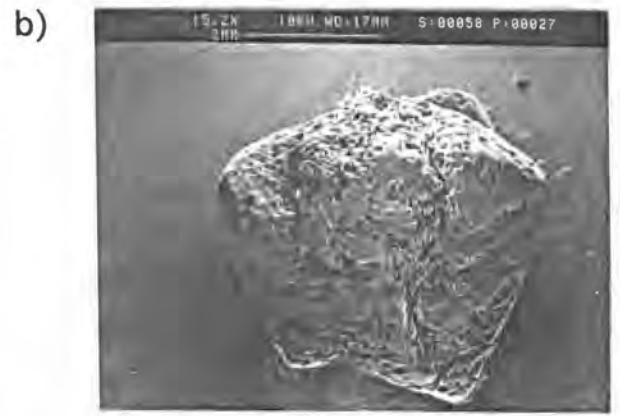


Fig. 3.2. SEM photomicrographs of George Creek diamonds.

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Fig. 3.2. SEM photomicrographs of George Creek diamonds cont...
growth features, deformation features, fracture and cleavage surfaces

- i) High magnification photomicrograph of triangular plates on an unresorbed diamond. The triangular plates have positive relief, unlike trigons.
- j) Knob-like asperities on the surface of an unresorbed diamond.
- k) Prominent wide lamination lines along which displacement has occurred as a result of extreme plastic deformation during diamond mantle residence time.
- l) “Scotch-plaid” texture of intersecting wide and fine lamination lines on a resorbed diamond surface.
- m) Irregular fracture surface on a diamond revealing internal layering from octahedral growth zones.
- n) Sub-conchoidal diamond fracture surface.
- o) High magnification photomicrograph of a cleavage surface.
- p) Inclusion cavity of well-faceted cubo-octahedral morphology contained within a large trigonal etch pit on a resorbed cleavage surface.

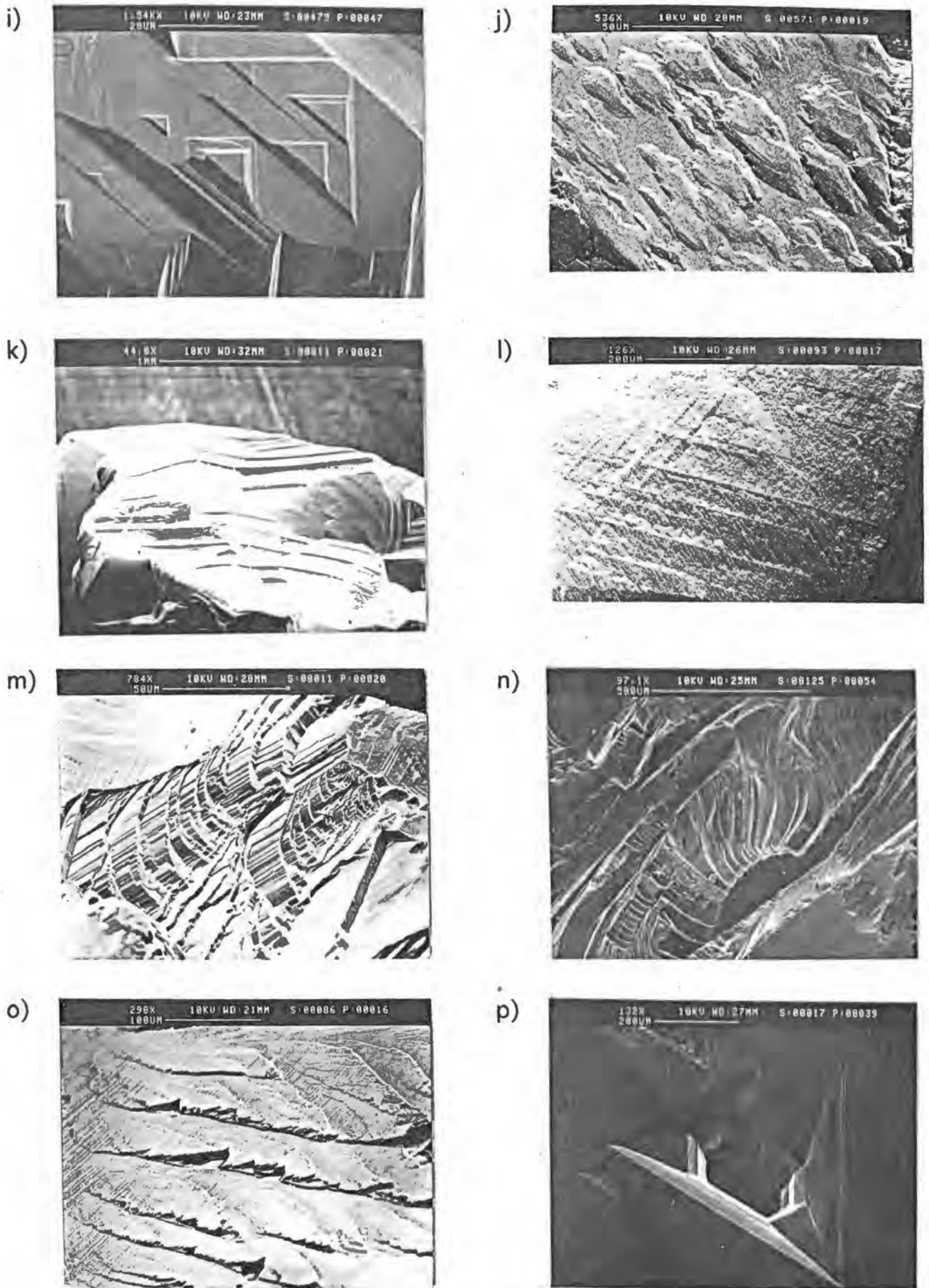


Fig. 3.2. SEM photomicrographs of George Creek diamonds.

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Fig. 3.2. SEM photomicrographs of George Creek diamonds cont...

Resorption features

- q) Resorbed, flattened dodecahedron with low relief surfaces and scarce ruts and etch pits.
- r) Resorbed and heavily-etched macle with a clearly-defined macle line which has been accentuated by resorption.
- s) Diamond aggregate of resorbed and etched morphology typical of many diamonds from George Creek.
- t) Well-resorbed diamond aggregate with low relief surfaces and deep ruts between individual crystals.
- u) Well-resorbed, flattened diamond aggregate with poorly-defined elongate hillocks and imbricate wedges on resorption surfaces. Deep ruts and scarce coarse etch pits may also be seen.
- v) Diamond showing differential etching and resorption on different faces.
- w) High magnification photomicrograph of elongate hillocks and micro-hillocks on a resorption surface.
- x) Elongate hillocks on resorption surfaces which meet at a triad axis of symmetry.

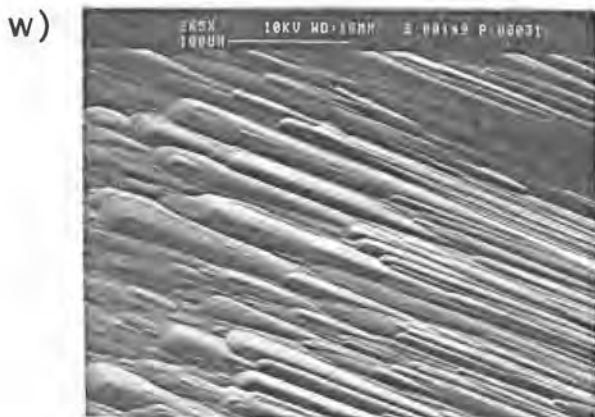
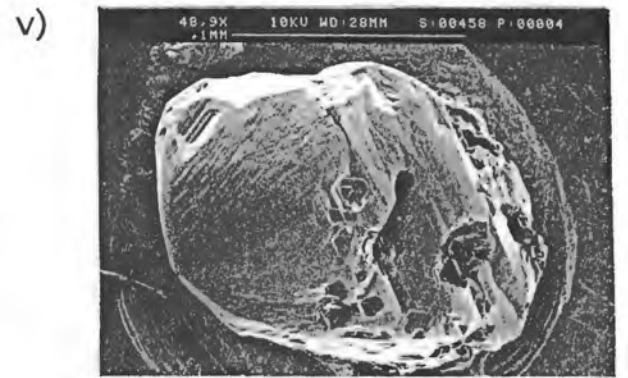


Fig. 3.2. SEM photomicrographs of George Creek diamonds.

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Fig. 3.2. SEM photomicrographs of George Creek diamonds cont...

etch features

- y) Resorbed octahedral diamond with coarse etch sculpture (CES) defined by abundant trigonal etch pits with negative orientation.
- z) High magnification photomicrograph of trigonal etch pits showing the development of small etch pits within large etch pits.
- aa) Heavily-etched octahedral diamond with etch sculpture (ES) defined by abundant coalescing hexagonal and trigonal etch pits.
- ab) High magnification photomicrograph of a heavily-etched diamond with etch sculpture.
- ac) High magnification photomicrograph of a heavily-etched diamond with etch sculpture.
- ad) Shallow, flat-bottomed tetragonal etch pits and imbricate wedges (lower right corner) on a diamond resorption surface.
- ae) Tetragonal etch pits with pointed bottoms on a diamond cleavage surface.
- af) Diamond surface exhibiting irregular etch pits.

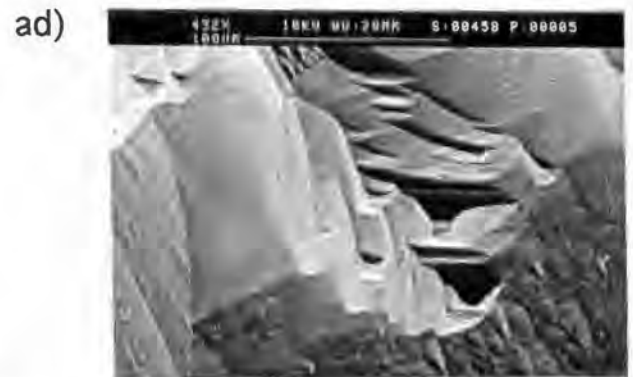
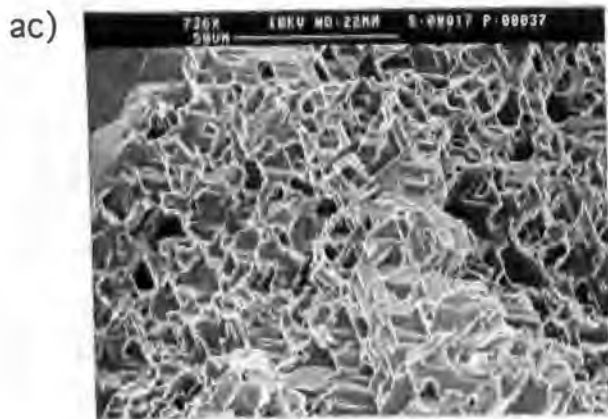
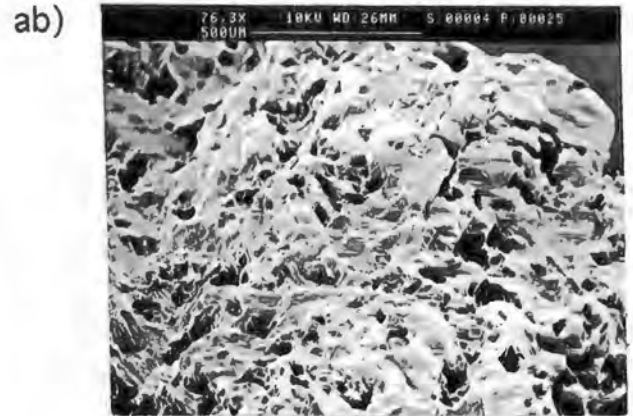
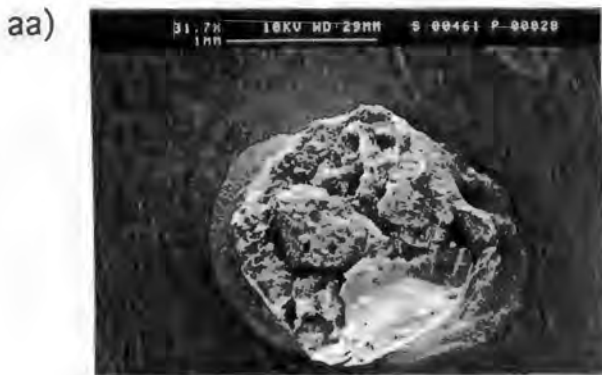
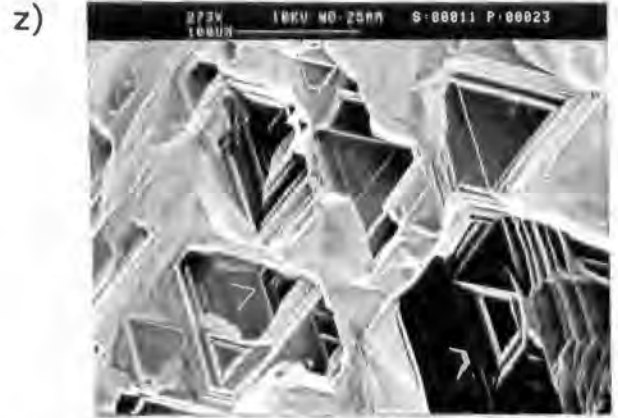
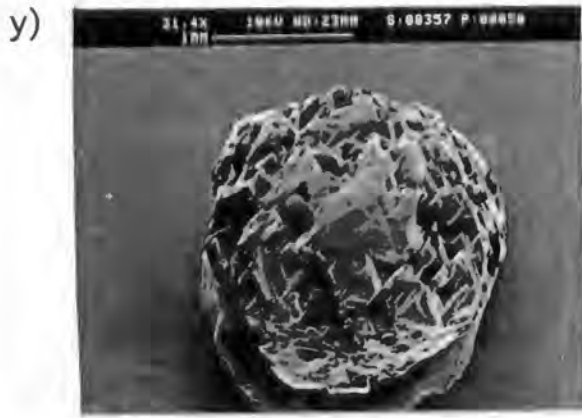


Fig. 3.2. SEM photomicrographs of George Creek diamonds.

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Fig. 3.2. SEM photomicrographs of George Creek diamonds cont...

Etch features cont.

- ag) Low magnification photomicrograph of the diamond illustrated in Fig. 3.2af, showing irregular etch pits and deep ruts.
- ah) Sinuous rut transecting a differentially-etched diamond. The most severe etching is associated with the rut, suggesting that the rut allowed relatively localized migration of the oxidizing fluid(s) responsible for etching.
- ai) Diamond transected by numerous ruts.
- aj) Well-etched simple diamond aggregate of two interpenetrant octahedra, with ruts separating the smaller crystal from the large crystal.
- ak) High magnification photomicrograph of the diamond aggregate illustrated in Fig. 3.2aj.
- al) Heavily-etched diamond with well-developed pitted hemispherical cavities that are thought to result from preferential etching of inclusion cavities.
- am) Corrosion sculpture on a lightly-resorbed diamond surface.
- an) High magnification photomicrograph of imbricate wedges on a diamond resorption surface.

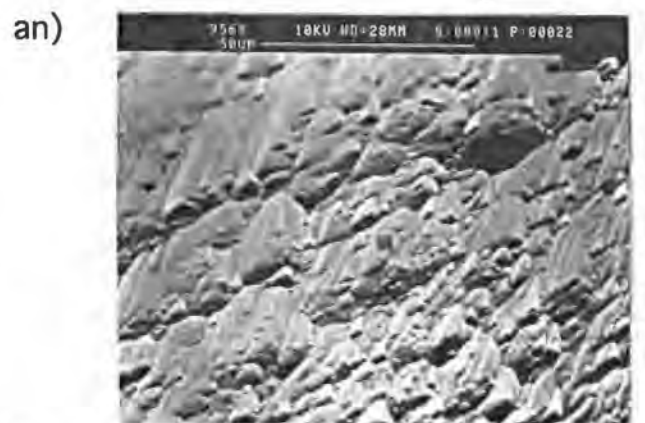
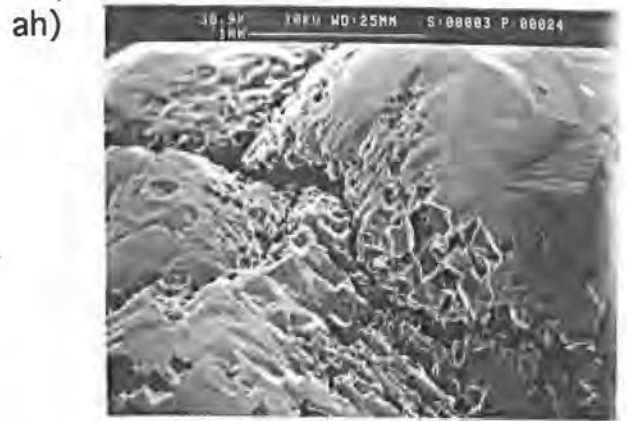


Fig. 3.2. SEM photomicrographs of George Creek diamonds.

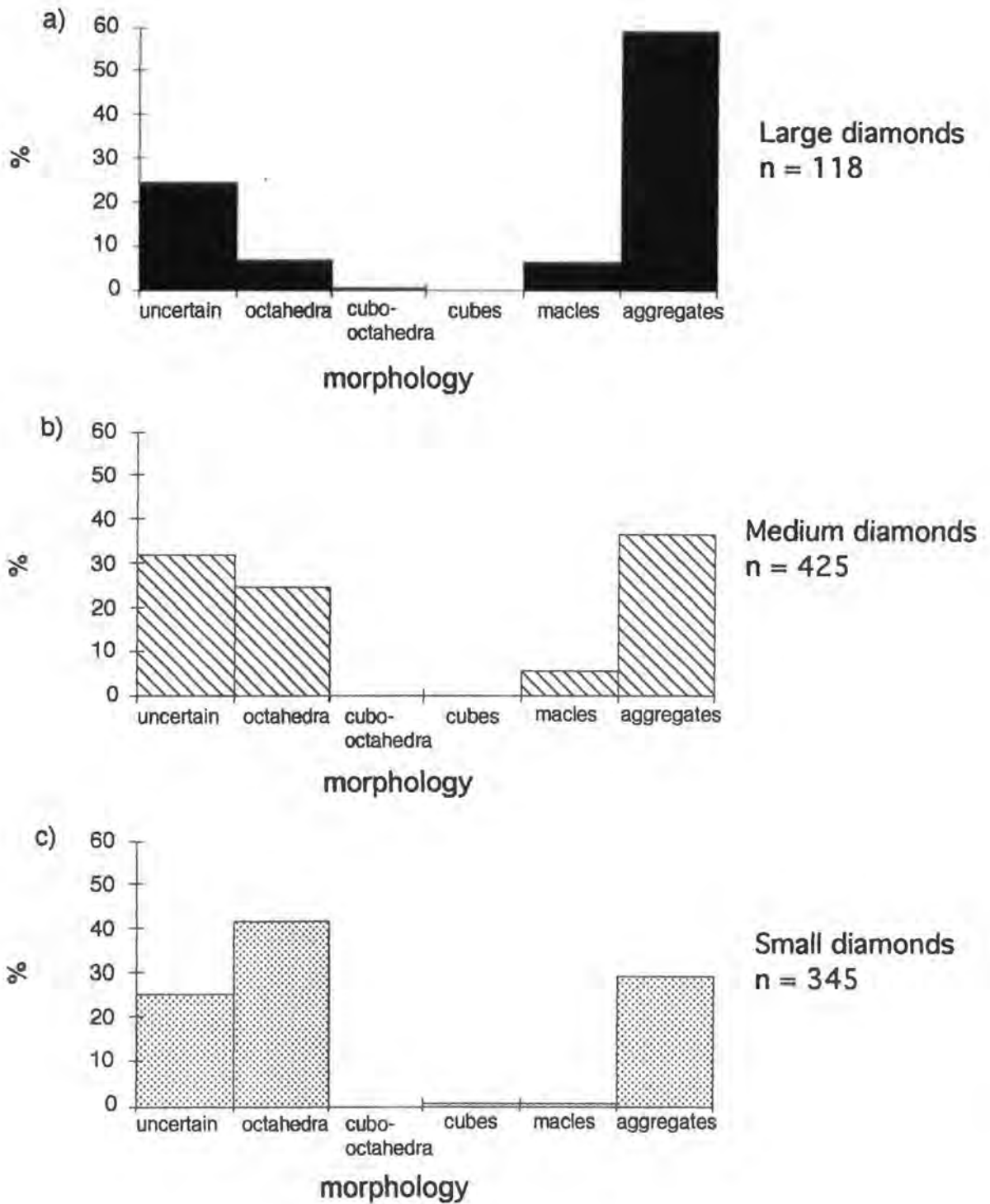


Fig. 3.3. Relationship between size and morphology for George Creek diamonds. The percentage of octahedral diamonds increases with decreasing diamond size, whereas the percentage of aggregates and macles decreases with decreasing diamond size.

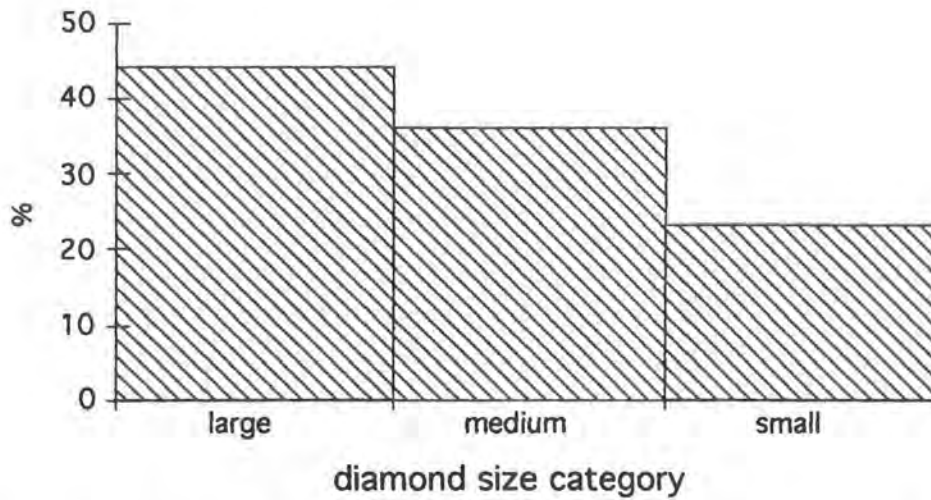


Fig. 3.4. Plot of the percentage of George Creek diamonds with aggregate morphology, and which contain a macle component, as a function of diamond size category. The decrease in abundance of aggregates containing macle components with decreasing size is similar to the trend for single crystals (see Fig. 3.3).

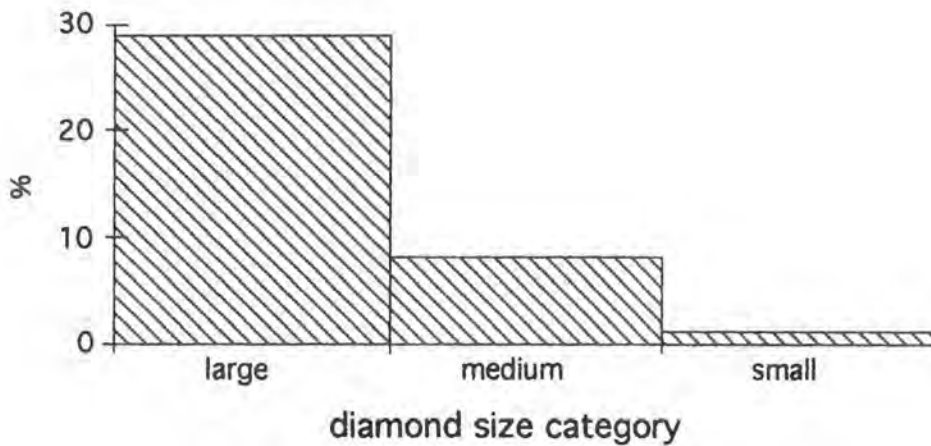


Fig. 3.5. Plot of the percentage of George Creek diamonds with surface features caused by plastic deformation, as a function of diamond size category.

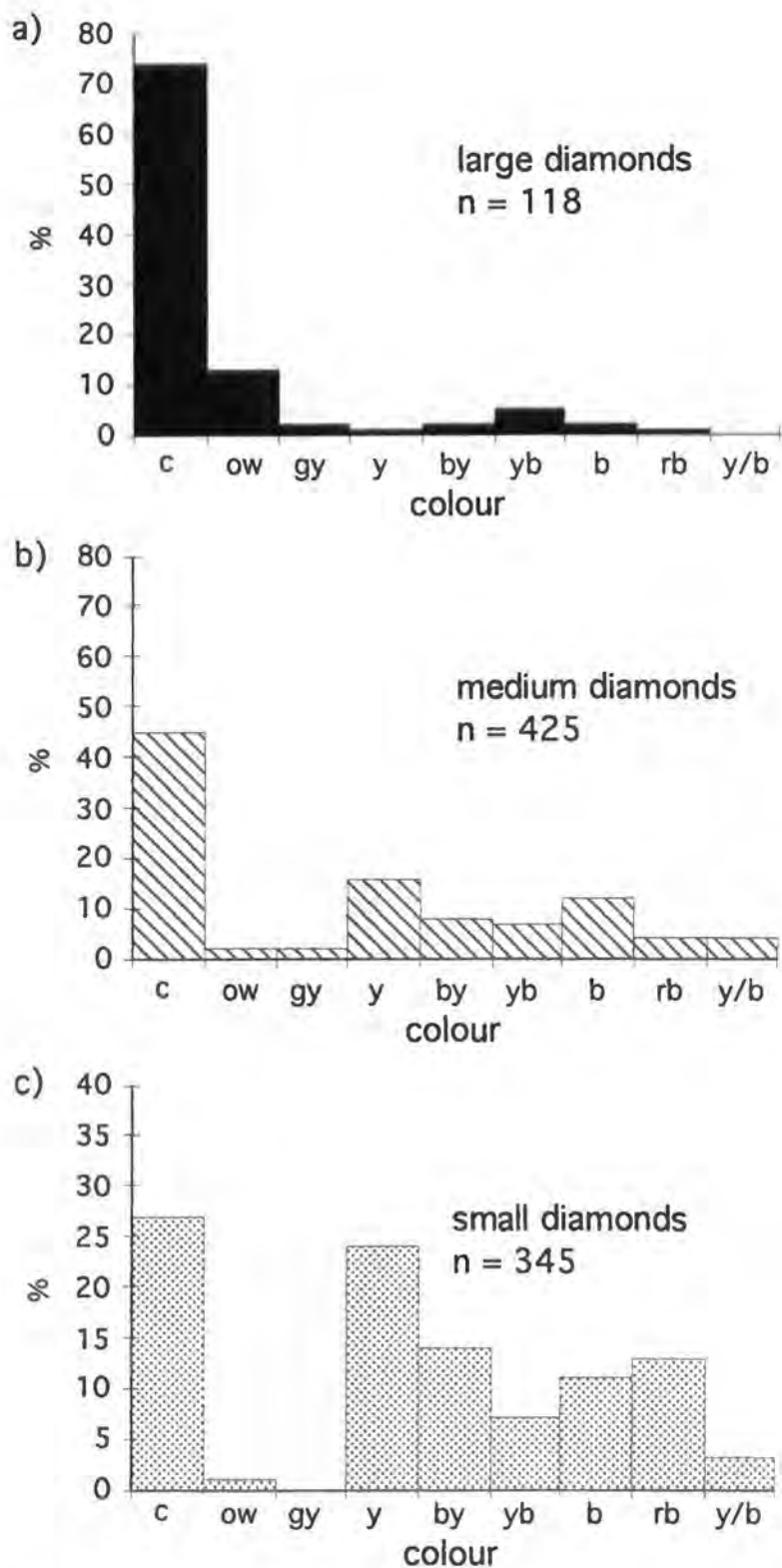


Fig. 3.6. Relationship between size and colour for George Creek diamonds.

colourless = c, off-white = ow, grey = gy,
 yellow = y, brown-yellow = by, yellow-brown = yb
 brown = b, red-brown = rb, yellow-and-brown = y/b.
 The colour distribution of George Creek diamonds is strongly influenced by the CO₂-bearing diamond generation, which is characterized by yellow, brown-yellow, yellow-brown, brown, yellow-and-brown and red-brown diamond colour.

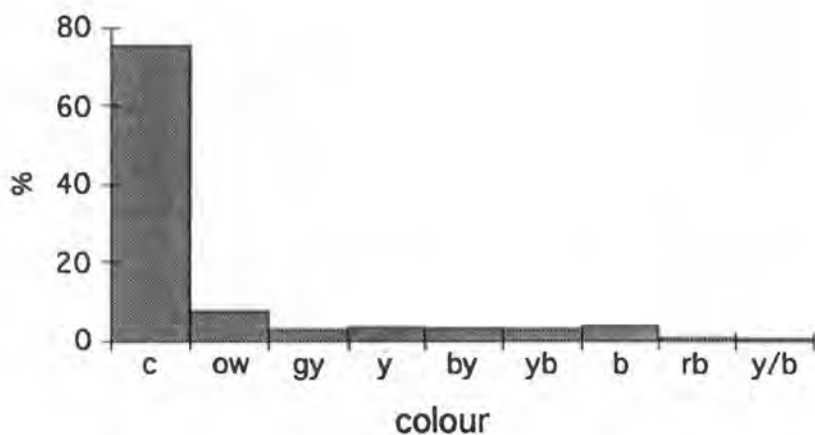


Fig. 3.7. Relationship between deformation and colour for George Creek diamonds.

colourless = c, off-white = ow, grey = gy,
 yellow = y, brown-yellow = by, yellow-brown = yb
 brown = b, red-brown = rb, yellow-and-brown = y/b.

The majority of plastically deformed diamonds are colourless. This suggests that the deformation which affected most George Creek diamonds was not accompanied by heating, as concomitant heating is thought to facilitate the precipitation of graphite, resulting in brown discolouration (Urovskaia and Orlov, 1964).

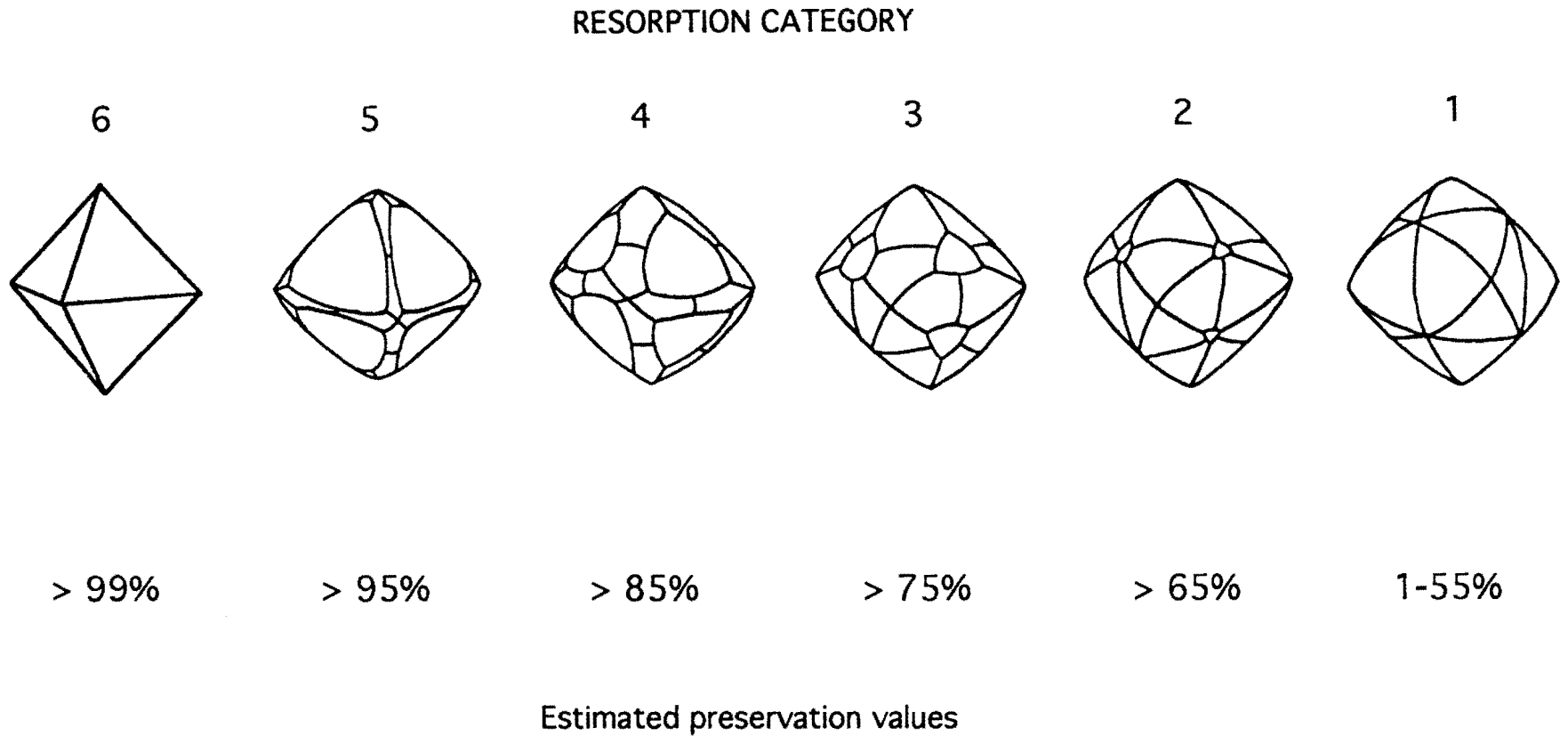


Fig. 3.8. Resorption classification scheme used to describe diamonds from George Creek. Resorption category numbers decrease with increasing degree of resorption from sharp-edged octahedral morphology to tetrahexahedroidal (dodecahedral) morphology. Modified from Otter (1990) and McCallum *et al.* (1994).

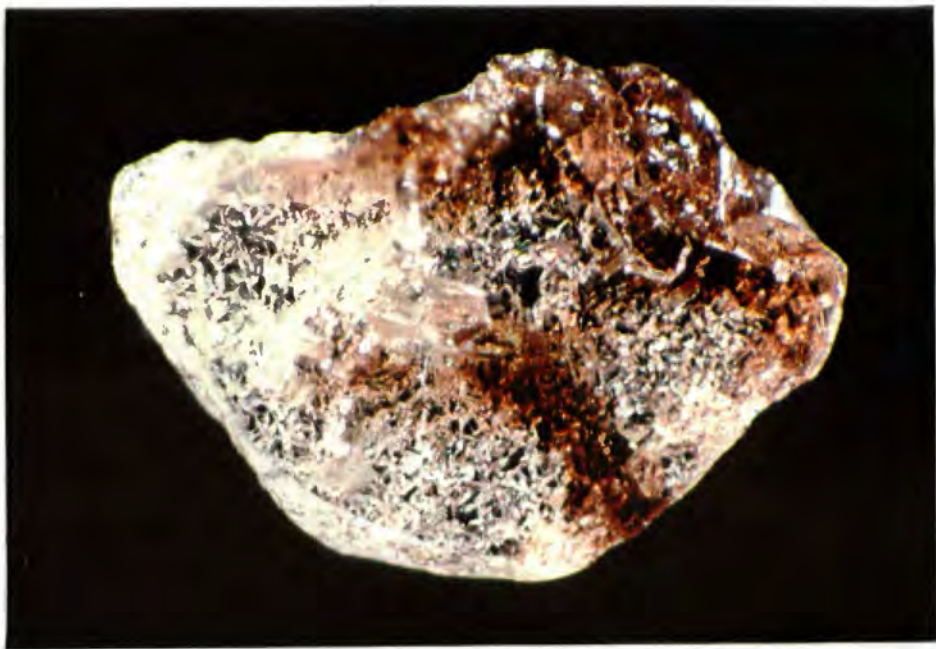


Fig. 3.9a. Reflected light photomicrograph of CO₂-bearing diamond GC314. The CO₂-bearing diamond growth generation is red-brown in colour, and appears to have crystallized in fractures in the (older) colourless CO₂-free fraction of the diamond. The nitrogen defect content of both diamond growth generations is below the detection limit of the IR spectrometer. Two mineral inclusion cavities with well-faceted cubo-octahedral morphology are present on the cleavage surface, suggesting that cleavage resulted from differential expansion between the inclusions and the host diamond. The diamond is ~2 mm in length.

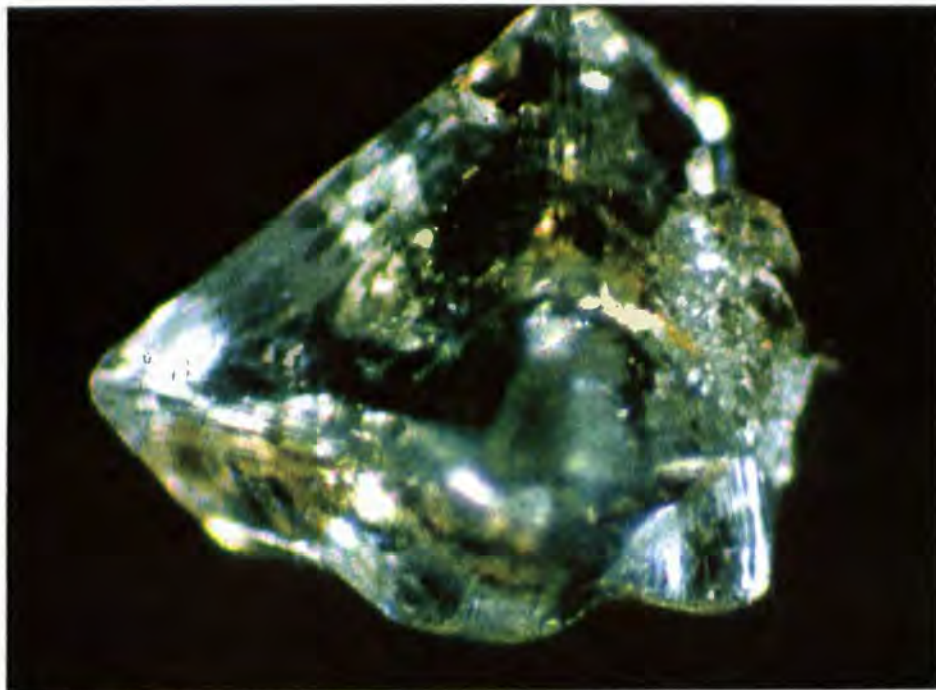


Fig. 3.9b. Reflected light photomicrograph of CO₂-bearing diamond GC783. Spectral evidence of high pressure CO₂ inclusions was obtained from areas of the diamond with yellow colour. The nitrogen content of the yellow CO₂-bearing diamond growth generation is below the detection limit of the IR spectrometer. Low contents of well-aggregated nitrogen defects characterize the colourless CO₂-free diamond growth generation. The diamond is ~1 mm in length.

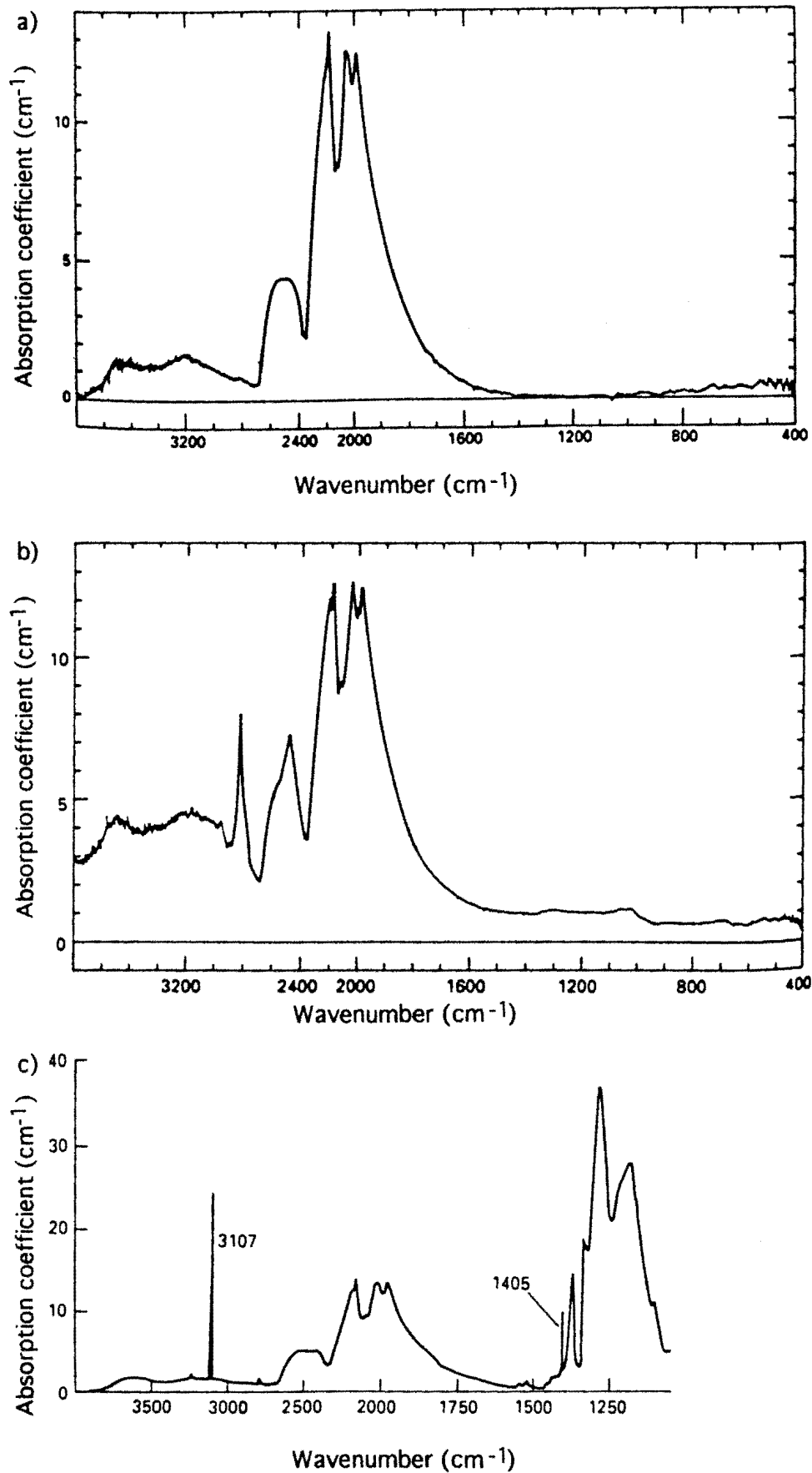


Fig. 4.1. Characteristic IR absorption spectra for diamonds.

- a) Intrinsic lattice absorption of Type IIa diamond (from Wilks and Wilks, 1991)
 b) Type IIb absorption due to the presence of boron (from Wilks and Wilks, 1991)
 c) Type IaAB spectrum with strong absorption peaks at 3107 and 1405 cm^{-1} due to the presence of hydrogen (from Davies *et al.*, 1984 in Wilks and Wilks, 1991).

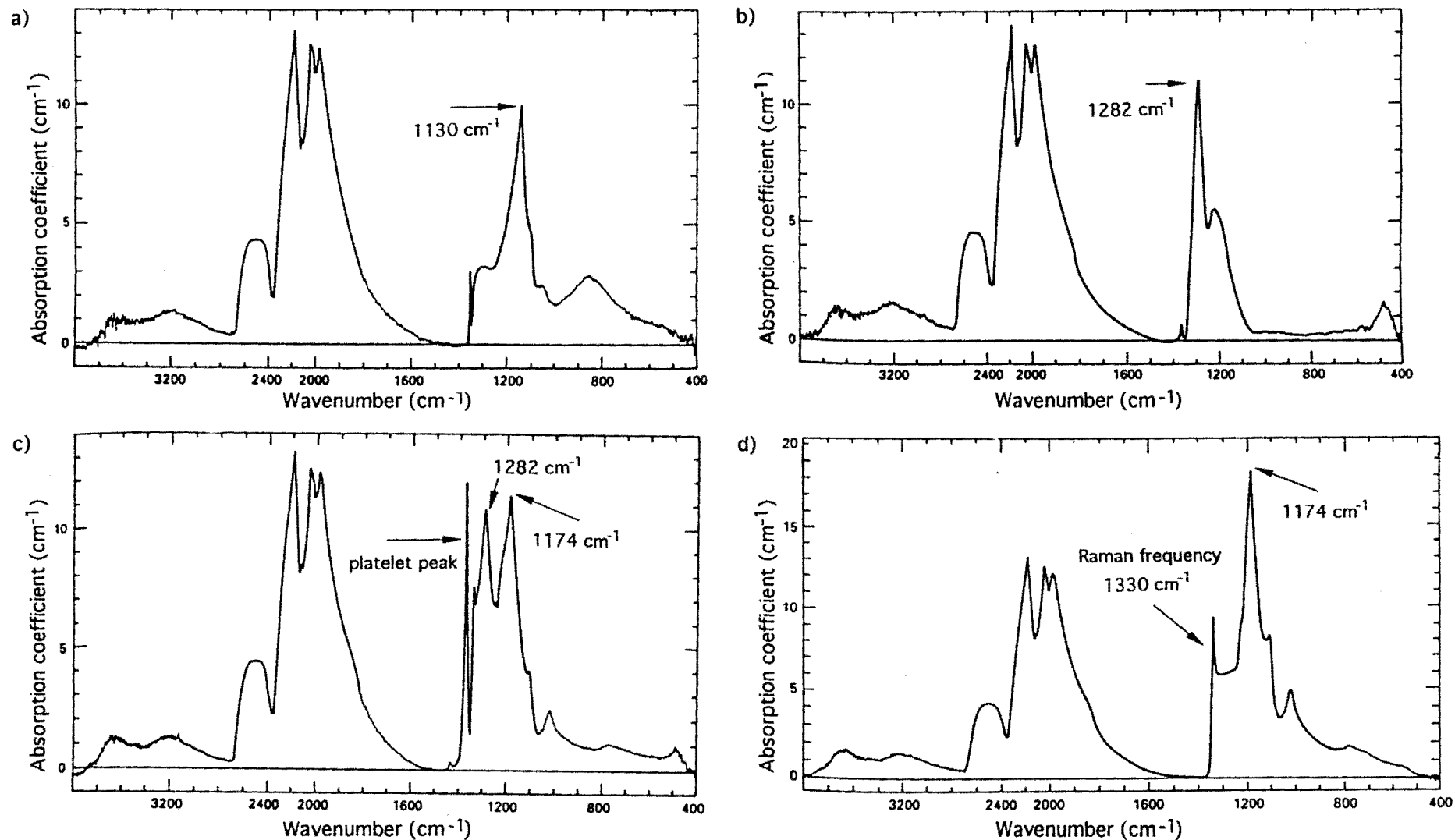


Fig. 4.2. Characteristic IR spectra of diamonds containing substitutional nitrogen defects, arranged in order of increasing aggregation state.
 a) Type Ib spectrum indicative of the presence of unaggregated nitrogen defects. b) Type IaA spectrum indicative of the presence of A aggregates.
 c) Type IaAB spectrum indicative of the presence of A and B aggregates and platelets. d) Type IaB spectrum indicative of the presence of B aggregates.
 Nitrogen aggregation in natural diamonds is controlled by nitrogen concentration, temperature and mantle residence time. Spectra from Wilks and Wilks (1991).

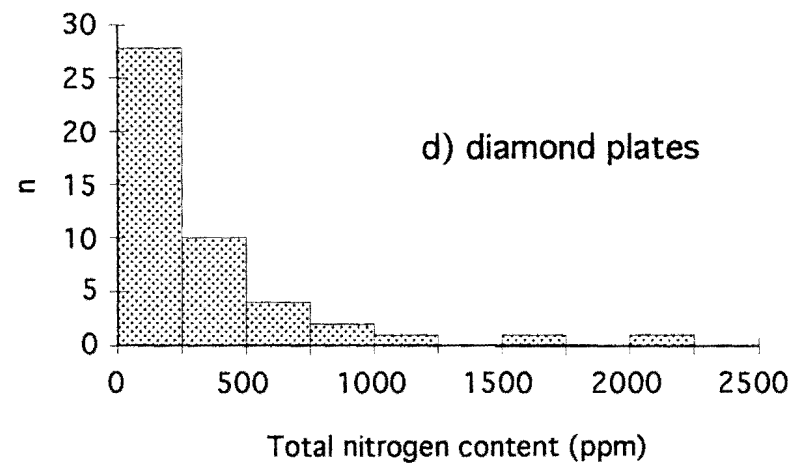
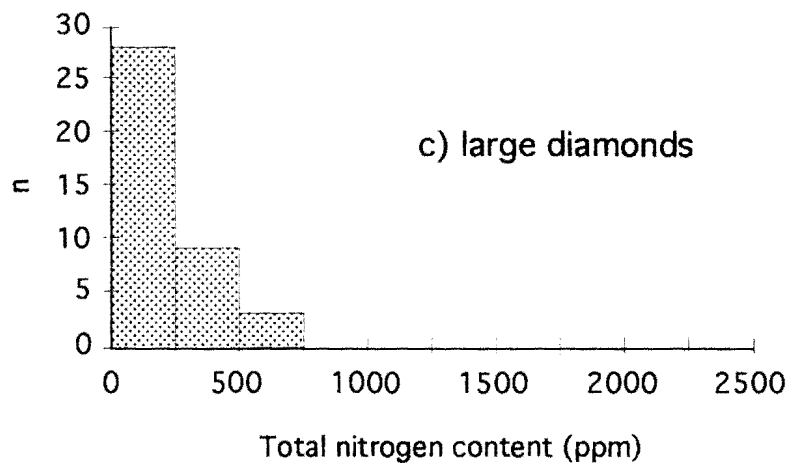
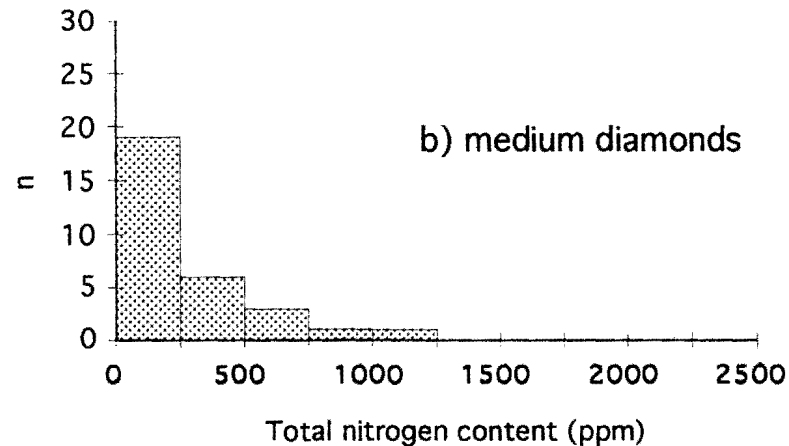
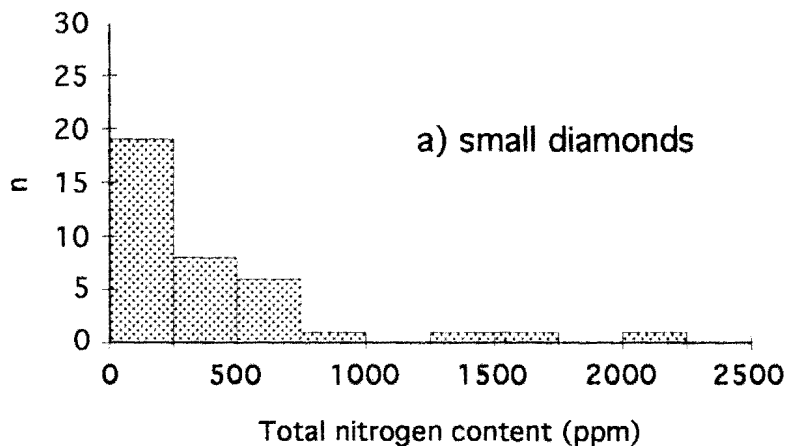


Fig. 4.3. Histograms of total nitrogen content (determined spectrally) for selected George Creek diamonds.

- a) histogram represents 37 IR spectral analyses of 34 small diamonds
- b) histogram represents 32 IR spectral analyses of 19 medium diamonds
- c) histogram represents 39 IR spectral analyses of 28 large diamonds
- d) histogram represents 48 IR spectral analyses of 8 plates

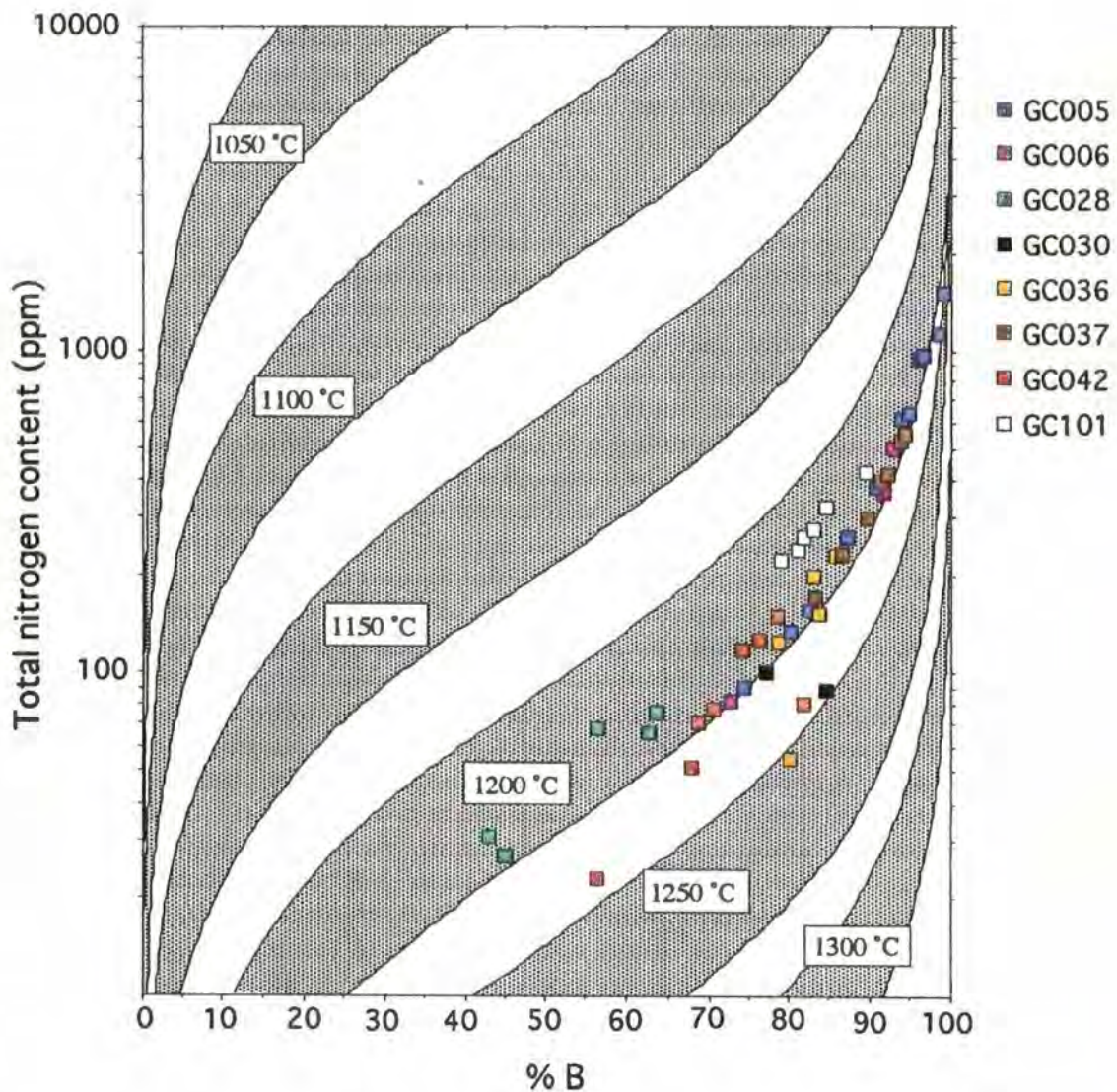


Fig. 4.4. Plot of total nitrogen content versus percentage of total nitrogen present in B defects (i.e. aggregation state) for George Creek diamond plates. The isotherm envelopes are bounded by upper and lower limits calculated for mantle residence times of 1 and 3 Ga respectively. Diamonds which have experienced similar thermal evolution during mantle residence time should define roughly linear trends parallel to the isotherms. Diamond plate GC030 (black symbol) contains complexly intergrown CO₂-bearing and CO₂-free diamond growth generations.

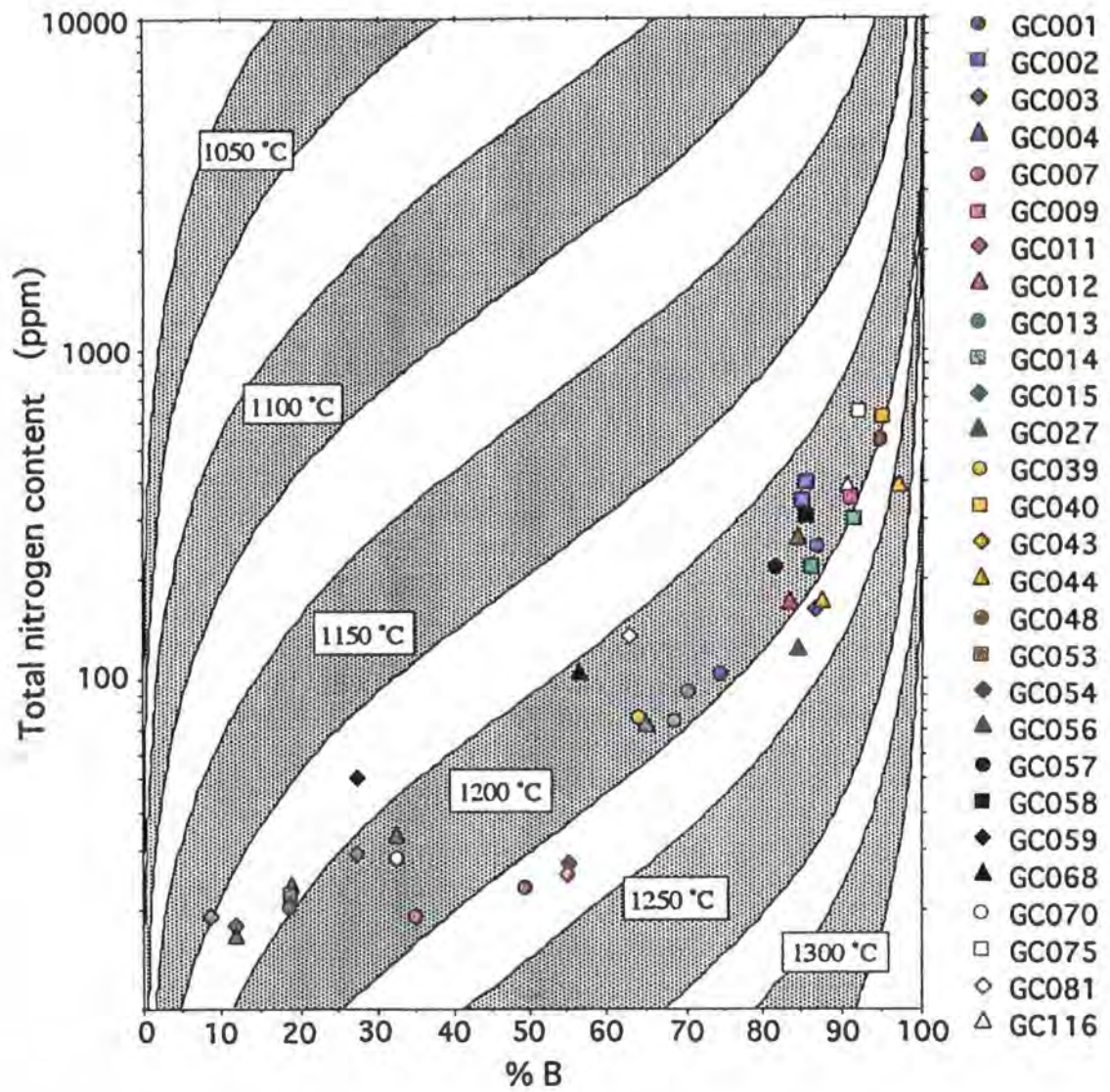


Fig. 4.5. Plot of total nitrogen content versus percentage of total nitrogen present in B defects (i.e. aggregation state) for George Creek large diamonds. The isotherm envelopes are bounded by upper and lower limits calculated for mantle residence times of 1 and 3 Ga respectively. None of the large diamonds represented in this plot is CO₂-bearing.

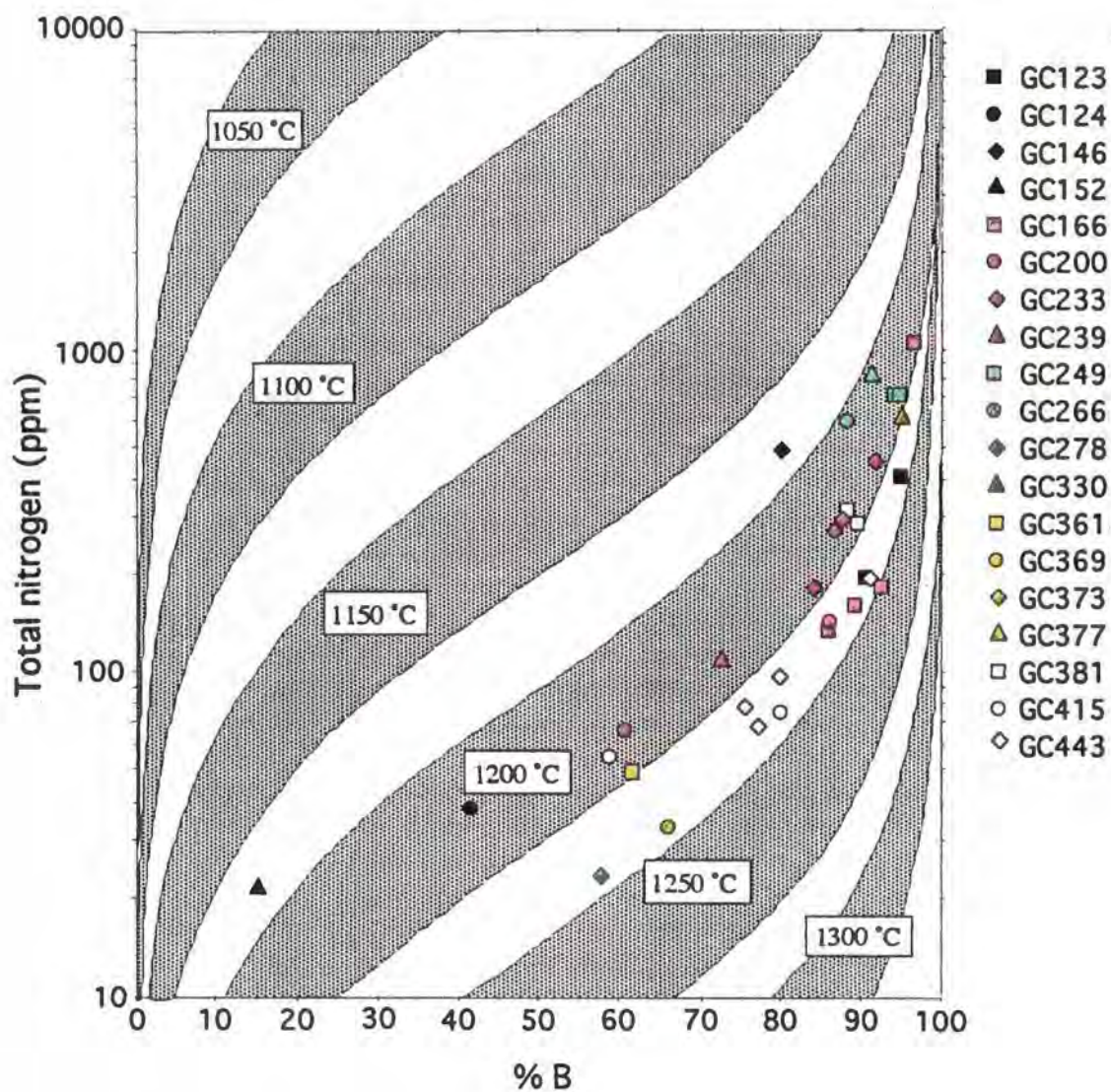


Fig. 4.6. Plot of total nitrogen content versus percentage of total nitrogen present in B defects (i.e. aggregation state) for George Creek medium diamonds. The isotherm envelopes are bounded by upper and lower limits calculated for mantle residence times of 1 and 3 Ga respectively.

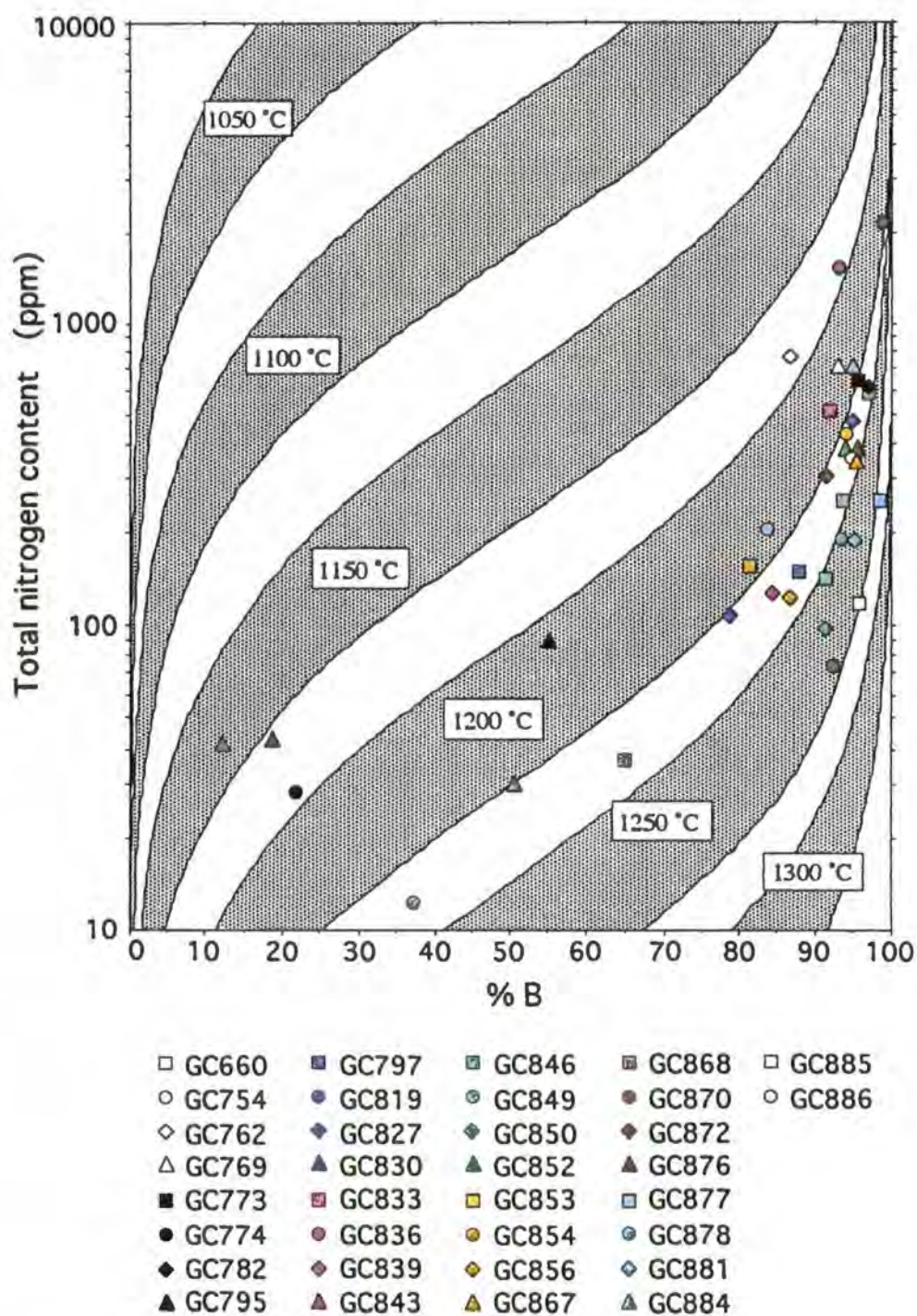


Fig. 4.7. Plot of total nitrogen content versus percentage of total nitrogen present in B defects (i.e. aggregation state) for George Creek small diamonds. The isotherm envelopes are bounded by upper and lower limits calculated for mantle residence times of 1 and 3 Ga respectively.

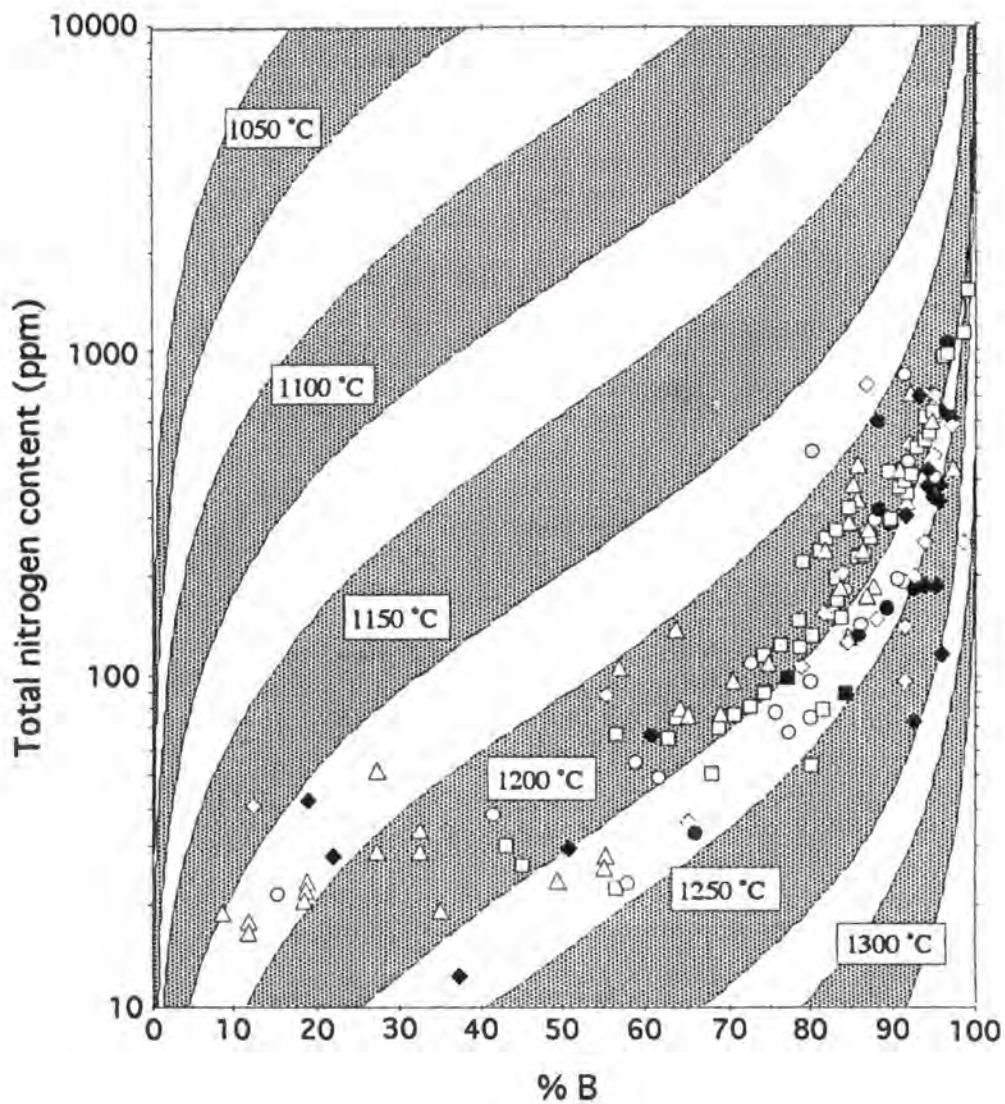


Fig. 4.8. Plot of total nitrogen content versus percentage of total nitrogen present in B defects (i.e. aggregation state) for George Creek diamonds.

The isotherm envelopes are bounded by upper and lower limits calculated for mantle residence times of 1 and 3 Ga respectively.

- ◇ small diamonds
 - medium diamonds
 - △ large diamonds
 - diamond plates
- Solid symbols represent CO₂-bearing diamonds.

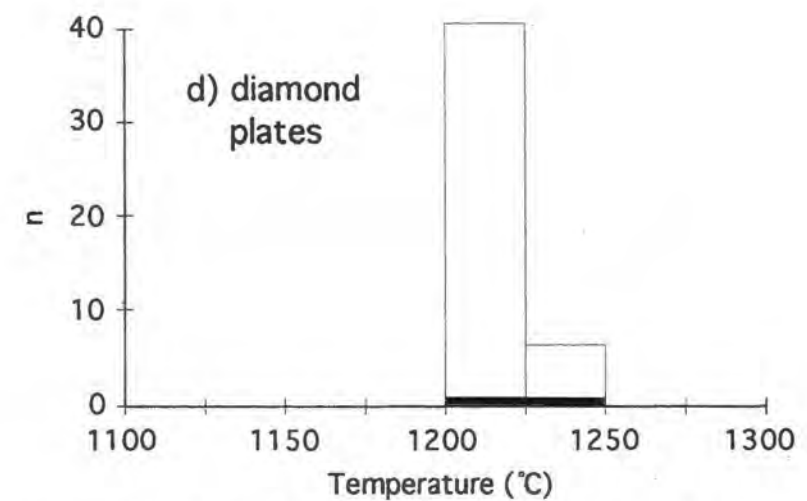
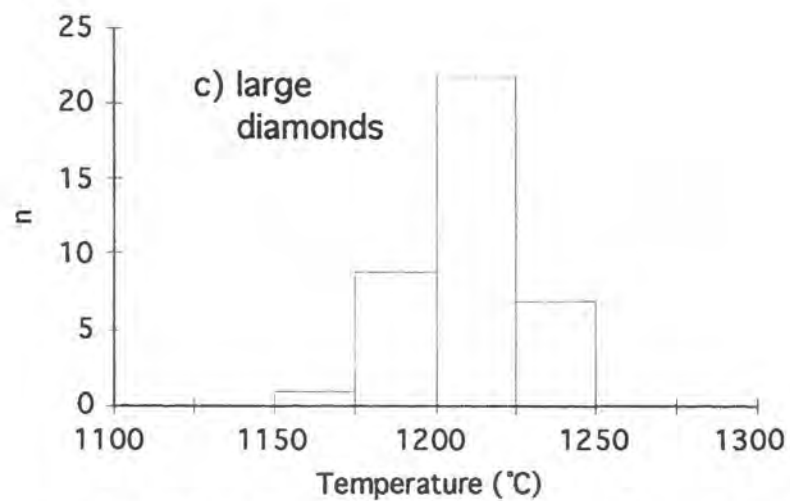
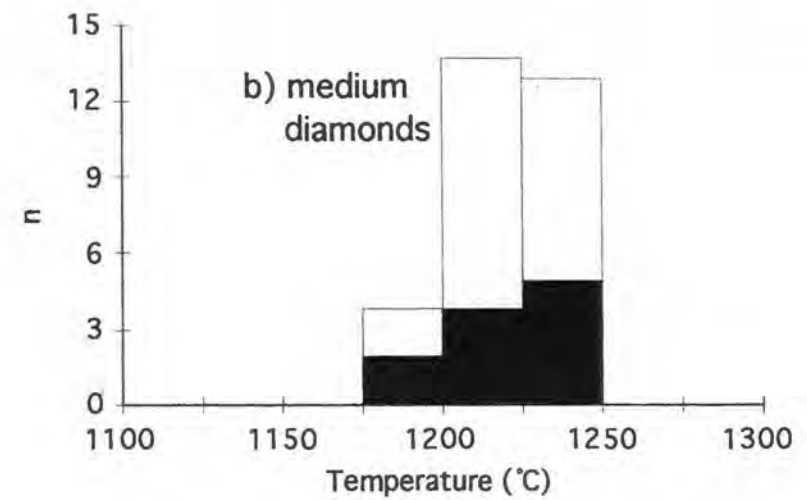
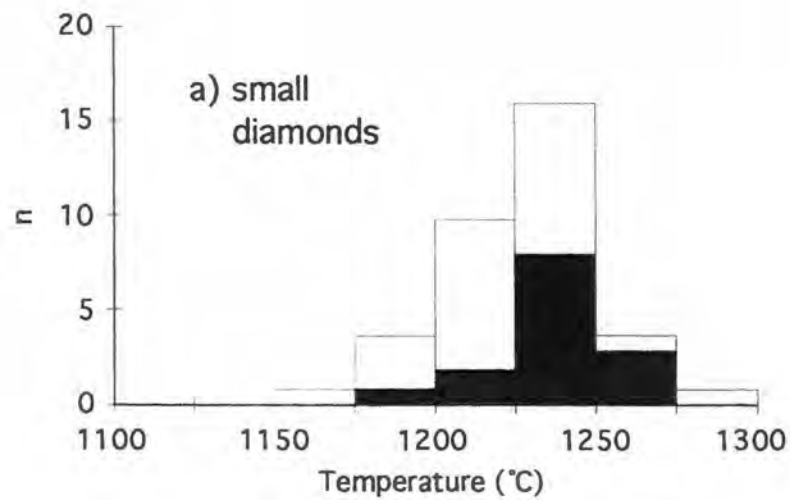


Fig. 4.9. Histograms of time-averaged mantle residence temperature (T_{NA}) calculated for selected George Creek diamonds. An assumed mantle residence time of 1.25 Ga was used for the calculations. Solid symbols represent CO₂-bearing diamonds. The number of spectral analyses for diamond plates and each size category is the same as in Fig. 4.3.

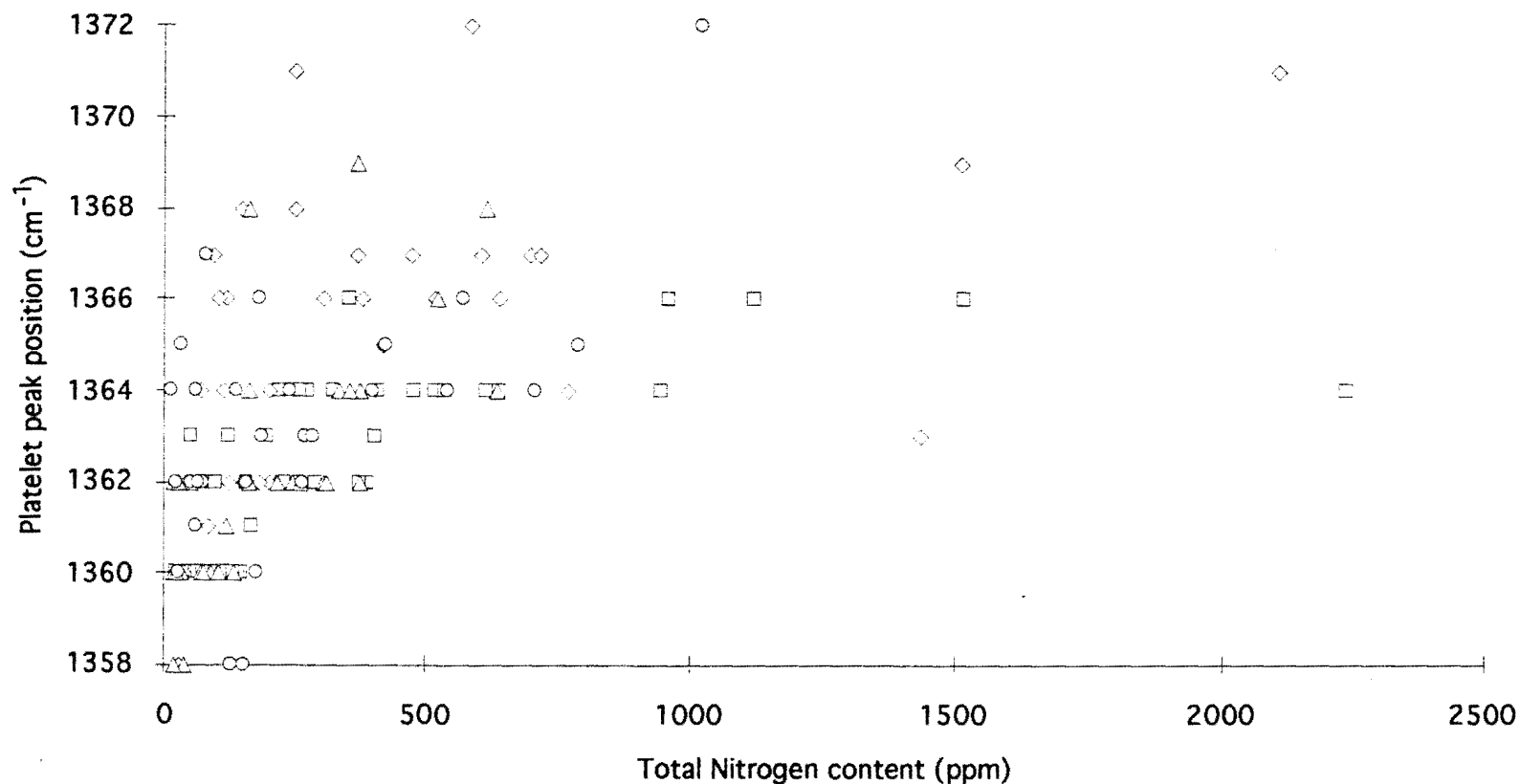


Fig. 4.10. Variation of platelet peak position with respect to spectrally determined total nitrogen content.

◊ small diamonds ○ medium diamonds △ large diamonds □ diamond plates

Low wavenumber positions of the platelet peak between 1358 and 1362 cm^{-1} (indicative of large platelets) are restricted to diamonds with total nitrogen contents of < 500 ppm. This is consistent with suppressed nucleation and slow growth of platelets to a large size in growth zones of low nitrogen content as a consequence of the aggregation of nitrogen defects (Woods, 1986).

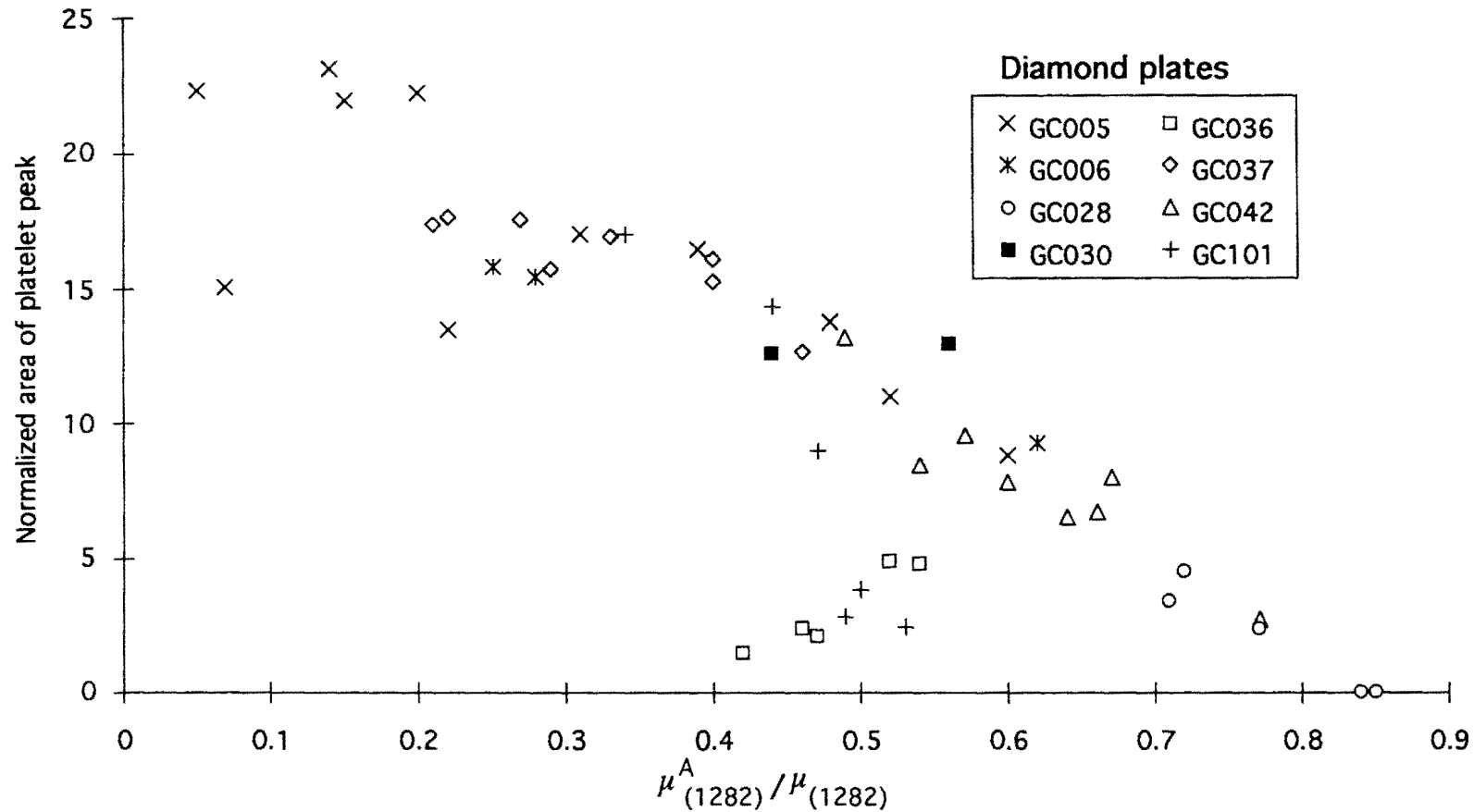


Fig. 4.11. Plot of normalized area of platelet peak versus proportion of absorption at 1282 cm^{-1} due to A defects. Diamonds which are characterized by "regular" platelet development as a consequence of the aggregation of nitrogen defects define a linear trend of decreasing percentage of nitrogen present in A defects (which have not yet aggregated to form B defects) with increasing intensity of the integrated platelet peak area, normalized with respect to diamond thickness (Woods, 1986). This general trend is recognized for George Creek diamond plates, but the relationship is variable, and plate GC036 shows the opposite trend. This cathodoluminescence features of this diamond indicate that it experienced extreme plastic and brittle deformation, which may have been responsible for platelet degradation. Solid symbol denotes CO_2 -bearing diamond.

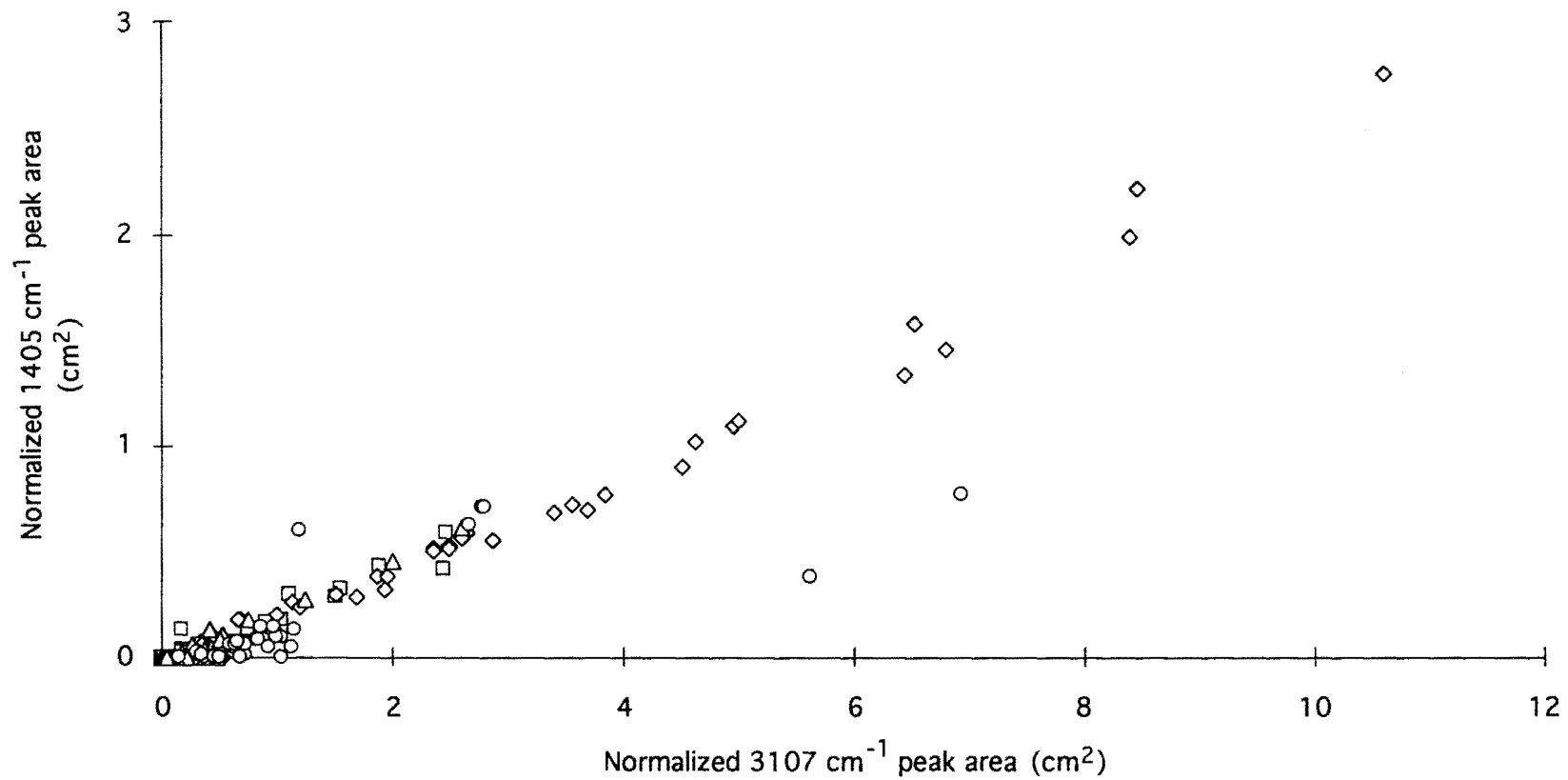


Fig. 4.12. Correlation between normalized peak areas due to the presence of hydrogen.

◇ small diamonds

○ medium diamonds

△ large diamonds

□ diamond plates

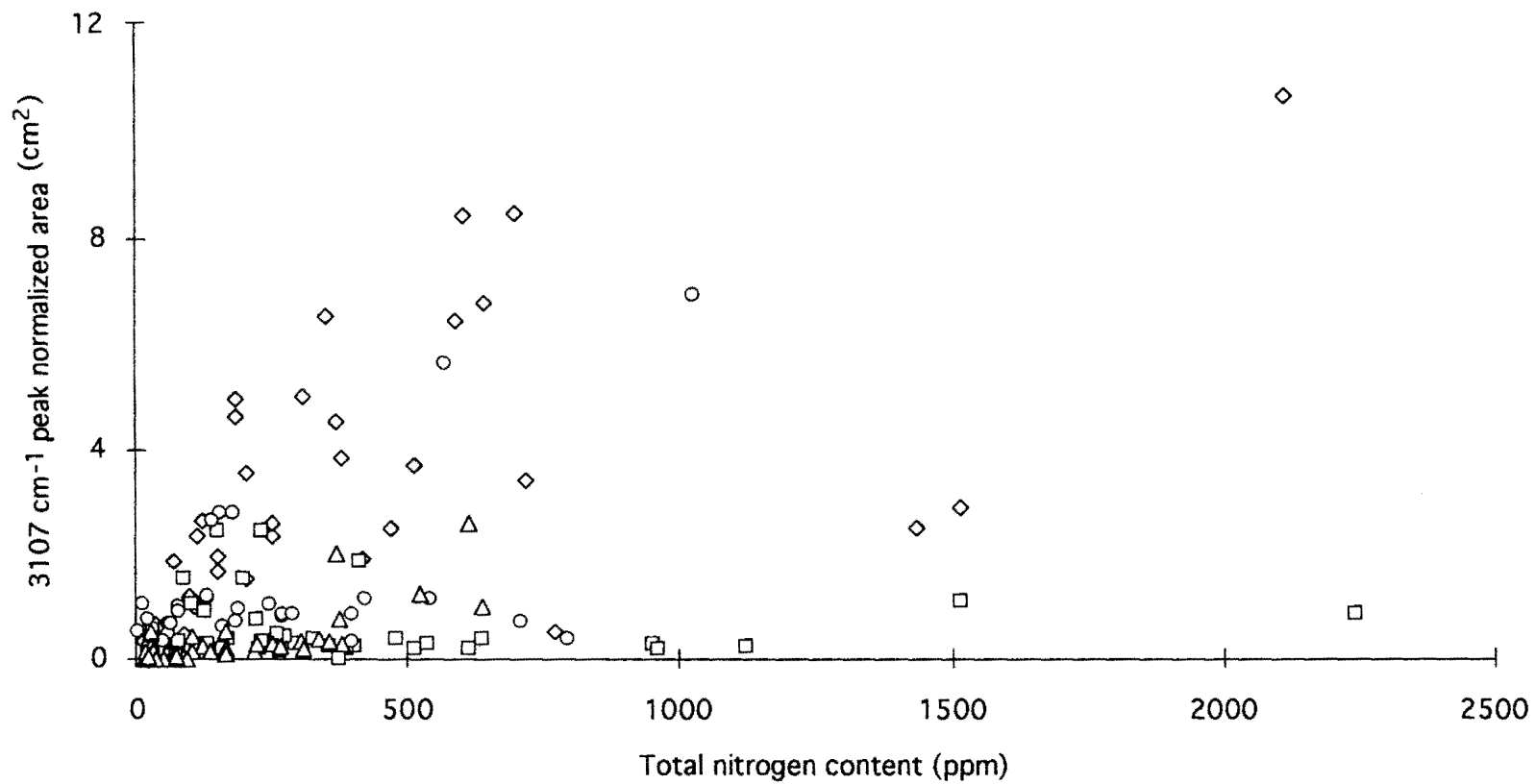


Fig. 4.13. Plot of normalized area of 3107 cm⁻¹ peak versus spectrally determined total nitrogen content.

The 3107 cm⁻¹ peak is due to the presence of hydrogen.

◇ small diamonds

○ medium diamonds

△ large diamonds

□ diamond plates

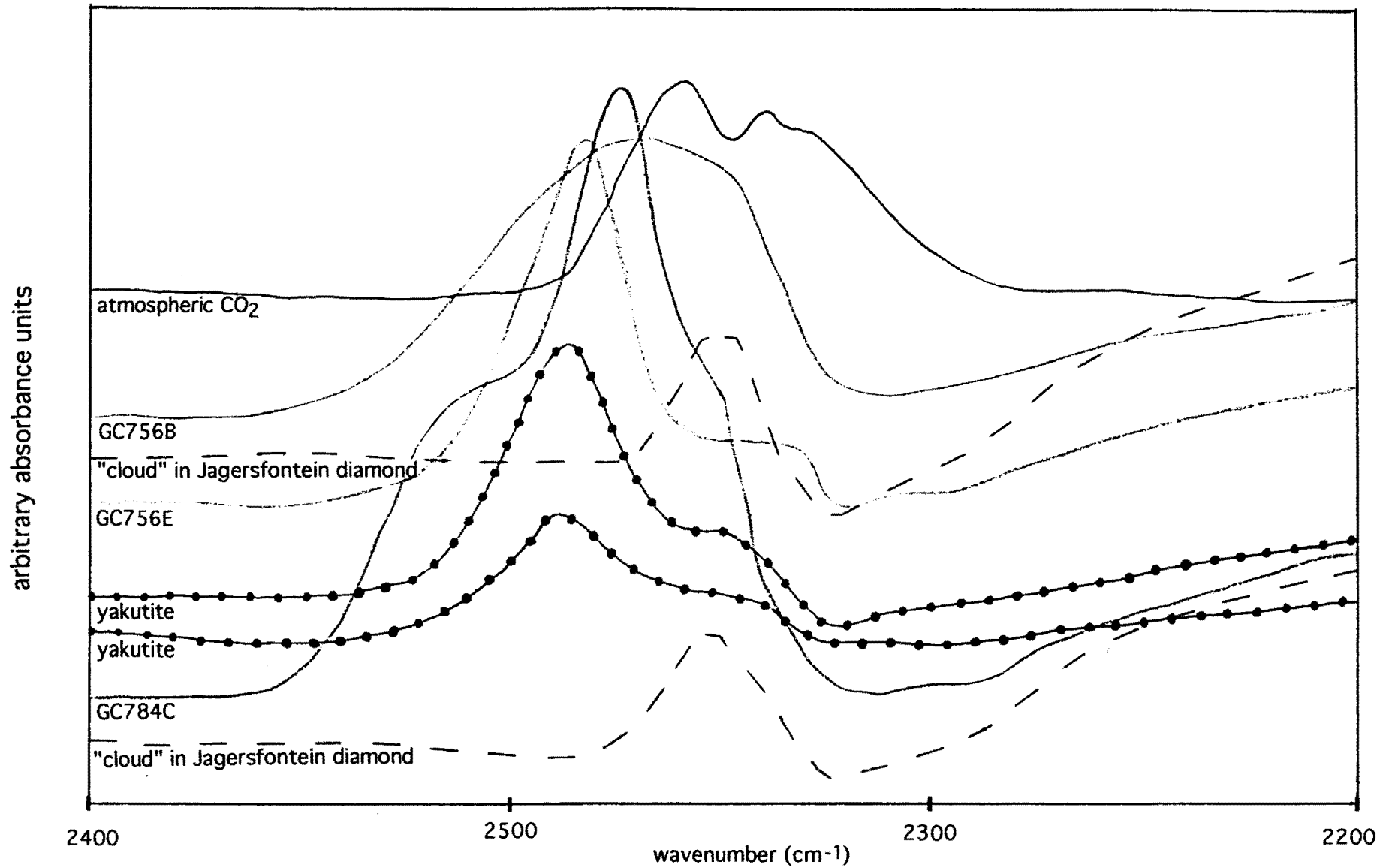


Fig. 4.14. Plot of CO₂ v₃ IR absorption peaks for selected diamonds from George Creek and Jagersfontein, yakutite from the Popigai astrobleme, and atmospheric CO₂ absorption.

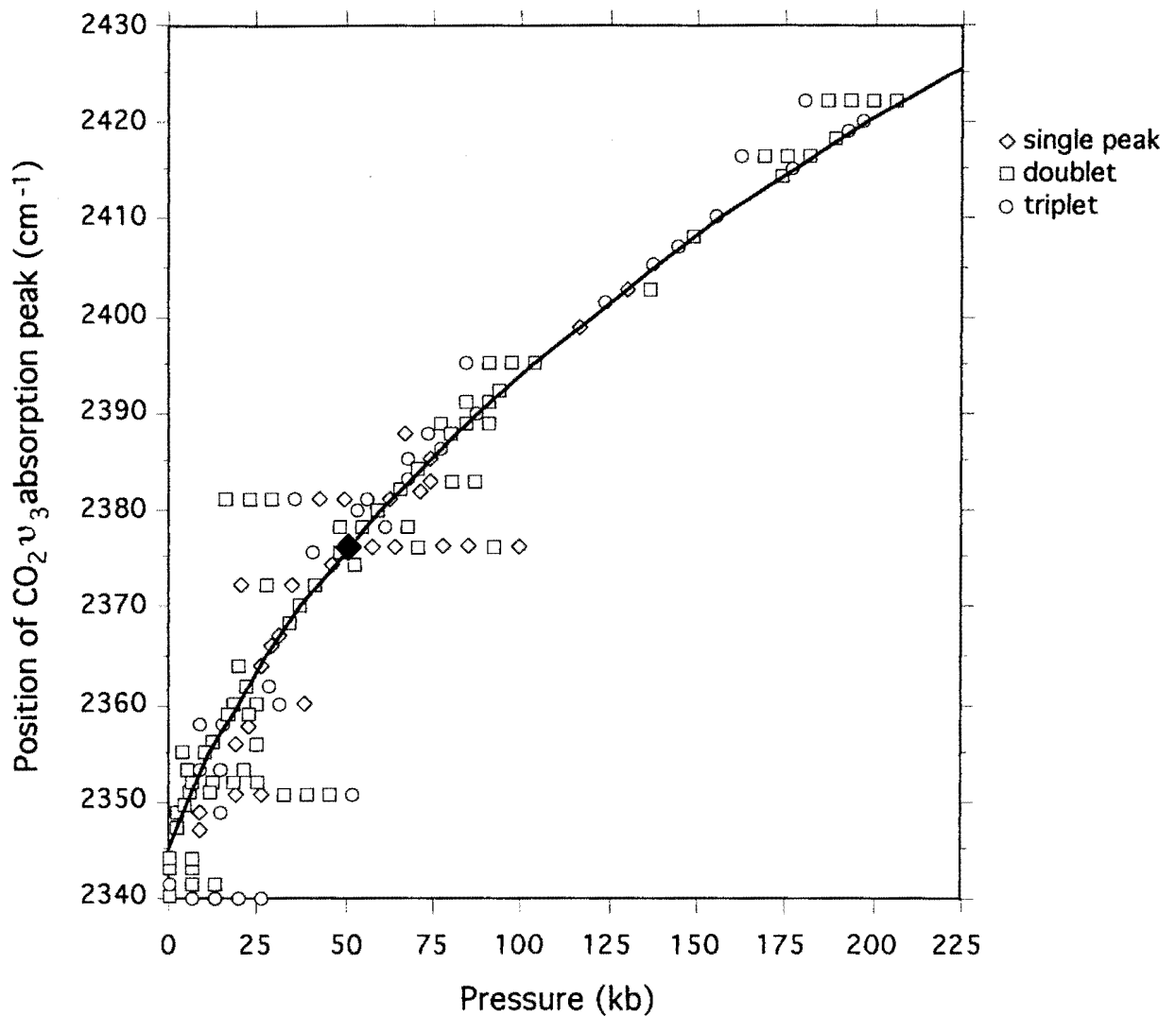


Fig. 4.15. Relationship between the position of the CO₂ν₃ absorption peak(s) and pressure (modified from Hanson and Jones, 1981).

The position of the single solid symbol indicates the pressure estimate for a CO₂-bearing diamond of unknown origin described by Schrauder and Navon (1993). All other data points are from George Creek diamonds. Data are plotted on the experimentally determined curve and multiple data points for absorption at the same wavenumber are plotted along the horizontal axis at the height corresponding to the relevant wavenumber. The highest wavenumber of 2424 cm⁻¹ recorded for the ν₃ peak in George Creek diamonds would imply an unrealistic internal CO₂ pressure in excess of 200 kb at room temperature.

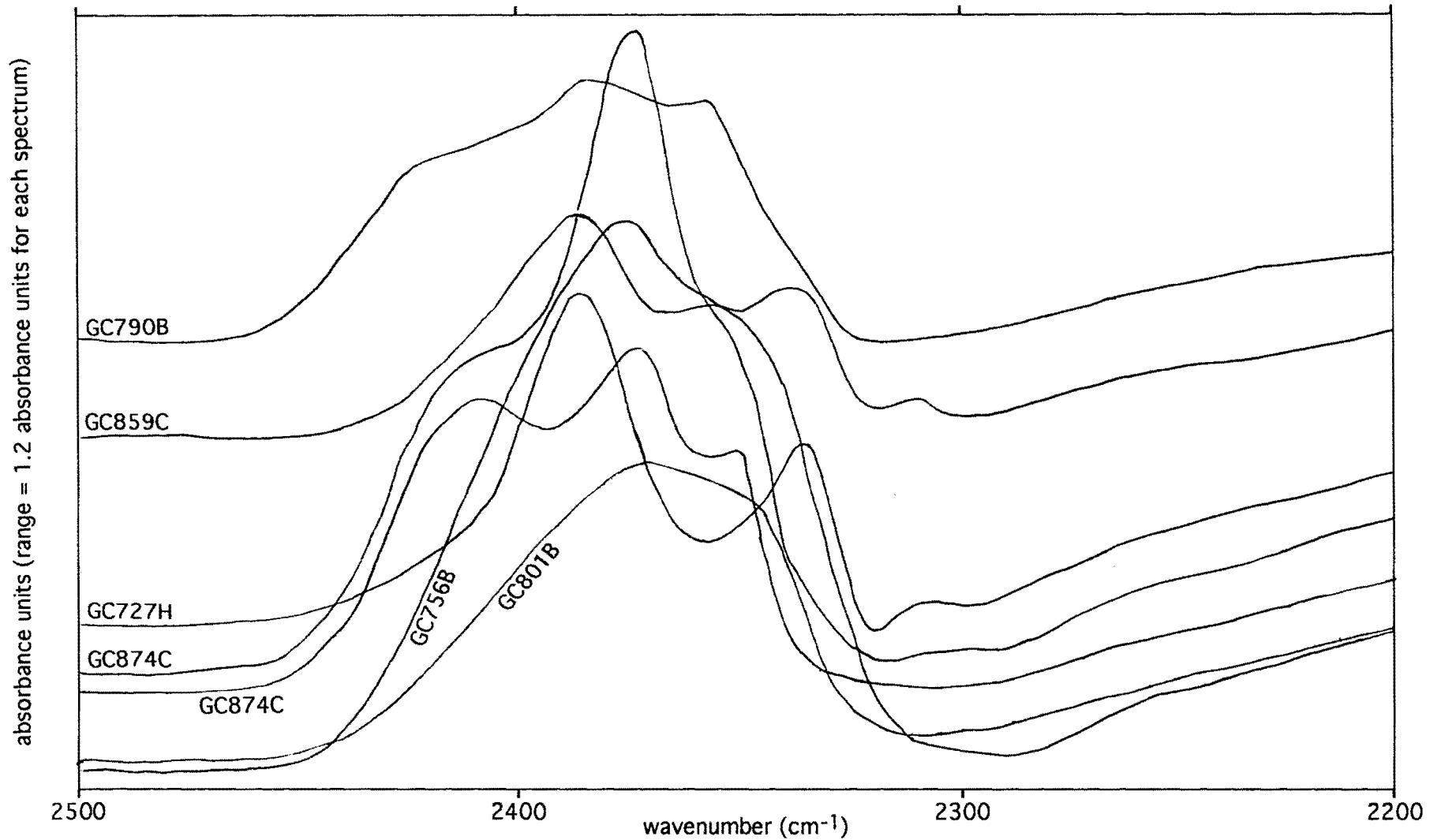


Fig. 4.16. Expanded IR spectra of CO₂-bearing diamonds from George Creek, showing the variation in wavenumber of the CO₂ ν₃ absorption peaks. The CO₂ absorption exhibits great variability in terms of peak position, peak morphology and peak intensity.

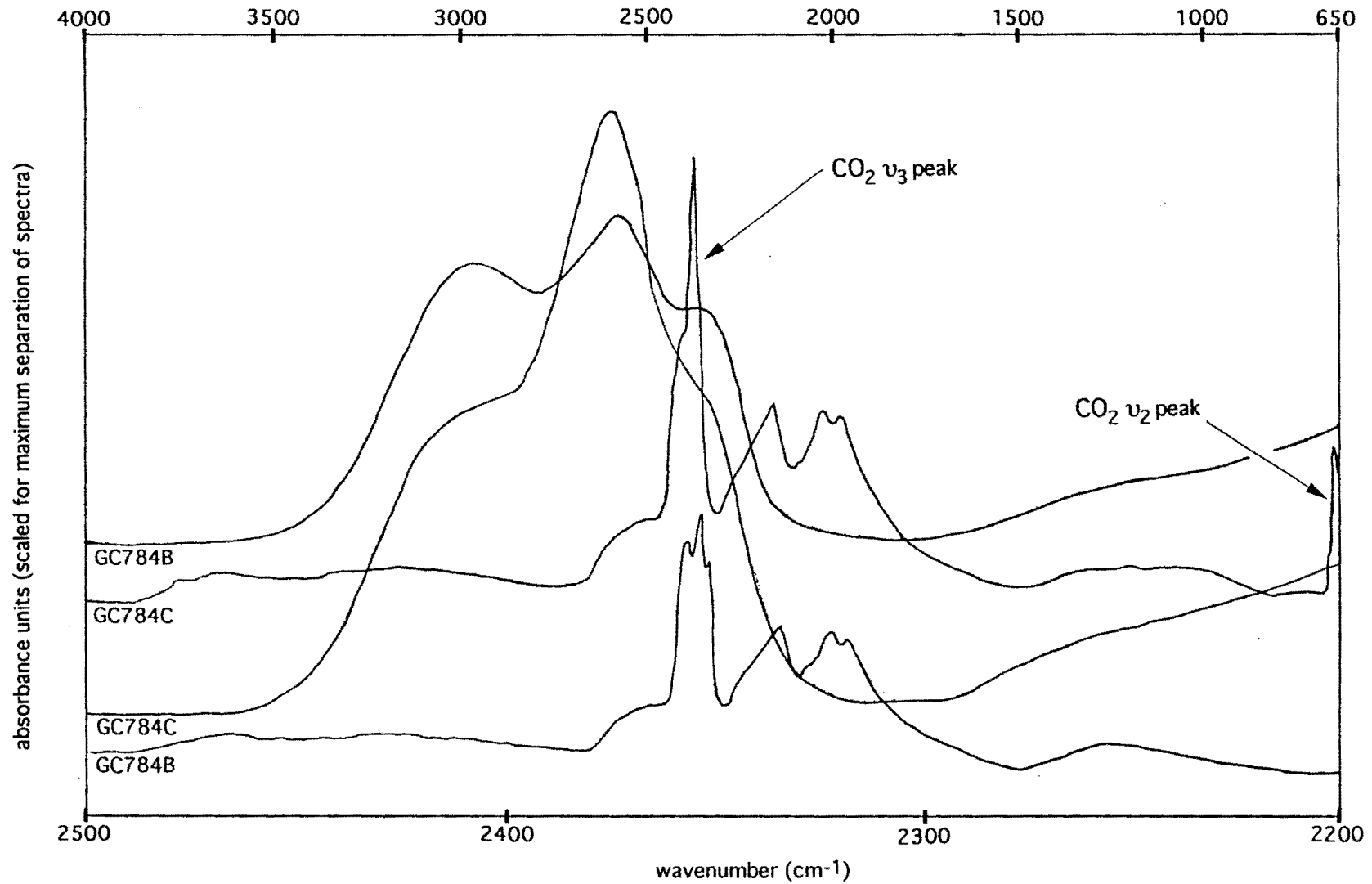


Fig. 4.17. Expanded and unexpanded spectra of a CO₂-bearing diamond (GC784) from George Creek, illustrating the complexity of the CO₂ absorption peaks.

Unexpanded spectra represent IR absorption between 4000 and 650 cm⁻¹, whereas expanded spectra represent IR absorption between 2500 and 2200 cm⁻¹. The absorption range for unexpanded spectra is 2 absorbance units, whereas the absorption range for expanded spectra is 1.2 absorbance units.

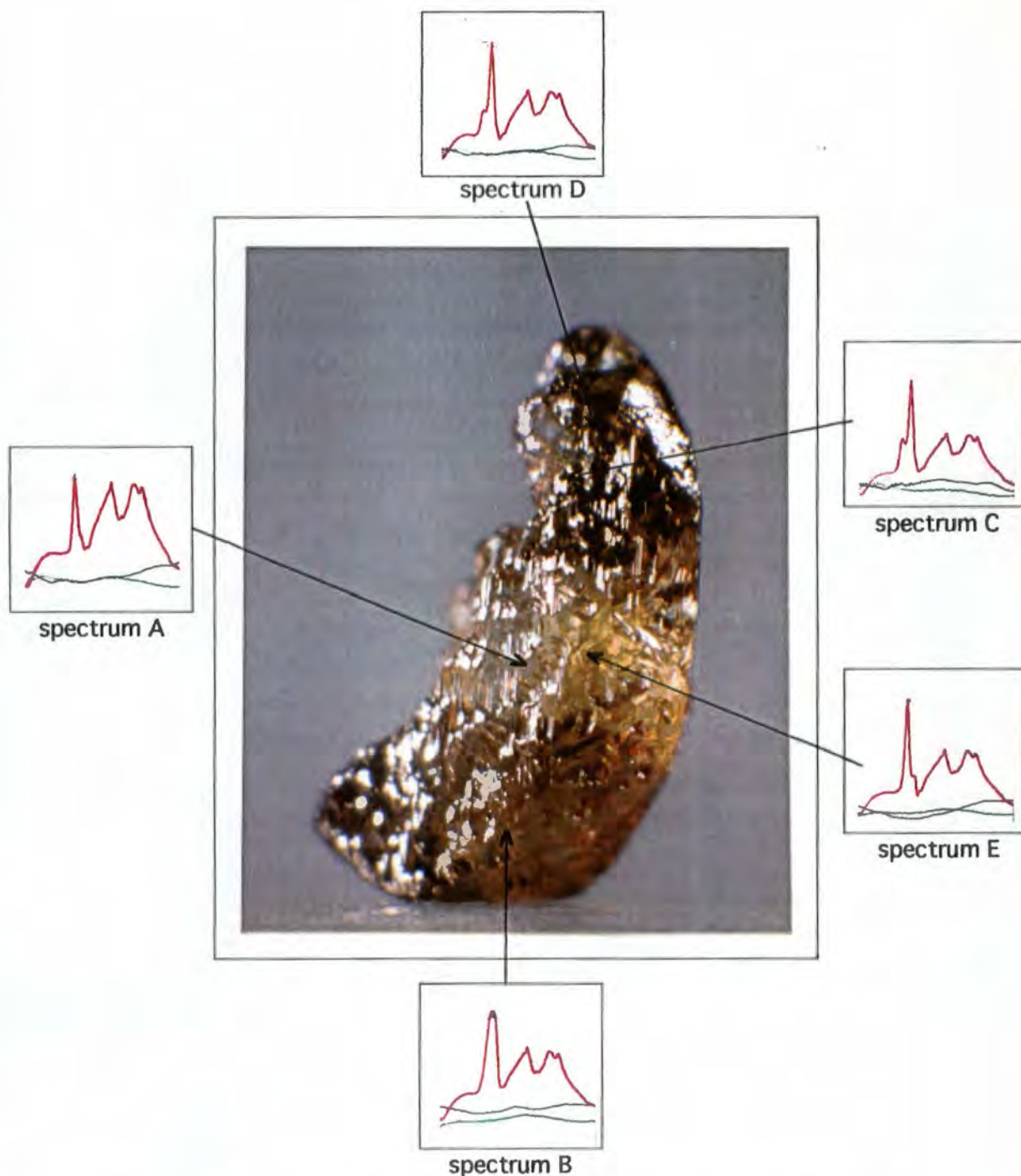


Fig. 4.18. Relationship between diamond colour and the nature of the ν_3 CO_2 absorption peaks for CO_2 -bearing diamond GC756.

The lower red-brown area is characterized by a single ν_3 peak (spectrum B), whereas the central yellow area is characterized by doublets with the lower peaks at lower wavenumbers (spectra A and E). The ν_3 CO_2 absorption peaks in the upper brown area are also doublets, but with the lower peaks at higher wavenumbers.

The green components of the "thumb-nail" spectra represent IR absorption in the range from $3050 - 2400 \text{ cm}^{-1}$. The red components represent IR absorption from $2400 - 1750 \text{ cm}^{-1}$, whereas the black components represent IR absorption from $1750 - 900 \text{ cm}^{-1}$. The latter IR range spans the region in which the characteristic nitrogen defect absorption peaks occur in Type I diamonds. The nitrogen defect content of this diamond is below the detection limit of the IR spectrometer.

Exposure of the diamond to oxidizing fluids resulted in the development of abundant hexagonal and trigonal etch pits. The diamond is $\sim 1 \text{ mm}$ in length.

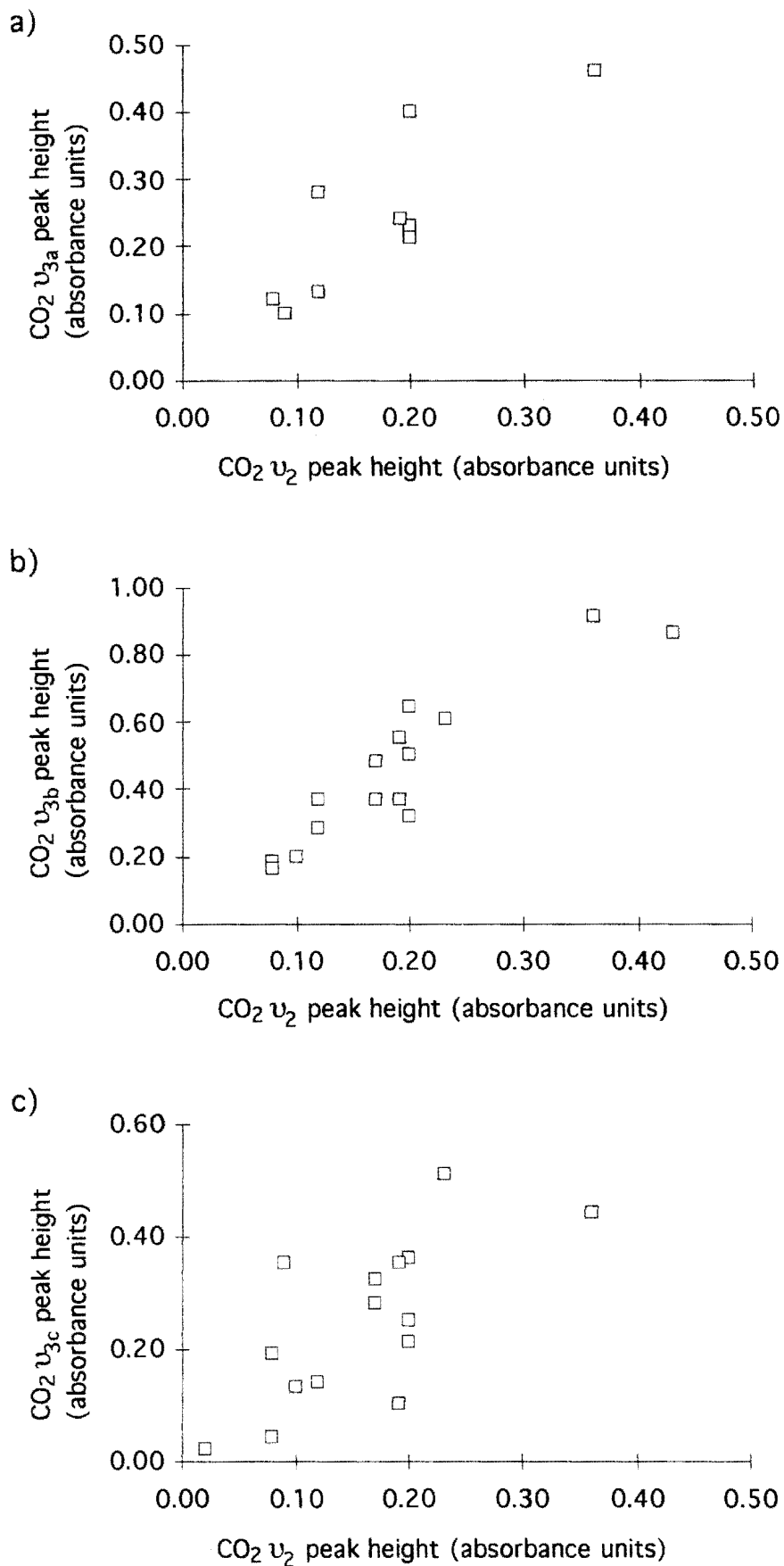


Fig. 4.19. Relationships between the heights of different CO₂ absorption peaks in diamonds from George Creek .

- a) Plot of ν_{3a} peak height versus ν_2 peak height.
- b) Plot of ν_{3b} peak height versus ν_2 peak height.
- c) Plot of ν_{3c} peak height versus ν_2 peak height.

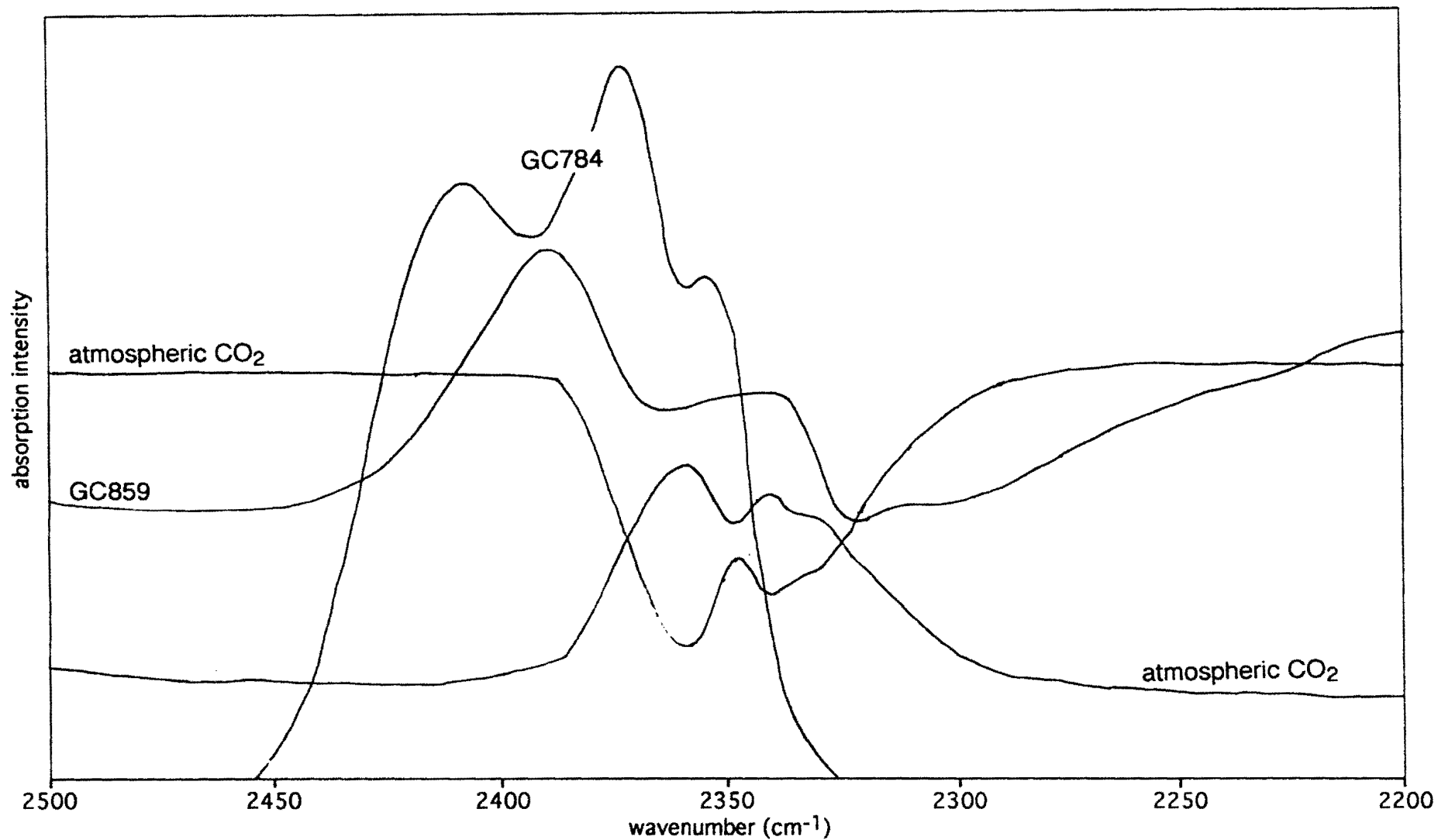


Fig. 4.20. Plot of expanded reference spectra with positive and negative background absorption from atmospheric CO₂, and expanded spectra from CO₂-bearing diamonds from George Creek. Note the similarity between the positions of absorption peaks in the reference spectra and the low wavenumber shoulders (i.e. ν_{3C} peaks) in certain diamond spectra. The absorption ranges are 0.3 and 0.6 absorbance units for the reference spectra and George Creek diamond spectra respectively.

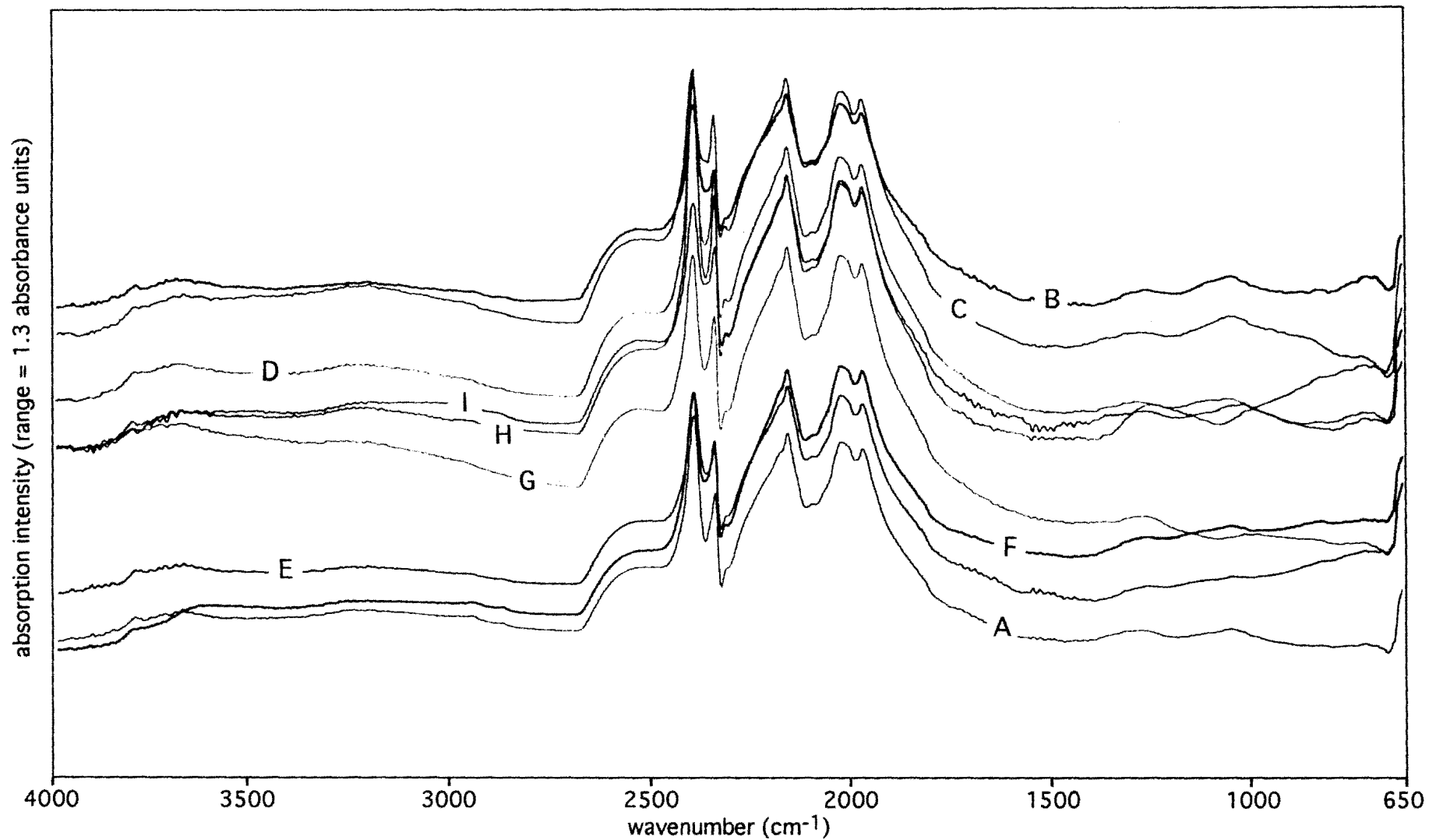


Fig. 4.21. Replicate spectra from CO₂-bearing diamond GC727 taken to investigate the effect of diamond orientation on the morphology and wavenumber of the CO₂ ν_3 absorption peaks.
 Spectra were measured sequentially from A to I and the diamond was rotated by approximately 45° between spectra. New background spectra were taken before spectra A and G. The negligible differences between spectra are thought to be due to differences in CO₂ inclusion content in the different paths through the diamond sampled by the IR beam.

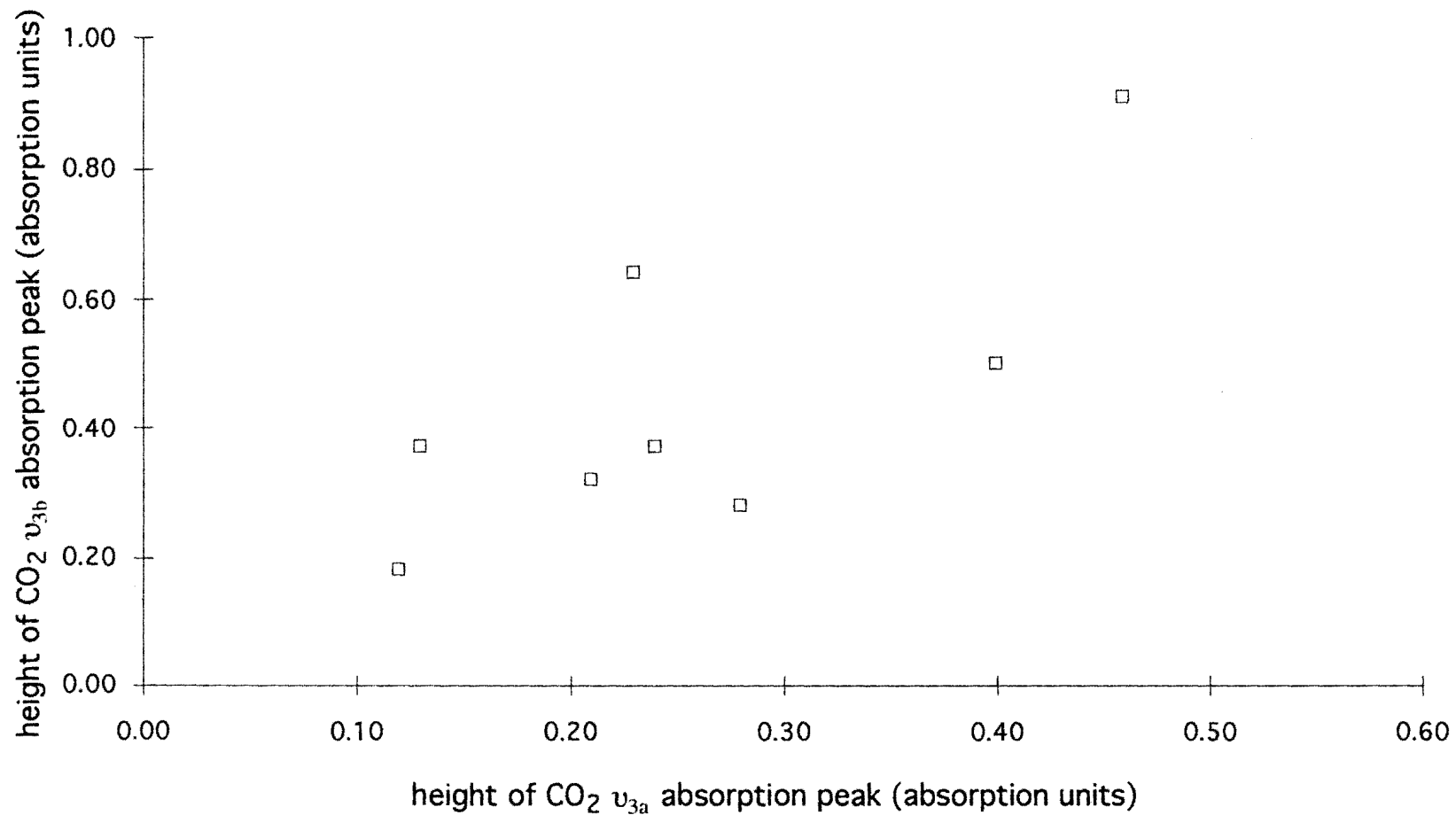


Fig. 4.22. Plot of the height of CO₂ ν_{3b} absorption peaks versus the height of CO₂ ν_{3a} absorption peaks for CO₂-bearing diamonds from George Creek which exhibit both peaks in their spectra.
A general positive correlation between the height of the two peaks is defined by the limited data set.

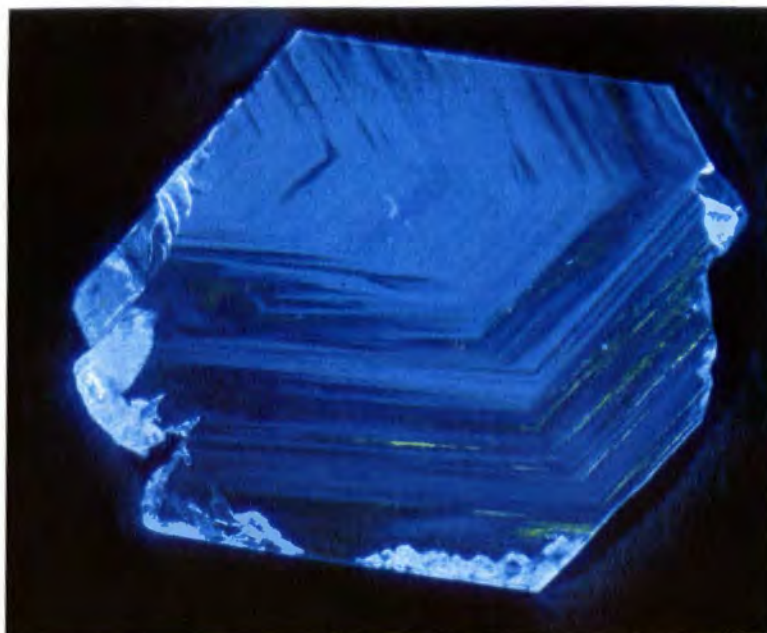


Fig. 5.1. Cathodoluminescence photomicrograph of polished diamond plate GC005. A "herringbone" pattern caused by intersecting octahedral growth layers delineates the presence of a macle twin plane in the older internal growth zone which has pale blue luminescence. The younger external growth zone is distinguished by the presence of yellow-green slip lines which are produced by plastic deformation. The diagonal dimensions of the plate are $\sim 3\text{mm}$ in length.



Fig. 5.2. High magnification cathodoluminescence photomicrograph of a resorbed diamond "seed" which acted as a nucleus for further growth in polished diamond GC006. The curvilinear truncation of growth layers in the diamond "seed" resulted from episodic resorption between diamond growth episodes. Poorly developed octahedral growth zones frame the "seed". Zones of yellow luminescence indicate the presence of platelets not resolved at this magnification. Diagonal dimension is $\sim 650\ \mu\text{m}$.

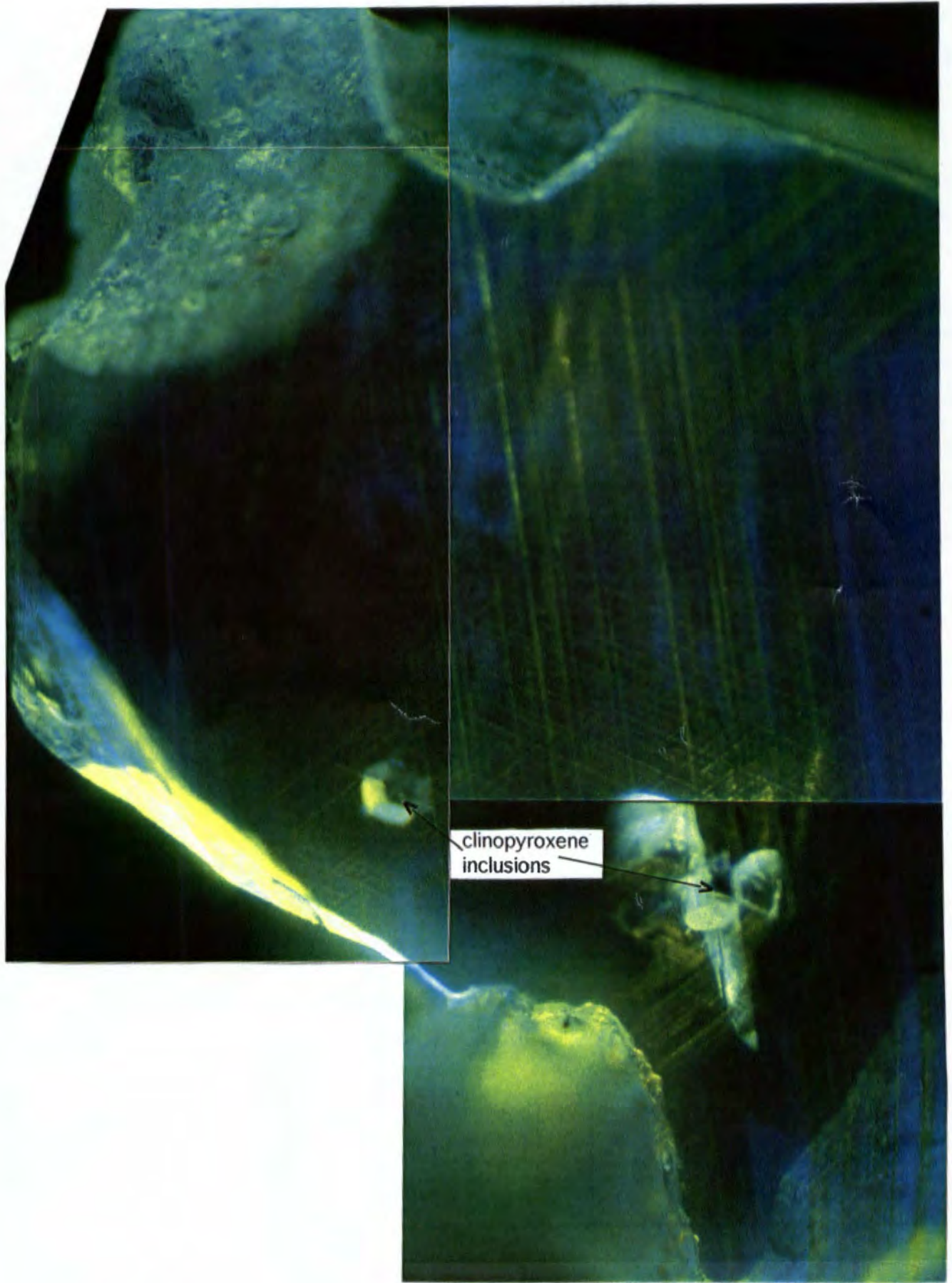


Fig. 5.3. Cathodoluminescence photomicrograph of polished diamond plate GC028. The dull blue luminescence, typical of diamonds with low nitrogen content, is transected by extremely well developed yellow-green slip planes. Longest dimension is ~2mm.

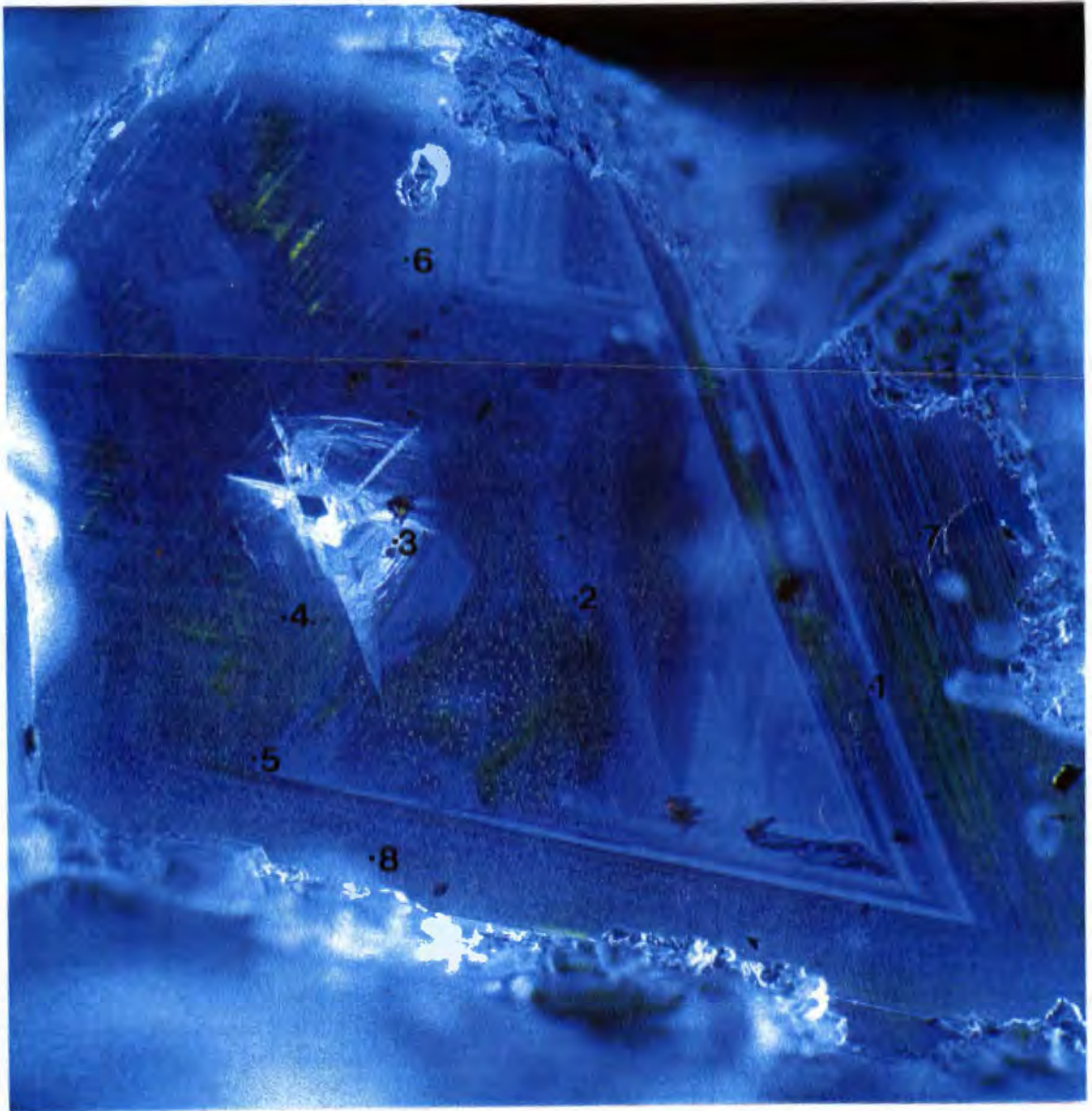


Fig. 5.4. Cathodoluminescence photomicrograph of polished diamond plate GC037. This diamond is characterized by clearly defined octahedral growth zones of variable nitrogen and platelet content. Platelets vary in size up to $\sim 15 \mu\text{m}$ in length, and are inhomogeneously distributed. Yellow-green slip planes are poorly developed. Cracks, radiating from a clinopyroxene inclusion with cubo-octahedral morphology, developed during the polishing process. Diagonal dimension is $\sim 1.8 \text{ mm}$. The locations of selected IR spectra used for quantitative analysis of nitrogen content and aggregation state are indicated. The following results were obtained and show an increase in nitrogen content and aggregation state towards the centre of the diamond:

<u>position</u>	<u>total nitrogen content (at. ppm)</u>	<u>% of total nitrogen in B aggregates</u>
1	253	87
2	388	91
3	537	94
4	406	92
5	229	87
6	575	94
7	168	84
8	295	90

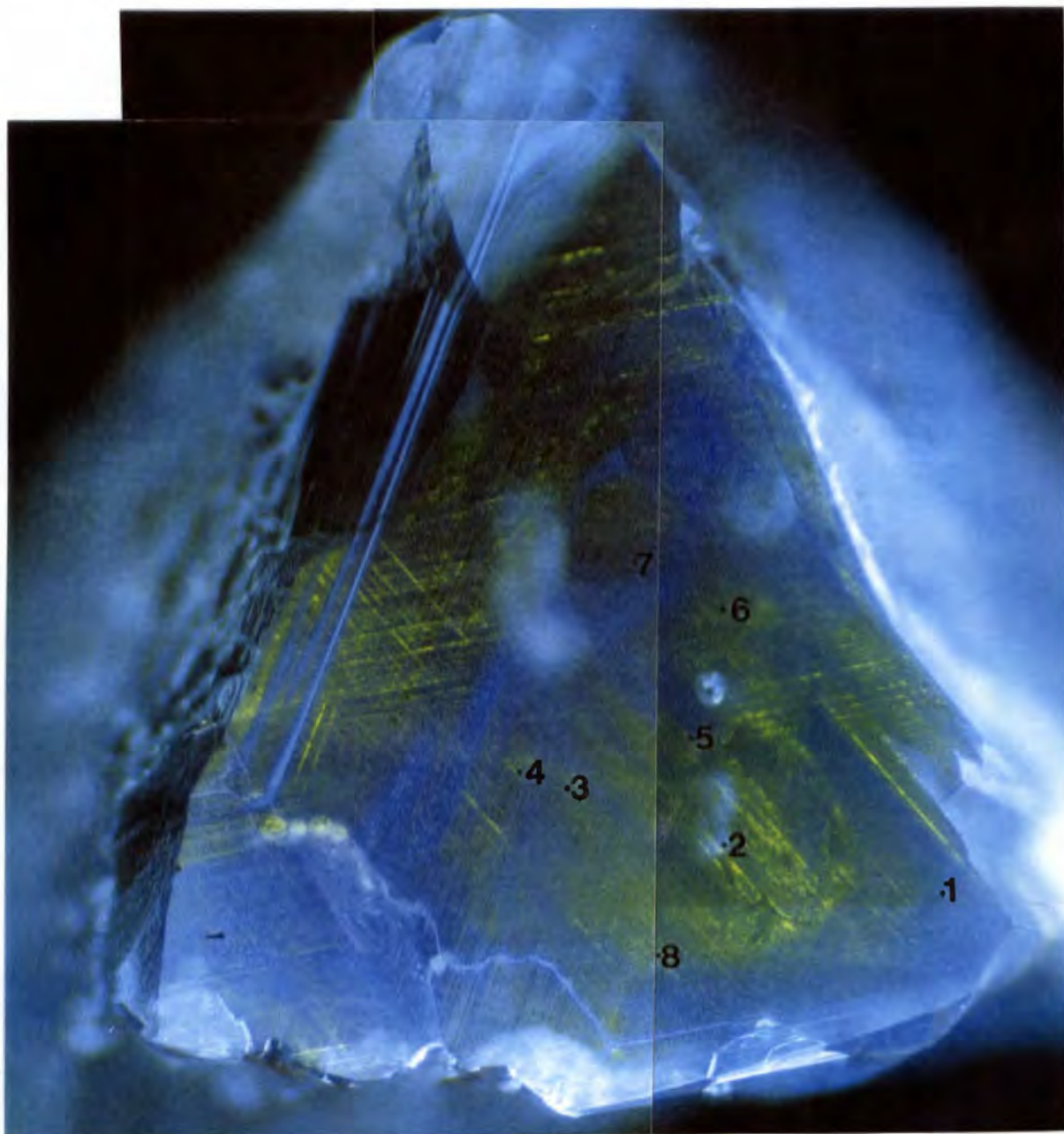


Fig. 5.5. Cathodoluminescence photomicrograph of polished diamond plate GC042. Octahedral growth zonation is obscured by the intense development of yellow-green slip planes, generated by plastic deformation during mantle residence time. Bright yellow haloes, caused by radiation damage from radioactive elements contained within secondary inclusions, are distributed along a fracture which connects to the etched surface of the diamond. The outlines of four clinopyroxene inclusions may be seen. Maximum dimension of the diamond plate is ~1.3 mm. The following quantitative analyses were obtained from selected IR spectra:

position	total nitrogen content (at. ppm)	% of total nitrogen in B aggregates
1	124	76
2	69	69
3	115	74
4	147	79
5	50	68
6	78	82
7	23	56
8	76	71

facing page:

Fig. 5.6. Cathodoluminescence photomicrograph of polished diamond GC036.

The cathodoluminescence of this plate is dominated by a “brecciated” texture comprising irregular, curved fragments of subtly different luminescence properties. A dark rutile inclusion is exposed at the polished surface in the “brecciated” region with the most intense pink luminescence. This texture may be the result of brittle deformation, caused by release of hydrogen from hydrous rutile inclusions or volume expansion associated with a phase transition from rutile to α -PbO₂ structure (Bendeliani *et al.*, 1967).

The curved fragments constituting the “brecciated” texture may have resulted from plastic deformation as they resemble sub-grain boundaries (B. Harte, pers. comm., 1995), but this texture has never been described in other plastically deformed diamonds. Abundant yellow-green slip planes caused by severe plastic deformation are revealed by the cathodoluminescence of an external zone of the diamond. It is surprising that growth features preserved in a polycrystalline nucleus (depicted at higher magnification in Fig. 5.7a.) close to the “brecciated” region have not been destroyed if plastic or brittle deformation processes are responsible for the “brecciated” texture. This suggests that the cathodoluminescence features of this diamond may have been caused by complex episodes of growth and dissolution (J.W. Harris, pers. comm., 1995).

A single halo (caused by radiation damage) surrounds an inclusion cavity at the irregular (etched ?) boundary between two zones with different cathodoluminescence properties. The inclusion is believed to have crystallized from secondary fluids which entered the diamond via a fracture between the different growth zones.

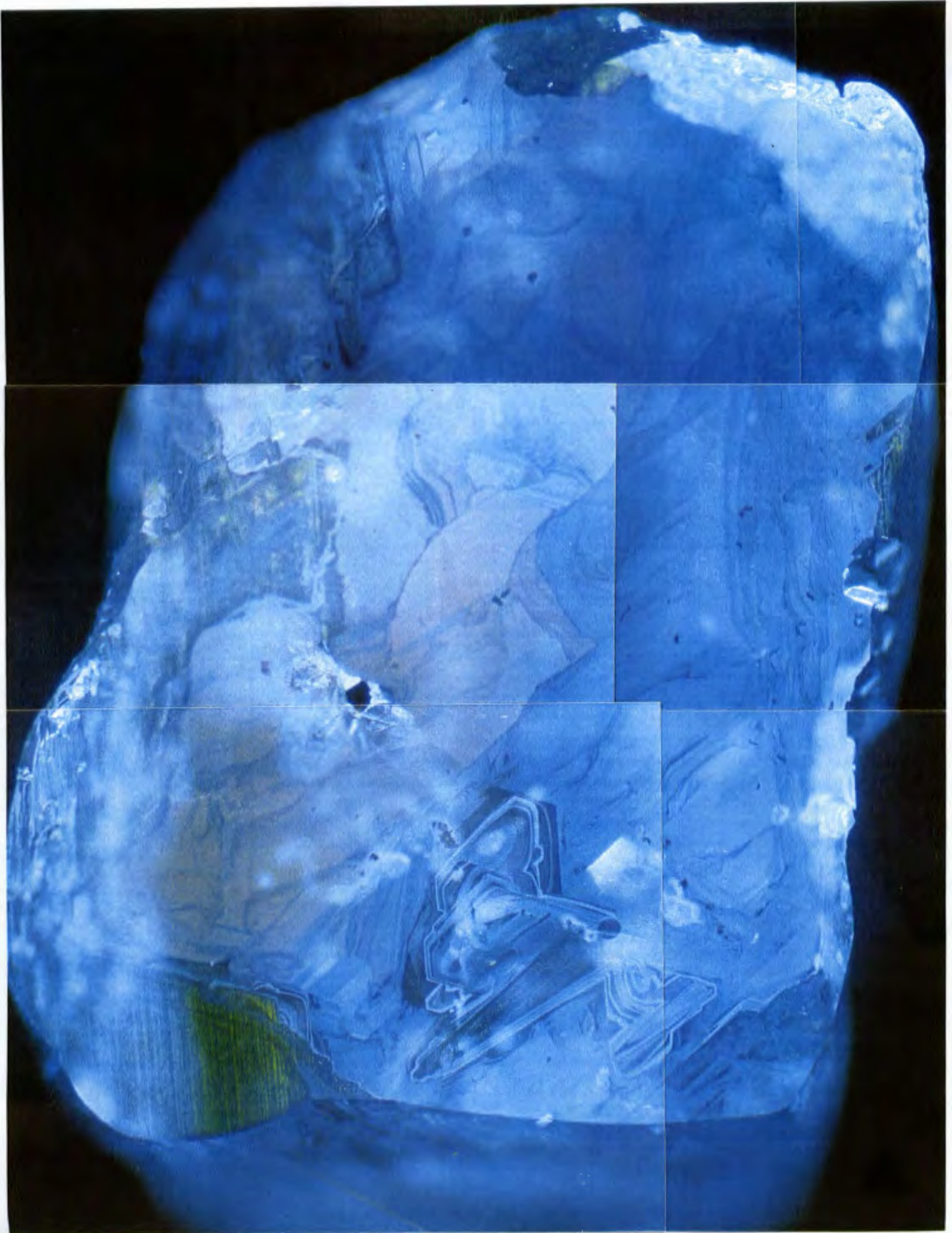


Fig. 5.6. Cathodoluminescence photomicrograph of polished diamond plate GC036. Maximum dimension of the diamond plate is ~3 mm. A description of the features revealed by cathodoluminescence is given on the facing page.



Fig. 5.7a. High magnification cathodoluminescence micrograph of a polycrystalline diamond "seed" in polished diamond plate GC036. Variations in the distribution of platelets and the intensity of cathodoluminescence reflect fluctuations in the conditions of diamond growth. Episodes of resorption resulted in curvature of external surfaces which were subsequently covered by renewed diamond growth. Diagonal dimension is $\sim 650 \mu\text{m}$.



Fig. 5.7b. Reflected light photomicrograph of polished diamond plate GC036. One large orange garnet inclusion and several smaller garnet inclusions are visible. Also present are dark brown rutile inclusions and a colourless inclusion surrounded by a graphite rosette. Maximum dimension of the diamond plate is $\sim 3 \text{ mm}$.

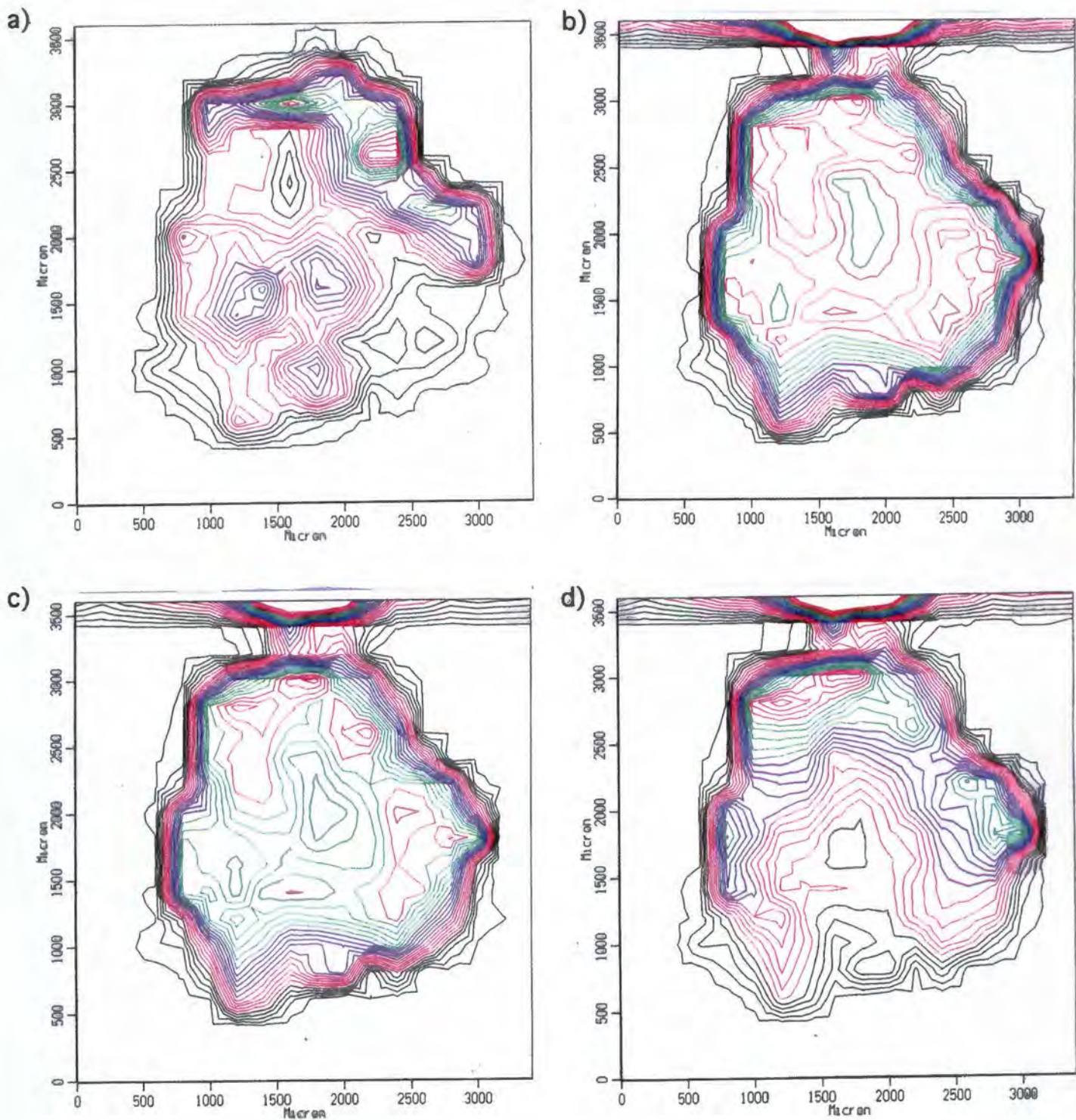


Fig. 5.10. Contour maps of IR absorption properties in polished diamond plate GC101. The distribution of hydrogen, A and B nitrogen defects, and platelets varies between radial growth sectors which are distinguished by subtle differences in cathodoluminescence properties. The colour of contour lines progresses with increasing absorption intensity from black-magenta-blue-green-red. Contour maps were produced by Paul Turner, of Bruker Spectrospin Ltd., Coventry.

a) Contour plot of IR absorption at 3107 cm^{-1} due to the presence of hydrogen.
 b) Contour plot of IR absorption at 1282 cm^{-1} due to the presence of A nitrogen aggregates.
 c) Contour plot of IR absorption at 1174 cm^{-1} due to the presence of B nitrogen aggregates.
 d) Contour plot of IR absorption at 1365 cm^{-1} due to the presence of platelets.



Fig. 5.8. Cathodoluminescence photomicrograph of the central region of polished diamond plate GC101.

The central part of this diamond is similar to synthetic diamonds as it has cubo-octahedral morphology and radial growth sectors of different impurity content which may be detected by cathodoluminescence. Diagonal dimension is ~ 2 mm.

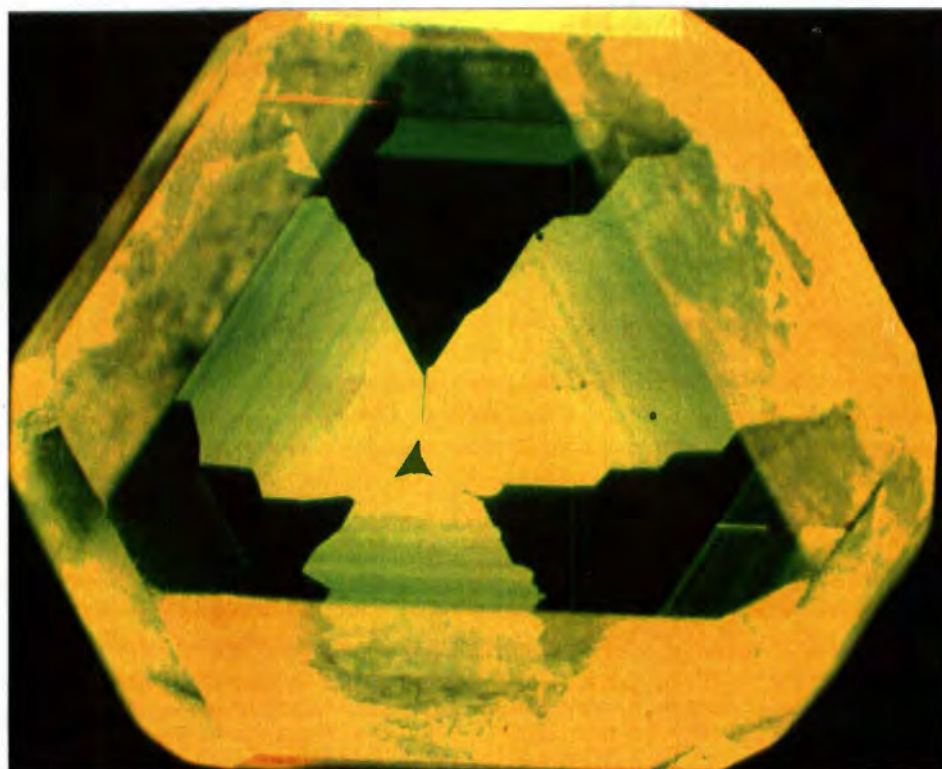


Fig. 5.9. Cathodoluminescence photomicrograph of a Type Ib synthetic diamond.

The yellow luminescence is caused by the presence of unaggregated nitrogen defects. The cubo-octahedral morphology and presence of radial growth sectors is characteristic of diamonds synthesized using molten metals as the catalyst/solvent. Photograph courtesy of H. J. Milledge.

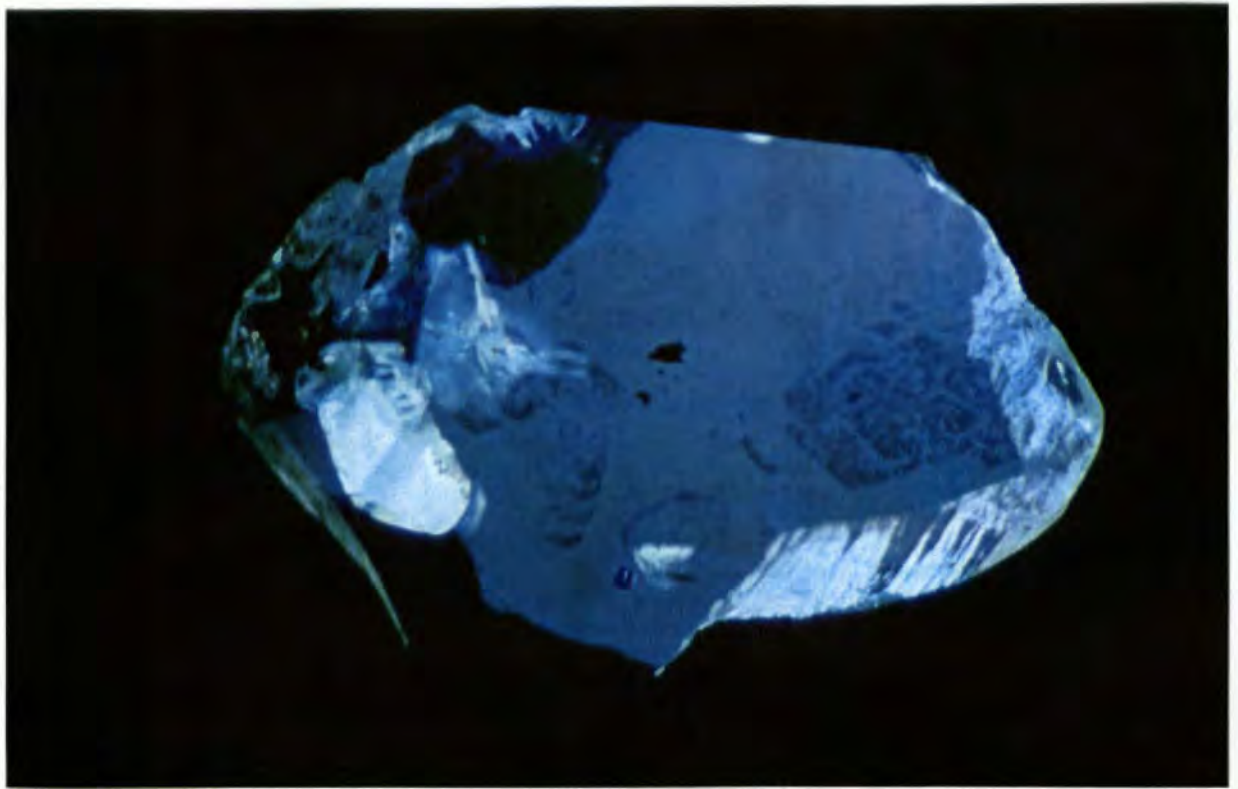


Fig. 5.11. Cathodoluminescence photomicrograph of polished diamond plate GC008. CO₂-bearing diamond, with anomalous pink-mauve luminescence, is intergrown with plastically deformed CO₂-free diamond, which is transected by abundant yellow-green slip planes. The bright area in the bottom left corner is caused by the reflection of light by a fracture plane and black spots in the centre are carbon dag. Maximum length of the diamond plate is ~3.5 mm.



Fig. 5.12. High magnification cathodoluminescence photomicrograph of GC008. A texture recognized in the pink CO₂-bearing zone is similar to textures produced by the annealing of fluid inclusions in quartz crystals (A. H. Rankin, pers. comm., 1993). A discontinuous thin layer of diamond with normal blue luminescence separates the older (?) CO₂-free diamond growth generation, which shows intensive development of plastic slip planes, from the younger (?) CO₂-bearing diamond growth generation. Diagonal dimension is ~ 1 mm.

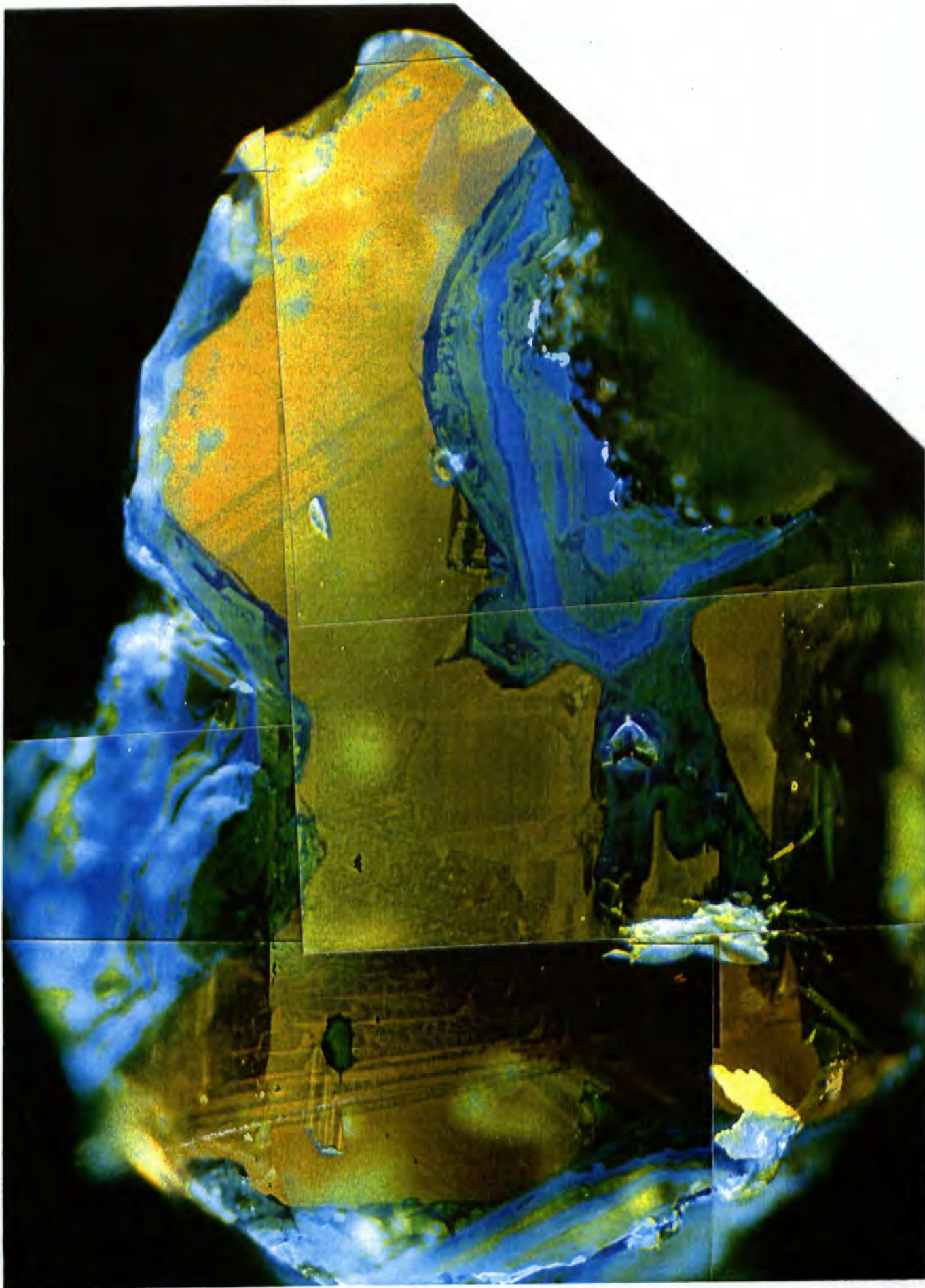


Fig. 5.13. Cathodoluminescence photomicrograph of polished diamond plate GC030. This diamond is characterized by complex intergrowth relationships between CO₂-bearing (orange luminescence) and CO₂-free (blue luminescence) diamond growth generations. Length of diamond plate is ~3 mm.

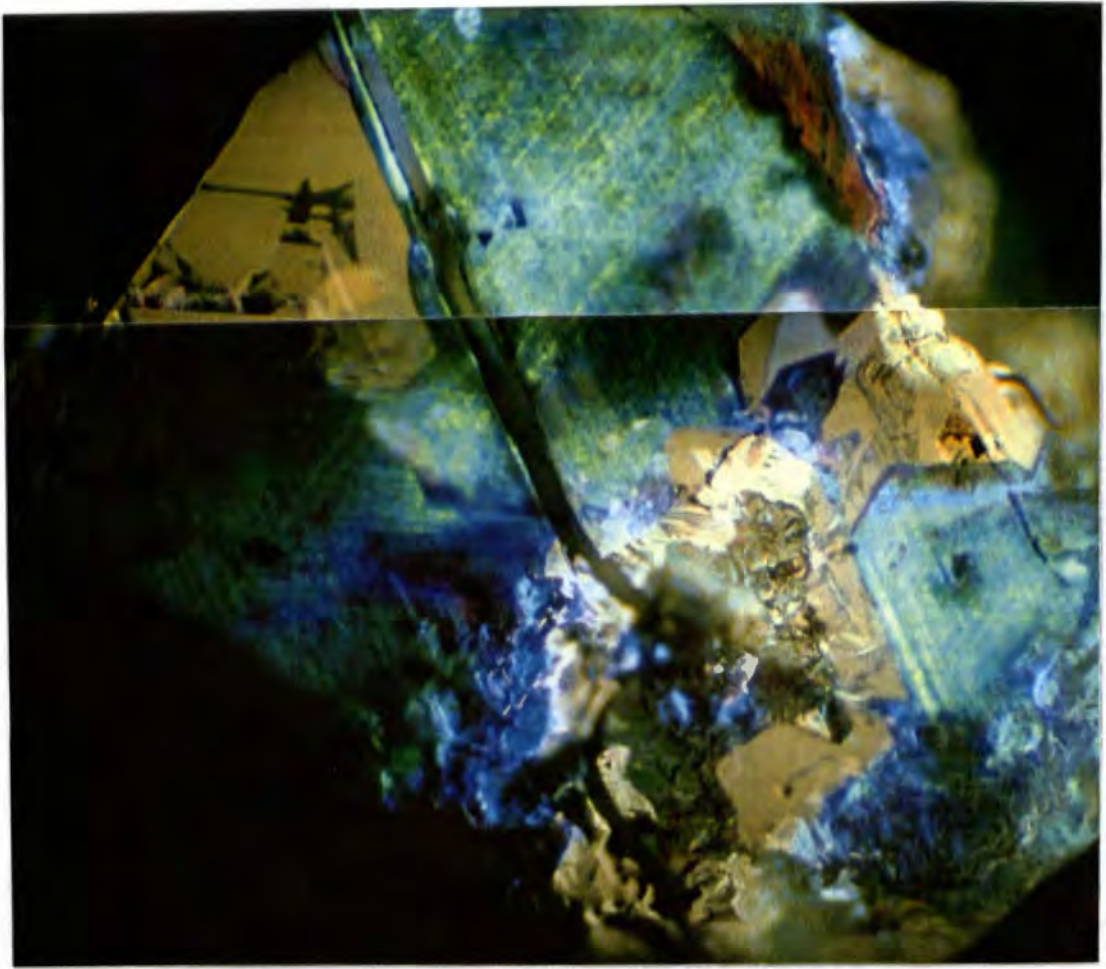


Fig. 5.14. Cathodoluminescence photomicrograph of polished diamond plate GC150. Zones of CO₂-bearing diamond with anomalous brown-orange luminescence are complexly intergrown with CO₂-free diamond. Yellow-green slip planes caused by plastic deformation are visible in the CO₂-free diamond. A crack (from the upper left corner to the bottom corner) developed during polishing. Diagonal dimension is ~2 mm.

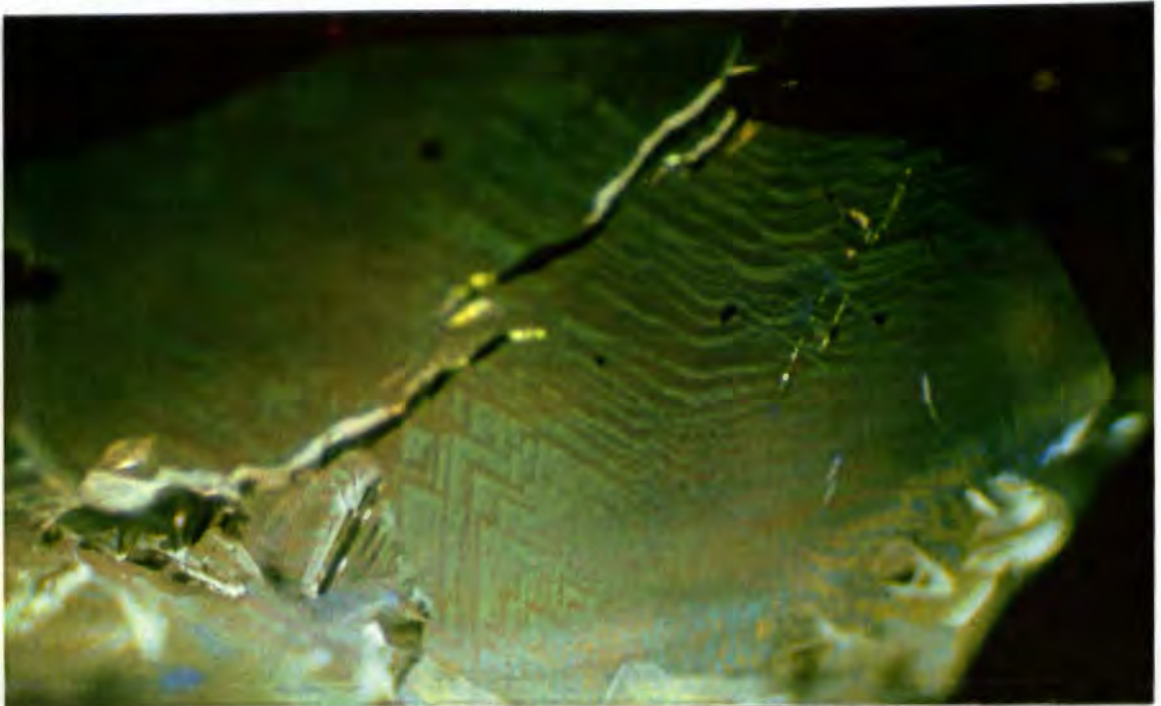


Fig. 5.15. Cathodoluminescence photomicrograph of polished diamond plate GC151. This plate lacks the blue luminescence typical of CO₂-free diamond, and consists entirely of CO₂-bearing diamond with anomalous green-brown luminescence. Features suggestive of octahedral and hummocky growth zonation are revealed by subtle variations in luminescence colour. Diagonal dimension is ~ 1.8 mm.

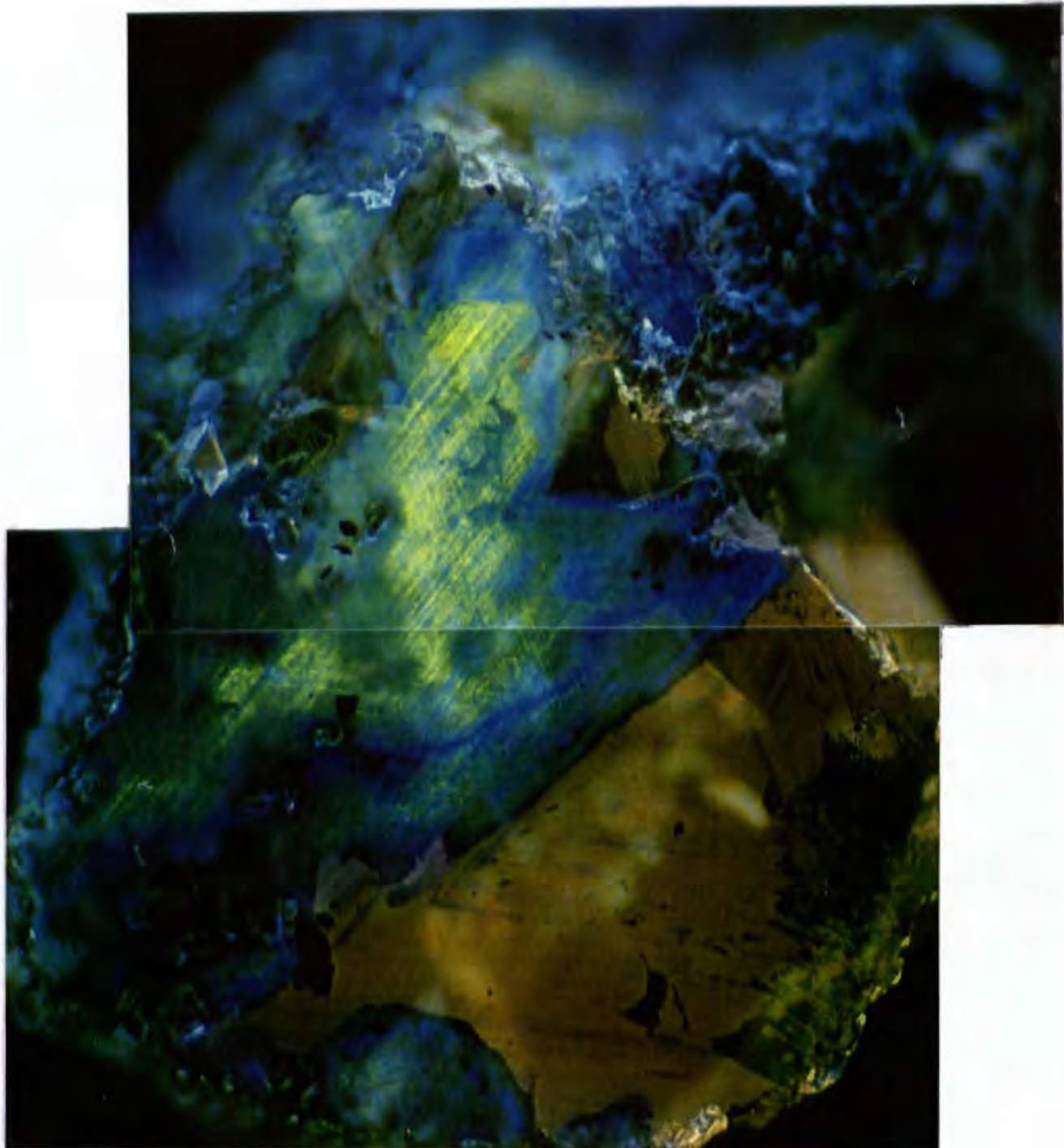


Fig. 5.16. Cathodoluminescence photomicrograph of polished diamond plate GC171. This diamond consists of a CO₂-bearing diamond growth generation intergrown with a CO₂-free generation. The presence of intersecting yellow-green slip planes in the CO₂-free generation is indicative of plastic deformation during residence in the mantle. The anomalous brown-orange luminescence of the CO₂-bearing growth generation may mask any yellow-green luminescence caused by plastic deformation. Alternatively, the CO₂-bearing growth generation is younger than the CO₂-free growth generation, and also post-dates the deformation event which affected the CO₂-free growth generation. The second explanation is thought to be more likely because of morphological relationships between the two diamond growth generations in other specimens (see Fig. 5.17b). Diagonal dimension is ~ 2.5 mm.

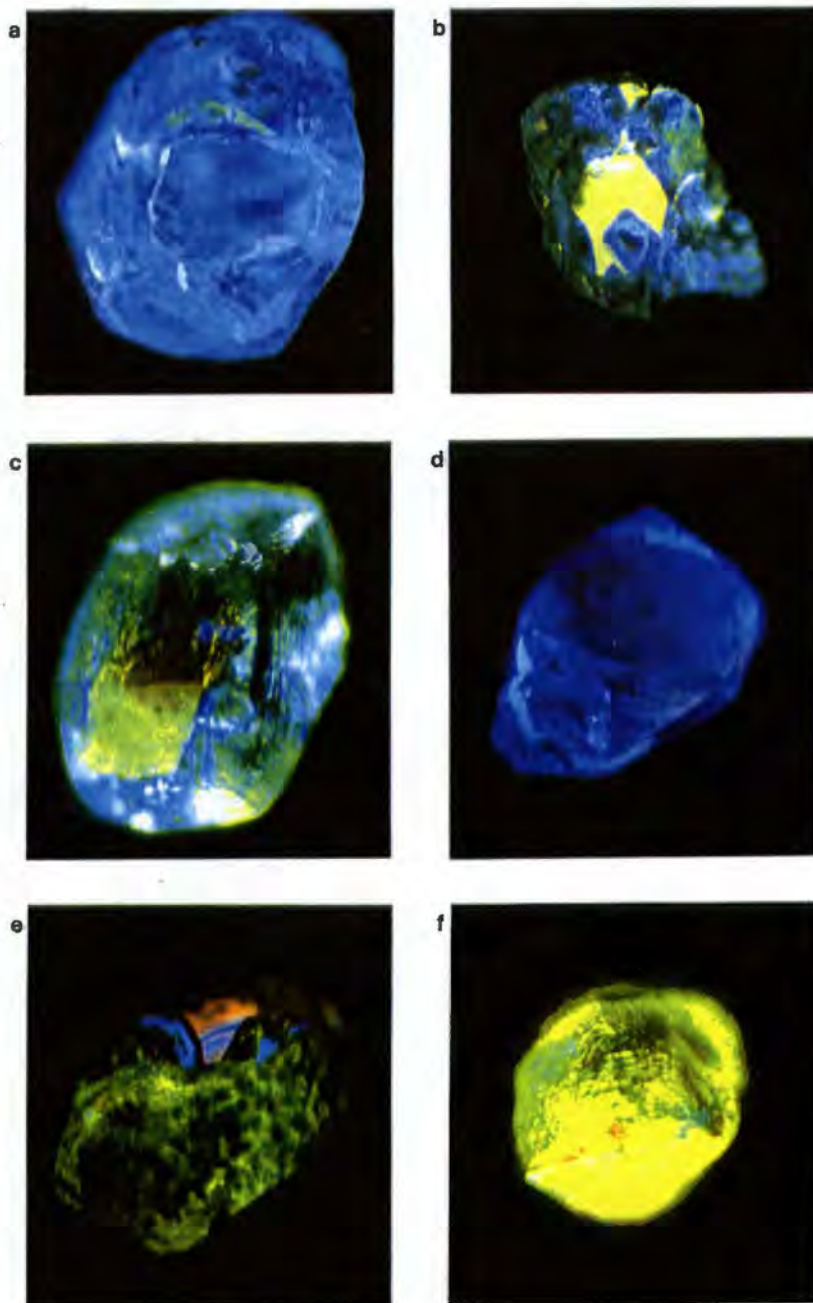


Fig. 5.17. Cathodoluminescence photomicrographs of selected unpolished diamonds.

- a) CO₂-free diamond GC753 which has typical blue luminescence and minor development of yellow-green slip planes, not resolved at this magnification. The outline of a large etched inclusion cavity is barely discernable.
 - b) In diamond GC755 the CO₂-bearing diamond growth generation with orange luminescence appears to have crystallized in a large cavity in the CO₂-free generation, similar to that depicted in a).
 - c) Diamond GC863 contains CO₂-bearing diamond which appears to have crystallized in a cavity in the CO₂-free diamond growth generation. Both diamond generations were subsequently resorbed by oxidizing fluids.
 - d) Diamond aggregate GC872 has been strongly resorbed to tetrahedral morphology. This diamond contains a small region of CO₂-bearing diamond in its centre. As cathodoluminescence is a surface phenomenon, no anomalous luminescence is visible. This "chemically polished" diamond has extremely lustrous faces.
 - e) Dark radiation damage haloes are visible against the yellow-green plastic slip planes in the CO₂-free growth generation in diamond GC870.
 - f) The uniform yellow-green luminescence of diamond GC874 is characteristic of experimentally irradiated diamonds which have been annealed at elevated temperatures (H. J. Milledge, pers. comm., 1994).
- Diamonds are all from the -1 Pierres sieve class and are ~ 1 mm in diameter.

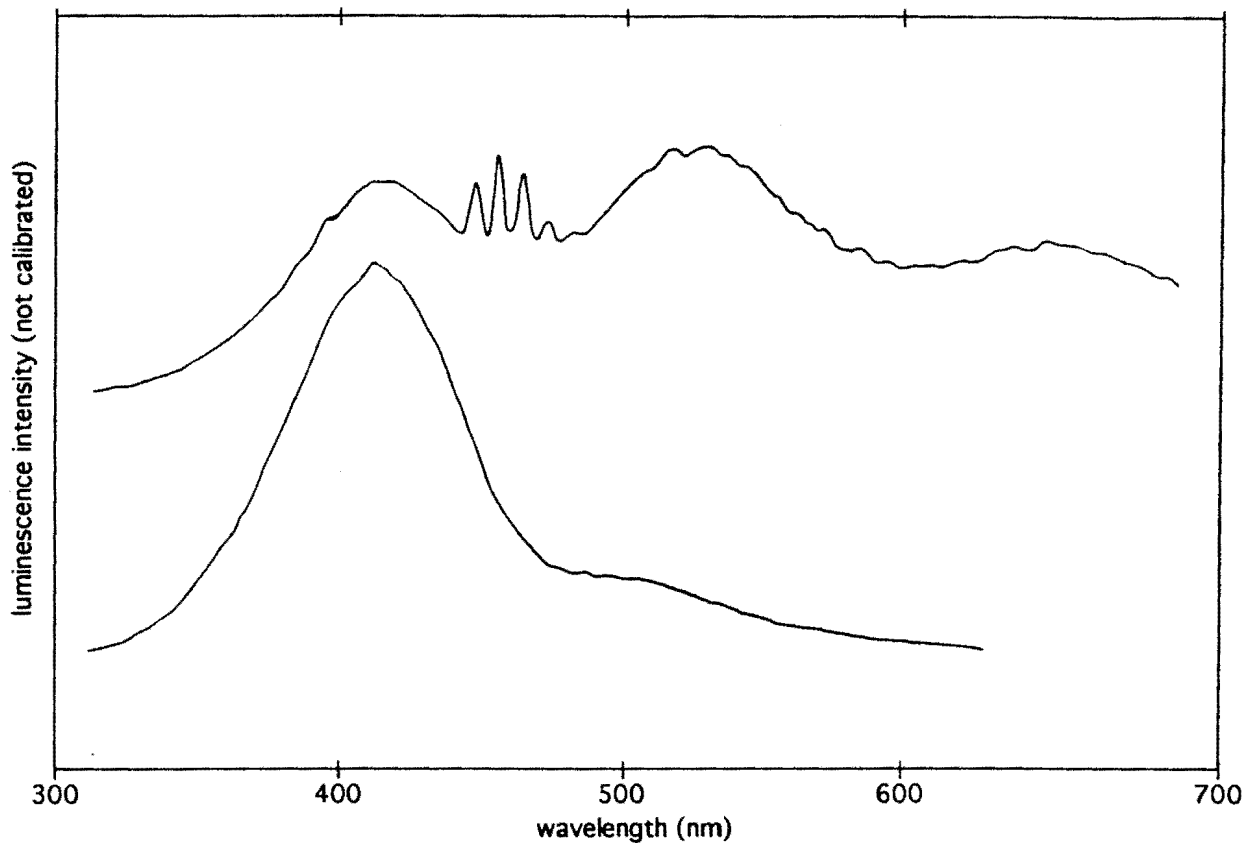


Fig. 5.18a. Cathodoluminescence spectra from CO₂-bearing diamond GC814. The upper spectrum was obtained from a CO₂-bearing region with anomalous orange luminescence, whereas the lower spectrum was obtained from a CO₂-free region with blue luminescence.

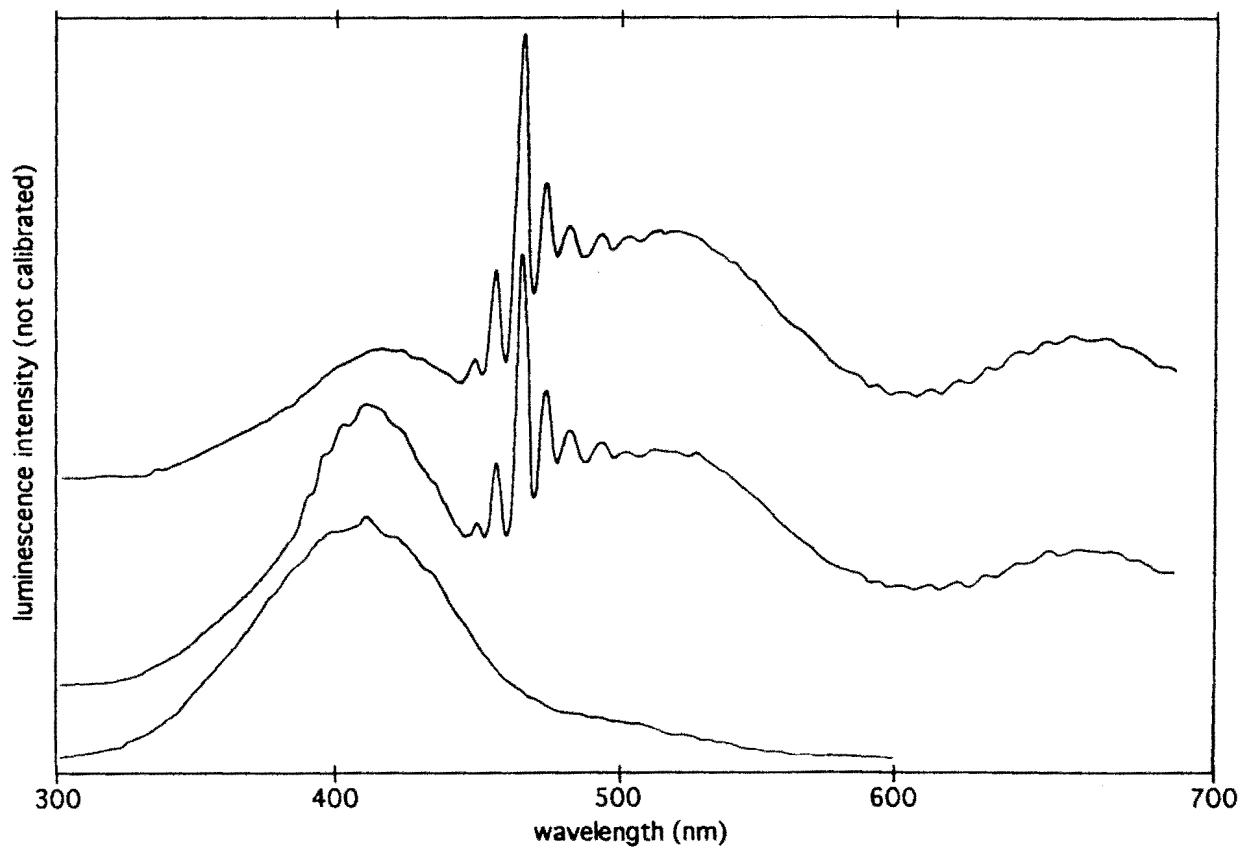


Fig. 5.18b. Cathodoluminescence spectra from CO₂-bearing diamond GC837. Broad similarities with the spectra from diamond GC814 are evident.

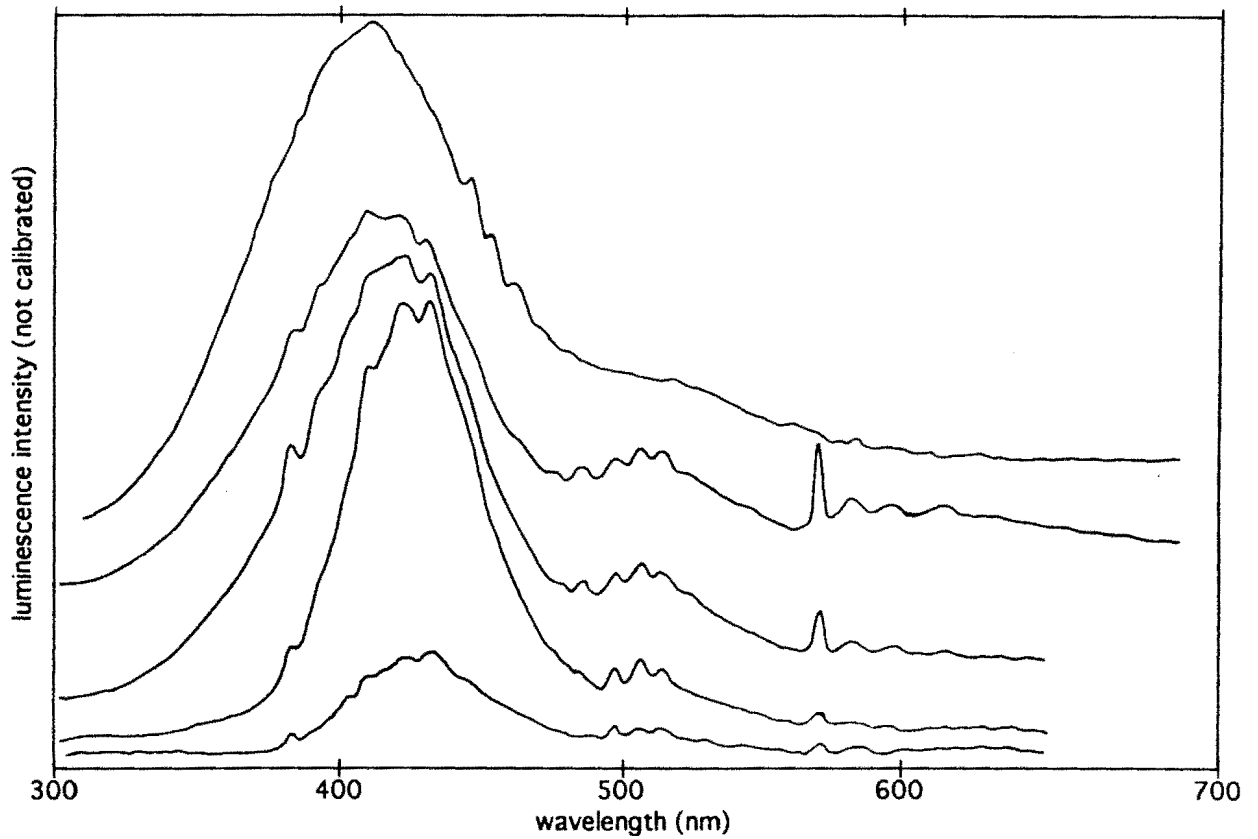


Fig. 5.19a. Cathodoluminescence spectra from CO₂-bearing diamond GC821.
 This diamond comprises CO₂-free diamond with yellow-green cathodoluminescence (from slip planes) intergrown with CO₂-bearing diamond with anomalous pink cathodoluminescence.

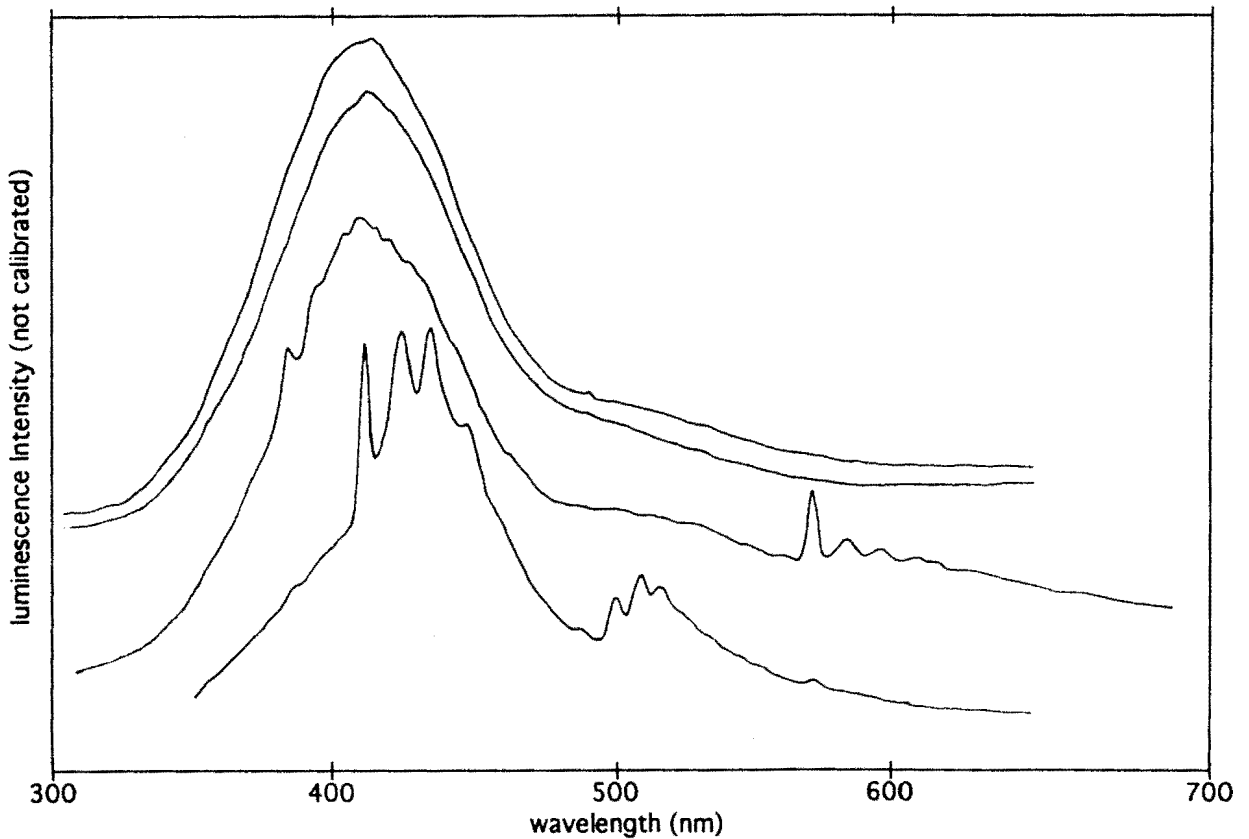
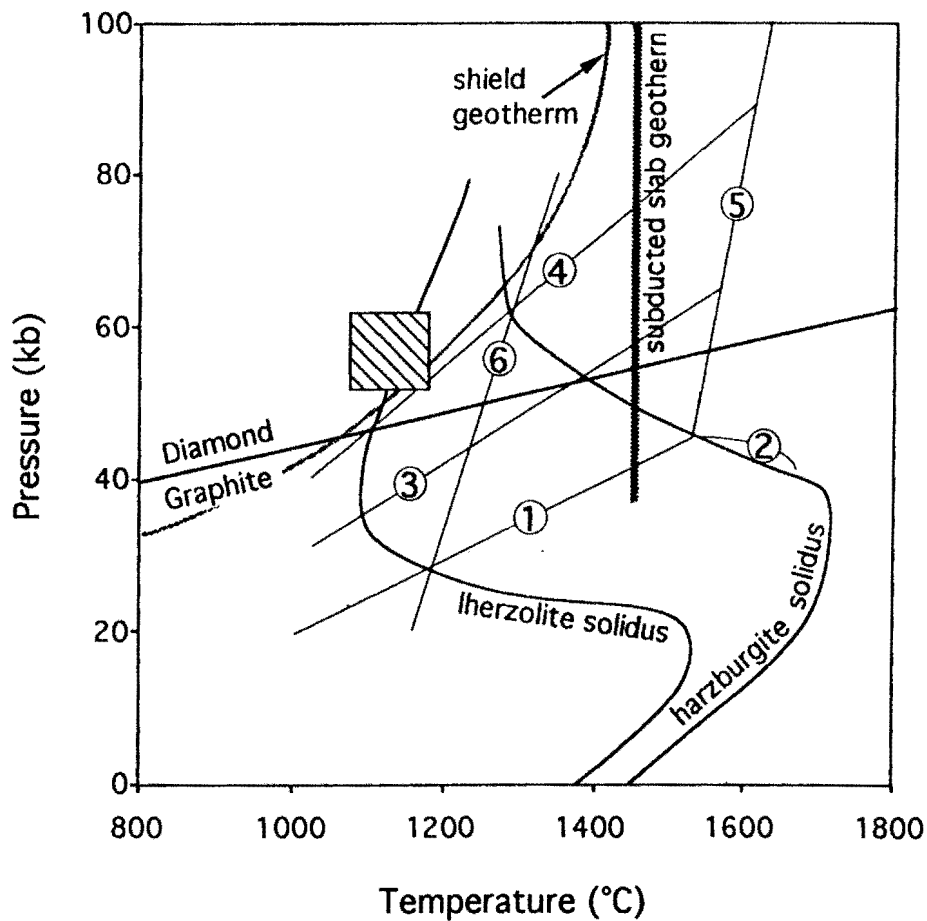


Fig. 5.19b. Cathodoluminescence spectra from CO₂-bearing diamond GC771.
 Broad similarities with the spectra from diamond GC821 are evident.



- ① Forsterite + CO₂ = Magnesite + Enstatite (Wyllie *et al.*, 1983)
- ② Forsterite + CO₂ = Enstatite + Liquid (Wyllie *et al.*, 1983)
- ③ Orthopyroxene + CO₂ = Magnesite + SiO₂
Clinopyroxene + CO₂ = Dolomite + SiO₂ + Orthopyroxene
(Wyllie *et al.*, 1983; Mäder and Berman, 1991)
- ④ Pyrope + CO₂ = Magnesite + Spinel + Coesite (Brown *et al.*, 1989)
- ⑤ Aragonite + Coesite = Liquid + CO₂
Magnesite + Coesite = Liquid + CO₂
(Wyllie and Huang, 1976; Huang *et al.*, 1980)
- ⑥ Minimum melting curve in CaO-MgO-SiO₂-CO₂ system
at high pressures this corresponds to:
Dolomite + coesite = Liquid + CO₂ (Wyllie and Huang, 1976)

Fig. 6.1. Pressure-temperature relationships of mantle carbonation reactions.

Shield geotherm and subducted slab geotherm are from Pollack and Chapman (1977) and Thompson (1992) respectively. Diamond-graphite phase boundary is from Kennedy and Kennedy (1976). Below the intersection of reactions (5) and (3), melting of magnesite and coesite consumes CO₂. Harzburgite and Iherzolite solidi in the presence of moderate amounts of H₂O and CO₂ are from Ellis and Wyllie (1980) and Wyllie (1978) respectively. The hatched area corresponds to temperature-pressure conditions of diamond formation estimated from coexisting mineral inclusions recovered from George Creek diamonds (see section 7.4).

Modified from Schrauder and Navon (1993).

facing page:

Fig. 7.1. Photomicrographs of mineral inclusions recovered from George Creek diamonds.

- a) Black graphite inclusions in diamond GC010. This diamond also contained eclogitic clinopyroxene inclusions, one of which is visible near the surface in the unetched area.
The diagonal dimension of the photomicrograph is ~5.5 mm.
- b) Green websteritic clinopyroxene inclusion in diamond GC022. Although this inclusion has well-faceted cubo-octahedral morphology, it does not meet the criteria to be analysed as a syngenetic inclusion because of the presence of fractures leading to the surface of the diamond. Two other inclusions unassociated with fractures were analysed: a biminerally clinopyroxene-orthopyroxene inclusion and a discrete clinopyroxene inclusion.
The length of the inclusion is ~180 μm .
- c) Pale orange eclogitic garnet inclusion, which contains two cubo-octahedral ilmenite inclusions, recovered from diamond GC055.
The length of the largest ilmenite inclusion is ~30 μm .
- d) Red-brown eclogitic rutile inclusions in diamond GC085 which also contained clinopyroxene and graphite inclusions.
Diagonal dimension is ~1 mm.

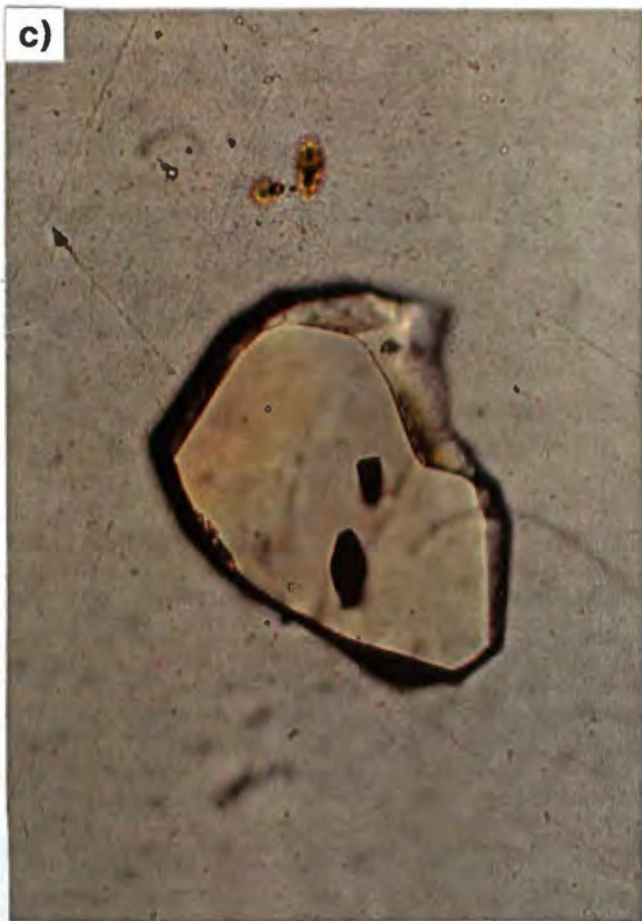
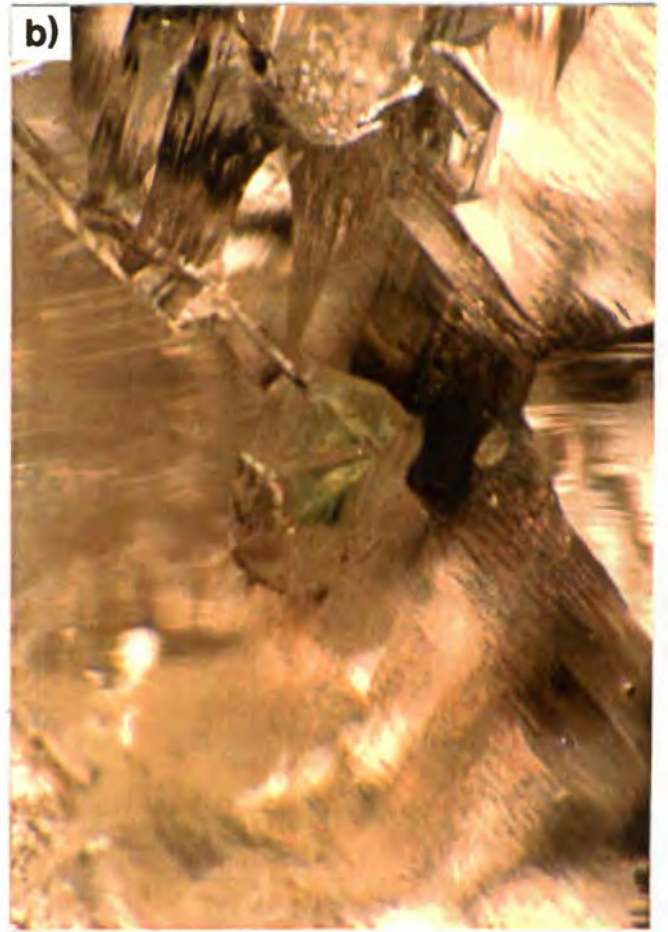


Fig. 7.1. Photomicrographs of mineral inclusions recovered from George Creek diamonds.

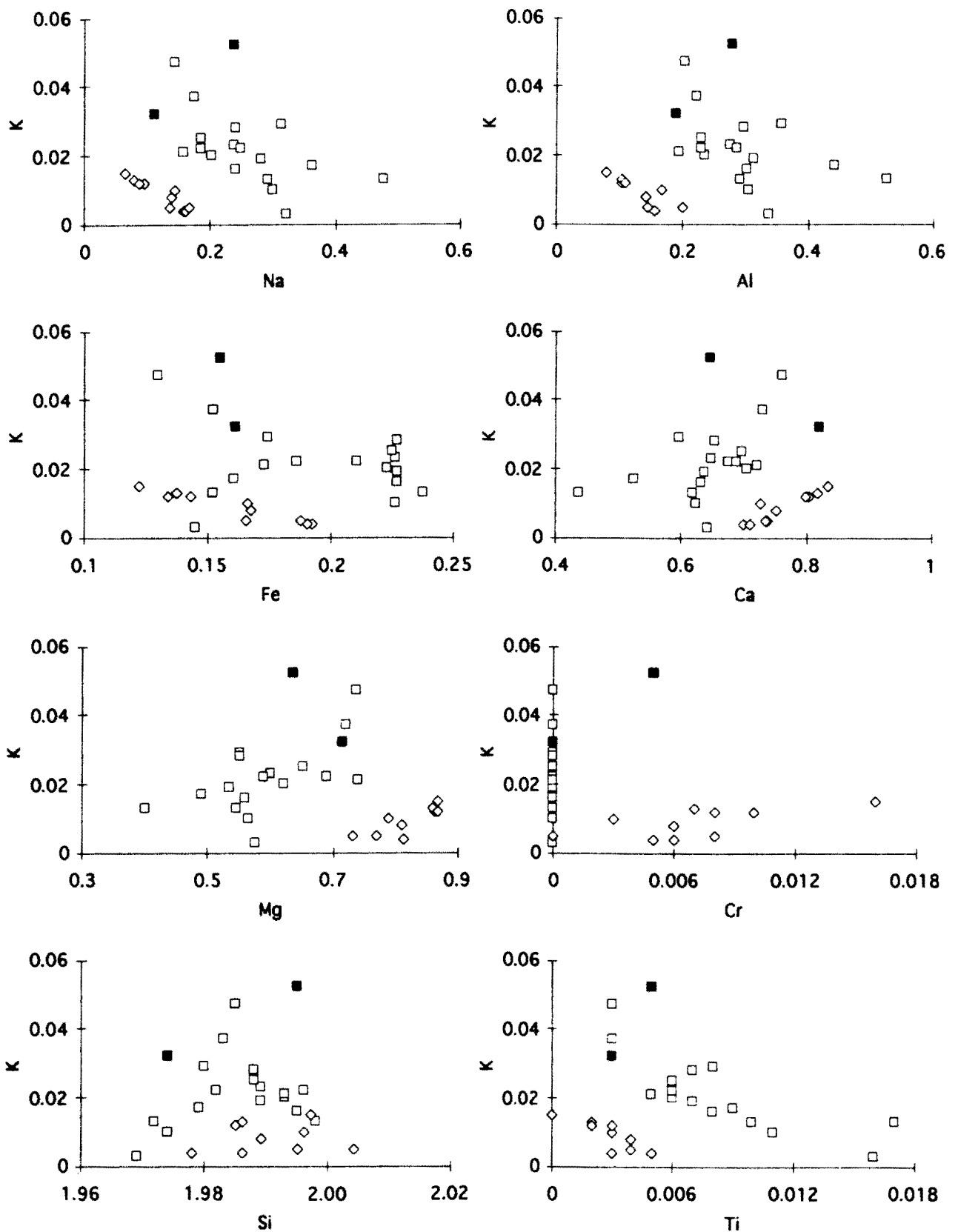


Fig. 7.2. Inter-element relationships in George Creek discrete clinopyroxene inclusions. The more refractory Group GC1 inclusions are represented by diamond symbols, whereas the compositionally more variable Group GC2 inclusions are represented by square symbols. Solid symbols denote inclusions recovered from CO₂-bearing diamonds. The units of the vertical and horizontal axes are in cations per formula unit (i.e. per 6 oxygen atoms).

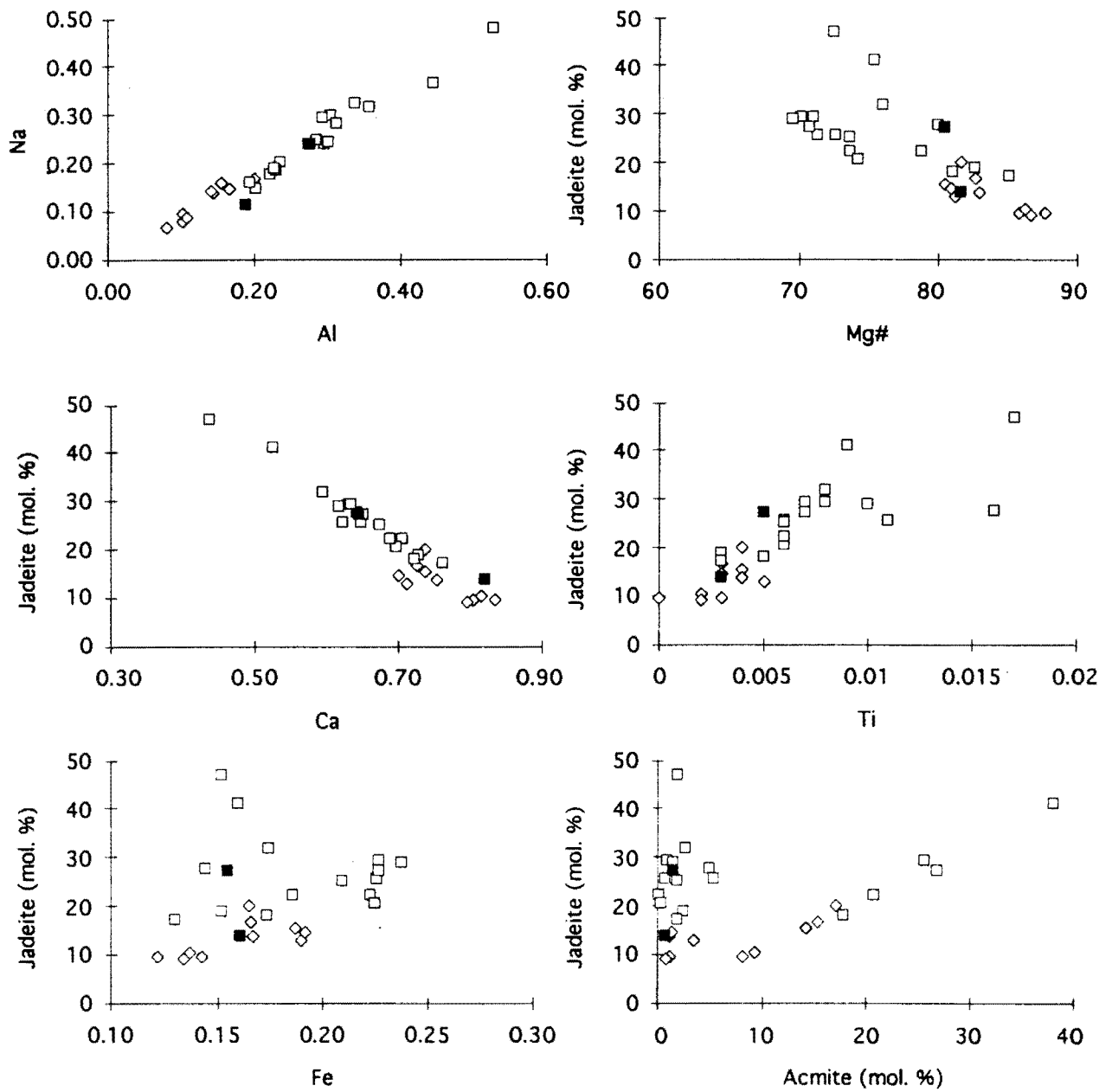


Fig. 7.3. Further inter-element and compositional relationships in George Creek discrete clinopyroxene inclusions.

- ◇ Group GC1 clinopyroxenes
- Group GC2 clinopyroxenes
- Group GC2 clinopyroxenes from CO₂-bearing diamonds

Unless stated otherwise the vertical and horizontal axes are in cations per formula unit (i.e. per 6 oxygen atoms). Pyroxene end-member proportions were calculated by the method of Hatton (1978).

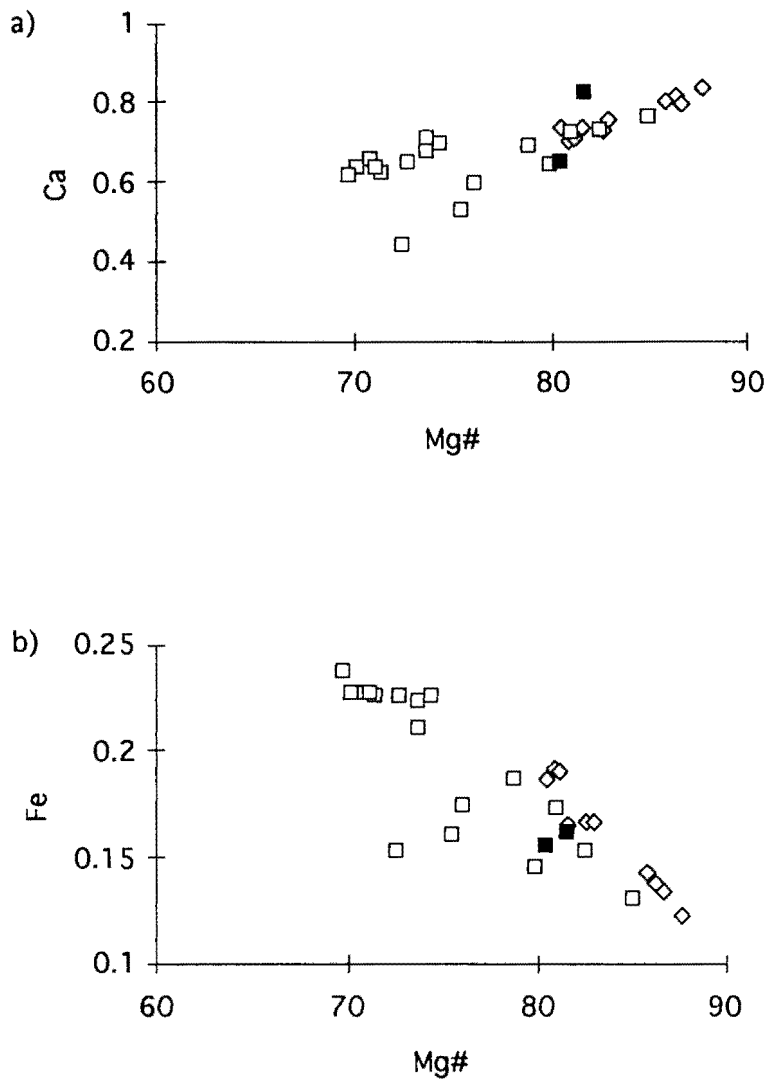


Fig. 7.4. Plots of the relationships between the Mg#, Ca and Fe contents of discrete clinopyroxene inclusions recovered from George Creek diamonds.
 ◇ Group GC1 inclusions □ Group GC2 inclusions
 Solid symbols denote inclusions recovered from CO₂-bearing diamonds.
 The Fe and Ca contents of the clinopyroxene inclusions are plotted in cations per formula unit (i.e. per 6 oxygen atoms).

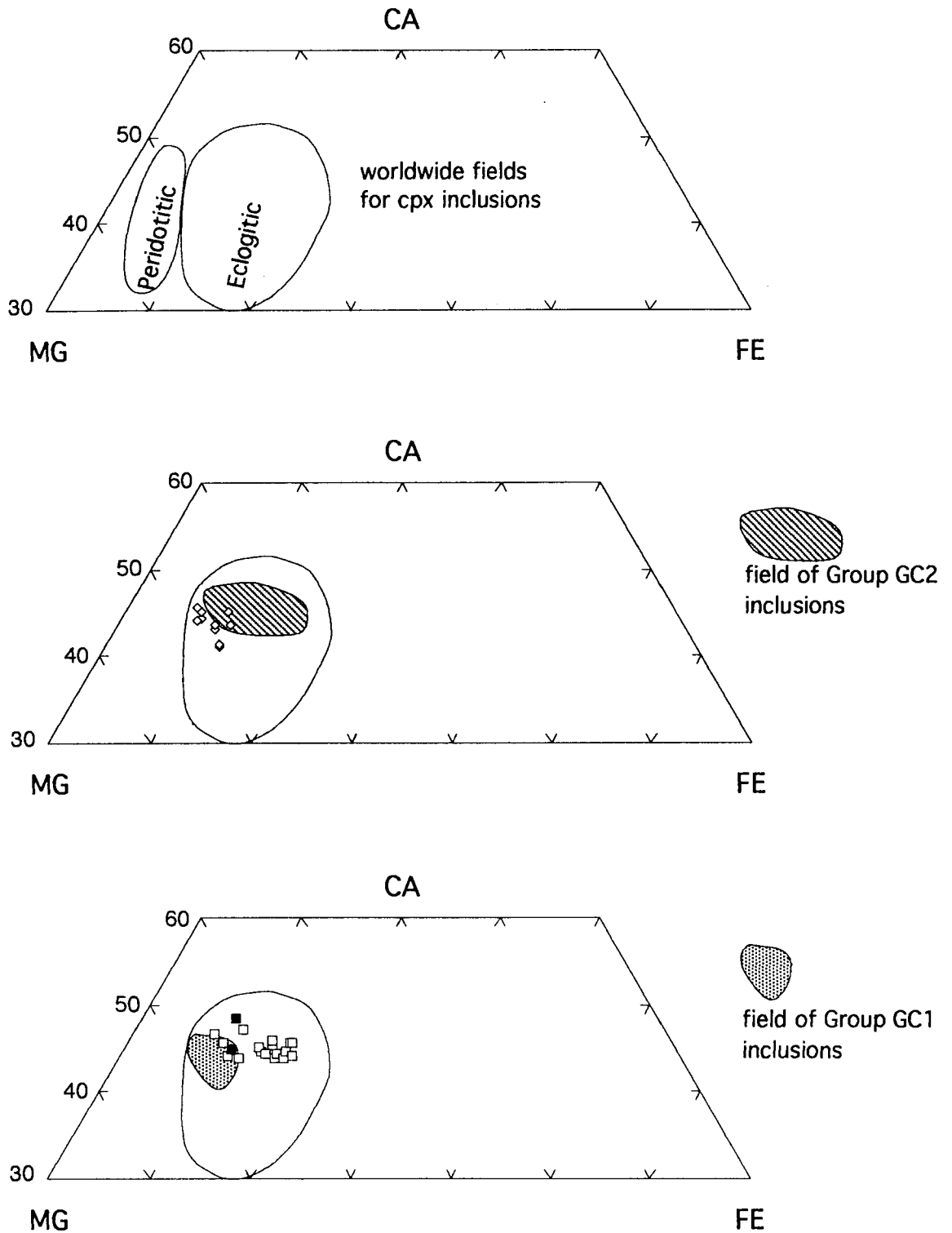
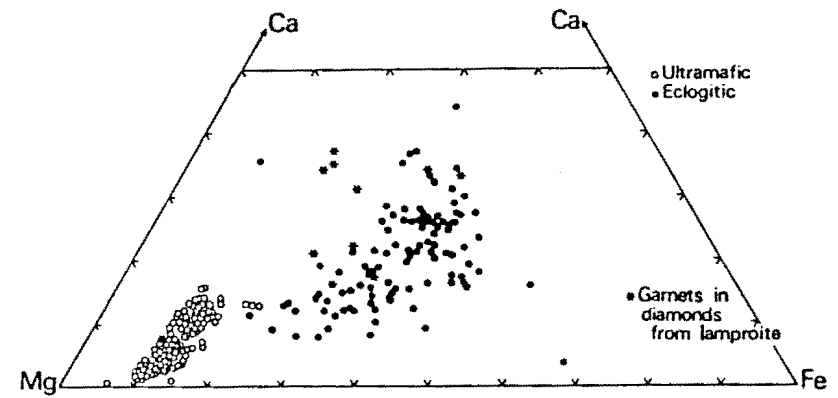
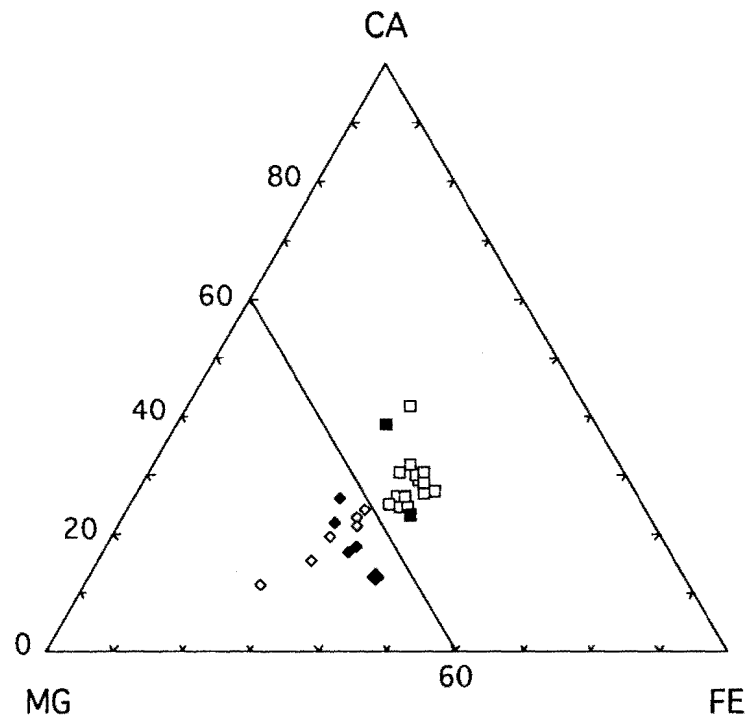


Fig. 7.5. Plots of portion of the Ca:Mg:Fe ternary diagram (mol. %) for discrete clinopyroxene inclusions recovered from George Creek diamonds.

- a) Worldwide distribution of eclogitic and peridotitic clinopyroxene diamond inclusions from Meyer (1987)
 - b) George Creek Group GC1 inclusions
 - c) George Creek Group GC2 inclusions
- Solid symbols denote inclusions from CO₂-bearing diamonds.



Worldwide garnet inclusion distribution from Meyer (1987)

Fig. 7.6. Ternary Ca:Mg:Fe diagram (mol. %) for discrete garnet inclusions recovered from George Creek diamonds.

◇ Group GC1 □ Group GC2 ◆ GC376A (websteritic green garnet)

Solid symbols represent inclusions from CO₂-bearing diamonds

Group GC1 garnet inclusions are effectively separated from Group GC2 inclusions by a line drawn at 60 mol. % Mg.

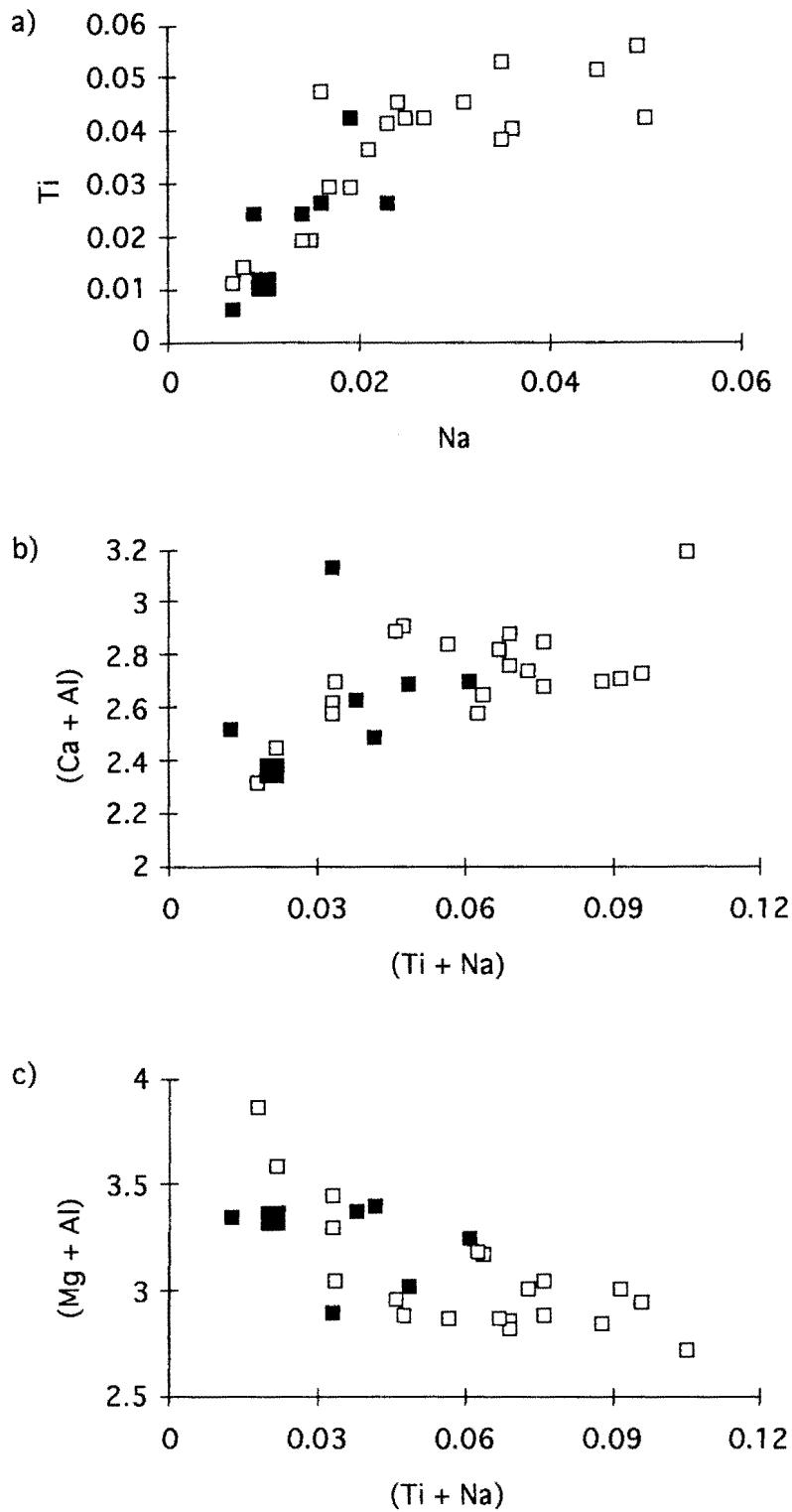


Fig. 7.8. Inter-element ratios for discrete garnet inclusions recovered from George Creek diamonds. Solid symbols denote garnets recovered from CO_2 -bearing diamonds. Large solid symbol represents the single green websteritic garnet (GC376). Group GC1 and Group GC2 inclusions are not distinguished for the sake of simplicity. The units of the axes are in cations per formula unit (i.e. per 12 oxygen atoms).

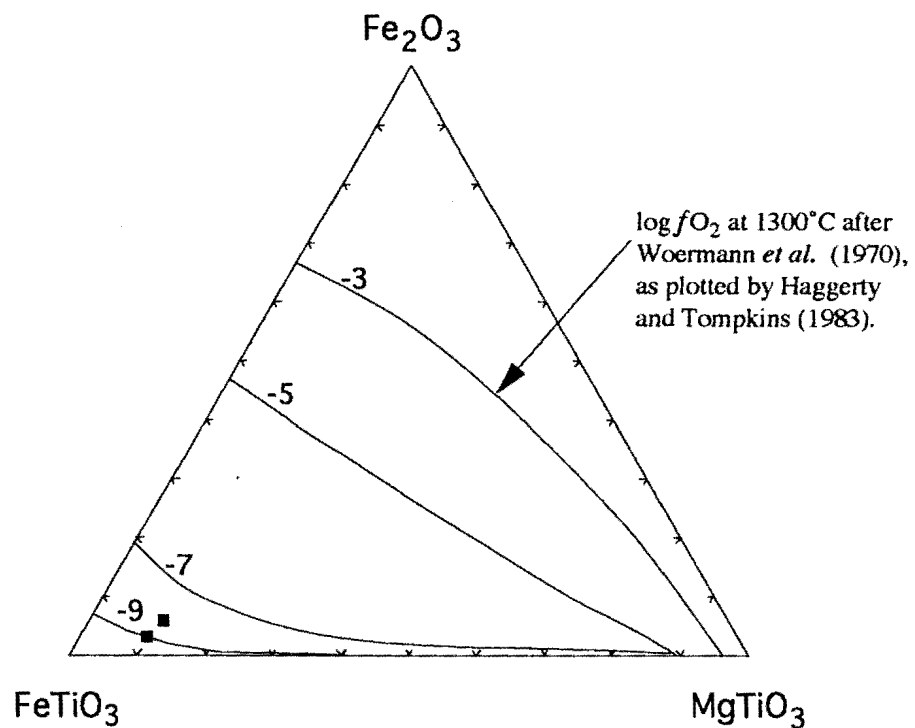


Fig. 7.9. Ternary plot of ilmenite inclusions recovered from George Creek diamonds. The relative proportions of the haematite (Fe_2O_3), geikielite (MgTiO_3) and ilmenite (FeTiO_3) endmembers are controlled by the oxygen fugacity during crystallization. The ternary diagram is contoured in terms of oxygen fugacity following Haggerty and Tompkins (1983). The compositions of ilmenite inclusions encapsulated in George Creek diamonds are consistent with crystallization under conditions of reducing oxygen fugacity ($\log f_{\text{O}_2} \sim -9$).

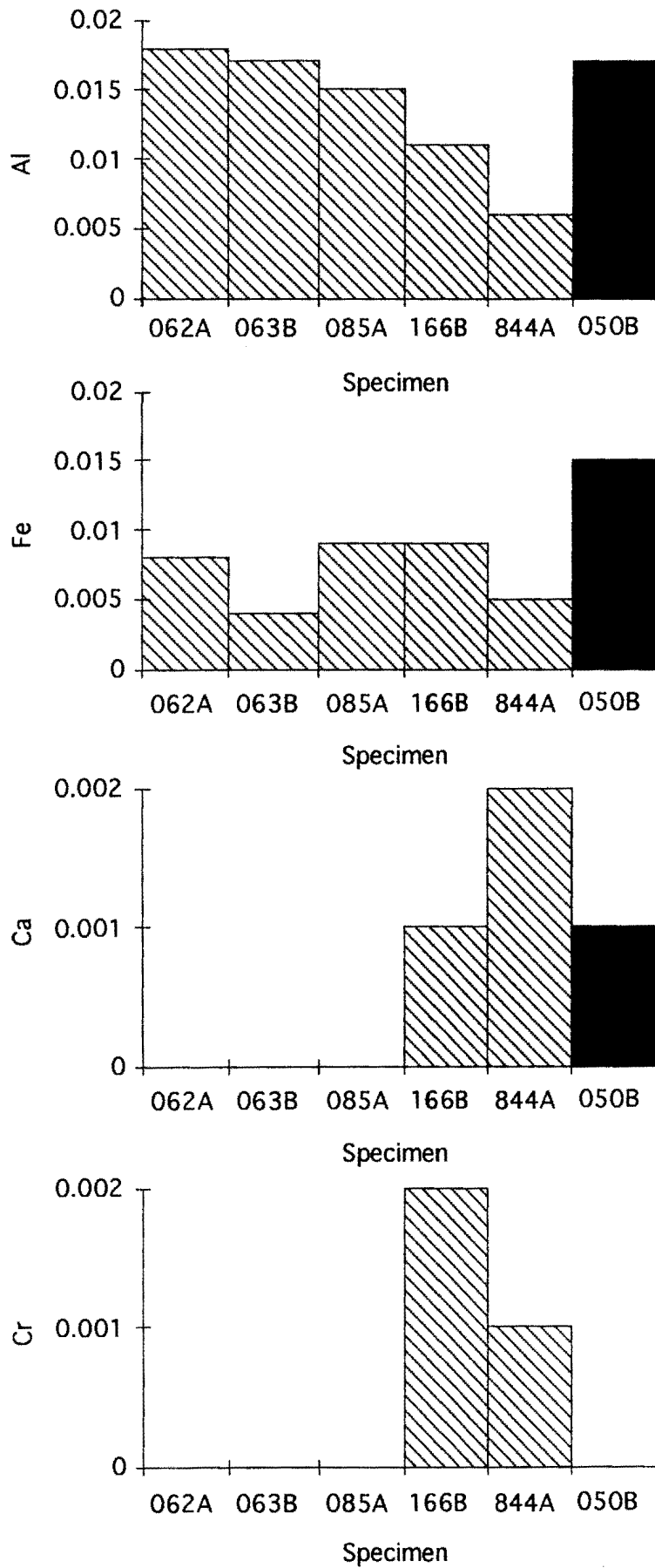


Fig. 7.10. Minor element compositions of rutile inclusions.
 Data are plotted in cations per formula unit
 (i.e. per two oxygen atoms).
 Solid symbols denote CO₂-bearing diamond.

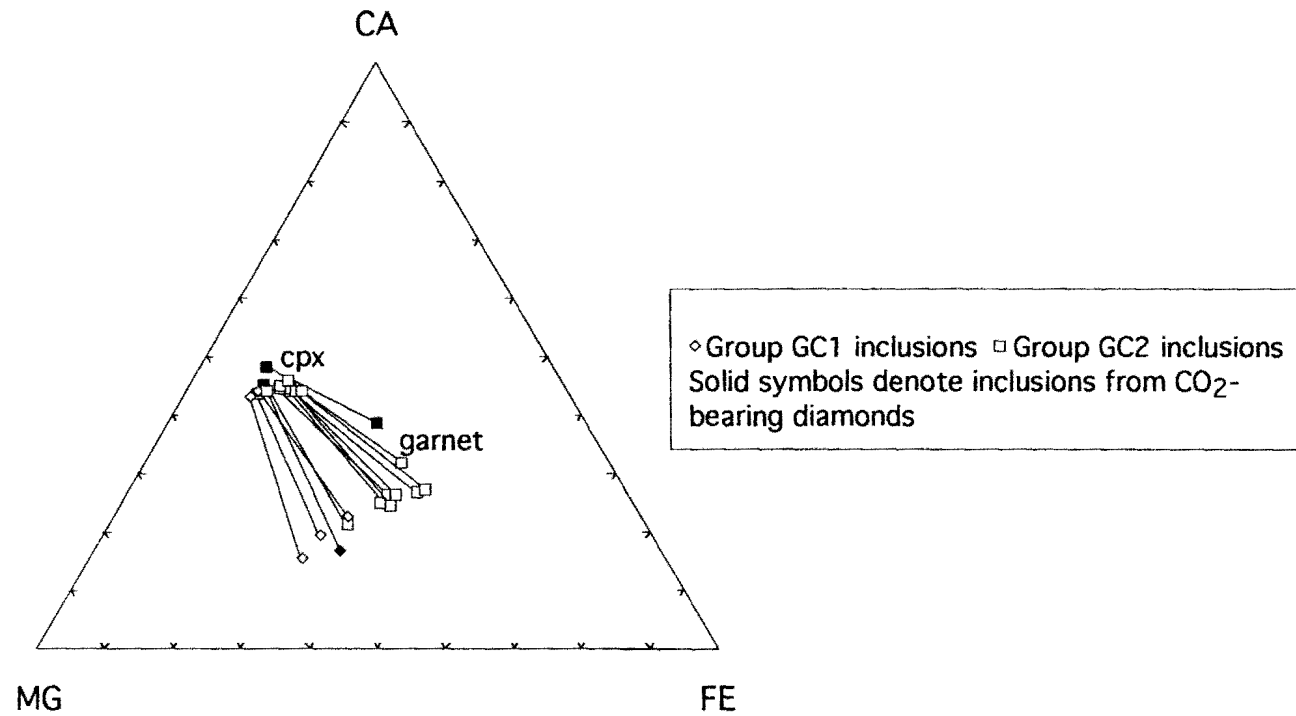


Fig. 7.11. Ternary Ca:Mg:Fe plot of George Creek discrete (non-touching) garnet and clinopyroxene mineral inclusion pairs. Crosscutting tie-lines on such a ternary plot are believed to indicate disequilibrium between mineral inclusion pairs. Temperature estimates of 1071 - 1178 °C (mean = 1138 °C) were calculated for coexisting garnet and clinopyroxene inclusions at an assumed pressure of 50 kb, using the method of Ellis and Green (1979). These temperatures are believed to correspond to diamond formation temperatures, if the mineral pairs crystallized in equilibrium.

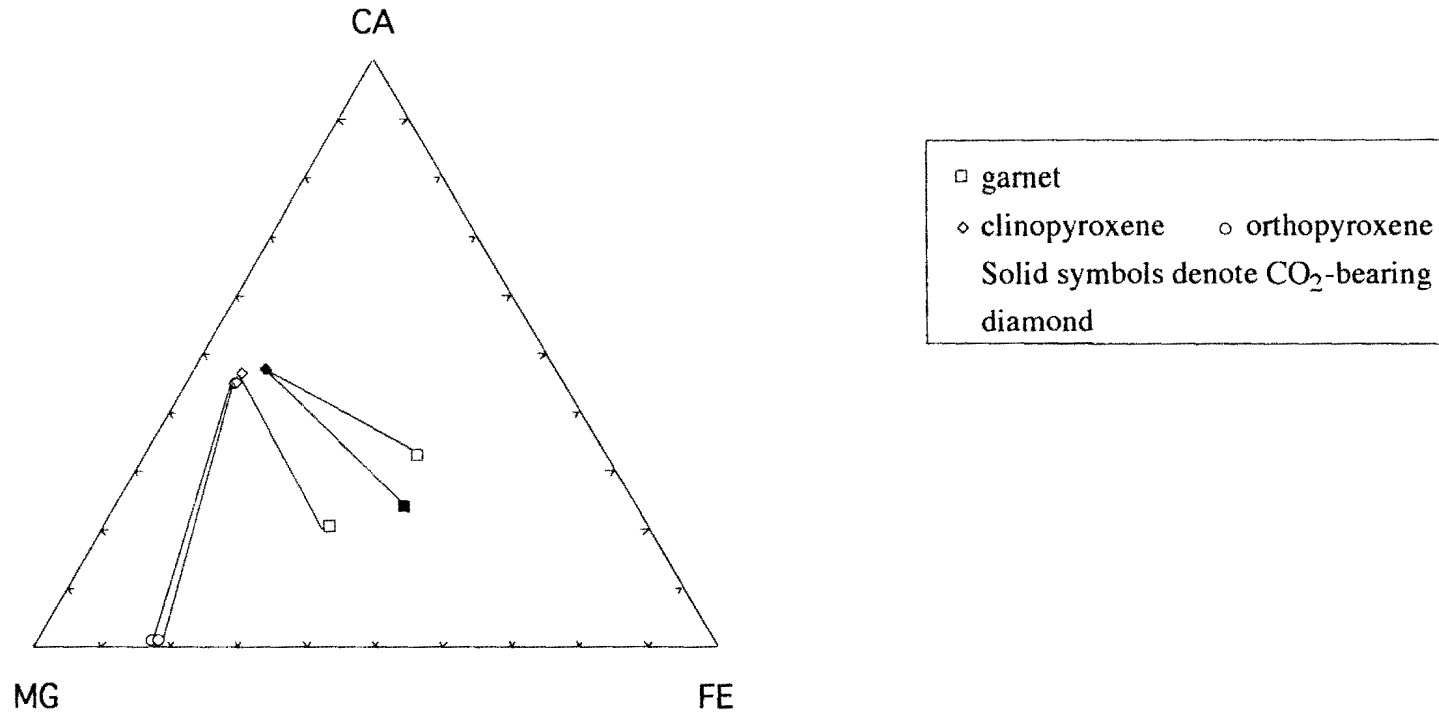


Fig.7.12. Ternary Ca:Mg:Fe plot (mol. %) of George Creek touching mineral inclusions.

The garnet-clinopyroxene mineral inclusion pairs belong to the eclogitic paragenesis, whereas the orthopyroxene-clinopyroxene mineral inclusion pairs belong to the websteritic paragenesis. Average temperature estimates of 955 °C and 915 °C were calculated from major element partitioning between the garnet-clinopyroxene and orthopyroxene-clinopyroxene inclusions respectively, using the methods of Ellis and Green (1979) and Bertrand and Mercier (1985). These temperatures are believed to correspond to mantle temperatures at the time of kimberlite eruption in the Devonian.

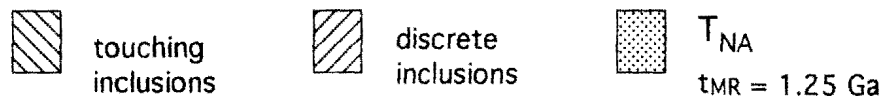
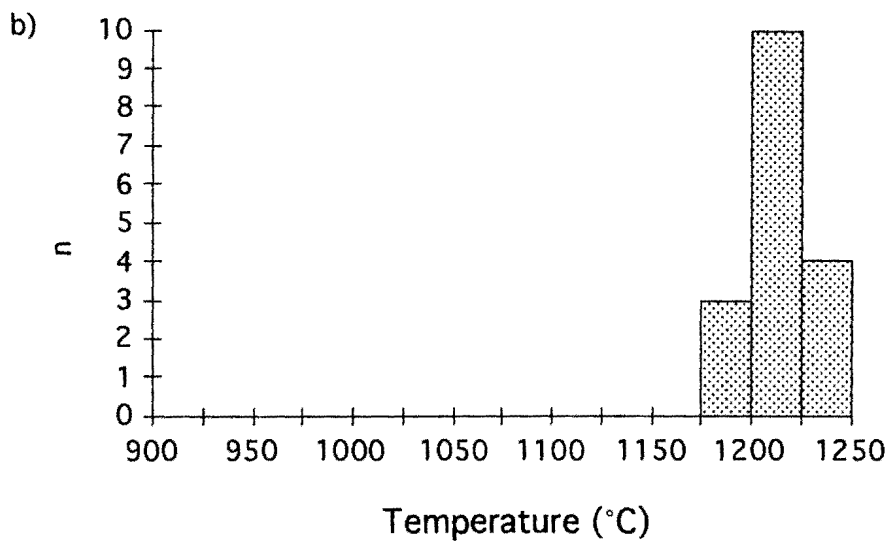
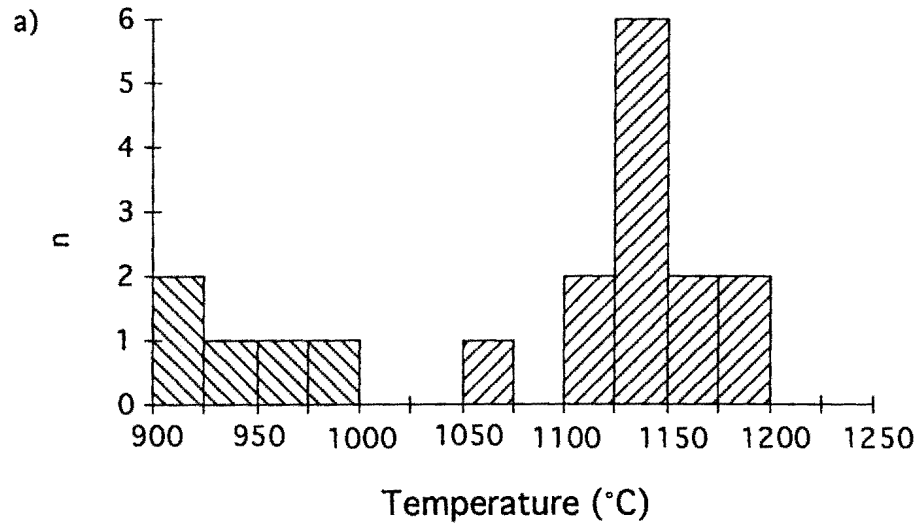


Fig. 7.13. Histograms of equilibration temperatures calculated for George Creek diamonds.

a) Temperatures calculated from gar-cpx and cpx-opx pairs, using the Ellis and Green, 1979 and Bertrand and Mercier, 1985 geothermometers respectively. Assumed pressure = 50 kb.

b) Temperatures calculated (for diamonds with discrete garnet and clinopyroxene inclusion pairs) from nitrogen aggregation state, assuming a mantle residence time (t_{MR}) of 1.25 Ga.

TABLE 1.1
Stable isotope compositions of selected diamonds from George Creek

SPECIMEN	GROWTH GENERATION	NITROGEN CONTENT (atomic ppm)	$\delta^{15}\text{N}$ (‰)	$\delta^{13}\text{C}$ (‰)
GC232	CO ₂ -free	314	+ 6.22	-15.89
GC232	CO ₂ -free	252	+ 6.29	-15.77
GC232	CO ₂ -free	336	+ 6.36	-15.58
GC769	CO ₂ -free	834	+ 0.87	-22.76
GC867	CO ₂ -free	173	+ 4.52	-24.28
GC745	CO ₂ -free	9.8	-14.03	-28.52
GC745	CO ₂ -bearing	9.9	+ 1.02	-30.47
GC856	CO ₂ -free	43.9	- 2.10	-19.66
GC856	CO ₂ -bearing	90.6	+ 4.84	-21.15
GC775	CO ₂ -bearing	15.6	- 0.13	- 8.01
GC858	CO ₂ -bearing	22.7	+ 4.51	-30.99
GC859	CO ₂ -bearing	14.2	- 3.53	-13.49
GC873	CO ₂ -bearing	36.9	+ 3.88	-18.48

analyses by J. M. Gibson, Department of Earth Science, Open University.

TABLE 3.1**Pierres diamond sieve classes**

PIERRES SIEVE #	SIEVE CLASS	APERTURE DIAMETER (mm)	NUMBER OF DIAMONDS
(large diamonds)			
20	+20	4.5	11
19	-20+19	4.3	2
18	-19+18	4.1	6
17	-18+17	3.9	6
16	-17+16	3.7	12
15	-16+15	3.5	7
14	-15+14	3.3	10
13	-14+13	3.1	21
12	-13+12	2.9	15
11	-12+11	2.7	16
10	-11+10	2.5	12
(medium diamonds)			
9	-10+ 9	2.3	29
8	- 9+ 8	2.1	51
7	- 8+ 7	1.9	171
6	- 7+ 6	1.7	(100) 285
5	- 6+ 5	1.5	(100) 808
(small diamonds)			
3	- 5+ 3	1.3	(100) 2435
1	- 3+ 1	1.1	(145) 3009
		TOTAL	(888) 6906

numbers in brackets indicate the number of diamonds studied from sieve classes smaller than -6.

TABLE 4.1**Classification of diamond type from spectral characteristics**

DIAMOND TYPE	CHARACTERISTIC IR ABSORPTION (cm ⁻¹)	NATURE OF LATTICE DEFECT RESPONSIBLE FOR ABSORPTION	CHARACTERISTIC DIAMOND COLOUR	PHYSICAL PROPERTIES
Type Ib	1130	singly substituted nitrogen atoms	dark yellow	paramagnetic
Type IaA	1282	substitutional pairs of nitrogen atoms	none	
Type IaAB	1282, 1174	substitutional pairs of nitrogen atoms and substitutional aggregates comprising 4 nitrogen atoms	none	
Type IaB	1174	substitutional aggregates comprising 4 nitrogen atoms	none	
Type IIa	intrinsic lattice absorption	—	none	
Type IIb	2460	substitutional boron atoms	blue	semi-conductor

modified from Wilks and Wilks (1991)

TABLE 4.2

Summary of the nitrogen content and aggregation state of George Creek diamonds

SIZE CATEGORY	N_{tot} (ppm)	% N_{tot} IN B DEFECTS (N aggregation state)	PLATELET PEAK POSITION (cm^{-1})	T_{NA} ($^{\circ}\text{C}$) (assumed $t_{\text{MR}} = 1.25 \text{ Ga}$)
DIAMOND PLATES: n = 8 (48 spectra)	$\chi = 295$ $\sigma = 306$ range = 23 - 1518	$\chi = 81$ $\sigma = 13$ range = 43 - 99	$\chi = 1362$ $\sigma = 1.9$ range = 1360 - 1366	$\chi = 1220$ $\sigma = 9$ range = 1205 - 1246
LARGE DIAMONDS: n = 28 (39 spectra)	$\chi = 174$ $\sigma = 169$ range = 17 - 635	$\chi = 63$ $\sigma = 28$ range = 8 - 97	$\chi = 1362$ $\sigma = 2.5$ range = 1358 - 1369	$\chi = 1211$ $\sigma = 16$ range = 1171 - 1248
MEDIUM DIAMONDS: n = 19 (32 spectra)	$\chi = 286$ $\sigma = 273$ range = 21 - 1065	$\chi = 79$ $\sigma = 18$ range = 15 - 96	$\chi = 1363$ $\sigma = 2.8$ range = 1358 - 1372	$\chi = 1220$ $\sigma = 15$ range = 1185 - 1243
SMALL DIAMONDS: n = 34 (37 spectra)	$\chi = 359$ $\sigma = 422$ range = 12 - 2115	$\chi = 81$ $\sigma = 24$ range = 12 - 98	$\chi = 1365$ $\sigma = 3.3$ range = 1358 - 1372	$\chi = 1226$ $\sigma = 25$ range = 1162 - 1275

Spectral data for diamond plates, and large, medium and small diamonds are presented in Appendices 2.2, 2.3, 2.4, and 2.5 respectively.

TABLE 7.1
Mineral inclusions recovered from diamonds worldwide

SYNGENETIC INCLUSIONS			EPIGENETIC	INCLUSIONS FROM CUBIC	UNCERTAIN ORIGIN
Peridotitic	Eclogitic	Websteritic	INCLUSIONS	AND COATED DIAMONDS	
Olivine	Omphacitic cpx	cpx	Serpentine	Apatite ^d	Phlogopite
Enstatite	Pyrope-almandine	opx	Calcite	Biotite ^e	Muscovite
Cr-diopside	Majoritic garnet	garnet	Haematite	Carbonates ^{f, g, h}	Amphibole
Cr-pyrope	Sulphides	phlogopite	Kaolinite	Ca-Ba carbonates ^f	Magnetite
Cr-spinel	Ilmenite		Acmite	Ankerite ^f	Titanomagnetite ^b
Sulphides	Rutile		Richterite	Phyllosilicates ^{g, h}	Moissanite
Mg-ilmenite	Kyanite		Perovskite	Quartz ^{g, h}	Wollastonite ^b
^g Mg-wustite	Sanidine		Mn-ilmenite	Hydrous and carbonatitic	Sphene ^b
(ferro-periclase)	K-feldspar ^b		Spinel	fluid inclusions ⁱ	Si-Ti-K phase ^b
Cohenite ^a	Coesite		Xenotime		Ti-K-Al silicate ^j
Diamond	Corundum ^b		Sellaite		Staurolite ^j
Clouds	Zircon		Goethite		Plagioclase ^k
	Ruby		Graphite		Albite ^l
	Diamond		Cr-Sr-loparite ^c		
	Clouds		Cr-chevkinite ^c		

Modified from Meyer (1987) and Harris (1992) with additional data from the following sources:

a: Bulanova and Zayakina (1991)

d: Lang and Walmsley (1983)

g: Navon *et al.* (1988)

j: Daniels (1991)

b: Otter (1990)

e: Walmsley and Lang (1992a)

h: Guthrie *et al.* (1991)

k: Moore and Gurney (1989)

c: M. G Kopylova, pers. comm., 1994

f: Walmsley and Lang (1992b)

i: Schrauder and Navon (1994)

l: Gurney *et al.* (1984b)

TABLE 7.2

Diamond ages determined from syngenetic inclusions

SOURCE	PARAGENESIS	AGE (Ma)	METHOD	ERUPTION AGE (Ma)	REFERENCE
Finsch	Peridotitic (garnet) <i>(harzburgitic)</i>	3200 ± 100	Sm-Nd	118	Richardson <i>et al.</i> (1984)
Finsch	Eclogitic (garnet)	1580 ± 50	Sm-Nd	118	Richardson <i>et al.</i> (1990)
Finsch	Eclogitic (garnet)	1670 ± 40	Sm-Nd	118	Smith <i>et al.</i> (1989)
Kimberley	Peridotitic (garnet) <i>(harzburgitic)</i>	3200 ± 100	Sm-Nd	85 ± 5	Richardson <i>et al.</i> (1984)
Premier	Eclogitic (garnet + cpx)	1150 ± 60	Sm-Nd	1180 ± 30	Richardson (1986)
Premier	Eclogitic (cpx)	1198 ± 14	⁴⁰ Ar/ ³⁹ Ar	1180 ± 30	Phillips <i>et al.</i> (1989)
Premier	Eclogitic (cpx)	1185 ± 94	⁴⁰ Ar/ ³⁹ Ar	1180 ± 30	Burgess <i>et al.</i> (1989)
Premier	Peridotitic (garnet + cpx) <i>(therzolitic)</i>	1930 ± 40	Sm-Nd	1180 ± 30	Richardson <i>et al.</i> (1993)
Orapa	Eclogitic (garnet + cpx)	990 ± 50	Sm-Nd	93	Richardson <i>et al.</i> (1990)
Orapa	Eclogitic (cpx)	102 (min. age)	⁴⁰ Ar/ ³⁹ Ar	93	Burgess <i>et al.</i> (1992)
Jwaneng	Eclogitic (cpx)	244 (min. age)	⁴⁰ Ar/ ³⁹ Ar	235 ± 2	Burgess <i>et al.</i> (1992)
Mbuji Mayi	Eclogitic ? (zircon)	628 ± 12	U-Pb	71.3 ± 1.1	Kinny and Meyer (1994)
Argyle	Eclogitic (garnet + cpx)	1580 ± 60	Sm-Nd	1126 ± 9	Richardson (1986)
Argyle	Eclogitic (cpx)	1158 ± 50 to 1542 ± 20	⁴⁰ Ar/ ³⁹ Ar	1126 ± 9	Burgess <i>et al.</i> (1992)
Udachnaya	Eclogitic (cpx)	425 (min. age) 1149 ± 30 (genesis age)	⁴⁰ Ar/ ³⁹ Ar	340-400	Burgess <i>et al.</i> (1992)

modified from Harris (1992)

TABLE 7.3
Mineral inclusion assemblages recovered
from George Creek diamonds

PARAGENESIS	ASSEMBLAGE	SPECIMEN	(n)
eclogitic	sulphide-graph	GC080	(1)
uncertain	qtz/coe-graph	GC778*	(1)
eclogitic	cpx ± graph	GC010, GC015, GC019, GC021, GC031, GC039, GC070, GC083, GC090	(9)
eclogitic	cpx-moi-graph	GC024	(1)
eclogitic	gar ± graph	GC040, GC053, GC084 GC097, GC443, GC551, GC600	(7)
eclogitic	gar-cpx ± graph	GC002, GC004, GC007 GC012, GC020, GC027, GC045, GC094, GC717	(9)
eclogitic	(cpx-gar)-gar-graph	GC309*	(1)
eclogitic	(cpx-gar)-gar-cpx ± graph	GC014, GC034*	(2)
eclogitic	(gar-ilm)-gar-graph	GC035, GC564	(2)
eclogitic	(gar-ilm)-gar-cpx ± graph	GC001, GC041, GC055, GC132, GC0538	(5)
eclogitic	(gar-ilm)-gar-(gar-cpx)	GC009	(1)
eclogitic	(gar-rut-ilm)-cpx-graph	GC166*	(1)
eclogitic	rut ± graph	GC050*, GC062, GC063 GC844	(4)
eclogitic	rut-cpx-graph	GC085	(1)
websteritic	gar-graph	GC376*	(1)
websteritic	(opx-cpx)-cpx	GC022	(1)
websteritic	(opx-cpx-phlog)-graph	GC057	(1)
TOTAL			48

* denotes CO₂-bearing diamond

TABLE 7.4

Electron microprobe analyses of worldwide phlogopite diamond inclusions

SOURCE	GEORGE CREEK (GC057)	UNKNOWN	FINSCH	MONASTERY	SLOAN
SiO ₂	43.0	36.6	40.7	40.2	42.8
TiO ₂	9.77	10.8	1.71	2.18	1.33
Al ₂ O ₃	12.5	11.8	13.2	7.19	9.53
Cr ₂ O ₃	0.49	0.35	0.93	0.05	0.08
FeO	7.80	12.1	5.38	9.05	5.40
MgO	13.1	12.6	25.9	22.9	25.8
CaO	0.24	0.09	0.05	n.d.	n.d.
MnO	n.d.	0.04	0.06	0.12	0.16
Na ₂ O	0.12	0.10	0.08	n.d.	0.18
K ₂ O	9.89	9.60	10.2	9.60	10.4
TOTAL	96.9	94.1	98.2	91.3	95.7
Reference	This dissertation	Prinz <i>et al.</i> (1975)	Gurney <i>et al.</i> (1979a)	Moore and Gurney (1989)	Meyer and McCallum (1986)

TABLE 7.5.
Electron microprobe analyses of worldwide ilmenite diamond inclusions

SOURCE	GEORGE CREEK		SLOAN	SLOAN	FINSCH	MIR	KASAI	ARGYLE	BRAZIL
	GC009B	GC055D	(U.S.A)	(U.S.A)	(S Africa)	(Yakutia)	(Zaire)	(Australia)	
SiO ₂	n.d.	0.11	n.d.	0.66	0.04	0.01	0.16	0.03	0.18
TiO ₂	54.0	53.3	53.4	52.2	52.1	52.9	52.5	51.8	50.5
Al ₂ O ₃	0.66	0.42	0.10	1.20	0.78	0.47	0.48	n.d.	0.22
Cr ₂ O ₃	n.d.	n.d.	1.89	3.33	0.01	0.44	2.54	n.d.	0.03
FeO	41.2	41.0	28.3	19.8	33.8	36.5	29.5	46.6	47.4
MnO	0.15	0.20	0.34	0.89	0.26	0.27	0.29	0.68	0.73
MgO	4.58	4.93	14.2	19.6	11.8	9.10	13.0	0.47	0.11
CaO	0.08	0.34	0.11	0.35	0.04	n.a.	0.04	0.04	0.07
Na ₂ O	n.a.	n.a.	n.a.	n.d.	0.03	n.a.	0.17	n.d.	n.a.
K ₂ O	n.a.	n.a.	n.a.	n.d.	0.01	n.a.	n.d.	n.d.	n.a.
NiO	n.a.	n.a.	n.a.	0.05	0.03	n.a.	0.05	n.d.	n.a.
TOTAL	100.7	100.3	98.3	98.1	98.9	99.7	98.6	99.6	99.2

Reference:This dissertation..... a b c d e f g
a: Otter (1990) b: Meyer and McCallum (1986) c: Tsai (1978)
d: Sobolev *et al.* (1976) e: Mvuemba Ntanda *et al.* (1982) f: Jaques *et al.* (1989)
g: Meyer and Svisero (1975)
n.a. not analysed n.d. not detected

TABLE 7.6
Calculated equilibration temperatures (°C) for George Creek inclusion-bearing diamonds

SPECIMEN	GROUP	ASSEMBLAGE	TEMPERATURE			TEMPERATURE			TEMPERATURE _{NA}		
			discrete inclusions			touching inclusions			Nitrogen aggregation		
			a	b	c	a	b	c			
GC001	GC 1	gar-cpx-(gar-ilm)-br	1115	1099	1085				1194	1217	1219
GC014	GC 1	gar-cpx-(gar-cpx)	1106	1092	1112	954	933	924	1219	1224	
GC022	GC 1	cpx-(cpx-opx)				917 ^d					
GC057	GC 1	(cpx-opx-phlog)-br				912 ^d			1209		
GC002	GC 2	gar-cpx-br	1133	1121	1153				1203	1205	
GC004	GC 2	gar-cpx-br	1176	1165	1201				1186	1196	
GC007	GC 2	gar-cpx-br	1178	1168	1208				1216	1229	
GC009	GC 2	gar-(gar-cpx)-(gar-ilm)				977	960	968	1218		
GC012	GC 2	gar-cpx-br	1142	1130	1164				1220		
GC020	GC 2	gar-cpx	1134	1122	1152						
GC034*	GC 2	gar-cpx-(gar-cpx)-br	1130	1120	1131	934	913	912			
GC041	GC 2	gar-cpx-(gar-ilm)	1172	1162	1200						
GC094	GC 2	gar-cpx-br	1140	1127	1148						
GC166*	GC 2	(gar-rut)-cpx-br	1071	1053	1042				1232	1236	1243
GC538*	GC 2	gar-cpx-(gar-ilm)	1158	1146	1165						
GC717	GC 2	gar-cpx-br	1138	1126	1159						
			$\chi = 1138$	1125	1148	$\chi = 955^a$	$\chi = 915^b$		$\chi = 1216$		
			$\sigma = 30$	32	47				$\sigma = 15$		

*: CO₂-bearing diamond
br: black rosette inclusion

Assumed pressure = 50kb a: Ellis and Green, 1979: gar-cpx
b: Powell, 1985: gar-cpx
c: Krogh, 1988: gar-cpx
d: Bertrand and Mercier, 1985: cpx-opx

T_{NA} calculated for mantle residence of 1.25 Ga
Multiple values of T_{NA} are calculated from different
spectra from the same specimen.
Minerals in parenthesis indicate polymineralic inclusions.

TABLE 7.7
Calculated equilibration temperatures for worldwide diamond inclusions

SOURCE	PARAGENESIS	ASSEMBLAGE	TEMPERATURE (°C)	METHOD	PRESSURE (kb) (method)	REFERENCE
<i>South Africa</i>						
Finsch	Peridotitic	garnet + olivine	970-1300 n = 4	O'Neill and Wood (1979)	57 (assumed)	Hervig <i>et al.</i> (1980)
	Peridotitic	garnet + olivine	900-1330 n = 31	O'Neill and Wood (1979)	50 (assumed)	Boyd and Finnerty (1980)
Koffiefontein	Peridotitic	garnet + olivine	940-1180 n = 3	O'Neill and Wood (1979)	50 (assumed)	Rickard <i>et al.</i> (1989)
	Peridotitic	garnet + opx	1014-1156 n = 4	Mori and Green (1978)	45-57 Nickel and Green (1985)	Rickard <i>et al.</i> (1989)
Roberts Victor	Peridotitic	garnet + olivine	1271-1368 n = 3	O'Neill and Wood (1979)	50 (assumed)	Gurney <i>et al.</i> (1984b)
Monastery	Peridotitic	garnet + olivine	1173 n = 1	O'Neill and Wood (1979)	50 (assumed)	Moore and Gurney (1989)
Jagersfontein	Peridotitic	cpx + opx	1005 n = 1	Lindsley and Dixon (1976)	49 MacGregor (1974)	Boyd and Finnerty (1980)
⊗ Premier	Peridotitic	opx ± cpx	1150-1260 n = 13	O'Neill and Wood (1979) Lindsley and Dixon (1976)	50 (assumed)	Gurney <i>et al.</i> (1985)
Dokolwayo	Peridotitic	cpx	1185 n = 1	Lindsley and Dixon (1976)	30 (assumed)	Daniels and Gurney (1989)
	Peridotitic	garnet + olivine	950 n = 1	O'Neill and Wood (1979)	50 (assumed)	Daniels and Gurney (1989)
	Peridotitic	garnet + opx	990 n = 1	Mori and Green (1978)	50 (assumed)	Daniels and Gurney (1989)
Orapa	Peridotitic	garnet + olivine	1165 n = 1	O'Neill and Wood (1979)	50 (assumed)	Gurney <i>et al.</i> (1984a)
<i>Central Africa</i>						
Mwadui	Peridotitic	garnet + olivine	1260 n = 1	O'Neill and Wood (1979)	57 (assumed)	Boyd and Finnerty (1980)
<i>Australia</i>						
Argyle	Peridotitic	garnet + olivine	1160 n = 1	O'Neill and Wood (1979)	50 (assumed)	Jaques <i>et al.</i> (1989)
Ellendale	Peridotitic	garnet + olivine	1055-1235 n = 3	O'Neill and Wood (1979)	50 (assumed)	Jaques <i>et al.</i> (1989)
<i>North America</i>						
Sloan	Peridotitic	garnet + olivine	1294-1374 n = 2	O'Neill and Wood (1979)	50 (assumed)	Otter (1990)
	Peridotitic	cpx	1224 n = 1	Lindsley and Dixon (1976)	50 (assumed)	Otter (1990)

TABLE 7.7 continued...
Calculated equilibration temperatures for worldwide diamond inclusions cont...

SOURCE	PARAGENESIS	ASSEMBLAGE	TEMPERATURE (°C)	METHOD	PRESSURE (kb) (method)	REFERENCE
<i>South Africa</i>						
Finsch	Eclogitic	garnet + cpx	1095 n = 1	Råheim and Green (1974)	50 (assumed)	Gurney <i>et al.</i> , (1979)
Koffiefontein	Eclogitic	garnet + cpx	895-1231 n = 6	Ellis and Green (1979)	50 (assumed)	Rickard <i>et al.</i> , (1989)
Roberts Victor	Eclogitic	garnet + cpx	1250-1275 n = 4	Ellis and Green (1979)	50 (assumed)	Gurney <i>et al.</i> , (1984b)
Monastery	Websteritic	opx ± cpx	1400-1428 n = 2	Lindsley and Dixon (1976) Bertrand and Mercier (1985)	38 Nickel and Green (1985)	Moore and Gurney (1989)
Star	Eclogitic	garnet + cpx	1100 n = 1	Ellis and Green (1979)	50 (assumed)	Gurney and Hatton (1989)
Premier	Eclogitic	garnet + cpx	1199-1363 n = 22	Ellis and Green (1979)	50 (assumed)	Gurney <i>et al.</i> , (1985)
Orapa	Eclogitic	garnet + cpx	1135-1212 n = 12	Ellis and Green (1979)	50 (assumed)	Gurney <i>et al.</i> , (1984a)
<i>Australia</i>						
Argyle	Eclogitic	garnet + cpx	1098-1577 n = 27 (avc. 1245)	Ellis and Green (1979)	50 (assumed)	Jaques <i>et al.</i> , (1989)
Ellendale	Eclogitic	garnet + cpx	1115-1217 n = 2	Ellis and Green (1979)	50 (assumed)	Jaques <i>et al.</i> , (1989)
<i>North America</i>						
Sloan	Eclogitic	garnet + cpx	1087-1114 n = 8	Ellis and Green (1979)	50 (assumed)	Otter (1990)
<i>South America</i>						
Sao Luiz	Eclogitic	garnet + cpx	1297-1412 n = 13	Ellis and Green (1979)	50 (assumed)	Wilding (1990)
<i>Russia</i>						
Mir	Eclogitic	garnet + cpx	1050-1500 n = 21	Ellis and Green (1979)	50 (assumed)	Sobolev <i>et al.</i> , (1983)
Udachnaya	Eclogitic	garnet + cpx	1200 n = 1	Råheim and Green (1974)	60 (assumed)	Sobolev <i>et al.</i> , (1976)

Modified from Meyer (1987) and Harris (1992)

APPENDIX 1

PHYSICAL CHARACTERISTICS OF GEORGE CREEK DIAMONDS

The physical characteristics of George Creek are described largely according to the terminology of Otter (1990) and M. E. McCallum (pers. comm., 1992), incorporating aspects of the description schemes used by Harris *et al.* (1975) and Robinson (1979). Abbreviations used to describe the diamonds are explained on the following page.

COLOUR: C = colourless OW = off-white GY = grey
 (COL) Y = yellow BY = brown-yellow YB = yellow-brown
 B = brown RB = red-brown Y,B = yellow-and-brown

UV FLUORESCENCE: N = non-fluorescent B = blue
 (UV) W = white Y = yellow
 O = orange

CRYSTAL STATE: W = whole
 (STATE) C = chipped (< 10 % volume lost through breakage)
 B = broken (10 - 50 % volume lost through breakage)
 F = fragment (> 50 % volume lost through breakage)

BREAKAGE SURFACES: C = cleavage surface S = subconchoidal fracture
 (BREAK) CS = stepped fracture M = macle plane
 D = deformation plane G = grain boundary

CRYSTAL REGULARITY: EQ = nearly equidimensional
 (REG) E = elongate (2 dimensions < 1/2 other dimension)
 F = flattened (1 dimension < 1/2 other dimensions)
 D = distorted U = uncertain

In the case of aggregates the regularities of all individual crystals were described.

PRIMARY MORHOLOGY: O = octahedron M = macle (contact) twin
 (MORPH) C = cube CO = cubo-octahedron
 A = simple aggregate U = uncertain

SUB-MORPHOLOGY: O = octahedron M = macle
 (SUB-MORPH) C = cube CO = cubo-octahedron
 U = uncertain

Sub-morphology refers to the morphology of individual crystals in aggregates.

RESORPTION:
 1: Category 1 = 1 - 55 % preservation
 2: Category 2 = 56 - 70 % preservation
 3: Category 3 = 71 - 80 % preservation
 4: Category 4 = 81 - 90 % preservation
 5: Category 5 = 91 - 99 % preservation
 6: Category 6 = 99 - 100 % preservation
 U: uncertain DR = differential resorption

SURFACE FEATURES:

GROWTH FEATURES: (XENO)

SF = smooth faces SL = serrate laminae
TP = triangular plates KA = knob-like asperities

DEFORMATION FEATURES:

WLL = wide lamination lines (> 100 μm separation
between individual lamination lines)

FLL = fine lamination lines (< 100 μm separation
between individual lamination lines)

SPT = scotch-plaid texture of intersecting wide and/or
fine lamination lines

OCTAHEDRAL SURFACES: (OCTA)

TP = trigonal etch pits: - or + orientation

HP = hexagonal etch pits

HPT = hexagonal etch pits containing trigonal etch pits

CUBIC SURFACES: (CUBE)

TT = tetragonal etch pits: -, + or unknown (u) orientation

CST = crescentic steps

RESORPTION SURFACES: (THH i.e. tetrahexahedroidal)

EH = elongate hillocks T = terraces

HH = hexagonal etch pits on elongate hillocks

MH = microhillocks CS = corrosion sculpture

OT = other e.g. IW = imbricate wedges

CP = circular micropits

OTHER SURFACE FEATURES

ML = macle line R = rut

PHC = pitted hemispherical cavity

CES = coarse etch sculpture (intense development of
coalescing etch pits > 50 μm in diameter)

ES = etch sculpture (intense development of coalescing
etch pits < 50 μm in diameter)

NOTE: c, m, f = coarse, medium and fine etch pits of >
50, 50-10, < 10 μm diameter respectively

FE = degree of etching on crystal faces

BE = degree of etching on breakage surfaces

NOTE: + = intense, X = moderate, - = mild, 0 = absent

IC = inclusion cavity on breakage surface

RBS = resorbed breakage surface

ST = surface staining from radiation damage

NOTE: G = green, B = brown

GRAPH % = percentage of graphitized surface area

VISUAL INCLUSION ASSESSMENT:

SYNGENETIC INCLUSIONS:

(1° INC)

TRANSPARENT INCLUSIONS:

OR = orange (garnet and rutile)

CL = colourless (e.g. olivine, clinopyroxene,
orthopyroxene, quartz/coesite, diamond)

GR = green (e.g. clinopyroxene, moissanite)

OPAQUE INCLUSIONS:

BR = black rosette of graphite

B = faceted black inclusion (e.g. ilmenite, rutile)

Br = brown inclusion (e.g. rutile)

BrR brown rosette inclusion (graphite)

BRe = black rosette of graphite with a crystalline "eye"

EPIGENETIC INCLUSIONS

(2° INC):

H = haematite or iron staining

Br = brown inclusion (e.g. sellaite)

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC001	>20	C	B	B	C,CS	EQ	O		U				FLL	-	X	X		
GC002	>20	C	B	W		EQ,D	CA	O,M	4,3,2	X	X			-	X	X		
GC003	>20	C	W	B	CS	EQ	CA	O,M	3		X			-	X	X		
GC004	>20	C		B	C,CS	EQ,F	CA	O	5					-	X	X		
GC005	>20	C	B	F	C,CS	U	U	U	U					-				
GC006	>20	C		W		D	O		5					-	X	X		X
GC007	>20	C		W		F	M		5		X			-	X	X		
GC008	>20	RB	O	B	C,CS	U	CA	O	4,1	X			FLL	-	X	X	X	CST
GC009	19-18	C	B	W		F	CA	M	5		X			-	X	X		
GC010	17-16	C	W	C	S	EQ,D	CA	O	5,4,1	X				-	X	X		X
GC011	20-19	OW	W	B	CS,D	EQ	U	U	U				WLL	-	X	X		
GC012	19-18	C	B	B	CS	U	CA	O,M	5		X			-	X	X		
GC013	19-18	C		F	CS,S	U	U	U	5				WLL	-	X	X		
GC014	18-17	C	B	F	CS,S,D	E	U	U	5				F,WLL	-	X	X		X
GC015	18-17	C	W	B	C,S	U	U	U	U					-	X	X		
GC016	18-17	C		B	C	F	CA	O	5,1	X				-	X	X		
GC017	18-17	C		B	C,CS	EQ	CA	O	5					-	X	X		
GC018	18-17	C		B	CS	D	CA	O	5				FLL	-	X	X		
GC019	17-16	C		B	C,CS	F	CA	O	5					-	X	X		
GC020	17-16	C		C	CS	F	CA	O,M	4,3,2	X	X			-	X	X		X
GC021	17-16	C	B	B	C,CS	EQ	CA	O	5,4	X				-	X	X		
GC022	17-16	C	B	F	C,CS,D	U	U	U	U				F,WLL	-	X	X		
GC023	17-16	C		W		EQ	CA	O	5,4	X				-	X	X		X
GC024	17-16	C	B	B	CS	U	CA	O	5					-	X	X		
GC025	16-15	OW		B	C,M	F	CA	M	4		X			-	X	X		
GC026	15-14	C	B	B	C	F	U	U	U					-	X	X		
GC027	15-14	C	W	B	CS	F	U	U	4		X			-	X	X		
GC028	15-14	C		F	CS	U	U	U	U				FLL	-	X	X		
GC029	15-14	C,B	O	F	C,CS	U	U	U	U				FLL	-	X	X		
GC030	15-14	Y	O	B	CS	U	CA	U	U					-	X	X		
GC031	14-13	OW	B	F	C,CS	U	CA	M	5		X			-	X	X		
GC032	14-13	OW	W	C	CS	F	CA	O	5,4	X				-	X	X		X
GC033	14-13	YB	O	B	CS,S	U	U	U	5				FLL	-	X	X		
GC034	14-13	YB	O	B	C	EQ	CA	O	5					-	X	X		
GC035	14-13	C	W	B	CS	F	CA	M	5		X			-	X	X		
GC036	14-13	C		W		E	CA	O	5,3	X			WLL	-	X	X		
GC037	14-13	C		F	CS,D	F	M		5				WLL	-	X	X		
GC038	14-13	C	W	F	CS	U	U	U	5				FLL	-	X	X		
GC039	14-13	C	W	B	CS,S	F	M		5		X			-	X	X		
GC040	14-13	C	W	W		D	CA	O	5,4	X			WLL	-	X	X		X
GC041	14-13	C	W	B	C,CS	D	CA	O	5,4	X			F,WLL	-	X	X		
GC042	14-13	C		F	CS	F	M		5		X		FLL	-	X	X		
GC043	13-12	C	W	F	CS,S	U	U	O	5					-	X	X		X
GC044	13-12	C	W	B	C,CS	EQ	CA	O	5					-	X	X		
GC045	13-12	C,B	W	F	CS,S	U	U	U	U					-	X	X		
GC046	13-12	C	B	C	CS	D	CA	O,M	5,4	X	X		WLL	-	X	X		
GC047	13-12	BY	O	B	CS	F	M		5		X		WLL	-	X	X		X
GC048	13-12	C	B	C	C	D	CA	M	1		X			-	X			
GC049	13-12	OW	W	W		F,D	CA	O,M	5,4,1	X	X			-	X	X		
GC050	13-12	C,B	W,Y	F	M	F	M		5					-	X	X		
GC051	13-12	C	B	F	CS,S	U	U	U	U					-	X	X		
GC052	12-11	C	W	F	CS	U	U	U	U				FLL	-	X	X		
GC053	12-11	C	W	F	CS,S	U	U	U	U				FLL	-	X	X		
GC054	12-11	C	W	B	CS,S	D	CA	O	5				WLL	-				
GC055	12-11	C	B	C	C,S	U	U	U	U					-				
GC056	>20	OW	B	B	CS,D	U	U	U	U					-	X	X		
GC057	>20	OW	B	F	CS,S,D	U	U	U	U				FLL	-	X	X		
GC058	>20	C	B	B	C	EQ,F	CA	O,M	5,4	X	X			-	X	X		
GC059	20-19	OW	W	C	C	F	CA	M	U					-	X	X		
GC060	19-18	C	B	W		U	CA	O	5					-	X	X		
GC061	19-18	C	W	F	C,CS	U	U	U	U					-	X	X		
GC062	19-18	C	B	B	C,S	U	CA	O,M	4					-	X	X		
GC063	18-17	C	B	B	C,CS	U	CA	O	4,3,2	X				-	X	X		
GC064	17-16	C	B	B	C,S	F	CA	O,M	U	X				-	X	X		X
GC065	17-16	C	W	W		E,F	CA	O	4,2,1	X				-	X	X		

SPECIMEN	THH					R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC			20 INC		
	EH	T	HH	CS	MH										OT	%	TRANSPARENT		OPAQUE	
																	OR			CL
GC001							X	CES	X	0,X		X		2	4	BR				
GC002							X	X	CES	+				1	1	5	BR			
GC003	X		X		X		X		CES	X,+	0						BR			
GC004		X	X				X		ES	+	0,-	X		0.5	1	3	BR			
GC005	X				X				CES	X	0,X,-				2					
GC006	X				X			X	CES	X,+					10		BR			
GC007			X				X	X	CES	X,+			G		2	6	BR,BrR			
GC008	X	X			X		X	X	CES	X	-						BR			
GC009	X	X			X		X		CES	X,-					12	3	BR			
GC010	X		X						CES,ES	X,+	-					2	BR			
GC011			X	X						0,-	0,-	X					BR			
GC012	X				X		X		CES,ES	X,+	0,X				3	5	BR			
GC013	X				X	IW		X	ES	0,X	0,-				1	1	BR			
GC014	X				X			X	CES,ES	X,+	0,-				7	12	BR			
GC015								X	ES	X,+	0,X					3	BR			
GC016					X			X	ES	+	-	X				3				
GC017					X			X	ES	X,+	0,X					1	BR			
GC018	X								ES	X,-	0,-	X				5	BR			
GC019	X				X	CP			ES	X,-	0,-				4	3	BR			
GC020	X				X				CES,ES	X,+	0				8	3				
GC021	X		X				X		CES,ES	X,+	0,+	X	G				BR			
GC022	X		X	X			X		ES	X	0,-	X	X			3				
GC023	X				X	IW	X		CES	X,+					8	12	10			
GC024	X	X			X		X	X	CES,ES	X,+	0,-	X				5	BR			
GC025	X	X			X		X	X	CES	X,+	X,-	X					BR			
GC026	X				X				ES	X,-	X,-	X				6	BR			
GC027	X				X				CES,ES	X,+	0,+	X				12	BR			
GC028	X	X			X		X		ES	X	X,0				2	1				
GC029			X	X			X		m,f	X	0,-						BR			
GC030	X				X		X		CES	X	0,-				7	1	BR			
GC031	X				X		X		ES	X	X,0	X			2	8	BR			
GC032	X	X			X	IW	X	X	CES,ES	X	-	X		3	2	4	BR			
GC033	X				X	IW		X	c,m,f	-	0,-	X			4		BR			
GC034	X				X				ES	X,+	-				1	2	BR			
GC035	X				X				CES,ES	+	X,-				3		BR			
GC036	X				X				CES,ES	+					6	3	BR			
GC037	X		X	X			X		CES,ES	+	0,-					10				
GC038	X		X	X			X		CES,ES	+	0,+					1	BR			
GC039	X				X		X		m	X	0	X			3	2	BR			
GC040	X	X			X		X		CES	+					2		BR			
GC041					X		X	X	CES,ES	X	0,-	X		2	9	7	Br			
GC042	X				X				CES	X,+	0,-	X			7	3				
GC043	X	X			X		X		CES,ES	X	X,0				10		BR			
GC044	X				X		X		CES,ES	+	0,-	X	X		3		BR			
GC045	X	X			X	IW	X	X	CES	+	0	X			1	3	BR			
GC046	X				X		X		c,m,f	X,-	0,-				2	2	BR,Br			
GC047	X	X			X		X		c,m	X,-	0,-	X			1		BR			
GC048	X	X			X		X		c,f	-	0				1	1	BR			
GC049	X				X		X		CES	X,+					2	2	BR			
GC050	X	X			X				CES	X,+	X,0,-	X					BR			
GC051	X				X		X		ES	X,+	0,-	X					BR			
GC052	X		X	X			X		ES	X,+	0,-			18	2	2	BR			
GC053	X				X		X	X	CES,ES	X	0,-	X			1		BR			
GC054	X				X		X		CES	X,+	X,-				25		BR			
GC055					X				f	-	0	X			10	5				
GC056			X	X	CP		X		c,m,f	X	0,-				1	1	BR			
GC057	X				X	CP		X	ES	X	0,-	X				1	BR			
GC058	X				X				CES,ES	X,+										
GC059	X				X			X	CES,ES	X,+	X				5		BR			
GC060	X	X			X	CP	X	X	CES,ES	X,+							BR			
GC061					X		X	X	ES	X,+	0,-									
GC062	X	X			X		X	X	CES,ES	+	0	X			2		BR			
GC063	X	X	X		X		X	X	CES,ES	X,+	X,0			10	10	1	1	BR,BR		
GC064					X		X		ES	+	0	X		70						
GC065	X	X			X				CES	X,+								BR		

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC066	17-16	C	B	F	M	F	M		4	X				-	X	X		
GC067	17-16	OW		F	CS	U	U	U	U					-	X	X		
GC068	17-16	OW	W	C	S	U	CA	O,M	3,2	X				-	X	X	X	
GC069	16-15	C		B	C,CS	D	CA	O	4					-	X	X		
GC070	16-15	C	W	B	M	EQ,F	CA	O,M	4,3,2	X	X			-	X	X		
GC071	16-15	Gy	W	F	CS	EQ	CA	O	4					-	X	X		
GC072	16-15	C	W	B	CS	EQ	CA	O	4,3,2	X				-				
GC073	16-15	OW		F	CS,S,C	EQ,F	CA	O,M	4,3,2	X	X			-	X	X	X	
GC074	16-15	C	B	F	C,S	D	O		5					-				
GC075	15-14	OW	W	B	S	U	U	U	U					-	X	X		
GC076	15-14	C	W	B	C,CS	E	O		5					-	X	X		
GC077	15-14	YB	O	F	M	F	CA	M	4,3,2	X	X			-	X	X		
GC078	15-14	C	W	B	C,CS,D	EQ	CA	O	4					-	X	X		
GC079	15-14	C		F	C,CS	EQ	CA	O	U					-	X	X		
GC080	14-13	C		C	S	D	CA	O	5					-	X	X	X	
GC081	14-13	C		F	C,CS	F	CA	M,O	4,3,2	X	X		WLL	-	X	X		
GC082	14-13	C		W		EQ	CA	O	3					-	X	X		
GC083	14-13	C	W	B	CS	EQ	CA	O	5,4	X				-	X	X		
GC084	14-13	C	B	F	C	F	CA	M	5					-	X	X		
GC085	14-13	C		W		F,D	CA	M,O	4,3,2	X				-	X	X		
GC086	14-13	C	W	F	C	F	CA	M	5					-	X	X		
GC087	14-13	C	B	B	C,CS,D	F	M		U					-	X	X		
GC088	14-13	C	B	B	CA	EQ,D	CA	O	4,3	X				-	X	X		
GC089	13-12	C	W	B	CS,S	D	O		5				FLL	-	X	X		
GC090	13-12	OW		F	CS	U	U	U	U		X		WLL	-	X	X		
GC091	13-12	BY		B	CS,G	U	FA		U					-	X	X		
GC092	13-12	C	B	B	C,CS	EQ,F	CA	O,M	U		X		WLL	-	X	X		
GC093	13-12	C	W	F	C,D	D	U	U	U				SPT	-	X	X		
GC094	13-12	C	W	B	C,M	F	CA	M	3,2	X	X			-	X	X		
GC095	.12-11	OW	W	B	S	U	U	U	U				WLL	-	X	X		
GC096	.12-11	C	B	B	CS,M	F,U	CA	M	U		X		WLL	-	X	X		
GC097	.12-11	C	W	C	C	EQ,D	CA	O	4,3,2	X			WLL	-	X	X		
GC098	.12-11	C		B	C,S	U	U	U	U					-	X	X		
GC099	.12-11	C		B	C	D,E	O		U					-	X	X		
GC100	.12-11	C,Y	W,Y	B		D	CA	O,U	4,3,2	X				-	X	X		
GC101	.12-11	C		B	C	D	CO		U					-	X	X		
GC102	.12-11	YB	O	C	C	F	CA	O	4,3	X				-	X	X		
GC103	.12-11	C	B	F	C,S	U	U	U	U					-	X	X		
GC104	.12-11	C	B	F	D	D	CA	O	U				WLL	-	X	X		
GC105	.12-11	C	W	B	C	F	CA	M	5		X			-	X	X	X	
GC106	.12-11	C	B	B	C,S	E,F	CA	O,M	5					-	X	X		
GC107	.11-10	YB	O	B	C	F	CA	O	4					-	X	X		
GC108	.11-10	C	W	F	C	U	U	U	U					-				
GC109	.11-10	YB	N	F	C,CS	U	CA	O	U					-	X	X		
GC110	.11-10	OW	W	F	C,CS	EQ	O		5					-	X	X		
GC111	.11-10	C	B	F	C	EQ,F	CA	O,M	5		X			-	X	X		
GC112	.11-10	C	B	F	C	EQ	O		5				WLL	-	X	X		
GC113	.11-10	Gy	B	B	C,S	U	CA	U	4,3,2	X				-	X	X		
GC114	.11-10	C	B	W		F	CA	M	4,3,2	X			WLL	-	X	X		
GC115	.11-10	C	B	F	C	EQ	CA	O	5					-	X	X		
GC116	.11-10	C	W	B	C	EQ	CA	O	5					-	X	X	X	
GC117	.11-10	C	W	B	C	U	CA	M	U		X		WLL	-	X	X	X	
GC118	.11-10	C	W	B	C	F	CA	O,M	5					-	X	X		
GC119	.10-9	OW	W	B	C	EQ	CA	O	4,3	X				-	X	X	X	
GC120	.10-9	C,RB	N	B	C,CS	EQ	O		5					-	X	X		
GC121	.10-9	C,Y	O	C	S	D	CA	O	4,1	X				-	X	X		
GC122	.10-9	C	B	F	C	U	U	U	U					-	X	X		
GC123	.10-9	C	B	F	C,D	U	U	U	U				WLL	-	X	X		
GC124	.10-9	C	B	B	C	F	CA	M	4					-	X	X		
GC125	.10-9	C		F	C,D	U	U	U	U				WLL	-	X	X		
GC126	.10-9	C	W,Y	B	C,G	EQ	CA	O	3					-	X	X		
GC127	.10-9	BY	N,O	F	C,M	F	M		5					-	X	X		
GC128	.10-9	C,Y	O	W		E,D	CA	O	5,1	X				-	X	X		
GC129	.10-9	C	B	F	C,S	U	U	U	U					-	X	X		
GC130	.10-9	C	W	F	C,S	EQ,F	CA	O	3				WLL	-			X	

SPECIMEN	THH					R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH %	10 INC			20 INC		
	EH	T	HH	CS	MH										OT	TRANSPARENT			OPAQUE	
																OR	CL			GR
GC066	X				X			ES	X,-	0				2			BR			
GC067	X							m,f	X,-	X							BR			
GC068	X	X	X	X		X	X	CES,ES	X,+	X							BR	H		
GC069	X			X		X	X	ES	X,+	0										
GC070	X			X		X	X	ES	X,+						2		BR			
GC071				X		X	X	ES	X,+	0,-		X		1			BR			
GC072	X			X		X	X	CES	X,+	0	X	X					BR			
GC073	X	X		X				ES	X,+	0,-					4		BR			
GC074	X			X		X		CES	X,+	X,0		X		1			BR			
GC075			X	X	CP			m,f	X	-	X	X			1		BR			
GC076				X			X	ES	+	X,-		X								
GC077	X			X			X	CES,ES	X,+	X,0							BR			
GC078	X	X		X			X	CES,ES	X,+	0,-					1		BR	Br		
GC079	X			X			X	CES,ES	X,+	X,-	X			3			BR			
GC080				X		X	X	CES,ES	+	X							BR			
GC081	X	X		X	CP	X	X	CES,ES	X,+	0	X				3	4	BR			
GC082	X	X	X				X	CES,ES	0,+				G				BR			
GC083	X	X		X			X	CES,ES	X,+	X	X		G			2	BR			
GC084	X	X					X	CES,ES	+	0	X			1			BR			
GC085	X	X	X	X	X		X	CES,ES	X,+					5	2		BR,Br			
GC086				X	X		X	CES,ES	X,+	0,-					4		BR			
GC087	X	X	X	X			X	CES,ES	X,+	+		X		1			BR	H		
GC088	X	X		X			X	CES,ES	X,+	0							BR			
GC089	X	X		X			X	CES,ES	+	0							BR			
GC090	X			X	CP		X	CES,ES	X,-	0,-	X	X			1	2	BR,BrRe			
GC091	X						X	ES	X,+	X,0			5							
GC092	X	X		X	CP		X	ES	X,+	X,0	X	X			1		BR	Br		
GC093	X			X				ES	-	0,-		X								
GC094	X	X	X		X		X	CES,ES	X,+	0,-	X			1	5		BR			
GC095	X			X	X		X	CES	X,0	X,0	X			1	2		BR			
GC096	X					X		CES,ES	X	0,-				2			BR	Br		
GC097	X	X	X		X	X	X	CES,ES	X,+	0,-				2			BR	Br		
GC098	X	X	X		X	X		CES	X,+	0	X						BR			
GC099	X	X		X				CES,ES	X,+	X							BR			
GC100	X	X		X			X	CES,ES	X,+	+							BR			
GC101	X			X			X	CES,ES	X,+	0,-					2		BRRe			
GC102	X	X		X		X		CES	X	0,-							BR			
GC103				X	X			CES	X,-	X,0	X	X				6	BR			
GC104	X					X		ES	X,+	0,-							BR			
GC105	X	X		X		X		CES,ES	X,+	-	X	X		2	6		BR			
GC106			X	X		X	X	ES	+	X,-		X								
GC107	X	X		X				CES,ES	+	X,-		X					BR,Br			
GC108	X			X				c,m,f	-	-	X	X			2		BR			
GC109	X			X			X	CES,ES	X,+	0,-							BR			
GC110				X			X	ES	+	X,0	X		1	3	2		BR			
GC111								l	+	X,+					2					
GC112	X	X		X	CP			CES	X,+	0		X		1	6		BR			
GC113	X	X		X		X	X	CES	X	X							BR	H		
GC114	X	X		X		X	X	CES,ES	X,+								BR,Br	H		
GC115	X			X			X	ES	-	X,-	X	X								
GC116				X			X	ES	+	0,-							BR			
GC117	X	X		X				CES	X,0	0,-	X	X		2	12		B,BR	Br		
GC118		X	X					CES	+	0					1		BR	Br		
GC119			X	X			X	ES	+	-										
GC120	X			X				CES	X,+	X,0,-										
GC121	X	X		X				CES	X,+	X					2		BRRe			
GC122				X		X		ES	X	0,-							BR			
GC123						X		m,f	0,-	X,-	X			3	5		BR			
GC124	X	X	X	X			X	ES	X,-	X,-							BR			
GC125	X			X				CES,ES	X,+	X,+										
GC126	X	X	X	X		X	X	ES	X,+	0	X	X		1	4	1	BR,BrRe			
GC127			X	X	CP	X	X	c,m,f	X	0	X				4		BRRe			
GC128	X	X		X				CES	X,+						3		BR,BrRe			
GC129				X			X	ES	X,+	X,+										
GC130				X		X		CES	+	X,-					1		BR			

SPECIMEN	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC131	.10-9	C	W	F	C,D	U	U	U	U				FLL	-	X	X		
GC132	.10-9	C		F	C,S	U	U	U	U				WLL	-	X	X		
GC133	.10-9	C	W	C	S	EQ	CA	O	4,3	X			WLL	-	X	X	X	
GC134	.10-9	C	B	F	C,S,S	EQ	O		4					-	X	X	X	CST
GC135	.10-9	C	B	F	M	F	M		5		X			-	X	X		
GC136	.10-9	C	B	F	C	EQ,F	CA	O	4					-	X	X		
GC137	.10-9	C	O	B	C	EQ,D	CA	O	4,1	X				-	X	X		
GC138	.10-9	C	W	F	C	F	U	U	U				FLL	-	X	X		
GC139	.10-9	C		F	C	EQ	CA	O	6,5	X			WLL	-	X	X		
GC140	.10-9	C	W	B	C	F	CA	M	5,3	X			WLL	-	X	X		
GC141	.10-9	C	W	B	S	EQ,F	CA	O	3					-	X	X		
GC142	.10-9	C		F	M	F	M		4					-	X	X		
GC143	.10-9	C		B	C	U	CA	O	U				WLL	-	X	X		
GC144	.10-9	C	W	B	S	U	U	U	U					-	X	X		
GC145	.10-9	C,B,Y		F	C	EQ	O		5					-	X	X		
GC146	.10-9	C	W	F	C	U	CA	U	U					-	X	X		
GC147	.10-9	C	B	F	C	E	O		5					-	X	X		
GC148	.9-8	C	W	C	S	D	CA	O	3					-	X	X		
GC149	.9-8	C	W	B	C	EQ,D	CA	O	4,3	X				-	X	X	X	
GC150	.9-8	C,B,Y		F	M	F	M		4					-	X	X		
GC151	.9-8	RB		B	C	E	O		4					-	X	X		
GC152	.9-8	C	W	B	C	F	CA	M	3					-	X	X		
GC153	.9-8	C	W	F	CS	EQ	O		5					-				
GC154	.9-8	C	B	B	C	F	CA	M	U					-	X	X	X	
GC155	.9-8	Y,B	N	F	C	U	U	U	U					-	X	X		
GC156	.9-8	C	W	F	C	E	U		U					-	X	X		
GC157	.9-8	C	W	B	C	EQ,D	CA	O	5					-	X	X		
GC158	.9-8	C		B	C	U	CA	U	U					-	X	X		
GC159	.9-8	C	B	B	C	EQ	CA	O	3,1	X			WLL	-	X	X	X	
GC160	.9-8	C	B	W		D	CA	O	3					-	X	X		
GC161	.9-8	C	B	F	D	U	U	U	U					-	X	X		
GC162	.9-8	C	W	F	C	F	M		4					-	X	X		
GC163	.9-8	Gy	Y	B	C,CS	E,D	CA	O,M	5					-	X	X		
GC164	.9-8	C	O	B	C	EQ	CA	O	4					-	X	X		
GC165	.9-8	Y	O	W		D	CA	O	4					-	X	X		
GC166	.9-8	C,Y	O	B	C	EQ	O		4,3	X				-	X	X		
GC167	.9-8	C	B	F	S	U	U	U	U					-	X	X		
GC168	.9-8	C,B		B	C	D	O		5,4,3	X				-	X	X		
GC169	.9-8	Gy		B	D,CS	D	CA	O	U				WLL	-	X	X	X	
GC170	.9-8	C	W	F	C,CS	U	U	U	U				WLL	-	X	X		
GC171	.9-8	C,B,Y		F	M,CS	F	M		U					-	X	X		
GC172	.9-8	YB		F	C	U	U	U	U					-	X	X		
GC173	.9-8	OW	B	B	C,CS	U	U	U	U				WLL	-	X	X		
GC174	.9-8	C,B,Y	W,O	B	C	U	U	U	U					-	X	X		
GC175	.9-8	C	W,Y	W		EQ,F	CA	O,M	3,2	X	X			-	X	X		
GC176	.9-8	C,B	O	B	C	EQ	O		5					-	X	X		
GC177	.9-8	Y		B	C,S	EQ,D	CA	O	U					-				
GC178	.9-8	C,Y,B	N	B	C,CS	EQ,D	CA	O	4,1	X				-	X	X		
GC179	.9-8	Y,B	N	C	C	D	O		4,3	X				-	X	X	X	
GC180	.9-8	C,Y	O	B	C	E	CA	O	4,3	X				-	X	X		
GC181	.9-8	BY	N,Y	B	C,S	D	O		4					-	X	X		
GC182	.9-8	BY,B		F	C,S	EQ,D	CA	O	4,3,2	X				-	X	X		
GC183	.9-8	C		F	M	F	M		4					-	X	X		
GC184	.9-8	C,RB	N	F	C,M	F	M		5					-	X	X		
GC185	.9-8	C		C	C	F	CA	O,M	5		X		WLL	-				
GC186	.9-8	Y,B	O	B	S	F	M		U					-	X	X		
GC187	.9-8	C	W	F	C,CS	U	CA	O	U					-	X	X		
GC188	.9-8	C		F	M	F	M		5					-	X	X		
GC189	.9-8	C,Y		B	C,CS	D	CA	O	4,3,2	X				-	X	X		
GC190	.9-8	C	W	F	C	U	U	U	U					-	X	X		
GC191	.9-8	C	W	B	S	EQ,D	CA	O	3,2	X				-	X	X		
GC192	.9-8	C	W	F	M	F	M		5					-	X	X		
GC193	.9-8	C	B	F	C,CS	F	CA	O,M	U	X			WLL	-	X	X		
GC194	.9-8	C	B	C	C	D	O		5,4	X				-	X	X		
GC195	.9-8	C	W	F	M	F	M		U					-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
GC131						ES	X,+	X,-				G			BR	
GC132	X			X	X	ES	+	X,0	X					1	BR	
GC133				X	X	ES	+	X,+							BR	
GC134	X	X	X	X		CES	X,+	X,-							BR	
GC135						CES	X,+	X,+							BR	
GC136		X	X	X		CES	+	0,-			G,B				BR	Br
GC137	X	X	X	X	X	CES	+	X							BR	
GC138				X	X	m,f	X,0	X,0	X							
GC139				X	X	c,m	X	0	X				3			
GC140	X	X	X	X	X	CES	+	0					1		BRe	
GC141		X	X	X	X	CES,ES	X,+	X,0	X			0.5		1		Gr
GC142	X			X	X	CES,ES	+	+	X						BR	
GC143	X			X	X	CES,ES	X,+	0,-			G				BR	
GC144	X	X	X	X		m,f	X	-								
GC145				X	X	ES	X	-						2		BR
GC146	X	X		X	X	CES	X,+	0,-					7	3	BR,BRe	
GC147				X	X	ES	X,+	0,-						1	BR,BRe	
GC148				X		CES	+	X,0							BR	
GC149		X	X	X	X	CES,ES	+	0							BR	
GC150	X	X	X	X		CES,ES	X	X							BR	
GC151	X			X	X	CES,ES	X	0,-	X						BR	
GC152		X	X		X	CES,ES	+	X,+			G					
GC153			X	X		m,f	X,-	X,-	X					1		
GC154			X	X		m,f	X,-	X,-							BR	
GC155	X	X		X	X	CES	X,+	X,0	X						BR	
GC156		X	X			CES	X,+	-	X					3		
GC157				X	X	ES	+	X								Br
GC158	X	X		X	X	CES,ES	X,+	X,0	X						BR	
GC159	X	X		X	IW	CES,ES	X	0								
GC160	X	X		X	X	CES	X,+									Br
GC161						f	X,-	X,0							BR	
GC162		X	X	X	X	CES,ES	X,+	0							BR	
GC163		X	X	X		CES,ES	X	-	X						BR	
GC164		X	X	X		CES	X,+	X	X						BR	
GC165		X		X		CES	X,+						1	1	BR	
GC166	X	X		X		CES	X,+	+					1		BR	
GC167			X	X		ES	X,+	X,0							BR	
GC168	X	X		X	X	CES,ES	X,+	+	X		G					Br
GC169						CES	X	X							BR	
GC170				X		ES	X	0,-							BR	
GC171			X	X	X	CES,ES	+	X,+							BR	
GC172			X		X	CES,ES	X,+	0,-							BR	
GC173						ES	+	-							BR	
GC174						ES	+	0							BR	
GC175	X	X		X	X	CES	X,+								BR	
GC176					X	ES	X	X,0							BR	H
GC177			X	X		m,f	X	X,0	X					1	BR,BRe	
GC178	X	X		X	X	CES,ES	0,+	+						1	BR,BRe	
GC179	X	X		X		CES	X,+	X								
GC180		X		X		CES	+	X,0	X				2		BR	H
GC181	X			X		CES	X,+	0	X	X				2	BR	
GC182		X		X	X	CES,ES	X	0,-							BR	
GC183	X			X		CES,ES	+	X,0							BR	
GC184				X		ES	X,+	X,0	X						BR	
GC185						0	0								BR	Br
GC186		X		X		CES	X,+	-			G				BR	
GC187		X		X	X	ES	X	0							BR	
GC188	X			X		CES	+	X	X						BR	
GC189	X	X	X	X		CES	X,+	0,-							BR,BRe	
GC190	X			X		CES	X	0,-							BR	
GC191		X		X	X	ES	+	0		X					BR	
GC192			X	X		CES	+	X,-							BR	
GC193			X	X	X	CES,ES	X,+	-						2	BR,BRe	
GC194	X	X		X	X	CES,ES	X,+	X						2	BR,BRe	
GC195				X	X	CES	+	X	X						BR	

SPECIMEN	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC196	.9-8	C		F	C	D	CA	O	4,3	X				-	X	X		
GC197	.9-8	C	W	F	C,CS	U	U	U	U					-	X	X		
GC198	.9-8	Y,B	N	C	C	F	M		5				WLL	-	X	X		
GC199	.8-7	Y	O	B	C	U	U	U	U					-	X	X		
GC200	.8-7	C,Y		W		D	CA	O	2,1	X				-				
GC201	.8-7	B,Gy	Y	F	C,CS	U	CA	U	U					-				
GC202	.8-7	C	W	F	U	U	U		U					-	X	X		
GC203	.8-7	C	B	B	M	F	CA	M	3				WLL	-	X	X		
GC204	.8-7	B,C	N	B	C,CS	D,F	CA	O	3,1	X				-	X	X		
GC205	.8-7	Y,B	N	B	CS	F	O		4					-	X	X		
GC206	.8-7	B,Gy	N	B	CS	EQ	CA	O	5					-	X	X		
GC207	.8-7	C	W	F	C	U	U	U	U					-	X	X		
GC208	.8-7	C		F	C,CS	U	U	U	U					-	X	X		
GC209	.8-7	B,C	O	B	C	EQ	O		5					-	X	X		
GC210	.8-7	C	W	B	CS	D	O		5					-	X	X		
GC211	.8-7	C,YB	O	B	C,S	U	U	U	U				WLL	-	X	X		
GC212	.8-7	BY		F	M,CS	F	CA	M	U					-	X	X		
GC213	.8-7	C,YB	O	F	C	D	CA	O	5					-	X	X		
GC314	.8-7	Y	O	F	M	F	M		5					-	X	X		
GC215	.8-7	YB	O	C	C	F	CA	O,M	4					-	X	X		
GC216	.8-7	C	W	B	C	EQ	CA	O	5					-	X	X		
GC217	.8-7	C,Y	O	B	C	F	M		4					-	X	X		
GC218	.8-7	C	W	F	S	EQ	O		4,1	X				-	X	X		
GC219	.8-7	C,Y		C	C	D	CA	O	4,2	X				-	X	X		
GC220	.8-7	C	N	B	C,CS	EQ	O		5					-	X	X		
GC221	.8-7	C,YB	O	F	C,CS	U	U	U	U					-	X	X		
GC222	.8-7	C	O	F	C,CS	EQ,F	CA	O,M	5					-	X	X		
GC223	.8-7	C,B	W	B	C	D,F	CA	O,M	U					-	X	X		
GC224	.8-7	C,B	O	F	M	F	M		5					-	X	X		
GC225	.8-7	C,Y	W	F	C,D	D	O		5				WLL	-	X	X		X
GC226	.8-7	Y	O	F	C,CS	U	U	U	U					-	X	X		
GC227	.8-7	C	W	F	C	D	CA	O	3				F,WLL	-	X	X		
GC228	.8-7	C	W	F	C,M	F	M		U				WLL	-	X	X		
GC229	.8-7	C	W	F	U	U	U	U	U					-	X	X		
GC230	.8-7	C	W	F	C,CS	U	U	U	U					-	X	X		
GC231	.8-7	C,Y	W	B	C,CS	D	O		5					-	X	X		
GC232	.8-7	C,B	N	F	C	D	O		4					-	X	X		
GC233	.8-7	C	B	W		D	CA	O	4					-	X	X		
GC234	.8-7	C	B	F	C	U	U	U	U					-	X	X		
GC235	.8-7	C		F	M,C,CS	F	M	U	U					-	X	X		
GC236	.8-7	C,B		C	C	D	CA	O	5					-	X	X		X
GC237	.8-7	C	W	F	C,D	D	O		5				WLL	-				
GC238	.8-7	Gy,Y	O	B	CS	F	CA	M	5,1	X				-	X	X		X
GC239	.8-7	C	B	C	C	F	CA	M	4,3	X	X			-	X	X		
GC240	.8-7	C,B	B	F	C,CS	U	U	U	U				FLL	-	X	X		
GC241	.8-7	C,YB	Y	F	C	U	U	U	U					-	X	X		
GC242	.8-7	C,Y,B	N	F	CS,S	D	O		5,3	X				-	X	X		
GC243	.8-7	C	W	B	CS	D	O		5					-	X	X		
GC244	.8-7	C	W	W		D	CA	O	U					-	X	X		
GC245	.8-7	C,B	W	F	C,S	U	U	U	U					-	X	X		
GC246	.8-7	C,Y	O	C	C	D	O		5					-	X	X		
GC247	.8-7	C	W	W		E,D	CA	O	3					-	X	X		
GC248	.8-7	C	B	B	C,CS	E	O		5					-	X	X		
GC249	.8-7	C	B	F	C,CS	EQ	CA	O	6,5	X				-	X	X		
GC250	.8-7	C	W	F	C,CS	F	CA	O,M	4					-	X	X		X
GC251	.8-7	C	W	F	C,CS	U	U	U	U					-	X	X		
GC252	.8-7	Y	O	F	C	F	CA	M	5					-	X	X		
GC253	.8-7	C		F	C,CS	EQ,D	CA	O	U					-	X	X		
GC254	.8-7	C,YB		C	CS	F	M		4		X			-	X	X		
GC255	.8-7	C,B	B	B	C	EQ	CA	O	5					-	X	X		
GC256	.8-7	C,RB		B	C,CS	U	U	U	U					-	X	X		
GC257	.8-7	C		F	C,CS	D,F	CA	O,M	U					-	X	X		
GC258	.8-7	C	O	F	C,CS	U	U	U	U					-	X	X		
GC259	.8-7	C		B	CS	EQ,F	CA	O	4,1	X				-	X	X		
GC260	.8-7	C	W	F	C,S	EQ,F	CA	O,M	5		X			-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH %	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
GC196	X				X	CES	X,+	0	X				2		BR	
GC197	X		X	X		CES	X	0		X		3			BR	
GC198	X	X	X	X		CES	+	-								
GC199		X		X	X	CES,ES	+	X,0							BR	
GC200	X	X		X			0,-						3		BR	
GC201							-	0							BR	H
GC202		X		X		ES	+	X,-								
GC203			X	X	X	ES	X,-	X								
GC204	X	X		X		ES	X,0	-	X							
GC205			X	X		CES,ES	X,+	X,-		X					BR	
GC206		X		X	X	c,m,f	X	0				60				
GC207				X	X	ES	X,+	X,-								
GC208				X	X	CES,ES	X,+	-								
GC209			X	X		CES	+	-					1		BR,BRe	
GC210		X		X	X	CES	X,+	X,+					3		BRe	
GC211				X	X	ES	X,+	0,-							BR	
GC212	X	X		X		CES,ES	X	X,-	X							
GC213				X	X	CES,ES	X,+	0,-	X	X					BR	
GC314			X	X		CES	+	-		X		1	1		BR	
GC215	X	X		X	X	CES,ES	X,+	X	X							
GC216		X		X		ES	+	X,0								
GC217		X	X	X		CES	X	X					4		BR,BRe	H
GC218	X			X		CES	X,+	0		X					BR	H
GC219	X			X	X	CES,ES	X	0,-					7	2	BR	
GC220				X		m,f	X	X,0				70				
GC221		X		X		ES	X	X,-					1		BR,BRe	
GC222		X		X	X	CES,ES	+	X							BR	
GC223		X		X	X	CES,ES	+	X							BR	
GC224		X		X	X	CES,ES	+	X							BR	
GC225	X	X		X	X	CES,ES	+	-							BR	H
GC226			X	X	X	CES	+	0							BR	
GC227			X	X	X	ES	X,+	0,+	X	X			2			
GC228				X	X	ES	-	X,0	X							
GC229				X	X	c,m,f	X	0								
GC230				X		ES	+	X,-		X						
GC231		X	X	X		CES,ES	X	X		X					BR	
GC232	X	X		X		CES,ES	X,+	X,0					1		BR	
GC233	X	X		X		CES	+								BR	
GC234			X	X		ES	+	0,+	X	X						
GC235	X	X		X	X	m,f	-	0,-							BR	
GC236		X		X		ES	+	X,+								
GC237			X	X			-	0		X					BR	
GC238	X			X		c,m,f	X,0	X,0							BR	
GC239	X	X		X		CES	X,+	X							BR	
GC240				X	X	ES	+	0,+		X				1	BR	
GC241	X			X		CES	+	X	X						BR	
GC242	X	X		X	X	CES,ES	+	X,+							BR	
GC243	X			X	X	CES	+	X	X						BR	H
GC244					X	CES,ES	+								BR	
GC245				X		ES	X	X,0		X					BR	
GC246				X		CES,ES	+	+							BR	
GC247		X	X	X	X	CES	+						1		BR	
GC248		X	X	X	X	ES	X,+	X							BR	
GC249				X		m,f	X	X,0				15				
GC250	X		X	X		CES	X,-	X,0						1	BR	
GC251			X	X		ES	X	0,-		X					B	
GC252	X	X		X		CES	+	X,-						1	BR	
GC253	X	X	X	X	X	CES,ES	X,+	0						1	BR	
GC254	X	X		X	X	CES	X	0							BR	
GC255			X	X	X	ES	+	X,0		X					BR	
GC256	X			X	X	CES,ES	X,+	0,+							BR	
GC257	X			X	X	CES,ES	+	0,-		X					BR	
GC258				X	X	CES	X	X,0		X					BR	
GC259	X	X	X	X	X	CES	X,-	X							BR	H
GC260				X		CES	X	0,-		X	G					

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC261	8-7	C,B	W,O	B	C	EQ,D	CA	O	4					-	X	X		
GC262	8-7	C	W	F	S	U	U	U	U					-	X	X		
GC263	8-7	C	B	F	C,CS	U	U	U	U					-	X	X		
GC264	8-7	C,B,Y	O	F	C	F	CA	M	5		X			-	X	X		
GC265	8-7	C		F	C,CS	U	U	U	U					-	X	X		
GC266	8-7	C,B	W,N	F	C,CS	U	U	U	U					-	X	X		
GC267	8-7	C	W	F	C	D	O		5					-	X	X		
GC268	8-7	OW		F	CS,D	U	U	U	U				WLL	-	X	X		
GC269	8-7	C,Y	O	F	C	D	CA	O	3,1	X				-	X	X		
GC270	8-7	C,Y	O	B	C	U	U	U	U					-	X	X		
GC271	8-7	C,B,Y		F	CS	EQ	CA	O	5					-	X	X		
GC272	8-7	C	W	F	C,CS	U	U	U	U					-	X	X		
GC273	7-6	C	B	F	C,CS	D	O		5					-	X	X		
GC274	7-6	Y,B	N	C	C	EQ	CA	O	5,4	X				-	X	X		
GC275	7-6	Gy	O,N	B	C	D	CA	O,M	5		X			-	X	X		
GC276	7-6	Gy	O,N	B	C,CS	U	U	U	U				WLL	-				
GC277	7-6	C	W	B	C	F	CA	O	4,1	X				-	X	X		
GC278	7-6	C,Y	O	W		E,D	CA	O	4					-	X	X		
GC279	7-6	C,B,Y		F	C,CS	U	U	U	U				WLL	-	X	X		
GC280	7-6	C	W	F	S	U	U	U	U					-	X	X		
GC281	7-6	C	B	F	C	U	U	U	U					-				
GC282	7-6	C	W	F	S	U	U	U	U					-				
GC283	7-6	C,B	W	F	C	D	O		5					-	X	X		
GC284	7-6	C,Y	O	W		D	CA	O	5,4	X				-	X	X		
GC285	7-6	C	W	C	CS	D,F	CA	O	1					-				X
GC286	7-6	C	W	F	C	EQ	O		5					-	X	X		
GC287	7-6	C	W	W		D	CA	O	3,2	X				-	X	X		
GC288	7-6	C,Y	W	F	C,CS	U	CA	U	U					-	X	X		
GC289	7-6	C,B,Y	W,O	F	C,CS	D	O		4					-	X	X		
GC290	7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC291	7-6	C	B	F	C	EQ,F	CA	O,M	4		X			-	X	X		
GC292	7-6	C	W	F	C,CS	D	O		5					-	X	X		
GC293	7-6	C	W	F	C	U	U	U	U					-	X	X		
GC294	7-6	C		B	C,CS	U	U	U	U					-	X	X		
GC295	7-6	C,RB		F	C,CS	U	U	U	U					-	X	X		
GC296	7-6	YB	N	B	C,CS	D,EQ	CA	O	5,4	X				-	X	X		
GC297	7-6	C,Y	O	F	C,CS	F,EQ	CA	O	5					-	X	X		
GC298	7-6	C	Y	F	C,CS,S	U	U	U	U					-	X	X		
GC299	7-6	C,YB	W,N	F	CS	D,F	CA	O,M	U					-	X	X		
GC300	7-6	C,B,Y		F	C,CS	U	U	U	U					-	X	X		
GC301	7-6	YB	O	C	C	D,F	CA	U	U					-	X	X		X
GC302	7-6	C,RB		B	CS	D	O		5					-	X	X		
GC303	7-6	C,B	N	F	C,CS	U	U	U	U					-				
GC304	7-6	Gy	Y	C	C,CS	F	CA	M	3,1	X	X			-	X	X		
GC305	7-6	C	B	C	CS	D	CA	O	U					-	X	X		
GC306	7-6	C,Y	O	B	CS	EQ	O		6					-	X	X		
GC307	7-6	Y,B	Y,N	C	CS	D	O		5					-	X	X		
GC308	7-6	C,B	W	W		F	CA	M	U					-	X	X		
GC309	7-6	C,B,Y		C	CS	F,D	CA	O	5,4,3	X				-	X	X		
GC310	7-6	C,YB	N	W		D,F	CA	M	4,3	X				-	X	X		
GC311	7-6	C,RB	N	B	C	D	O		5,3	X				-	X	X		
GC312	7-6	C,B	W	B	C	EQ,F	CA	O,M	3,1	X	X		WLL	-	X	X		X
GC313	7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC314	7-6	C,RB	N	F	C	F	M		4					-	X	X		
GC315	7-6	OW	N	F	C	D,F	CA	O,M	U		X			-	X	X		
GC316	7-6	C	B	B	C	EQ,F	CA	O	5					-	X	X		
GC317	7-6	OW	W	B	C,CS	EQ	O		5					-	X	X		
GC318	7-6	C	B	F	C,D	EQ,F	CA	O,M	U		X		WLL	-	X	X		
GC319	7-6	C,Y	O	F	C	EQ,F	CA	O,M	4					-	X	X		
GC320	7-6	C	W	F	C,S	U	U	U	U					-	X	X		
GC321	7-6	C	B	F	M	F	M		U					-	X	X		
GC322	7-6	C	W	F	D,C	U	U	U	U				FLL	-	X	X		
GC323	7-6	C,B	N	B	CS	D	O		4					-	X	X		
GC324	7-6	C	W	F	C	U	U	U	U					-	X	X		
GC325	7-6	C	W	B	C,CS	D	O		5					-	X	X		

SPECIMEN	THH					R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC		
	EH	T	HH	CS	MH										OT	%		TRANSPARENT	OPAQUE
																		OR	CL
GC261	X		X		X	X	CES	+	0							BR	H		
GC262			X	X			m,f	X,0	0,-		X								
GC263		X	X	X			CES	+	0		X								
GC264	X	X		X			CES	+	X,0	X						BR			
GC265				X		X	CES	X	X,0	X			1			BR			
GC266	X			X		X	CES	X,0	0,-							BR			
GC267		X		X			ES	+	0,+							BR			
GC268	X	X		X		X	CES,ES	+	0,+		X								
GC269	X	X	X	X	X		CES	+	0,+	X						BR	Br		
GC270		X		X			CES	X,+	X,0	X									
GC271				X		X	ES	+	-							BR			
GC272			X	X		X	ES	+	X,-		X					BR			
GC273		X		X			CES	+	0,-				1	1		BR			
GC274	X			X			CES	X	X,-								H		
GC275		X		X		X	CES,ES	X,+	X,-		G					BR			
GC276				X			CES,ES	+	X,0			10					H		
GC277	X			X		X	ES	X,0	0,-							BR			
GC278	X			X		X	CES,ES	X,+	+							BR			
GC279	X			X		X	CES	X	0,-										
GC280			X	X			CES,ES	X,+	X,-				1	1					
GC281							CES	+	-							BR			
GC282			X	X				0	0		X					BR	H		
GC283	X	X		X			CES,ES	+	X	X	X			5		BR	Re		
GC284	X	X		X		X	CES,ES	X,+					1	1		BR	H		
GC285	X			X			c,m,f	0,-	0							BR	H		
GC286				X		X	ES	+	0,+							BR			
GC287	X	X		X		X	CES	X,+					1	1		BR,BR	Re		
GC288				X		X	CES,ES	+	0,+		X					BR			
GC289		X		X		X	CES,ES	+	0,-							BR			
GC290				X		X	CES,ES	+	0,+	X							Br		
GC291		X	X	X		X	CES,ES	+	X,0		X					BR			
GC292		X	X	X			ES	+	X,0							BR			
GC293		X		X			CES	+	0	X						BR			
GC294	X			X		X	CES,ES	X,+	X,0										
GC295						X	ES	+	X,+	X						BR			
GC296	X			X			CES	X	0,X	X						BR			
GC297				X		X	CES,ES	+	0,+		X					BR			
GC298				X			m,f	X	X,0		X					BR			
GC299			X	X		X	c,m,f	X,-	X		X					BR			
GC300	X			X			CES	X,+	X,0										
GC301	X			X		X	CES	X,-	X										
GC302				X		X	CES,ES	X,+	0										
GC303							CES,ES	X	X,0					1		BR			
GC304			X	X		X	CES	X,-	X,-							BR			
GC305				X		X	CES,ES	+	0,+		X					BR			
GC306						X	CES,ES	+	X,+			8							
GC307	X			X		X	CES,ES	X,+	X										
GC308	X						CES	+								BR	H		
GC309	X			X		X	CES	X,-	X				1			BR			
GC310	X	X		X			CES	X,+								BR			
GC311	X			X		X	CES,ES	X,+	X,0							BR			
GC312	X	X		X		X	CES	0,-	0,-	X						BR	H		
GC313				X		X	ES	0,+	0,+		X					BR			
GC314	X	X		X		X	CES	+	0,-	X	X			2		BR	Re		
GC315				X		X	ES	+	0,+							BR			
GC316				X		X	CES,ES	+	X,+										
GC317	X			X		X	CES,ES	+	X,0	X				3		BR,BR	Re		
GC318		X	X	X		X	ES	X,-	X,0		X		1	1					
GC319	X			X			CES	X,+	0	X				3		BR			
GC320				X			ES	+	0,+		X			1					
GC321				X			CES,ES	X,+	+					1		BR			
GC322				X			ES	X,+	X,-		X		1			BR			
GC323	X	X	X	X		X	CES,ES	+	-		X					BR			
GC324				X		X	ES	+	0		X						H		
GC325	X	X	X	X		X	CES	+	+										

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC326	7-6	C,Y		F	CS	U	U	U	U					-	X	X		X
GC327	7-6	C	W	F	M	EQ,F	CA	O,M	4,1	X				-	X	X		
GC328	7-6	C	W	F	C	D	CA	O	1					-	X	X		
GC329	7-6	C,B,Y	O	B	C,CS	EQ	CA	O	3,1	X				-	X	X		
GC330	7-6	C,YB		B	CS	D	O		5					-	X	X		
GC331	7-6	C,B		B	C,CS	E	O		5					-	X	X		X
GC332	7-6	C,Y,RB		F	CS	U	U	U	U					-	X	X		
GC333	7-6	C	W	B	C,CS	D	O		5					-	X	X		
GC334	7-6	C,Y	W,O	B	C,CS	D	CA	O	4					-	X	X		
GC335	7-6	C,B,Y		B	C,CS	D	O		5					-	X	X		
GC336	7-6	C,Y	W	F	C,CS	U	U	U	U					-	X	X		
GC337	7-6	Gy	Y	B	CS	D,F	CA	O,M	3,1					-	X	X		
GC338	7-6	C,Y	O	B	C	D	O		6					-				
GC339	7-6	C,B	B	B	S	F	CA	M	4		X			-	X	X		
GC340	7-6	C	W	C	C,CS	F	CA	M	U		X		WLL	-	X	X		
GC341	7-6	C,RB	N	C	CS	F	M		5					-	X	X		
GC342	7-6	YB	O	B	C,S	U	U	U	U					-	X	X		X
GC343	7-6	C,Y	W,O	B	C,CS	D	O		5					-	X	X		
GC344	7-6	C,B	N	F	CS	U	U	U	U					-	X	X		
GC345	7-6	C,Y	W	C	C	F	CA	M	3,2,1	X	X			-	X	X		
GC346	7-6	C,YB	W,N	F	C	U	U	U	U					-	X	X		
GC347	7-6	Gy	N	W		EQ	CA	O	5,4	X				-	X	X		
GC348	7-6	BY	O	F	C	D	O		5					-	X	X		
GC349	7-6	C	N	F	C,CS	EQ	O		6					-	X	X		
GC350	7-6	C	B	B	C,CS	F	CA	M	5				WLL	-	X	X		
GC351	7-6	C,RB	N	B	CS	D,F	CA	O	5					-	X	X		
GC352	7-6	C,B	N	B	C	D	O		5					-	X	X		
GC353	7-6	C,B,Y	O	F	C	U	U	U	U					-	X	X		
GC354	7-6	C	W	F	C	U	U	U	U					-	X	X		
GC355	7-6	C	W	C	C,S	E	O		5					-	X	X		
GC356	7-6	C,B,Y	W,O	B	C	D	O		5					-	X	X		
GC357	7-6	C,B	N	C	CS	EQ	O		5					-				
GC358	7-6	C,B,Y	O	F	M	F	M		5					-	X	X		
GC359	7-6	C,B	W	F	C	F	CA	O,M	U					-	X	X		
GC360	7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC361	7-6	C	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC362	7-6	BY	O	C	CS	U	U	U	U					-	X	X		X
GC363	7-6	Y,B	W,N	W		E	O		4					-				
GC364	7-6	C	B	F	C,CS	U	U	U	U					-				
GC365	7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC366	7-6	C		F	C,CS	U	U	U	U					-	X	X		
GC367	7-6	C,YB	O	B	C	U	U	U	U					-	X	X		X
GC368	7-6	C	B	B	C,S	U	U	U	U					-	X	X		
GC369	7-6	C,B	W	C	C	D	O		4,1	X				-	X	X		
GC370	7-6	C	W	F	CS	U	U	U	U					-	X	X		
GC371	7-6	C	W	F	C,CS	EQ	O		5					-	X	X		
GC372	7-6	C	B	F	C,CS	EQ,F	CA	O,M	5					-	X	X		
GC373	7-6	C	W	F	CS,G	D	CA	O	3,2,1	X				-	X	X		
GC374	7-6	C,YB	W	F	C,CS	EQ	O		5					-	X	X		
GC375	7-6	C	Y	F	C,CS	U	U	U	U					-	X	X		X
GC376	7-6	C,Y		F	C	E	O		5					-	X	X		
GC377	7-6	C,B	Y	W		F	O		4,3,2	X				-	X	X		
GC378	7-6	C,Y	N,O	F	CS	U	U	U	U					-	X	X		
GC379	7-6	C,B	N	F	C,CS	EQ	CA	O	6					-	X	X		
GC380	7-6	C		B	CS	EQ	CA	O	3,2,1	X				-	X	X		
GC381	7-6	C,RB	W,N	C	CS	E	O		5					-	X	X		
GC382	7-6	C,B	O	F	S	D	O		5					-	X	X		
GC383	7-6	C,B		C	CS	EQ	O		5,4	X				-	X	X		
GC384	7-6	C	Y	B	CS	EQ,D	CA	O	3,2,1	X				-	X	X		X
GC385	7-6	C	W	F	C	U	U	U	U					-	X	X		
GC386	7-6	C,Y	N	C	CS	D	O		4,3	X				-	X	X		
GC387	7-6	C,Y	N	F	C	EQ	O		5					-	X	X		
GC388	7-6	C,YB	N	C	C	D	O		4,3	X				-	X	X		
GC389	7-6	C,RB	N	F	C	EQ	O		5					-	X	X		
GC390	7-6	C,B	Y,N	F	CS,D	EQ	O		5					-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC		
	EH	T	HH										CS	MH		OT	%
													OR	CL	GR		
GC326	X			X		CES	X,+	0,+								BR	
GC327	X	X		X		CES	+	0	X					1		BR	
GC328			X	X	X	ES	X,0	0,-		X						BR	
GC329	X			X		CES	0,+	0,+	X	X				10		BR,BRe	
GC330	X			X		CES,ES	X,+	X,-						1	1	BR,BRe	
GC331	X			X		CES,ES	+	0,-						2		BRe	
GC332	X	X		X	X	c,m,f	X,+	X,-									
GC333				X	X	CES,ES	+	X,0	X							BR	
GC334	X	X		X		CES	X,+	X,0	X	X						H	
GC335	X			X		CES	X,+	X,0								BR	
GC336	X	X		X	X	ES	X,+	0,-		X						BR	
GC337	X	X		X	X	CES	X,-	0								BR	
GC338						CES	+	X,0								BR	
GC339	X			X		CES	+	X,0		X				1		BRe	
GC340	X	X		X		CES	X,+	X,0						1		BR	
GC341				X	X	CES,ES	+	+									
GC342				X		ES	X,-	X,-	X	X							
GC343	X			X		CES	X,+	X,-						5		BRe	
GC344		X		X		m,f	X	0								BR	
GC345	X	X		X	X	c,m,f	X,-	0								BR	
GC346				X	X	CES,ES	+	X	X							BR	
GC347		X		X	X	CES,ES	+							1		BR	
GC348				X		CES	+	X,-	X	X							
GC349			X	X		CES,ES	X,+	X,+	X	X						BR	
GC350				X	X	ES	+	X,0								BR	
GC351	X			X	X	CES,ES	X,+	+						1		BR	
GC352	X			X		CES	+	0	X							BR	
GC353		X	X	X		ES	X,+	0,-		X							
GC354			X	X		CES	X,+	0,-						1	2	BR	
GC355	X			X	X	CES	X	X						1		BR,BRe	
GC356				X		ES	+	0,+	X	X							
GC357				X		CES	+	X								BR	
GC358			X	X	X	CES,ES	+	X,+	X						1	BR	
GC359		X		X		CES	+	X								BR	
GC360				X		c,m	X,-	0,-	X					1	3		
GC361				X	IW	m,f	X,-	0,-						1		BR	
GC362	X		X	X		c	X,-	0									
GC363				X		CES	-									BR	
GC364				X			+	0		X	G					Br	
GC365				X	X	ES	+	0,+								BR	
GC366				X		ES	X,-	X,0									
GC367		X		X	X	CES	+	0,+	X	X							
GC368				X	X	ES	0,+	0,+		X							
GC369	X	X	X	X	X	CES	X,0	0								BR	
GC370				X		m,f	X	X,0		X						BR	
GC371	X	X	X	X	X	ES	+	0,+	X					3		BR,BRe	
GC372			X	X		ES	X,+	X,0		X						BR	
GC373	X	X		X	X	CES	X,+	X,0	X							BR	
GC374			X	X	X	CES,ES	+	0,-						4		BR,BRe	
GC375	X			X		c,m,f	X,-	X,-				5			1	BR	
GC376	X	X		X		CES	X,+	0	X						1	BR	
GC377	X	X		X		CES	X,+									BR	
GC378		X		X		CES	X,+	X	X	X						BR	
GC379				X	X	ES	+	0,+				60				BR	
GC380	X	X	X	X		CES	+									BR	
GC381	X			X		CES	X	X								BR	
GC382				X		CES	+	0		X						BR	
GC383	X	X	X	X	X	CES	X,+	X								BR	
GC384	X	X	X	X	X	CES	X,-	X,0								BR	
GC385				X	X	ES	X,+	0				2				BR	
GC386	X	X		X	X	CES,ES	+									BR	
GC387	X			X		CES	X,+	-	X							BR	
GC388	X	X		X	X	CES,ES	X	X,0		X						BR	
GC389				X		CES	+	X,0	X							BR	
GC390				X	X	CES,ES	+	0								BR	

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC391	.7-6	C,B	N	F	C	D	O		5					-	X	X		
GC392	.7-6	C,YB	O	B	C	EQ	O		4,3,2	X				-	X	X		
GC393	.7-6	C	W	B	CS	EQ,F	CA	O	4,3,1	X				-	X	X		
GC394	.7-6	C,B,Y	O	B	C	D	CA	O	5					-	X	X		
GC395	.7-6	C	B	F	C,CS	U	U	U	U					-	X	X		
GC396	.7-6	C,B,Y		B	CS	D	CA	O	3					-	X	X		
GC397	.7-6	C,B	N	B	CS	F	CA	M,O	4					-	X	X		
GC398	.7-6	C	W	F	CS,D	U	U	U	U					-	X	X		X
GC399	.7-6	C	N	F	C	U	U	U	U					-	X	X		
GC400	.7-6	C,Y	W,O	B	CS	EQ	O		4,3	X				-	X	X		
GC401	.7-6	C	B	F	CS	EQ	O		5					-	X	X		
GC402	.7-6	C,YB	N	C	CS	D	O		4,3,2	X				-	X	X		
GC403	.7-6	C,YB	N	B	CS	D	CA	O	5					-	X	X		
GC404	.7-6	C	Y	F	C,S	D	O		5					-	X	X		
GC405	.7-6	Y	N	F	C,CS	U	U	U	U					-	X	X		
GC406	.7-6	C,B,Y	B,O	F	C	U	U	U	U					-	X	X		
GC407	.7-6	B,C	N	F	CS	D	CA	O	5					-	X	X		
GC408	.7-6	C,B,Y	N	F	C,CS	U	U	U	U					-	X	X		
GC409	.7-6	C	B	C	CS	EQ	O		4,3,2	X				-	X	X		
GC410	.7-6	C	N	B	CS	U	U	U	U					-	X	X		X
GC411	.7-6	C,RB		F	C	U	U	U	U					-	X	X		
GC412	.7-6	C	W	C	CS	D	CA	O	3,2,1	X				-	X	X		
GC413	.7-6	B,C	N	B	CS	D	CA	O	5,2	X				-	X	X		
GC414	.7-6	C	B	C	CS	F	M		5					-	X	X		
GC415	.7-6	C	B	B	CS	F	CA	O	3,2,1	X				-	X	X		
GC416	.7-6	Y	N	B	CS	EQ	O		5					-	X	X		
GC417	.7-6	C,B	N	B	CS	EQ	O		5					-	X	X		
GC418	.7-6	C,Y	Y	F	C	F	CA	M	5					-	X	X		
GC419	.7-6	C	B	F	CS	D	CA	O	5					-	X	X		
GC420	.7-6	C,Y	N	C	CS	EQ	O		5					-	X	X		
GC421	.7-6	C,Y	B	B	C,CS	EQ,D	CA	O	U					-	X	X		X
GC422	.7-6	C		F	CS	U	U	U	U					-	X	X		
GC423	.7-6	C,Y		F	CS,S	EQ	CA	O	4					-	X	X		
GC424	.7-6	C,Y	Y	F	C,CS	EQ	O		5					-	X	X		
GC425	.7-6	C	W	F	D	U	U	U	U				WLL	-	X	X		
GC426	.7-6	C,B	Y	W		F	CA	O,M	5					-	X	X		
GC427	.7-6	C,RB	O	F	C,CS	U	U	U	1					-	X	X		
GC428	.7-6	C,YB	N	C	CS	F	O		5,4	X				-	X	X		
GC429	.7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC430	.7-6	C	N,Y	B	C,CS	D	O		5,4	X				-	X	X		
GC431	.7-6	C,YB		F	CS	EQ	O		U					-	X	X		
GC432	.7-6	C,Y	W	F	C,CS	D	CA	O	5					-	X	X		
GC433	.7-6	C	W	F	C,CS,D	U	U	U	U					-	X	X		
GC434	.7-6	C	W	B	CS	U	U	U	U					-	X	X		
GC435	.7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC436	.7-6	C,Y	O	F	C	EQ	O		4					-	X	X		
GC437	.7-6	C	B	F	CS,D	U	U	U	U					-	X	X		
GC438	.7-6	C,B,Y		F	C,CS	U	U	U	U					-	X	X		
GC439	.7-6	C	W	F	C,CS	U	U	U	U					-	X	X		
GC440	.7-6	C,YB	O	B	S	U	U	U	U					-	X	X		
GC441	.7-6	C	W	F	C,S	U	U	U	U					-	X	X		
GC442	.7-6	BY	O	B	C	U	U	U	U					-	X	X		
GC443	.7-6	C	W	W		F	CA	M	5,4	X	X			-	X	X		
GC444	.6-5	C,B	O	C	C	EQ	O		3,2,1	X				-	X	X		
GC445	.6-5	BY	N	C	CS	D	O		5					-	X	X		
GC446	.6-5	C	W	F	C	D	O		5					-	X	X		
GC447	.6-5	C	B	F	C	EQ	O		6					-	X	X		
GC448	.6-5	C	W	F	C,D	D	CA	O	3					-	X	X		
GC449	.6-5	C	N	F	C,CS	U	CA	O	4,3,2	X				-	X	X		
GC450	.6-5	C	W	F	C,CS	U	U	U	U					-	X	X		
GC451	.6-5	C		F	CS	U	U	U	U					-	X	X		
GC452	.6-5	C	W	F	C	U	U	U	U					-	X	X		
GC453	.6-5	C	B	B	CS	EQ	CA	O	3,2,1	X				-	X	X		
GC454	.6-5	C	W	C	U	F	U	U	U					-	X	X		
GC455	.6-5	C	B	F	C,CS,D	U	U	U	U					-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
													OR	CL	GR	
GC391			X		X	CES,ES	+	0,+								BR
GC392	X		X			CES	+	-	X							BR
GC393	X	X	X		X	CES	X,-	-		X						BR
GC394	X	X			X	CES,ES	X,+	0,+	X	X						
GC395			X	X		CES,ES	+	0,+		X						
GC396	X		X		X	CES	X,+	X,0								BR
GC397	X		X			CES	X,+	X								BR
GC398			X	X	X	ES	X,+	X,-		X						BR
GC399				X	X	CES,ES	+	0,+	X	X			2			
GC400			X	X		CES	X,+	X					1			BR
GC401			X	X		CES,ES	X,+	-								BR
GC402	X		X			CES	X,-	-	X							BR
GC403	X		X		X	CES	X,+	X,-								BR
GC404			X	X	X	CES	X,+	0,-		X						BR
GC405			X			CES	X,+	X,0		X						
GC406				X	X	ES	+	0,+	X	X			1			BR
GC407	X		X		X	CES,ES	X,+	X,0								
GC408	X		X		X	CES	X,+	X,0					1			BR
GC409	X			X	X	CES,ES	X,+	X								BR
GC410			X	X	X	CES,ES	+	X,0								H
GC411				X		CES	X,+	X,0	X							BR
GC412	X	X			X	CES,ES	X,+	X								
GC413			X	X		CES	X	X,0								
GC414	X			X		CES	X,+	X,+								
GC415	X		X	X		CES	X,+	X,-					1			BR
GC416				X		ES	+	X,0		X		80				
GC417				X		CES	+	X,0	X				2			BR,BR
GC418				X	X	CES,ES	+	X,0	X							BR
GC419				X	X	CES	+	X,-		X						
GC420	X		X		X	CES,ES	+	X								BR
GC421	X		X			CES	+	X,0		X						H
GC422	X			X		ES	X,-	X,-								BR
GC423	X			X		CES	X,+	0,-								BR
GC424				X	X	CES,ES	+	X,0								BR
GC425				X		ES	+	X,+		X						
GC426	X		X		X	CES	X,+									BR
GC427				X		c,m,f	X,0	0,-		X			9			BR
GC428	X			X		CES	X,+	0								
GC429				X	X	CES,ES	+	X,-		X						BR
GC430	X		X	X		CES	X,+	X,-	X	X						BR
GC431				X		CES,ES	X,+	X,-	X		G		2			BR
GC432				X		CES	+	X,0	X	X			1			BR
GC433						ES	+	0,+								
GC434			X	X	X	ES	+	X,+		X						
GC435				X	X	CES,ES	+	0,+								BR
GC436	X			X	X	CES,ES	X,+	0,-								BR
GC437				X		CES	+	0								BR
GC438				X		CES	+	0	X				1			
GC439				X		ES	+	0,+	X							H
GC440				X		CES	+	X,0		X						BR
GC441				X	X	ES	X,+	0,+								BR
GC442	X		X	X		CES	X,-	X,0		X						BR
GC443	X			X	X	c,m	X,-						6			BR
GC444	X			X		CES	X	X,0								BR
GC445	X		X		X	CES	+	X								BR
GC446				X	X	CES,ES	+	X	X							BR
GC447					X	CES	+	X,+	X							BR
GC448				X	X	CES	X,+	X,0	X				1			BR
GC449	X			X		CES	X,-	X,-								BR
GC450				X	X	ES	+	0,-	X							BR
GC451				X		CES	X	X								BR
GC452				X	X	ES	+	0,+								BR
GC453	X		X	X		CES	X,-	-	X							BR
GC454					X	CES,ES	+	+								
GC455				X	X	CES,ES	+	0,+								

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC456	.6-5	C,BY	O	B	C	U	U	U	U					-	X	X		
GC457	.6-5	C	W,Y	F	CS,D	F	O		5,4	X				-	X	X		
GC458	.6-5	Y	O	C	CS	D	O		4,3,2	X				-	X	X		
GC459	.6-5	Y	O	B	CS	EQ	CA	O	3,2,1	X			WLL	-	X	X		
GC460	.6-5	C	B	F	C,D	F	CA	M	4				WLL	-	X	X		
GC461	.6-5	C,B	O	C	CS	D	O		6					-	X	X		
GC462	.6-5	C		F	CS	U	U	U	U					-	X	X		
GC463	.6-5	C	W	F	C,CS	U	U	U	U					-	X	X		
GC464	.6-5	C,BY	N	C	C	F	CA	M	4					-	X	X		
GC465	.6-5	C	B	F	C,CS	EQ	CA	O	5					-	X	X		
GC466	.6-5	C,B		C	CS	EQ,F	CA	O	3,2,1	X				-	X	X		
GC467	.6-5	C		F	CS,D	U	U	U	U					-	X	X		
GC468	.6-5	C,Y	Y	C	C	D	CA	O	6					-				
GC469	.6-5	C	B	F	C,D	U	U	U	U		X		WLL	-	X	X		
GC470	.6-5	C,B	N	B	C,CS	D	CA	O	4,3,2	X				-	X	X		
GC471	.6-5	C	W	B	C,CS	D,EQ	CA	O	2,1	X				-	X	X		X
GC472	.6-5	C,Y	O	B	CS	EQ	O		5					-	X	X		
GC473	.6-5	C	W	F	CS	U	U	U	U					-	X	X		X
GC474	.6-5	C,B		F	C,CS	U	U	U	U					-	X	X		
GC475	.6-5	C,YB		F	CS	U	U	U	U					-	X	X		
GC476	.6-5	C,Y	W	C	CS	F	CA	M	U					-	X	X		
GC477	.6-5	C,B	N	F	CS	U	O		5					-	X	X		
GC478	.6-5	C,BY	Y	F	CS	F	CA	O,M	4					-	X	X		
GC479	.6-5	C,YB		B	CS	EQ	CA	O	4				TRP	-	X	X		
GC480	.6-5	C	B,N	B	CS	U	U	U	U					-				
GC481	.6-5	C	B	F	CS,S	U	U	U	U					-	X	X		
GC482	.6-5	C,Y	W,O	F	C,CS	D	O		5,4	X				-	X	X		
GC483	.6-5	C,YB	N,Y	F	C,CS	U	U	U	U					-	X	X		
GC484	.6-5	C,RB		F	C,CS	F	O		U					-	X	X		
GC485	.6-5	C,YB	N	B	C	F	O		5					-	X	X		
GC486	.6-5	C		B	C,CS	D	O		4					-	X	X		
GC487	.6-5	Y,B	O	B	C	E	U	U	5					-	X	X		
GC488	.6-5	C,BY	O	F	C,CS	U	U	U	4,1	X				-	X	X		
GC489	.6-5	C,Y	O	C	CS	D	O		5					-	X	X		
GC490	.6-5	Gy	O	F	CS	U	U		U					-	X	X		X
GC491	.6-5	C,BY	O	B	C	EQ,F	CA	O,M	3					-	X	X		
GC492	.6-5	C	N	F	C,CS	U	U	U	U					-	X	X		
GC493	.6-5	C	B	C	C	D	O		5					-	X	X		
GC494	.6-5	C		F	C,CS	F	U	U	U					-	X	X		
GC495	.6-5	C,YB	N	B	C,CS	U	U	U	U					-	X	X		
GC496	.6-5	C,YB	O	B	CS	D	CA	U	U					-	X	X		
GC497	.6-5	C,B	O	B	C,M	F	CA	M	U					-	X	X		X
GC498	.6-5	C	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC499	.6-5	C	W	F	CS	U	U	U	U					-	X	X		
GC500	.6-5	C,BY	O	B	C,CS	EQ	O		6					-	X	X		
GC501	.6-5	C,YB	N	F	C	EQ	O		U					-	X	X		
GC502	.6-5	OW	W,Y	F	C,CS	U	CA	O	U					-	X	X		
GC503	.6-5	C,Y	W,Y	F	C	D	O		5					-	X	X		
GC504	.6-5	C,Y	W,Y	F	C,S	F	CA	M	U					-	X	X		
GC505	.6-5	C,Y,B	Y,N	F	C,S	U	U	U	U					-	X	X		
GC506	.6-5	C		B	CS	D	O		4,3	X				-	X	X		
GC507	.6-5	C,Y,B		F	CS	U	U	U	U					-	X	X		
GC508	.6-5	B		B	CS,S	EQ	CA	O	4					-	X	X		
GC509	.6-5	C,B	N	F	CS	U	U	U	U					-	X	X		
GC510	.6-5	C,Y,B	O	C	CS	F	CA	O,M	U					-	X	X		
GC511	.6-5	C,RB	N	F	C	U	U	U	U					-	X	X		
GC512	.6-5	C,RB	N	B	C	E,D	CA	O	5					-	X	X		
GC513	.6-5	C	W	F	C	F	M		5					-	X	X		
GC314	.6-5	C,BY	O	F	CS	U	U	U	U					-	X	X		
GC515	.6-5	C,B	N	F	C,CS	D,E	CA	O	4,1	X				-	X	X		
GC516	.6-5	C		F	C,CS	U	U	U	U					-	X	X		
GC517	.6-5	C,B	O,N	F	C,CS	E	O		5					-	X	X		
GC518	.6-5	C,Y	O	F	C,CS	F	CA	M	U					-	X	X		
GC519	.6-5	C	B	F	CS	F	CA	M	U					-	X	X		
GC520	.6-5	C,BY	O	C	CS	E	O		4					-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH %	10 INC		20 INC			
	EH	T	HH										CS	MH		OT	TRANSPARENT	OPAQUE
																	OR	CL
GC456	X		X			CES	+	X	X									
GC457	X		X			CES	X,+	0	X						BR	H		
GC458	X		X			CES	X,+	+							BR			
GC459	X		X		X	CES	X,+	X,-							BR			
GC460	X	X	X		X	CES,ES	+	0,-							BR			
GC461					X	ES	+	0,+				2			BR			
GC462	X		X			CES	X,+	X,-							BR			
GC463			X		X	CES	+	X,0		X								
GC464	X	X	X		X	CES	X,+	+							BR			
GC465			X	X		CES	X	0,-	X	X					BR			
GC466	X	X	X		X	CES	X,-	X,0	X						BR			
GC467	X		X	X		CES,ES	+	X,+										
GC468						CES	X,+	X	X						BR			
GC469	X		X	X		ES	+	X,-		X								
GC470	X	X	X		X	CES	X,-	X,-	X						BR			
GC471	X		X	X		ES	X,+	0,+							BR			
GC472			X			CES	X,+	X,-							BR			
GC473			X			CES	X	X,0							BR	Br		
GC474			X		X	CES	+	X,-							BR			
GC475	X		X			CES	X,-	X,-	X						BR			
GC476	X	X	X		X	CES,ES	+	0,+				1			BR,BRe	H		
GC477			X		X	CES,ES	+	0,-		X					BR			
GC478	X	X	X		X	CES	X,+	X							BR			
GC479	X		X		X	CES	+	-				1			BR			
GC480						c	X	-		X		80						
GC481			X			CES	+	X,+		X					BR			
GC482	X	X	X		X	CES,ES	X,+	X,-					1		BR			
GC483	X		X	X		CES	X,+	X	X						BR			
GC484	X		X			CES	+	-					1		BR			
GC485	X		X			CES	X,+	X	X									
GC486			X			CES	X,+	X,0										
GC487			X			CES	+	X,-		X			1		BR			
GC488	X	X	X		X	CES,ES	0,+	X,0							BR			
GC489			X			CES	X,+	+				5			BR,BRe			
GC490		X	X			CES	X,+	X		X					BR			
GC491			X			CES	+	0,+		X					BR			
GC492			X		X	CES,ES	+	0,+							BR	Br		
GC493			X			CES	X,+	+							BR	H		
GC494	X		X			CES	X	X,-	X						BR			
GC495					X	ES	+	X,+		X					BR			
GC496			X		X	CES	X	X							BR			
GC497	X		X			CES	X	X	X			1			BR			
GC498			X			CES	X,+	0,+							BR			
GC499			X		X	CES,ES	X,+	0,+	X						BR			
GC500						ES	X,+	0,+	X									
GC501						ES	X,+	X,0							BR			
GC502			X		X	ES	X,+	0,+							BR	H		
GC503			X			CES	+	-							BR			
GC504			X		X	CES,ES	X	X,+		X					BR			
GC505					X	ES	+	X,0		X								
GC506	X		X			CES	+	+							BR			
GC507						CES	+	X,+	X						BR			
GC508			X		X	CES	X,+	X,+0										
GC509	X		X		X	CES	X	X,-							BR			
GC510	X	X	X		X	CES,ES	X,-	X,+					1		BR			
GC511	X		X		X	CES,ES	+	0,+	X						BR			
GC512	X		X			CES	X,+	X,0					1		BR			
GC513			X		X	CES,ES	+	0,+	X						BR			
GC314			X	X		CES	X,+	X,0	X						BR			
GC515	X		X		X	CES,ES	X,+	X,+	X						BR			
GC516			X			c,m,f	-	-							BR			
GC517	X		X			CES	+	-	X						BR			
GC518			X			CES	X	X,0					1		BR			
GC519			X	X		CES	+	X,-			5				BR			
GC520	X	X	X		X	CES,ES	X,+	X							BR			

SPECIMEN	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC521	6-5	C,B	O	F	C,CS	D	O		5					-	X	X		
GC522	6-5	C	W	F	C,CS	U	U	U	U					-	X	X		
GC523	6-5	C	B	F	CS	F	CA	M	1					-	X	X		
GC524	6-5	C,Y	O	C	CS	F	CA	O,M	4,1	X				-	X	X		
GC525	6-5	C,Y	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC526	6-5	C	B	F	C,CS	EQ	O		5					-	X	X		
GC527	6-5	C,Y,B	O,N	F	C,G	EQ,D	CA	O	U					-	X	X		
GC528	6-5	C,Y	O	F	CS,D	U	U	U	U					-	X	X		
GC529	6-5	C	W	B	C,CS	EQ,F	CA	O,M	3,2,1	X				-	X	X		
GC530	6-5	C,B	N	B	C,CS	D	O		4					-	X	X		
GC531	6-5	Y	Y	F	C	F	U	U	U					-	X	X		
GC532	6-5	C	W	F	C,CS	U	CA	O	U					-	X	X		
GC533	6-5	C,Y	W	F	CS,M	F	M		4					-	X	X		
GC534	6-5	C,Y	W,O	F	C,CS	EQ	CA	O	5					-	X	X		
GC535	6-5	C,B	N	F	CS	EQ	O		5					-	X	X		
GC536	6-5	C	B	F	CS,D	U	U	U	U					-	X	X		
GC537	6-5	C,RB	N	W		F	O		3,2,1	X				-	X	X		
GC538	6-5	C,Y	W,Y	F	CS	U	U	U	U					-	X	X		
GC539	6-5	C,B	W	F	C	F	O		4					-	X	X		
GC540	6-5	C,Y	O	F	CS,D	E,D	CA	O	U					-	X	X		
GC541	6-5	C	B,Y	B	CS	U	U	U	U					-	X	X		
GC542	6-5	C,YB	O	F	C,CS	U	O		5					-	X	X		
GC543	6-5	C,Y	W,Y	B	C,CS	EQ,F	CA	O,M	4					-	X	X		
GC544	5-3	C,RB	N	F	C,CS	EQ	O		5					-	X	X		
GC545	5-3	C	W	B	C,CS	D	CA	O	U					-	X	X		
GC546	5-3	C,B		F	C	D	O		4					-	X	X		
GC547	5-3	C,Y,B	N	W		E,D	CA	O	4,3	X				-	X	X		
GC548	5-3	C,B	N	B	CS	U	U	U	U					-	X	X		
GC549	5-3	C,B	W,O	C	C	F,D	CA	M	1		X			-	X			
GC550	5-3	C,B,Y	O	F	C,CS	U	U	U	U					-	X	X		
GC551	5-3	C,Y	N	C	CS	E,D	CA	O	4,1	X				-	X	X		
GC552	5-3	C,Y	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC553	5-3	C,B	Y,N	B	C,CS	EQ	CA	O	4,3	X				-	X	X		
GC554	5-3	YB	N	B	C,CS	U	U	U	U					-	X	X		
GC555	5-3	C,RB	N	F	C,CS	D	O		5					-	X	X		
GC556	5-3	Y,B	N	B	CS	D	CA	O	4,3	X				-	X	X		
GC557	5-3	C,Y	O	C	CS	E	CA	U	4,3	X				-	X	X		
GC558	5-3	C	W	F	C,CS	U	U	U	U					-	X	X		
GC559	5-3	C,RB	N	B	C,CS	EQ	O		5					-	X	X		
GC560	5-3	C	W	F	C	U	U	U	U					-	X	X		
GC561	5-3	C,B,Y	N,O	B	CS	U	U	U	U					-	X	X		
GC562	5-3	C,RB	N	F	C,CS	EQ	O		4					-	X	X		
GC563	5-3	C	B	F	C	F	CA	U,M	U		X			-	X	X		
GC564	5-3	C,Y	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC565	5-3	C,RB	N	F	C,CS	U	U	U	3,2,1	X				-	X	X		
GC566	5-3	C,RB	N	F	C	EQ	O		5					-	X	X		
GC567	5-3	C,B,Y	O	F	C,CS	D	O		5					-	X	X		
GC568	5-3	C,B,Y	O	F	C	U	U	U	U					-	X	X		
GC569	5-3	C,YB	B,N	B	C,CS	D	O		5					-	X	X		
GC570	5-3	C,Y,B	N	F	C,CS	EQ,F	CA	O,M	3		X			-	X	X		
GC571	5-3	C	B	B	C,G	EQ,F	CA	O,M	6,1	X	X	KA		-				
GC572	5-3	C	W	F	C,CS	EQ	CA	O	4					-	X	X		
GC573	5-3	C,B,Y	O	B	S	U	U	U	U					-	X	X		
GC574	5-3	C,Y,B	N	F	C,CS	D	O		5					-	X	X		
GC575	5-3	C,B	N	F	C	EQ	O		5					-	X	X		
GC576	5-3	C,B	N	C	CS	D	O		5					-	X	X		
GC577	5-3	C,B,Y	Y	F	C,CS	U	U	U	5					-	X	X		
GC578	5-3	C,B,Y	W,O	C	CS	U	U	U	U					-	X	X		
GC579	5-3	C,Y	O	C	C	D,F	CA	O,U	3,2	X				-				X
GC580	5-3	C,RB	W,N	W		EQ,D	O		5					-	X	X		X
GC581	5-3	C,B	N	F	CS	U	U	U	U					-	X	X		
GC582	5-3	C,B,Y	W,O	W		E	O		4					-	X	X		
GC583	5-3	C,Y	W,O	B	C	D	O		5					-	X	X		
GC584	5-3	C,B	N	F	CS	U	U	U	U					-	X	X		X
GC585	5-3	C,YB		B	C	D	O		4,2	X				-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC		
	EH	T	HH										CS	MH		OT	%
													OR	CL	GR		
GC521					X	ES	+	0,+	X							BR	
GC522						CES,ES	+	X,0		X							
GC523			X	X		m,f	X,0	X,0								BR	
GC524					X	CES	X,-	X								BR	
GC525						CES,ES	X,+	X,-								BR	
GC526					X	CES,ES	X,+	X,-	X					1		BR	
GC527	X	X				ES	X,+	X,-	X							BR	
GC528	X					CES	X,-	X,-	X							BR	
GC529						CES	+	X,0								BR	
GC530	X		X	X		CES,ES	X,+	X,-	X				2			BR	Br
GC531						ES	+	X,-	X					3		BR	
GC532	X					CES	X,+	X,+								BR	
GC533	X					CES,ES	X,+	X								BR	H
GC534					X	CES,ES	X,+	X,-	X	X						BR	
GC535						CES	+	0,+								BR	
GC536				X		m,f	+	0,+									
GC537	X					CES	X+									BR	
GC538						CES,ES	X+	X+								BR	
GC539	X	X			X	CES	+	X	X					1		BR	H
GC540	X	X				CES	X,+	X,0								BR	
GC541			X	X		CES	X	X,0	X	X						BR	
GC542						CES	+	X	X					2		BR	
GC543	X	X				CES	+	X,0								BR	
GC544						CES	X	X,0	X	X							
GC545					X	CES,ES	X,+	X,-	X	G						BR	
GC546	X					CES	X,-	X,0	X					1		BR	
GC547	X	X				CES	X							1		BR,BRe	
GC548						ES	+	-		X						BR	
GC549	X	X				m,f	-	0						1		BR	
GC550						CES	0	0,-		X						BR	
GC551	X					CES	0,-	0						2		BR	
GC552					X	ES	+	X,+								BR	
GC553	X				X	CES	X,-	X,-								BR	
GC554			X	X		X	CES	X	X,+		X						
GC555	X	X				CES	X,+	X,0		X						BR	
GC556	X	X			X	CES	X,-	X									
GC557	X	X				CES	X,+	X								BR	
GC558	X		X	X		CES	X	0,-						1	6	BR	
GC559	X		X	X	X	CES	X,+	0,+	X							BR	
GC560	X	X				CES	X,-	-		X							
GC561						m,f	X,-	X,-		X							
GC562	X	X	X	X		CES,ES	X,+	X,0								BR	
GC563	X		X	X		CES,ES	X,+	-		X				3			
GC564	X	X				CES	X	-						1		BR	
GC565	X	X				CES	X,+	X	X							BR	
GC566						CES	+	X,0									
GC567					X	X	CES,ES	X,+	X,-							BR	
GC568	X					CES	X,-	X						1		BR	
GC569			X	X	X	CES,ES	+	-								BR	
GC570	X					CESS	X,-	X,0									
GC571	X	X					0	0								BR	
GC572			X	X		X	CES,ES	+	X,+		X					BR	
GC573						CES	+	0,+		X							
GC574						CES	X,+	-									
GC575	X					CES,ES	X,+	-								BR	
GC576	X					CES	X,+	X,0	X								
GC577			X	X		CES	+	X,+	X	X							
GC578						CES	+	X								BR	
GC579	X	X				c	0,-	0						4		BR,BRe	
GC580	X				X	CES	+										
GC581						CES	X,0	X,0	X								
GC582	X					CES	X,+									BR	
GC583					X	CES,ES	+	X,+								BR	
GC584					X	c,m,f	X	X,0	X	X							
GC585						CES,ES	X,-	X,+									

SPECIMEN	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC589	.5-3	C	W	F	C,CS	F	CA	M	U		X							
GC590	.5-3	C,B		F	C	U	O		5					-	X	X		
GC591	.5-3	C,Y	N,O	B	CS	F	CA	M,U	4,1	X				-	X	X		
GC592	.5-3	C		W		D	O		5,4,1	X								
GC593	.5-3	C,YB		C	C,CS	EQ	CA	O	5,4,3	X				-	X	X		
GC594	.5-3	OW	N	B	C	D	CA	O	1									
GC595	.5-3	C,Y	W,O	F	C,CS	D	O		5					-	X	X		
GC596	.5-3	C,B		F	C,CS	U	U	U	U					-	X	X		
GC597	.5-3	C	N	F	C,CS	U	U	U	U					-	X	X		
GC598	.5-3	C,B	N	W		F	O		1								X	
GC599	.5-3	C	N	B	CS	D	CA	O	5					-	X	X		
GC600	.5-3	C,YB	N	B	CS	D	CA	O	4					-	X	X		
GC601	.5-3	C,RB	N	F	C	U	U	U	U					-	X	X		
GC602	.5-3	C,RB	N	B	C,CS	EQ	CA	O	5					-	X	X		
GC603	.5-3	C,Y	W	F	CS	U	U	U	U					-	X	X		
GC604	.5-3	C	B	F	C	EQ	CA	O	4					-	X	X		
GC605	.5-3	C,Y	W,O	C	CS	D,E	O		4,3,2	X				-	X	X		
GC606	.5-3	C,B,Y	O	F	C	U	U	U	U					-	X	X		
GC607	.5-3	C	B,N	C	CS	U	U	U	U									
GC608	.5-3	C,RB	N	B	C,CS	D	CA	O	U					-	X	X		
GC609	.5-3	C,YB	N	C	CS	D	O		4					-	X	X		
GC610	.5-3	C,RB	N	F	C,CS	D	CA	O	4,1	X				-	X	X		
GC611	.5-3	C,Y	W,O	C	C	E	O		4,2	X				-	X	X		
GC612	.5-3	C,RB	N	F	C	U	U	U	U					-	X	X		
GC613	.5-3	C,RB	N	F	C,CS	U	U	U	U					-	X	X		
GC614	.5-3	C,Y	W,O	F	CS	U	U	U	U					-	X	X		
GC615	.5-3	C	B	F	C	EQ	CA	O	4,3	X				-	X	X		
GC616	.5-3	C	B	F	C	U	U	U	U					-	X	X		
GC617	.5-3	C,Y,B	N	C	CS	D	CA	O	3,2,1	X				-	X	X		
GC618	.5-3	C,Y	W,O	F	C	U	U	U	U					-	X	X		
GC619	.5-3	C,RB	N	F	C	U	O		U					-	X	X		
GC620	.5-3	C,RB	N	B	CS	D,F	CA	O,U	4,3,2	X				-	X	X		
GC621	.5-3	C,Y	N	C	C	D	CA	O	3,2,1	X				-	X	X		
GC622	.5-3	C	W,Y	B	CS	D	O		5					-	X	X		
GC623	.5-3	C,YB	N	B	CS	EQ	CA	O	3,2,1	X				-	X	X		
GC624	.5-3	C	B	F	CS	U	U	U	U					-	X	X		
GC625	.5-3	C,RB	N	F	C	D	CA	O	5,1	X				-	X	X		
GC626	.5-3	C		F	C	U	U	U	U					-	X	X		
GC627	.5-3	C,YB	O,W	W		U	U	U	U					-	X	X		
GC628	.5-3	C,B,Y	N	W		F	O		4,3	X				-	X	X		
GC629	.5-3	C,Y,B	N	B	CS	D	CA	O	4,1	X				-	X	X		
GC630	.5-3	C,B	N	W		D	O		4,3,2	X				-	X	X		
GC631	.5-3	C,Y	W	B	C	D	O		5					-	X	X		
GC632	.5-3	C	B	B	C,CS	EQ	O		6					-	X	X		
GC633	.5-3	C,B,Y	O	F	C,CS	D	O		6					-	X	X	X	
GC634	.5-3	C	N,O	F	C,CS	EQ,D	CA	O	4,3,2	X				-	X	X		
GC635	.5-3	C,Y	O	B	C	D	CA	O	3,2,1	X				-	X	X		
GC636	.5-3	C	B	B	CS	EQ,D	CA	O	4					-	X	X		
GC637	.5-3	C,Y	Y	B	C	EQ	O		4,3	X				-	X	X		
GC638	.5-3	C	B	C	CS	F	CA	M	4,3	X	X			-	X	X		
GC639	.5-3	C,YB	N	F	C,CS	D	CA	O	5					-	X	X		
GC640	.5-3	C	W,Y	F	CS	U	U	U	4,1	X				-	X	X		
GC641	.5-3	C,B,Y	N	F	C,CS	U	U	U	U					-	X	X		
GC642	.5-3	C	W	F	CS	U	U	U	U					-	X	X		
GC643	.5-3	C,Y	N,O	F	CS	U	U	U	U					-	X	X		
GC644	.3-1	C	W	F	C	U	U	U	U					-	X	X		
GC645	.3-1	C,YB	O	F	C,S	U	U	U	U					-	X	X		
GC646	.3-1	C,Y,B	N	B	C,CS	D	O		U					-	X	X		
GC647	.3-1	C,B,Y	N,O	C	C	D	CA	O	2,1	X				-				
GC648	.3-1	C,B	O	B	CS	D	O		3,2,1	X				-	X	X		
GC649	.3-1	C,B,Y	W,O	F	C,CS	U	U	U	U					-	X	X	X	
GC650	.3-1	C,B,Y	W,O	B	C	EQ,D	CA	O	4					-	X	X		
GC651	.3-1	C	B	F	CS	U	U	U	U					-	X	X		
GC652	.3-1	C,B	N	W		D	O		3,2,1	X				-	X	X		
GC653	.3-1	C,Y	W,O	W		D	CA	O	1									

SPECIMEN	THH					R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC
	EH	T	HH	CS	MH										OT	%	
GC589			X	X		X	m,f	0,+	0,-		X						
GC590	X			X			CES	X	0,-	X					1		BR
GC591	X	X		X			CES	X,0	+								BR
GC592	X	X		X				0							1	2	BR
GC593	X			X		X	ES	X	X,-								
GC594	X	X		X		X		0,-	0								BR Br
GC595				X			CES	+	0,-	X	X						BR
GC596				X			ES	+	0,+								
GC597				X			CES	X	0,-		X		10				
GC598	X	X		X		X	c,m	-									BR H,Br
GC599	X	X		X			CES,ES	+	X,+			25					BR
GC600	X	X		X		X	CES,ES	X,-	0					1			BR
GC601				X			CES	+	X								BR
GC602	X	X		X			CES	+	0	X	X				2		BR,BrRe
GC603			X	X			CES,ES	+	X,-		X						
GC604				X			CES	+	0			G					BR
GC605	X	X		X		X	CES,ES	X,+	+						1		BR
GC606			X	X			CES	X,0	0,+		X						BR
GC607								U	0				90				
GC608	X			X		X	CES	+	X								
GC609	X			X			CES	X,+	+								BR
GC610	X			X		X	CES	X,0	0,-	X	X						BR
GC611	X			X			CES	X,+	+						1		BR
GC612	X			X			c,m,f	X	0								
GC613	X			X			CES	X,-	X,-		X						BR
GC614				X			CES	+	X,-	X							BR
GC615	X	X		X			CES	+	0								BR
GC616				X			CES	+	0	X					1		BR
GC617	X	X	X	X			CES	X,-	0					1		1	BR
GC618				X			CES,ES	+	X,+								B H
GC619				X			CES	+	0	X							BR
GC620	X	X	X	X			CES	+	0,+								BR
GC621	X	X	X	X		X	CES	0,+	X								BR Br
GC622	X	X		X		X	CES,ES	+	+								BR
GC623	X			X		X	c,m,f	X,-	0,-		X						BR
GC624			X	X		X	ES	0,+	X,+		X				1		BR
GC625	X			X			CES	0,+	X	X					1		BR
GC626				X			ES	+	0,-								BR
GC627	X	X		X		X	CES	X,+									BR
GC628	X			X			CES	X,-									BR
GC629	X	X	X	X		X	CES,ES	+	X,+		X						
GC630	X			X		X	c,m	0,-							2		BR
GC631				X			ES	+	X,+						1		BR
GC632						X	ES	+	0								BR
GC633	X			X		X	m,f	0,-	X,-						1		BR
GC634	X			X		X	CES	X,0	0,-								BR H
GC635	X	X		X			CES	0,+	0								BR
GC636	X	X		X	CP	X	CES	+	X	X	X						BR
GC637	X			X			CES	X,+	-	X							BR
GC638	X			X			CES	X,+	-		X						BR H
GC639							ES	+	0,-	X	X						BR
GC640	X			X			c,m,f	-	-		X						BR
GC641	X			X			CES	0,+	0		X						
GC642	X			X			ES	0,+	0,+			G			3		BR
GC643				X			ES	X,+	0				18				
GC644				X			ES	+	X		X						BR
GC645						X	CES,ES	+	0		X						
GC646	X			X		X	CES	X,-	-	X	X						BR H
GC647	X	X		X		X	c	0,-	0	X							BR
GC648	X	X	X	X			CES	X,0	+								BR
GC649				X			CES	+	0,-		X						
GC650	X			X			CES	X,+	0,+	X	X						
GC651				X		X	ES	+	0,+		X						BR Br
GC652	X	X		X		X	ES	X,-							2		BR
GC653	X	X		X		X		0,-									BR

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC654	.3-1	C,YB	N	C	CS	D	O		3					-	X	X		
GC655	.3-1	C,YB	N	C	CS	D,E	O		4,1	X				-	X	X		
GC656	.3-1	C	O	B	S	D,E	CA	O,U	1					-	X	X		X
GC657	.3-1	C,RB	N	C	C	D	O		4,3	X				-	X	X		
GC658	.3-1	C,RB	N	B	CS	D	O		1					-	X	X		
GC659	.3-1	C,Y	N	F	C,CS	EQ	CA	O	4					-	X	X		
GC660	.3-1	C,Y	W,O	C	CS	D	O		4					-	X	X		
GC661	.3-1	C,B	N	F	CS	U	U	U	U					-	X	X		
GC662	.3-1	C,B,Y	O	F	CS	U	U	U	U					-	X	X		
GC663	.3-1	C,B,Y	N	F	CS	D	O		5					-	X	X		
GC664	.3-1	C,RB	N	C	CS	D	O		4,1	X				-	X	X		
GC665	.3-1	C,Y	O	B	CS	EQ	CA	O	5					-	X	X		
GC666	.3-1	C,B	W,Y	B	CS	EQ,E	CA	O	3,2	X				-	X	X		
GC667	.3-1	C,B	N	F	CS	D	CA	O	U					-	X	X		
GC668	.3-1	C,Y	N	F	CS,D	U	U	U	U					-	X	X		
GC669	.3-1	C,B	N	F	C,CS	D	CA	O	4					-	X	X		
GC670	.3-1	C,Y		F	CS	U	U	U	U					-	X	X		
GC671	.3-1	C,Y	W,O	C	CS	E	O		5					-	X	X		
GC672	.3-1	C,Y	O	W		E	O		4,2,1	X				-	X	X		
GC673	.3-1	C,Y	O	F	CS	U	U	U	U					-	X	X		
GC674	.3-1	C	B	B	C	D	CA	O	2,1	X			FLL					
GC675	.3-1	C,Y		B	C,S	U	C		5									X
GC676	.3-1	C,Y	W	F	C,CS	U	U	U	U					-	X	X		
GC677	.3-1	C	B	W		D	CA	O	4,1	X				-	X	X		X
GC678	.3-1	C,Y	W,Y	B	C,CS	E	CA	O	2,1	X				-	X	X		
GC679	.3-1	C	W,Y	B	CS	D	O		4,3	X				-	X	X		
GC680	.3-1	C,Y	N	C	CS	EQ	CA	O,U	4,1	X				-	X	X		
GC681	.3-1	C	N	F	C	F	CA	M,U	U					-	X	X		
GC682	.3-1	C,B,Y	O	B	C,CS	EQ	CA	O	4					-	X	X		
GC683	.3-1	C,Y	O	F	CS	U	U	U	U					-	X	X		
GC684	.3-1	C	B	F	CS	U	U	U	U					-	X	X		
GC685	.3-1	C	N	F	CS	EQ	CA	O	5					-	X	X		
GC686	.3-1	C	N	C	G	F	CA	M,O	1									
GC687	.3-1	C,Y	O	C	CS	F	O		3,2,1	X				-	X	X		
GC688	.3-1	C,B	N	B	CS	EQ,U	CA	O	4					-	X	X		
GC689	.3-1	C	N	F	CS,D	U	U	U	U				FLL	-	X	X		
GC690	.3-1	C	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC691	.3-1	C	B	W		F	O		5,1	X				-	X	X		
GC692	.3-1	C	N	B	C	E	O		5					-	X	X		
GC693	.3-1	C,B,Y	N	F	C,S	EQ	O		5					-	X	X		
GC694	.3-1	C	W	F	C,CS	U	U	U	U					-	X	X		
GC695	.3-1	C,Y	O	B	C	EQ	O		4					-	X	X		
GC696	.3-1	C	B	F	C,CS	U	U	U	U					-	X	X		
GC697	.3-1	C	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC698	.3-1	C,Y	O	F	C	U	U	U	U					-	X	X		
GC699	.3-1	OW	B	F	C,CS	U	U	U	U					-	X	X		
GC700	.3-1	C	W,Y	B	CS	D	O		5					-	X	X		
GC701	.3-1	C,Gy	W,Y	F	C,CS	D	CA	O,U	U					-	X	X		
GC702	.3-1	C,Y	W,Y	F	C,S	U	U	U	U					-	X	X		
GC703	.3-1	C,Y	O	C	C	D	O		4					-	X	X		
GC704	.3-1	C	B	B	D,S	F	CA	M,U	1				WLL					
GC705	.3-1	C,B,Y	O	C	C	E	O		5,3	X				-	X	X		
GC706	.3-1	C,B,Y	N	F	C	EQ	CA	O	5					-	X	X		X
GC707	.3-1	C	C,Y	B	CS	D	O		4					-	X	X		
GC708	.3-1	C,Y	W	F	C	U	U	U	4,1	X				-	X	X		
GC709	.3-1	C,B,Y	W,Y	F	C,CS	U	U	U	U					-	X	X		
GC710	.3-1	Y,B	N	B	CS	U	U	U	U					-	X	X		
GC711	.3-1	C	B	F	C,CS	U	O	U	U					-	X	X		
GC712	.3-1	C,B,Y	N	B	CS	D	CA	O	4,2	X				-	X	X		
GC713	.3-1	C	W	F	CS,D	D,F	CA	O,M	4,3	X				-	X	X		
GC714	.3-1	C,Y	O	C	CS	EQ	O		5					-	X	X		
GC715	.3-1	C,B,Y	N,Y	F	C,CS	D	CA	O	2,1	X				-	X	X		
GC716	.3-1	C,B,Y	N,O	F	C	U	U	U	U					-	X	X		
GC717	.3-1	C	N,O	C	C	D	O		1					-	X	X		
GC718	.3-1	C,Y	Y	F	C,CS	U	U	U	U					-	X	X		

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
													OR	CL	GR	
GC654	X		X			CES	X,+	X,0		X						BR
GC655	X		X			CES	0,+	+								
GC656	X		X			m,f	-			X						
GC657	X	X	X			CES	X,+	X								
GC658	X		X			c,m,f	0,-	0,+	X	X						
GC659	X	X	X			CES,ES	+	X,+							BR	H
GC660	X	X	X			CES	X,0	X							BR	
GC661	X	X	X			CES	X	-	X						BR	
GC662			X		X	CES,ES	X,+	X							BR	
GC663	X	X	X			CES	+	X								
GC664	X		X			CES	0,+	+		X						
GC665	X		X			CES	+	+							BR	
GC666	X		X		X	CES	X,-	X,-							BR	
GC667	X	X	X			c,m,f	X,0	-							BR	
GC668			X			m,f	X	-		X					BR	
GC669	X		X		X	CES	X,+	X,-	X						BR	
GC670			X			CES	+	+							BR	H
GC671			X			CES	+	X							BR	
GC672	X	X	X			CES	0,+								BR	
GC673			X	X		ES	+	X,-	X	X					BR	
GC674	X		X				0	0			X					
GC675						m,f	-	0,-		X						
GC676	X		X		X	CES	+	X,-		X					BR	
GC677	X	X	X			m,f	0,-								BR	
GC678	X	X	X			m,f	0,-	X		X					BR	H
GC679	X		X			CES	+	X,+				4			BR,B	
GC680	X		X		X	CES	X,+	X							BR	
GC681	X	X	X			CES	0,+	0,+		X			1			
GC682	X		X		X	CES	X,+	X	X						BR	
GC683			X		X	CES,ES	+	+		X					BR	H
GC684			X			ES	+	X,+		X					BR	
GC685			X		X	CES,ES	+	X,+							BR	
GC686	X	X	X				0	0,-							BR	
GC687	X	X	X			CES	0,+	+							BR	
GC688	X		X		X	CES	X,+	+								
GC689			X	X		ES	X,0	X,0								
GC690			X	X		m,f	X,0	0,-								
GC691	X	X	X			CES	+								BR	
GC692	X	X	X			CES	+	+							BR	
GC693	X		X			CES	X,+	0	X	X						
GC694			X			ES	0,+	0,+		X						
GC695			X			CES	X,+	X							BR	
GC696			X			CES	+	X,0							BR	H
GC697						CES	+	0,+		X						
GC698			X			CES	+	X,0		X					B	
GC699			X		X	c,m,f	X	X,-							BR	
GC700			X			CES	+	0		X					BR	
GC701	X		X	X	X	CES,ES	X,+	X	X	X					BR	
GC702			X	X		ES	+	X,0		X					BR	
GC703			X	X		ES	X,+	X								
GC704	X		X				0	-		X			1			
GC705	X		X			CES	X,+	X				1			BR	
GC706			X			CES	+	0	X			2			BR	
GC707	X		X			CES	X,+	X,-							BR	
GC708	X		X			CES	0,+	0,+	X	X					BR	
GC709			X		X	ES	+	X,-	X						BR	H
GC710			X			CES	0,+	-		X						
GC711						m,f	0,+	0,+	X						BR	
GC712	X		X		X	CES	0,-	+							BR	
GC713			X			CES,ES	X,+	X							BR	Br
GC714	X		X			CES	X,+	X,-				1			BR	
GC715	X		X		X	c,m,f	-	X,-		X					BR	
GC716			X			CES	X,+	0,+							BR	
GC717	X	X	X			c,m,f	0	X	X			1	1		BR	
GC718	X		X			CES	X,+	0,-		X					BR	

SPECIMEN CAT	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC719	.3-1	C,Y	O	F	CS	EQ	O		6									
GC720	.3-1	C,BY	N	B	CS	D	O		5,4,3	X					X	X		
GC721	.3-1	C,B	N	F	CS	EQ	O		5						X	X		
GC722	.3-1	C,B	N	F	C,CS	D	CA	O,M	3,2,1	X	X				X	X		
GC723	.3-1	C,Y	N	B	CS	D	O		4,1	X					X	X		
GC724	.3-1	C,Y	O	F	C,S	U	O		5						X	X		
GC725	.3-1	C,RB	N	F	C,CS	U	U	U	3,2,1	X					X	X		
GC726	.3-1	C	B	F	C,CS	F,U	CA	O,M	U						X	X		
GC727	.3-1	C,YB	W,O	F	CS	EQ	O		4						X	X		
GC728	.3-1	C,RB	N	F	C,CS	D,U	CA	O	5,4,1	X					X	X		
GC729	.3-1	C,Y	N,O	B	C,CS	D	O		4,1	X								X
GC730	.3-1	C,Y	N,O	B	C,CS	U	U	U	U						X	X		
GC731	.3-1	C,B	N	C	C,M	F	CA	M	4,3	X	X				X	X		
GC732	.3-1	C,B	W,Y	F	C,CS	D	O		5,1	X					X	X		
GC733	.3-1	OW	N	F	CS	U	CA	O,U	U						X	X		
GC734	.3-1	C	N	F	CS	D	O		4						X	X		
GC735	.3-1	C	B	F	CS	U	O		6						X	X		
GC736	.3-1	C,YB	N	F	C	D	O		5,1	X					X	X		
GC737	.3-1	C	W	B	C	D	CA	O	5,4	X					X	X		
GC738	.3-1	C,BY	N	B	CS	U	U	U	U						X	X		
GC739	.3-1	C,BY	N	B	C	U	U	U	U						X	X		
GC740	.3-1	C,B	N	B	C	E	O		4						X	X		
GC741	.3-1	C	W	F	CS	U	U	U	U						X	X		
GC742	.3-1	C	O	C	CS	D	O		4,3,2	X					X	X		X
GC743	.3-1	C,Y	N	F	C,CS	U	U	U	U									
GC744	.-1	C,Y	W,Y	W		D	O		5,4	X								
GC745	.-1	C,B	N	F	C,CS	D,E	U	U	U						X	X		
GC746	.-1	C,Y	Y	F	C,CS	D	O		5						X	X		
GC747	.-1	C,Y	O	F	C,CS	U	U	U	U						X	X		
GC748	.-1	C,YB	W,Y	F	S	U	U	U	U						X	X		
GC749	.-1	C,YB		W		E,D	CA	O	4,3,2	X					X	X		
GC750	.-1	BY		F	C	D	O		4						X	X		
GC751	.-1	C,YB	N	C	C	D	O		4						X	X		
GC752	.-1	C	W	F	C	EQ	O		5						X	X		
GC753	.-1	C	W	F	C	D	O		4						X	X		
GC754	.-1	C		F	C,CS	U	U	U	U						X	X		
GC755	.-1	C,Y	N	F	C,CS	D	CA	O	4						X	X		X
GC756	.-1	Y,B,RB	N	F	C,CS	F	U	U	U						X	X		
GC757	.-1	C,B	N	F	C,CS	D	U	U	1									
GC758	.-1	C,YB	W,O	F	C	EQ	CA	O	5						X	X		
GC759	.-1	C,BY	Y	C	C	D,E	CA	O,U	3,2,1	X					X	X		X
GC760	.-1	C,YB	N	F	C	EQ	CA	O	4,1	X					X	X		
GC761	.-1	C	N	C	C	D,F	CA	O,M	6		X	SF,SL						
GC762	.-1	C	B	B	C	D	CA	O	6,5	X		SF,SL						
GC763	.-1	C,RB	N	B	CS	F	CA	O,U	U						X	X		
GC764	.-1	C,RB	N	F	C,CS	U	U	U	U						X	X		
GC765	.-1	C,Y,RB	N	F	C,CS	U	U	U	U						X	X		
GC766	.-1	C,RB	N	F	C,CS	U	U	U	U						X	X		
GC767	.-1	C,RB	N	C	C	D	O		4									
GC768	.-1	C,Y	B	F	C,CS	U	U	U	U						X	X		
GC769	.-1	C		W		EQ	O		5						X	X		
GC770	.-1	C,Y	N,O	F	C	EQ	O		4						X	X		
GC771	.-1	C,BY	Y	F	C,CS	U	U	U	U						X	X		
GC772	.-1	Y		W		EQ	O		6			SF,SL						
GC773	.-1	C,RB	N	W		D	O		3,2,1	X					X	X		
GC774	.-1	C		W		D	O		2,1	X								
GC775	.-1	BY		F	C,CS	U	U	U	U						X	X		
GC776	.-1	C,Y	W,O	F	C,S	U	CA	O	4						X	X		
GC777	.-1	C,BY	W,O	B	CS	D	O		2,1	X					X	X		
GC778	.-1	C,Y		W		EQ	O		5			SF						
GC779	.-1	C,BY		W		D	O		1									
GC780	.-1	C	W	B	C,CS	D	CA	O	6			SF						
GC781	.-1	C,RB	N	W		EQ,D	CA	O,M	6,5	X	X	SF,SL						
GC782	.-1	C,Y		W		D,F	CA	O,M	U		X							
GC783	.-1	C,Y		W		F	M		6		X	SF						

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
													OR	CL	GR	
GC719				X		CES	+	X,0								BR
GC720	X	X		X	X	CES	X,+	X	X		G					BR
GC721				X		CES	+	0								BR
GC722	X			X	X	CES	X,+	X								BR
GC723	X	X		X	X	c,m,f	X,-	X,-	X	X	G					BR
GC724				X	X	CES,ES	+	-	X	X						
GC725	X			X	X	c,m,f	0,-	-	X	X						BR
GC726				X		ES	+	0,+			G					
GC727	X			X		CES	X	X								BR H
GC728	X	X	X	X		CES	X,+	X,0	X							BR H
GC729	X	X		X		c	0,-	0		X			1			BR H
GC730	X			X	X	CES	X,+	X,0	X	X						BR,BRc
GC731	X			X	X	CES	0,+	X	X							BR Br
GC732	X			X		CES	0,+	0	X				2			BR
GC733				X	X	CES	X,+	X,0								BR Br
GC734				X	X	CES	X,+	X,+								BR H
GC735						CES	X,+	0	X							BR
GC736	X	X		X		CES	+	X,+	X				2			BR
GC737	X			X	X	CES,ES	+	X,+								BR H
GC738						X	-		X			40				
GC739				X	X	ES	0,+	+								BR H
GC740	X			X		CES	X,+	X	X	X						BR
GC741				X	X	CES,ES	+	+								BR
GC742	X			X		CES	X,-	X								BR H
GC743				X		c	X	-		X						
GC744	X			X			0,-						2			BR H
GC745				X		CES	X	X,-		X						
GC746				X		CES	X	0,-								
GC747				X		CES	X,-	X,0		X						
GC748			X	X	X	CES	+	-		X			1			
GC749	X			X		CES	X						1			BR
GC750				X		CES	X	0,-		X						BR
GC751				X		CES	X,+	X								BR
GC752						ES	+	X,0	X				1			BR
GC753	X	X		X		CES	X	X	X	X						BR
GC754				X		CES	X	X,0	X		G					
GC755	X	X		X		CES	X	X,0	X		G					BR
GC756	X	X		X		CES	+	-					1			BR
GC757				X		c	0	0,-								
GC758				X		CES	+	+								BR
GC759	X			X	X	CES	X,-	-								BR
GC760	X	X		X	X	ES	0,+	+								
GC761							0	0					2			BRc
GC762			X	X			0	0								
GC763	X			X		CES	X,-	X,-								
GC764	X			X		CES	X,+	0,-					1			BR
GC765				X		f	0,-	0,-	X							
GC766	X			X	X	CES	X,-	X	X	X						
GC767	X			X		CES	+	+					1			BR
GC768	X			X		CES	X	0,-			G		1			BR
GC769	X			X		CES	X									BR
GC770	X			X	X	CES,ES	X,+	+	X							
GC771	X			X		CES	X,-	X,0								
GC772							0							4		BR
GC773	X	X		X		CES	0,+						1			
GC774	X	X		X			0	0								
GC775				X		CES	X,-	-		X						
GC776	X			X		c,m	X,0	0,-		X						BR
GC777	X	X		X		c	0	-								BR
GC778	X			X			0	0								BR
GC779	X	X		X			0	0								BR
GC780							0	0				1	1			BR H
GC781	X			X			0	0								BR H
GC782	X			X			0						1			
GC783							0									BR H

SPECIMEN	SIEVE	COL	UV	STATE	BREAK	REG	MORPH	SUB	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC784	-1	C, RB		F	CS	EQ	O		4,3,2	X				-	X	X		
GC785	-1	C, BY	N	C	CS	D	O		6			SL		-	X	X		
GC786	-1	C, RB		F	C	D	O		3					-	X	X		
GC787	-1	C	N	F	C, CS	E	O		1									
GC788	-1	C	W	F	C, CS	EQ	O		3					-	X	X		
GC789	-1	C, YB	W, O	F	C, CS	D	CA	O	4					-	X	X		
GC790	-1	C, RB	N	F	C	D	O		4,3,2	X				-	X	X		
GC791	-1	C, Y	W, Y	C	C	D	O		4,3,2	X								
GC792	-1	C, RB	N	F	C, S	U	U	U	U									
GC793	-1	C, RB	N	C	C	D	O		1					-	X	X		
GC794	-1	C, Y	W, Y	B	CS	EQ	O		4,3	X				-	X	X		
GC795	-1	C	W	W		D	O		4,1	X								
GC796	-1	C, Y		W		EQ	O		6			SF						
GC797	-1	C	W	F	C, CS	U	U	U	U					-	X	X		
GC798	-1	C, YB	N	C	CS	E	O		4,1	X				-	X	X		
GC799	-1	C, Y	W, O	W		D	O		4,1	X								
GC800	-1	C, RB	N	F	C	U	U	U	U					-	X	X		
GC801	-1	C, YB		C	C	D	CA	O	6									
GC802	-1	C, Y	W, Y	C	C	D	CA	O	6			SF						
GC803	-1	C, B	N	F	C, CS	U	U	U	U					-	X	X		
GC804	-1	C, RB	N	W		D	O		5,4	X				-	X	X		
GC805	-1	C, Y	Y	C	C	E	O		4,3	X				-	X	X		
GC806	-1	C, Y		W		EQ	O		5,4	X								
GC807	-1	C, BY	N, O	C	C	D	CA	O	4,3	X				-	X	X		X
GC808	-1	C, B		B	C	E	O		6			SF						
GC809	-1	C, Y	W, Y	B	C, CS	D	O		4,3	X				-	X	X		
GC810	-1	C, Y	Y	W		D	O		4,1	X								X
GC811	-1	C, BY	W, O	B	C	E	O		5					-	X	X		
GC812	-1	C, B	N	B	CS	D	CA	O	3,1	X				-	X	X		
GC813	-1	C	B	F	C	U	U	U	U				FLL	-	X	X		
GC814	-1	C, BY	W, Y	F	C	D, E	CA	O	4,1	X				-	X	X		
GC815	-1	C, Y	O	F	CS	U	U	U	U					-	X	X		
GC816	-1	C, RB	N	F	CS	D	O		5,1	X				-	X	X		
GC817	-1	C	B	W		D, F	CA	O, M	4,1	X	X							
GC818	-1	RB	N	B	CS	D	O		4					-	X	X		
GC819	-1	C	Y	W		F	M		3,2,1	X	X			-	X	X		
GC820	-1	BY	N	B	CS	U	U	U	U					-	X	X		
GC821	-1	C, BY		F	C, CS	U	U	U	U					-	X	X		
GC822	-1	C	B	B	C, D	U	U	U	U				FLL	-	X	X		
GC823	-1	C, Y	O	F	CS	U	U	U	U					-	X	X		
GC824	-1	C, RB	N	F	C	D	O	O	4,3	X				-	X	X		
GC825	-1	C, B		F	C, CS	D	O		4					-	X	X		
GC826	-1	C		B	C	F	CA	M	5					-	X	X		
GC827	-1	C		F	C, CS	U	U	U	U					-	X	X		
GC828	-1	C, RB	N	F	CS	U	O	U	U					-	X	X		
GC829	-1	C, BY	W, Y	W		F, D	CA	O	3,2,1	X								
GC830	-1	C, Y		F	C, CS	U	U	U	U					-	X	X		
GC831	-1	C, Y	W, O	W		D	O		4,3,2	X				-	X	X		
GC832	-1	C, BY	O	B	C	EQ	O		5,4,3	X				-	X	X		
GC833	-1	C		F	C, CS	EQ	CA	O	6					-	X	X		
GC834	-1	C, RB	N	C	CS	E	O		5					-	X	X		
GC835	-1	C	B	F	C, CS	E	O		U									
GC836	-1	C		B	CS	D	O		6					-	X	X		
GC837	-1	C, Y		F	C	D, F	CA	O	4					-	X	X		
GC838	-1	C, B		C	C	EQ	O		6					-	X	X		
GC839	-1	C		F	C	EQ, F	CA	O, M	5		X			-	X	X		
GC840	-1	C, Y		W		EQ, D	CA	O	5					-	X	X		
GC841	-1	C		F	C, CS	U	U	U	U					-	X	X		
GC842	-1	C		W		D	O		5					-	X	X		
GC843	-1	C		B	C	U	O		U									
GC844	-1	C		C	CS	EQ	O		5					-	X	X		
GC845	-1	C, Y		B	C	D	O		5					-	X	X		
GC846	-1	C		B	C	D	O		4					-	X	X		
GC847	-1	C		C	C	D	O		4,3,2	X				-	X	X		
GC848	-1	C		W		EQ, D	CA	O	4,1	X								

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC				
	EH	T	HH										CS	MH		OT	%	TRANSPARENT	OPAQUE
																		OR	CL
GC784	X					CES	X,0	X								BR			
GC785							0	0						4		BR			
GC786	X					CES	X	X,0						1					
GC787	X						0	0								BR			
GC788	X	X				CES	+	0,+								BR			
GC789			X	X			X,+	0,-	X	X				3		BR			
GC790	X					CES	X,-	X,0	X	X						BR			
GC791	X	X					0	0								BR			
GC792						c	X	0,-		X									
GC793	X	X				CES	X,-	+											
GC794	X	X				CES	X	+											
GC795	X	X				m	0,-												
GC796							0									BR			
GC797	X					CES	X,+	X,0								H			
GC798	X	X				CES	X,0	X						1		BR			
GC799	X	X					0	0						2					
GC800	X		X	X		CES	0,-	0,+		X									
GC801							0	0						2					
GC802							0	0						2		BR			
GC803			X		X	CES	+	X,0											
GC804	X					CES	+							1		BR			
GC805	X					CES	X,-	X								BR			
GC806							0	0								BR			
GC807	X					CES	X,-	0	X	X						BR			
GC808							0							3		BR			
GC809	X				X	ES	X,-	X								BR			
GC810	X	X				m,f	0,-									Br			
GC811	X					CES	+	+								BR			
GC812	X	X			X	CES	0,+	+								BR			
GC813						CES	0,+	+		X									
GC814	X					CES	X	-	X					2		BR			
GC815						ES	+	-		X						BR			
GC816			X	X		CES	0,+	+								BR			
GC817	X					m,f	0,-									BR			
GC818	X					CES	X	X								Br			
GC819	X					m	0,-									BR			
GC820					X	ES	+	X				28							
GC821						CES	-	-											
GC822						CES	X	X,-	X	X						BR			
GC823						ES	X	0,-		X						BR			
GC824					X	ES	X,+	0,+	X										
GC825	X					CES	X,-	X,0		X									
GC826	X					CES	X,-	0,-								BR			
GC827						CES,ES	X	X,-											
GC828						CES,ES	+	X,0								BR			
GC829	X	X					0							2		BR			
GC830						CES,ES	X	X,-								BR			
GC831	X	X					0,-									BR			
GC832	X					CES	X,-	-								BR			
GC833						ES	+	X						3					
GC834			X		X	CES,ES	X,+	+								BR			
GC835					X	ES	+	0,+								BR			
GC836						CES	X,+	-											
GC837						CES	X,-	-											
GC838						ES	+	X,-				70							
GC839						CES	+	+				20							
GC840							-	0,-								BR			
GC841	X	X				CES	+	+			G					H			
GC842						CES	+					40							
GC843							U	0				30							
GC844						CES	U	X,0				75	4						
GC845	X	X				CES	X	-		X						BR			
GC846	X					CES	+	X,-								H			
GC847	X					CES	X	X,-								BR			
GC848	X						0	0								BR			

SPECIMEN	SIEVE CAT	COL	UV	STATE	BREAK	REG	MORPH	SUB MORPH	RES	DR	ML	XENO	DEFM	OCTA			CUBE	
														TP	HP	HPT	OT	TTP
GC849	.-1	C,Y		C	CS	E,D	CA	O	4					-	X	X		X
GC850	.-1	C,B		B	C,CS	U	U	U	U					-	X	X		
GC851	.-1	C,RB		W		EQ	O		1									
GC852	.-1	C,YB		W		D	O		4,2	X					X			
GC853	.-1	C		B	C	EQ	O		4,3,1	X				-	X	X		
GC854	.-1	C,YB		W		F	M		4		X							
GC855	.-1	C,BY		W		EQ	O		3,2	X				-				
GC856	.-1	C,Y		F	C,CS	F	CA	M	4					-	X	X		
GC857	.-1	Y		F	C,CS	E	O		4					-	X	X		
GC858	.-1	BY		F	C	EQ	O		5					-	X	X		
GC859	.-1	C,Y		F	C,CS	D	O		4					-	X	X		
GC860	.-1	C,Y,B		B	C,CS	F,D	CA	O	5					-	X	X		
GC861	.-1	C,RB	N	F	C,CS	D	O		6					-	X	X		
GC862	.-1	C,RB		B	C,CS	D	CA	O	3,2,1	X				-	X	X		
GC863	.-1	C,RB		W		D	O		1									
GC864	.-1	C,RB		B	C	U	U	U	1					-	X	X		X
GC865	.-1	C,B		B	C,CS	D	CA	O	4					-	X	X		
GC866	.-1	C,RB		B	C,CS	E	O		2,1	X				-	X	X		
GC867	.-1	C		C	C	EQ	O		4					-	X	X		
GC868	.-1	C	W	W		D	O		4,1	X				-	X	X		
GC869	.-1	C		W		F	O		1									
GC870	.-1	C,BY		W		D	O		3,2,1	X								
GC871	.-1	BY		C	CS	D	O		4					-	X	X		
GC872	.-1	C,Y		W		EQ,D	CA	O	1									
GC873	.-1	C,YB		W		EQ	O		5									
GC874	.-1	C,RB		W		D	O		4,3,1	X								
GC875	.-1	C,B		C	C,CS	D	O		4,3,2	X				-	X	X		
GC876	.-1	C,BY		W		D	CA	O	6			SF						
GC877	.-1	C	N	C	C	D	CA	O,M	6		X	SF						
GC878	.-1	C		W		D,F	CA	O,M	6,5	X	X							
GC879	.-1	C,B		C	C	D	CA	O	5									
GC880	.-1	C,Y		W		D	CA	O	3,2	X								
GC881	.-1	C,Y		F	M	F	M		5					-				
GC882	.-1	C		F	C,CS	U	U	U	U					-	X	X		
GC883	.-1	C		F	C	U	U	U	U					-				
GC884	.-1	C	B	B	C	D	CA	O,M	6		X			-				
GC885	.-1	C		W		D	CA	O	4					-	X	X		
GC886	.-1	C,BY		W		D	CA		1									
GC887	.-1	Y		W		EQ	O		1									
GC888	.-1	C,B		W		D	O		4,2,1	X				-				

SPECIMEN	THH			R	PHC	CES/ES	FE	BE	IC	RBS	ST	GRAPH	10 INC		20 INC	
	EH	T	HH										CS	MH		OT
													OR	CL	GR	
GC849						CES	X,+	X							BR	H
GC850	X					CES	X	X,-							BR	H
GC851	X	X					0	0							BR	H
GC852	X					c	0,-								BR	
GC853	X	X				CES	X,0	X							BR	
GC854	X						0	0							BR	
GC855	X	X				m	-								BR	
GC856	X					CES	X,-	0,-							BR	
GC857	X					CES	X	-							BR	
GC858						CES	X,+	X,0		X					BR	
GC859	X					CES	X,-	0,-								
GC860	X					CES	X,-	0,-								
GC861						CES,ES	+ 0,+		X				1		BR	
GC862	X					CES	X	X,-							BR	
GC863	X	X					0								BR	
GC864	X					c,m	-	0,-		X						
GC865	X					CES	X,-	0,-		X						
GC866	X	X				CES	0,-	0,-		X						
GC867	X					CES	X	0							BR	
GC868	X	X	X			c	-								BR	
GC869	X	X					0								BR	
GC870	X	X					0								BR	
GC871	X					ES	-	0							BR	
GC872							0								BR	
GC873							0								BR	H
GC874	X						0									
GC875	X					CES	X,-	0								
GC876							0								BR	
GC877							0	0				1			BR	
GC878							0									
GC879							0								BR	
GC880	X						0								BR	H
GC881						CES	X,+	X							BR	
GC882	X					CES,ES	X	X								
GC883						CES	X,+	X								
GC884						m,f	-	0							BR	
GC885	X					m,f	-								BR	
GC886	X	X					0								BR	
GC887	X	X					0								BR	
GC888	X	X					X									

APPENDIX 2

IR ABSORPTION PROPERTIES OF

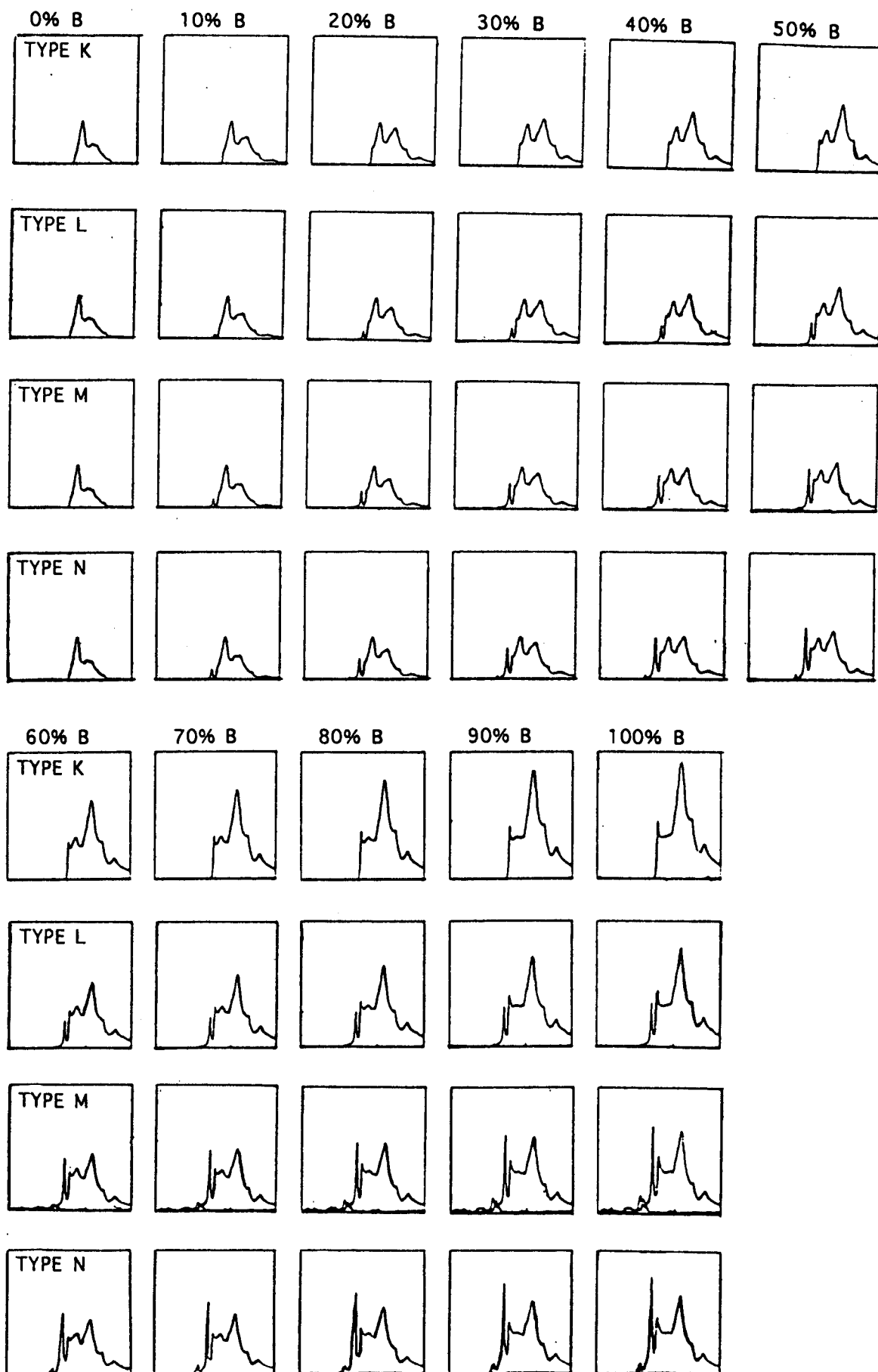
GEORGE CREEK DIAMONDS

Spectra were measured using the Bruker IFS45 FTIR spectrometer with a microscope attachment in the Crystallography and Mineral Physics Unit, Department of Geological Science, University College London. Instrumental resolution of 8 cm^{-1} was achieved over the detection range of $4000 - 650\text{ cm}^{-1}$. Liquid nitrogen was used to cool the detector. Reference spectra were taken without diamond specimens present and were subtracted from diamond spectra to compensate for background levels of CO_2 and water in the atmosphere.

Spectra were stored on floppy disc for quantitative processing of spectra. Print-outs of "thumb-nail" spectra (Milledge and Mendelsohn, 1988) were used for qualitative assessment of nitrogen content and aggregation state, strength of the platelet peak, and determination of the presence or absence of hydrogen and CO_2 . Quantitative determination of nitrogen content and aggregation state required baseline correction of spectra using the system software. Spectra used for quantitative analyses were chosen to have minimal interference from the effects of fringing caused by thick specimens, and lacked significant absorption from silicate mineral inclusions which may obscure the characteristic nitrogen defect absorption peaks. Nitrogen content in A and B defects was determined from equation (1) in section 4.2.

Estimation of the spectral proportions of A and B nitrogen defects was made by comparison of corrected spectra with reference "thumb-nail" spectra of synthetic mixtures of different proportions of A and B defects, and variable platelet peak intensity. The reference "thumb-nail" spectra are presented in Appendix 2.1, and are discussed in Mendelsohn and Milledge (1995; in prep.). A brief summary of this discussion is presented below.

Examination of spectra from large numbers of natural diamonds has indicated that a wide variability exists in natural diamonds in terms of the platelet peak (B') height relative to the height of the 1282 cm^{-1} (A defect) peak (Mendelsohn and Milledge, 1995; in prep.). Spectral Types K, L, M and N were arbitrarily assigned to have ratios of B' peak height versus 1282 cm^{-1} height of ~ 0 , ~ 1 , ~ 2 and ~ 2.4 respectively and thus define a sequence of decreasing degree of platelet peak degradation. For diamonds from some localities this scheme is not adequate to characterize the complex variations in relative platelet peak intensity, and the causes of this variability are not well understood.



Appendix 2.1. Reference "thumb-nail" plots of increasing spectral proportion of B defects for nitrogen aggregation sequences of variable platelet peak intensity. Vertical axis represents arbitrary absorbance units, horizontal axis from left to right represents the IR range from 1750 - 900 cm⁻¹. (Modified from Mendelsohn and Milledge, in prep.)

SPECIMEN	SPECTRUM	COL	MORPH	INCLUSIONS	1992 H	PATHLENGTH μm	PL POS cm-1	Norm PL height	Norm PL area	height @ 1282	Norm 3107 area
GC036	4	c	AGGREG	gar-rut-br	0.990	805	1363	0.041	0.684	0.113	0.578
GC036	8	c	AGGREG	gar-rut-br	1.002	815	1360	0.070	0.863	0.295	2.444
GC036	13	c	AGGREG	gar-rut-br	1.003	815	1362	0.088	0.752	0.426	2.458
GC036	15	c	AGGREG	gar-rut-br	1.001	814	1363	0.086	1.014	0.392	1.557
GC036	19	c	AGGREG	gar-rut-br	1.008	820	1363	0.103	1.565	0.270	0.900
GC030	1	y	AGGREG	cpx-gar-br	0.809	658	1362	0.208	2.554	0.133	1.520
GC030	16	y	AGGREG	cpx-gar-br	0.733	596	1362	0.271	3.582	0.165	1.053
GC042	2	c	MACLE	cpx	0.788	641	1360	0.298	3.211	0.215	0.101
GC042	7	c	MACLE	cpx	0.825	671	1360	0.133	1.429	0.144	0.144
GC042	9	c	MACLE	cpx	0.824	670	1360	0.250	2.570	0.219	0.222
GC042	10	c	MACLE	cpx	0.828	673	1360	0.320	3.249	0.258	0.141
GC042	16	c	MACLE	cpx	0.812	660	1360	0.123	1.255	0.104	0.092
GC042	17	c	MACLE	cpx	0.805	654	1362	0.220	2.513	0.125	0.143
GC042	20	c	MACLE	cpx	0.840	683	1360	0.010	0.232	0.057	0.064
GC042	24	c	MACLE	cpx	0.840	683	1360	0.133	1.487	0.155	0.056
GC037	1	c	MACLE	cpx	0.884	719	1362	0.662	8.143	0.363	0.165
GC037	3	c	MACLE	cpx	0.882	717	1363	1.076	13.798	0.561	0.253
GC037	6	c	MACLE	cpx	0.888	722	1364	1.306	16.719	0.684	0.166
GC037	10	c	MACLE	cpx	0.890	724	1362	0.675	7.869	0.373	0.329
GC037	13	c	MACLE	cpx	0.890	723	1362	1.026	12.008	0.552	0.188
GC037	15	c	MACLE	cpx	0.884	718	1364	1.330	17.018	0.703	0.274
GC037	19	c	MACLE	cpx	0.895	727	1361	0.443	5.059	0.289	0.400
GC037	20	c	MACLE	cpx	0.881	716	1362	0.852	10.204	0.432	0.267
GC005	1	c	UNCERT	cpx-br	0.254	206	1364	2.571	36.107	0.339	0.281
GC005	2	c	UNCERT	cpx-br	0.257	209	1366	3.999	53.933	0.505	1.108
GC005	3	c	UNCERT	cpx-br	0.258	210	1364	1.960	25.612	0.242	0.370
GC005	4	c	UNCERT	cpx-br	0.256	208	1362	0.773	9.474	0.120	0.158
GC005	5	c	UNCERT	cpx-br	0.261	212	1362	0.442	5.366	0.083	0.183
GC005	9	c	UNCERT	cpx-br	0.262	213	1362	1.083	12.856	0.161	0.000
GC005	11	c	UNCERT	cpx-br	0.260	211	1366	3.007	38.235	0.348	0.165
GC005	19	c	UNCERT	cpx-br	0.256	208	1360	0.220	2.293	0.054	0.000
GC005	20	c	UNCERT	cpx-br	0.250	203	1360	0.349	3.813	0.070	0.296
GC005	21	c	UNCERT	cpx-br	0.914	743	1366	1.825	27.457	1.350	0.249
GC005	22	c	UNCERT	cpx-br	1.296	1054	1364	1.094	15.217	1.188	0.182
GC006	1	c	OCTA	gar-br	1.149	934	1366	0.855	10.677	0.643	0.252
GC006	6	c	OCTA	gar-br	0.674	548	1362	0.172	2.137	0.127	0.329
GC006	7	c	OCTA	gar-br	0.976	794	1364	1.100	14.370	0.720	0.368
GC028	3	c	UNCERT	cpx	0.691	562	1360	0.094	0.991	0.125	0.000
GC028	6	c	UNCERT	cpx	0.718	584		0.000	0.000	0.079	0.038
GC028	8	c	UNCERT	cpx	0.694	565	1360	0.060	0.604	0.143	0.049
GC028	12	c	UNCERT	cpx	0.715	582		0.000	0.000	0.067	0.000
GC028	13	c	UNCERT	cpx	0.714	580	1360	0.087	0.859	0.148	0.029
GC101	3	c	CUB-OCT	cpx-br	0.552	448	1364	0.466	5.960	0.296	0.446
GC101	4	c	CUB-OCT	cpx-br	0.562	457	1364	0.188	2.335	0.275	0.869
GC101	7	c	CUB-OCT	cpx-br	0.556	452	1364	0.143	1.801	0.290	0.463
GC101	12	c	CUB-OCT	cpx-br	0.501	407	1364	0.115	1.440	0.235	0.747
GC101	13	c	CUB-OCT	cpx-br	0.327	265	1364	1.176	14.558	0.226	1.895
GC101	14	c	CUB-OCT	cpx-br	0.484	394	1364	0.897	10.877	0.298	0.364

Appendix 2.2. IR absorption properties of polished diamond plates.

SPECIMEN	Norm 1430 area	Norm 1405 area	μ 1282	μ A	μ A/ μ T	χ (B) %	Ntot ppm	N(B) ppm	N(A) ppm	%N(B)/ Ntot	T(MR) °C	CO2 peak height	CO2 pos cm-1
GC036	0.000	0.074	0.140	0.073	0.52	0.48	55	44	11	80	1246	absent	-
GC036	0.000	0.420	0.362	0.166	0.46	0.54	153	128	25	84	1224	absent	-
GC036	0.000	0.589	0.523	0.220	0.42	0.58	231	198	33	86	1217	absent	-
GC036	0.000	0.322	0.482	0.227	0.47	0.53	201	167	34	83	1215	absent	-
GC036	0.000	0.169	0.330	0.178	0.54	0.46	126	99	27	79	1220	absent	-
GC030	0.000	0.287	0.202	0.089	0.44	0.56	88	74	14	85	1242	absent	-
GC030	0.000	0.178	0.277	0.155	0.56	0.44	104	80	24	77	1224	weak	2376
GC042	0.000	0.000	0.336	0.192	0.57	0.43	124	95	29	76	1218	absent	-
GC042	0.000	0.000	0.214	0.141	0.66	0.34	70	48	22	69	1223	absent	-
GC042	0.000	0.000	0.327	0.196	0.60	0.40	116	86	30	74	1216	absent	-
GC042	0.000	0.000	0.383	0.207	0.54	0.46	147	115	32	79	1216	absent	-
GC042	0.000	0.000	0.157	0.105	0.67	0.33	50	34	16	68	1231	absent	-
GC042	0.000	0.000	0.190	0.093	0.49	0.51	78	64	14	82	1239	absent	-
GC042	0.000	0.000	0.084	0.065	0.77	0.23	23	13	10	56	1239	absent	-
GC042	0.000	0.000	0.228	0.146	0.64	0.36	76	54	22	71	1223	absent	-
GC037	0.188	0.000	0.506	0.202	0.40	0.60	229	198	31	87	1219	absent	-
GC037	0.449	0.023	0.783	0.211	0.27	0.73	406	374	32	92	1220	absent	-
GC037	0.591	0.130	0.947	0.208	0.22	0.78	515	483	32	94	1221	absent	-
GC037	0.149	0.032	0.515	0.206	0.40	0.60	233	202	31	87	1219	absent	-
GC037	0.256	0.000	0.763	0.221	0.29	0.71	388	354	34	91	1218	absent	-
GC037	0.580	0.026	0.979	0.206	0.21	0.79	537	506	31	94	1221	absent	-
GC037	0.054	0.072	0.398	0.183	0.46	0.54	169	141	28	84	1221	absent	-
GC037	0.231	0.034	0.604	0.199	0.33	0.67	295	265	30	90	1221	absent	-
GC005	0.462	0.027	1.641	0.246	0.15	0.85	949	912	37	96	1217	absent	-
GC005	0.981	0.299	2.414	0.121	0.05	0.95	1518	1500	18	99	1237	absent	-
GC005	0.257	0.045	1.150	0.230	0.20	0.80	637	602	35	95	1218	absent	-
GC005	0.042	0.000	0.576	0.225	0.39	0.61	264	230	34	87	1217	absent	-
GC005	0.000	0.000	0.389	0.187	0.48	0.52	160	132	28	82	1220	absent	-
GC005	0.053	0.000	0.756	0.234	0.31	0.69	377	341	36	91	1217	absent	-
GC005	0.423	0.039	1.648	0.231	0.14	0.86	962	927	35	96	1219	absent	-
GC005	0.000	0.000	0.259	0.155	0.60	0.40	92	68	24	74	1222	absent	-
GC005	0.008	0.000	0.344	0.179	0.52	0.48	135	108	27	80	1221	absent	-
GC005	1.775	0.040	1.816	0.127	0.07	0.93	1124	1105	19	98	1236	absent	-
GC005	0.938	0.018	1.128	0.248	0.22	0.78	613	575	38	94	1216	absent	-
GC006	0.389	0.000	0.689	0.193	0.28	0.72	354	325	29	92	1222	absent	-
GC006	0.000	0.000	0.231	0.143	0.62	0.38	80	58	22	73	1224	absent	-
GC006	0.518	0.062	0.907	0.227	0.25	0.75	480	445	35	93	1218	absent	-
GC028	0.000	0.000	0.222	0.160	0.72	0.28	65	41	24	63	1217	absent	-
GC028	0.000	0.000	0.135	0.114	0.85	0.15	30	13	17	43	1216	absent	-
GC028	0.000	0.000	0.253	0.195	0.77	0.23	68	38	30	56	1209	absent	-
GC028	0.000	0.000	0.115	0.097	0.84	0.16	27	12	15	45	1222	absent	-
GC028	0.000	0.000	0.254	0.181	0.71	0.29	76	48	28	64	1214	absent	-
GC101	0.126	0.034	0.660	0.310	0.47	0.53	276	229	47	83	1207	absent	-
GC101	0.000	0.113	0.602	0.301	0.50	0.50	2243	197	46	81	1207	absent	-
GC101	0.000	0.000	0.641	0.314	0.49	0.51	262	214	48	82	1206	absent	-
GC101	0.000	0.129	0.577	0.306	0.53	0.47	224	177	47	79	1206	absent	-
GC101	0.115	0.426	0.853	0.290	0.34	0.66	412	368	44	89	1210	absent	-
GC101	0.165	0.062	0.756	0.333	0.44	0.56	328	277	51	85	1205	absent	-

Appendix 2.2. IR absorption properties of polished diamond plates.

SPECIMEN	SPECTRUM	COL	MORPH	INCLUSIONS	1992 H	PATHLENGTH	PL POS	Norm PL	Norm PL	height	Norm 3107
						μm	cm-1	height	area	@ 1282	area
GC001	B	C	OCTA	gar-cpx-br	1.5640	1272	1360	0.199	2.242	0.377	0.153
GC001	A	C	OCTA	gar-cpx-br	0.8860	720	1360	0.013	0.057	0.083	0.000
GC001	C	C	OCTA	gar-cpx-br	1.5646	1272	1362	0.557	6.439	0.701	0.285
GC002	A	C	AGGREG	gar-cpx-br	1.4211	1155	1364	0.813	11.180	0.997	0.276
GC002	B	C	AGGREG	gar-cpx-br	1.6022	1303	1364	0.713	9.849	1.006	0.374
GC003	A	C	AGGREG	br	2.3960	1948	1364	0.393	5.369	0.712	0.175
GC004	A	C	AGGREG	gar-cpx-br	0.6116	497	1362	0.014	0.107	0.049	0.128
GC004	B	C	AGGREG	gar-cpx-br	0.7701	626	1360	0.005	0.001	0.082	0.386
GC007	A	C	MACLE	gar-cpx-br	1.2057	980	1360	0.021	0.165	0.092	0.043
GC007	B	C	MACLE	gar-cpx-br	1.3240	1076	1360	0.022	0.213	0.104	0.051
GC009	A	C	AGGREG	gar-cpx-br	1.3447	1093	1364	0.819	10.632	0.777	0.322
GC011	A	OW	UNCERT	br	1.5287	1243		0.000	0.008	0.131	0.258
GC012	A	C	AGGREG	gar-cpx-br	1.2643	1028	1362	0.383	4.352	0.413	0.104
GC013	A	C	UNCERT	cpx-br	1.3934	1133	1360	0.083	0.800	0.268	0.000
GC013	B	C	UNCERT	cpx-br	1.3701	1114	1360	0.160	1.661	0.321	0.000
GC014	B	C	UNCERT	gar-cpx-br	1.1224	913	1362	0.560	6.419	0.449	0.145
GC014	A	C	UNCERT	gar-cpx-br	1.0822	880	1362	0.768	9.665	0.533	0.339
GC015	B	C	UNCERT	cpx-br	1.2216	993	1360	0.016	0.144	0.152	0.070
GC015	A	C	UNCERT	cpx-br	0.8466	688	1360	0.010	0.099	0.081	0.000
GC027	B	C	UNCERT	cpx-br	1.2291	999	1361	0.309	3.344	0.286	0.257
GC027	A	C	UNCERT	cpx-br	1.3099	1065	1360	0.145	1.481	0.252	0.059
GC039	A	C	MACLE	cpx-br	0.4839	393	1360	0.117	1.088	0.100	0.033
GC040	A	C	AGGREG	gar-br	1.2663	1030	1368	1.174	15.747	1.143	2.593
GC043	A	C	UNCERT	gar-br	0.6698	545	1360	0.032	0.243	0.053	0.515
GC044	B	C	AGGREG	cpx-br	0.8837	719	1369	0.812	11.173	0.452	1.994
GC044	A	C	AGGREG	cpx-br	0.8704	708	1368	0.310	4.602	0.256	0.535
GC048	B	C	AGGREG	gar-cpx-br	1.3206	1074	1366	1.136	15.439	1.009	1.248
GC053	A	C	UNCERT	gar-br	0.9717	790	1360	0.006	0.013	0.102	0.026
GC054	A	C	AGGREG	cpx-br	1.1583	942	1358	0.015	0.066	0.095	0.134
GC056	A	OW	UNCERT	gar-cpx-br	1.2714	1034	1360	0.022	0.137	0.168	0.160
GC056	B	OW	UNCERT	gar-cpx-br	1.4261	1159	1362	0.551	6.298	0.715	0.215
GC057	A	OW	UNCERT	cpx-opx-phlog	0.8799	715	1362	0.517	5.896	0.391	0.295
GC058	A	C	AGGREG		1.8830	1531	1362	0.638	7.689	1.084	0.191
GC059	B	OW	AGGREG	cpx-br	0.5088	414	1362	0.051	0.616	0.108	0.000
GC068	A	OW	AGGREG	br	1.1990	975	1360	0.052	0.556	0.384	0.410
GC070	B	C	AGGREG	cpx-br	0.8757	712	1362	0.006	0.020	0.100	0.476
GC075	A	OW	UNCERT	cpx-br	0.8346	679	1364	1.424	18.684	0.839	1.007
GC081	A	C	AGGREG	cpx-br	1.1783	958	1360	0.263	2.688	0.444	0.125
GC116	B	C	AGGREG	br	0.5674	461	1362	1.005	11.104	0.349	0.746

Appendix 2.3. IR absorption properties of large diamonds.

SPECIMEN	Norm 1430 area	Norm 1405 area	μ 1282	μ A	μ A/ μ T	x(B) %	Ntot ppm	N(B) ppm	N(A) ppm	%N(B)/ Ntot	T(MR) °C	CO2 peak height
GC001	0.000	0.000	0.296	0.178	0.60	0.40	105	78	27	74	1219	-
GC001	0.000	0.000	0.116	0.110	0.95	0.05	21	4	17	19	1194	-
GC001	0.157	0.032	0.551	0.221	0.40	0.60	250	216	34	87	1217	-
GC002	0.615	0.000	0.863	0.371	0.43	0.57	378	322	56	85	1203	-
GC002	0.569	0.035	0.772	0.340	0.44	0.56	335	283	52	85	1205	-
GC003	0.299	0.023	0.365	0.150	0.41	0.59	164	141	23	86	1228	-
GC004	0.000	0.000	0.099	0.096	0.97	0.03	17	2	15	12	1186	-
GC004	0.000	0.000	0.130	0.124	0.95	0.05	23	4	19	19	1191	-
GC007	0.000	0.000	0.094	0.083	0.89	0.11	20	7	13	35	1216	-
GC007	0.000	0.000	0.097	0.080	0.82	0.18	23	11	12	49	1229	-
GC009	0.499	0.027	0.711	0.220	0.31	0.69	355	321	34	91	1218	-
GC011	0.000	0.055	0.105	0.082	0.78	0.22	28	15	13	55	1232	-
GC012	0.000	0.000	0.401	0.189	0.47	0.53	168	139	29	83	1220	-
GC013	0.000	0.000	0.237	0.159	0.67	0.33	75	51	24	68	1219	-
GC013	0.000	0.000	0.288	0.187	0.65	0.35	94	66	28	70	1216	-
GC014	0.118	0.000	0.492	0.207	0.42	0.58	218	187	31	86	1219	-
GC014	0.325	0.005	0.606	0.182	0.30	0.70	306	278	28	91	1224	-
GC015	0.000	0.000	0.153	0.141	0.92	0.08	29	8	21	27	1198	-
GC015	0.000	0.000	0.118	0.116	0.98	0.02	20	2	18	8	1171	-
GC027	0.000	0.000	0.287	0.129	0.45	0.55	123	103	20	84	1231	-
GC027	0.000	0.000	0.237	0.166	0.70	0.30	71	46	25	65	1217	-
GC039	0.000	0.000	0.255	0.181	0.71	0.29	76	48	28	64	1214	-
GC040	2.216	0.613	1.100	0.222	0.20	0.80	615	581	34	95	1219	-
GC043	0.000	0.078	0.097	0.075	0.78	0.22	26	14	12	55	1234	-
GC044	1.701	0.461	0.629	0.082	0.13	0.87	370	258	12	97	1248	-
GC044	0.484	0.112	0.362	0.141	0.39	0.61	166	144	22	87	1230	-
GC048	1.260	0.275	0.940	0.188	0.20	0.80	521	492	29	95	1224	-
GC053	0.000	0.000	0.129	0.123	0.95	0.05	23	4	19	19	1191	-
GC054	0.000	0.000	0.101	0.098	0.97	0.03	17	2	15	12	1185	-
GC056	0.000	0.000	0.163	0.146	0.90	0.10	33	11	22	32	1201	-
GC056	0.136	0.000	0.616	0.277	0.45	0.55	264	222	42	84	1210	-
GC057	0.000	0.000	0.547	0.274	0.50	0.50	221	179	42	81	1209	-
GC058	0.209	0.000	0.708	0.304	0.43	0.57	310	264	46	85	1208	-
GC059	0.000	0.000	0.262	0.241	0.92	0.08	51	14	37	27	1184	-
GC068	0.022	0.129	0.394	0.303	0.77	0.23	105	59	46	56	1197	-
GC070	0.000	0.000	0.141	0.127	0.90	0.10	28	9	19	32	1205	-
GC075	0.915	0.136	1.237	0.346	0.28	0.72	636	583	53	92	1206	-
GC081	0.000	0.000	0.464	0.334	0.72	0.28	136	85	51	63	1197	-
GC116	0.455	0.175	0.757	0.242	0.32	0.68	374	337	37	90	1216	-

Appendix 2.3. IR absorption properties of large diamonds.

SPECIMEN	SPECTRUM	COL	MORPH	INCLUSIONS	PATHLENGTH	PL POS	Norm PL	Norm PL	height	Norm 3107
							μm	cm-1	height	area
GC146	B	C	AGGREG	0.7470	607	1364	0.102	1.388	0.773	0.319
GC233	A	C	AGGREG	0.6589	536	1364	0.730	9.769	0.335	1.051
GC233	B	C	AGGREG	0.6400	520	1362	0.461	5.873	0.230	0.618
GC233	C	C	AGGREG	0.7251	590	1365	1.114	15.498	0.530	1.161
GC233	D	C	AGGREG	0.7421	603	1363	0.798	10.386	0.404	0.817
GC239	A	C	AGGREG	0.6359	517	1367	0.072	1.184	0.169	0.988
GC123	A	C	UNCERT	0.6243	508	1363	0.546	7.134	0.196	0.973
GC123	B	C	UNCERT	0.6754	549	1364	1.043	13.888	0.397	0.862
GC124	A	C	AGGREG	0.6553	583	1358	0.009	0.086	0.090	0.000
GC278	A	C,Y	AGGREG	0.6204	504	1364	0.048	0.505	0.045	1.038
GC152	A	C	AGGREG	0.4999	406		0.000	0.000	0.050	0.505
GC377	B	C,B	OCTA	0.3849	313	1366	1.805	23.669	0.337	5.612
GC415	A	C	AGGREG	0.6167	501	1365	0.087	1.153	0.103	0.592
GC415	C	C	AGGREG	0.3699	301	1364	0.166	2.467	0.059	0.653
GC443	C	C	AGGREG	0.3583	291	1361	0.137	1.517	0.066	0.475
GC443	F	C	AGGREG	0.3320	270	1362	0.272	3.052	0.069	0.924
GC443	I	C	AGGREG	0.3745	305	1366	0.606	8.058	0.122	0.722
GC443	A	C	AGGREG	0.3688	300	1362	0.124	1.720	0.056	0.344
GC249	A	C	AGGREG	0.4970	404	1364	1.975	25.042	0.545	0.695
GC361	B	C	UNCERT	0.2125	173	1360	0.047	0.283	0.030	0.156
GC373	A	C	AGGREG	0.5412	440	1372	2.200	24.747	0.803	6.936
GC266	B	C,B	UNCERT	0.3876	315	1364	1.730	22.476	0.413	1.140
GC166	A	C,Y	OCTA	0.6545	532	1358	0.000	0.586	0.160	1.194
GC166	B	C,Y	OCTA	0.8354	679	1360	0.000	0.053	0.234	2.766
GC166	C	C,Y	OCTA	0.8289	674	1358	0.045	0.504	0.219	2.788
GC200	A	C,Y	AGGREG	0.7228	588	1362	0.059	0.461	0.137	0.658
GC200	B	C,Y	AGGREG	0.7975	648	1364	0.161	2.301	0.208	2.655
GC330	A	C,YB	OCTA	0.6096	496	1365	1.913	26.735	0.846	0.370
GC381	A	C,RB	OCTA	0.6287	511	1362	0.873	10.402	0.320	0.882
GC381	E	C,RB	OCTA	0.5837	475	1363	0.942	11.477	0.331	0.851
GC369	D	C,B	OCTA	0.6279	511	1362	0.077	0.828	0.057	0.742

Appendix 2.4. IR absorption properties of medium diamonds.

SPECIMEN	Norm 1430 area	Norm 1405 area	μ 1282	μ A	μ A/ μ T	χ (B) %	Ntot ppm	N(B) ppm	N(A) ppm	%N(B)/ Ntot	T(MR) °C	CO2 peak height	CO2 pos cm-1
GC146	0.058	0.023	1.273	0.662	0.52	0.48	400	101	501	80 ²⁵	1185	ABSENT	-
GC233	0.416	0.090	0.624	0.250	0.40	0.60	245	38	283	87 ¹⁶	1214	ABSENT	-
GC233	0.204	0.049	0.442	0.199	0.45	0.55	159	30	189	84	1219	ABSENT	-
GC233	1.100	0.129	0.899	0.252	0.28	0.72	423	38	461	92	1215	ABSENT	-
GC233	0.505	0.077	0.670	0.255	0.38	0.62	272	39	311	88	1213	ABSENT	-
GC239	0.126	0.096	0.326	0.202	0.62	0.38	81	31	112	73	1215	ABSENT	-
GC123	0.276	0.139	0.387	0.124	0.32	0.68	191	172	19	90	1234	ABSENT	-
GC123	0.830	0.149	0.722	0.144	0.20	0.80	400	378	22	95	1231	ABSENT	-
GC124	0.000	0.000	0.169	0.146	0.86	0.14	38	16	22	41	1208	ABSENT	-
GC278	0.000	0.000	0.089	0.068	0.76	0.24	14	10	24	58	1239	ABSENT	-
GC152	0.000	0.000	0.122	0.117	0.96	0.04	3	18	21	15	1187	ABSENT	-
GC377	1.727	0.381	1.077	0.205	0.19	0.81	571	31	602	95	1222	ABSENT	-
GC415	0.039	0.061	0.205	0.154	0.75	0.25	34	23	57	59	1216	ABSENT	-
GC415	0.113	0.053	0.196	0.102	0.52	0.48	61	16	77	80	1236	ABSENT	-
GC443	0.010	0.003	0.226	0.131	0.58	0.42	62	20	82	76	1228	ABSENT	-
GC443	0.000	0.052	0.255	0.133	0.52	0.48	80	20	100	80	1229	ABSENT	-
GC443	0.564	0.055	0.401	0.120	0.30	0.70	183	18	201	91	1235	ABSENT	-
GC443	0.000	0.006	0.186	0.104	0.56	0.44	54	16	70	77	1235	ABSENT	-
GC249	1.224	0.000	1.349	0.270	0.20	0.80	706	41	747	95	1214	ABSENT	-
GC361	0.000	0.000	0.173	0.126	0.73	0.27	31	19	50	61	1223	ABSENT	-
GC373	4.493	0.765	1.825	0.255	0.14	0.86	1027	39	1066	96	1216	PRESENT	?
GC266	0.900	0.048	1.310	0.485	0.37	0.63	540	74	614	88	1196	PRESENT	?
GC166	0.000	0.596	0.300	0.126	0.42	0.58	133	114	19	86	1232	PRESENT	2385
GC166	0.000	0.703	0.344	0.093	0.27	0.73	178	164	14	92	1243	PRESENT	?
GC166	0.000	0.709	0.325	0.114	0.35	0.65	155	138	17	89	1236	PRESENT	?
GC200	0.000	0.070	0.233	0.173	0.74	0.26	66	40	26	60	1214	PRESENT	2367
GC200	0.102	0.622	0.320	0.134	0.42	0.58	142	122	20	86	1230	PRESENT	?
GC330	1.740	0.000	1.707	0.495	0.29	0.71	793	75	868	91	1197	PRESENT	?
GC381	0.326	0.085	0.625	0.213	0.34	0.66	270	32	302	89	1219	PRESENT	?
GC381	0.460	0.080	0.698	0.258	0.37	0.63	288	39	327	88	1213	PRESENT	?
GC369	0.030	0.015	0.111	0.077	0.69	0.31	23	12	35	66	1239	PRESENT	?

Appendix 2.4. IR absorption properties of medium diamonds.

SPECIMEN	SPECTRUM	COL	MORPH	PATHLENGTH	PL pos	Norm PI	Norm PI	height	Norm 3107
				μm	cm-1	height	area	@ 1282	area
GC769	A	C	OCTA	361	1367	0.996	9.537	0.478	8.469
GC836	A	C	OCTA	236	1369	4.039	50.306	0.676	2.874
GC833	A	C	AGGREG	254	1366	1.159	15.163	0.254	3.698
GC839	A	C	AGGREG	219	1362	0.350	3.725	0.065	1.142
GC843	A	C	UNCERT	186	1360	0.037	0.394	0.046	0.053
GC885	D	C	AGGREG	236	1371	0.503	6.019	0.112	2.347
GC885	B	C	AGGREG	264	1372	1.263	15.825	0.264	6.443
GC846	B	C	OCTA	253	1363	0.457	5.498	0.072	2.495
GC850	A	C,B	UNCERT	288	1367	0.184	2.728	0.056	1.191
GC853	A	C	OCTA	323	1362	0.337	4.113	0.123	1.686
GC754	D	C	UNCERT	258	1366	0.921	11.959	0.181	3.834
GC868	A	C	OCTA	333	1360	0.043	0.525	0.040	0.675
GC785	A	C	OCTA	305	1361	0.099	1.207	0.104	0.465
GC774	A	C	OCTA	275	1358	0.018	0.328	0.043	0.530
GC877	E	C	AGGREG	246	1368	0.651	8.866	0.101	2.600
GC878	A	C	AGGREG	319	1362	0.440	5.878	0.155	1.520
GC762	B	C	AGGREG	298	1364	2.095	27.127	0.507	0.506
GC797	D	C	UNCERT	281	1368	0.400	5.091	0.092	1.945
GC802	A	C,Y	AGGREG	284	1371	4.329	52.749	0.970	10.614
GC884	C	C	AGGREG	270	1367	1.933	25.905	0.350	3.400
GC827	C	C	UNCERT	306	1366	0.101	1.170	0.086	1.006
GC827	B	C	UNCERT	246	1367	1.351	17.132	0.210	2.497
GC886	E	C,B,Y	AGGREG	314		0.000	0.000	0.018	0.354
GC849	D	C,Y	AGGREG	241		0.000	0.000	0.084	4.955
GC852	A	C,YB	OCTA	303		0.000	0.145	0.036	0.688
GC854	A	C,YB	MACLE	302	1365	1.245	16.271	0.232	1.922
GC856	A	C,Y	AGGREG	308	1366	0.146	1.714	0.083	2.648
GC830	B	C,Y	UNCERT	229	1362	0.084	0.695	0.054	0.224
GC867	B	C	OCTA	242		0.000	0.000	0.154	6.536
GC600	B	C,YB	OCTA	440	1364	0.109	1.547	0.089	2.349
GC870	A	C,B,Y	OCTA	322	1364	0.154	1.990	0.045	1.874
GC872	B	C,Y	AGGREG	265	1366	0.180	1.796	0.162	5.002
GC773	A	C,RB	OCTA	306	1366	1.954	25.937	0.344	6.802
GC876	B	C,B,Y	OCTA	287	1367	1.169	15.239	0.189	4.508
GC782	C	C,Y	AGGREG	339	1367	1.338	17.870	0.348	8.399
GC881	B	C,Y	MACLE	242	1362	0.070	0.724	0.081	4.619

Appendix 2.5. IR absorption properties of small diamonds.

SPECIMEN	N 1430 area	N orm 1405 area	μ 1282	μ A	μ A/ μ T	x(B) %	Ntot ppm	N(B) ppm	N(A) ppm	%N(B) Ntot	T(MR) °C	CO2 peak height	CO2 pos
GC769	1.213	2.212	1.323	0.331	0.25	0.75	699	649	50	93	1208	ABSENT	
GC836	5.537	0.550	2.866	0.717	0.25	0.75	1515	1406	109	93	1187	ABSENT	
GC833	1.462	0.699	1.002	0.280	0.28	0.72	515	472	43	92	1212	ABSENT	
GC839	0.026	0.262	0.298	0.134	0.45	0.55	127	107	20	84	1230	ABSENT	
GC843	0.000	0.000	0.246	0.239	0.97	0.03	41	5	36	12	1162	ABSENT	
GC885	0.921	0.511	0.475	0.114	0.24	0.76	253	236	17	93	1237	ABSENT	
GC885	2.963	1.340	0.998	0.130	0.13	0.87	588	568	20	97	1235	ABSENT	
GC846	0.110	0.533	0.285	0.085	0.30	0.70	1434	130	13	91	1245	ABSENT	
GC850	0.173	0.237	0.194	0.058	0.30	0.70	98	89	9	91	1256	ABSENT	
GC853	0.097	0.289	0.381	0.191	0.50	0.50	154	125	29	81	1219	ABSENT	
GC754	0.937	0.774	0.700	0.154	0.22	0.78	380	357	23	94	1229	ABSENT	
GC868	0.000	0.178	0.121	0.085	0.70	0.30	37	24	13	65	1236	ABSENT	
GC795	0.000	0.100	0.340	0.265	0.78	0.22	89	49	40	55	1200	ABSENT	
GC774	0.000	0.000	0.157	0.148	0.94	0.06	29	6	23	22	1190	ABSENT	
GC877	1.061	0.567	0.412	0.033	0.08	0.92	253	248	5	98	1275	ABSENT	
GC878	0.098	0.294	0.486	0.224	0.46	0.54	206	172	34	84	1216	ABSENT	
GC762	1.042	0.000	1.701	0.680	0.40	0.60	770	667	103	87	1187	ABSENT	
GC797	0.448	0.378	0.327	0.124	0.38	0.62	152	133	19	88	1233	ABSENT	
GC819	9.507	2.757	3.417	0.239	0.07	0.93	2114	2078	36	98	1218	ABSENT	
GC884	2.546	0.688	1.297	0.259	0.20	0.80	718	679	39	95	1215	ABSENT	
GC827	0.000	0.208	0.281	0.152	0.54	0.46	108	85	23	79	1224	ABSENT	
GC827	1.470	0.518	0.853	0.171	0.20	0.80	472	446	26	95	1228	ABSENT	
GC886	0.000	0.053	0.057	0.050	0.88	0.12	13	5	8	37	1235	PRESENT	
GC849	0.000	1.092	0.348	0.083	0.24	0.76	186	173	13	93	1246	PRESENT	2394
GC852	0.000	0.181	0.120	0.097	0.81	0.19	30	15	15	50	1225	PRESENT	
GC854	0.954	0.324	0.768	0.169	0.22	0.78	418	392	26	94	1227	PRESENT	
GC856	0.000	0.584	0.271	0.108	0.40	0.60	123	106	17	87	1237	PRESENT	
GC830	0.000	0.000	0.236	0.225	0.95	0.05	42	8	34	19	1175	PRESENT	
GC867	0.000	1.571	0.637	0.127	0.20	0.80	352	333	19	95	1235	PRESENT	2400
GC660	0.011	0.509	0.203	0.032	0.16	0.84	116	111	5	96	1274	PRESENT	2378
GC870	0.000	0.389	0.140	0.038	0.27	0.73	73	67	6	92	1269	PRESENT	
GC872	0.000	1.117	0.612	0.184	0.30	0.70	308	280	28	91	1223	PRESENT	
GC773	2.108	1.449	1.126	0.191	0.17	0.83	640	611	29	96	1224	PRESENT	2370
GC876	1.117	0.900	0.660	0.119	0.18	0.82	372	354	18	95	1237	PRESENT	2367
GC782	1.815	1.986	1.027	0.133	0.13	0.87	604	584	20	97	1234	PRESENT	
GC881	0.000	1.022	0.334	0.064	0.19	0.81	187	177	10	95	1255	PRESENT	

Appendix 2.5. IR absorption properties of small diamonds.

SPECIMEN	SPECTRUM	V3 + V1	V3 + V1	V3a	V3a	V3b	V3b	V3c	V3c	V2	V2
		position (cm-1)	height (abs. units)	position (cm-1)	height (abs. units)	position (cm-1)	height (abs. units)	position (cm-1)	height (abs. units)	position (cm-1)	height (abs. units)
GC381	381A	3757	0.01					2351	0.02	663	0.02
GC381	381B	3760	0.01	2408	0.28	2382	0.28	2353	0.14	660	0.12
GC381	381C	3755	0.01	2416	0.12	2385	0.18	2352	0.04	661	0.08
GC381	381D	3759	<0.01	2419	0.23	2376	0.64	2356	0.21	660	0.20
GC381	381E	3761	<0.01					2353	0.02	664	0.02
GC726	SS37H	3755	0.01			2386	0.48	2336	0.28	653	0.17
GC756	SS40B	3755	0.01			2372	0.37	2349	0.32	653	0.17
GC756	SS40C	3750	0.02	2425	0.13	2374	0.37			660	0.12
GC756	SS40E	3757	0.02			2383	0.55	2343	0.10	658	0.19
GC784	SS47B			2408	0.40	2374	0.50	2354	0.36	660	0.20
GC784	SS47C	3738	0.02	2407	0.46	2374	0.91	2351	0.44	659	0.36
GC784	SS47F	3751	0.01	2406	0.21	2376	0.32	2353	0.25	660	0.20
GC790	SS44A	3758	0.01	2418	0.10			2361	0.35	656	0.09
GC790	SS44B			2422	0.24	2382	0.37	2359	0.35	656	0.19
GC801	SS41A					2384	0.16	2358	0.19	658	0.08
GC801	SS41B	3761	0.01			2383	0.61	2359	0.51	657	0.23
GC856	SS22B	3738	0.04			2378	0.86			661	0.43
GC859	SS38C	3749	0.01			2386	0.20	2338	0.13	658	0.10

Appendix 2.6. Nature of CO₂ absorption peaks in IR spectra from selected George Creek diamonds.

APPENDIX 3

ELECTRON MICROPROBE ANALYSES OF MINERAL INCLUSIONS RECOVERED FROM GEORGE CREEK DIAMONDS

Diamond inclusions were analysed using the Cameca/Camebax Microbeam electron microprobe which is in routine use in the Department of Geological Sciences, University of Cape Town. Counting times of 10 seconds were used, except for Na in garnet and K in clinopyroxene. In these instances 30 and 60 second counting times were used respectively to improve the detection limit and increase precision. A beam current of approximately 40 nA and an accelerating voltage of 15 kV was used. The electron beam size was focussed to a diameter of 5 - 10 μm .

Well-calibrated natural and synthetic minerals (such as Kakanui pyrope and hornblende, synthetic rutile, and chromite 52N111) were used as standards. Reduction of data for silicates was performed on-line using the method of Bence and Albee (1968), whereas data for sulphides was modified using the ZAF correction factors as modified by Henoc *et al.* (1973). Total Fe content is reported as Fe^{2+} .

The following abbreviations are used in the presentation of electron microprobe analyses:

cpx	= clinopyroxene	opx	= orthopyroxene
gar	= garnet	phlog	= phlogopite
rut	= rutile	ilm	= ilmenite
moi	= moissanite	qtz/coe	= pure silicon oxide
br	= black rosette	graph	= graphite
()	= bimineralic/polymineralic inclusions	sulph	= sulphide
n.d.	= not detected	n.a.	= not analysed
$\text{Mg}^{\#}$	= $100 \times \text{Mg}/(\text{Mg}+\text{Fe})$		

Appendix 3.1

George Creek discrete clinopyroxene inclusion compositions: Group GC1

SPECIMEN ASSEMBLAGE	GC001C gar-(gar-ilm)- cpx-br	GC014H gar-(gar-cpx)- cpx	GC015B cpx-br	GC019B cpx-br	GC021B cpx-br	GC022A cpx-(cpx-opx)	GC031A cpx	GC039C cpx-br	GC090A cpx-br
SiO ₂	54.7	54.9	54.5	54.5	54.6	55.0	54.3	55.2	54.6
TiO ₂	0.12	0.15	0.14	0.10	0.12	n.d.	0.17	0.15	0.08
Al ₂ O ₃	3.84	3.38	3.28	2.41	3.62	1.83	3.64	4.66	2.53
Cr ₂ O ₃	0.11	0.27	0.19	0.35	0.17	0.57	0.20	n.d.	0.26
FeO	5.45	6.13	5.46	4.68	6.30	4.03	6.25	5.46	4.39
MnO	n.d.	n.d.	n.d.	n.d.	n.d.	0.11	n.d.	n.d.	0.12
MgO	14.5	14.1	14.9	15.9	15.0	16.0	15.0	13.6	16.0
CaO	18.6	18.9	19.3	20.6	18.0	21.4	18.2	19.0	20.5
Na ₂ O	2.04	1.93	1.97	1.33	2.22	0.93	2.27	2.36	1.25
K ₂ O	0.22	0.10	0.18	0.26	0.09	0.33	0.09	0.11	0.26
TOTAL	99.58	99.86	99.92	100.13	100.12	100.20	100.12	100.54	99.99
Si	1.996	2.004	1.989	1.985	1.986	1.997	1.978	1.995	1.985
Ti	0.003	0.004	0.004	0.003	0.003	n.d.	0.005	0.004	0.002
Al	0.165	0.145	0.141	0.103	0.155	0.079	0.156	0.199	0.108
Cr	0.003	0.008	0.006	0.010	0.005	0.016	0.006	n.d.	0.008
Fe	0.166	0.187	0.167	0.143	0.192	0.122	0.190	0.165	0.134
Mn	n.d.	n.d.	n.d.	n.d.	n.d.	0.003	n.d.	n.d.	0.004
Mg	0.788	0.768	0.811	0.861	0.812	0.868	0.814	0.731	0.867
Ca	0.726	0.738	0.753	0.804	0.701	0.834	0.710	0.736	0.797
Na	0.144	0.137	0.140	0.094	0.157	0.066	0.160	0.166	0.088
K	0.010	0.005	0.008	0.012	0.004	0.015	0.004	0.005	0.012
SUM	4.001	3.996	4.019	4.015	4.015	4.000	4.023	4.001	4.005
Mg [#]	82.60	80.42	82.92	85.76	80.88	87.68	81.08	81.58	86.61

Appendix 3.2

George Creek discrete clinopyroxene inclusion compositions: Group GC2

SPECIMEN ASSEMBLAGE	GC002A gar-cpx-br	GC004A gar-cpx-br	GC007C gar-cpx-br	GC010A cpx-br	GC010B cpx-br	GC012A gar-cpx-br	GC020E gar-cpx	GC024A cpx-moi-br	GC027J gar-cpx-br
SiO ₂	55.6	54.5	55.5	54.7	54.9	54.0	54.8	54.2	54.5
TiO ₂	0.33	0.23	0.65	0.12	0.10	0.40	0.29	0.21	0.25
Al ₂ O ₃	10.6	6.40	12.6	5.18	4.76	7.11	8.38	5.43	6.91
Cr ₂ O ₃	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
FeO	5.38	7.40	5.11	5.03	4.30	7.41	5.77	7.24	7.46
MnO	n.d.	n.d.	n.d.	n.d.	n.d.	0.14	n.d.	n.d.	0.07
MgO	9.25	11.0	7.55	13.3	13.7	10.3	10.3	11.4	10.1
CaO	13.8	16.6	11.6	18.8	19.7	15.9	15.4	17.9	16.7
Na ₂ O	5.28	3.36	6.93	2.48	2.07	4.21	4.48	2.83	3.38
K ₂ O	0.38	0.49	0.29	0.79	1.02	0.20	0.63	0.43	0.60
TOTAL	100.62	99.98	100.23	100.40	100.55	99.67	100.05	99.64	99.97
Si	1.979	1.989	1.972	1.983	1.985	1.974	1.980	1.993	1.988
Ti	0.009	0.006	0.017	0.003	0.003	0.011	0.008	0.006	0.007
Al	0.443	0.275	0.526	0.221	0.202	0.306	0.357	0.235	0.297
Cr	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fe	0.160	0.226	0.152	0.152	0.130	0.226	0.174	0.223	0.227
Mn	n.d.	n.d.	n.d.	n.d.	n.d.	0.004	n.d.	n.d.	0.002
Mg	0.491	0.600	0.400	0.719	0.737	0.563	0.552	0.623	0.550
Ca	0.526	0.649	0.439	0.729	0.761	0.624	0.597	0.706	0.653
Na	0.364	0.237	0.477	0.174	0.145	0.299	0.314	0.202	0.239
K	0.017	0.023	0.013	0.037	0.047	0.010	0.029	0.020	0.028
SUM	3.989	4.005	3.996	4.018	4.010	4.017	4.011	4.008	3.991
Mg#	75.42	72.64	72.46	82.54	85.01	71.36	76.03	73.64	70.79

Appendix 3.2 continued...

George Creek discrete clinopyroxene inclusion compositions: Group GC2

SPECIMEN	GC041C	GC045A	GC070A	GC083A	GC094B	GC538C	GC717A	GC034A*	GC166C*
ASSEMBLAGE	gar-(gar-ilrn)-cpx	gar-cpx-br	cpx-br	cpx-br	gar-cpx-br	gar-(gar-ilrn)-cpx	gar-cpx-br	gar-(gar-cpx)-cpx-br	(gar-rut-ilrn)-cpx-br
SiO ₂	54.5	54.6	55.3	54.9	54.8	54.2	54.6	54.2	55.1
TiO ₂	0.21	0.23	0.31	0.25	0.20	0.17	0.38	0.12	0.16
Al ₂ O ₃	6.68	5.35	7.11	7.32	5.32	4.47	6.79	4.41	6.52
Cr ₂ O ₃	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.17
FeO	6.91	7.37	7.54	7.49	6.12	5.62	7.74	5.28	5.12
MnO	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
MgO	10.9	12.0	10.4	9.88	12.7	13.5	9.96	13.2	11.8
CaO	17.3	17.9	16.3	16.4	17.7	18.3	15.8	21.0	16.7
Na ₂ O	3.51	2.62	3.44	4.00	2.64	2.21	4.10	1.59	3.37
K ₂ O	0.46	0.53	0.34	0.42	0.47	0.44	0.28	0.69	1.13
TOTAL	100.47	100.60	100.74	100.66	99.95	98.91	99.65	100.49	100.07
Si	1.982	1.988	1.995	1.989	1.996	1.993	1.998	1.974	1.995
Ti	0.006	0.006	0.008	0.007	0.006	0.005	0.010	0.003	0.005
Al	0.286	0.230	0.302	0.313	0.228	0.194	0.293	0.189	0.278
Cr	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.005
Fe	0.210	0.225	0.227	0.227	0.186	0.173	0.237	0.161	0.155
Mn	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mg	0.588	0.651	0.558	0.533	0.691	0.739	0.544	0.715	0.636
Ca	0.676	0.697	0.632	0.636	0.689	0.722	0.618	0.821	0.646
Na	0.248	0.185	0.241	0.281	0.186	0.157	0.291	0.112	0.237
K	0.022	0.025	0.016	0.019	0.022	0.021	0.013	0.032	0.052
SUM	4.018	4.007	3.979	4.005	4.004	4.004	4.004	4.007	4.009
Mg#	73.68	74.32	71.08	70.13	78.79	81.03	69.65	81.62	80.40

* denotes inclusion from CO₂-bearing diamond

Appendix 3.3

George Creek discrete clinopyroxene end-member compositions: Group GC1

SPECIMEN ASSEMBLAGE	GC001C gar-(gar-ilm)- cpx-br	GC014H gar-(gar-cpx)- cpx	GC015B cpx-br	GC019B cpx-br	GC021B cpx-br	GC022A cpx-(cpx-opx) (websteritic)	GC031A cpx	GC039C cpx-br	GC090A cpx-br
CaAl ₂ SiO ₆ Ca Tschermak	0.000	0.000	0.005	0.009	0.006	0.000	0.016	0.000	0.012
NaAlSi ₂ O ₆ Jadeite	0.168	0.153	0.137	0.095	0.148	0.095	0.130	0.199	0.092
NaFeSi ₂ O ₆ Acmite	0.154	0.142	0.011	0.011	0.013	0.081	0.034	0.171	0.008
Ca _{0.5} AlSi ₂ O ₆ Pseudojadeite	0.014	0.011	0.000	0.000	0.000	0.014	0.000	0.028	0.000
CaMgSi ₂ O ₆ - CaFeSi ₂ O ₆ Diopside- Hedenbergite	0.719	0.733	0.748	0.795	0.695	0.830	0.694	0.722	0.789
Mg ₂ Si ₂ O ₆ - Fe ₂ Si ₂ O ₆ Enstatite- Ferrosilite	0.041	0.040	0.110	0.099	0.148	0.040	0.138	0.002	0.102

Compositions are given in cations per formula unit according to the method of Hatton (1978)

Appendix 3.3 cont...

George Creek discrete clinopyroxene end-member compositions: Group GC2 cont...

SPECIMEN ASSEMBLAGE	GC002A gar-cpx-br	GC004A gar-cpx-br	GC007C gar-cpx-br	GC010A cpx-br	GC010B cpx-br	GC012A gar-cpx-br	GC020E gar-cpx	GC024A cpx-moi-br	GC027J gar-cpx-br
CaAl ₂ SiO ₆ Ca Tschermak	0.016	0.011	0.028	0.017	0.015	0.026	0.020	0.007	0.012
NaAlSi ₂ O ₆ Jadeite	0.411	0.253	0.470	0.187	0.172	0.254	0.317	0.221	0.273
NaFeSi ₂ O ₆ Acmite	0.381	0.007	0.020	0.024	0.020	0.055	0.026	0.001	0.267
Ca _{0.5} AlSi ₂ O ₆ Pseudojadeite	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
CaMgSi ₂ O ₆ - CaFeSi ₂ O ₆ Diopside- Hedenbergite	0.495	0.638	0.411	0.712	0.746	0.602	0.577	0.699	0.640
Mg ₂ Si ₂ O ₆ - Fe ₂ Si ₂ O ₆ Enstatite- Ferrosilite	0.000	0.091	0.061	0.068	0.051	0.066	0.062	0.073	0.000

Compositions are given in cations per formula unit according to the method of Hatton (1978)

Appendix 3.3 cont...

George Creek discrete clinopyroxene end-member compositions: Group GC2 cont...

SPECIMEN ASSEMBLAGE	GC041C gar-(gar-ilm)- cpx	GC045A gar-cpx-br	GC070A cpx-br	GC083A cpx-br	GC094B gar-cpx-br	GC538C gar-(gar-ilm)- cpx	GC717A gar-cpx-br	GC034A* gar-(gar-cpx)- cpx-br	GC166C* (gar-rut-ilm)- cpx-br
CaAl ₂ SiO ₆ Ca Tschermak	0.018	0.012	0.005	0.011	0.004	0.007	0.002	0.026	0.005
NaAlSi ₂ O ₆ Jadeite	0.250	0.206	0.292	0.291	0.220	0.180	0.289	0.137	0.273
NaFeSi ₂ O ₆ Acmite	0.020	0.004	0.257	0.009	0.208	0.178	0.015	0.007	0.016
Ca _{0.5} AlSi ₂ O ₆ Pseudojadeite	0.000	0.000	0.035	0.000	0.012	0.002	0.000	0.000	0.000
CaMgSi ₂ O ₆ - CaFeSi ₂ O ₆ Diopside- Hedenbergite	0.658	0.685	0.610	0.625	0.679	0.714	0.616	0.795	0.641
Mg ₂ Si ₂ O ₆ - Fe ₂ Si ₂ O ₆ Enstatite- Ferrosilite	0.060	0.094	0.061	0.063	0.000	0.010	0.075	0.037	0.067

Compositions are given in cations per formula unit according to the method of Hatton (1978)

Appendix 3.4

George Creek discrete garnet inclusion compositions: Group GC1

SPECIMEN ASSEMBLAGE	GC001B gar-(gar-ilrn)-cpx-br	GC014K gar-(gar-cpx)-cpx	GC053A gar-br	GC094A gar-cpx-br	GC443B gar-br	GC538A gar-(gar-ilrn)-cpx
SiO ₂	40.7	40.1	41.1	40.2	40.0	40.1
TiO ₂	0.26	0.82	0.21	0.34	0.74	0.34
Al ₂ O ₃	22.9	21.4	23.3	22.6	21.8	22.7
Cr ₂ O ₃	0.25	0.56	0.95	0.15	0.09	n.d.
FeO	15.2	16.1	12.7	17.1	17.1	15.4
MnO	0.31	0.36	0.30	0.36	0.35	0.34
MgO	14.6	11.8	17.5	12.0	11.3	13.2
CaO	5.93	8.36	4.30	8.15	9.11	7.46
Na ₂ O	0.06	0.11	0.05	0.09	0.16	0.10
TOTAL	100.21	99.61	100.41	100.99	100.65	99.64
Si	2.983	3.003	2.966	2.970	2.980	2.977
Ti	0.014	0.046	0.011	0.019	0.041	0.019
Al	1.977	1.887	1.977	1.968	1.916	1.982
Cr	0.014	0.033	0.054	0.009	0.005	n.d.
Fe	0.931	1.006	0.766	1.060	1.063	0.957
Mn	0.020	0.023	0.018	0.023	0.022	0.022
Mg	1.598	1.314	1.878	1.321	1.251	1.465
Ca	0.465	0.670	0.332	0.646	0.727	0.593
Na	0.008	0.017	0.007	0.014	0.023	0.014
SUM	8.010	7.999	8.010	8.030	8.028	8.029
Mg#	63.19	56.64	71.03	55.48	54.06	60.49

Appendix 3.5

George Creek discrete garnet inclusion compositions: Group GC2

SPECIMEN	GC002B	GC004B	GC007F	GC009E	GC012D	GC020B	GC035A
ASSEMBLAGE	gar-cpx-br	gar-cpx-br	gar-cpx-br	gar-(gar-cpx)- (gar-ilm)	gar-cpx-br	gar-cpx	gar-(gar-ilm)-br
SiO ₂	39.7	39.8	39.5	38.8	39.1	39.5	39.5
TiO ₂	0.66	0.34	0.89	0.73	0.93	0.79	0.75
Al ₂ O ₃	22.2	22.1	21.6	21.3	20.9	21.5	22.4
Cr ₂ O ₃	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
FeO	18.1	19.3	18.6	19.1	19.9	18.2	19.4
MnO	0.35	0.35	0.31	0.43	0.43	0.41	0.28
MgO	9.50	9.68	8.91	8.20	8.30	9.89	9.14
CaO	9.63	9.19	9.70	10.8	9.87	9.25	9.03
Na ₂ O	0.24	0.10	0.31	0.17	0.24	0.21	0.34
TOTAL	100.38	100.86	99.82	99.53	99.67	99.75	100.84
Si	2.986	2.985	2.996	2.971	2.997	2.989	2.969
Ti	0.038	0.019	0.051	0.042	0.053	0.045	0.042
Al	1.961	1.956	1.933	1.927	1.886	1.919	1.980
Cr	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fe	1.138	1.209	1.180	1.221	1.273	1.150	1.218
Mn	0.022	0.022	0.020	0.028	0.028	0.026	0.018
Mg	1.034	1.084	1.008	0.937	0.948	1.116	1.025
Ca	0.775	0.739	0.789	0.889	0.810	0.750	0.727
Na	0.035	0.015	0.045	0.025	0.035	0.031	0.050
SUM	8.019	8.029	8.022	8.040	8.030	8.026	8.029
Mg [#]	47.61	47.27	46.07	43.42	42.68	49.25	45.70

Appendix 3.5 continued...

George Creek discrete garnet inclusion compositions: Group GC2

SPECIMEN	GC040A	GC041D	GC055C	GC084B	GC097A	GC132A	GC717C
ASSEMBLAGE	gar-br	gar-(gar-ilm)-cpx	gar-(gar-ilm)-cpx	gar-br	gar-br	gar-(gar-ilm)-cpx-br	gar-cpx-br
SiO ₂	39.2	39.5	39.2	38.5	39.2	39.6	38.8
TiO ₂	0.99	0.51	0.63	0.78	0.70	0.51	0.73
Al ₂ O ₃	21.6	21.9	21.5	21.6	22.2	22.2	21.1
Cr ₂ O ₃	n.d.	n.d.	n.d.	n.d.	n.d.	0.08	n.d.
FeO	15.5	18.0	18.8	19.2	19.3	17.7	20.8
MnO	0.28	0.41	0.37	0.35	0.36	0.29	0.37
MgO	6.90	8.14	8.23	7.84	7.84	8.77	7.82
CaO	15.5	11.8	11.1	11.2	10.5	11.4	10.2
Na ₂ O	0.33	0.13	0.14	0.16	0.25	0.12	0.18
TOTAL	100.30	100.39	99.97	99.63	100.35	100.67	100.00
Si	2.971	2.986	2.983	2.950	2.969	2.975	2.976
Ti	0.056	0.029	0.036	0.045	0.040	0.029	0.042
Al	1.927	1.954	1.929	1.952	1.984	1.966	1.912
Cr	n.d.	n.d.	n.d.	n.d.	n.d.	0.005	n.d.
Fe	0.983	1.142	1.200	1.231	1.224	1.110	1.334
Mn	0.018	0.027	0.024	0.023	0.023	0.018	0.024
Mg	0.779	0.918	0.934	0.894	0.886	0.982	0.895
Ca	1.257	0.952	0.906	0.922	0.856	0.917	0.836
Na	0.049	0.019	0.021	0.024	0.036	0.017	0.027
SUM	8.040	8.027	8.033	8.041	8.018	8.019	8.046
Mg [#]	44.21	44.56	43.77	42.07	41.99	46.94	40.15

Appendix 3.6

George Creek discrete garnet inclusion compositions: inclusions from CO₂-bearing diamonds

SPECIMEN	GC166A	GC309A	GC551A	GC564A	GC376A*	GC034E	GC600A
ASSEMBLAGE	(gar-rut-ilm)-cpx-br	gar-(gar-cpx)-br	gar-br	(gar-ilm)-br	gar-br	gar-(gar-cpx)-cpx-br	gar-br
GROUP	GC1	GC1	GC1	GC1	websteritic	GC2	GC2
SiO ₂	39.8	40.1	40.5	40.4	39.9	40.0	39.3
TiO ₂	0.46	0.11	0.75	0.43	0.20	0.43	0.46
Al ₂ O ₃	22.5	22.6	21.9	22.6	22.5	22.2	22.2
Cr ₂ O ₃	0.18	0.10	n.d.	0.17	0.10	n.d.	n.d.
FeO	17.4	17.8	14.8	15.3	20.4	14.8	19.3
MnO	0.30	0.31	0.31	0.24	0.30	0.36	0.47
MgO	12.8	12.2	12.0	12.8	12.3	8.27	8.94
CaO	6.31	6.61	9.86	8.33	4.79	14.5	8.39
Na ₂ O	0.11	0.05	0.13	0.10	0.07	0.06	0.15
TOTAL	99.86	99.88	100.25	100.37	100.56	100.62	99.21
Si	2.966	2.990	3.002	2.980	2.980	2.992	2.996
Ti	0.026	0.006	0.042	0.024	0.011	0.024	0.026
Al	1.977	1.983	1.912	1.964	1.976	1.961	1.994
Cr	0.011	0.006	n.d.	0.010	0.006	n.d.	n.d.
Fe	1.085	1.110	0.914	0.945	1.273	0.928	1.230
Mn	0.019	0.019	0.020	0.015	0.019	0.023	0.030
Mg	1.419	1.361	1.329	1.406	1.367	0.922	1.018
Ca	0.504	0.528	0.782	0.659	0.383	1.161	0.686
Na	0.016	0.007	0.019	0.014	0.010	0.009	0.023
SUM	8.023	8.010	8.020	8.017	8.025	8.020	8.003
Mg#	56.67	55.08	59.25	59.80	51.78	49.84	45.28

* denotes green garnet inclusion, all other garnet inclusions are orange in colour

Appendix 3.7
George Creek biminerallc garnet-clinopyroxene inclusion compositions

SPECIMEN ASSEMBLAGE GROUP	GC009C cpx	GC009C gar	GC014G cpx	GC014G gar	GC034C* cpx	GC034C* gar
	gar-(gar-cpx)-(gar-ilm)		gar-cpx-(gar-cpx)		gar-cpx-(gar-cpx)-br	
	GC2	GC2	GC1	GC1	GC2	GC2
SiO ₂	55.2	38.9	54.3	39.4	54.3	39.7
TiO ₂	0.59	0.85	0.17	0.25	0.17	0.21
Al ₂ O ₃	8.02	21.7	2.41	21.9	4.33	22.1
Cr ₂ O ₃	n.d.	n.d.	0.33	0.82	n.d.	0.09
FeO	4.85	19.2	4.30	16.2	5.50	20.4
MnO	n.d.	0.44	n.d.	0.36	n.d.	0.42
MgO	10.8	7.30	15.2	12.7	12.9	9.07
CaO	16.8	12.3	21.6	7.53	19.8	8.81
Na ₂ O	4.65	0.23	1.55	0.07	2.43	0.06
K ₂ O	0.07	n.a.	n.d.	n.a.	0.61	n.a.
TOTAL	100.98	100.92	99.86	99.23	100.04	100.86
Si	1.969	2.956	1.982	2.957	1.987	2.990
Ti	0.116	0.049	0.005	0.014	0.005	0.012
Al	0.337	1.938	0.104	1.942	0.187	1.961
Cr	n.d.	n.d.	0.010	0.049	n.d.	0.005
Fe	0.145	1.218	0.131	1.017	0.168	1.287
Mn	n.d.	0.028	n.d.	0.023	n.d.	0.027
Mg	0.576	0.826	0.828	1.419	0.702	1.018
Ca	0.643	0.998	0.843	0.606	0.776	0.711
Na	0.322	0.033	0.110	0.010	0.172	0.009
K	0.003	n.a.	n.d.	n.a.	0.029	n.a.
SUM	4.011	8.046	4.012	8.038	4.026	8.020
Mg [#]	79.89	40.41	86.34	58.25	80.69	44.16

* denotes CO₂-bearing diamond

Appendix 3.8
George Creek ilmenite inclusion compositions

SPECIMEN ASSEMBLAGE	GC009B gar-(gar-cpx)-(gar-ilmen)	GC055D gar-cpx-(gar-ilmen)
SiO ₂	n.d.	0.11
TiO ₂	54.0	53.3
Al ₂ O ₃	0.66	0.42
Cr ₂ O ₃	n.d.	n.d.
FeO	41.2	41.0
MnO	0.15	0.20
MgO	4.58	4.93
CaO	0.08	0.34
TOTAL	100.7	100.3
Si	n.d.	0.003
Ti	0.985	0.976
Al	0.019	0.012
Cr	n.d.	n.d.
Fe	0.835	0.835
Mn	0.003	0.004
Mg	0.165	0.179
Ca	0.002	0.009
SUM	2.009	2.018
FeO*	39.8	38.5
Fe ₂ O ₃ *	1.51	0.45

(* calculated by stoichiometry)

Appendix 3.9

George Creek rutile inclusion compositions

SPECIMEN ASSEMBLAGE	GC062A rut-br	GC063B rut-br	GC085A rut-cpx-br	GC166B (gar-rut-ilm)-cpx-br	GC844 rut	GC050B* rut-br
SiO ₂	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TiO ₂	97.2	98.0	97.7	97.2	99.0	97.1
Al ₂ O ₃	1.14	1.08	0.98	0.67	0.40	1.08
Cr ₂ O ₃	n.d.	n.d.	n.d.	0.17	0.14	n.d.
FeO	0.72	0.38	0.83	0.77	0.42	1.36
MnO	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
MgO	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
CaO	n.d.	n.d.	n.d.	0.08	0.16	0.05
TOTAL	99.06	99.46	99.51	98.89	100.1	99.59
Si	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ti	0.983	0.986	0.985	0.986	0.991	0.981
Al	0.018	0.017	0.015	0.011	0.006	0.017
Cr	n.d.	n.d.	n.d.	0.002	0.001	n.d.
Fe	0.008	0.004	0.009	0.009	0.005	0.015
Mn	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mg	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ca	n.d.	n.d.	n.d.	0.001	0.002	0.001
SUM	1.009	1.007	1.009	1.009	1.005	1.014

* denotes CO₂-bearing diamond

Appendix 3.10

George Creek websteritic inclusion compositions

SPECIMEN ASSEMBLAGE analysis	GC022B		GC057A	GC057A	GC057A	GC376A*
	cpx	cpx-(cpx-opx)-br opx	cpx	(cpx-opx-phlog)-br opx	phlog	gar-br gar
SiO ₂	54.3	56.3	54.6	56.4	43.0	39.9
TiO ₂	n.d.	n.d.	0.07	n.d.	9.77	0.20
Al ₂ O ₃	1.84	0.43	2.40	0.49	12.5	22.5
Cr ₂ O ₃	0.52	0.09	0.23	n.d.	0.49	0.10
FeO	4.17	11.4	4.49	11.6	7.80	20.4
MnO	0.09	0.18	n.d.	0.15.	n.d.	0.30
MgO	16.3	31.2	15.9	30.3	13.1	12.3
CaO	21.2.	0.45	21.0	0.51	0.24	4.79
Na ₂ O	0.99	0.06	1.12	0.07	0.12	0.07
K ₂ O	0.33	n.d.	0.27	0.02	9.89	n.a.
TOTAL	99.74	100.11	100.08	99.54	96.91	100.56
Si	1.985	1.986	1.986	6.009	6.009	2.980
Ti	n.d.	n.d.	0.002	1.043	1.043	0.011
Al	0.079	0.018	0.103	2.083	2.083	1.976
Cr	0.015	0.003	0.007	n.d.	0.055	0.006
Fe	0.127	0.336	0.137	0.344	0.926	1.273
Mn	0.003	0.005	n.d.	0.005	n.d.	0.019
Mg	0.888	1.637	0.860	1.601	2.773	1.367
Ca	0.828	0.017	0.817	0.019	0.036	0.383
Na	0.070	0.004	0.079	0.005	0.033	0.010
K	0.015	n.d.	0.013	0.001	1.791	n.a.
SUM	4.011	4.006	4.003	3.994	14.839	8.025
Mg [#]	87.49	82.97	86.26	82.31	74.97	51.78

* denotes CO₂-bearing diamond

calculated for
22 oxygen atoms

Appendix 3.11

George Creek miscellaneous inclusion compositions

SPECIMEN ASSEMBLAGE (analysis)	GC009B gar-(gar-cpx)- (gar-ilm) (ilm)	GC055D gar-(gar-ilm)- cpx (ilm)	GC778A* qtz/coe-br (qtz/coe)	GC024B cpx-moi-br (moi)	GC080B sulph-br (sulph)
SiO ₂	n.d.	0.11	99.3	Si	39.7
TiO ₂	54.0	53.3	n.d.	Ti	59.3
Al ₂ O ₃	0.66	0.42	n.d.	Al	0.22
Cr ₂ O ₃	n.d.	n.d.	n.d.	Cr	n.d.
FeO	41.2	41.0	n.d.	Fe	0.04
MnO	0.15	0.20	n.d.	Mn	0.03
MgO	4.58	4.93	n.d.	Mg	
CaO	0.08	0.34	n.d.	Ca	0.00
TOTAL	100.67	100.30	99.3	TOTAL	92.68
Si	n.d.	0.003		TOTAL	99.29
Ti	0.985	0.976			
Al	0.019	0.012			
Cr	n.d.	n.d.			
Fe	0.835	0.835			
Mn	0.003	0.004			
Mg	0.165	0.179			
Ca	0.002	0.009			
SUM	2.009	2.018			

* denotes CO₂-bearing diamond