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Ultra-slow spreading and hydrogen-based deep biosphere: Objectives and preliminary results of the H2DEEP project

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The notion of inorganic geochemical processes fueling a deep biosphere has gained support over the last ten years. Whereas the sulfur-based metabolism of black smoker systems is well accepted, it has more recently been suggested that oxidation of Fe^{2+} released by water-rock reactions may be a principal energy source for an extensive low-temperature, basalt-hosted deep biosphere. The finding of hydrogen and methane production by potentially exothermic ultramafic water-rock reaction implies that H_2/CH_4-based chemosynthetic ecosystems may be widespread in the deep ocean subsurface environment where water interacts with ultramafic rocks.

Ultraslow-spreading ridges consist of linked magmatic and amagmatic accretionary ridge segments where ultramafic, mantle rocks may be brought to the surface. The variability in thermal gradients and rocks types calls for a variety of hydrothermal systems. Peridotite hosted "Lost-City-type" vent-fields may be present next to basalt hosted, black smoker fields, and combinations of these, as well as unknown types may exist. A variety of deep-sea hydrothermal systems may presumably support a range of seafloor and subsurface hydrothermal biotopes.

The H2DEEP project of the EUROMARC program focuses on the southern Knipovich Ridge located in the Norwegian-Greenland Sea. This ultraslow spreading ridge show linked magmatic and amagmatic segments, as well as flank regions where lower crustal and mantle rocks are exhumed by low angel detachment faulting. Sediments derived from the nearby continental margin cover the eastern flank of the ridge and parts of the rift valley floor. The several hundred meters thick sedimentary deposits in parts of the rift valley floor provide a record of the volcanic and hydrothermal activity, as well as the tectonic evolution of the ridge. The sedimented rift valley provides a unique opportunity for zero-age core sampling, which potentially may provide new insight as to the existence of a hydrogen-based deep biosphere sustained by the formation and alteration of oceanic crust and mantle by ultraslow spreading.