How fast does climate drive erosion? - Constraining Rates of Colorado Plateau Erosion using Surface Exposure Dating

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Abstract: Recent recognition of interactions between climate, landscape development and tectonics has created a surge of interest in the rates of geomorphic erosion processes in a variety of climatic settings. The goal of this study is to quantify erosion in a semi-arid environment, where rates and styles of precipitation are well constrained. The Needles district, Utah, exhibits key erosion features that are observable throughout the Colorado Plateau, and are unique to semi-arid and arid climates. The exposed upland areas erode through grain-by-grain dissolution, aided by groundwater percolation through bedrock. The exceptionally well-preserved fluvial channel networks erode primarily through knickpoint retreat. A highly appropriate method for the measurement of erosion rates is Surface Exposure Dating (SED) using in-situ cosmogenic nuclides (^{10}Be and ^{26}Al). This proposal seeks funding for a pilot study in order to compare rates of processes in the slowly eroding upland areas, with those of the more rapidly eroding bedrock channels. Some specific questions that will be addressed include: (1) What are the rates of bedrock downwearing in a semi-arid environment? (2) How rapidly do knickpoints propagate upstream in a bedrock channel? (3) What is the rate of fluvial incision into bedrock in a semi-arid climate? and (4) How do these rates compare with other climatic environments?

The pilot is intended to provide the foundation study for a multi-disciplinary proposal to the NSF, combining the cosmogenic dating of fluvial and upland surfaces with Optically Stimulated Luminescence dating of fluvial deposits, in order to determine rates of erosion and deposition in the desert environment.