Geophysical Research Abstracts
Vol. 19, EGU2017-13348, 2017
EGU General Assembly 2017

Global rates of mantle serpentinization and H2 release at oceanic transform faults

Lars Ruepke (1) and Joerg Hasenclever (2)

(1) GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (lruepke@geomar.de), (2) MARUM Center for Marine Environmental Science, University of Bremen, Germany

The cycling of seawater through the ocean floor is the dominant mechanism of biogeochemical exchange between the solid earth and the global ocean. Crustal fluid flow appears to be typically associated with major seafloor structures, and oceanic transform faults (OTF) are one of the most striking yet poorly understood features of the global mid-ocean ridge systems. Fracture zones and transform faults have long been hypothesized to be sites of substantial biogeochemical exchange between the solid Earth and the global ocean. This is particularly interesting with regard to the ocean biome. Deep ocean ecosystems constitute 60% of it but their role in global ocean biogeochemical cycles is much overlooked. There is growing evidence that life is supported by chemosynthesis at hydrothermal vents but also in the crust, and therefore this may be a more abundant process than previously thought. In this context, the serpentine forming interaction between seawater and cold lithospheric mantle rocks is particularly interesting as it is also a mechanism of abiotic hydrogen and methane formation.

Interestingly, a quantitative global assessment of mantle serpentinization at oceanic transform faults in the context of the biogeochemical exchange between the seafloor and the global ocean is still largely missing. Here we present the results of a set of 3-D thermo-mechanical model calculations that investigate mantle serpentinization at OTFs for the entire range of globally observed slip rates and fault lengths. These visco-plastic models predict the OTF thermal structure and the location of crustal-scale brittle deformation, which is a prerequisite for mantle serpentinization to occur. The results of these simulations are integrated with information on the global distribution of OTF lengths and slip rates yielding global estimates on mantle serpentinization and associated H2 release. We find that OTFs are potentially sites of intense crustal fluid flow and are in terms of H2 release almost as important as MOR-related serpentinization.