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Carbonation of serpentinites by partly reduced metamorphic COH-fluids: petrological and in-situ carbon isotope evidence from the Baie Verte Ophiolites, Newfoundland

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Subduction zones have an important role in the deep Earth carbon cycle, since the dehydration of the oceanic sequence releases CO_2-bearing fluids that interact with serpentinized mantle wedge peridotites, forming unique lithologies such as listvenites. The sources and characteristics of CO_2-bearing fluids can be inferred from the $\delta^{13}C$ values of carbonate minerals precipitated during serpentinite carbonation. Here, we present petrological and in situ carbon isotope results of two carbonated ultramafic sequences from the Baie Verte Ophiolite (Newfoundland, Canada). Carbon isotope compositions of magnesite and dolomite were obtained using Secondary Ion Mass Spectrometry with composition-matched reference materials to correct drift and matrix effects. The ultramafic rocks are from the Point Rousse (T = 230–350 ºC, [1]) and Advocate (T ≈ 300 ºC, [2]) complexes, and consist of ophicarbonates (≤ 13 wt% CO_2), antigorite-bearing soapstones (antigorite–talc–carbonate rocks, 11–18 wt% CO_2), quartz-bearing soapstones (quartz–talc–carbonate rocks; 24–34 wt% CO_2), and listvenites (37–40 wt% CO_2). Bulk rock Fe^{3+}/Fe_{Total} values shows a systematic decrease during the carbonation process, decreasing from 0.6 to 0.1 in Point Rousse and from 0.8 to 0.1 in Advocate. Substantial reduction already occurs at low degrees of carbonation in Advocate (~5 wt% CO_2), while in Point Rousse the main reduction is observed during the formation of quartz-bearing soapstones (25 wt% CO_2). Magnesite grains show complex iron-rich zoning in both sequences. In-situ $\delta^{13}C$ analyses of magnesite range from -9 to -3‰ in Point Rousse and from -10 to -2‰ in Advocate (values relative to VPDB). Dolomite exhibits a comparable $\delta^{13}C$ range of -11 to -3 ‰ in both sequences. Taken together, we propose that the reduction, the Fe-zoning in carbonates, and the large variation in negative $\delta^{13}C$ values all point to carbonation driven by partly reduced metamorphic COH-fluids, potentially derived from fluid mixing and devolatilization of graphite and carbonate bearing metasediments from the partially subducted Laurentian passive margin.

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References:
[1] Garduño-Torres et al. (2026), EGU26-13709.
[2] Menzel et al. (2018), *Lithos 323, 238-261.*