**Project Summary**

Geoscientists cannot predict with any accuracy or precision how quickly different parts of Earth’s surface erode. We are even less able to predict how erosion rates respond to changes in boundary conditions including tectonic and climatic forcing. It is clear that rates of erosion are set by complex, non-linear feedbacks between multiple Earth systems including the solid Earth (tectonic uplift and rock shattering), the hydrosphere (rainfall intensity and distribution), and the biosphere (plants and soil biota); yet, these critical interactions occur on different temporal and spatial scales meaning that properties and relationships dominant at one scale may be unimportant at other scales.

Accurate, global prediction of background erosion rates is critical because erosion is the means by which sediment in generated, fresh rock is exposed to CO2-consuming weathering reactions, soil is created, landforms change over time, and mass is moved from the continents to the oceans and eventually recycled via the process of subduction and volcanism. Earth’s ability to support billions of inhabitants depends critically on the resiliency of the soil system, which erosion affects directly.

Advances in isotopic and geostatistical methods over the past two decades, in concert with a deepening appreciation for the complex interaction between surface and deep Earth processes, have set the stage the stage for transformative advances in our ability to predict erosion rates and quantify the interactions between erosion, landscape evolution, and the solid Earth. Compilation of >1200 extant erosion rate estimates is tantalizing; yet, the data are grossly incomplete and spatially biased.

We seek support for 5 faculty, 11 graduate studetns and 21 undergraduates to gather and interpret thousands of new 10Be, 137Cs, and 210Pb data from around the world -data needed to understand and predict the global distribution of erosion rates over space and time. The combined isotopic data will be used to inform complex systems models that will predict erosion rates for any watershed on Earth’s surface and back through time under the influence of changing climate and tectonic regime.

Personnel and Collaborating Institutions - P. Bierman and D. Rizzo (University of Vermont), E. Kirby (Penn State), K. Nichols (Skidmore), D. Rood (Livermore), N. Fernandes (UFRJ), A. Corrêa (), G. Schneider (Namibian Survey), D. Roberts (CGS), D. Fink (ANSTO), P. Hesse (MacQuarie Uni).

Intellectual Merit - Our research and modeling approaches a fundamental problem in Earth Science – the rate at which landscapes erode, removing soil and providing mass to the sedimentary system. A complex systems approach to creating predictive models including neural networks and non-parametric analyses will provide a means by which the erosion rate of watersheds anywhere on Earth can be predicted. Such quantitative prediction of mass transfer rates will be transformative for a wide range of disciplines including geomorphology, petroleum geology, geochemistry, tectonics, and stratigraphy.

Broader Impacts **-** Broader impacts for this project are significant and varied including: easy access to data important to a wide variety of Earth Science disciplines, training the next generation of geoscientists to have a broad, coherent view of Earth’s sedimentary system, broadening participation of underrepresented groups, and integrating research and education through travelling short courses that disseminate project results internationally to the broader scientific community including students, faculty, and postdoctoral associates.