

Tectonics and Climate in the Andes

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INTRODUCTION

- The regional geology within the Andes mountains is rather unique because even though it is a continuous range, there are three relatively distinct sections (north, central, and south) that vary in their topography and geologic makeup.
- The Northern Andes topography is controlled by fluvial (stream produced) processes, while the Southern portion is mainly controlled by glacial erosion. The Central Andes plateau (Altiplano) is largely controlled by tectonic uplift and is not affected by fluvial processes.
- Drainage, precipitation rates, and vegetation all play a role in the deposition of sediment, which affects climate change.



In the Andes, the climate controls the landscape and uplift in three main ways: fluvial erosion and high precipitation in the northern Andes.

There is little erosion in the central Andes, increasing the mass balances which promotes crustal thickening.

Lastly, the highest portions of the Southern Andes are carved by glacial erosion (Montgomery, 2001).

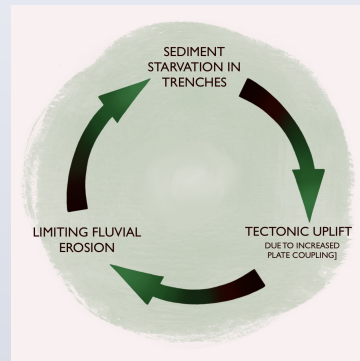
Figure 1. Generalized visual representation of the Northern, Central, and Southern sections of the Andes Mountain chain made with Google Earth Pro and Microsoft Paint.

OBJECTIVES

Understanding feedback loops that continue to exist in the Andes Mountain Range.

One example is the process of sediment starvation in the trenches on west coast of the central portion of the Andes:

- mass balance changes result in uplift and crustal thickening
- limiting the amount of fluvial erosion possible in the western central portion of the Andes
- further limiting sediment supply to the trenches.



Feedback system controlling climate through tectonics in the Andes Mountains represented in this simplified diagram, created by Ava Kopellas.

- Plate coupling is responsible for uplift that increases sediment starvation.
- Uplift and sediment starvation promote vertical development leading to higher altitudes.
- Mass balances throughout the Andes Mountain range vary due to differing amounts of eroded sediment deposited into the trenches

RESULTS

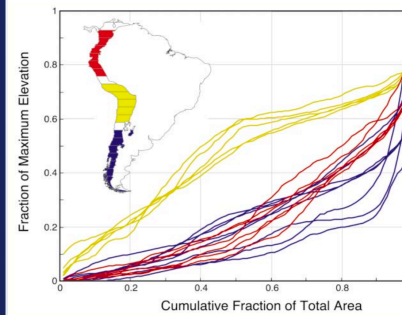


Figure 2. Normalized hypsometric curves (which is representative of land distribution, or elevation) of Andes for the "Climate, tectonics, and the morphology of the Andes" lab; curve color corresponds to location in northern (red), central (yellow), and southern (blue) Andes. (Montgomery, Balco, & Willett, 2001).

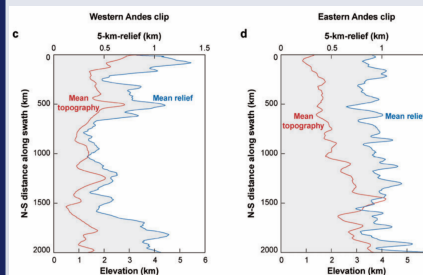


Figure 3. These two graphs show differences in elevation and relief between the eastern and western flanks of the Central Andes, which reflect patterns of the rain shadow effect. (Figure from Strecker, 2007)

- In the eastern Andes, relief is mostly high and on the western flank, the relief is comparably low in most places, with few exceptions, indicating the absence of fluvial and glacial erosional processes (Strecker, 2007).
- Looking at the contrast in mean relief indicates differences in erosion in the Western and Eastern Andes

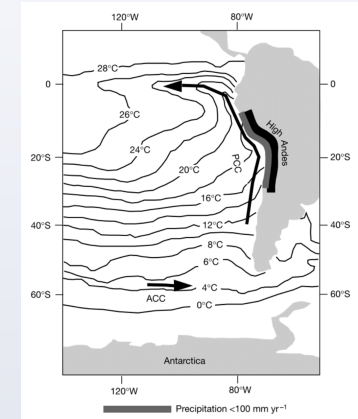


Figure 4. Ocean surface temperature data was collected by satellite and *in situ* measurements by NOAA for July 2002 and interpolated by Lamb & Davis, 2003.

- Atmospheric circulation and ocean circulation in tandem with the local rain shadow in effectively block moisture from the Amazon in the east in the central Andes.
- The cold Peru-Chile current system (PCC) prevents moisture from rising and precipitating

CONCLUSION

In the Andes, climate and topography are interrelated through many feedback systems.

- The topography is controlled by tectonics and climate, yet topography also controls tectonics and climate to an extent.
- Ocean and atmosphere circulation with topographic constraints controls the local climate.

REFERENCES

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- Strecker, M. R., Alonso, R. N., Bookhagen, B., Carrapa, B., Hilley, G. E., Sobel, E.R., & Trauth, M. H. (2007). Tectonics and climate of the southern central Andes. *Annu. Rev. Earth Planet. Sci.*, 35, 747-787.