

Plate Convergent Process and Block Motions in Mindanao, the Philippines

SHIOMI, Masahiko^{1*} ; TABELI, Takao² ; OHKURA, Takahiro³ ; KIMATA, Fumiaki⁴ ; ITO, Takeo⁵

¹Grad. School Int. Arts Sciences, Kochi Univ., ²Fac. Science, Kochi Univ., ³Aso Volcanological Laboratory, Kyoto Univ., ⁴Tono Research Institute of Earthquake Science, ⁵Earthquake and Volcano Research Center, Nagoya Univ.

Tectonics of the Philippine Archipelago is characterized by westward subduction of the Philippine Sea plate (PHS) at the Philippine Trench in the east, eastward subduction of the Sunda plate (SUP) in the west, and left-lateral strike-slip movement of the Philippine fault inland. Ohkura et al. (2015) used GPS campaign measurement data spanning 2010-2014 to make clear the plate locking distribution at the Philippine Trench and slip/locking pattern of the Philippine fault in order to estimate earthquake generation potential in Mindanao. The displacement rate field with respect to SUP shows that west-northwestward motions are dominant due to the convergence of PHS from the east but their spatial decay with increasing distance from the trench is not significant. Elastic deformation caused by a strong coupling at the PHS interface can not explain the observed displacement rates. Thus, they needed to introduce translations of multiple crustal blocks to interpret the observed deformation pattern. However GPS data in Mindanao are too sparse to conduct geodetic inversion analyses.

In this study, we introduce a Markov Chain Monte Carlo method (MCMC) into the simultaneous estimation of slip deficit distribution on the PHS interface, lateral slip along the Philippine fault and translations of multiple crustal blocks. MCMC can get posterior probability density function of unknown parameters from enormous number of forward calculations. In the modeling we represent configuration of the plate interface and fault segments of the Philippine fault by 64 and 4 rectangular elements, respectively. Slip deficit rates, lateral fault slip rates and block translation rates are searched by MCMC while the direction of slip deficit is fixed to that of the PHS-SUP relative motion.

Preliminary results show that southern portion of the PHS interface is strongly locked. But its contribution to the displacement rate field is as small as 29% of the observation at the maximum and the rest can be attributed to the translation of crustal block. Along the Philippine fault that is the major boundary between forearc and backarc blocks, slip rate changes from south to north even in Mindanao. While stronger locking is estimated in the southern segment, clear creep motion is detected in the north. Creep rate in the northern Mindanao is comparable to that detected in Leyte Island just north of Mindanao. Some segments of the Philippine fault are estimated to release strain stationary.

Keywords: MCMC, Philippine fault, Philippine Trench, Mindanao, GPS observation