USING WIND DRIVEN TUMBLEWEED ROVERS TO EXPLORE MARTIAN GULLY FEATURES

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Gully features on the slopes of numerous Martian crater walls, valleys, pits, and graben are of particular interest because of their apparent young age and the potential association with liquid water. The overarching question is how did these gullies form? Specifically, what is the agent of erosion and what is the source of the erosional agent? Several mechanisms for gully formation have been proposed, including: liquid water aquifers (shallow and deep), melting ground ice, snow melt, CO_2 aquifers, and dry debris flow. Observational tests conducted using remote sensing by the Mars Global Surveyor - Mars Orbiter Camera (MGS MOC), the Mars Orbiter Laser Altimeter (MOLA) and the Thermal Emission Spectrometer (TES) indicate that the most likely *erosional agent* is liquid water; however, debate concerns the source of this water. The observations favour a liquid water aquifer as the primary candidate and because the current strategy in the search for life on Mars is to "follow the water" these areas are of primary interest for conducting additional in situ investigations.

A vehicle with the ability to traverse across and around the gullies is needed to conduct an in-situ investigation. While this is currently not feasible using conventional rovers, a new unconventional vehicle known as a Tumbleweed rover could potentially be used. Designed to derive mobility through use of the surface winds on Mars, Tumbleweed rovers would be lightweight and relatively inexpensive, allowing multiple rovers to be deployed in a single mission to particular areas of interest. Tumbleweeds would be used to complement currently planned missions by conducting surveys, pinpointing locations of interest for detailed follow-on investigations by rovers, landers, or perhaps human explorers. NASA Langley Research Center (LaRC), is currently studying deployable structure Tumbleweed concepts.

A mission would begin by deploying a group of Tumbleweed rovers on the upslope plateau behind an area with gullies. The Tumbleweeds would first characterize the plateau, which would include subsurface sounding to detect an aquifer if it exists. The Tumbleweeds, equipped with a simple ability to stop and start (e.g., changing shape of the structure), would then proceed toward the gullies when the wind direction is favourable. Proceeding down the slope, the Tumbleweeds would continue the search for evidence of a shallow aquifer, which would take the form of an ice plug beneath the overlying plateau, but close to the cliff face surface. Evidence of liquid water would also be searched for on the exposed portions of the rock layers. As the Tumbleweeds proceed down the channels, the interior of the channels would be examined to provide improved measurements regarding channel bed shape, channel depth, channel path (i.e., deflection around obstacles), etc. The Tumbleweeds would complete their mission by examining the debris apron to determine size of particles being transported down-slope and the composition of the soil in the debris apron.

Many challenges exist for implementing this mission using a Tumbleweed rover. For example, how can the aerodynamic properties of a Tumbleweed rover be "controlled" in order provide a stop/start capability that will allow the vehicle to not only make measurements at particular locations but also allow it to wait for favourable wind conditions? What are the wind conditions near Martian gully regions? This paper will address these issues and provide an in-depth discussion on the latest scientific findings concerning the gullies and their potential formation mechanisms.