Investigating Erosion of the Panamint Mountains Using Cosmogenic Nuclides in Sediment

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There are several factors that can control the erosion rates of mountains, such as tectonic uplift rate, amount of precipitation and thus associated erosion by water. However, to study this is difficult due to the large time scale of erosional processes, and our relatively short period of direct human observations. One useful tool frequently used to investigate erosion over >> human timescales, is the precise measurement of rare cosmogenic radionuclides (e.g. cosmogenic nuclides, for instance 10Be) in sediment. By collecting sand samples from the mouth of streams along the western Panamint Mountains, California (USA) and analyzing quartz grains for cosmogenic 10Be, we will be able to quantify the spatial pattern of erosion rates for much of the mountain range, over multi-millennial timescales. The techniques we will use works because as rocks slowly approach the surface of the Earth through the progressive removal of overburden (surface erosion), quartz minerals become increasingly bombarded with high energy particles known as cosmic rays. These high energy cosmic rays produce the rare isotope 10Be in quartz through reactions with secondary cosmic ray neutrons, protons, and muons (Granger and Schaller, 2014). The longer quartz minerals stay near or at the surface, the higher the content of 10Be becomes. With known production and decay rates for cosmogenic nuclides, the rate of erosion in a fluvial catchment can be calculated, and is inversely proportional to the concentration of 10Be found in quartz sand collected from rivers exiting mountain catchments.

We performed field work during December and January of 2019-2020 to sample sediment to quantify erosion in the Panamint Mountains, California. The next phase of our work will be to measure 10Be in our samples, and to calculate erosion rates using the concentrations of 10Be in sediment samples. The ultimate goal of this study is to examine how the rapid uplift of the Panamint Mountains, and subsidence of the Panamint Valley, affected the erosion rates in the area. After this information is attained, it then becomes possible to integrate those findings on a larger scale by looking at regional geology and comparing the results of our erosion rates to, for instance, documented uplift of the Panamint Mountains beginning at ~3-4 million years ago (Bidgoli et al., 2015). One catchment exiting the western Panamint Mountains has already been documented as having a rather stable erosion rate for over one million years (mason and Romans, 2018). The new data gathered in this project will assist in clarifying the spatial variation in erosion rates, and will help quantify the erosional response and the magnitude of the erosion caused by known rates of tectonic uplift in Mountain ranges.