Crustal Deformation Detected by the KSP VLBI Network

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Abstract

A precise geodetic measurement called Key Stone Project (KSP) has been carried out around the Tokyo metropolitan area by the Communications Research Laboratory (CRL), using three modern space techniques: very long baseline interferometry (VLBI), satellite laser ranging (SLR), and global positioning system (GPS). One of the main objectives of the KSP is to monitor regional deformation and strain accumulation in the plate boundary region of the Kanto district [**Figure 1**].

The VLBI measurements span the last three and half years and indicate that the Miura and Tateyama sites are moving with respect to Kashima at velocities of 17.0 and 20.9 mm/year toward the NNW, respectively [**Figure 2 and Figure 3**]. The east components of the KSP VLBI and KSP GPS velocities measured at Koganei, Miura, and Tateyama agree within less than 1 mm/year. The north components of the KSP GPS velocities measured at Miura and Tateyama are 2.7 mm/year and 3.9 mm/year more than those obtained by KSP VLBI, respectively. Both directions of horizontal vectors from the VLBI and GPS measurements at the three sites agree well. The velocities of Miura and Tateyama suggest the effect of the subducting Philippine Sea plate beneath northern Honshu along the Sagami Trough.

Extraordinary drifts in both VLBI and GPS measurements after the end of June 2000, namely the baseline length between Kashima and Tateyama were shortened by about 5 cm in two months [**Figure 4**]. Similar displacements at four GPS sites (Katsuura, Kyonan, Miura, and Tateyama) of the GPS Earth Observation Network (GEONET) by the Geographical Survey Institute (GSI) were also detected. According to the inversion using half-infinite elastic model, the crustal deformation at Tateyama is caused by a dike intrusion at about 3 km depth and co-seismic offsets between the Izu islands [**Figure 5**].

The observed result by KSP VLBI is available almost 30 minutes after the last observation of the 24 hours session because VLBI observation system of the KSP is connected via a high-speed network. The latest results of the KSP VLBI data are immediately made available for public use after each experiment using a WWW browser *(http://ksp.crl.go.jp)*.

Figure 1 KSP network

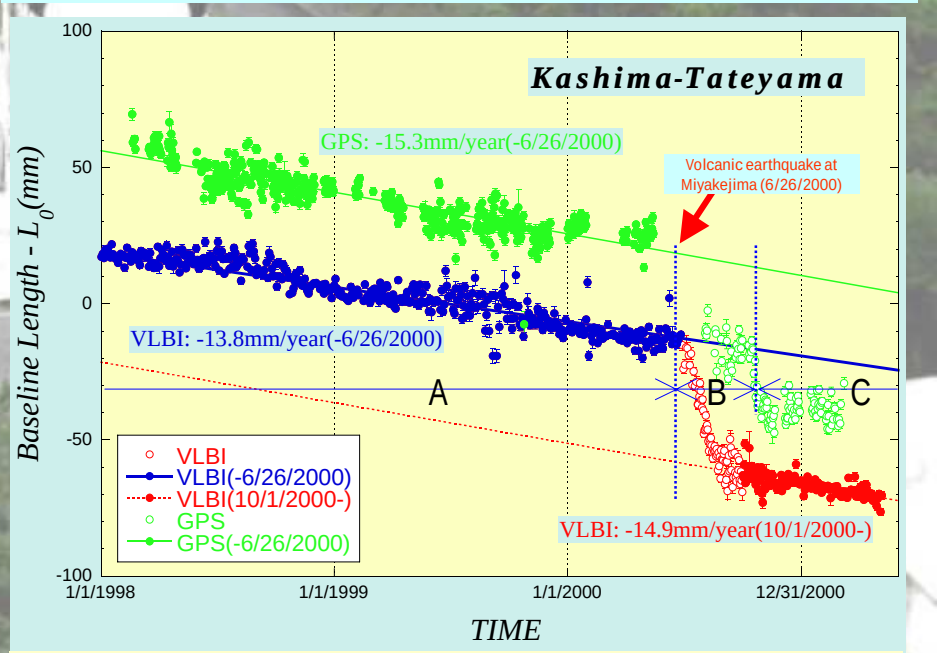

Figure 2 Kashima-Tateyama baseline time series, 1998.1-2001.5.

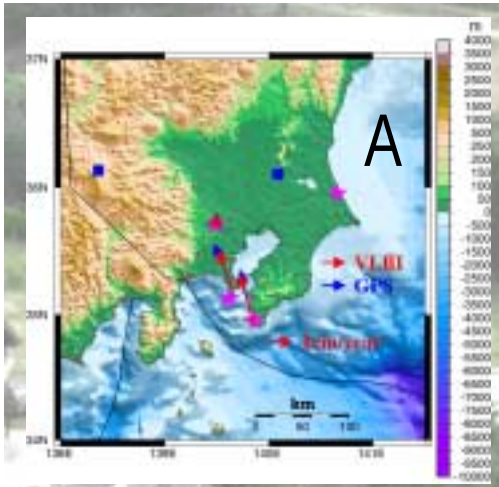

Figure 3 Horizontal velocity vectors relative to Kashima estimated by data before June 26, 2000.

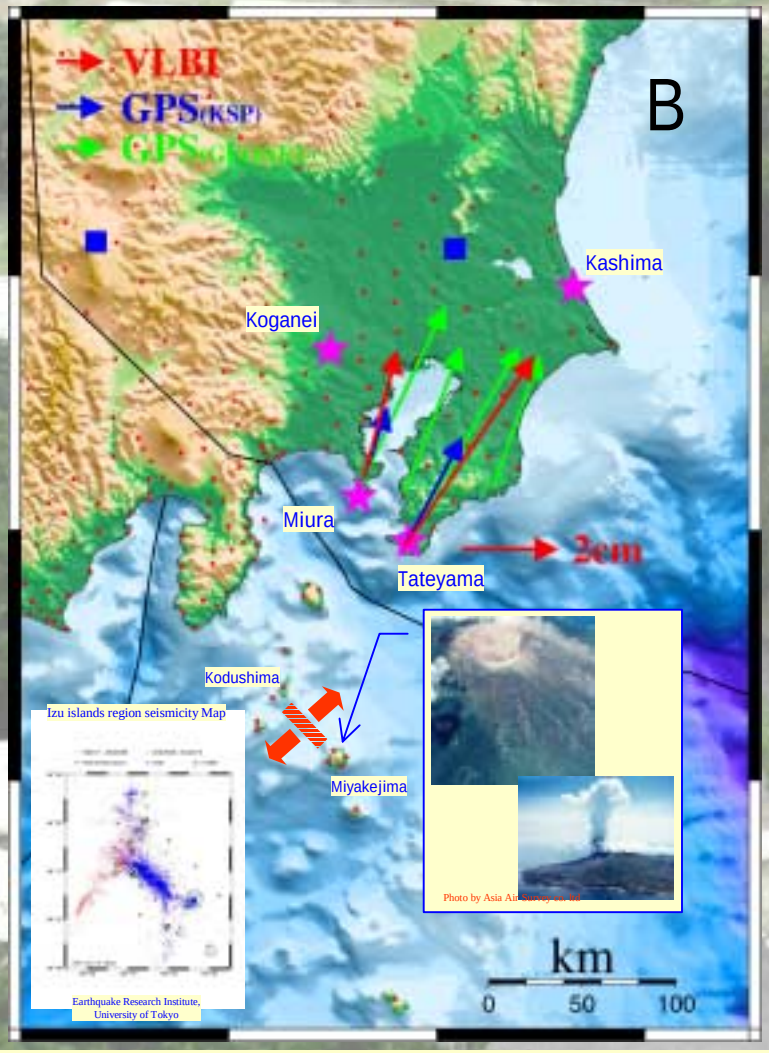

Figure 4 Accumulated displacements from VLBI, KSP GPS and GEONET GPS sites from July to September 2000. *Following the magma intrusion in the Izu Islands (about 150 km south of Tokyo), during June 26 and 27, 2000, crater subsidence and volcanic eruptions continued in July and August at one of the islands, Miyakejima. In addition, high seismic activity and significant crustal deformation has continued around Miyakejima and Niijima-Kodushima since the end of June. According to the inversion using half-infinite elastic model, the crustal deformation at Tateyama, located about 100 km north-east of Kodushima island, is caused by a dike intrusion at about 3 km depth and co-seismic offsets between the islands [Kimata et al., 2000]. The strike of the simulated dike is N140E, which is almost perpendicular to the azimuth from Kodushima toward Tateyama. This geometrical configuration can move the Tateyama site toward the north-east by the deformation due to the simulated dike.*

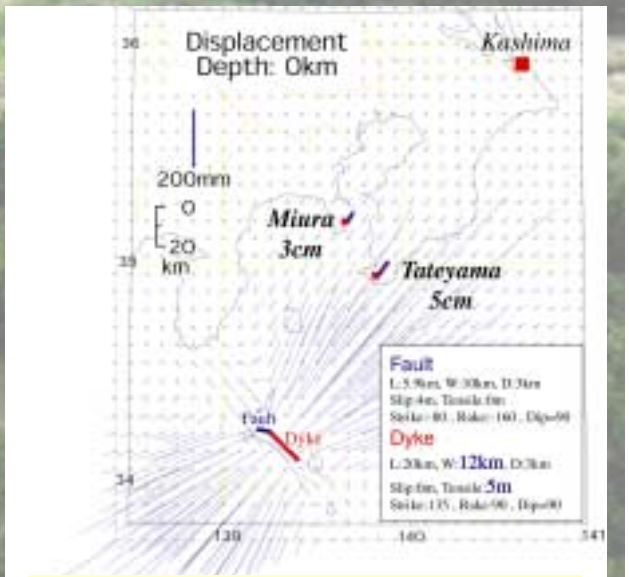

Figure 5 Simulated displacement field.
We refer to the model parameters by Nagoya University [Kimata et al., 2000] for the calculation. Dyke width and tensile opening values are modified in this study.
Dislocation Model: Okada [1992]
Graphic: MICAP-G software [Naito and Yoshikawa, 1999]

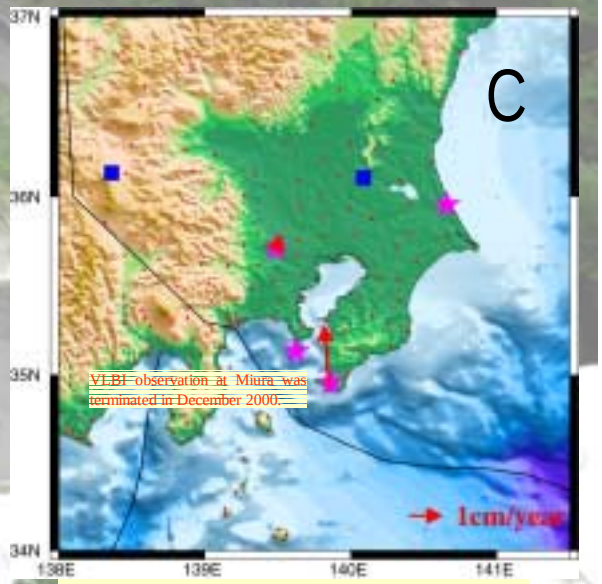

Figure 6 Horizontal velocity vectors relative to Kashima estimated by data after October, 2000.