New internally consistent data and activity composition models for S-bearing phases, and application to thermodynamic modelling of mafic greenschist facies rocks from the St. Ives gold camp, Western Australia

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Sulphur is ubiquitous in many ore-forming environments and plays a critical role in that it combines with with metals of economic interest in aqueous species and minerals. Prediction of the relative stability of S-bearing phases and aqueous species is a valuable tool in the formulation of conceptual models for ore formation. However, sulphur-bearing phases have proved difficult to incorporate rigorously into thermodynamic models, because of non-ideal mixing relationships and the difficulty of defining equations of state for materials with multiple phase changes.

Here we present an augmented version of the Holland and Powell (1998) internally consistent dataset [1] that includes common S-bearing phases. A thermodynamic description of the troilite-pyrrhotite solid solution series has been formulated that agrees well with experimental heat capacity data and studies of activity-composition relationships.

The dataset, which is incorporated into the thermodynamic modelling software THERMOCALC, has been used to construct pseudosections, which are phase diagrams for a specific bulk composition, for rocks with bulk compositions similar to those that host gold at the St. Ives gold camp, Western Australia. The results demonstrate that observed accessory phase assemblages, which have been attributed to mixing between mixing between oxidised and reduced fluids, are also consistent with gradients in temperature, fluid composition, and extent of water:rock interaction.

[1] Holland & Powell (1998) *J. Met. Geol* **16**, 309-343/

(U-Th)/He Magnetite dating of exhumed serpentinized mantle: A case study from the Tasna Ocean-Continent Transition, SE Switzerland

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The development of magnetite (U-Th)/He dating offers unprecedented potential for direct dating of serpentinization and mantle exhumation. While mantle rocks do not contain mineral phases typically used in geo- and thermochronometric studies, magnetite is ubiquitous as it forms from the breakdown of olivine during serpentinization. It has been shown in basaltic rocks that magnetite can be dated reliably by (U-Th)/He thermochronometry and is characterized by a He closure temperature of ~250°C. The novel application of magnetite (U-Th)/He thermochronometry on exhumed serpentinized mantle would provide critical age constraints on continental breakup during rifting of magma-poor continental margins. Serpentinization of exhumed mantle rocks has been proposed to occur during the final phase of rifting during continental break. Direct dating of mantle exhumation and serpentinization, therefore, would not only constrain the timing of continental rupture, but also elucidate the duration of tectonic processes leading from rifting and continental attenuation to continental break-up.

The ocean-continent transition (OCT) preserved in the Tasna nappe of SE Switzerland provides an ideal area to undertake a systematic study on the viability of magnetite (U-Th)/He thermochronometry of exhumed sublithospheric mantle. The Tasna OCT is comprised of a sliver of highly attenuated continental basement juxtaposed against serpentinized mantle peridotites along a low-angle normal fault system and capped by Cretaceous to Eocene post-rift sediments. Magnetite (U-Th)/He data from the serpentinized mantle combined with zircon (U-Th)/He data from the thin wedge of continental basement across the Tasna OCT will provide new constraints on mantle exhumation and give insight to the sequence and timing of processes that occur in a more general sense at OCTs in magma-poor rift margins.