1. PRF#: 57428-ND8
2. Project Title: Alluvial Suspended Sediment Routing as a Filter of Source Area Tectonic and Climatic Signals: 3-D Stratigraphic Analysis and Modeling
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During the first period of this project, progress has been made gathering data from the field site along Powder River in Montana, interpreting samples in the laboratory, and in developing new theoretical tools to better understand suspended sediment routing as a filter of source area tectonic and climatic signals.

Our research group and colleagues from the U.S. Geological Survey (John A. Moody) have embarked on 3 different field excursions to Powder River, one in June, 2017, another in Sept. 2017, and the last in August, 2018. We excavated floodplain trees and obtained samples for dendrochronology, described and sampled four trenches in floodplain deposits, obtained wood samples from eroding cutbanks, and completed a transect of hand auger cores. These data collection efforts are all designed to enable us to develop a 3-dimensional chronostratigraphic framework for interpreting the depositional history of Powder River's floodplaion and to infer suspended sediment storage timescales and other parameters needed to model suspended sediment routing along this meandering stream system.

Tara Metzger, an M.S. student, used methods of dendrochronology on samples from excavated trees to quantify histories of floodplain growth along Powder River. Her results, supported by analyses of Cs137 activities and historical aerial imagery, provide quantitative histories of the development of Power River's floodplain through vertical and lateral accretion, and also suggest recent vertical incision of the channel as it migrates laterally. These observations are critical for developing sediment routing theories that incorporate episodic storage of floodplain sediment. Metzger completed her M.S. thesis in June, 2018.

Progress has also been made analyzing map data sources in a GIS-environment. Margaret Krauthauser, an undergraduate geology major (supported independently of this project), worked during the summer of 2017 to quantify bank erosion in the study area between 1973 and 1992 using historical aerial imagery. Sheila Trampush, a postdoctoral researcher supported by the project, produced a detailed map of a 10-km reach of Powder River defining floodplain deposits based on relative ages defined by cross-cutting discontinuities in vegetation, soil type, and geomorphic features. We are now focusing on quantifying the age relationships defined by this mapping using absolute dating methods based on dendrochronology, optically stimulated luminescence, radiocarbon, historical aerial imagery, and Cs137 analyses.

Progress has also been made in developing new mathematical theories of suspended sediment routing that incorporate floodplain storage, and that can be used to unravel quantitative relationships between sediment production in source areas and its delivery to sedimentary basins. A theory of alluvial sediment reservoirs has been developed that incorporates time-varying sediment dynamics and that explains how storage timescales are related to temporally varying sediment accommodation and the passage of suspended sediment pulses.

During the next year, several goals will be attained. These include developing a quantitative 3-dimensional stratigraphic framework for alluvial deposits of Powder River, development of a contemporary sediment budget for the river, and estimation of the age distribution of sediment currently being eroded by Powder River. These data can be used to quantify storage timescales for this alluvial system, which provide the basis for modeling how storage can modify alluvial sediment signals that travel downstream along a meandering river.

This project has generated a variety of products. One M.S. thesis has been completed (Metzger, 2018), and preliminary results have been presented at the 2017 Geological Society of America (GSA) National Meeting (1 presentation) and the 2017 Fall Meeting of the American Geophysical Union (AGU) (2 presentations). Abstracts have been accepted for the 2018 GSA National Meeting and the 2018 AGU Fall Meeting. A preliminary journal article based on Metzger's M.S. thesis has been completed and will be submitted for publication during Fall, 2018. Pizzuto has agreed to submit a featured research article to the journal Geomorphology that will present some of the new theoretical results developed from the project (to be submitted during the summer of 2019).

The project has also enhanced the training of geoscientists at several levels. Several undergraduates have worked on the research project, gaining valuable experience in geological research. Metzger (2018) completed an M.S. thesis, which involved in-depth training in dendrochronology and stratigraphy. A postdoctoral researcher (Shiela Trampush) received a year of experience working with Holocene fluvial deposits. The PI has developed new expertise in alluvial stratigraphy.