

Carbonate-eclogite in the upper mantle

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Subduction of altered, carbonated oceanic crust may be an important mechanism for recycling carbon into the mantle. High pressure experiments suggest that some of this carbonate survives subduction and is transported into the deeper mantle. Its fate is unclear, but it may be an important part of the global carbon cycle on geological time scales. Links between carbonatite metasomatism in the mantle and isotopic evidence for recycled oceanic crustal material in some intraplate volcanics may express this recycling, as may the OIB-like isotopic compositions of many crustally emplaced carbonatites.

Recent high pressure experimental studies [1-3] confirmed that carbonate-bearing eclogite can melt to produce broadly dolomitic carbonatite liquids. Solidus temperatures are complexly controlled by pressure and by bulk compositional parameters such as Na₂O/CO₂ and CaO/MgO. Carbonatite melt from discrete carbonated eclogite bodies in the peridotite-dominated upper mantle may infiltrate peridotitic wall rock and metasomatise it. The nature of this process will depend on the relative PT positions of the eclogite-CO₂ and peridotite-CO₂ solidii and on oxygen fugacity (f_{O_2}).

f_{O_2} is a fundamental control on CHO-fluid speciation. Garnet peridotite xenoliths suggest that subcratonic f_{O_2} s are consistent with CHO-fluids dominated by reduced CH₄ and H₂O, rather than by oxidised carbonate [4,5]. However, f_{O_2} conditions in discrete eclogite bodies in peridotite-dominated mantle are not well constrained, but may be higher than peridotite [6]. CH₄+H₂O fluids percolating from reduced peridotite into relatively oxidised eclogitic domains in the mantle may oxidise to H₂O-dominated, or carbonate-rich fluids/melts on the graphite saturation curve. This may induce redox melting at H₂O undersaturated solidii, in the deep cratonic lithosphere or asthenosphere, leading to production of siliceous partial melts, residual biminerally eclogite and precipitation of diamond.

References

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