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STRIKE-SLIP FAULTING, WRINKLE RIDGES, AND TIME VARIABLE STRESS STATES IN THE COPRATES REGION OF MARS.

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The existence of strike-slip faults has recently been documented in two locations on Mars [1,2]. In this abstract I review two clear examples located southeast of Valles Marineris and present preliminary evidence for more widespread strike-slip deformation elsewhere in Coprates.

Strike-slip faults and wrinkle ridges both deform Early Hesperian plains materials in eastern Coprates between 20-25° S and ~55° W [2]. The strike-slip faults are defined by echelon arrays of linear structures that bound polygonal or rhombohedral plateaus located within their stepovers. The faults are oriented obliquely (~60°) to the overall, north-south trend of the wrinkle ridges. The plateaus were probably formed within contractional strike-slip stepovers rather than by simple lateral or vertical offset of pre-existing markers. Crustal shortening along each echelon fault array may exceed 1-2 km. Northwest trending strike-slip faults in this area are left lateral, as inferred by their sense of step and type of stepover, whereas northeast trending faults are right lateral. The lack of orthogonal fault-ridge intersections implies that the faults did not serve as passive transforms during wrinkle ridge deformation. Indeed, some wrinkle ridges located at fault terminations occur in the fault's compressional quadrants and have angular relationships to the strike-slip faults suggesting that they may have nucleated as a result of the localized strike-slip activity. Strike-slip faulting in this part of Coprates may have predated or overlapped episodes of wrinkle ridge growth and was probably also driven by Tharsis generated stresses.

Strike-slip faulting becomes more complex near 26-28° S in Coprates (Fig. 1). Here, northeast trending linear zones that look like wrinkle ridge material appear to be closely spaced strike-slip faults. Wrinkle ridges that cross these zones are not noticeably offset, suggesting that the zones occurred before the ridges. In contrast, left lateral strike-slip faults occurring in the same area appear to offset at least one ridge, and portions of many other ridges appear defined by scarps of similar orientations to these faults. Inferred remote stress states for the three sets of structures (Fig. 1a, b) are comparable to those predicted from Tharsis deformation models. It appears that right lateral strike-slip faulting first occurred in the curvilinear zones, then was replaced by coeval left lateral strike-slip faulting and wrinkle ridge growth.

Most wrinkle ridges south of Valles Marineris trend northeast but older, northwest trending ridges are also present [e.g., 3]. Fig. 3 shows the geometry of some large ridges southeast of Melas Chasma. Crosscutting relations indicate that northwest ridges formed first (Fig. 2a), so a change in remote stress orientation over time is implied. A resolved shear stress may have acted along or within northwest trending ridges during superposition of the second wrinkle ridge producing stress state. This would explain the growth of short oblique "crenulations" on the southern ridge (Fig. 2b) and growth of some northeast trending ridges in the inferred compressional stress quadrants of older ridges (see [2]). This example differs from the previous two in that discrete strike-slip faults are not observed. Instead, the lateral growth of wrinkle ridges appears to have been locally influenced by the relative orientations of ridges and remote principal stresses [e.g., 4-6]. Interestingly, the older northwest trending ridges with inferred left lateral shear strain parallel the left lateral strike-slip faults to the east [2, Fig. 1].

The first two examples show that strike-slip faulting occurred in a broad zone east of the Coprates Rise spanning ~400 km east-west by perhaps 1000 km north-south. The last example suggests that the growth of major wrinkle ridges throughout Coprates may have been influenced by horizontally directed shear stresses and that more than one generation of ridges was produced. Thus, "compressional" deformation of ridged plains south of Valles Marineris was spatially heterogeneous and a temporal change in stress state may have been involved.

REFERENCES: [1] Forsythe, R.D. and J.R. Zimbelman, *Nature, 336*, 143-146, 1988. [2] Schultz, R.A., *Nature, 341*, 424-426, 1989. [3] Watters, T.R. and T.A. Maxwell, *Icarus 56*, 278-298, 1983. [4] Tija, H.D., *Geol. Soc. Am. Bull., 81*, 3095-3100, 1970. [5] Raitala, J., *Moon Planets, 25*, 105-112, 1980. [6] Aubele, J.C., *Lunar & Planet. Sci., XIX*, 19-20, 1988.

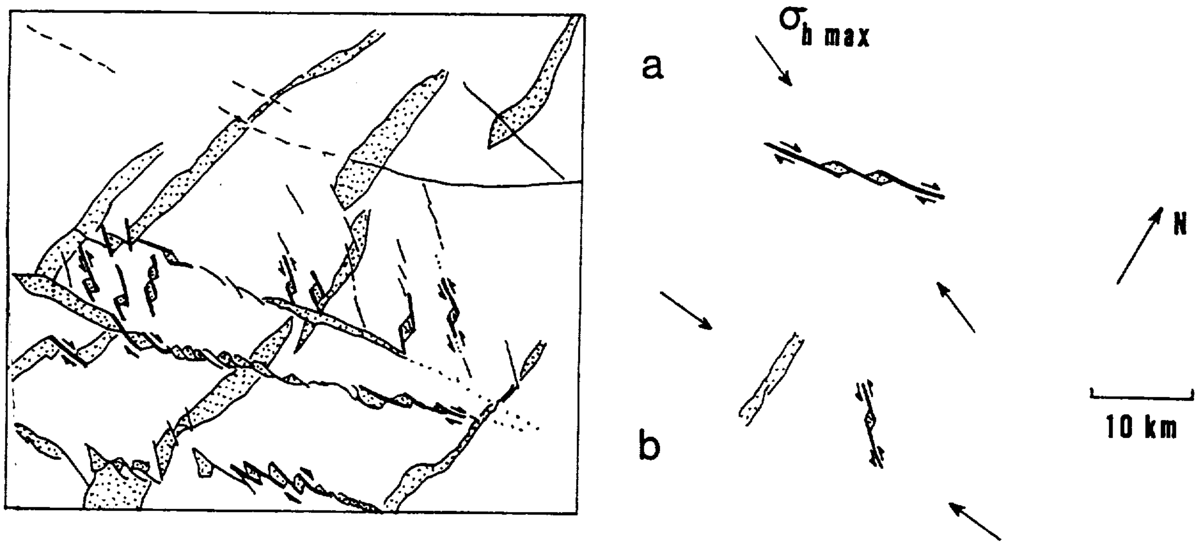

Fig. 1. Sketch map showing relationships between strike-slip faulting and wrinkle ridge growth in Coprates. Wrinkle ridges are stippled. Deformation inset (a) preceeded deformation (b). Viking orbiter images 610A27, A44.

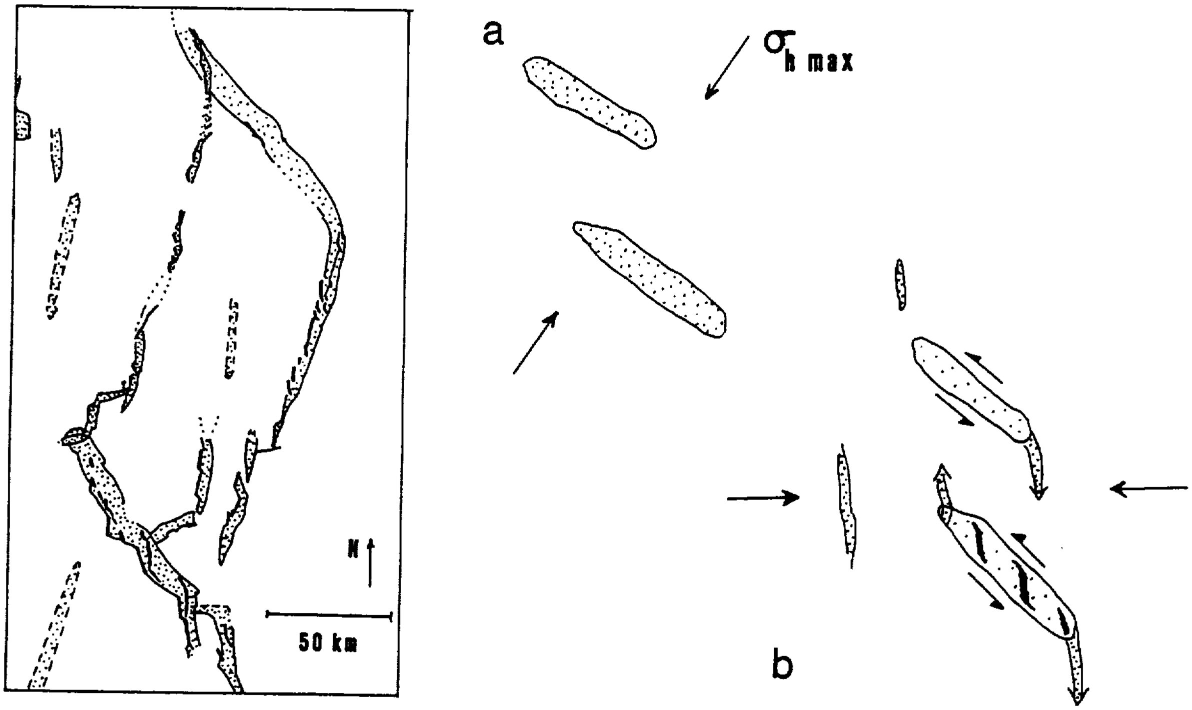

Fig. 2. Northeast trending regional set of wrinkle ridges are superimposed on northwest trending ridges. Insets show inferred time variation of associated stress states. Viking image 608A51.