Comparative morphotectonics in the Himalayan foreland and the forearc of Southwest Japan

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The Southwest Japan, which is developed along a subduction boundary, is not a typical island arc. It has rich granitoid and crystalline, poor active volcano, thick upper crust and so on. These geophysical characteristics are in common with a collision mountain range such as the Himalayas. Geodetic surveying and seismology in SW Japan are ahead with those in the Himalayas. On the other hand, the Himalayan front that is a subaerial plate boundary has advantage for geologic and geomorphic studies. Therefore, comparative studies in the two boundaries aid to clarify their active tectonics by recovering the deficiency of each other.

Reflecting crustal thickness and shortening rate, the Himalayas is about twice larger in relief energy and far shorter in topographic wavelength than the SW Japan arc. In a seismotectonic sense of the boundary fault, the arc is divided into proto-thrust zone, imbricate thrust zone, multi-decollement zone, and earthquake thrust zone (Kagami et al. 1983). Morphostructural similarity in the Himalayas and the SW Japan is obvious as close to the plate boundaries. The proto-thrust zone is just on the plate boundary and is filling up with thick sediments. These characteristics are in common with the Ganges foredeep. Geostructure and morphology on the imbricate thrust zone is similar to those of the Sub-Himalaya. Both areas are deformation fronts with relatively low relief, and consist of Neogene-Quarternary deposits, which are sliced by imbricate thrusts in piggyback sequence. In a sense of lithostrigraphy, the area above the multi-decollement zone can not correlate to the Lesser Himalaya directly. However, nappe structure and its related crustal processes in the Lesser Himalaya resemble the development of the multi-decollement. In addition, its geomorphic pattern composed of the Mahabharat Range and the midland depression also corresponds to a series of outer ridges (Tosa-bae etc.) and forearc basins (Muroto trough etc.) on the decollement zone. The area above the earthquake thrust zone forms steep slope from the Muroto Trough to the Shikoku Island. Relief energy of the slope is the largest in the SW Japan arc. Though there is rare similarity in lithostratigraphy, south face of the Higher Himalaya may equivalent to the slope on the earthquake thrust zone by its remarkable topographic gap.

The above mentioned meso-scale morphotectonic features, which are over 10 km in topographic wavelength, are essentially formed by stable slip of flat-lying boundary faults. A dislocation model (Kimura and Komatsubara 2000) can reproduce it. In this model, ridges and basins and of the Himalayan foreland are mainly simulated by slip on thrust ramps branched off from the decollement. Also, slip on the decollement may be considered. Its topographic profile is in accord with the interseismic (post-seismic) crustal movement. On the other hand, remarkable uplift by the 1905 Kangra earthquake, which is considered to be a huge inter-plate earthquake, was observed along topographic depressions in the sub-Himalaya (Yeats and Lillie 1991). This is simulated chiefly by rupture on the decollement beneath the Lesser to Higher Himalayas. These facts show that coseismic crustal movement is less effective to form morphotectonic sequence of the Himalayas. Similar trend is known in the SW Japan Arc. For example, seismic uplift by the 1946 Nankai earthquake (M 8.0) was only observed on the south margin of the Shikoku Island (Ohmori 1978) that is topographic depression in front of the pre-Neogene prism.

Regardless, seismic slip by inter-plate earthquake occurs beneath a frontal margin of a pre-Neogene accretionary wedge, which forms as a steep topographic gap. It means that implications of the next inter-plate earthquake are hidden in the Lesser Himalaya to the southern slope of the Higher Himalaya. Intensive research of seismology and geodesy should be focused to these zones. In addition, the areas above the earthquake thrust zone and their backarc side, there are minor active faults, which are causes of intra-plate earthquakes. Though the earthquakes are relatively small and their recurrent interval are usually over 10^3 years, they must be care as secondary important seismic hazards. Their behavior can be clarified by geomorphic and trenching survey.

References

Kagami H, S Shiono and A Taira. 1983. Plate subdution and formation of accretionary prism in the Nankai trough. *Kagaku (Science)* **53**: 429-438 (*in Japanese*)

Kimura, K. and T. Komatsubara. 2000. Is the Himalayan Frontal Fault a source of the great earthquakes? *Chikyu Monthly (Gekkan Chikyu)* 28: p 54-60 (*in Japanese*)

Ohmori H 1978. Relief structure of the Japanese mountains and their stages in geomorphic development. *Bulletin of Department of Geography, the University of Tokyo* **10**: 31-85

Yeats RS and RJ Lillie. 1991. Contemporary tectonics of the Himalayan Frontal Fault system: folds, blind thrusts, and the 1905 Kangra earthquake. *Journal of Structural Geology* **13**: 215-225