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Active half graben at the northern tip of Taiwan mountain belt: constraints from decadal ground elevation change in the Taipei Basin and geomorphic characteristics of the Shanchiao Fault

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Northern Taiwan, unlike the southern and central parts of the island where arc-continent collision is currently in progress with intense crustal shortening, has underwent post-collisional processes by incorporating into the Ryukyu subduction and back arc system. Such tectonic regime change which appears to be caused by slab break-off and flipping of subduction polarity, is evidenced by Quaternary extensional structures, GPS velocity pattern, and earthquake focal mechanisms. One of the most prominent manifestations of these processes is the triangle-shaped Taipei Basin, a half graben bounded in the west by the active Shanchiao fault. Possible earthquakes generated by this normal fault have raised concerns in the recent decades. In this study, ground elevation change of the Taipei Basin and geomorphic analysis of the fault zone area provide insights on not only properties of the Shanchiao fault, but also active tectonics of the region.

Leveling data in the Taipei area during 1975 to 2003 were analyzed to investigate the evolution of the rate of ground elevation change since the termination of the groundwater pumping. The overall subsidence rate in the Taipei basin gradually decreased since 1975, and around 1989 the basin switched to slight uplift throughout a large part of the basin; such trend essentially demonstrated the effects of natural recharge to previously depleted aquifers, and is explained by the hydro-mechanical coupling of aquifer materials to the rising piezometric level. Shallow soil compaction is in-

terpreted to be responsible for localized subsidence along river channels and marshy areas. Asymmetric tectonic subsidence related to the Shanchiao Fault is illuminated after removing the effects of shallow soil compaction and considering aquifer rebound. While the fault subsidence rate cannot be accurately solved, it is estimated to be 1.75 mm/yr and 0.9 mm/yr in the western part and the central part of the basin, respectively, using simple structure geometry.

Fault zone geomorphic analyses are carried out on 40-m, 2-m LiDAR Digital Terrain Model, and high-accuracy field topographic measurements. Various agents influencing local terrain including forces from exterior (e.g., river erosion and deposition), interior (e.g., faulting) and artificial (i.e., human construction) are identified on the DTMs. Combining published borehole analyses, we remapped the geomorphic scarps and then interpret them as the surface trace of the Shanchiao Fault, which shows segmented in an en-echelon array, indicating complex fault development at surface level which is also revealed in underground geology. Mapped fault trace length and existing paleoseismic documentation are also incorporated to infer possible earthquake scenarios (magnitude 6.8-7.2) and fault dimension (rupture length over 30-55 km), implying a likely connection to northern neighboring Chinshan fault in the Tatun volcanoes area.