Global Oscillations and Tectonics of Alaska

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Intro/Abstract

At various tectonic settings around the world, scientists have observed increased rates of erosion and sedimentation over the past few million years. These changes have been studied extensively on the continental margin of southern Alaska where the Yucatat plate is subducting beneath the North American Plate to form the St. Elias Mountains. These rates are thought to be attributed to erosion by glaciers during interglacial periods.

Analysis of glaciomarine sediments at the Surveyor Fan sourced from the St Elias mountains (Reece et al.) allow for the exploration of how climate change impacts the rates of glacial marine sedimentation in the subarctic environment. We will be examining sedimentation rates in terms of glacial oscillations related to the tectonics of Alaska.

Geologic Background and Context

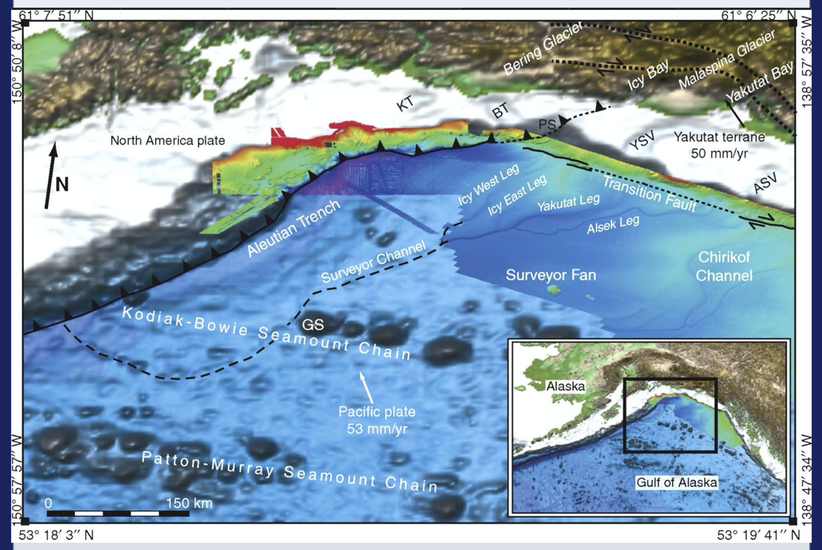

Figure 1: Three-dimensional perspective view of the bathymetry and topography of the southern Alaska continental margin, showing tectonic boundaries, and the Surveyor Fan in high-resolution bathymetry. ASV—Alsek Sea Valley; BT—Bering Trough; GS—Giacomini Seamount; KT—Kayak Trough; PS—Pamplona Spur; YSV—Yakutat Sea Valley. Plate boundaries adapted from Gulick et al. (2007); high-resolution bathymetry (Gardner et al., 2006); remaining bathymetry (Smith and Sandwell, 1997); Yakutat terrane motion relative to North America (Elliott et al., 2010); Pacific plate motion (Kreemer et al., 2003).(Reece et al.)

Geologic Background and Context (cont.)

- Our area of focus is in the southern region of Alaska where the transform boundary between the Yucatat and north American plates interact adjacent to the St Elias orogeny.
- South of the Gulf of Alaska is the Surveyor Fan, where there is an abyssal plain of deep sea sediments, the source for which being the St. Elias mountains. In the north west direction from the Gulf is the Aluetian trench, a subduction interaction between the Pacific and North America plates.

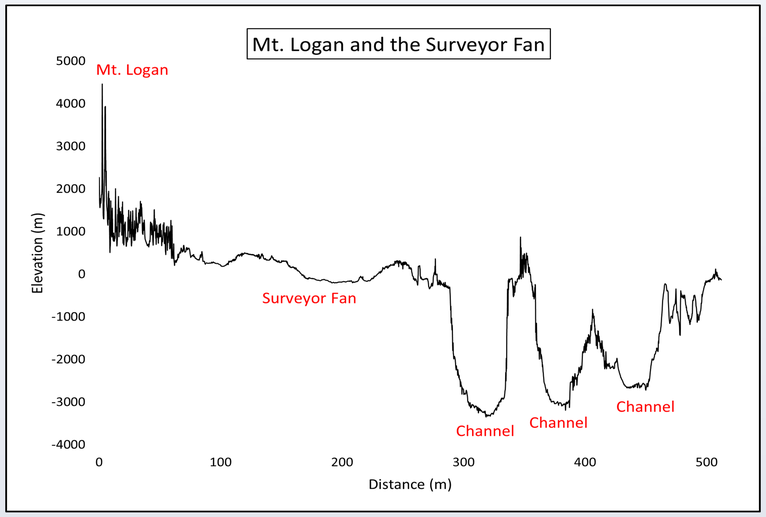

Figure 2: Topographic profile showing the relief from Mt. Logan over the Surveyor Fan. Created using the scripps database (https://topex.ucsd.edu/cgi-bin/get_data.cgi).

Goals/Objectives

- Determine the forces acting on sedimentation rates and climate changes occurring in the region of the Alaskan gulf.
- Observe how climate changes and sedimentation rates are related to the unique morphology and topographic expression of the regions landscape
- Recognize the relationships between tectonics and glacials and how certain interactions can result in changes in climate.

Discussion/Conclusion

- The rapid change in topography from orogenic events in the region could have set off a rapid cooling effect (Huber et al. 2003) (Sheaf et al. 2003), potentially triggering erosion in specific areas. This may suggest the use of tectonics as a predictive tool for climate driven erosional processes in the area
- Relating tectonics to climate, some argue that the St. Elias orogeny caused the glaciation (Huber et al. 2018).
- Rearranging this empirical formula to say that erosion rates can be observed-accounting for rates of orogen to find past climate rates, and predict them in the future.
- In evaluating past sedimentation rates in the Gulf of Alaska, a discrepancy was found (Sheaf et al. 2003). Calculated erosion rates would suggest swaths of “exposed” “lower crust” which are simply, not there which “indicate that either Holocene sediment yields are anomalously high, erosion rates in the orogen have accelerated over time, or both” (Sheaf et al. 2003).
- It has also been established that rates of terrigenous sedimentation have been higher in the past 5 million years than any 5 myr period before, likely due to glaciation influencing sea level and increasing erosion through fluvial activity. (Peizhen et al. 2001).
- The forces responsible for the changes in sedimentation rates are most likely related to glaciation.

References

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