東海スロースリップイベントに対応する地磁気全磁力の変化
The Piezomagnetic Field in the Slow Slip Event Epicentral Area in Tokai Area

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Earthquake Research Institute of the Univ. of Tokyo has deployed continuous geomagnetic observation sites in Tokai area, central Japan. In this area, large interplate earthquakes have occurred repeatedly due to subduction on the Philippine Sea Plate, and one of the objectives of our geomagnetic observations is to detect tectonomagnetic signals in association with the subduction process. Recently, data at one site shows a characteristic variation. Until 2000, geomagnetic total forces had decreased at a rate of 1 nT/year. This decrease had stopped during a period from 2000 to 2004. And it started decreasing again since 2005. The period during which the decrease had stopped corresponds to the Tokai Slow Slip Event which was detected by geodetic observations, and the variation found in the total forces may have some relation to the Slow Slip Event. To investigate the possible relation between the changes in the geomagnetic total force and the Tokai Slow Slip Event, we performed piezomagnetic modelings.

In general, piezomagnetic fields are generated by the heterogeneities of the initial magnetization of the crust and/or those of the stress field. To clarify which heterogeneity is dominant in generation of the observed changes in Tokai area, we conducted two types of numerical modelings, one for the uniformly magnetized crust with the realistic stress field, and one for the uniform regional stress field with a highly magnetized rock body near the station. In the former case, the stress field variation calculated from the slip distribution estimated by the geodetic data (Ohta et al., 2004) was substituted to the calculation. In the latter case, simple magnetization structures suggested from aeromagnetic surveys and geological studies were assumed for the cauculation. Estimated changes obtained from the latter model are by one order of larger than that from the former case. Therefore, the latter effect is more plausible.

Whether this effect can be the generating mechanism of magnetic changes or not is depend on the stress sensitivity of the crust. Our simulation results have indicated that the sensitivity as large as 1×10^{-7} Pa^{-1} is required to generate 1nT/yr changes on ground. However, this value is far larger than those obtained by past studies. Stress sensitivities determined from determined from laboratory experiments for intact rocks are the order of 1×10^{-9} Pa^{-1}. Those obtained by experimental studies for some porous rocks (Hamano, 1983) and observational studies (e.g., Davis and Stacey, 1972) are the order of 1×10^{-8} Pa^{-1}. This difference indicates that the stress sensitivities of crusts may vary widely according to the phenomenon which the crust experiences.

References

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