

Seismicity Patterns and High Resolution Bathymetry Constrain Extent of Deformation in Yakutat Microplate's Leading Edge

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Abstract

Within the Gulf of Alaska the Pacific plate subducts beneath North America along the Aleutian trench to the west and translates along the Queen Charlotte-Fairweather strike-slip fault system to the east. The margin is further complicated by the oblique collision and flat-slab subduction of the Yakutat microplate beneath the North American continent, resulting in the Chugach-St Elias orogenic system. Resistance of the Yakutat block to subduction causes geodetically observed differential motion between the Pacific and Yakutat plates. We compare seismicity patterns with surface ruptures observed on high-resolution bathymetric and seismic reflection data in order to investigate the extent that active deformation in the leading corner of the Yakutat block accommodates this differential motion.

High-resolution (100 m) United Nations Law Of the Sea (UNCLOS) bathymetric data shows possible active faulting in the western third of the Transition fault, where observed earthquakes may correlate with surface deformation. Seismic activity is also concentrated on the southeast slope of the microplate and on the shelf offshore Cross Sound, where a strike-slip fault is visible on high-resolution seismic reflection profiles. Sparse seismicity observed on most of the remaining Yakutat shelf corroborates previous assertions that the Yakutat block is a deformation-resistant oceanic plateau, with relative plate motions primarily accommodated at the plate boundaries. However, seismically imaged sediments overlying the Kayak Island fault zone, which was previously suspected to be the active northeastern extension of the Aleutian trench, exhibit limited deformation. In addition to limited seismicity in the area, this observation suggests that the Kayak Island zone no longer accommodates Yakutat-North American differential motion. A conspicuous grouping of earthquakes concentrated along the eastern extent of the Pamplona fold and thrust belt and continuing onshore north of Icy Bay may indicate significant intraplate deformation within the leading corner of the exposed Yakutat block.