Application of Magnetometric Resistivity (MMR) method to a marine gas hydrate region, off Niigata, Japan Sea

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We present preliminary results of an electrical resistivity survey over a marine gas hydrate region, off Niigata, Japan Sea during JAMSTEC R/V Kaiyo KR05-08 cruise. The Magnetometric Resistivity (MMR) method is used to investigate the electrical resistivity structure of the crust including the marine gas hydrate region. The MMR method is a logistically simple magnetic technique that involves two components: a vertical bipole electric current as a source, and separate ocean bottom electro-magnetometers (OBEMs) as receivers. Four OBEMs were placed around the marine gas hydrate region along an east-west line with instrument spacing of 200 meters. All OBEMs were equipped with fluxgate sensors and electrodes to measure three components of magnetic and electric fields at the seafloor and with two-component tilt meters to measure its attitude. Those data were recorded at one-second intervals. A transponder was also attached to each OBEM, which enabled us to determine a precise location of OBEM using Kaiyo SSBL (Super Short Base Line) positioning system. Forty-four transmission stations were completed along four north-south lines and one east-west line. The vertical bipole source, which generated a rectangular wave-form with a period of 16 s and with a peak current of approximately 8 A, was applied between electrodes at the sea-surface and on the end of the wire just above the seafloor. The ship was kept on each station for 30 minutes to allow stacking at the periodic wave signals, improving the signal to noise ratio.

The electrical resistivity of the seafloor is estimated from the relation between the amplitude of induced magnetic field and the source-receiver separation. The average electrical resistivity of 5 Ohm meters is calculated for the seafloor, and this average resistivity is recognized as an ambient standard resistivity in this area surveyed. The standard amplitude of induced magnetic field at each transmission station is calculated using the average resistivity and the source-receiver separation. Anomalous amplitude of induced magnetic field, which is difference between the observed and the standard amplitudes at each transmission station, is a good indicator of anomalous electrical resistivity structure. The results of the anomalous amplitude maps show that the western part of the surveyed area has lower amplitude, indicating higher electrical resistivity. This lower amplitude is probably result from some amount of gas hydrate, because gas hydrate has higher electrical resistivity and some cores of gas hydrate were sampled from this lower amplitude area during the Kaiyo KR05-08 cruise. The lower amplitude exists in an area of nearly 300 meters by 800 meters, suggesting that the gas hydrate reserver is localized in this area.