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Determining the origin of fluids in the cratonic lithosphere

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Micro-fluid inclusions (typically < 0.5 µm) contained within fibrous and cloudy diamonds provide insight into the nature of fluids in the cratonic lithosphere. Fluids play a key role in mantle processes such as melting and metasomatism and serve as a key agent for the transport of volatiles between different mantle reservoirs. As such, the composition, and therefore origin, of these upper mantle fluids exerts control over the volatile, trace element, and isotopic composition of these mantle reservoirs.

Previous research coupling Sr-Nd-Pb isotopes with trace element ratios suggests the involvement of subduction-derived fluids in the cratonic lithosphere (Weiss et al. 2023). However, the C, N, halogen and He and Ar isotopic values in micro-fluid inclusion-bearing diamonds are similar to present-day upper mantle values, implying a purely mantle origin for these fluids (Boyd et al. 1992; Wada and Matsuda 1998; Johnson et al. 2000; Broadley et al. 2018). Indeed, micro-fluid inclusions from fibrous diamonds worldwide show a narrow yet distinctly mantle-like isotopic compositions ($\delta^{13}C$ = -7.5 to -4.1 ‰; Boyd et al. 1992). Trace element compositions of micro-fluid inclusions reflect a limited range in fluid compositions and yield patterns similar to kimberlites or carbonatites, suggesting a direct relationship between diamond-forming fluids and mantle-derived melts (Schrauder et al. 1996; Tomlinson et al. 2005; Zedgenizov et al. 2007).

To shed further light on the origin of fluids in the cratonic lithosphere, we will present coupled stable oxygen isotope and trace element data for micro-fluid inclusions in fibrous diamonds from the Democratic Republic of Congo.

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