Pre-existing crust and a mantle anomaly in the tectonic evolution of the South China Sea

*Maria Luisa Tejada[1], Paterno Castillo[2], Xiaolong Huang[3], Ryoko Senda[1]

1. Department of Solid Earth Geochemistry, Japan Agency for Marine-Earth Science and Technology, 2. Scripps Institution of Oceanography University of California San Diego , 3. Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

One of the main objectives of International Ocean Discovery Program (IODP) Expedition 349 is to determine the spreading history and tectonic development of the South China Sea (SCS) and the mechanisms responsible for the initiation of spreading. Two of the suggested mechanisms involved 1) back-arc basin opening as a result of slab pull from subduction of pre-existing proto-SCS crust and 2) the role of an upwelling mantle anomaly. Cores of oceanic crust were successfully recovered, close to the fossil spreading centers at the East Subbasin (U1431) and at the Southwest Subbasin (U1433B and U1434A). Isotopes and geochemical data of representative samples from Site U1431E, U1433B, and U1434 are used to determine the different source inputs during the last stages of spreading in the SCS. The Os-Nd isotope data indicate three isotopically distinct magma types, representing at least three sources. The most radiogenic Os isotopic compositions occur in Site U1434 basalts and may be attributed to the influence of continental lower crust input toward the end of spreading in the Southwest Subbasin. In contrast, the earlier stage of spreading in the Southwest Subbasin, at Site U1433B, produced basalts that show the least radiogenic Os, combined with radiogenic Nd isotopic compositions, which could represent a normal ridge mantle source with altered oceanic crust input. Spreading at Site U1431E may have also occurred in two stages, with an earlier stage dominated by mixed sources involving enriched mid-ocean basalt (MORB)-type mantle with altered normal oceanic crust input, which later evolved into enriched MORB-type magmatism with ocean island basalt-type source input. The oceanic basement composition at both Site U1433 and Site U1431 indicates a similar enriched MORB-type mantle source but requires an altered MORB crust assimilant, suggesting incorporation of old oceanic crustal component. Alternatively, the Os-Nd isotope data could indicate that the upwelling magma at both sites interacted with old pre-existing crust, possibly from a previous back-arc spreading phase. Our results highlight evidence for pre-existing proto-SCS and the increasing role of a melting anomaly during the latest stages of rifting, leading to seamount volcanism for another 3-10 m.y., before magmatic activity finally ceased.

Keywords: South China Sea, melting anomaly, proto-South China Sea crust

