



Geochemical implications of melange zones at the slab-mantle interface

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The slab-mantle interface is characterised by chemical and mineralogical contrasts between crustal rocks composing the slab and ultramafic rocks of the mantle. It is also a zone of strong mechanical activity as subducting slabs are moving with velocities of cm/a. Therefore, the formation of mélanges of rocks formed by mechanical and metasomatic mixing at the slab-mantle interface is an intrinsic process of subduction, with evidence coming from numerical modelling and from various field studies. In areas of exhumed high-pressure metamorphic rocks occurring in all orogenic belts around the globe, mélangé zones are almost ubiquitous. They consist of metaigneous, metasedimentary and ultramafic blocks or schistose material, accompanied by varying portions of hybrid rock types.

Studies on exhumed high-pressure mélanges demonstrate the impact of these hybrid rock sequences on the budget of certain trace elements. The chemical compositions of hybrid mélangé rocks have no equivalent in the oceanic lithosphere, stabilising minerals in proportions never observed in chemically unchanged metamorphic rocks. This has a pronounced impact on the rocks' mechanical properties, and on their ability to sequester certain trace elements. Consequently, mélangé rocks display a strong fractionation of parent/daughter ratios of radiogenic isotope systems, while stable isotope signatures are products of various mixing parameters, such as fluid mobilities and diffusion rates of the elements involved.

The juxtaposition of the contrasting rock types (peridotite/serpentinite with crustal rocks) drives dehydration reactions that would not occur where each bulk composition

is considered separately. As a result, these reactions make an uncounted and not fully characterised contribution to the water budget for a dehydrating slab. The physico-chemical and mineralogical processes controlling dehydration and remobilisation of elements stored in the metasomatic reaction zones have to be accounted for in the geochemistry of crustal recycling.