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Axial versus older magnetic anomaly amplitude variations: Evidence for a common origin

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Seafloor spreading magnetic anomalies in the oceans have been used to reconstruct the plate tectonic history of the ocean basins for almost 40 years. Although the use of magnetic isochrons for the implicit dating of ocean floor remains of primeval importance, the use of magnetic measurements to better understand the fundamental processes of mid-ocean ridge accretion is becoming more and more important. With the increased data density, the higher precision of the observations, both in positioning and sensitivity, as well as the availability of data at different scales and different altitudes relative to the ocean floor, an entire new spectrum of applications of marine magnetic anomalies is opening up. In this contribution, we compare recent observations of Ravilly et al. (JGR, 1998), along the axis of the mid-Atlantic Ridge, with those made many years ago off axis in the Cretaceous magnetic quiet zone (85 - 118 Ma). Ravilly et al. observed that along segments of the mid-Atlantic Ridge, between 20 and 40 N, the axial magnetic anomaly is higher by a factor of about 2 near the segments ends as compared to the segment centres. The preferred explanation is that both variations in the Fe-Ti content resulting from shallow magma fractionation and serpentinisation of shallow mantle rocks near the segment ends are responsible for this variation. One question is then if this signature persists as the crust generating the axial magnetic anomaly becomes older and moves away from the spreading axis by seafloor spreading. The best region to look for such a signature off axis is the Cretaceous magnetic quiet zone, because there the signal is not contaminated by large reversals in the Earth's magnetic field. Collette et al. (1984) observed such an increase in effective magnetization near the ends of segments, which expresses itself as distinctly positive anomalies over the fossil fracture zone valleys, when the magnetic anomalies are reduced to the pole. Hence, we conclude that both observations are consistent and that the processes responsible for the amplitude variations are restricted to the axial region. Hydrothermal processes off axis may be responsible for additional changes in the total magnetic structure of the oceanic crust, but the fundamental 'magnetic' segmentation is preserved.