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Insights into pore fluid geochemistry of the Azores Plateau: From early diagenesis to hydrothermal vents

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During the 2017 research cruise M 141 “Azores Tephra” of the German R/V Meteor to the Azores Plateau and Terceira Rift, pore water geochemistry of sediments from 27 gravity cores were analyzed for major elements and isotopic composition of 87Sr/86Sr, δ34S, δ26Mg, δ18O, δD, δ30Si, and δ11B.

We use this data set to characterize fluid sources of active hydrothermal vents, as well as the fluid evolution during early diagenesis. In general, pore fluids show a down-core decrease in Ca, while Na and K show no significant changes. A main component of the sediments are ash layers from volcanoes in the Azores archipelago. Early alteration of these ashes may result in a Ca-rich zeolite formation, and thus represent a potential sink of Ca. In contrast, Sr concentrations typically increase significantly, accompanied by rather constant 87Sr/86Sr ratios. Such a pattern has frequently been observed in similar pelagic sediments and is referred to calcium carbonate recrystallization within carbonate oozes.

Until now, only one submarine hydrothermal vent is known in the Terceira Rift at the D. Joao de Castro seamount. Our findings indicate that at least one further vent is active in the rift. Fluids here are significantly different from typical Mid-Oceanic hydrothermal systems. Pore fluids are marked by elevated total alkalinity, Mg, and SO4 concentrations while Ca stays at background values. The most straightforward way to interpret this finding in combination with the isotopic results is a re-dissolution of a hydrothermally formed magnesium-sulfate-hydroxide-hydrate, a meta-stable mineral previously reported once from the East Pacific Rise.

In addition to that, we identified 5 further locations on the Azores Plateau with indications for hydrothermal activity. Here, down-core Mg and SO4 decrease is accompanied with an increase in Ca concentration, which follows the trend of typical Mid-Oceanic hydrothermal systems. Seismic data suggest that close to the core locations magmatic intrusions are present in the subsurface. The geochemical findings together with the evidence of a heat source in the subsurface lead to the assumption that hydrothermal seepage is active on the entire Azores Plateau.