

The speciation of sulphur released in fluids from sulphide-bearing serpentinite

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Serpentinites dehydrate at sub-arc depth and have been shown to be involved with arc melting and metasomatism (e.g., [1], [2]). The oxidation state of sulphur in fluids released from serpentinites is controversial because serpentinites are oxidized as they contain a portion of their iron as ferric iron in magnetite and serpentine minerals [3], however, they are likely to contain sulphides [4].

We performed high-pressure experiments in which FeS-enriched natural antigorite-bearing serpentinite was dehydrated at 2.5 GPa and 700°C for 4-6 days, such that the released hydrous fluid would pass through a hot-pressed orthopyroxene core and react with MgO on the other side to form brucite. A final layer was comprised of MgO and 5 wt.% of Fe metal. On the relatively short time scale of the experiment water did not pass through the Opx layer. However, Fe-metal in the lowest layer completely oxidised to produce magnetite, pyrrhotite and magnesite. It is possible, therefore, that both sulphur and carbon were transported by a very mobile oxidised, fluid phase.

In order to isolate the fluids released from serpentinite a second type of experiment was performed: the same natural serpentinite was dehydrated, and synthetic fluid inclusions were formed in quartz at the same experimental conditions as those in the first type of experiments. Raman spectra of the fluid inclusions appear to contradict the results of the first type of experiment, as they contained, in addition to water, the reduced species H₂S and CH₄ and no sign of oxidised sulphur species. Longer experiments produced inclusions with more CH₄, so it is possible that reduction is occurring in these experiments through the ingress of H₂ from outside of the capsule. Thermodynamic calculations indicate that the switch in dominance between reduced and oxidised sulphur species in water-rich fluids occurs in vicinity of the oxygen fugacities of the experiments.

[1] Rüpke et al. (2004), *EPSL*, 223, 17-34.

[2] Scambelluri & Tonarini (2012), *Geology*, 40, 907-910.

[3] Evans (2008), *J. Petrol.*, 49, 1873-1887.

[4] Frost (1985), *J. Petrol.*, 26, 31-63.