The diamond potential of electronically-disaggregated eclogites from Roberts Victor, R.S.A.

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Introduction

Mechanical disaggregation of xenoliths, such as jaw crushing, causes irreversible damage to diamonds in eclogites. The SELFRAG is designed to disaggregate along grain boundaries, with the aim of releasing more diamonds with fewer fractures. We assess the nature of disaggregation using the SELFRAG, and the diamond content of eclogite sample RV09.

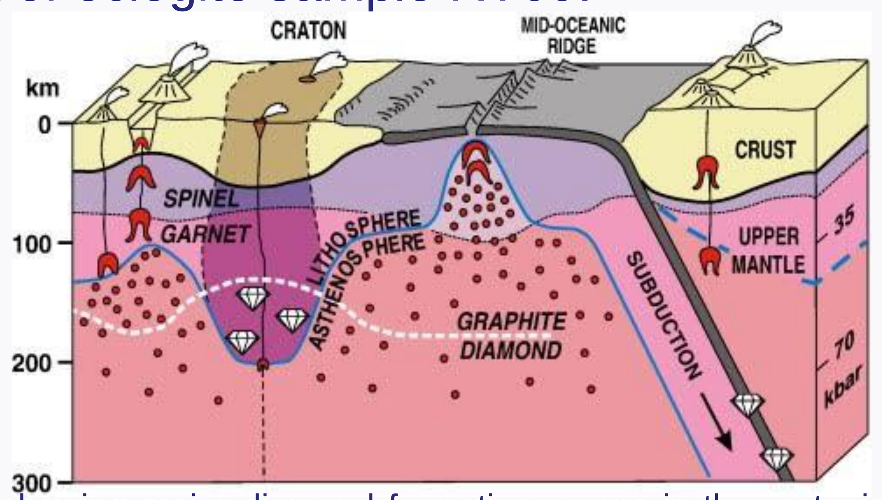
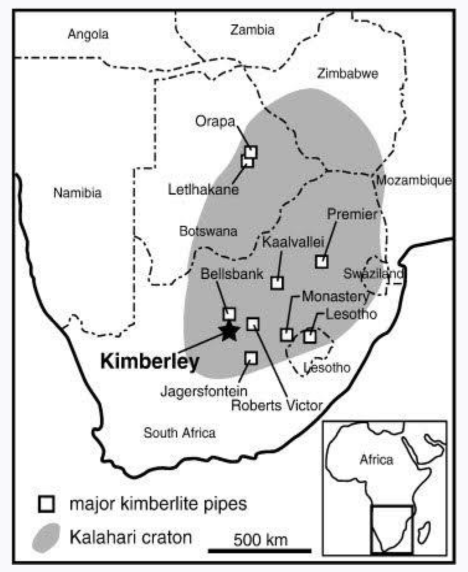


Figure 1. Cross-section showing major diamond formation occurs in the cratonic mantle. The cratonic root provides ideal temperature and pressure conditions (1).



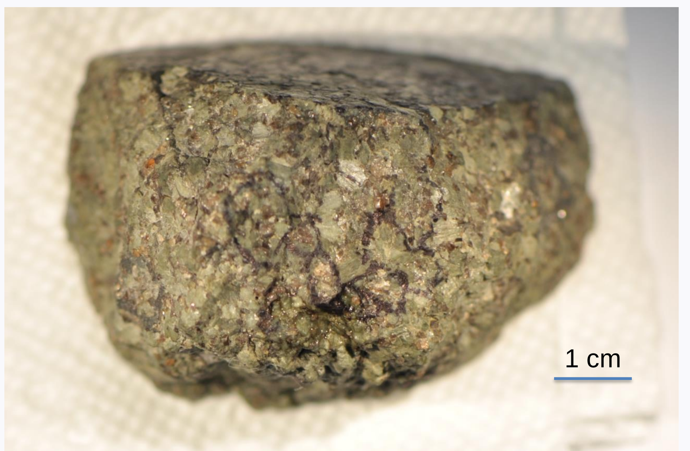


Figure 2. (left) Map of southern Africa detailing the occurrence of major kimberlite pipes within the Kalahari craton (2). **Figure 3.** (right) Visible light image of the RV09 sample. One half underwent jaw crushing while the other half went into the SELFRAG.

200 kV

~100 shocks

20 mm electrode gap

5 hz frequency

Figure 4. Analytical run conditions (above) for the SELFRAG (right). The SELFRAG uses high voltage (200 kV) electrical discharges to separate rocks into their individual constituents.

SELFRAG Disaggregation

Does high voltage disaggregation cause damage to the diamonds?

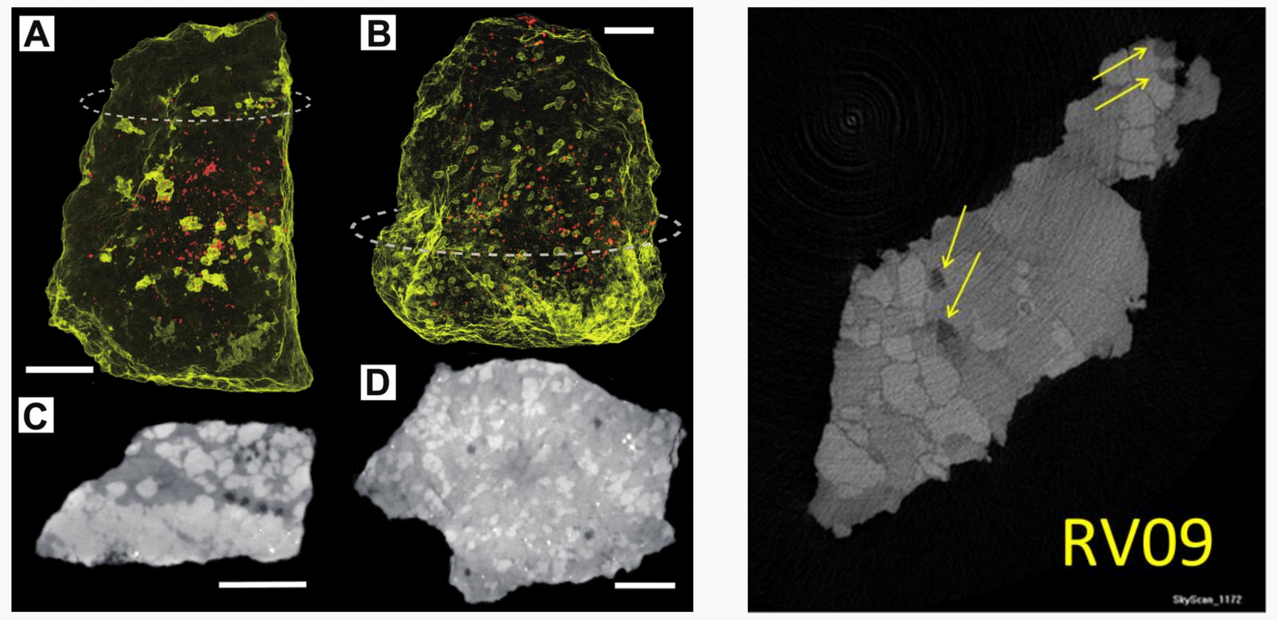


Figure 5. Using methods similar to Ishikawa *et. al* (3, left), we probed our sample RV09 for its constituent minerals (right). The brighter areas correspond to garnet, while the larger spots of dark grey are clinopyroxene. The dark spots found on the right are likely diamond (indicated).

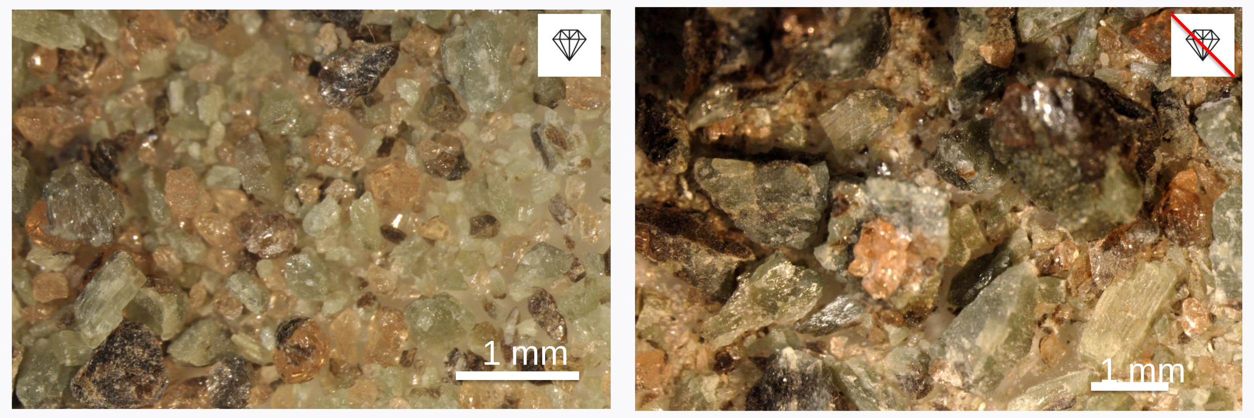


Figure 6. Sample disaggregated by the SELFRAG (left) is separated uniformly into individual minerals, whereas conventional crushing (right) produces composite aggregations.

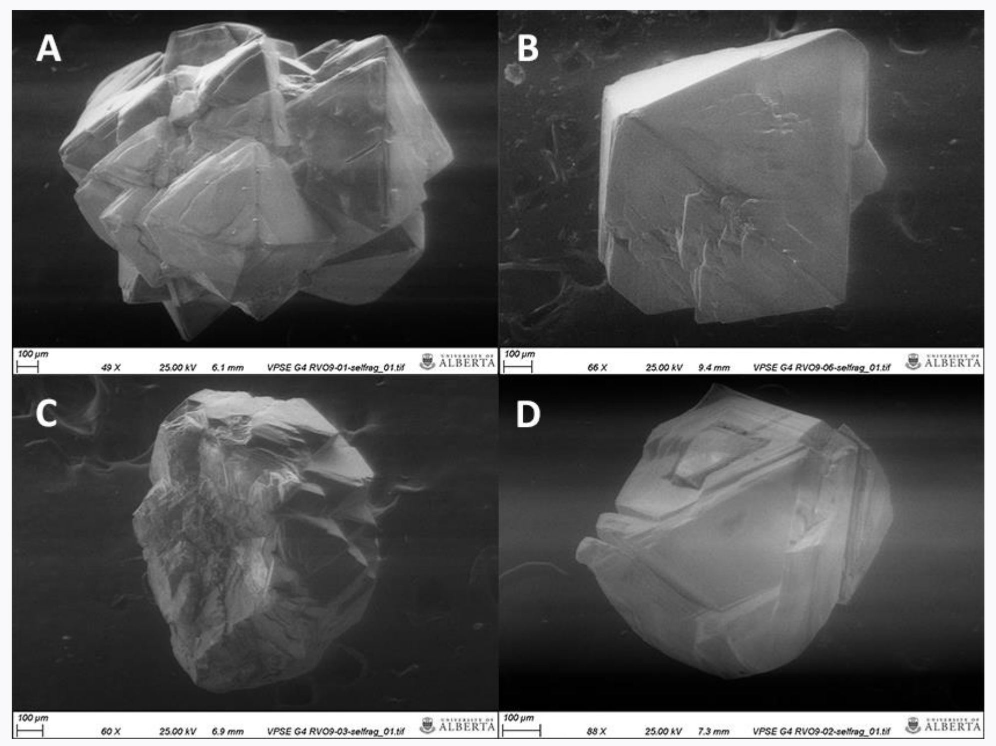


Figure 7. SELFRAG-released diamonds imaged by scanning electron microscopy (SEM). Most diamonds liberated show no signs of visible breakage (a, b) but a few show signs of possible damage, although it may have occurred during the kimberlite eruption (c, d).

Diamond Formation

To better understand the process of diamond formation we used multiple techniques to calculate the thermometric constraints for sample RV09.

METHOD 1: Silicate Minerals

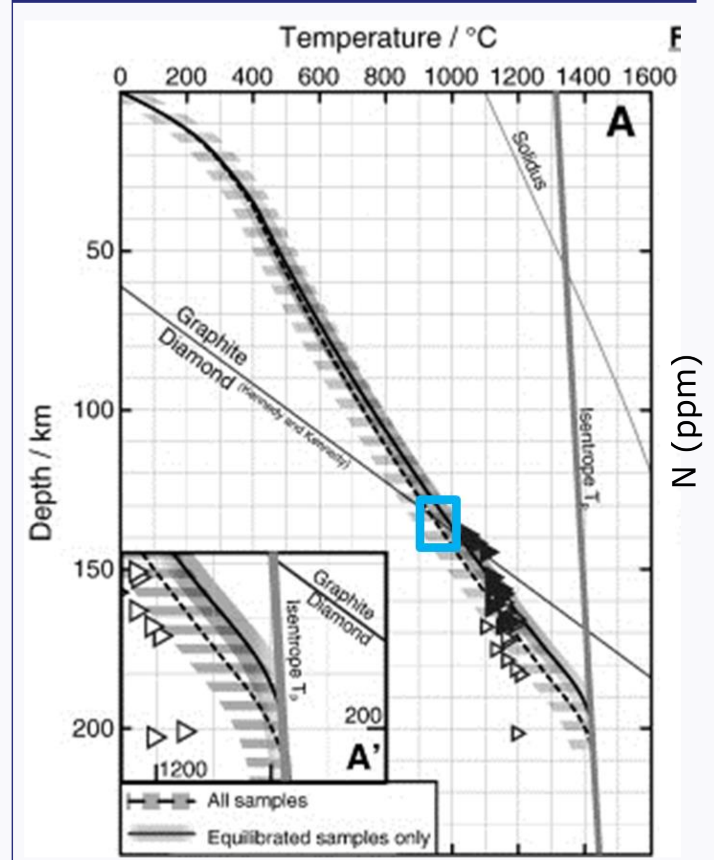


Figure 8. Using electron probe microanalysis (EPMA), we calculated the temperature of the co-existing garnets and clinopyroxene at Mg-Fe equilibrium (6).

Results were plotted on a comparable geotherm from the Finsch pipe (7), which indicates that our eclogite lies at the diamond-graphite transition.

METHOD 2: Nitrogen Aggregation

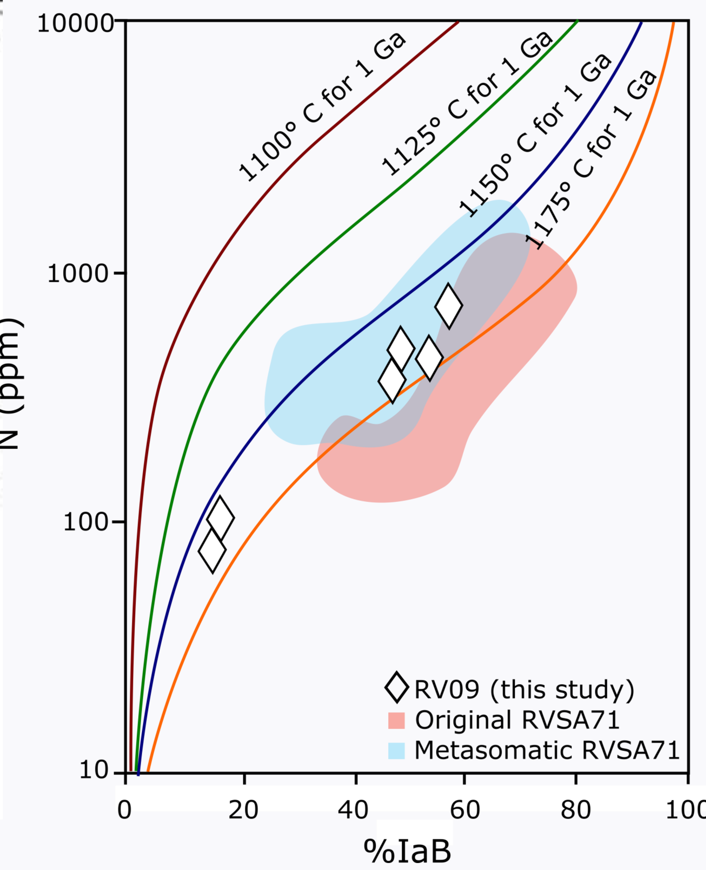


Figure 9. Nitrogen concentration vs. nitrogen aggregation for sample RV09 (◇) plots in the cpx-rich, metasomatic zone of diamondiferous eclogite RVSA71 (blue, 3).

Nitrogen aggregation and concentration determined using Fourier transform infrared spectroscopy (FTIR) and processed on spreadsheet provided by D. Howell (4,5).

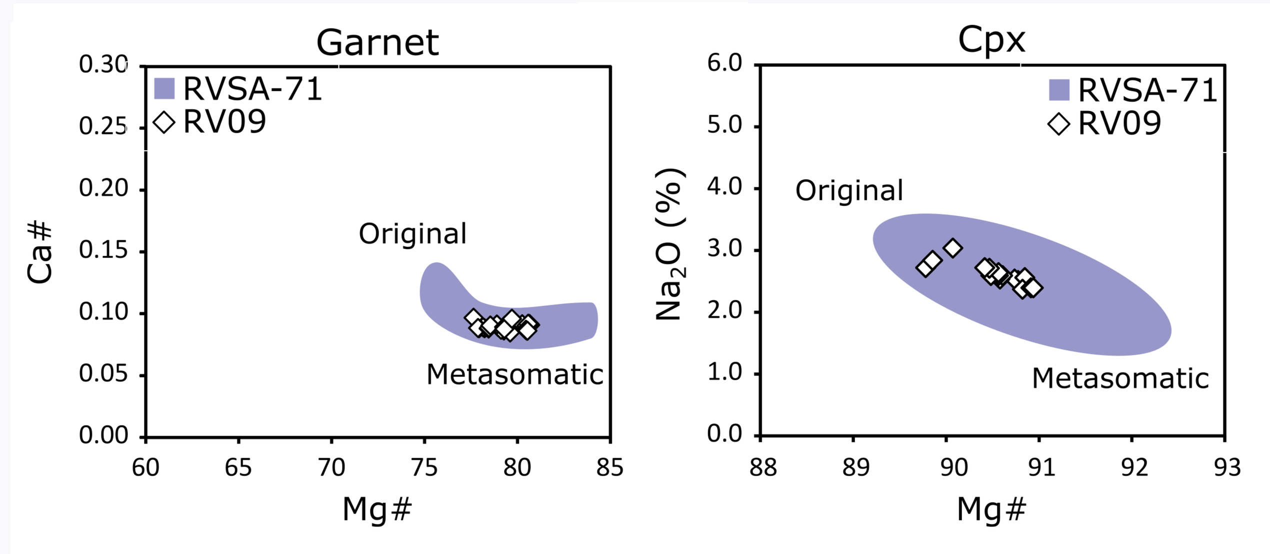


Figure 10. Plots of major element chemistry of garnet and cpx for RV09 compared to diamondiferous eclogite RVSA-71 (3). Our sample lies between the garnet-rich zone and the diamondiferous metasomatic cpx-zone of RVSA71.

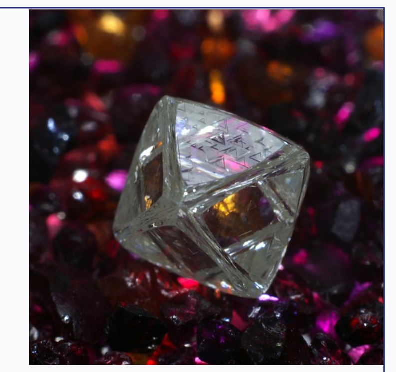
Conclusion

1: SELFRAG disaggregation

	SELFRAG	Jaw crusher
Diamonds recovered	10	0

- The lack of diamonds found in the jaw crushed portion suggests that the SELFRAG preserves grains that would otherwise be broken during jaw crushing.
- The SELFRAG causes minimal fracturing of diamonds within the eclogite, as seen in Figure 7.
- The process of chamber disassembly and reassembly to prevent cross-contamination is time-consuming. These inconveniences could hamper industry applicability.

2: Diamond Formation



- RV09 is derived from close to the diamond-graphite transition at a depth of ~145 km.
- Diamond nitrogen aggregation of RV09 matches the 'young vein' diamond population from RVSA71 (4), and garnet-cpx chemistry of RV09 approaches that of the diamond-rich portion of RVSA71.
- This shows, for the first time, evidence of a shared diamond population in two distinct host rocks produced by metasomatism.

References and Acknowledgments

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