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Development of deep-seated gravitational slope deformation on a shale dip-slope: observations from high-quality drillcores

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The internal structures within a gravitationally deformed slope were observed using high-quality drillcores obtained from a dip slope of a series of shale-dominated sediments. This slope has dimple-like depressions and an overall gentle slope angle, but has no well-defined landslide scarp, suggesting that this area underwent gravitationally deformation but with no separation of the deformed portion from the surrounding area. Three drillcores, to a maximum depth of 96 m, were used during this study, with detailed observations of cut paraffin-impregnated core surfaces used to characterize gravitational deformation in the study area. This logging identified shear zones that consist of disintegrated (brecciated) and pulverized zones that were up to 88 and 19 cm thick, respectively. Disintegrated zone breccias have local jigsaw-fit textures, but other areas contain compositional trails formed by cataclastic flow, and rounded outlines formed by attrition. Pulverized zones underwent increased amounts of shearing, leading to the formation of more rounded fragments and increasing amounts of clayey matrix material, but still containing more than 30% of visible rock fragments. As such, these zones are still classified as breccias in terms of fault rock classification. Planar structures, such as R and Y shears, and P foliations, are not developed in the study area. Shear zones are intermittently located across the slope and have not formed a through-going master sliding zone. Incipient shear zones are present within the slope, including a pair of shear surfaces with a pull apart-like opening, and thin disintegrated or pulverized zones in intact rocks at 3–10 m below the base of the main area of gravitational deformation, suggesting that these shear zones propagate downward in a step-wise manner. This propagation may be related to the redistribution of stress induced by river incision.