UNRAVELING THE COMPLEX HISTORY OF FAULTING FOR THE TERRA SIRENUM REGION; MARS. R. C. Anderson[1], and J. M . Dohm[2]. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [2]University of Arizona. **robert.c.anderson@jpl.nasa.gov**.

Introduction: Structural mapping is vital to unraveling the geologic histories at local to global scales on Earth and Mars [e.g. 1]. For example, maps delineating structures of various relative ages can be used to characterize potential stress sources [e.g., 1], strain magnitudes and fault history [e.g., *2*], and pre-existing structural controls that may relate to episodes of local or regional tectonism [3]. In the case for at least the equatorial region of Mars, the formation of the Tharsis rise dominated the geologic and tectonic histories. A key region to assess this major part of the geologic history of Mars is Terra Sirenum region. As such, we are constructing a geologic map of the region at 1:5,000,000-scale in both digital and print formats that will detail, in particular, the stratigraphic and crosscutting relations among rock materials and tectonic structures.

The Terra Sirenum region is located along the southwestern flank of Tharsis and is centered at 39.7°S and 210°E. Due to its location, this region holds a significant key to improving our understanding of the timing of the major fault systems associated with the formation of the Tharsis rise. Five major fault systems are associated with the southern region of Tharsis (Figure 1). Of these five major fault systems, three have been identified within the Terra Sirenum region: Memnonia Fossae, Sirenum Fossae, and Icaria Fossae. Detailed examination of these structures within this region provides an excellent window into identifying the tectonic processes that influenced the geologic evolution of the western hemisphere region.

Background: Many studies have laid the groundwork for continued investigation of the geologic evolution of the Tharsis province [e.g., 4-9], and many studies have developed detailed geologic/tectonic histories at local to regional scales [e.g., 10-13]. One for example [1], used a comprehensive paleotectonic data set of all tectonic structures to quantitatively evaluate their radial geometry as a clue to the causative stress field. Over 24,000 tectonic features in the western hemisphere of Mars were mapped, classified, digitized and relative-age dated within the established stratigraphic framework of Mars. Unfortunately, their dataset is based on medium resolution (hundreds of meters per pixel) Viking Orbiter data and there are misidentified and/or missing structures as well as missed crosscutting relationships. Higher resolution data is available in the PDS that can be used to better constrain the paleotectonic history of Mars, including the prominent Tharsis rise. For example, in order to better constrain the spatial and temporal histories of the three Tharsis-associated major fault systems listed above, we are remapping and reevaluating the rock materials and structures using post-Viking data in the Terra Sirenum region to improve our understanding of the geologic and tectonic evolution of the western equatorial region Mars.

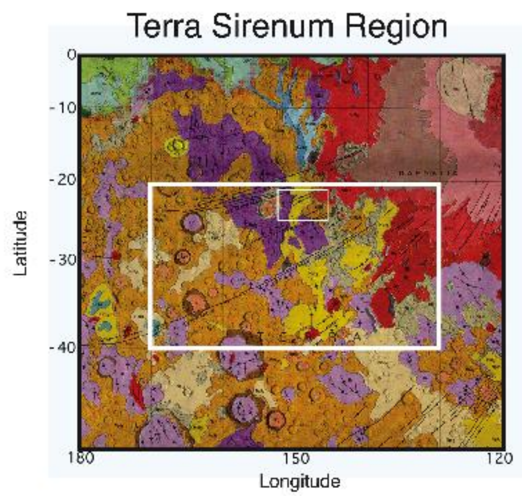

Fig. 1 Location map of the propose study area. Smaller white box illustrates the location of a close up section shown in Fig. 2.

Preliminary Results: Using the new data, detailed mapping and assessment of the stratigraphic and crosscutting relations among the rock materials and structures are showing greater complexity that has been previously recognized [14]. Fig. 2 illustrates a northern portion of the Terra Sirenum map and although still in its preliminary stage, it illustrates the tectonic complexity for this region and shows several stages of faulting, including newly formed faults, fault reactivation, and modified faults (e.g., fluvial and/or possible collapse structures. For example, in this mapped section, two graben trends have been observed crosscutting each other: N25^{o}E (Trend 1) and N18^{o}E (Trend 2) (Fig. 3). Trend 1 appears to be the dominant fault system identified in this region and consists of long, narrow, well-defined graben. Although detailed crater counting of the units it crosses has not been completed, this set of graben is believed to be stratigraphically the youngest and possibly corresponds to the Stage 3 center graben defined by Anderson et al., 2001 [1]. Trend 2 graben are believed to be a set of older graben

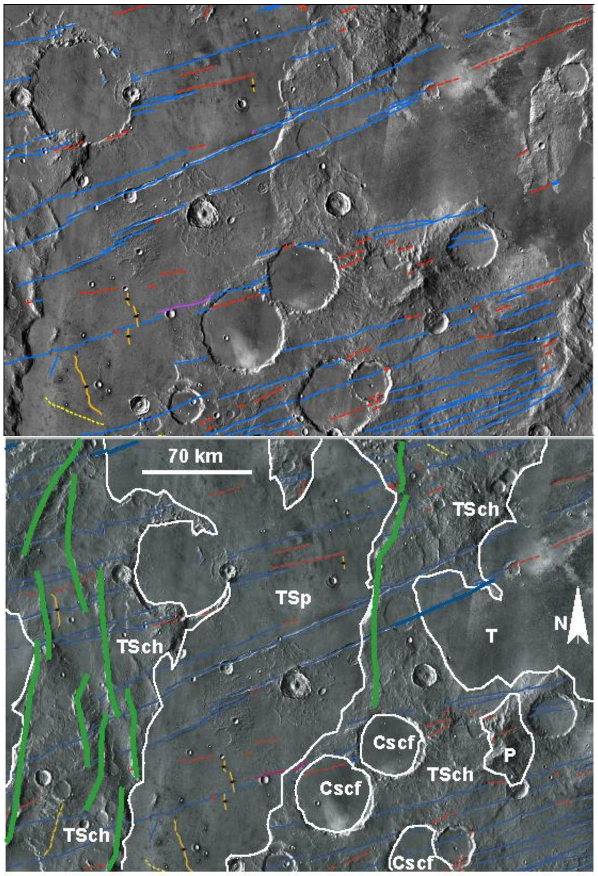

Fig. 2 A) THEMIS IR daytime mosaic of part of the preliminary geologic map of the Terra Sirenum region showing both tectonic structures and stratigraphy. Tectonic structures include graben (blue lines), buried faults, (red dashes), modified faults by possible collapse and/or fluvial activity (tan lines), wrinkle ridges (yellow line with black diamond), and macrostructures (tectonic structures that are more ancient and large than the other mapped tectonic structures, marking an ancient stage of Martian tectonism) in green lines. **B)** The map units (from oldest to youngest) include Terra Sirenum cratered highlands materials (TSch), Terra Sirenum plains forming materials (TSp), and Tharsis lava flow materials (T). Also shown are smooth crater floor materials (Cscf). Note that there are distinct stratigraphic and crosscutting relations that will help us unfold the tectonic history, including Tharsis-driven tectonism (trends, systems, timing such as newly formed, reactivated, and modified structures), a primary objective of the geologic mapping investigation.

identified in this region. These structures consist of highly modified and eroded wide graben that appear to be located in older terrains. At the conference we will detail these new findings, including other preliminary mapping results such as fault, fault-length, and modified fault densities of the major stages of Tharsis evolution.

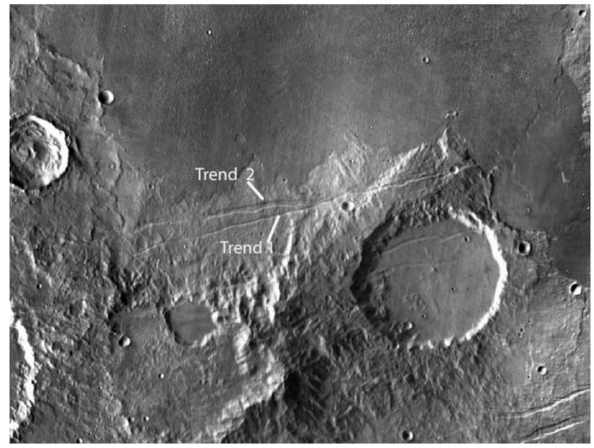

Fig. 3 Close up region showing two set of graben intersecting. Although the crater counts of these units are incomplete, Trend 1 is stratigraphically younger than Trend 2 by its crosscutting relationship.

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