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Metasomatic modification of oceanic crust during early stages of subduction recorded in Mariana blueschist

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Serpentine mud volcanoes from the Mariana forearc bear unique witness of metasomatic processes in an active subduction zone in the form of centimeter-size blueschist-facies xenoliths. Charcateristic metamorphic assemblages point to conditions of ca 400°C and a formation depth of 27 km. Bulk rock compositions of amphibole-talc schists and chlorite-rich schists lie on a mixing line, extending from typical MORB towards SiO_2-enriched mantle. Such mixing trends are remarkably similar to findings from the amphibolite-facies assemblages of the Catalina schist, although they equilibrated at much lower temperatures (Pabst et al. 2012). These observations demonstrate that the material experienced severe metasomatic changes at the slab-mantle interface in the shallow forearc. Further supporting evidence derives from δ11B measurements: phengite, amphibole and chlorite within the clasts have boron isotope values of -6$\pm$4‰ significantly lighter than oceanic crust, requiring isotopic fractionation by fluids carrying an isotopically heavy B component (Pabst et al. 2012).
Although most current models assume that the Mariana blueschists record conditions of the ongoing subduction process, our recent findings indicate otherwise. Large (>100 μm) rutiles with high U (ca 20 ppm) found in one blueschist clast were dated by HR-SIMS at UCLA employing recently established U/Pb dating techniques (Schmitt & Zack 2012). Rutile concordia ages were tightly constrained at 48.1$\pm$2.9 Ma and are reproduced by concordia ages of low Th/U zircons at 47.5$\pm$1.5 Ma in the same sample. As those ages are interpreted to be formation ages of metasomatically modified blueschists and are only a few million years older than subduction initiation (at ca 50-52 Ma), we draw the following conclusions: (1) fast cooling of the downgoing oceanic crust must occur right after subduction initiation; (2) effective metasomatic and mechanical mixing processes (subduction channels?) must be established early in subduction zones and (3) the forearc mantle (source region of serpentine mud volcanoes) must contain stable areas where 48 Ma old low-grade samples are not being reset.
Pabst S et al. 2012: Lithos 132-133, pp. 162-179; Schmitt AK & Zack T 2012: Chem Geol 332-333, pp. 65-73.