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2D geochemical-thermomechanical modelling of Pb, Hf, Sr and Nd isotopes evolution in intra-ocean subduction zones

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Isotopes behave differently in different processes involved in a subduction zone such as slab dehydration, mantle wedge hydration and partial melting. Therefore, they are indicative of when and where different processes are active. The aim of this study is to extend the 2D coupled petrological- thermomechanical numerical model (I2ELVIS) of intra–oceanic subduction processes to include a treatment of isotopic signatures. With this extension we hope to gain more insights into the recycling system within the mantle wedge and are able to visualize the interaction between slab components and the depleted mantle. This will allow us to draw conclusions from isotopic signatures in arc lavas about the involved chemical processes.

A chemical contamination of slab components with wedge peridotite leads to specified signatures in arc magmas. Two slab components play a key role in this contamination: first, the altered oceanic basalt crust, and second its thin layer of sediment (e.g. Poli & Schmidt, 2002). Based on these results and the well known enrichment of LILE, Pb, U, and Th as well as the decrease of HFSE, Nd and Hf in island arcs in respect to the N-MORB, we focus on a limited number of elements (Pb, Hf, Sr and Nd) for our numerical model.

Our first results show that combination of finite differences and marker in cell techniques allows successful coupling of thermomechanical evolution of subduction with mobilisation, transport and radioactive decay of isotopes. Preliminary modelling results reconcile well with observations. Particularly, our models predict a significant increase of Strontium and Lead and a slight increase of Hafnium and Neodymium in the newly formed magmatic arc crust relative to the depleted mantle (DMM), which is comparable with data from the literature. In addition, our model confirmed the evidence for slab derived fluid /melt in the newly formed crust.