UNUSUAL DIAMONDS AND UNIQUE INCLUSIONS FROM NEW SOUTH WALES, AUSTRALIA.

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Diamonds occur in Tertiary alluvial stream gravels in the region of Inverell, northern New South Wales, particularly in the areas of Bingara and Copeton. Akin to the occurrence of placer gold, and diamonds, in California, the alluvial gravels were later overlain by basaltic flows thus aiding preservation of the deposits. However, whereas the observation of diamonds in California was more of scientific interest, the diamonds in New South Wales have been actively mined and in excess of 300,000 cts have been recovered since 1881. The primary source of the diamonds is unknown.

Soon after the diamond came onto the commercial market their difficulty in polishing was noted as was the final excellent adamantine luster. The reason for the difficulty in polishing is because of the large number of stones which display "Naats" or "Knots". These are areas of twinning which occur in the diamond, and may or may not be continuous throughout the stone. These twin defects are sometimes seen as raised notches on the surface of the diamond and are also well displayed in cathodo-luminenscence photographs. The population of stones with these naats is fairly high (approximately 80% out of over 70 stones examined). Why they should be predominant in these New South Wales diamonds in uncertain but is most probably the result of a kinetic chemical growth phenomenon.

Another common feature of the Copeton/Bingara diamonds is that they sometimes have irregular pockmarked surfaces. It is likely these pits are due to either the mechanism of emplacement of the diamonds in the crust or to some later absorption effect. The suite of 71 diamonds examined range is size from 0.06 to 0.65 cts, and are predominantly colorless, to pale yellow (about 50% of each, and this agrees with previous reports). Most are rounded and represent modified rhombodecahedra; octahedra are rare.

Following the initial work of Sobolev et al. (1984) a detailed study of the micro infrared spectra (IR), cathodo luminescence (CL), nitrogen aggregation states, carbon and nitrogen isotopes, inclusion chemistry and trace element contents has been initiated. Some results are reported herein.

Based on the IR absorption characteristics a majority of diamonds show >50% N aggregation, some with Nitrogen contents in excess of 3000ppm. The colorless diamonds overall have lower N contents whereas the yellow diamonds have the higher contents. The IR absorption spectra are distinct for different types of N aggregation and it is possible to determine both the total N content and % of aggregation of each type from the IR data. Since aggregation is a function of residence time and temperature in the mantle, if one variable is known the other can be calculated. The CL study demonstrated that the most diamonds examined showed either blue or yellow colors with very little structure, or some with mixed colors and layering. In general the lower the N content the more structure was displayed in CL. The difference in N content is a function of the environment in which the diamonds grew. The initial conclusion is that there are at least two populations of diamond. This is also confirmed from the temperatures calculated from the IR spectra. Because there is no independent age known for the Copeton/Bingara diamonds two ages were used; one of 3 Ga and one of 0.3 Ga. Using only the best IR data the temperature range for the Low N is 1157°C, and the High N is 1040°C, using 0.3 Ga residence time. Using 3.0 Ga the temperature changes about -50°C

One of the unique aspects of the New South Wales diamonds is the carbon isotopic signatures. These are generally positive or very low negative values for $\Delta^{13}C$ compared to all other worldwide localities for diamond. We have confirmed these results by micro analysis, including $\Delta^{15}N$ of various diamond chips from Copeton/Bingara (Fig 1).

A number of diamonds were polished to expose inclusions on the surface of diamond and others were broken to extract the inclusions. The results confirmed those of Sobolev et al (1984) except that an eclogitic inclusion, comparable with ones from the Finsch Mine, South Africa, was observed. This is the first authenticated occurrence of a genuine eclogitic inclusion in the Copeton/Bingara suite. The other inclusions observed and analyzed were coesite, clinopyroxene (almost pure diopside) and clinopyroxene plus coesite (Table A, Figs 2 & 3). Of particular interest is the fact that no ultramafic nor eclogitic garnets have yet been observed, nor sulfides and spinels.

Table A: Inclusions in Copeton/Bingara Diamonds.

	CPX Calc Silicate			CPX Eclogite	COESITE
SiO_2	54.0	55.6	55.4	48.8	100.35
TiO_2	0.15	0.06	0.44	0.32	0.00
Al_2O_3	2.45	1.38	3.52	7.71	0.00
Cr_2O_3	0.09	0.04	0.06	0.00	0.02
FeO	2.36	0.21	4.49	10.8	0.03
MgO	16.3	18.3	13.1	16.2	0.00
CaO	22.5	24.1	20.9	12.3	0.00
MnO	0.00	0.00	0.00	0.29	0.03
NiO	0.06	0.00	0.02	0.04	0.00
Na_2O	1.02	0.56	2.13	1.14	0.00
K_2O	0.07	0.05	0.25	0.60	0.00
Totals	99.01	100.3	100.3	98.2	100.4

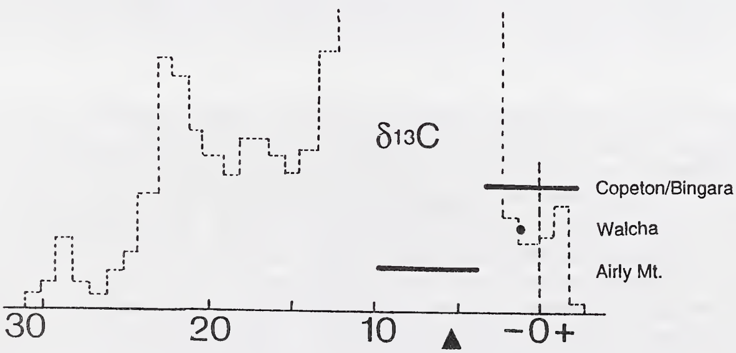
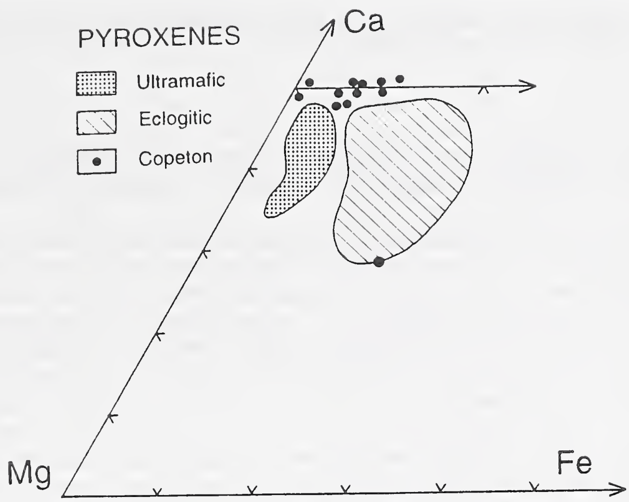
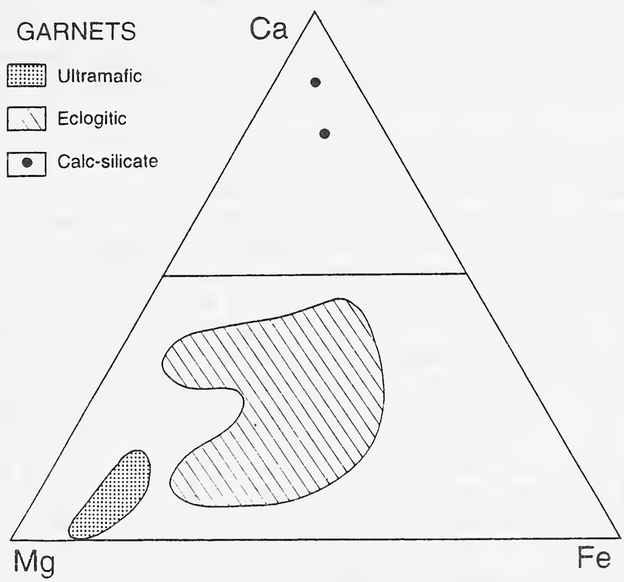


Figure 1: $\Delta^{13}C$ values for diamonds from New South Wales and others worldwide.





Figures 2 and 3: Inclusions in diamonds from New South Wales (Milledge, 1961; Sobolev et al, 1984; This study).

REFERENCES:

Sobolev et al. (1984) Dominanting Calc-silicate assemblage of crystalline inclusions in diamonds from alluvials in south eastern Australia. Dokl. Akad. Nauk., **274**, 172-178.