Magnetization of oceanic crust off the Japan Trench

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We present characteristics of magnetic anomaly and crustal magnetization off the Japan Trench. The northwestern margin of the Pacific Plate is being subducted beneath the northern Japanese Islands at the Japan Trench. In the northern part of this trench, the Pacific Plate has a series of parallel magnetic anomalies (Japanese Lineation Set), identified as chron M11-M7 (135-127 Ma) [e.g. Nakanishi et al., 1989]. These anomalies are well lineated and have high-amplitudes of ~500-1000 nT, peak-to-trough, in the seaward slope of the trench. The amplitudes of anomalies gradually decrease towards the land from the trench axis. Noda et al. [2003] have discussed phenomena of gradually decay in amplitude of the magnetic anomaly to the landward from the trench axis, associated with the plate subduction. In their study, however, characterization of the oceanic plate 'before the subduction' remained less known because of limited areas of existent data in the seaward of the Japan Trench where should be studied for comprehensive understanding of the magnetic source layer in the oceanic lithosphere. KR04-08 and KR03-07 cruises are an unprecedented opportunity to collect data in such areas [Hirano et al., 2001; Hirano, 2005]. We compiled the data with the magnetic data published by GSJ [1996] and NGDC and made a magnetic anomaly map off the Japan Trench. We used the NGDC data processed by Ishihara [2004], using CM3 (Comprehensive Model phase 3) [Sabaka et al., 2002]. To correct for effects of seafloor topography, crustal magnetization was calculated. We used the three-dimensional inversion method of Parker and Huestis [1974]. The top of the magnetic source layer is assumed to be the surface of the igneous oceanic crust. In the seaward slope, ocean drillings and seismic reflection profiles indicate that the thickness of sediment layer is ~500 m. Therefore, the depth to magnetic source layer is estimated by subtracting uniformly 500 m from seafloor topography. We assumed a 1 km thick uniform magnetic source layer. The inclination of magnetization in the source layer was assumed to be around 30 degree, based on previous magnetic studies of seamounts in the Pacific, off the coast of Japan. The declination and inclination of the ambient geomagnetic field are referred from IGRF and DGRF. Bandpass filters with cosine tapers for wavelengths between 7-15 km and between 120-150 km prevent instabilities during the inversion. Along-lineation variation shows high magnetization along the Nosappu Fracture Zone extending in the direction of NNW-SSE along ~150E. The result also indicates along-lineation variation with a period of ~50-200 km. Wakes of the higher magnetization, sub-perpendicular to the strike of lineations and sub-parallel to the Nossappu Fracture Zone, could suggest non-transform discontinuities and crustal segmentation that originates at a mid-ocean ridge, where the oceanic crust was formed. The segmentation is a characteristic feature of seafloor spreading along the global mid-ocean ridge system. The low magnetization appears on the seaward trench slope where horst-graben structure is developed. This result would suggest that the lower magnetization relates to formation of the horst-graben structure associated with plate bending and normal faulting. The across-lineation variation may indicate temporal variation of intensity of the paleo-magnetic field in Jurassic. The ~135 Ma crust has higher magnetization and gradually decreases towards ~130 Ma in the study area. Our result is slightly different from results obtained in the Atlantic Ocean where high magnetization appears in ~120-130 Ma [e.g. Sayanagi et al., 1992].