Fractal geometry in the Taiwan active fault system

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The Central Geological Survey of Taiwan (CGS) has found 42 active faults in Taiwan Island. Due to the topography of the island, the active faults are distributed at western alluvial plain and longitudinal valley and no active faults locate at the central mountain area. The most recently largest earthquake (Chi-Chi earthquake) occurred in the central Taiwan on 1999 September 20 with local magnitude ML=7.3 which is associated to the Chelungpu fault. The surface ruptures of the Chi-Chi earthquake can be clearly observed at the surface and precisely mapped. In this study, we use the fractal dimension (D) to express the complexity of the surface traces of the active fault. We adopt the Okubo and Aki's (1987) measurement method, which uses a minimum number of circles with a chosen radius to cover the fault-related surface traces, to estimate the D value of the fault. The map of the surface traces of the active faults used in this study was compiled by CGS at the scale of 1:25,000.

The D value of the surface traces of Chelungpu fault is 1.12 which can reflect the fault slip and geometry at depth. However, the D values of surface traces of the other active faults are nearly 1 that shows the traces of the faults are almost straight lines in fractal geometry. These results imply that only the fresh active fault (Chelungpu fault) exhibit fractal characteristics. However, for the traces of the other active fault after erosion, weathering and concealed, the CGS after surveys and investigations can only use straight lines to fit them in 1:25,000 scale map.