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Orientation of compaction-dominated deformation bands in Aztec Sandstone at Valley of Fire, Nevada, USA.

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Weakly cemented eolian sandstone at Valley of Fire contains deformation bands with macroscopic shear offset, referred to as shear bands, and compaction-dominated bands (CDB's) that lack macroscopic shear offset. Based on field-structural characteristics, CDB's can be grouped into three types. The first type of CBS's occurs in three, approximately orthogonal, sets, where one set is typically oriented parallel to bedding within a dune set of the cross-bedded sandstone. Well-developed type-1 CDB's are 3-5 cm thick planar zones containing 5-10 parallel thinner bands and extend over 10-50 m in map view. Across dune boundaries, type-1 CDB's either continue straight across for 1-3 m before terminating, or continue across with a gradual change in orientation. Cross-cutting relations among type-1 bands indicate that all three sets formed synchronously, with single strands of one set turning 80-90 degrees to continue as bands of the orthogonal set. Type-2 CDB's bisect type-1 CDB's. Unlike type-1 CDB's, type-2 bands are always composed of single strands and maintain a planar orientation only over short distances (3-5 m). More commonly, they zigzag around an overall orientation that bisects the type-1 CDB's but with the zigzagging band segments orientated parallel to type-1 CDB's within the same dune set. Amplitude and wavelength of zigzagging type-2 CDB's varies from 1 - $>$10 cm along the same band and among adjacent bands. Upon approaching type-1 CDB's, type-2 bands turn into parallelism with, and continue as, type-1 bands, indicating that bands of both types form concurrently. Type-3 bands are planar like type-1 bands, composed of single strands, and are oriented at 15-20 degrees relative to type-1 CDB's. Type-3 bands also turn into parallelism with type-1 bands, indicating that all three types of CDB are coeval. In some cases, type 3 bands and bedding-parallel type 1 bands develop macroscopic shear off-

set. Based on the spatial arrangement of all types of CDB's it is inferred that straight type-2 CDB's are perpendicular to the maximum shortening direction and thus form pure compaction bands. Type-1 bands are oriented at approximately 45 degrees relative to the maximum shortening direction. Type-3 bands are oriented at approximately 30 degrees relative to the maximum shortening direction and the inferred direction of the maximum principal stress, consistent with Mohr-Coulomb theory. Although some occurrences of band curving can be attributed to local stress field reorientation due to elastic and plastic interaction of adjacent structures, observed curving of CDB's over 90 degrees, and the switch from one type into another, suggest that yield surfaces in this material can attain any orientation relative to the loading direction. Yet, the prevalence of certain directions suggests that, under given loading conditions, orientations at 45 and 30 degrees relative to the inferred direction of the maximum principal stress are preferred. Pure compaction bands appear to be inherently unstable as planar structures, preferring to break into zigzagging segments that parallel the 45 degree orientation. With all three types of CDB's occurring in the same material and formed under presumably similar overall loading conditions, it is suggested that the switch among the three types of CDB's may be controlled by local variations in the ratio of principal stress magnitudes.