ANALOGS AND INTERPRETATIONS FOR THE MARTIAN THUMBPRINT TERRAIN AND SINUOUS RIDGES; J.W. Rice Jr.[1] and J.D. Mollard[2], Department of Geography, Arizona State University, Tempe Arizona 85287, USA [1]; Mollard and Associates Ltd., 2002 Victoria Ave., Regina, Sask., S4P 0R7, Canada [2].

Large Scale Retrogressive Slope Failures On Mars:

A new explanation for certain types of Martian "thumbprint" terrain is that these landforms are ribbed retrogressive earth flows. Several possible terrestrial analogs have been located in the Interior Plains region of Canada. Retrogressive slope failures are a mass movement landform and process characterized by downslope translation of soil and weathered rock over a discrete basal shear surface. The failed slopes can be rather shallow, flattening out as a result of slow creep movements to gradients as low as 9.5 to 4 degrees (1).

The Canadian slope failures occur most commonly in Upper Cretaceous bentonitic marine clay shale, silty shale, and claystone, commonly with siltstone and sandstone interbeds. These earthflows form multiple, arcuate, elongate ridge and depression topography that may extend for several kms and cover areas many tens of square kms (1). The location of these flows usually occur near the reaches of active lateral river erosion and on the flanks of mesa like uplands in the Interior Plains region.

In most places where there are slope failures, clay and silt deposited during transgression and regression of the Champlain Sea are covered by fluvial and deltaic fine - medium grained sand with some gravel. Postglacial uplift resulted in stream incision into the plains sediments forming sand terraces at different elevations. Locally, the terraced sands show features of abandoned shorelines, dunes and blowouts.

The style of failure and repetitive pattern of transverse ribs was explained by plastic flow and extrusion which takes place in a soft layer underlying a stiffer layer that in turn underlies surficial saturated sand. It has been proposed (2) that the extrusion of the underlying, remolded soft clay very rapidly transported successive and intact slices of the stiff layer away from the retreating backscarp. Elongate crescent shaped slices then subside intact as the softened clay is extruded with ridges and pinnacles of the remolded clay being squeezed upward between successive blocks. Slope failure is usually initiated by snowmelt runoff thus causing high pore pressure, but active stream erosion at the toe of slopes and earthquakes can also start failures.

Raised Channel Systems On Mars:

Raised channel systems are alluvial stream deposits that have been cemented and differentially exposed by weathering and erosion to form a series of upstanding, multistorey, linear ridges and sheets representing an area of inverted drainage (3). Raised channel deposits have been identified in numerous terrestrial desert regions (Saudi Arabia, Oman, Egypt, Transvaal, New Mexico, and Texas) and have been described under various terms such as suspendritic drainage lines, bas relief, pseudo-eskers,

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gravel capped ridges, gravel trains, perched wadis, wadi ridges, and suspenparallel drainage.

The raised channels systems of Oman will serve as the prime example of these features for this study. The system in Oman represents over 12 seperate episodes of fluvial activity such that the ridges intersect one another and successive paleochannel deposits are superimposed on one another (3). Work by Maizels has differentiated paleofluvial deposits by contrasts in elevation, morphology, sedimentology, and lithology.

The fluvial deposits are cemented during periods of high water tables, associated with rapid evaporation rates and precipitation of salts within the gravel sequence. The deposits once cemented are more resistant to erosion, additionally, the deposits are protected from deflation by the concentrations of gravel on the channel floor. Initial burial of the fluvial deposits can be achieved by fluvial accretion, overbank facies, and eolian deposition. The subsequent exhumation of these deposits can be accomplished by fluvial, eolian, or marine activity.

The raised channel systems extend across low gradient alluvial fans for a distance of up to 250 km from the Eastern Oman Mountains. The Plio-Pleistocene period raised channel systems are comprised of heavily varnished chert and ophiolite rich gravels. The channels are sinuous, broad, gravel topped ridges 1 to 2 km wide, several hundred km long, and rising over 35 m above the adjacent desert floor (3).

There are numerous examples of raised channels systems on Mars. Some locations are the Mangala Vallis region, and the Auqakah Vallis region. It is also proposed here that the ridges in Argyre Planitia and Dorsa Argentea are raised channels. The sinuous ridges in Argyre and Dorsa Argentea have been explained in the past as eskers, longitudinal dunes, lacustrine spits and bars, wrinkle ridges, and clastic or igneous dikes (4-8). Additonally, inverted stream beds have been mentioned but dismissed by one researcher and only mentioned in passing by the other. In addition to the regions listed, I have located raised channels along the the inner rim of Moreux crater and east of Argyre Planitia.

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