

## Inverse analysis of lobe/gully on Mars: examination by 2D Voellmy fluid model

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It has been known lobate deposits accompanied with small gullies distribute on the surface of Mars, but their origin has not been clarified yet. Topographic features of lobate deposits on Mars resemble deposits of debris flow on Earth, which is a flow composed of high-concentration and fluid (water). Therefore, lobate deposits have been focused as proxies of fluid phase of water on Martian surface environments. However, several studies suggested that lobate landform can also be formed by other processes such as rock avalanches, and thus water in fluid phase may not be required for producing such deposits. Thus, the controversy on existence of fluid water has not been settled. To this end, this study aims to distinguish the formation process of lobes on Mars by inverse analysis of rheological properties of the flow. Two dimensional Voellmy fluid model was employed as the forward model, which has been proved to be capable of reproducing behavior of debris flows or snow avalanches on Earth. Istok Crater that locates in mid latitudes of the southern Hemisphere of Mars was chosen as the study area. Geomorphology of a lobate deposit on the northern fringe of the crater was measured from DEM, and the rheological parameters of the flow was reconstructed by parametric optimization of the forward model to fit the calculation results to actual geomorphology. As a result, the inverse analysis suggested that the rheological property of the formative process of the lobate deposit was quite different from terrestrial debris flows estimated on Earth. Also, the reconstructed parameters largely deviated from other known processes such as rock or snow avalanches. This may imply that the unknown processes such as avalanches of CO<sub>2</sub> frost that does not exist on Earth should be supposed as the formation process of lobes.

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