Syros, blocks and matrix structure: evolution of a mélange along the subduction interface

Thomas Gyomlai, Philippe Agard, and Laurent Jolivet  
Sorbonne Université, CNRS-INSU, Institut des Sciences de la Terre de Paris, ISTeP UMR 7193, 4 pl. Jussieu, Paris 75005, France

The nature and processes occurring at the subduction plate interface remain poorly constrained. In particular, the behavior of fluids and its impact on the rheology and the chemistry of the plate interface are mostly unknown. Based on detailed fieldwork, petrographic, geochemical analyses and thermodynamic modelling, the present study documents an example of a reacted “mélange” and metasomatism along the subduction interface: the Lia mélange zone on Syros island. Syros island is located in the Cycladic Archipelago in the centre of the Aegean domain which corresponds to the deepest exhumed parts of the Hellenides–Taurides belt. We show that this particular mélange zone is a disrupted yet still relatively coherent fragment of transitional lithosphere (i.e., OCT type from the Pindos Ocean), which has undergone dominant exhumation-related deformation with top to the east shearing. A large part of the “mélange” structure is inherited from the initial lithostratigraphic setting. Through detailed mapping and a statistical study of the nature of blocks and matrix we show that, as a first approximation, metasomatism occurs in contact between metavolcanite layers and serpentinite, with diffusion of Ca from the metavolcanites to the matrix and diffusion of Mg from matrix to metavolcanite. Most of the metavolcanite layers and blocks (mafic and carbonate) are mostly only partly digested but the ultramafic matrix has been largely metasomatised forming a tremolite-chlorite-talc schist, a “hybrid” rock, with an intermediate chemical composition. Geochemical data suggest that exhumation-related metasomatism is probably triggered and/or enhanced by the arrival of fluids from the dehydrating slab underneath. The Lia mélange zone shows that hybrid rocks can be formed by metasomatism along the subduction interface. Due to the absence of major tectonic mixing and of evidence of prograde reactions, this metasomatism may not be representative of deeper hybridization (as a potential source of arc volcanism). However, by changing the mineralogy of the matrix, the metasomatism changes the rheological properties of the mélange and thus could impact that of the subduction interface and the exhumation processes. This study highlights the significance of rock hybridization through metasomatism, largely in the context of a syn-convergent exhumation, along the slab interface and emphasizes its potential chemical and rheological impacts.