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Mechanisms governing brittle fault mechanics – a multi-scale study from the Permian Khao-Kwang fold-and-thrust belt, Thailand

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Despite our qualitative understanding of factors contributing to thrust and detachment weakness such as mineralogy, pore fluid pressure, or efficiency of structure localization, it is difficult to assess the contribution of the individual factors. Here we present multi-scale analysis of a mixed clay / carbonate high displacement (kms of heave) thrust zone, where it is possible to study structures formed within a similar temperature and pressure regime, and thus only varying due to lithological contrasts. We mapped the well-exposed thrust zone in a large quarry at outcrop scale in five separate sections present along a strike-distance of 1 km. The thrust zone shows considerable variations in structural style, as well as localization within different clay and limestone horizons. Zones of low and high strain have been identified. We investigate these changes in macroscopic deformation style using Virtual Polarizing Microscopy, and the combined methods of Broad Ion Beam milling and Scanning Electron Microscopy in addition with XRD analysis. We characterize structural and mineralogical variations in the thrust zone at all scales, from outcrop down to nano-meters. Results show strain localization is heterogeneous, with strong variations along strike. Within the clay package, strain localizes along zones rich in organic matter. Microstructures are complex, and show multiple deformation events, including crack-seal processes and reworking of vein material. Pressure solution is dominant. XRD analysis shows mineralogical differences between zones of high and low strain within the shale-dominated package. However, highest strain does not only occur in the clay units, but partly is accommodated in the surrounding limestone.