



Metamorphic conditions of blueschist erupted from serpentinite mud volcanism in the Mariana forearc

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From ca. 52 Ma to present, the western Pacific plate has been subducting under the Philippine Sea plate, forming the oceanic Izu-Bonin-Mariana (IBM) subduction system (Stern and Bloomer, 1992). It is the only known location where subduction zone products are actively transported to the surface by serpentinite-mud volcanoes (e.g., Pabst et al., 2012). In the southern Mariana segment, volcanoes sample the slab surface at a depth of ~ 27 km (Pabst et al., 2012), allowing a unique window into the processes operating at these depths. A large volcano forms the South Chamorro Seamount, 85 km to the west of the trench, and was drilled by ODP during leg 195. This returned serpentinite muds, large serpentinitized peridotite blocks as well as small (1mm – 1cm) clasts of mafic lithologies that typically record blueschist-facies conditions. One mafic chip contains abundant amphibole and chlorite, as well as epidote, clinozoisite, rutile, titanite, clinopyroxene and pumpellyite. Phase equilibria modelling suggests that this clast reached conditions of ~ 1.45 GPa and ~ 570 °C, well exceeding those expected at the base of the Chamorro seamount. The calculated thermobarometric gradient (~ 370 °C/GPa) is slightly warmer than those predicted by typical numerical models for blueschist-generating subduction worldwide (Penniston-Dorland et al., 2015). U–Pb rutile and zircon data from Zack et al. (2013) indicates the high-pressure mineral assemblage formed ca. 49 Ma. Therefore, we interpret that this high-pressure assemblage formed at a depth of ~ 50 km within the subduction channel during the onset of subduction, and was exhumed to shallower depths below the seamount prior to eruption. This provides a modern example of forced return flow of material from depth within a subduction channel, a behaviour predicted in numerical models and suggested for exhumation of high-pressure rocks from palaeosubduction zones. It also demonstrates that high-pressure material can be trapped within subduction zones for significant periods of time without being exhumed. Such behavior has been inferred for ancient subduction systems. However, the Mariana system shows that long-term retention of subduction products occurs in modern oceanic subduction settings.

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