Listwanitization as a source of Mg for dolomitization: field evaluation in Atlin, British Columbia

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Most basinal brines, commonly invoked as source fluids for hydrothermal dolomite (HTD), have low Mg/Ca ratios and thus limited dolomitization potential. Interaction with primary mafic minerals (olivine and pyroxene) provides an alternative source for Mg, but the mechanism for extracting significant volumes of Mg from these minerals is unclear as secondary minerals (chlorite and serpentine) tend instead to sequester Mg from solution. Subduction-related fluids charged with magmatic CO_2 can drive carbonation (listwanization) of ultramafic lithologies, forming a quartz-carbonate assemblage. Serpentine dissolution is accompanied by simultaneous precipitation of magnesite and quartz. Upon serpentine exhaustion, fluid pH drops and magnesite dissolves (replaced by quartz), resulting in a fluid enriched in Mg. There is debate regarding the degree to which listwanitization is isochemical in various localities.

In Atlin, listwanites formed *in situ* post-orogeny, are exposed immediately adjacent to limestones. Limestones are significantly dolomitized and silicified, with zebra-fabrics and large breccia bodies. Rims of thick (1cm) pore-lining saddle dolomite cements are rich in both nickel (115ppm) and iron (48,300 ppm), with light carbon and oxygen isotopes (-0.26 to -0.04 $\delta^{13}C_{vpdb}$ and +1.01 to +1.57 $\delta^{18}O_{vsmow}$). Pore-filling dolomite is relatively metal poor (~10,000ppm iron and undetectable nickel), and isotopically heavier (+1.94 to +1.89 $\delta^{13}C_{vpdb}$ and +2.32 to +3.33 $\delta^{18}O_{vsmow}$). Elevated metal concentrations appear to correlate with mobility of elements interpreted from whole rock data such as Ni, although prior listwanite studies report no leaching of Fe or Mg. Isotopic signatures indicate dolomite precipitation from hot meteoric fluids.

The proximity and volumetrically significant quantities of HTD suggest Mg-rich fluid originating from the listwanite is responsible for dolomitization and associated silicification. Under conditions of high CO_2 and temperature (150-300^{o}C) listwanitization may be an Mg source for dolomitization, including in rift settings.