COMPLEX STRUCTURE OF THE THAUMASIA REGION OF MARS;
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Introduction. The Thaumasia region was the first center of Tharsis tectonism [1, 2], and it is the most complex and poorly understood [2]. We are therefore compiling a geologic map of the entire Thaumasia region (lat 15° to 50° S., long 50° to 115°) at 1:5,000,000 scale. This region is mostly made up of the Thaumasia plateau, which includes the high plains of Syria, Sinai, and Solis Plana and surrounding highlands; the highlands are fractured by Thaumasia, southern Claritas, Coracis, Melas, and Nectaris Fossae. Our preliminary structural analysis of the most complexly faulted area in the region (the central part, at lat 30° to 45° S., long 80° to 100°) indicates that, unlike other regions of Mars, Thaumasia has undergone extensive deformation by both small- and large-scale extensional and compressional structures (Fig. 1). These results indicate that the early (Noachian) style of tectonism commonly involved lithospheric-scale deformation, in contrast to most younger tectonism (which mainly affected the upper parts of the crust above mechanical discontinuities); this difference may be due to a weaker (and thus more readily deformable) early lithosphere in this region.

Small-scale structure (Fig. 1A). Narrow grabens (mostly <5 km across) probably reflect deformation of the upper few kilometers of the crust above shallow mechanical discontinuites [3]. Claritas Fossae include northwest-trending Noachian and Early Hesperian grabens that dissect rugged terrain in the western part of the central Thaumasia region; these grabens appear related to Syria Planum-centered faulting [4]. Some grabens extend southward and southeastward, splaying out into two main groups; the north-trending Thaumasia Fossae make up the western group that cuts Lower Hesperian plains material that embays the Thaumasia plateau. A few grabens of Claritas Fossae cut the Upper Hesperian lava flows of the Syria Planum Formation that embay the northern part of the Thaumasia highlands [see also 4]; thus, older grabens of Claritas having similar trends may have been reactivated as well. Coracis Fossae include narrow, north-trending, Noachian (and perhaps Early Hesperian) faults in the eastern part of the area shown in Fig. 1; wider grabens (5 to 10 km across) may be bounded by secondary faults mentioned below. Scattered northeast-trending grabens farther west appear to be part of the same fault pattern.

Wrinkle ridges have been attributed to buckling of upper crustal layers decoupled from the lower lithosphere [5] or to thrust-faulting of the entire lithosphere [6]. A belt of wrinkle ridges, possibly formed during the Early Hesperian, flanks the south edge of the Thaumasia plateau.

Large-scale structure (Fig. 1B). High-relief, mostly east-trending ridges and scarps of Noachian to Early Hesperian age, particularly along the edge of the Thaumasia plateau, are associated with wrinkle ridges and truncated impact craters. The ridges and scarps are part of the proposed Thaumasia fold belt that wraps around the south half of the Tharsis region; the belt is proposed to have formed by periodic lithospheric-scale folding and thrust faulting [7]. Broad (15- to 50-km-wide), irregular, mostly north-trending grabens of Coracis Fossae reflect lithospheric rifting [3]. They cut Noachian and Lower Hesperian rocks and may be partly filled by Upper Hesperian volcanic material; subsequently, parts of the graben floors have failed, resulting in deep, enclosed depressions.

Conclusion. The complex tectonic history of the Thaumasia region resulted from multiple local and regional lithospheric stresses. The prevalent lithospheric-scale deformation observed may be a consequence of a relatively thin, weak lithosphere of early Mars. Through further geologic mapping and structural analysis, we will attempt to (1) reconstruct in detail the sequence of deformation in the Thaumasia region, (2) interpret development of thin- and thick-skinned styles of deformation, and (3) identify the sources of tectonic stresses.

References cited. [1] Frey, H., 1979, *JGR 84,* 1009-1023. [2] Plescia, J.B., and Saunders, R.S., 1982, *JGR 87,* 9775-9791. [3] Banerdt, W.B., et al., 1992, *in* Mars, Univ. Ariz. Press, ch. 8. [4] Tanaka, K.L., and Davis, P.A., 1988, *JGR 93,* 14,893-14,917. [5] Watters, T.R., 1991, *JGR 96,* 10,236-10,254. [6] Golombek, M.P., et al., 1991, *PLPSC 21,* 679-693. [7] Tanaka, K.L., and Schultz, R.A., *this volume.*

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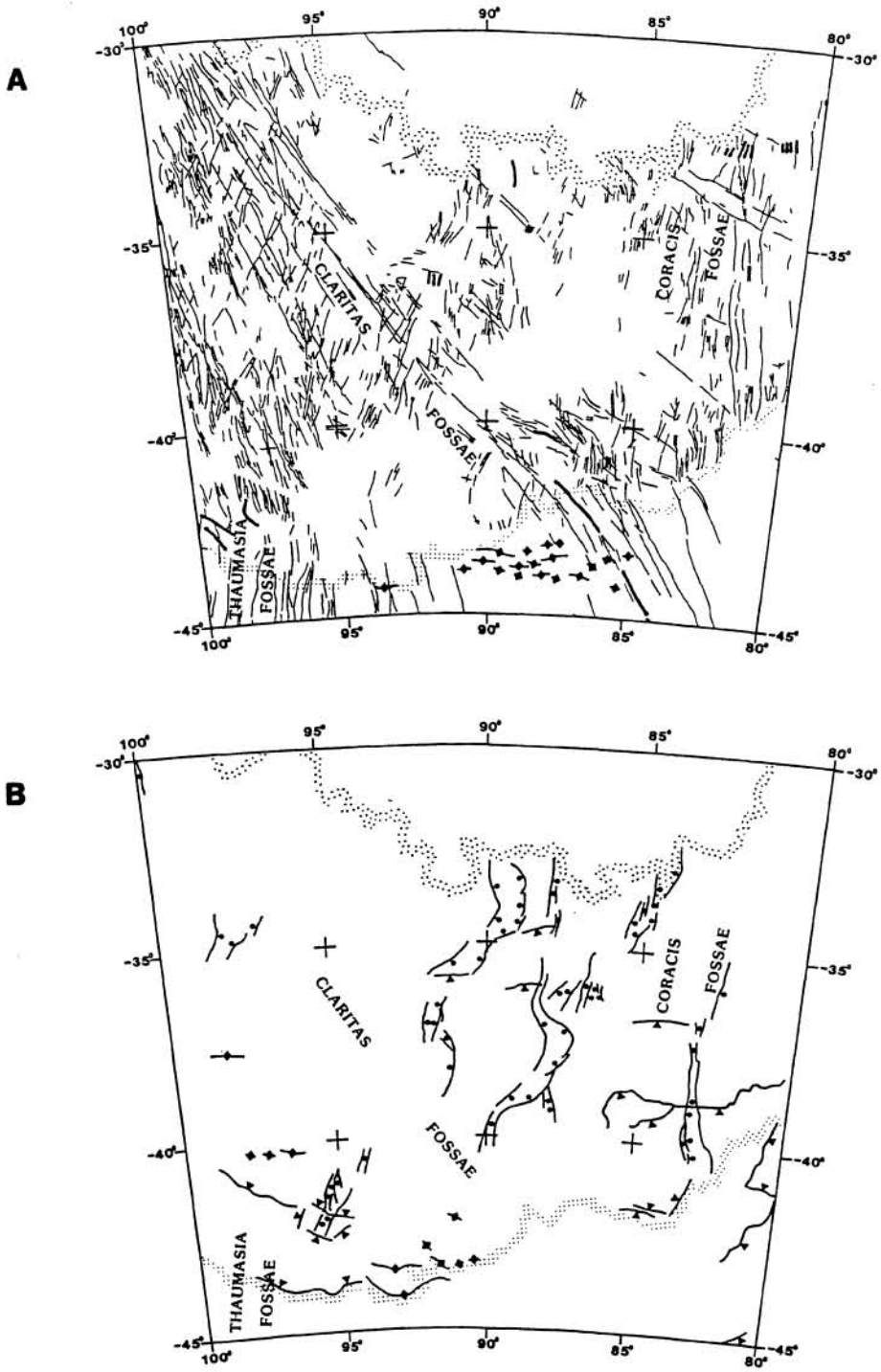

Figure 1. Structural maps of central Thaumasia region. Stippled line in north is contact between Syria Planum Formation and Thaumasia highlands; stippled line in south is edge of Thaumasia plateau. *A*, Small-scale structures: grabens <5 km wide shown by thin lines, grabens 5 to 10 km wide by thick lines, wrinkle ridges by lines with diamonds. *B*, Large-scale structures: normal faults bounding broad grabens (bar and ball on down-thrown side), high ridges (lines with diamonds), and scarps (barbs on upper flank).