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Thermodynamic constraints on talc formation via Si-metasomatism of ultramafic rocks along the slab-mantle interface

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Talc is a hydrous and mechanically weak mineral found in serpentinized peridotites in oceanic settings and exhumed high-pressure rocks from subduction zones. In subduction zones, talc is thought to form during the metasomatism of ultramafic rocks by silica-rich fluids released from dehydration of hydrous minerals in the subducting slab. Its formation and distribution in subduction zones are believed to profoundly affect the volatile budget, rheological properties, and the down-dip limit of the coupling-decoupling transition of the slab-mantle interface. Therefore, illuminating the processes that facilitate talc formation at high pressure-temperature conditions are important in assessing its importance in plate interface processes. Here we present thermodynamic reaction-path models to evaluate the reactions between slab-derived Si-rich fluids and ultramafic rocks over a range of pressures and temperatures relevant to subduction zones. In particular, we assess different fluid-rock interactions involving serpentinite or mantle peridotite reacting with a fluid that previously equilibrated with either a subducted metabasalt or a metapelite. We discuss the geochemical and petrological controls on talc formation, and highlight the rheological and geochemical implications of Si-metasomatism of ultramafic rocks in subduction zones.