Three-dimensional crustal and potential models off Sanriku and Shikoku by Frontier research program

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We are developing a global marine geophysical database system and making compilations and analyses of these data. We are in the process of compiling crustal structure, marine geomagnetic and gravity data off northeastern Japan to clarify the geophysical characteristics of magnetic lineations on the subducting plate and trench gravity anomalies in that region. The characteristics of different geophysical properties are related to the tectonic component origins, subsequent deformation and other possible processes of subduction. We will continue to examine several subduction models as additional data are obtained during future Frontier surveys.

The feasibility and necessity of geophysical exploration have increased substantially in recent years in tandem with the acquisition of various global data sets. Both the accuracy of measuring devices and the associated analytical techniques are being constantly improved: the ocean was an almost unknown region 20 years ago, but now we can acquire densely-spaced, real-time data from the atmosphere, hydrosphere and lithosphere using oceanographic observation networks.

The JAMSTEC Computer and Information Office (JCIO) routinely records, edits and collates digital marine geophysical data such as water depth, meteorological phenomena, tidal behavior, gravity, earth magnetism, and heat flux. The traditional approach to interpretation of such datasets has been one in which separate datasets were examined individually and independently. This approach is limiting, as it does not readily permit the complementary nature of different datasets to be exploited. Recent advances in computing power, data storage and retrieval, and database software, may make possible more integrated analyses of different datasets, and facilitate better understanding of global geophysics.

The ancillary role of a database is threefold: to collate and manage data; to provide methods of quality control; and, to produce data syntheses. Additionally, it is important that the user also be able to interact with and use the database in an efficient and accessible manner. This highlights the need for an appropriate interface that can be used by the research community, and a database design that permits generality and flexibility in routine scientific use. In this paper, we discuss the development of an efficient, user-friendly and useful geophysical database.

The Frontier geophysical database project is one component of the 1997 and subsequent fiscal years' Frontier Research Program for Subduction Dynamics (FRPSD) and designed specifically to help clarify the seismogenic mechanism of great subduction zone earthquakes and construct long-term earthquake recurrence models. It contains reflection and refraction seismic data, bathymetry and ship track locations, gravity, earth magnetism, heat flow and fluid seep data acquired by deep-sea research vessels.

In designing the Frontier database, it has been necessary to consider several operational requirements. In particular, the database must be capable of being added to in the future as new data are obtained. The data are used as input to crustal deformation models: to date we have constructed three-dimensional models of the Japan Trench and Nankai Trough subduction zones. Using the integrated datasets with inversion and forward modeling software, we are also able to perform verification of the models' results.

In order to facilitate the study of past, contemporary and future changes in the deep sea environment near ocean trenches, we aim for an object-oriented approach to the collection of data from a variety of sources. The construction of a database containing datasets of seismicity and potential field data, crustal and thermal structures, and other data will make it possible to carry out multi-faceted studies of the geophysical properties of particular oceanic regions. However, we expect the flow of information through such a database to be bi-directional. That is, while data from the database are used as the basis for numerical simulation of plate behavior or seismic activity, the results of such analysis should be fed back into the database so that future geophysical surveys can be more reliably planned and executed. This iterative approach will enable us to firmly establish the reliability of the database and its associated models.