Infrared investigation of Timber Creek 01 Kimberlite diamonds

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The 179±2 Ma [1] Timber Creek 01 Kimberlite (TC01) pipe intrudes into Proterozoic sediments of the Victoria River Basin, Northern Territory, overlying the concealed and little understood North Australian Craton. The nearest known diamondiferous intrusion is the Argyle Lamproite (245km to WSW) within the Halls Creek Mobile Zone. Over 17,000 diamonds (>1.0mm) have been recovered from incomplete examination of 3800 tonnes of Timber Creek kimberlite.

An infrared investigation on both chips and whole stones shows that the resorbed TC01 diamonds span a large range of nitrogen concentrations, from 23 to 3090 ppm. A second chip from the diamond with the lowest N concentration returned 32 atomic ppm N, indicating this diamond is a low level Type I, as opposed to Type II with no nitrogen. The Argyle diamond population includes 11% of this Type II diamond, and nitrogen concentration ranges up to 2000 ppm [2]. Repeats analyses of two diamonds show consistent N concentrations (within 10 ppm N) and consistent aggregation states. One diamond from the Timber Creek 04 Kimberlite dyke recorded 919 ppm total N and 100% IaB, within the range of the TC01 diamond population. Virtually all the nitrogen in TC01 diamonds is in the fully aggregated state (Type IaB). The mean B state is 94%, the lowest was 59%, and 40% of the diamonds record fully aggregated (100% IaB) state. Even the very high-N (3090 ppm N) diamond is 96% aggregated, as is the very low-N (23-32 ppm N) diamond with 100% aggregation. Assuming a similar diamond crystallisation age to Argyle (1.55Ga, [3]) the calculated diamond mantle residence temperature ranges from 1138 to 1575 ºC, with an average of 1343 ºC. This is significantly higher temperatures than Argyle with 1085 to 1366 ºC [2].

The spectra peak associated with active hydrogen is observed in 76% of the TC01 diamonds, compared to 59% at Argyle [2]. Platelets occur in 76% of the diamonds, and abundance is strongly correlated with ppm N.

The TC01 diamonds can be distinguished from Argyle diamonds as a separate population by infrared investigation.

References

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