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THE DORSA ARGENTEA, MARS: COMPARISON TO NEW TERRESTRIAL ANALOGUES AND STATISTICAL TESTS FOR TOPOGRAPHIC RELATIONSHIPS.

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Introduction: The Dorsa Argentea (DA) are an assemblage of ridges in Mars' southern high latitudes (70°-80°S, 56°W-6°E). Glacial eskers and inverted channels remain as active hypotheses for their formation [1-9] ~3.48 Gyr ago [9]. Eskers are ridges formed by sediment deposition in subglacial meltwater conduits. We undertake the first large-scale quantitative analysis [10] of the planar geometries of the DA in a comparison to >5900 terrestrial esker systems in Canada [11].

Results: We mapped ~7514 km of DA ridge *systems* (n = 260, Fig. 1) using topographic and image data. Systems are defined as chains of related ridge *segments* (individual, unbroken ridges), separated by gaps. Planar geometry data for DA systems are displayed in Table 1 and are consistent with previous workers [1-2, 6, 8-9]. System length (L_i) is linearly interpolated across gaps between segments, continuity is the ratio between the total length of segments comprising a system and L_i, and sinuosity is the ratio between L_i and the shortest linear distance between end points of the system. Gaps between segments account for ~10% of L_i. Long systems are typically straighter than shorter ones (Fig. 2) and those at the entry to East Argentea Planum have higher sinuosity (~1.48-1.7 $\pm$ 0.03) than those within the main valley (~1-1.3 $\pm$ 0.03, Fig. 1). A lateral pedestal is observed on the outer bend of the longest (~314 $\pm$ 5 km) ridge (Fig. 1) close to its entry to East Argentea Planum.

	Canada	DA
Sample size, n	5932	260
Continuity	0.65	0.90
Mean length (km)	15.6	36.5
Median length (km)	4.1	22.2
Maximum length (km)	760	314
Mean sinuosity	1.08	1.10
Median sinuosity	1.06	1.07
Maximum sinuosity	2.45	1.91

Table 1. Planar geometries of DA and Canadian [11] esker systems.
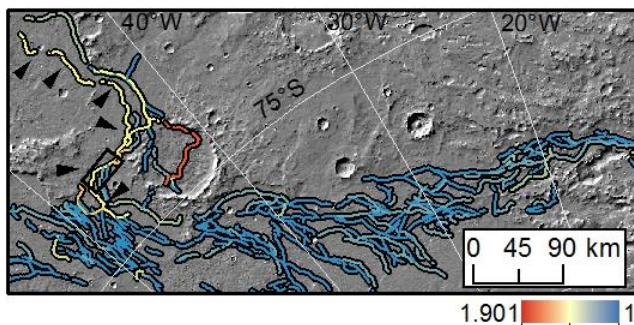
Discussion: Planar geometries of the DA are compared to >5900 Canadian esker systems [11] in Table 1. The DA exhibit similar log-normal length distributions to the Canadian eskers. The greater continuity of the DA may be an outcome of significantly lower post-depositional erosion rates on Mars. The great lengths and high continuity of the DA ridges is consistent with terrestrial eskers formed synchronously in long, stable channels extending from the interior of a former, likely stagnant, ice sheet and terminating in a proglacial lake [6, 9, 12]. Lower sinuosity of longer systems relative to shorter systems (Fig. 2) is consistent with the Canadian eskers. Low sinuosity of ridges in the main basin supports their formation beneath thick ice, while higher sinuosity of the northernmost ridges supports their formation closer to a stable former ice margin. Water under pressure beneath thick ice can ascend topography and follow straighter paths (controlled by the slope of the ice surface) than water closer to atmospheric pressure near to the ice margin, which is more strongly controlled by bed topography. The longest ridge (Fig. 1) may represent the main drainage pathway funneling meltwater to East Argentea Planum from the Argentea Planum catchment of a former ice sheet. Intrusion of water into cavities in the surrounding basal ice as water pressure exceeds that exerted by the overlying ice under high discharges on this major drainage pathway is tentatively proposed as an explanation for its lateral pedestal (Fig. 1), which may be analogous to lateral esker fans in south-central Ontario [13].

Conclusions: (1) Statistical distributions of length and sinuosity of the DA are similar to those of terrestrial eskers in Canada. (2) Planar geometries across the DA support formation in conduits extending towards the interior of an ice sheet that thinned towards its northern margin, terminating in a proglacial lake.
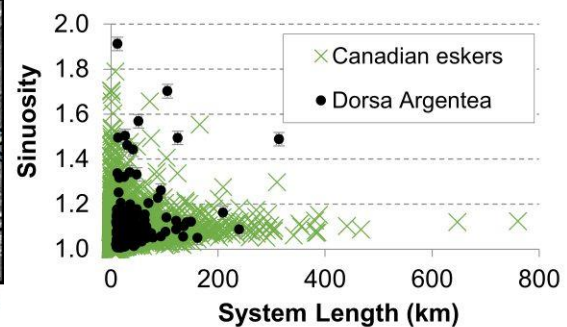
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Figure 1. DA classified by system sinuosity. Black arrows indicate the longest ridge. Black box is location of lateral pedestal and entry to East Argentea Planum to the north. MOLA hillshade basemap.

Figure 2. System sinuosity and length of the DA and Canadian eskers [9]