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Relationship of compaction bands in Utah, USA, to monoclinal folding

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Field investigation of compaction bands in Navajo Sandstone at the Buckskin Gulch site in south-central Utah, USA, demonstrates that compaction bands are widely distributed as subparallel spaced sets throughout the intervening fault blocks, rather than being formed preferentially at the tips of small thrust-sense deformation bands as previously concluded in the literature. Thick zones of compaction bands correspond to the exposed parts of deformation band shear zones (DBSZs) that define a series of west-dipping imbricate thrust lenses having offsets of several meters, as indicated by stratigraphic offsets across the zones. Compaction band growth is controlled by host-rock properties including high porosity, large grain size, weakly cemented, and well-sorted grains with sufficiently large horizontal regional compression.

The tectonic setting of compaction bands at the Utah site is folding above the footwall of a blind thrust fault beneath the East Kaibab monocline. Forward mechanical modeling of folding in the monocline by using the Coulomb dislocation program reveals that compaction bands are associated with horizontal shortening strains near the monocline, with band orientations related to the local principal stress trajectories. Layer bending thus contributes the enhanced compression needed to localize compaction bands in this location. Comparable styles of deformation band-related deformation may be expected near thrust-related monoclines on the Earth and near analogous structures (wrinkle ridges) deforming porous sedimentary sequences on Mars.