Using GPS to Understand the Tectonics of the Eastern Edge of the Yakutat Block

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The Saint Elias orogen of south central Alaska and the adjacent area of Canada is the highest coastal mountain range on earth, with peaks that exceed 6000 meters in elevation. The driving force behind this stunning topography is the Yakutat block, an actively accreting terrane located within the complex transition zone between a transform plate boundary along the Fairweather-Queen Charlotte system and normal subduction along the Aleutian Megathrust.

As a first step toward understanding this region, we have used GPS velocities at 95 sites in southeastern Alaska (Figure 1) to elucidate the tectonic regime along the eastern boundary of the Yakutat block. Visco-elastic rebound of the earth's crust resulting from massive glacial ice loss is a major component of the observed GPS velocities. We use a rebound model developed for southeast Alaska [Larsen et al., 2005] to apply a glacial rebound correction to the data and isolate the tectonic signal.

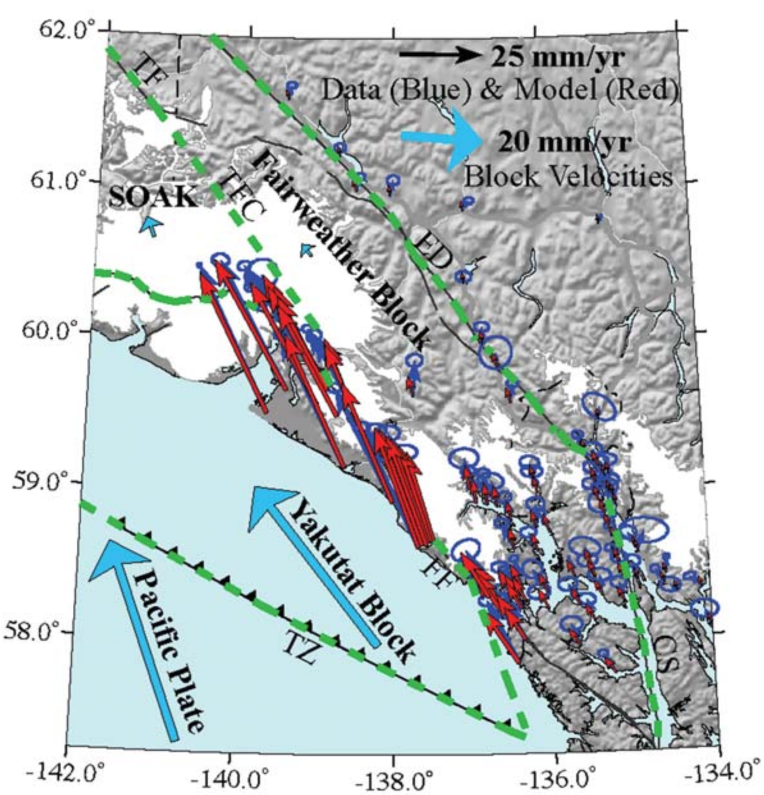

Figure 1. Tectonics of southeast Alaska. Green dashed lines represent postulated block boundaries. SOAK sands for Southern Alaska block, TF is the Totschunda fault, TFC is a proposed Toschunda-Fairweather connector, FF is the Fairweather fault, ED is the eastern Denali fault, CS is the Chatham Strait fault, and TZ is the Transition Zone fault.

We model the GPS velocities as a combination of block motion and strain accumulation along various faults. The horizontal velocities are best fit when the Yakutat block has a velocity that is parallel to the Fairweather fault. Block motion and strain accumulation on strike-slip faults are the largest contributors to the velocities seen in southeast Alaska but cannot fully explain the azimuths. We find that convergence across the eastern end of the Transition Zone fault can provide the necessary component.

The difference between the velocity we determined for the Yakutat block and the motion of the southern Alaska block [Fletcher, 2002] indicate that 40 mm/yr of convergence is taken up within the Saint Elias orogen. Over the next few years, we plan to build on this work by using GPS velocities from a network of 69 campaign sites across the orogen that was established as part of the STEEP project to determine where the convergence is accommodated. UNAVCO supported this project through equipment loans during eight field seasons, data archiving, and equipment repair. Availability of more equipment enabled more efficient use of field time and allowed us to collect a substantially more robust data set than we initially envisioned.

References

Fletcher, H.J. (2002), Tectonics of interior Alaska from GPS measurements, Ph.D. thesis, 257 pp., Univ. Alaska Fairbanks, Fairbanks, Alaska.

Larsen, C.F., R.J. Motyka, J.T. Freymueller, K.A. Echelmeyer, and E.R. Ivins (2005), Rapid Viscoelastic uplift in southeast Alaska caused by post-Little Ice Age glacial retreat, Earth Planet. Sci. Lett., v. 207, 548-560.

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