Evaluation of the stability of the deep geological environments on the basis of 3D gravimetric and geomagnetic tomography I.

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The method to visualize the 3D geological structures to about 20km depth as the difference in material properties such as density and magnetic intensity have been studying, in order to contribute to the evaluation of the geological stability of the deep region. Here, we exhibit the 3D density structure around the focal region of 2000 Tottori-ken-seibu earhquake and its relation to the seismic acitivity.

In the 3D tomography, the ground is approximated by the assemblege of rectangular blocks and the mean properties of the blocks are estimated using simulated annealing, one of the stochastic optimization method. Gravimetric and geomagnetic tomography has severe problems about the nonuniqueness and instability of the solution. In our method, these problems are circumvented to the minimum by introducing the supplementary argorithims such as;

(1) smootheness constraint with sensitivity control,

(2) ensemble (multi-model ensemble) analysis, and

(3) geological and modelling of geophysical a priori information.

Following characteristic features are recognized from the results of 3D gravimetric tomography:

(1) There is a close correlation between the distribution of epicenters including off-fault aftershocks, and the density anomaly structure, showing the the possibility of controlling the earthquake occurrence by original rock properties (strength) in this region. Epicenters are distributed within the relatively high density anomaly region. This possibility were also pointed out on the basis of seismic tomography (Shibutani et al., 2005). However, there is a problem to be considered, with respect to the correlation between seismic velocity distribution and density anomaly distribution in the nothwestern part of the row of aftershocks.

(2) In the nothwestern part of the row of aftershocks, high density anomaly region which dips to the southeast are present. Similar structure was reported on the basis of electromagnetic tomography (Oshiman et al., 2003).

(3) High denisty anomaly regions are present at the edge part of the row of aftershocks, which are considered as barriers eliminating the extension of aftershock row.

(4) Low density anomaly region, which is likely to be a a root of the Paleogene granitic rocks, is distributed on the southewest of the epicenter of the mainshock. In this root-like region, seismic activity is sparse.

This test application shows the usefulness of the characterization of the deep geological environments (-20km depth) by 3D inversion. We hope this method have a possibility to contribute to the evaluation of the geological stabilities of the deep environments by connecting the results of the other survey method such as seismic and electromagnetic tomography, even in the area without seismic acitivity, so will continue to examine the concrete ways of its application.