Deformation mechanism transitions in the Cobequid fault zone, Nova Scotia

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As a lithosphere-scale displacement zone, the Cobequid fault zone provides an exceptional opportunity to examine mid- to upper crustal deformation processes. This is spectacularly demonstrated within the Grenville Bay segment where displacements are accommodated by discrete fractures, coherent semi-brittle processes, and penetrative ductile flow. Variations in the deformation processes can largely be interpreted as combinations of inherent strength anisotropy among difference protoliths and localized partitioning of stress and/or strain rate. The widest range of deformation modes is exhibited by fault zone rocks assigned to the Grenville River Formation. The background deformation is pervasively ductile, indicating the predominance of a seismic displacement at the currently exposed crustal level of the fault zone. However, along the tectonic contact between Grenville River sedimentary rocks and a competent rhyolite fault sliver, the expression of deformation changes zonally from extensive sheath fold formation to multiple foliation phyllites to phyllosilicate-rich coherent breccia and gouge as the rhyolite block is approached. This transition suggests a strain rate gradient culminating in transient seismic events adjacent to the rhyolite block. Critical observations include the ability of the fine-grained sedimentary rocks to accommodate large displacements (at high strain rates?), effectively by superplastic flow, and the localized partitioning of displacement into brittle and semi-brittle deformation within a predominantly ductile regime.