STRAIN HISTORIES AMONG ALBA AND SYRIA PLANUM, MARS, R. C. Anderson[1], J. M. Dohm[2], T. Hare[3], A. F. C. Haldemann[1], and V. Baker[2], [1]Jet Propulsion Laboratory, Pasadena, CA 91109, [2]University of Arizona, [3]U.S.G.S., Flagstaff, AZ. robert.c.anderson@jpl.nasa.gov.

Introduction and Objectives: The centers work of Anderson et al. (2001) [1] identified two prominent centers in the Tharsis region, Syria Planum and Alba Patera (Stage 2 and Stage 4 respectively). Because of their perceived influence on the geologic and possible paleoclimatic histories of Mars, Mars Orbiter Laser Altimetry (MOLA) along with published stratigraphic and paleotectonic information (including the centers information) were analyzed using Geographic Information Systems (GIS) to perform a comparative investigation of their strain histories through time. This investigation highlights their similarities and distinctions, including their topographic and morphologic signatures, deformational extent, and intensities and durations of activity.

Syria Hanum: Syria Planum is the site of long-lived (Noachian to Late Hesperian) magmatic-driven activity, displaying distinct episodes of intensive early magmatic/tectonic activity. Located within the southern part of the Tharsis Magmatic Complex (TMC), its dominant characteristics include: (1) local and regional centers of uplifts, (2) extensional and contractional tectonism, (3) magmatism including the formation of shield fields and the emplacement of dikes [2] and voluminous sheet lavas [3,4], and (4) a central summit region that exhibits a topographic low to the west and shield fields to the east surrounded by an annulus of extensional faults [3].

Alba Patera: Oneof the largest shield volcanoes found on the martian surface [3], the Alba Patera egional center of magmatic-driven tectonism, is located in the northern region of the Tharsis magmatic complex. Alba Patera displays many of the characteristics of Syria Planum, including concentric and radial fault systems of varying relative ages, pit crater chains, and lava flow fields. Distinctions include: (1) a prominent shield volcano marked by summit calderas central to the concentric and radial fault systems (perhaps marking a central vent), (2) a scarcity of shield fields, and (3) wrinkle ridges that transect the summit [3].

Methodology and results: In order to determine the durations and intensities of tectonic activity for each center, the deformational extent of each center was first calculated. This was completed by analyzing MOLA-based cross-sections for each center in order to determine their topographic extent. Since the size of the magma bodies are at best poorly understood at depth, the topography, in our opinion, best constrains the source for the observed radial strain. Next, the Vector Analysis approach [1] was applied to a subset of the western equatorial paleotectonic dataset using only the simple grabens. Simple grabens were used because they represent the dominant structural feature for the western equatorial region. After identifying the structures radial to the Alba Patera and Syria Planum centers for all stages, respectively, published geologic maps, Viking imagery, and MOLA topography were used to conservatively estimate the maximum and minimum geographical/structural extents for each of the two centers. GIS-based comparative analysis was performed using the paleotectonic information of both the minimum and maximum regions for each center to compare their major stage of geologic activity (fault and fault-length densities) (Figure 1). The paleotectonic information was compiled by the following procedure: starting with the youngest aged units, Stage 5, all Stage 5 geologic unit polygons were identified. Next, using ARCVIEW, all faults that intersect polygons of Stage 5 materials were assigned a Stage 5 designation, since the youngest material a fault cuts conservatively represents its maximum stratigraphic age. All Stage 5 faults were then attributed, counted, and their lengths were totaled. Both the Stage 5 total fault count and total fault length were then divided by the sum of the area of the Stage 5 units. This same procedure was completed for Stages 4-1 (a succession of increasing relative age), but without using previous selected faults and material unit polygons. In the case of Stage 1, for example, all Stage 1 geologic units were selected and any faults that intersected the Stage 1 polygons and that were not a part of any previous younger selection were mapped.

Comparison among the two centers: Although Syria Planum and Alba Patera are similar in geographic size and shape, they are two distinct styles of tectonic activity. Alba Patera is a prominent shield volcano located in the northern-central region of the Tharsis magmatic complex and represents the last regional center of magmatic-driven tectonic activity [1]. Alba displays many of the same characteristics of Syria Planum, including concentric (prominent annuli) and radial fault systems of varying relative ages, pit crater chains, and lava flow fields [3,4]. Alba Patera, for example, occurs along the north-trending Ceraunius fault system and a north-trending alignment of prominent centers of magamtic-driven activity, including Claritas rise, Syria Planum, Ceraunius rise, and Alba Patera [1]. Whereas Syria Planum occurs on the north-trending alignment of Alba Patera, it also occurs at the central intersection of east-trending Valles Marineris canyon and fault systems, northeast-trending Tempe, Sirenum, and Memnonia Fossae, and north-trending Ceranius and Claritas (a system of faults that fan outward away from Syria) Fossae.

Distinctions between Alba Patera and Syria Planum include: (1) magmatic-driven activity at Alba Patera was relatively short, lasting from at least the Early Hesperian extending into the Amazonian. Syria Planum, on the other hand is the site of long-lived (Noachian to Late Hesperian) magmatic-driven activity with distinct pulse-like episodes of intensive early magmatic/tectonic activity that declined in tectonic intensity from the Late Noachian to Late Hesperian, transitioning mainly into a dominantly volcanic setting during the Late Hesperian [4], (2) Alba Patera is a distinct shield volcano marked by summit calderas central to the concentric and radial fault systems (perhaps marking a central vent) with a paucity of shield fields and a few wrinkle ridges that mark its summit region, whereas Syria Planum is a subdued, shield-like structure [5] that lacks distinct calderas, but rather is marked by shield fields [6] and a depressed region that may mark a former caldera(s) within the east-central and west-central regions interior to the annulus of extensional structures, respectively, (3) when compared to Hesperian and Amazonian lava flow fields that largely compose Alba Patera, Syria Planum is constructed from the emplacement of voluminous sheet lavas that range in relative age from at least the Late Noachian to the Late Hesperian [3,4], and (4) greater number of faults appear to project back to the Syria center at greater distances than those that project back to the Alba center (e.g., more faults occur outside of the maximum area of Syria compared to the Alba maximum area.

Summary: Our approach is useful in performing comparative analysis of the evolutional histories among primary centers of magmatic-driven [1]. The major distinctions among Alba Patera and Syria Planum noted above may be related to numerous factors, including age (time of erosion), basement structural fabric, duration of development, crustal and lithospheric thickness at the time of formation (e.g., Alba Patera may be still developing compared to the older Syria Planum that may be experiencing post-magmatic isostatic adjustment), and magma body/chamber dimensions (e.g., plume size and shape) and complexities (e.g., varying number and relative age of contributing magma bodies).

References: [1] Anderson R C et al. (2001) *JGR*, 106, 20,563-20,585, 2001. [[2] Head J W et al. (2001) *Space Sci. Rev.*, 96, 263-292. [3] Scott D H and Tanaka K L (1986) *USGS I-Map 1802-A*. [4] Dohm, J M, K L Tanaka, and T M Hare, *USGS Misc. Inv. Ser. Map I-2650*, scale 1:5,000,000, 2001b. [5] Dohm, J M, J C Ferris, V R Baker, R C Anderson, T M Hare, R G Strom, N G Barlow, K L Tanaka, J E Klemaszewski, and D H Scott, *J. Geophys. Res.*, 106, 32943-32958, 2001a. [6] Head J W, R Greeley, M P Golombek, W K Hartmann, E Hauber, R Jaumann, P Masson, G Neukum, L E Nyquist, and M. H. Carr, *Space Sci. Rev.*, 96, 263-292, 2001.

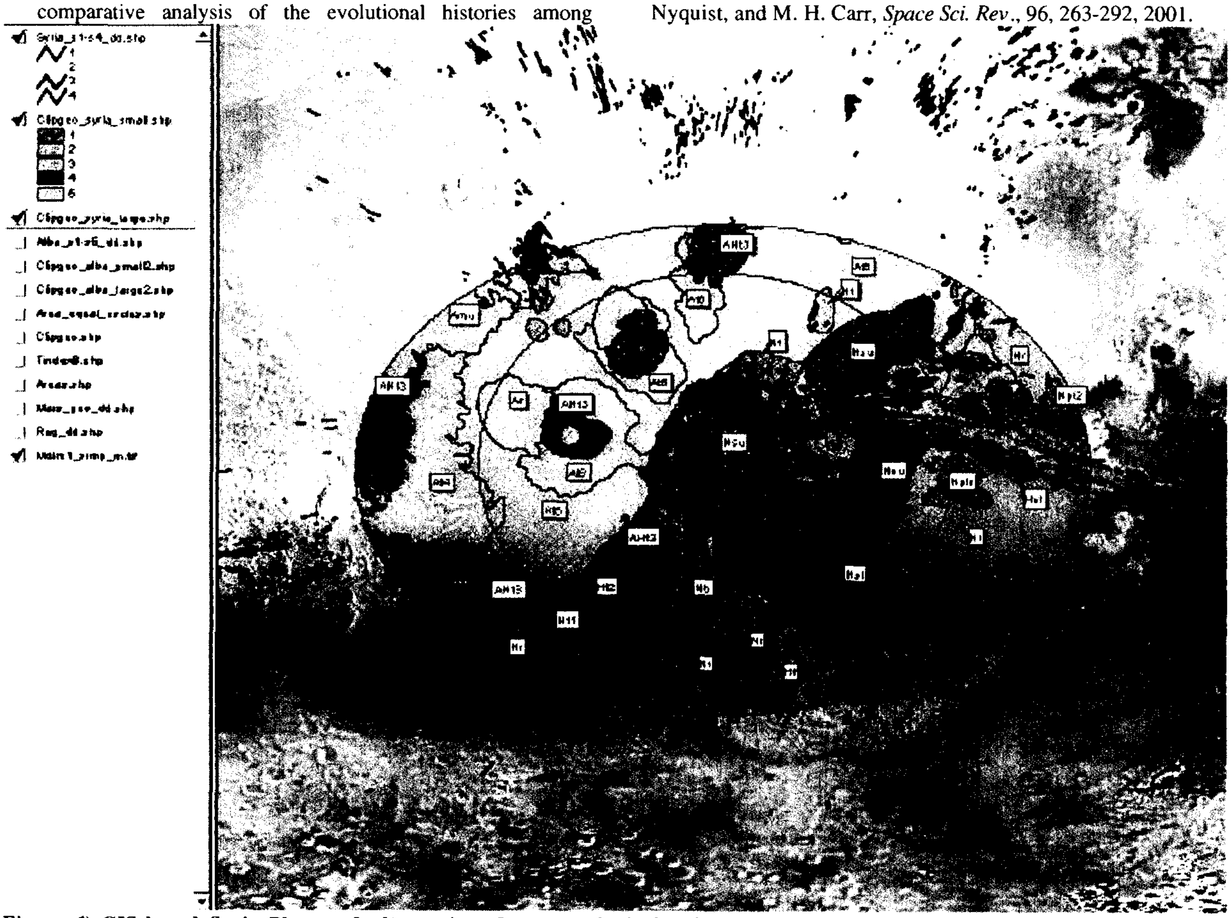

Figure 1) GIS-based Syria Planum faults projected onto geological units of Scott and Tanaka (1986) [3]. Colored faults and geologic map unit polygons correspond (color coded) to major stages of Tharsis geologic activity of Anderson et al. (2001) [1] and Dohm et al. (2001) [4,5].