LONG-TERM SEAFLOOR ELECTROMAGNETIC OBSERVATION IN THE NORTHWEST PACIFIC MAY DETECT THE VECTOR GEOMAGNETIC SECULAR VARIATION

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ABSTRACT

Sea Floor ElectroMagnetic Stations (SFEMSs) are now operating at two deep seafloor sites called the 'WPB' and the 'NWP' in the West Philippine Basin and the Northwest Pacific Basin, respectively. One of the main objectives of the SFEMSs is to detect the geomagnetic secular variations on the deep seafloor where long-term geomagnetic observations have not so far been achieved. SFEMSs can measure the absolute geomagnetic total force as well as the geomagnetic vector field with precise attitude monitoring systems. The vector geomagnetic time-series that was observed for more than 5 years revealed that the westward drift of the equatorial dipole dominates in the geomagnetic secular variation at the NWP.

Keywords: Seafloor geomagnetic observatories, Attitude monitoring, Geomagnetic secular variations, Westward drift, Equatorial dipole

1 INTRODUCTION

It has long been pointed out that a “land-locked” view alone cannot provide the true image of the Earth because the continents occupy only 30% of the Earth’s surface. Disciplines in solid Earth geophysics such as seismology strongly require an “ocean-locked” view of the Earth as well as the “land-locked” view in order to know the true internal structures of our planet. Some disciplines such as geodesy or geomagnetism may circumvent this difficulty because remote sensing of potential fields by low-Earth-orbit satellites (e.g., Gaya-Piqué et al., 2005) is possible in those disciplines. The “ocean-locked” view, however, is indispensable even for disciplines in which Earth-observing satellites play dominant roles in providing the bulk of the data, especially when temporal variations of geophysical phenomena are of particular interest.

A considerable amount of effort has been made to develop ocean bottom geophysical observatories. For example, pilot deployments of a multi-disciplinary seafloor observatory have been repeated in the Mediterranean Sea (Beranzoli et al., 1998; 2003). In North America, a broadband ocean bottom seismic observatory was installed in the Monterey Bay, which was firstly uncabled (Romanowicz et al., 2006) and then recently realized real-time connection through a submarine cable (http://www.mbari.org/mars/). However, it should be noted here that the seafloor observatories are mostly coastal rather than deployed in open oceans, and the coastal observatories have been maintained at better instrument servicing and data recovery rates.

Toh et al. (1998) developed a prototype geomagnetic observatory for use in remote open oceans. The instrument, the SeaFloor ElectroMagnetic Station (SFEMS), was designed to continuously measure not only the geomagnetic but also the geoelectric field for more than one year by one-minute sampling. In the course of its development, it was found that attitude monitoring is crucial to realize the absolute observation of the geomagnetic vector field (Toh et