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# Development of High Temperature Superconductor Based SQUID (HTS-SQUID) Magnetometer System for Super-sensitive Observation of Geomagnetic Field Changes

Yuta Katori (1), Kan Okubo (1), Tsunehiro Hato (2), Akira Tsukamoto (2), Keiichi Tanabe (2), Nobuhito Onishi (3), Chikara Furukawa (3), Shinji Isogami (4), and Nobunao Takeuchi (5)

(1) Tokyo Met. University, Tokyo, Japan, (2) ISTEC-SRL, Tokyo, Japan, (3) TIERRA TECNICA, Tokyo, Japan, (4) Fukushima National College of Technology, Fukushima, Japan, (5) Res Cent Predict Earthq Volcan, Tohoku Univ., Miyagi, Japan

The key point of this presentation is that we successfully develop the high-temperature-superconductor based superconducting-quantum-interference-device (HTS-SQUID) magnetometer system for super-sensitive observation of geomagnetic field changes.
Electromagnetic changes associated with earthquakes have been investigated previously. Our research group also employed flux-gate magnetometers whose specifications are the measurement with accuracy of 0.01 nT and with the sampling interval of 0.5sec for seismomagnetic observations.
Our observation site happened to be situated at an epicentral distance of 26 km from the 2008 Iwate-Miyagi Nairiku earthquake of M 7.2, NE Japan. In this earthquake, we have reported successful observation of “co-faulting" Earth’s magnetic field changes due to piezomagnetic effects caused by earthquake rupturing(Okubo et al., 2011 EPSL). Magnetic field components began to change almost simultaneously with the onset of the earthquake rupture and grew non-linearly before the first P wave arrival. Such magnetic signals are most probably generated by the changing stress field due to rupturing, i.e. the piezomagnetic effect. This observation result is an epoch-making discovery, and further efforts could lead us to a new system for super-early warning of destructive earthquakes with the magnetic measurements.
On the other hand, by our past study, it was suggested that the geomagnetic variation signal accompanying fault movement, whose sources are the piezomagnetic effects, is very small (a few hundred pT per 5 sec). Therefore, to realize the super-early warning, development of a high-sensitive magnetometer system is very important.
Then, our research group tried to develop the HTS-SQUID magnetometer system for high-resolution observation of Earth’s magnetic field. The features of this HTS-SQUID magnetometer are as follows: Three components of the magnetic field can be high-sensitively measured. It has a very low temperature dependence. The running cost is small because it is possible to maintain super conductivity by liquid nitrogen.
Since March 2012, we have observed 3 components of the geomagnetic field using a HTS-SQUID magnetometer at Iwaki observation point in Fukushima, Japan. The sampling interval of the magnetometer is 0.02 sec. The observation clock has been synchronized by use of GPS signals. An accelerometer is also installed at observation point. These observed data is uploaded to the server through the mobile network; therefore, we can keep a real-time watch on these behaviors. In this study, we reported the feature of our HTS-SQUID magnetometer and evaluation results, and show the signals observed at Iwaki observation point.