Active Tectonics of the Southern Alaska Margin Constrained by GPS

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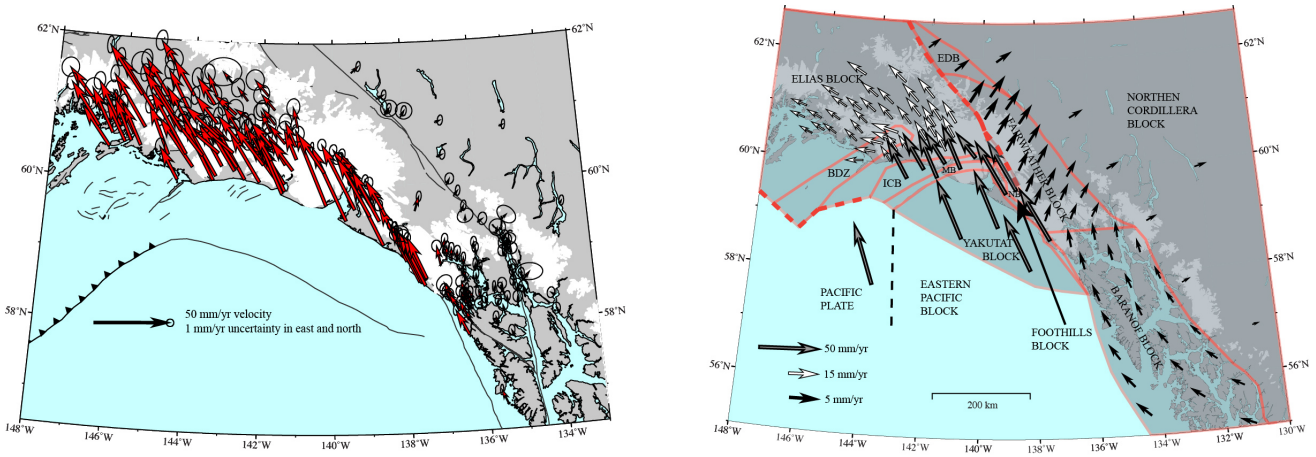
GPS data from southern Alaska and eastern Canada have helped redraw the picture of the region's present-day tectonics. Instead of a relatively simple boundary, the interactions of the Pacific plate and the Yakutat block with Alaska have created a complex margin made up of a number of small blocks and deformation zones. Relative motion is distributed along a variety of structures. We present GPS data from across the area and use it to constrain a tectonic model for the southern Alaska margin and the adjacent region of Canada.

According to our model, the Yakutat block itself moves NNW at a rate of 50 mm/yr. In southeast Alaska, which contains the fragmenting eastern boundary of the Yakutat block, the majority of the relative plate motion is accommodated by 45 mm/yr of slip along the dextral Fairweather – Queen Charlotte fault system. Some of the relative motion is transferred eastward, causing the region inboard of the Fairweather fault to rotate clockwise into the northern Canadian Cordillera. About 5% of the relative motion is transferred even further east to cause small northeasterly motions that extend for 100's of kilometers inland.

Further north and west, our results indicate that the current deformation front between the Yakutat block and southern Alaska runs along the western side of the Malaspina Glacier. The majority (~35 mm/yr) of the relative plate motion is accommodated along a narrow band of crustal thrust faults concentrated in the southeastern part of the St. Elias orogen, but about 10-15% of the motion is transferred further north where it causes the counterclockwise rotation of the region south of the Denali fault. Near the Bering Glacier, there is an abrupt transition from crustal thrust faulting to subduction of the Yakutat block beneath the western St. Elias orogen and Prince William Sound. This change aligns with the dextral Gulf of Alaska shear zone, implying that the Pacific plate may be fragmenting in response to the Yakutat collision. From the Bering Glacier, the subduction interface extends north and west beneath much of the Chugach range. At the western end of our study region, our model suggests that crust may be laterally escaping along the Aleutian forearc.

Our results suggest that while strain from the plate interactions is transferred inboard of the main boundary, where it drives block rotations and slip along the Denali, Totschunda, and Duke River faults, some is also transferred outboard where it drives slip along the Gulf of Alaska shear zone and deformation of the Pacific plate.

These studies have direct applications to seismic hazard studies of southern Alaska and general tectonic surveys of the Chugach National Forest, Wrangell-St. Elias National Park and Preserve, and Kluane National Park and Reserve. A public talk on this work was given in McCarthy, Alaska as part of the National Park Service's lecture series in Wrangell-St. Elias. Several lectures have been given to an undergraduate field school based in McCarthy and materials are being developed for use in field school/academic settings and in general public education efforts with Park visitors.



Left: GPS velocities along the southern Alaska Margin. Right: Predicted model block velocities.