Observed Geomagnetic Fluctuations Possibly Linked with the Taiwan Earthquake M= 6.4, December 19, 2009

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The Northern part of Taiwan Island, on 19th of December 2009, was struck by an earthquake measuring 6.4 on the Richter scale at depth ≈ 45 km. The epicenter was located about 20 Km away from the Hualien station (MAGDAS I station). The earthquake caused some damages in the vicinity of the epicenter.

In order to identify the possible occurrence of any anomalous geomagnetic variations associated with the seismic activity in Taiwan on the 19th of December 2009, geomagnetic data recorded at Hualien station (HLN) were analyzed. Amami-oh-shima (AMA) station in Japan was used as a remote reference station. The geomagnetic components (H, D and Z) recorded at HLN station showed baseline fluctuations during December 2009. These anomalous variations started about 1 week before the occurrence of the earthquake and lasted for about 2 weeks with ≈ 15-20 nT amplitude. In addition, we observed less than 1 nT increase in the total intensity of geomagnetic field that occurred about two minutes before the onset of seismic activity. Furthermore, there was an enhanced ULF signal in the range of Pc3 (10-45 sec) linked with the seismic event and observed a few days before the onset of the earthquake. In addition, there was a good correlation between the occurrence time of the earthquake and the polarization ratio (Z/H) of the Pc3, where there was a decrease in the polarization ratio at HLN a few days before the onset of the EQ.

The mechanism for generating such observed anomalous geomagnetic fluctuations is not fully understood. Previously, different mechanisms were purposed to explain the observations of anomalous geomagnetic variations related to a number of earthquakes. Generally, changes in the magnetic susceptibly, conductivity, remanent and induced magnetization of the rocks as a piezomagnetic effect or the earthquake-related currents along the fault planes can cause geomagnetic changes during the seismic activities. However in the present study, we expect that the crustal stress perturbations played an important role for generating our observed geomagnetic variation as a tectonomagnetic effect. In addition, the crustal stress also can drive the underground currents along the fault plane which maybe also contributed to the observed geomagnetic variations. So, the observed anomalous geomagnetic fluctuations may be connected to the seismic activity near the HLN station.