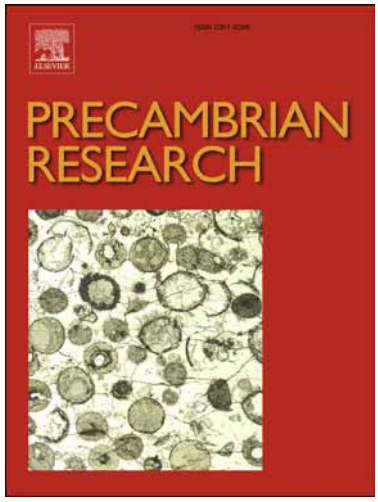

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Strain Variations across the Proterozoic Penokean Orogen, USA and Canada

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Abstract

Strata in the Huron (2.5-2.0 Ga) and Animikie (2.2-1.85 Ga) basins were deposited on the southern margin of the Archean Superior province. These rocks were deformed during the Penokean orogeny (~1850 Ma) followed by subsequent accretionary orogens to the south at 1750 Ma (Yavapai) and 1630 Ma (Mazatzal). Strain patterns are unique to each orogenic belt with no far-field effect: Archean Wawa terrane rocks in the Penokean foreland preserve deformation associated with Archean accretion with no younger Penokean, Yavapai or Mazatzal strain overprint. The Penokean orogeny deformed Huron-Animikie basin sediments into a north-vergent fold-and-thrust belt with no Yavapai or Mazatzal strain overprint. Yavapai orogen strains (SW-NE margin-parallel shortening) are unique when compared to the younger Mazatzal shortening (N20°W) shortening, with no strain overprint.

Penokean deformation is characterized by shortening from the south including uplifted Archean gneisses and a northerly thin-skinned fold-and-thrust belt, with north-vergent nappes and a gently-dipping foreland. Our study of finite and calcite twinning strains (n=60) along (~1500 km) and across (~200 km) the Penokean belt indicate that this orogeny was collisional as layer-parallel shortening axes are parallel across the belt, or parallel to the tectonic transport direction (~N-S). Penokean nappe burial near the margin resulted in vertical shortening strain overprints, some of which are layer-normal. The Sudbury impact layer (1850 Ma) is found across the Animikie basin and provides a widespread deformation marker with many local, unique strain observations. We also report new geochronology (U-Pb zircon and apatite) for the gneiss-mafic dike rocks at Wissota (Chippewa Falls, WI) and Arbutus (Black River Falls, WI) dams, respectively, which bears on Penokean-Yavapai deformation in the Archean Marshfield terrane which was accreted during the Penokean orogen.