Structural Development and Petrogenesis along the Southern Central Indian Ridge

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The southern Central Indian Ridge (S-CIR) was the target of the cruise INDEX 2011, which was aming to examine the bathymetry, structural geology, magnetic signatures, and crustal development of the area with special emphasis on the petrogenesis and hydrothermal processes.

The S-CIR is characterized by intermediate to slow spreading rates and a highly variable regional to small-scale structural pattern of seafloor spreading [1] with recent volcanic activity focussing on cone-shaped volcanoes and neovolcanic ridges in the central valley or along its flanks. The structural development has triggered complex petrogenetic processes including differentiation and fractionation processes as well as the exhumation of deep oceanic lithosphere. The ridges in the Indian Ocean generally show strong indications for intense plume-ridge interactions, all of which leads to the formation of a wide and variable range of rock compositions [2, 3]. The deep and active fault systems and sustainable heat supply have also triggered a range of fossil and recent hydrothermal activity alongside the rift valley.

For the detailed petrological and geochemical study a large variety of rock samples were collected along the S-CIR using dredge and TV-grab. The rock suite includes basalts, gabbros, and ultramafic rocks from five different ridge sections along the active spreading center. Next to the analysis of major and trace elements in bulk samples of fresh rocks and volcanic glass, microanalytical studies allow for the analysis of specific minerals for petrogenetic purposes.

First results gained from bulk analysis of the mafic rocks indicate small but explicit differences with respect to the differentiation and fractionation processes, especially pronounced in the major and trace element composition. This is true for the rock suites from different ridge sections investigated during INDEX2011 as well as deviations from data published on the CIR [e.g. 2]. More specifically their character appears less differentiated, however, fractionation and the involvement of mantle heterogeneities or variable depths sources are suggested by elevated concentrations of incompatible and volatile elements.

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Tracing anthropogenic Hg deposition in peat bogs with Hg stable isotopes

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Abstract

Ombrotrophic peatlands integrate atmospheric deposition and are therefore used as archives to interpret variations of natural and anthropogenic mercury (Hg) emission sources. However, the question remains whether peat Hg profiles reflect local, regional or global Hg deposition. On a global scale, coal combustion is today the major anthropogenic Hg source to the atmosphere. The unique range of Hg isotopic compositions observed in coal deposits suggests that Hg isotope signatures may offer a new tool to track coal Hg emissions and deposition. We examined 3 peat cores from the Pinet peat bog (French Pyrenees, 42°51'52N, 1°58'29E, 880m a.s.l.). for variability of Hg accumulation rates and Hg isotopic signatures. Loss on ignition, water content, density and radionuclides were measured in each core. The 3 cores have been dissected in slices of 1cm allowing a temporal resolution of 20 years at the bottom part and less than 2 years in the top part. The Pinet peat bog is relatively sheltered from direct emission sources and integrates therefore mostly Hg transported over long distances. However, local mining and smelting activities in neighboring valleys might have been additional sources during the last 200 years. A combined ^{210}Pb-^{14}C age-depth model was applied to all cores and revealed that the Wardenaar cores of approximately 75cm-length go back in time until 2300BC. Mercury accumulation rates (Hg AR) are around 1.5μg.m^{-2}.y^{-1} before times of significant industrial emissions (2300 to 1900BC), consistent with other European peat records. First signs of anthropogenic impacts are evidenced by an increase of Hg AR to 8μg.m^{-2}.y^{-1} (1650 to 1900AD). Hg AR continue to increase in the 20th century to values of 38μg.m^{-2}.y^{-1}. Major Hg AR peaks of 42, 52, 62 and 100μg.m^{-2}.y^{-1} occur in the periods 1956, 1979, 1994 and 2001 respectively. Only very recently a decrease in Hg AR of 28% is visible. This decrease might be attributed to reduced Hg emssions following the implementation of antipolution policies.

A modified combustion and trapping method was used to isolate and purify Hg from the organic peat matrix before analysis of Hg isotopes using MC-ICPMS. Mercury's isotopic signatures in the Anthropocene (δ^{202}Hg: -0.84 to -1.65‰) are different from the Holocene (δ^{202}Hg = -0.5‰) and correspond to that of average coal (δ^{202}Hg = -1.3‰; [1,2]).

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