USING GPS TO UNRAVEL THE TECTONICS OF THE SAINT ELIAS OROGEN, ALASKA

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The Saint Elias orogen of south central Alaska and the adjacent area of Canada is the highest coast mountain range on earth, with peaks that exceed 6000 meters in elevation. It is located in the complex transition zone between transform motion along the Queen Charlotte-Fairweather fault system and subduction along the Aleutian Megathrust. The Yakutat terrane lies in the gap between the end of the Megathrust and the end of the transform system. Roughly 4 cm/yr of convergence is accommodated within the continental crust, onshore and possible offshore, as the Yakutat terrane collides with southern Alaska. This collision provides the driving force behind the stunning topographic relief of the orogen.

As part of the Saint Elias Erosion and Tectonics Project (STEEP) designed to unravel the tectonic complexities of this region, we have made GPS measurements at 47 sites in south central Alaska. The postseismic signal from the 2002 Denali Fault earthquake is significant in this area, so we cannot use velocities obtained from post-2002 measurements until a post-seismic model, which requires more post-earthquake timeseries, is completed. Here we present results from 15 campaign GPS sites that had pre-earthquake velocities. The span of measurements at these campaign sites range from two to seven years. All of the sites show northwestward motion and uplift. Sites near the coast show over 30 mm/yr of horizontal motion while sites further north across the Bagley Icefield have velocities of nearly 20 mm/yr and a site at McCarthy moves about 10 mm/yr. The highest amounts of uplift occur at several coastal sites near Icy Bay where average rates surpass 24 mm/yr. Sites along the Bagley Icefield display an average uplift rate of about 20 mm/yr. A significant portion of this uplift is caused by the melting of regional icefields and tidewater glacial retreat in Icy Bay.

The azimuths of the horizontal velocities within the orogen require convergence at the rate and orientation of the velocity at Yakutat, 41 mm/yr directed N37W. A model consisting of a block rotation of southern Alaska and strain accumulation on a series of thrust faults can explain all but the westernmost velocities. These velocities show the influence of the transition to normal subduction along the Aleutian Megathrust and require a more complex model.