Geophysical Research Abstracts
Vol. 21, EGU2019-9958, 2019
EGU General Assembly 2019

Magmatic versus tectonic control on the evolution of a slow-slipping multi-transform fault: the St. Paul system, Equatorial Atlantic.

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The St. Paul multi-transform system is formed by four slow-slipping transform faults, bounding three short intra-transform ridge segments (ITRS), which offset the Equatorial Mid Atlantic Ridge by 630 km. The system formed ca 40 My ago when a change in plate motion induced extension at the large-offset paleo-St Paul transform fault. The opening of the transform domain resulted in the progressive formation of the ITRS, in a similar way as for the fast-slipping leaky transform systems observed in the Pacific Ocean. The spreading styles of the three segments are very different and appear to depend on the sub-lithospheric mantle temperature and composition as well as on the structure of the lithosphere. The spreading is more magmatic in the northern ITRS, whilst it is dominated by tectonic processes in both the southern ITRS, which displays large Oceanic Core Complexes, and the central ITRS, where mantle is exposed at the seafloor. Basalts were sampled in the axial domains of the three ITRS, showing that melting occurs within the transform domain. This observation is not easily explained by current numerical models, which instead predict cold mantle beneath slow slipping transform faults. These contrasting observations suggest that the still poorly constrained melting processes at large multi-transforms may rather depend on the mantle characteristics than on the thermal structure of the lithosphere, in contradiction with proposed models.