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Organization Name : **University Of Texas, Austin**	17-SSW17-0318

Proposal Title : **A new framework for decoding the structure and history of debris-covered glaciers on Mars**

SECTION VII - Project Summary

Goals and Objectives:

Debris-covered glaciers (DCG) on Mars are perhaps the most direct evidence of global redistribution of ice on any planetary body. The water ice within these landforms, estimated to be 50 Ma to 1 Ga in age, exists where ice cannot accumulate in today#s climate, yet these glaciers that have persisted through many hundreds of obliquity cycles due to their protective debris blankets. We propose to develop a new observational and theoretical framework to isolate the signature of cyclic accumulation history from flow dynamics on observable surface topography in order to extract first-order paleoclimate information from martian DCG needed to understand climate processes fundamental to multiple planets.

Most DCG on Mars exhibit regular, flow-transverse ridges on their surface that could be caused by climate-induced internal debris bands, or they may be the result of flow dynamics in a debris-covered glacier. Multiple ridge wavelengths and amplitudes are observed, indicating distinct sources; however, our ability to discriminate between these sources is greatly limited by a lack of basic knowledge about the processes that govern DCG evolution on any planetary body.

Methods:

In order to meet our objectives, we will implement a finite-element, full Stokes, thermomechanical numerical model with an adaptive mesh. A novel aspect of this proposed work is that the model will be validated by a suite of new, comprehensive measurements of terrestrial DCGs that provide the needed constraints. We will then apply and test our new framework for examples on Mars to evaluate its potential to decode DCG morphology on Mars.

We have identified two DCGs that are accessible and appropriate for our work. They are in the Rocky Mountains of Wyoming and the Wrangell Mountains of Alaska. Based on our preliminary studies, we have determined that these DCG are flowing by internal deformation rather than basal slip, so they are appropriate analogs even though temperature is higher than on Mars. Their relatively fast flow allows for measurable change.

Our observational methods for terrestrial DCGs include ground-penetrating radar, time-domain transient electromagnetic methods and airborne photogrammetry which results in high-resolution digital terrain models and orthophotos. We will undertake repeat measurements to quantify change across the surface. We have acquired preliminary data for all aspects of this work that validates our technical approach and establishes our capability to achieve the objectives. For Mars we will incorporate high-resolution topography, imagery, and radar sounding to constrain our model application and comparative analysis.

Relevance to Solar System Workings:

This proposal is relevant to Solar System Workings because the program specifically supports #field studies of terrestrial analogs of planetary environments," which is the major component of our proposed work, providing the needed basis to answer fundamental processes regarding volatiles, climate and the cryosphere of Mars.

Our project addresses the following topical area under Surfaces and Interiors, as described in the announcement: [Evolution and modification of surfaces. Characterize and understand the chemical, mineralogical, and physical features of planetary surfaces (such as geologic formations and impact craters) and fluid inventories that interact with the surface (including hydrospheres, cryospheres, atmospheres, and other volatile reservoirs). Develop theoretical and experimental bases for understanding these features in the context of the varying conditions through time after formation.]

This project will also address basic questions about DCG such as debris thickness and variability, which is important for potential access in future exploration and in-situ resource utilization on Mars, both NASA priorities.

This proposal would not be appropriate to MDAP because it includes a major fieldwork component.