NEW GEOLOGIC MAP OF THE SCANDIA REGION OF MARS. **K.L. Tanaka[1], J.A.P. Rodriguez[2], J.A. Skinner, Jr.[1], R.K. Hayward[1], C. Fortezzo[1], K. Edmundson[1], and M. Rosiek[1].** [1]U.S. Geological Survey, Flagstaff, AZ, ktanaka@usgs.gov, [2]Planetary Science Institute, Tucson, AZ

Introduction: We have begun work on a sophisticated digital geologic map of the Scandia region (Fig. 1) at 1:3,000,000 scale based on post-Viking image and topographic datasets. Through application of GIS tools, we will produce a map product that will consist of (1) a printed photogeologic map displaying geologic units and relevant modificational landforms produced by tectonism, erosion, and collapse/mass wasting; (2) a landform geodatabase including sublayers of key landform types, attributed with direct measurements of their planform and topography using Mars Orbiter Laser Altimeter (MOLA) altimetry data and High-Resolution Stereo Camera (HRSC) digital elevation models (DEMs) and various image datasets; and (3) a series of digital, reconstructed paleostratigraphic and paleotopographic maps showing the inferred distribution and topographic form of materials and features during past ages.

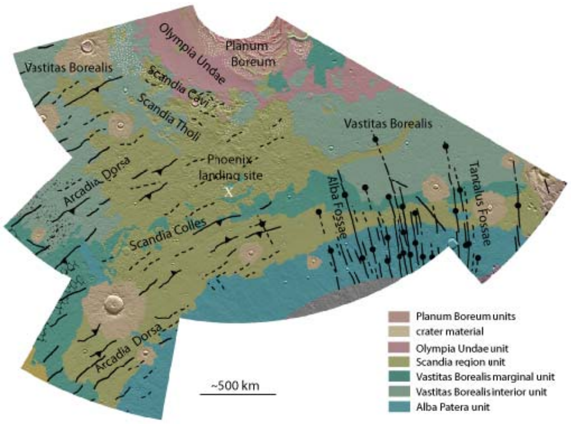

Figure 1. *Geologic map of the Scandia region of Mars extracted from the northern plains regional map of [1]. Unit colors are draped over shaded-relief base derived from MOLA data; region ranges 45-85°N, 160-195°E; Polar Stereographic projection; north pole at top.*

Background: The Scandia region unit consists of a zone of accentuated resurfacing within the northern plains of Mars [1, 2]. The broader region, which was apparently influenced by the Scandia region processes (herein referred to as the "Scandia region") covers ~5 million km^2 and seven regionally-identified geologic units that span the Late Hesperian to the Late Amazonian (Fig. 1). The Scandia region unit, as defined by [1], has an irregularly-shaped margin that encloses ~2 million km^2 of depositional and modificational lowland materials. The unit dominates a broader region of the northern plains that extends from the northern flanks of the Alba Patera volcanic shield northward to the sand seas and marginal scarps of Planum Boreum (Fig. 1). This geographic setting suggests that Alba Patera volcanism and tectonism may be responsible for regional resurfacing events and the formation of the Scandia region unit [1, 2], possibly leading to deposition of basal materials of Planum Boreum [3].

The Scandia region unit was interpreted to have formed through a complex mix of surface degradation, deflation, deformation, and material emplacement related to magmatically-induced mud volcanism and/or sedimentary diapirism and the subsequent erosion and redistribution of these materials [1, 2]. Alternatively, Fishbaugh and Head [4] interpreted the Scandia Tholi and Cavi as lag deposits associated with glacial-like retreat of the polar layered deposits. More recently, Tanaka et al. [3] added to the story of how Scandia materials have been redeposited as the thickly- and evenly-layered basal materials of Planum Boreum, which form the distinctive Rupes Tenuis unit. This unit is distinguished from an irregularly, finely, and locally cross-bedded unit from which dark dunes and rippled sand sheets appear to originate [4, 5]. Based on detailed geologic mapping of the north polar region [3], these geologic relations can be summarized in a schematic geologic section that shows likely sources and sinks of Scandia and north polar materials (Fig. 2).

We thus see how geologic mapping of the north polar plateau has greatly elucidated those parts of the Scandia region unit, showing how they can be clearly distinguished as new map units and where they fit into the development of Planum Boreum. However, the remainder of this unit in the present state of mapping continues to be an unsorted mélange of terrains and materials. For example, the southern margins of the units are defined by the extents of knobs and not by embayment relations. This is strongly indicative that the unit is mainly deflational and degradational in character, similar to the knobby terrains along highland/lowland margins of Mars, which include isolated depressions (making up the Hesperian-Noachian Nepenthes unit of [1]; the Deuteronilus Mensae and Utopia Planitia units also share some of these characteristics). What are the ages of the knobs? Do they have multiple origins? Could many of them be pedestal craters? Do they define one or more broad surfaces that have since been eroded, such as those of the Vastitas Borealis units? Additional deflation is represented by depressions that appear to result from collapse and subsidence. When did these form, and by what processes and drivers? Does this overall history conform to the suggested history of progressively lower resurfacing of the northern plains, from the Late Noachian on into the Amazonian as proposed by [2]? What evidence is there for tectonic, volcanic, and hydrologic associations spatially and temporally between Alba Patera and Scandia?

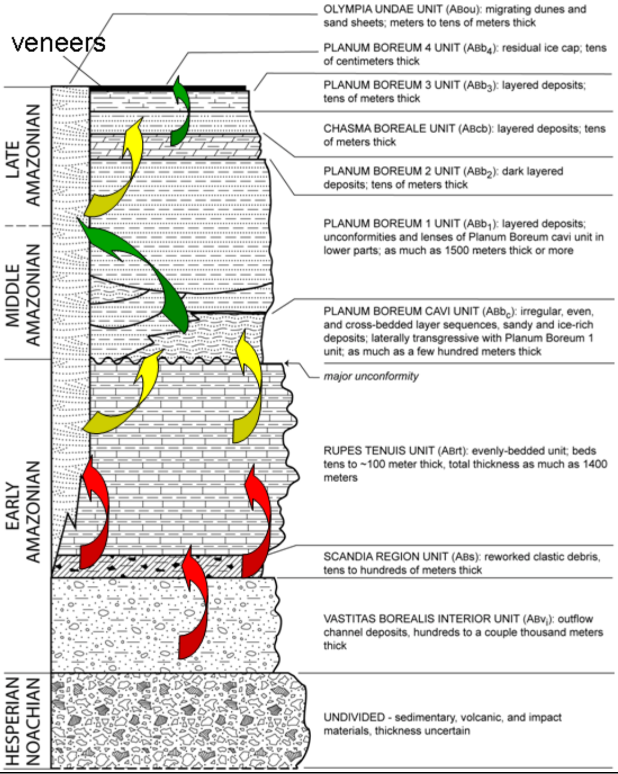

Figure 2. *Stratigraphic column of the north polar region showing paths of sedimentary recycling. Green arrows are demonstrated pathways ([6] for upper arrow and [3] for the lower one). Yellow and green arrows are pathways that are being addressed by an MDAP project (led by Tanaka). Paths shown by red arrows involving the Scandia region unit will be investigated in this proposal.*

Approach: We can begin to see how to address such questions by examining how the complexities within the Scandia region can be systematically unraveled. We can do this by dividing the Scandia region into zones of similar geomorphic characteristics and determining what sorts of features can be mapped and described within them. Our initial inspection reveals at least three such zones from south to north, as follows. (1) The knobby zone constitutes extensive fields of knobs, including Scandia Colles, along the lower northern flank of Alba Patera. Along sinuous, well-preserved wrinkle-like ridges, knobs commonly form denser clusters. A few rimmed, fractured mesas also occur along wrinkle ridges along the Alba Patera margin. In addition, there are numerous occurrences of discontinuous circular ridges composed of knobs; these landforms are likely erosional vestiges of impact crater rims indicative of pervasive degradation. (2) The subdued zone contains widespread “ghost” impact craters and topographically-subdued wrinkle ridges. Its gradation from the knobby zone closely follows the -4000 m elevation contour. Numerous craters with preserved ejecta blankets appear partly degraded. Knobs and mesas are generally less dense and more dispersed compared to the knobby zone. Irregular depressions with knobby floors, generally <100 km across and <200 m deep, are scattered throughout this zone. The Phoenix landing site occurs within the subdued zone. (3) The tholi zone is characterized by populations of irregularly-shaped raised-rim depressions 100s of km across and 100s of m in relief (including Scandia Cavi), nested depressions and pits 10s to >100s of km across and locally >300 m deep, and ovoid, knobby mounds with moats 10s to 1000s of km across in isolation and in clusters (Scandia Tholi). The tholi, deeper depressions, and cavi generally occur below -4700 m elevation. The Scandia zones also contain an array of tectonic structures (grabens, wrinkle-like ridges, fractures, and narrow linear ridges that may be dikes) and impact crater morphologies. Additional contextual information is provided by the topographic and geologic characteristics of Alba Patera lava flows that locally reach into Scandia, of subjacent and adjacent Vastitas Borealis units, and of north polar layered deposits and dunes of Planum Boreum and surroundings.

The Scandia region unit includes widespread remnants of Vastitas Borealis units and perhaps other deposits eroded and modified to form distinctive classes of features largely confined within topographic zones. These features can be mapped and measured, from which the volumes of eroded material can be calculated. When such mapping and measurements are put into their geologic and temporal contexts, a resurfacing history emerges that can constrain rates of geologic activity.

References: [1] Tanaka K.L. et al. (2005) *USGS Map SIM-2888.* [2] Tanaka K.L. et al. (2003) *JGR, 108,* 10.1029/2002JE001908. [3] Tanaka K.L. et al. (2008) *Icarus, 196,* 318-358. [4] Fishbaugh K. and Head J.W. (2005) *Icarus, 174,* 444-474. [5] Byrne S. and Murray B. (2002) *JGR, 107* (E6). [6] Rodriguez J.A.P. et al. (2007) *Mars, 3,* 29-41.