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Pseudomorphic replacement of diopside during interaction with (Ni,Mg)Cl_2 aqueous solutions

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Diopside – Talc assemblages are commonly found in calc silicate rocks such as dolostone during contact metamorphism. Contact metamorphism generally involves significant mass transport on a local scale, and hence can be considered as a metasomatic reaction. Over a wide range of pressure and temperature, in the presence of a fluid phase, dissolution-reprecipitation is kinetically more favourable mass transport process over solid state diffusion. During diopside - (Ni,Mg)Cl_2 solution interaction, diopside is pseudomorphically replaced by talc and serpentine up to 600^OC [1].

We present an experimental investigation of the interaction between diopside and choride solutions of different pH and composition to observe the replacement reaction mechanism and behaviour of elemental redistribution. Two different fluid compositions were used i.e. 1M $NiCl_2$ and 1M (Ni,Mg)Cl_2. Experiments were carried out in cold seal pressure vessel at up to 600^OC and 1 kb pressure for duration of 15 days in gold capsules. The solutions were also enriched with various trace elements. SEM and microprobe analyses have been carried out on reacted samples to observe textural and compositional features.

Detailed SEM observation have revealed a $\sim 40\mu$m thick replaced zone for both types of solution compositions. Although different zone thicknesses were also present, this depended on the availability of fractures and other solution pathways in the crystals. The replaced zone shows subsequent removal of Ca from its preliminary composition and enrichment of both Ni and Mg from the fluid. In the case of pure $NiCl_2$ solution, two different replacement zones have been observed where low Ni-Talc ($\sim$14%) was again replaced by high Ni- Talc ($\sim$33%). In the case of (Ni,Mg)Cl_2solution, dioside was replaced by Ni talc that in turn was again replaced by serpentine. The sharp compositional change at the diopside talc interface can be explained as evidence of dissolution-reprecipitation reaction during mineral fluid interaction. However, there is also a significant enrichment of Ni ($\sim$0.25%) within the diopside close to the reaction interface. This suggests that some Ni may have diffused into the diopside at these temperatures and pressures, although analyses at higher spatial resolution may be required to determine whether this is an artifact. Further work is needed to determine the relative importance of dissolution-precipitation, and solid state diffusion during these reactions.

[1] Velde, B (1988) Experimental pseudomorphism of diopside by talc and serpentine in (Ni,Mg)Cl_2 aqueous solutions. Geochim Cosmochim Acta, 52: 415-424.