Hodges, K., 2006, Climate and the evolution of mountains: Scientific American Magazine, v. July 2006, p. 54-61.

Summary by Student Ex

Introduction: While the effects of climate on the surface of the earth are well known, new evidence suggests that climate may also cause subsurface movement of rock. This paper explains and summarizes, a feedback loop that exists between crustal channel extrusion in Himalayan-Tibetan orogenic system and the climatic trends that may drive extrusion,.

Methods: A new theory of the formation of the Himalayas and the effect of climate has been proposed using the theoretical modeling and field observations of previous research. Analysis of the radioactive decay of cosmogenic isotopes on rocks from the Himalayan front and GPS measurements provide information on the surface erosion and extrusion rates. By utilizing geologic chronometers within crystalline rock, time constraints and rates on channel extrusion and flow below the surface are estimated. Precipitation studies of the Himalayan front and the Tibetan Plateau have uncovered specific weather patterns for the region.

Results: Many aspects of the Himalayan-Tibetan orogenic system have been described by researchers. In addition to thrust fault systems common to collisional plate boundaries region, The Himalayan-Tibetan orogen has been unroofed by an orogen-scale normal-sense fault. This recognition of orogen-scale thrust faults juxtaposed beneath normal faults has led to a model that uses channel extrusion to explain the Himalayan-Tibetan orogenic system. This model consists of a channel of partially-melted crustal material to flow beneath the Tibetan Plateau and the

Himalayas. This crustal channel intercepts the surface at the path of least resistance, which in this region is the Himalayan front.

Climate is tied to the evolution of the orogen since the high elevation of the Himalayan front effectively blocks moisture, causing high amounts of rainfall on the Himalayan front and very little precipitation on the Tibetan Plateau. The high levels of precipitation focus erosion on the southern front of the topographically high and steep Himalayan.

Discussion: The increased erosion of the high-elevation Himalayan front creates the least resistant pathway to the surface for the flowing crustal channel below the orogenic system. As more erosion occurs, the area becomes less and less resistant to the flow of crustal material to the surface. Thus a feedback loop exists where more extrusion creates higher topography in the Himalayan front that in turn allows more precipitation and erosion to occur, which makes the Himalayan front less resistant to extrusion coming up to the surface.

Conclusions: The interaction between climate and mountain-building events is a newly proposed theory. The feedback loop between erosion, precipitation, and crustal extrusion in the Himalayas may occur with different or similar variables in other regions. This link between climate studies and geology may help to interconnect other research areas in the future.

Critique: This paper simplified the more scientific papers that we have read previously. I liked the simplification, but sometimes I felt the paper used too many analogies in an attempt to dumb-down the concepts being presented. These analogies can sometimes cause my mind to get side-tracked with other visualizations.

Questions

1. Do any other channels that move away from the Tibetan Plateau intercept an area of high erosion that allows them to come to the surface?

2. Why aren't the geologic chronometers given by name? They give radiocarbon as an example, but they never give any details on this work.

3. How would ecosystems affect mountain ranges? I always seem to think they are caused by certain climates, not acting separately.