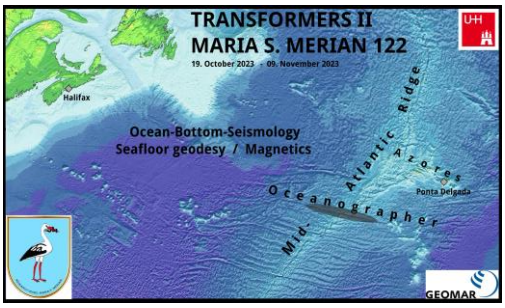
MARIA S. MERIAN 122

Ponta Delgada – Halifax
19. Oktober bis 9. November 2023



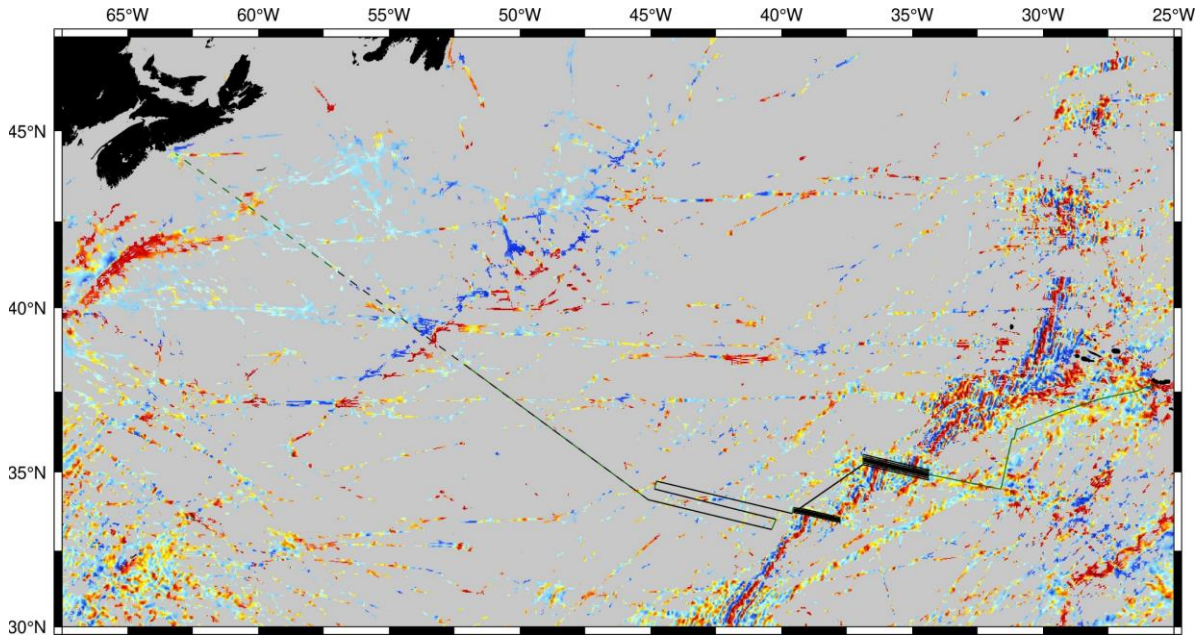
3. Weekly Report (30.10.- 05.11.2023)

At oceanic transform faults two tectonic plate are sliding past each other. They are located in the middle of ocean basins below several kilometres of water and hence we have only a limited understanding of processes acting on and forming them. The first two weeks of the expedition were dedicated to a long-term monitoring programme at the Oceanographer transform, where the North American and the African plate are juxtaposed and move past each other at a rate of ~2 cm per year. As previously reported, we deployed a large seismic network and a seafloor geodetic network to measure fault motion and record earthquakes issuing from tectonic stresses acting at the plate boundary. Both networks will monitor for one year, being deinstalled during the cruise M204 of the RV METEOR in October 2024.

Magnetic gradiometer of the University of Hamburg; both sensors will be towed 300 m behind the vessel, being space at 100 m.

Seismology and geodesy are studying active tectonic processes, which affect the seafloor and hence shape the oceanic lithosphere and its properties. During the third week of the cruise, we studied seafloor morphology and the magnetic field and hence features of the seafloor that were generated over millions of years in the course of transform faulting and plate tectonics. We focused our activities on the Hayes transform fault located about 150 km to the south of the Oceanographer, offsetting the Mid-Atlantic Ridge by ~90 km roughly westwards. We used the EM122 swath mapping system of the MARIA S. MERIAN and a towed magnetic gradiometer. To minimize the impact of the ship and its electric engine on the measurements, the magnetometer was towed 300 m behind the stern of the vessel. Magnetic field anomalies provide critical information about the age of the igneous seafloor. Thus, the Earth's magnetic field is reversing its polarity at intervals of several hundreds of thousands to millions of years. New crust formed at a mid-ocean ridges is keeping the direction of the magnetic field when its crust cools below the Currie temperature. Consequently, the seafloor shows a "Zebra-like" magnetisation pattern of positive and negative anomalies representing past reversals of the Earth's magnetic dipole field. Knowing the rhythm of those reversals, the age of the seafloor can be derived.

Thereafter, we surveyed an abandoned transform fault system to the southwest of Hayes. On Saturday the 4th of November 2023 we concluded the mapping and magnetic measurements and began our transit to Halifax.



Map of magnetic anomalies from available ship surveys over the northwest Atlantic Ocean; black: magnetic survey lines of the cruise MSM122

Over the next four days the MARIA S. MERIAN will steam north-westwards and reach Halifax on the 9th of November 2023. During the transit we keep surveying the seafloor as only about 20% of Earth's Oceans have been mapped. Furthermore, we're continuing to record the magnetic field. Today, global maps of our oceans may give the impression that they have been mapped and that the age of the seafloor is known. However, assessments are based on global and often crude models, while there are indeed huge gaps where no magnetic data have ever been collected (see map above) to define its age. In addition, most of the existing data were obtained during the early days of marine exploration in the 1950s and 1960s before satellite navigation became available. Therefore, a large number of the uncharted areas will provide exciting new features to be discovered during future ocean exploration.

In the name of all cruise participants, best regards from 36°30'N / 49°5'W,

Ingo Grevemeyer
GEOMAR Helmholtz Centre for Ocean Research Kiel