MAPPING OF SINUOUS RIDGES IN OXIA PALUS, MARS: NEW INSIGHT INTO THE AQUEOUS RECORD. R. M. E. Williams[1] and F. C. Chuang[1], [1]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106, Tucson, AZ 85719, williams@psi.edu.

Introduction: The relative timing and duration of aqueous events on Mars is of great interest in identifying former habitable environments. Valley networks are the most common drainage feature on the planet and they are frequently cited as evidence of former clement climate conditions [e.g., 1]. A range of preservation states for valley networks is now recognized [2, 3], which expands our understanding of the spatial distribution of these landforms [4]. New geomorphic mapping within the Oxia Palus quadrangle (Mars Chart 11; 0-30˚ N, 315-360˚ E) of sinuous ridges and associated features reveals additional details about the aqueous history of the region.

Methods: Using previously known sinuous ridge locations identified in Mars Orbiter Camera (MOC; 0.5-12 m/pix) and Thermal Emission Imaging System (THEMIS; infrared 100 m/pix and visible 18-36 m/pix) images [4], we conducted detailed mapping of sinuous ridges within the study region using Context (CTX, ~6 m/pix) images supplemented with THEMIS IR images. Mapping was performed using ESRI ArcGIS Desktop software in which all observable sinuous ridge segments were recorded as line features. Transitions in sinuous ridge morphology were documented, including continuity relations where the ridge varied between ridge, aligned pits and valley forms (Figure 1).

Previous work identified variations in valley network preservation including inverted valleys (ridges), filled valleys, and exhumed negative-relief valleys [3]. Likewise, we interpret newly mapped features as various preservation styles of valley networks and note the planimetric form (frequently dendritic) is similar to terrestrial river networks (Figure 2). Thus, we use the term 'valley network' to include landforms that may not have any negative-relief components, but are a marker of former fluvial pathways.

Observations: Over 2500 kilometers of new valley network segments were identified, half of which are ridge forms (Figures 1-3). The landforms in this study are narrower than valley networks identified in Viking images (few kilometers width), spanning from ~100 m to ~1 kilometer across. The majority of the new mapped features are located in western Arabia Terra (concentrated near Mawrth Vallis) and northwestern Sinus Meridiani, terrain that is devoid of valley networks in previous mapping studies [5-7] (Figure 3). This discrepancy is due in part to the increased resolution of CTX images examined in this study, but also the inclusion of a wider range of form (e.g., interpreting sinuous ridges as inverted valley networks).

Figure 2 illustrates a pitted network with a space-filling dendritic pattern. Locally the drainage density is 1.3 km^{-1} (Figure 2B), an order of magnitude higher than the maximum reported in global studies of valley networks [6, 7]. This suggests that the scarcity of fine-scale valley networks observed on Mars is, at least in part, related to preservation (e.g., burial, removal by erosion, etc.) [8].

Newly mapped valley networks show associations with specific geologic units and vary in stratigraphic position. Edgett [3] identified four stratigraphic units in western Sinus Meridiani: (from youngest to oldest): lower unit, ridge-forming unit, scarp-forming unit and plains unit. In this study, valley networks were found within all but the uppermost plains unit. All examples of aligned pits are concentrated in a small region (~12,000 km^2) and found exclusively within the scarp-forming unit. Three sinuous ridge systems have bulbous shapes at one end, potential sites of former paleolakes. Interestingly, all three are within the lower stratigraphic unit suggesting that they formed within the same temporal window.

Discussion: Recognition of various preservation styles for valley networks has led to identification of these landforms on terrain previously thought to be devoid of fluvial landforms, and expands the known record of aqueous activity on Mars. Variations in form within the same valley network reflect heterogeneity within the system and a complex history. Certain valley network forms are associated with specific stratigraphic units, and provide new details about the relative timing of aqueous events. These new results imply that Mars had fluctuations of fluvial activity in the Noachian, including a period of standing bodies of water.

References:

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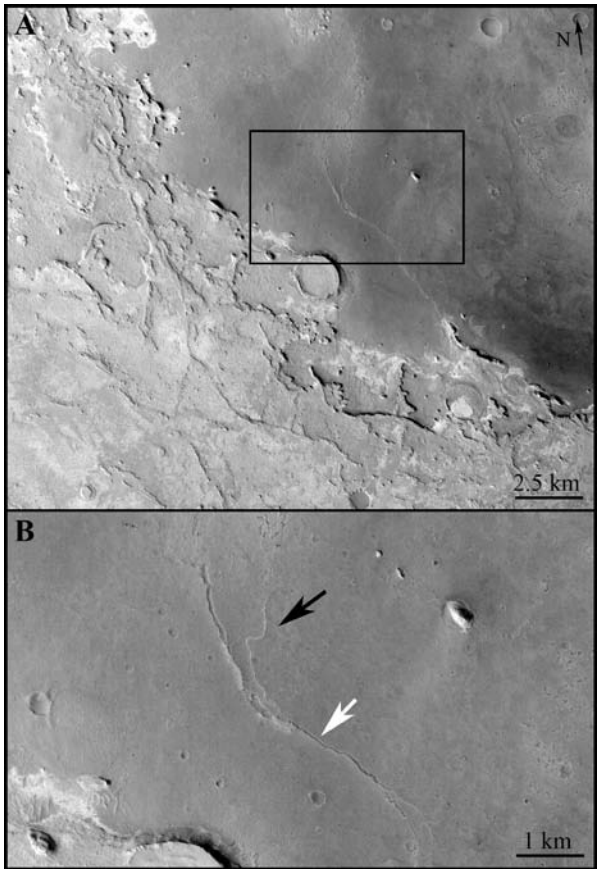

Figure 1: Sinuous ridge (black arrow) transitions to aligned pits (white arrow). CTX P07_003880_1824.

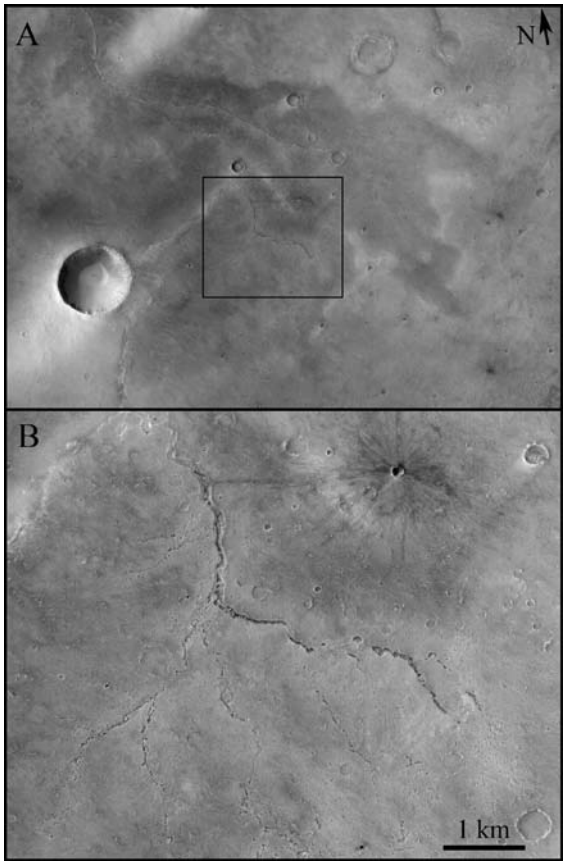

Figure 2: Example of dendritic, pitted network. CTX P06_003313_1855.

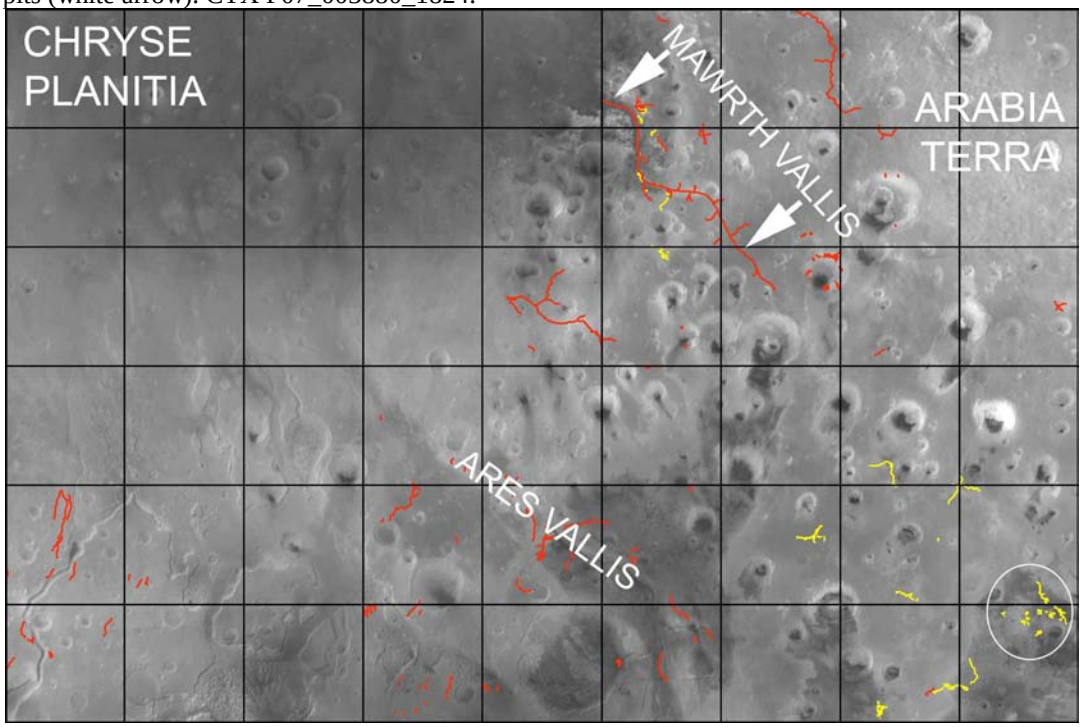

Figure 3: Map of new valley network segments (yellow) identified in this study compared to prior work [7] shown in red. White circle marks location of segments with aligned pits. Basemap is MOC WA mosaic.