Mixing at the plate interface and its importance for convergent margins

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We recently proposed an integrated physico-chemical model of subduction zones that includes mélange formation at the slab-mantle interface as the dominant physical mixing process in subduction zones, as well as low-density mantle-wedge diapirs that transport the well-mixed materials into the hot corner of the mantle wedge beneath arcs [1].

The strong petrologic and chemical contrast at the slab-mantle interface leads to the production of hybrid rock compositions by metasomatic reactions, diffusion, advection, and mechanical mixing. Exposures of these rocks may be streated as kilometre-scale natural laboratories that allow us to investigate the mechanisms and products of mixing of mafic, sedimentary and ultramafic components at a variety of relevant *P*-*T* conditions. The importance of hybrid rock types at the slab-mantle interface is manifold: (1) the new mineralogy affects the redistribution of major and minor elements, creating mixed compositions composed of the three initial components; (2) the newly formed mineral assemblages have significant potential for storing and releasing H_2O and other volatiles; (3) these new rocks have a low mechanical strength and may lubricate the slab surface, influencing mechanical flow and hence the seismic response of subduction and the thermal structure of the slab-mantle wedge system; and (4) growth of low-density layers may lead to mechanical instabilities on the slab surface that lead to the exhumation of high-*P* rocks and trigger the formation of mantle-wedge plumes. The latter may transport volatiles and slab materials into the source region of arc magmas and contribute to subduction-zone magmatism.

These mélange plumes may partially melt in the hot corner of the mantle wedge due to heating and decompression, or their interior parts may dehydrate and flux-melt the overlying mantle-wedge harzburgite. The combination and degree of contribution of all these processes may produce the large range of major and trace-element compositions found in modern island arc volcanic rocks.

[1] Marschall, Schumacher (2012) *Nature Geosci.* **5** 862–867