SUPPLEMENTARY INFORMATION

A. Representative photographs of various sample types exposed at Amba Dongar and Siriwasan carbonatite-alkaline complexes.

**Calcioscarbonatites**

- Ankerite-rich vein in calcioscarbonatite

**Nephelinites**

- Calcite vein in nepheline

**Calcite veins in fossil-rich limestone**

**Calcite veins in cherty limestone**
B. Isotopic parameters and temperature relationship.

Fractionation factors used respectively for O and C in CaCO₃-CO₂ system from Chacko et al., (1991) are given as:

\[
1000 \ln \alpha^{18O}_{CO_2-cal} = -0.038435 + 5.0077x - 1.0703x^2 + 0.15452x^3 - 0.014366x^4 + 0.00073624x^5 - 0.000015567x^6 \quad \cdots \cdots \cdots \text{ (B1)}
\]

\[
1000 \ln \alpha^{13C}_{CO_2-cal} = -0.10028 + 5.4173x - 2.5076x^2 + 0.47193x^3 - 0.049501x^4 + 0.0027046x^5 - 0.000059409x^6 \quad \cdots \cdots \cdots \text{ (B2)}
\]

where \( x = 10^6/T^2 \) (T in Kelvin)

Fractionation factors for CaCO₃-H₂O are from Friedman and O'Neil (1977), given as:

\[
1000 \ln \alpha^{18O}_{cal-H_2O} = 2.78 \left( \frac{10^6}{T^2} \right) - 2.89 \text{ (T in Kelvin)} \quad \cdots \cdots \cdots \text{ (B3)}
\]

Fig B1. Oxygen isotope fractionation between calcite and water plotted as a function of 1000lnα against temperature. The maximum difference in 1000lnα values among the three calibrations is more significant at 0 °C (4.02) and reduces to 1.86 as temperature increases to 500 °C.

The \( \Delta_{47} \)-T equation used in calculating apparent equilibrium temperatures is taken from Davies and John (2019), modified after Kluge et al., (2015). T in Kelvin and \( \Delta_{47} \) in ‰.

\[
\Delta_{47CDES25} = 0.03998 (\pm 0.03) \times 10^6/T^2 + 0.2423 (\pm 0.002) \quad \cdots \cdots \text{ (B4)}
\]
REFERENCES


