A terrestrial analog for Mars faulting? New insights from the Deformation Bands in the Shihtiping Tuffs, Taiwan

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Tuffs are consolidated volcaniclastic and pyroclastic deposits that may hold significant volumes of fluids in certain sedimentary basins of earth as well as extra-terrestrial sedimentary basins of telluric planets. In the last decade, faults and deformation bands have been recognized in layered deposits in the equatorial region of Mars and are believed to have channelized fluid-flow (water) and localized related-mineralization (calcite, zeolite). Providing terrestrial analog for such deformed rocks is critical to constrain tectonic/diagenetic processes that have occurred at Mars future exploration potential sites.

Volcanic tuffs are spectacularly well exposed in the Coastal range of Taiwan, where porous tuffs are related to past Luzon volcanic arc activity (5.1-5.2 My) and have been deformed during the recent stages of shortening (< 5My) related to Luzon Arc/Eurasian Plate collision. The deformation is mainly expressed by faults and 3 types of deformation bands that formed by strain localization.

Pure compaction bands show pore collapse and mineral grain reorganization expressing a loss of volume/porosity without any shear displacement. Based on their microstructure and lack of cataclastic deformation, we infer they will have limited impact on fluid-flow.

Reverse compactional shear bands show cataclastic mechanisms of deformation, involving intra- and trans-granular fracturing of minerals and volcanic glass. Porosity values are lower by 1 order of magnitude compared to the host rocks, thereby suggesting a significant impact on permeability and local fluid-flow.

Strike-slip compactional shear bands affect the whole pyroclastic and volcaniclastic succession, and feature similar deformation mechanisms as the *reverse compactional shear bands,* but with more intense cataclasis. The high network connectivity and greater band thickness suggest that these bands would have a far more significant impact on aquifer-scale fluid-flow than type (2).

This study offers a rare insight to structural heterogeneities (faults, fractures, deformation bands) and related mineralization (zeolites) in volcanic tuffs, providing calibration tools for the analysis of both Mars satellite and rover images.

Mots-Clés : Faulting; tectonics; volcaniclastics; pyroclastics; planetary geology

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