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Metasomatic formation and petrology of mélange rocks from Syros (Greece): implications for subduction zone element cycling

D. P. Miller (1,2), H. R. Marschall (1), J. C. Schumacher (1)

(1) Dept. Earth Sciences, University of Bristol, Wills Memorial Building, Queen's Road, Bristol, BS8 1RJ. U.K., (2) Dept. Erdwissenschaften, ETH Zürich, Institute for Mineralogy Petrology, Zürich, CH-8092, Switzerland (david.miller@erdw.ethz.ch / Phone: +41 44 632 78 19)

The interface between subducting crustal rocks and the harzburgitic mantle is characterised by striking petrologic and chemical contrasts. Disparities between essentially every chemical species leads to the formation of chemical potential gradients resulting in the development of metasomatic (blackwall) reaction zones above the subducting slabs. Fluids released during slab dehydration have to pass from the metabasites and metasediments of the slab into the ultramafic rocks of the mantle as they migrate upwards. This overall alteration of rock chemistry leads to profound changes in the properties of the fluid and results in the formation of new mineral phases and assemblages in the metasomatised rock.

Here we examine the mélange zone of northern Syros, where sedimentary, mafic and ultramafic lithologies are juxtaposed and metamorphosed to blueschist-facies conditions, providing a natural laboratory to study the physico-chemical and mineralogical processes operating at the slab-mantle interface at intermediate depths. Metasomatic assemblages containing glaucophane + epidote + chlorite; chlorite + titanite; omphacite + epidote + chlorite $\pm$ tourmaline and chlorite $\pm$ rutile $\pm$ apatite were formed during exhumation at intermediate pressures ($\sim$0.6 – 1.2 GPa). Formation of these hybrid assemblages at the contact of a metasedimentary (glaucophane + epidote + phengite + garnet) schist and serpentinite was enhanced by the influx of hydrous

fluids. In addition, a wide range of accessory phases (apatite, allanite, rutile, titantite, tourmaline, zircon and monazite) formed in the reaction zone during metasomatic exchange.

Hybrid rocks above the subducting slab carry exotic trace-element patterns and isotopic signatures and are formed at shallow depth (20 to 70 km) above zones of major dehydration in the footwall. Subsequent burial of these metasomatised rocks as part of the progressively subducted slab could deliver trace elements and volatiles to the arc-magma source region. Hence, the geochemical signatures observed in arc magmas may be derived from mechanical mixing of hybrid rocks into the mantle wedge rather than from direct slab-source melting and dehydration of metasediments or metabasic sequences. Our model implies that the influx of fluids into the mantle wedge and the arc-magma source region is not solely and directly governed by dehydration reactions in metasediments, metabasites or serpentinite within the subducting slab, but rather by the (in-)stability of hybrid metasomatic assemblages at the slab-mantle interface.