Rock magnetic properties, grain size, and layer thickness of turbidites at the northern Hikurangi margin, New Zealand: Results from IODP Exp. 375, Site U1520

*Atsushi Noda[1], Annika Greve[2]

1. National Institute of Advanced Industrial Science and Technology, 2. Department of Earth Sciences, Utrecht University, The Netherlands

Environmental magnetism is the study of the fine magnetic minerals in sediments. Differences in type, abundance, magnetic grain-size, and diagenetic state allow to draw conclusions about the sediment source regions, transport and depositional conditions. Here we present the results of detailed rock magnetic investigations conducted on turbidites deposited within the trough sediments at IODP site U1520, Exp. 375, northern Hikurangi Margin, New Zealand. The study encompassed the measurement of rock magnetic properties and grain size on a total 67 turbidites in the upper part (Lithological Units 1–3, 0–510 mbsf) of the hole U1520D.

Discrete paleomagnetic samples were collected from cores by pushing standard 7-cm^3 plastic cubes into the sediment near the basal part of turbidites. The cubes were subjected to magnetic analysis at JAMSTEC. Low-field, mass-dependent magnetic susceptibility (χ) and AMS were measured using an AGICO Kappabridge KLY-4S. AFD and ARM acquisition experiments were conducted using a horizontal 2G cryogenic passthrough magnetometer with an in-build degausser. ARM was imparted in a peak alternating field of 80 mT (AF), and a 100-μT biasing field along +z. Subsequently we imparted an IRM along +z using an ASC Impulse Magnetizer and a field of 1.2 T. Remanence was subsequently measured and the same procedure repeated by applying reverse fields of 0.1 and 0.3 T. Magnetic hysteresis parameters (B_c, B_{cr}, M_s, M_{rs}) were measured using a MicroMag Vibrating Sample Magnetometer. As final step, grain-size analyses were conducted using a laser diffraction/scattering particle size distribution analyzer.

The magnetic susceptibility (χ), SIRM (here: $IRM_{1.2T}$), NRM and M_s are sensitive to the concentration of magnetic minerals within the turbidites. and are parameters to indicate the magnetic grain-size. The S-ratios are calculated using and , respectively. S-ratios help to distinguish between the contributions of magnetically hard and soft remanence carriers (e.g. magnetite vs. hematite). The ratios of the hysteresis parameters M_{rs}/M_s and $B_{cr}/B_c$are indicative for the magnetic domain and thus grainsize. We applied the K-means cluster analysis for these magnetic properties to characterize the turbidites into the three units which have distinct magnetic properties.

Samples in cluster 1 have relatively low values of χ, SIRM, S-ratios and SIRM/χ, and intermediate values of M_{rs}/M_s and B_{cr}/B_c. The majority of the turbidites sampled in Unit 2 and parts of Unit 3 were classified into cluster 1. Samples from cluster 2 show low values of B_{cr}/B_c, intermediate values of χ, and high values of SIRM, S-ratios and SIRM/χ, and high values of M_{rs}/M_s. These samples can be found throughout Units 1–3. Cluster 3 is represented by high χ, S-ratios, intermediate SIRM and B_{cr}/B_c, and low M_{rs}/M_s and SIRM/χ values. This cluster was recognized only in Unit 1. Most of the thick and coarse-grained turbidites belong into Cluster 3. One of the major differences between cluster 3 and the other clusters is that the SIRM is weaker than in cluster 2, while χ is higher than cluster 2. The other difference is a very low M_{rs}/M_s and high B_{cr}/B_c ratios, indicating cluster 3 is dominated by multidomain (MD)-sized grains.

There are two viable interpretations for this dataset: The distribution of the clusters may reflect on different source regions of the turbidity currents. A major difference exists between the rock magnetic properties of lithological units 1 and 2. This may indicate a major change in the dominant sediment provenance and transport direction. Alternatively, the differences in the rock magnetic properties may also be caused by differing diagenetic state through the sequence (e.g. magnetite–greigite–pyrite). These differences may be affected by depositional conditions such as submarine landslides or turbidity currents.

Keywords: IODP, Hikurangi Trough, New Zealand