

ULF Geomagnetic Changes Associated with Large Earthquakes

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<http://www-es.s.chiba-u.ac.jp/geoph/ulf/index.html>

The short-term earthquake prediction seems to be difficult by means of the conventional elastic measurements. Therefore, new methods or phenomena to realize it are highly required. Electromagnetic phenomena are now considered as a promising candidate for the short-term prediction of large earthquakes. Being stimulated by the Japanese two earthquake frontier projects (International Frontier Research on Earthquake by the Institute of Physical and Chemical Research, hereafter RIKEN and Earthquake Remote Sensing Frontier by National Space Development Agency of Japan, hereafter NASDA), there have been accumulated observational reports on the earthquake-related electromagnetic studies in a very wide frequency range all over the world. Measurements of electromagnetic phenomena can be classified into three types: (1) the passive ground-based observation for lithospheric emissions in a wide frequency range from DC to VHF, (2) the ground-based observation with the use of transmitter signals as active monitoring of seismo-atmospheric and seismo-ionospheric perturbations, (3) the satellite observations of plasma perturbations and radio emissions associated with earthquakes in the upper atmosphere.

This paper deals with ULF anomalies associated with large earthquakes. The ULF phenomena are believed as one of the most promising tools for earthquake-related electromagnetic studies because ULF emissions definitely come from the source region in the crust because of their large skin depth. In fact, there have been accumulated a lot of convincing evidence of the ULF magnetic signature before large earthquakes.

There are also similar electromagnetic phenomena associated with volcanic activities. Since the source region is well known for volcanic activities, observation is easier than in seismic cases. Before the Loma Prieta earthquake, geomagnetic anomalous changes associated with large earthquakes were reported. They mainly dealt with the anomalous change of the transfer functions before earthquakes and pointed out the possibility of change of electrical structure under the ground.

The aim of this paper is to summarize the ULF geomagnetic phenomena associated with large earthquakes, mainly on the historical experimental facts. Especially, the latest results of the detection of ULF emissions by means of sophisticated signal processing in Japan will be presented. Also, possible mechanisms and propagations are discussed. Finally, future tasks to be achieved for this subject will be proposed.