GRAND JUNCTION GEOLOGICAL SOCIETY

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SEPTEMBER MEETING

WEDNESDAY 20, 2017

Joint meeting with the CMU Geology Students

7:30 PM

Saccomanno Lecture Hall

(In the Wubben Science Building)

Andres Aslan, Geology Professor, CMU

Will Speak On

" Late Cenozoic Uplift and Landscape Evolution of the western US"

Abstract on the Reverse

Guests Are Always Welcome

Late Cenozoic Uplift and Landscape Evolution of the western U.S.

The western U.S. has experienced significant uplift since retreat of the late Cretaceous Interior Seaway. Present-day average elevations in the Rocky Mountain province (~2.3 km) and Colorado Plateau (~2.0 km) are much higher than during the late Cretaceous (ca. 80 Ma) when the seaway covered significant portions of the western U.S. While some post-Cretaceous uplift and increases in elevation can be attributed to traditional tectonic processes, ongoing studies of the upper mantle beneath the western U.S. strongly suggest that mantle buoyancy has significantly contributed to late Cenozoic uplift in the region. To better evaluate the timing and mechanism of late Cenozoic uplift, data on the incision histories of the Colorado and Green rivers are compared. Patterns of river incision are used as proxies for bedrock uplift histories, and are correlated with seismic velocity anomalies in the upper mantle to explain landscape changes during the late Cenozoic.

The Colorado River system originates in the Rocky Mountain province, flows southwest across the Colorado Plateau and through Grand Canyon, and eventually traverses south through the Basin and Range to the Gulf of California. The development of this river system began in the late Miocene (16-11 Ma) based on a combination of detrital zircon and sanidine dating of fluvial sandstone, and radiometric dating of Miocene basalt flows in the upper Colorado River basin. This initial stage of river development pre-dates integration through Grand Canyon ca. 6-5 Ma, and probably correlates with a period of internal drainage within the Colorado Plateau. Integration of the upper Colorado River and accelerated river incision began 9.5-7.8 Ma, and resulted in 750 to 1500 m of incision at rates of 96 to 155 m/Ma since 10 Ma. Largest magnitudes of incision and fastest incision rates are associated with areas of Miocene basaltic magmatism. The Green River is the principal tributary to the Colorado River, and it drains the Wyoming Rockies before joining the Colorado River near Moab, Utah. Integration of the upper Green River is poorly constrained between 8 and 2 Ma, and probably post-dates the advent of the ancestral Yampa River ca. 6 Ma. Using Oligocene river gravels as a datum, the Green River has incised <400 m at slow rates of <20 m/Ma over the past ca. 30 Ma.

Comparison of river incision patterns show that the upper Colorado River has incised more rapidly than other systems such as the Green River. Upper mantle P-wave anomalies associated with these different drainage basins suggests possible connections between rates of river incision and buoyancy of the upper mantle. Upper Colorado regions have the fastest incision rates and slowest P-wave velocities. In contrast, the upper Green River basin has the slowest incision rates and fastest P-wave velocities. These differences suggest that patterns of river incision and inferred differential bedrock uplift could be explained by differences in mantle flow or buoyancy between the upper Colorado and Green River basins. If true, this model has important implications for explaining uplift and subsidence patterns elsewhere in settings where traditional tectonic models cannot easily explain the timing and magnitude of landscape erosion.

As time permits, I will also show photographs of the geology of New Zealand and my re-visit (32 years later!) to the Franz Josef glacier.