Knowing the rate at which Earth's surface erodes and sediment is generated is important for quantifying the magnitude of human impact on landscapes. Although the short-term effects of human activity are easily measured, placing these human-induced rates of change in a long-term context has always been difficult. Without such a context, rational management of potentially impacted lands is not possible.

Recent advances in mass spectrometry have allowed measurement of isotopes produced primarily by the bombardment of cosmic-rays within the uppermost meter or two of Earth's surface (e.g. $^{10}$Be and $^{26}$Al). The abundance of such cosmogenic nuclides in rock and soil can be used to calculate rates at which rock erodes and sediment is generated. In short, the abundance of cosmogenic nuclides is proportional to landscape stability.

Building upon a “proof of method” study supported by the US ARO over the past three years, we will apply our analytical methods and expertise to two Army facilities in the Mojave Desert, Yuma Proving Ground and Fort Irwin. At Fort Irwin, we will collect 50 samples of rock and sediment from a variety of landscape elements including: rock outcrops, washes, and alluvial surfaces. Data from these samples will provide land managers with an overall view of the rate at which sediment is generated and moves within their facility. Outcrop and wash samples will be used to estimate rates of sediment generation. Samples from alluvial surfaces will be used to estimate rates of sediment transport over broad bajada and low-angle piedmont surfaces, a technique we have successfully pioneered using US ARO AASERT support.

Yuma Proving Ground has long been a test-bed for Army technology. Of late, the facility has been used similarly for testing environmental monitoring technology. Over the past three years, we have been using cosmogenic nuclides to understand better the rate at which sediment is generated in Yuma Wash. We have demonstrated that isotope abundance in sediments is independent of grain size, allowing us to estimate rates of erosion for the basin as a whole, about 40 m My$^{-1}$ or about a millimeter every 25 years. Research funded by this proposal will allow us to build upon the work we have begun at Yuma. In particular, we will collect samples from desert pavements, a common but fragile landscape feature easily impacted by Army maneuvers. We will make measurements to examine the effective age distribution of clasts exposed on natural desert pavement surfaces as well as the nuclide abundance of the fine grain material underlying such pavements. Such data will tell us more about natural rates and processes of surface stirring -- important information by which to judge the impact of vehicular traffic related to military activities.

Funding sought under this proposal will support the research and research training of two MS and two BS candidates at the University of Vermont as well as providing partial support for state-of-the-art accelerator mass spectrometric measurements at Lawrence Livermore National Laboratory under the auspices of Dr. Marc Caffee. It is our goal to provide land managers at Yuma and Fort Irwin, data regarding long-term rates of landscape change at their respective facilities. Because the PI has set up and manages a high-throughput sample preparation facility at the University of Vermont, and because the PI and collaborator Caffee have significant experience in isotopic analysis, modeling, and data interpretation, we offer the Army a unique combination of capability, experience, and facilities to meet project objectives.