Construction of the structure model of Japanese islands for the evaluation of earthquake potential

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Current long-term evaluation of active fault is carried out based on the paleoseismological data. The seismicity in the overlying plate is strongly controlled by the condition of plate boundary. It is clearly demonstrated by the difference before and after the 2011 Tohoku-oki earthquake (M9). The long-term evaluation derived from the paleoseismological data cannot involve the change in stress occurred in decade time-scale. We need to construct a physical model which can calculate the stress and crustal deformation produced by a change on plate boundaries. Japanese island is covered by dense GPS and seismic networks, if we can construct a physical (numerical) model, we can estimate the appropriate boundary conditions which satisfy the observed stress change and crustal deformation. In such model, we can obtain the change of Coulomb stress on source faults, if we can obtain enough information about the location and geometry of source faults. Such numerical model requires geometry of plate boundaries, Lithosphere / asthenosphere boundaries, thickness of plates, Moho-discontinuity, Rheology of lithosphere and asthenosphere (rock constitution and thermal structure) and information on source faults. For the parameters of source faults, based on the research of two decades of deep to shallow seismic profiling, we got many important findings that source faults were produced by the deformation of previous geological processes and reuse of pre-existing structure is common feature of deformation. In this term, to use the geological information is very crucial to make better estimate for the source faults. For the back-arc of Japanese island arcs, the fault-system which was active during the period of the opening of the Sea of Japan prays very important role to determine the geometry of source faults and dimension of source fault. The failed rift along the coastal area of the Sea of Japan side behaves as a week zone and marked by active faulting and folding. Such as the Median Tectonic Line active fault system in Shikoku and Wakayama, source fault geometry suggests discrepancy with observed stress field and high slip-rate in late Quaternary, suggesting the importance of the strength of faults. To evaluate the frictional strength of faults two collect the information of slip-rate of active faults is very important. Two-way approach will be needed to obtain a better quality model. One is to construct 1st-order-model by compilation and test the model by numerical simulations. The calculation results can compare with the time sequence of the historical and instrumental earthquakes. Also, new observation is very important to improve the basic model. The geophysical observation to contribute the model is strongly biased on onshore data. To evaluate the whole subduction system, it is in a very poor situation beneath the marine part. For example, very few research has been done about the thickness of lithosphere in the back-arc area. By using the GPS data, we can successfully obtained 1st-order rheological features beneath overlying plate. To improve it, we need more compilation of data and numerical calculations, at the same time, we need to proceed the effort to collect essential observation data.

Keywords: earthquake potential, lithospheric structure, subduction system, seismogenic source fault, rheology model, Japanese islands

