Forecast of tectonic situation relating to future earthquakes base on seismicity and strain on Japanese Island Arc

Nobuaki Niitsuma[1]

[1] Inst. Geosci., Shizuoka Univ.

Plate convergence and numbers of magnitudes of earthquakes were examined along the plate boundaries of Kuril Northeast Japan Arc along Kuril-Japan Trench, Ryukyu Arc along Ryukyu Trench and Taiwan, Izu Arc along Izu-Ogasawara-Mariana-Yap-Palau Trench, Southwest Japan Arc along Sagami-Suruga-Nankai Trough. The earthquakes from January 1997, reported on Monthly Report of Earthquakes and Volcanoes in Japan were used.

Convergent area in km2 per year Sy, Euler lattitude of ends of interval on plate boundary lat1 and lat2, and rate R of relative rotation along the plate boundary around Euler Pole in degree/million years relate as follow;

Sy = 0.7074 (sin lat1 - sin lat2) R

and area of dislocation Sf in km2 for earthquake with magnitude M is calculated according to Matsuda's Equations as follow;

Sf = 10 1.2M-9.9

Cumulative convergent areas Sy for relative plate motions and cumulative areas for dislocations Sf with earthquakes along plate boundaries correlated well.

The earthquakes did not uniformly occur along the plate boundaries, and division into stages is defined using the behavior of occurrence of earthquakes along the plate boundaries around Japanese Island arecs.

Ryukyu Arc Advance Stage [1] is characterized by activity on Ryukyu Arc more than Plate convergence and low activities on Kuril Northeast Japan Arc, Izu Arc, and Southwest Japan Arc.

Izu Arc Eastward Stage [2] is characterized by activities on Izu Arc and Ryukyu Arc with comparable rate of plate convergence and low activities on Kuril Northeast Japan Arc and Southwest Japan Arc from August 1998 to June 2002. Izu Arc and Ryukyu Arc with earthquakes slipped as east and west margins of Philippine Sea Plate. The Philippine Sea Plate could rotate, but Kuril Northeast Japan Arc without earthquake was stuck on Pacific Plate, then Izu Arc moved eastward relative to Kuril Northeast Arc.

Kuril Northeast Japan Arc Start Stage [3] is characterized by activity on Kuril Northeast Japan Arc with similar rate of plate convergence and low activities on Izu Arc, Southwest Japan Arc and Ryukyu Arc. Kuril Northeast Japan Arc with earthquake activity started to slip eastward on Pacific Plate.

Izu Arc Westward Stage [4] was initiated by 2003 off the Tokachi Earthquake which consumed the cumulative dislocation on Kuril Northeast Japan arc to the cumulative Plate convergence from January 1997. Activity on Kuril Northeast Japan Arc was comparable with plate convergent rate and low activities on Izu Arc and Ryukyu Arc. Izu Arc without earthquake activity was stuck on Pacific Plate and moved westward, but Kuril Northeast Japan Arc with earthquake activity slipped on Pacific Plate. Southwest Japan Arc consumed more than half of Plate convergence since 1997 and Chuetsu Earthquake happened.

The tectonic situation in the stages can be correlated with the Neogene tectonic development of Japanese Island Arc. The eastward movement of Northeast Japan Arc and westward movement of Izu Arc in Stage [4] induce the development of arc shaped bending of Northeast Japan Arc, as same as the Neogene Tectonics of Japanese Island Arc. The westward movement of Northeast Japan Arc and eastward movement of Izu Arc in Stage [2] regresses the Neogene Tectonics of Japanese Island Arc.

Strain condition of central Japan has been monitored with the changes in distance of the laser path with 3708.568 m between Yatsuyama Block and Udo Hills since 1995. The laser path distance reacted well to the stage division.

Because we can make stage division that is correlated with Neogene Tectonics of Japanese Island Arc, based on the seismic activities and the strain of Japan Island Arc can be monitored, we will be able to forecast the tectonic situation relating to the future earthquake.