

# **Incipient carbonate melting drives precious metal and sulfur mobilisation in the mantle**

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The solidus of volatile bearing (CO<sub>2</sub> and H<sub>2</sub>O) mantle lithologies is significantly (at least 300°C) depressed compared to anhydrous peridotite, and the incipient melts that are generated at the onset of melting are carbonatites provided that conditions remain oxidised, which is expected for the upper 200km within the Earth's mantle. These low-volume, highly mobile melts are often considered to be responsible for pervasive metasomatism of the subcontinental lithospheric mantle, (re)enriching it with incompatible and trace elements. However, the composition, oxidation state, and physical mechanisms by which incipient melts (re)enrich the lithospheric mantle are poorly constrained.

To address this lack of knowledge, we present results from high-pressure, high-temperature experiments that generate incipient carbonate melts at mantle conditions (~90km depth and temperatures between 900 - 1050°C). We show that these melts contain sulfur, in its oxidised form of sulfate, platinum group elements, and first-row transition metals, effectively mobilising them from mantle lithologies of peridotite and pyroxenite. These primitive oxidised melts may be effective agents to dissolve, redistribute and concentrate sulfur as well as chalcophile metals within the mantle, and from the mantle to shallower regions within the Earth, where localised dynamic physio-chemical processes can lead to ore genesis at various crustal depths. We propose that these carbonate-sulfur rich melts may be more widespread than previously recognised, and may play a first order role in the metallogenic enhancement of localised lithospheric domains.