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**INVERTED REGIONAL METAMORPHISM IN THE COAXIALLY REFOLDED TONGA FORMATION:  
EVIDENCE FOR MESOZOIC ACCRETIONAL TECTONICS IN THE CASCADES CRYSTALLINE  
COREJENSEN**

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The Tonga Formation, on the westernmost boundary of the Cascades crystalline core, records Cretaceous plutonism, contact to regional metamorphism, and multiple episodes of folding related to intense east-west contractional deformation. The Tonga Formation is exposed in a fault-bounded, north-south elongate tectonic domain that comprises pelite-psammite metasediments, which increase from greenschist to amphibolite grade south to north. This metamorphic gradient is inverted relative to a major westward verging and downward facing fold system that dominates the internal architecture of the formation.

Sedimentary structures are remarkably well-preserved in the Tonga Formation, which allowed for the determination of younging directions. Using these and bedding-cleavage relationships, detailed field mapping indicates a stratigraphically overturned section that forms a large-scale antiformal syncline (exposed in the northern and eastern domain) and related synformal anticline (southern and western domain). The overturned nature of the strata and the geometry of gently north-plunging folds imply upsection a pre-existing tight, recumbent anticline refolded into a co-axial (type III) fold interference pattern. The core of this early anticline, exposed in the northern domain, corresponds with the higher metamorphic conditions of the inverted metamorphic gradient and early Cascades regional metamorphism ("M1") rarely decipherable in the adjacent Chiwaukum Schist.

The co-axial, superposed folding in the Tonga Formation and the overall N-S arrangement of the component fold generations suggests a strong component of east-west shortening in the foreland of the Cascades core. Fold geometries account for the inverted metamorphic zonation as well as control the localization of plutons, which also elongate parallel to the regional fold axes. The central and southern and portion of Tonga Formation records subsequent contact ("M2") and regional ("M3") metamorphism, and appears to be a lower-grade equivalent of the Chiwaukum Schist, as protoliths of each unit are also similar. Exposure of the Evergreen fault is limited, but the observed structural and metamorphic relationships suggest that it is a late, east-dipping reverse fault that places the deeper, higher-grade Chiwaukum Schist structurally above the lower-grade Tonga Formation.