Massive Mg-rich fluid release across the brucite + serpentine reaction in subduction zones

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Résumé

Aqueous fluids in subduction zones are relevant due to their role in deep water and element cycling, seismicity, mantle wedge hydration and magma production. One of the major carrier of water production are serpentinites, containing around 13wt.% H2O. In subduction zones, serpentinized oceanic mantle is expected to dehydrate above 600◦C. Analysis of compilatory bulk composition of oceanic serpentinites and those exhumed in subduction collision zones shows that brucite (Brc) is also an important hydrous component (30wt.% H2O) of the subducted oceanic mantle, capable of carrying water to depth. The Atg+Brc=Ol+H2O reaction (R1) is thus highly relevent to deep subduction. Depending on the initial bulk composition of the serpentinized mantle, R1 can release more water than the Atg-out reaction. According to updated thermochemical data, Atg+Brc dehydration must occur in a narrow temperature range (< 30 ◦C), implying relatively high dehydration rates. Thermochemical modeling shows that the fluid released during R1 is highly magnesian (> 1 mol/kg) with MgOaq as the dominant aqueous species. The products of this reaction can be identified in metamorphic serpentinites from Zermatt-Saas (Swiss Alps) and Mont Avic (Italian Alps) ophiolites, which were involved in alpine subduction and exhumed. Strong Mg segregation can be identified by the formation of metamorphic olivine and titano-clinohumite veins, which is in agreement with thermodynamical modeling. These veins are crosscut by brucite veinlets that confirms the involvement of an Mg-rich fluid that interacted with the host rock for around a hundred years before being drained. Metamorphic olivine have high Mg content (Mg# > 92) compared to the mantellic ones (89 < Mg# < 91) and brucite are pure magnesian (Mg# > 99) single crystals. Dehydration processes of serpentinite in subduction zones can induce seismicity in these regions. Low Frequency Earthquakes recorded in the Mexican, Nankai and Cascadian subductions were located in a P-T diagram where they plot near the Atg-Brc reaction, supporting of the central role played by R1 as a main source of fluid in subduction zones.

Mots-Clés: Brucite, Metamorphic olivine, Serpentinite dehydration, Thermodynamic modeling, LFE, Zermatt, Saas ophiolite

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