Hydrous partial melting of S-rich sediments in subduction zones: An experimental approach

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Sediment partial melting is commonly required for key trace elements (such as Th) to be efficiently transferred into the mantle wedge in modern subduction zones. Recent high pressure experiments have already constrained phase relationships of crustal lithologies for pressure-temperature conditions relevant to sub-arc depths [1]. However, the effect of volatile elements – especially sulfur – on phase relationships and compositions in sedimentary systems remains poorly constrained [2]. Neverthless, experimental and geochemical evidence suggest that the sub-arc mantle is significantly enriched in sulfur, relative to MORB mantle, following percolation by a metasomatic agent expelled from subducted lithologies [3].

Using piston-cylinder apparatus, we performed melting and crystallization experiments (3 GPa; 800-1000°C; fO_2 ~ NNO+1) on a natural Ca-poor pelitic lithology undoped in trace elements with variable water (5 and 8 wt%) and sulfur (0 - 1 and 2 wt%) contents.

In most run products, peraluminous granitic melt coexists with garnet, kyanite, coesite and rutile. Sulphide and orthopyroxene appear in S-doped experiments. Sulfur solubility in hydrous melts ranges from about 200 and 1000 ppm. Increasing sulfur contents (at constant T and H_2O_{in}) in pelitic lithologies affects phase relations by increasing significantly the degree of partial melting and by destabilizing garnet in favour of orthopyroxene. The consumption of garnet for S-doped experiments leads to an increase of Mg# and a decrease of LREE-HREE fractionation in silicate melts.

These results show that S must be taken into account in geochemical models aimed at quantifying the role of sediments in arc magma petrogenesis. Though preliminary, these results suggest that the peraluminous metasomatic agent issued from the hydrous melting of a sediment moderately enriched in S (< 2 wt%) does not transport significant quantities of sulfur into the mantle wedge.

[1] Hermann & Spandler (2008) *J. Petrol.* **49**, 717-740. [2] Prouteau & Scaillet (2013) *J. Petrol.* **54**, 183-213. [3] Brandon *et al.* (2014) *Goldschmidt Abstracts* **2014** 267.