Role of the forearc in the geochemistry of subduction zones: new insights from the IODP expedition 366

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The Mariana forearc is a unique setting on Earth where forearc ultramafic clasts, originated at depths greater than 20 km, are exhumed at the surface. These rocks are serpentinized by interaction with slab derived fluids during the onset of subduction. They provide a record of the forearc mantle dynamic and fluid geochemistry at depth. We take advantage of the International Oceanic Discovery Program expedition 366 to study serpentinized ultramafic clasts contained in the serpentine muds of three different mud volcanoes located at increasing distance from the trench: Yinazao (55 km), Fantangisña (65 km) and Asùt Tesoru (70 km).

Our study reveals that the ultramafic clasts record two succesive stages of serpentinization: the early crystallization of brown serpentine composed of a mixt of Fe-rich brucite and chrysotile and/or lizardite; the formation of antigorite in equilibrium with magnetite and Fe-poor brucite at the expense of brown serpentine. The transition of lizardite to antigorite is enhanced by an increase of temperature from 200°C up to 410°C within the forearc area. This metamorphic evolution is compatible with a progressive burial of the forearc mantle wedge during subduction allowing us to track the evolution of slab derived fluid chemistry with depth. We attempt to constrain the composition and redox state of slab derived fluids by combining redox measurments, trace element and novel stable isotope (Fe, Zn) analyses. The results suggest that the serpentinization of the fore arc mantle wedge area can enhance H_2 production, while the dragged down residue will be progressively warmed-up until its dehydration at greater depth where it will contribute to arc magmas genesis.