Deep cycle of sulphur: the role of subducted sediments

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It is widely accepted that sediment-derived silicate melts are required to efficiently tranfer key trace elements (Be, Th) towards the mantle wedge [1,2]. If recent experimental studies highlight the role of H_2O, CO_2 or halogens (Cl, F) during the partial melting of subducted sediments, effect of sulphur remains poorly constrained [3]. Yet, this volatile element is often mentioned as a potential oxidising agent of the mantle wedge (as S^{6+}) [4] and geochemical studies show that sub-arc mantle is significantly eniched in S relative to MORB mantle following the percolation of a metasomatic agent expelled from subducted lithologies [5]. The main purpose of this study is to evaluate the ability of different sediment-derived silicate melts to transfer sulphur in the sub-arc mentle.

Using piston-cylinder apparatus, we performed melting experiments (3 GPa ; 750-1000°C ; fO_2 ~ NNO-NNO+1) on two types of natural, trace-element undoped and volatile-rich sediments: (1) a Ca-poor pelite and (2) a marlstone. These compositions correspond to the two main endmembers of sediments subducted worldwide. For the purpose of this study, some experiments were doped with elemental sulphur (1 and 2 wt%).

Silicate melts produced by the fluid-present melting of the pelite range from trondhjemitic to granitic compositions and are broadly peraluminous (A/CNK until 3.02). S contents in these melts range between 72 to 1033 ppm with a maximum at 850-900°C. For fluid-present melting of the marlstone, produced silicate melts are granodioritic and metaluminous or slightly peraluminous (0.95 < A/CNK < 1.07). S contents range from 371 to 2985 ppm and increase with the temperature. Preliminary results (raman spectroscopy) show that S can be dissolved as SO_4^{2-} (S^{6+}) in silicate melts derived from the pelitic sediment.

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