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The Evolution of Eocene Highlands and the Climate of the Western U.S. Cordillera

In this talk I present oxygen isotope records from Cretaceous to Recent terrestrial sediments in the western North American Cordillera. The purpose of this analysis is to use these data to understand the coupled surface elevation and climate history of this region through the Cenozoic. To do this we constructed δ^{18}O maps of surface waters for critical time intervals that display the origin of topography of the western U.S. These maps are based on 3887 oxygen isotope analyses from both published (3394) and new data (493). We determined the δ^{18}O of surface waters using temperatures previously determined from floral assemblages and the appropriate isotope fractionation factors. These data suggest that in the late Cretaceous to early Eocene the Sevier hinterland formed a modestly high plateau. Around 50 Ma a topographic wave developed in British Columbia and eastern Washington that swept southward reaching northeastern Nevada at 40 to 38 Ma, and southern Nevada 23 Ma. The topographic wave caused massive reorganization of drainage patterns such that the intraforeland basins of Wyoming and Utah drainages extended deep within the Sevier hinterland as the wave swept southward. The landscape within the Sevier hinterland developed into a rugged and high mountain range with the hypsometric mean elevation of 4 km and relief of 1.5 km. This Eocene highland was bordered on the west by a high Sierra Nevada ramp and on the east by the intraforeland basins that captured water off of these growing highlands. Growth of this highland occurred rapidly with 2.5 km of surface uplift in <2 Ma. The spatial and temporal evolution of this highland roughly correlates with the timing of volcanism and extension. These observations support tectonic models that call for north to south removal of the Farallon slab or mantle delamination. By the mid-Miocene the highlands began to collapse throughout the Northern and Central Basin and Range. Impingement of the Yellowstone hot spot modified the topographic evolution of the northern Basin and Range by creating a bulge that migrated eastward with the plume head and tail.

Biography

Dr. C. Page Chamberlain received his PhD in1985 from Harvard University, his M.A. in 1981 from Dartmouth College, and his B.S. 1979 from Syracuse University. His research expertise is in the broad area of isotope geochemistry. Current research projects involve the use of isotopes as tracers to investigate geochemical processes in the earth interior and surface, climate change, and environmental problems. His research combines both field and laboratory components. The Stable Isotope Biogeochemistry Laboratory includes a laser-based light stable isotope laboratory for oxygen isotope analysis and a fully automated continuous flow system for carbon, oxygen, nitrogen and hydrogen of minerals and organic matter. A sampling of current research projects: **Climate and Topographic Evolution of Mountain Belts:** Understanding the topographic history of mountain belts is an important problem in Earth Sciences both because of establishing the relationship between climate change and mountain building process and because it provides fundamental information about tectonic processes. However, documenting topographic histories has been difficult because there are relatively few methods available that allow quantitative estimates of paleorelief. We have shown that oxygen and hydrogen isotopes can be used to study the topographic evolution of mountain belts. Our current research includes reconstructing the paleotopography of the Sierra Nevada of California, the Southern Alps of New Zealand, the Rocky Mountains, and the Himalaya. **Chemical Weathering and the Carbon Cycle:** We are integrating numerical models with field studies in an effort to understand weathering processes in active orogens, in an effort to understand the relationship between chemical weathering and the long- and short-term carbon cycle. Our current research focusses on the Southern Alps of New Zealand. In this area we can examine how uplift, rainfall, and weathering are related. **Climate Change:** We use stable isotope records from terrestrial setting to understand climate change. We are investigating how the western US climate responded to past levels of high carbon dioxide in an effort to understand how it might respond to increased levels of carbon dioxide in the future. For more details please go the Dr. Chamberlain's website at: http://www.stanford.edu/group/crg/chamberlain.html