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Phyllosilicate precipitation in sediment and sill from the Guaymas basin : proxies for post magmatic and hydrothermal fluid circulation

Martine Buatier[1], Alban Cheviet[1], Marie Gameiro[1], Flavien Choulet[1], and Ivano Aiello[2]
[1]Université de Franche Comté, UMR ChronoEnvironnement, Département Géosciences, Besançon, France (martine.buatier@univ-fcomte.fr)
[2]Moss Landing Marine Laboratories, San Jose State University, USA 5. Department of Geological Sciences, California State University, Northridge, USA

The Guaymas Basin in the Gulf of California represents the nascent stage of an ocean, characterized by siliceous organic-rich sediments (diatom ooze) deposited at very high sedimentation rates. The basin is also characterized by a dense network of shallow mid-Pleistocene to recent sills that have intruded the subseafloor over a distance of several tens of kilometers from the spreading axis. These magmatic intrusions produce heat anomalies and sediment transformations in the contact aureoles that affect both organic and inorganic compounds, such as cracking of sediment OM, dehydration and dissolution of mineral phases, creation of porosity and convection of hydrothermal fluids. We focus our investigations on the phyllosilicates (clay minerals) that formed at the contact between the sill and the sediment (IODP Expedition 385, Sites U1546 and U1550): overall our results support the intepretation that these hydrated minerals can be used as proxies for fluid-rock interactions. In our study, we investigate sediment and sill samples from the contact zones by combining XRD analysis of oriented samples (< 2 and <16 µm fractions) with optical and SEM observations. The XRD patterns from the clay fractions of the siliceous claystones suggest that the background (non metamorphosed) sediment of the Guaymas basin is mainly composed of detrital smectite, kaolinite and illite. However, in both the lower and upper aureole, the contact sediment displays a different clay assemblage characterized by the occurrence of mixed-layer smectite and chlorite. In the sediment located just above the sill contact at Sites U1546 and U1550 the corrensite (a regular smectite-chlorite mixed-layered) is also present. SEM images support the interpretation that this mineral is authigenic and occurs together with with euhedral pyrrhothite and quartz suggesting that it precipitated from hydrothermal fluid circulation. The magmatic sill is associated with two types of phyllosilicates. One is mica (biotite composition) which occurs as large crystals (~50 to ~100 µm) intergrowths with magmatic plagioclase suggesting a magmatic origin. The other one, smectite aggregates filling vacuoles and replacing magmatic glass, is widespread in most basaltic samples. The latter is a trioctahedral Mg-Fe smectite (Saponite) with K or Na in the interlayer. The formation of the smectites suggest that basalt further interacted with connate fluids or seawater and that a significant hydratation of the basalt is located at sediment contact.

Authigenic phyllosilicates are abundant at sediment-sill interface, they registered the last stages of the fluid-rock interaction probably related to hydrothermal fluid circulation.