Magnetic structure of a slow-spreading ridge segment: insights from near-bottom magnetic measurements onboard a submersible

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Near-bottom magnetic measurements onboard submersible Nautile were carried out in the Mid-Atlantic Ridge (MAR) 21^o40'N segment and the deep-sea geomagnetic vector anomalies along the nineteen dive tracks were obtained by applying the processing method for the shipboard three component magnetometer (STCM) data. Using short-wavelength component of the anomalies mainly produced by both local topography and up-and-down motion of the submersible, a forward modeling technique was designed to estimate the absolute magnetization intensity of the seafloor. In the vicinity of the spreading axis a considerable number of magnetization estimations are confirmed as reliable by the high correlation between observed and modeled anomalies, whereas less and less reliable estimations are obtained as going away from the axis probably because the sediment hides the base topography. The natural remanent magnetization measured on basalt samples collected during these dives is compared with the magnetization from anomalies in the case reliable estimations are obtained near the sampling locations and an acceptable agreement were obtained between them. While the equivalent magnetization inverted from the sea-suface magnetic anomalies shows the axial magnetization significantly increasing from the segment center to the segment ends, the compiled results of the ten dives conducted near the spreading axis at different places in the segment show much less variation in magnetization intensity along the axis. We suppose the high magnetizations at segment ends confirmed by the sea-surface magnetics represent the preferential serpentinization of peridotite near the segment ends. The compiled results of the three across-axis cross sections composed of fifteen dives running in the spreading direction can be consistently interpreted as recording the paleointensity change during the Brunhes. Although the distribution of the high and low magnetizations generally agree with the relative change of paleointensity at a timescale of about a few hundreds kyr, the amplitude of variation seems more moderate in the paleointensity than in the magnetization intensity. The combination of the magnetization intensity variation based on the paleointensity change and the magnetic layer thickness variation resulted from the assumed volcanic activity change reasonably explains the shape of across-axis sections of the equivalent magnetization inverted from the sea-surface magnetic anomalies and their variety by places within the segment. At slow-spreading ridges like the MAR, the magnetic layer thickness variation resulted from the episodic or discontinuous accretion would significantly affect the sea-surface magnetic anomalies togerther with the magnetization intensity variation.