SINUOUS RIDGE FORMATION IN SOUTHEASTERN ARGYRE PLANITIA, MARS. N.P. Lang[1], [1]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996; nlang1@utk.edu.

Introduction: Argyre Planitia is located within an approximately 900 km diameter circular basin in the cratered southern highlands of Mars. Although workers agree that Argyre is a preserved impact crater, they disagree on the geologic processes that have subsequently operated within the basin [e.g., 1-4]. Specifically, two competing hypotheses have evolved: (1) Argyre represents a paleolake that was part of a larger surface hydrological system [1-2] and (2) the Argyre basin was modified through circumpolar glacial processes [3]. Part of the argument for both hypotheses involves a suite of sinuous ridges in the southeastern part of the basin. In the paleoloake hypothesis [1-2], these ridges represent spits and barrier islands formed through littoral currents [5]. In the glacial hypothesis, the ridges reflect eskers formed from sub-glacial meltwater streams [3-4]. However, despite their inclusion into both hypotheses and the recent acquisition of high resolution and altimetry datasets, surprisingly little work has addressed the detailed characteristics of these sinuous ridges. Detailed characterization of these ridges is crticial for understanding the processes involved in their formation and to begin testing the two competing hypotheses.

The purpose of this study is to begin characterizing sinuous ridges in southeast Argyre Planitia using high-resolution imagery and altimetry data sets of the Martian surface with the goal of constraining processes involved in ridge formation. I conclude that the characteristics of these ridges are most consistent with formation through sub-glacial fluvial processes. That is, these sinuous ridges likely represent eskers.

Data and Methodology: In this investigation of sinuous ridge formation in southeastern Argyre Planitia, I integrate imaging and topographic datasets from the Mars Global Surveyor (MGS) and Mars Odyssey (MO) missions. Imaging data include (1) MGS Mars Orbiter Camera (MOC) narrow-angle (~2-12 m/pixel resolution) images and (2) MO Thermal EMission Imaging System (THEMIS) daytime infrared (IR) images (~100 m/pixel resolution). Integrating images from these two missions allows for geomorphic characterization and geologic mapping of this portion of the Argyre Planitia; geologic mapping follows the guidelines and cautions of [6]. To analyze the topographic characteristics of these ridges, I use Mars Orbiter Laser Altimeter (MOLA) data from from MGS.

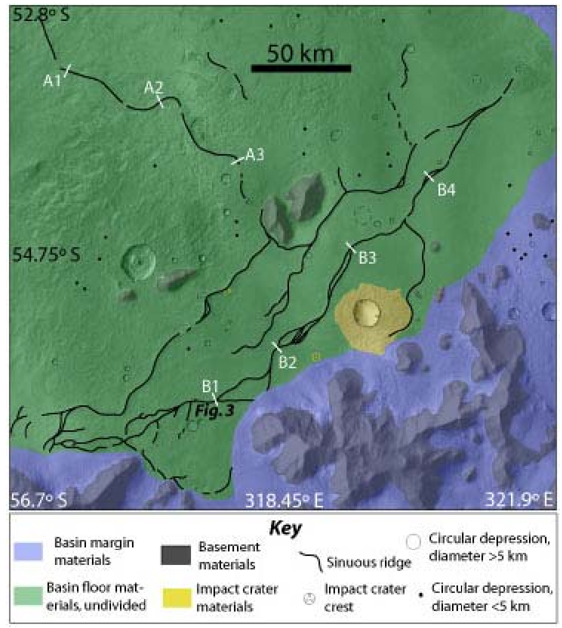

Figure 1: *Simplified geologic map showing the distribution of sinuous ridges in southeastern Argyre. Annotated white lines are locations of topographic profiles in Figure 2. Figure 3 is of the area in the vicinity of profile B1.*

Observations: Sinous ridges in southeast Argyre Planitia consists of several interconnected and braided, traces that trend mostly northeast, although local northwest trends occur (Figure 1). Each ridge trace consists of several discontinuous segments that range in length from <1- >100 km. Topographic profiles taken perpendicular to ridge trends (Figure 2) demonstrate that the ridges are approximately 5-10 km wide at their base and about 100 m high, although the height of the ridges varies along trend; ridge crests range from low, broad expressions to tall, sharp-crested features with some ridges displaying double-crested morphologies. Interestingly, Figure 2 illustrates that the overall elevation at which the ridges occur also varies along trend. That is, the ridges cross topography. The absence of tectonic structures within the basin floor suggests that this observation is a primary effect; this part of the basin does not appear to have been warped subsequent to ridge formation. Figrue 3 demonstrates other general ridge characteristics. In particular, the ridges have a spotted texture that appears to represent boulders, an interpretation consistent with [7] for the Kasei Vallis region. Also, located on and around the ridges are circular depressions that are approximately

50-100 m in diameter, contain no rim, and lack an obvious ejecta blanket; the absence of a rim and ejecta blanket suggests that these pits are not impact craters.

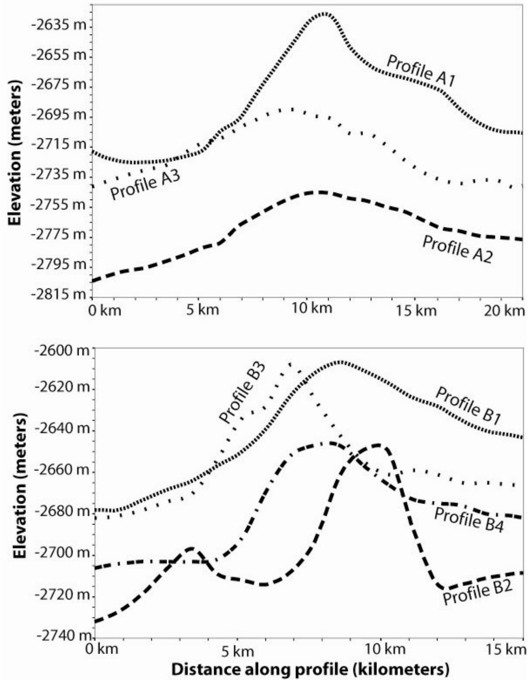

Figure 2: *Topographic profiles for two sinuous ridge segments.*

Discussion: Collected observational data allows for discussion of the geologic processes involved in ridge formation. The apparent horizontal bedding within the ridges implies their formation by a moving fluid, likely wind or water. The coarse-grained nature of the ridges and the observation that the ridges cross topography provides a means of further testing the processes involved in their formation. The coarse-grained nature of the ridges suggests that the the transporting medium moved in a high enough energy regime to transport boulders. This conceivably eliminates wind and littoral currents as candidate processes. Another possibility is a fluvial origin. Although fluvial processes could explain the presence of boulders, fluvial processes are apparently contradictory with the ridges crossing topography. However, this apparent contradiction could be explained by pressure-driven flow; a fluid driven by pressure can flow independent of topography. An example of pressure-driven flow involves sub-glacial streams; ice thickness can influence water pressure at the base of glaciers such that subglacial streams will cross topography [8]. Perhaps the sinuous ridges in southeast Argyre Planitia formed in sub-glacial stream systems such that they represent eskers. Such an explanation can also accommodate the rimless pits associated with the ridges. The rimless pits could represent kettles formed by blocks of ice that broke from a retreating ice sheet [9]. An esker interpretation for these sinuous ridges is consistent with [3-4] and supports a growing body of work suggesting that glaciation has occurred in the southern hemisphere of Mars [e.g., 10]. However, a glacial origin for the ridges does not exclusivley rule out the possibility that a lake once existed within the Argyre basin.

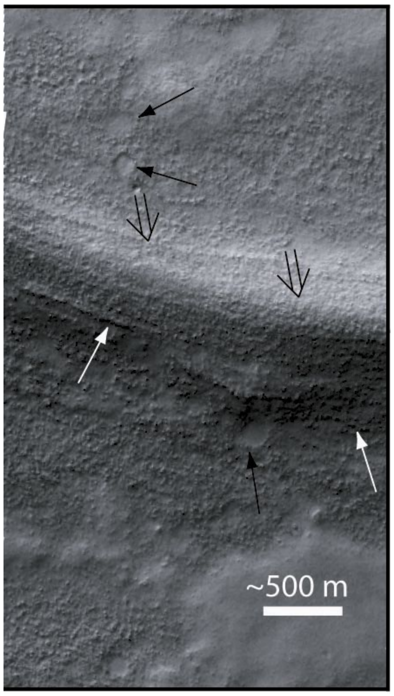

Figure 3: *Portion of MOC narrow-angle image R23-00809 showing the typical characteristics of the sinuous ridges discussed here. White arrows highlight horizontal bedding, double-barred arrows highlight some boulders, and black arrows highlight small circular pits associated with the ridges.*

References: [1] Parker, T.J. (1997), in Clifford, S.M., et al., *Conf. Early Mars*, 65. [2] Parker, T.J., et. Al. (2003), *Sixth Intl. Conf. Mars*, Abstract # 3274. [3] Kargel, J.S. and Strom, R.G. (1992), *Geology*, 20, 3-7. [4] Baker, V.R. (2001), *Nature*, 412, 228-236. [5] Parker, T.J. and Franklin, B. (2001), *Abs. Ann. Map. Meeting*, USGS Open-file Report 02-078. [6] Hansen, V.L. (2001), *EPSL*, 176, 527-542. [7] Williams, R.M.E. and Malin, M.C. (2004), *JGR*, 104, 10.1029/2003JE002178. [8] Shreve, R.L. (1985), *GSAB*, 96, 639-646. [9] Easterbrook, D.J. (1998), *Surf. Proc. Landfms.*, 2nd ed. [10] Head, J.W. and Pratt, S. (2001), *JGR*, 106, 12,275-12,299.