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Magnetization strucrure of thermal vent on island arc from vector magnetic anomlies using AUV

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The geomagnetic anomaly measured by a scalar magnetometer,such as a proton precession magnetometer cannot be defined its direction, then it does not satisfy the Laplace's equation. Therefore physical formula describing the relation between magnetic field and magnetization cannot be established.Because the difference between results obtained from scalar data and from vector data is very significant, we must use vector magnetic field data for magnetization analyses to get the more reliable and exact solutions.
The development program of fundamental tools for exploration of deep seabed resources started with the financial support of the Ministry of Education, Culture, Sports, Science & Technology (MEXT) in 2008 and will end in 2012. In this project, we are developing magnetic exploration tools for seabed resources using AUV (Autonomous Underwater Vehicle) and other deep-towed vehicles to measure not the scalar magnetic field but the vector magnetic field in order to estimate magnetization structure below the sea-floor exactly and precisely.
We conducted AUV magnetic survey in 2010 at the thermal area called Hakurei deposit in the Bayonnaise submarine caldera at the southern end of Izu island arc, about 400km south of Tokyo.
We analyzed the observed vector magnetic fields to get the vector magnetic anomaly Fields using the method of Isezaki(1984). We inverted these vector magnetic anomaly fields to magnetization structure.

CONCLUSIONS
1.The scalar magnetic field TIA (Total Intensity Anomaly) has no physical formula describing the relation between M (Magnetization) and TIA because TIA does not satisfy the Laplace's equation. Then it is impossible to estimate M from TIA.
2.Anlyses of M using TIA have been done so far under assumption TIA=PTA (Projected Total Anomay on MF (Main Geomagnetic Field)), however, which caused the analysis error due to εT= TIA - PTA .
3.We succeeded to measure the vector magnetic anomaly fields using AUV despite the severe magnetic noises around the magnetometer sensors. The method of Isezaki(1984) works good to eliminate these noises.
4.We got the very precise magnetization structure in the Bayonnaise submarine caldera area at the southern end of Izu island arc.
We used the prism model which forms the shape of magnetized source body whose top is the sea-floor. The total number od prisms is 1500 making the 3 layers (0-80m, 80-160m, 160- 240m below the sea-floor, 25x20=500 prisms in 1 layer). The 4500 unknowns(3 unknowns, Mx,My,Mz in each prosm) are obtained from 12000 observed vector magnetic anomaly fields by inversion method.
5. The tentative result shows that the 1st and 2nd layers have smaller

intensity of magnetization compared to the 3rd layer. The 2nd layer has the smallest of three layers. However the Hakurei deposit area in the 2nd layer has the a little bit greater magnetization than surrounding area which suggests that the Hakurei deposit includes some magnetic minerals.

6.We strongly recommend to carry out the magnetic survey using a three component magnetometer to get TF and TA which have many advantages for magnetic analyses (magnetization, upward continuation etc.) which cannot be done using scalar TIA.