The Eastern Romanche ridge-transform intersection (Equatorial Atlantic): slow spreading under extreme low mantle temperatures. Preliminary results of the SMARTIES cruise.

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A strong edge effect is predicted at the intersections between long-offset transforms and mid ocean ridge segments. The Equatorial Atlantic hosts several megatransforms, where the connections of potentially low mantle temperatures due to the large lithospheric age contrast with melt production are poorly understood. The SMARTIES cruise focused on the Romanche transform that offsets the Mid Atlantic Ridge (MAR) laterally by 900 km with an age offset of 55 Ma. The eastern Ridge-Transform Intersection (RTI) markedly shows the effects of the lateral cooling of the ridge segment. To better understand the thermal regime at these complex domains, we acquired surface geophysical data and bathymetry of the area, and geological observations and sampling during 25 HOV Nautile dives. The integrated study of rock characteristics and of geophysical surveys allows tackling the connections between magmatism and tectonics. A network of 19 OBS was also deployed to study the seismic activity during the cruise in collaboration with the ILAB project.

There is a striking change in deformation patterns along the ridge axis moving away from the transform southwards. The bathymetry is extremely complex, with several structural directions, partly resulting from transtension. A low melt supply is focused at the ridge axis resulting in a long oblique axial domain, that forms a relay zone between the roughly north-south ridge axis in the south and the area close to the transform fault, while the transform fault domain is highly complex. Trends oblique to both the main spreading axis direction and the transform fault direction are widespread. A clear Principal Transform Displacement Zone (PTDZ) can be followed as a long, near continuous alignment, on the seafloor of the wide Romanche valley. However, the valley morphology suggests a migration of the PTDZ and intense deformation within the transform domain. The RTI is complex and the position of the spreading axis clearly evolved with time, through at least two and possibly three eastward ridge jumps.

Six Nautile dives explored the northern wall of the Romanche, the damaged zone of the transform fault, and the exceptionally deep nodal basin. The north wall exposes a very thick basalt unit covered with a thick layer of sediments. Eight dives explored the southern flank of the Romanche
identifying fragments of old Oceanic Core Complexes (OCCs) formed by highly deformed peridotites, and a large OCC located at the RTI that exposes mylonitized peridotites and is dissected by several normal faults. The magmatic zones of the axial domain (nine dives) are formed by volcanic ridges affected by important tectonic activity. The dives show pillow and tube volcanic flows with intersecting faults. An oblique elongated faulted and sedimented ridge (2 dives) parallel to the oblique relay zone was shown to be of peridotitic nature. Recent faults have been observed, as well as traces of high-T hydrothermal activity consistent with black-smoker type venting, recently overprinted by low temperature diffuse venting related to active faulting.

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