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COMPLEX EARLY RIFTING IN VALLES MARINERIS: RESULTS FROM PRELIMINARY GEOLOGIC MAPPING OF THE OPHIR PLANUM REGION OF MARS, 1:500,000 SCALE.

Richard A. Schultz, Geodynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Ophir Planum is a relict plateau bounded on three sides by Valles Marineris troughs (Coprates, Melas, and Candor/Ophir Chasmata). The plateau is deformed by a distinctive array of grabens whose orientations differ by as much as 30° from the overall trend of the troughs. Photogeologic mapping of the Ophir Planum quadrangle (MTM -10067; Fig. 1) was undertaken to solve two main problems: (1) What controlled the location, orientation, and growth of Ophir Planum grabens? and (2) How are the grabens and trough faulting related?

Geology within the quadrangle is surprisingly diverse (Fig. 2). The Ophir Planum plateau is capped by plains materials that embay more rugged and densely cratered materials. New crater counts suggest that these plains materials are correlative to Early Hesperian ridged plains on Lunae Planum to the north [1] but significantly, no wrinkle ridges are found on Ophir Planum. The densely cratered materials are probably Noachian (Npl2?) in age, as is the trough wall rock beneath the plateau. Five units are identified in Coprates Chasma: cratered plains (Hpf in Fig. 2), 2 facies of basin beds (Hvl), landslide materials (As), and young possible volcanics (Avsd; see [2]). A third facies of basin bed is distinguished in Ophir Chasma to the north. Crater counts suggest that Hpf in Coprates is also of Early Hesperian age, implying that the Coprates trough floor is structurally lowered caprock of "Lunae Planum" age.

Well defined fault scarps divide Ophir Planum from Coprates Chasma. These trough bounding normal faults change strike from nearly east-west in the eastern part of the quadrangle (Fig. 1) to northwest. The orientations of grabens on Ophir Planum plateau mirror this change and plateau faults locally merge with trough bounding faults. These relationships suggest that plateau grabens are as old as the trough bounding normal faults and that they probably formed under the same stress regime. Ophir Planum grabens probably did not result from either lateral unloading due to landsliding or sliding of caprock into the troughs [3] because (a) their age is older than the periods of landsliding or development of spur-and-gully topography on trough walls, which occurred after downfaulting in the troughs; (b) they do not always parallel the plateau bounding scarp, as required by the mechanisms of [3]; and (c) stress analysis of lateral unloading shows that the grabens occur too far from bounding scarps to have resulted from scarp retreat.

The grabens on Ophir Planum define an echelon set and their changing orientations within the stepover are consistent with mechanical interaction between grabens as they grew into the echelon array [e.g., 4] (Fig. 3). The overall orientation of Valles Marineris troughs is consistent to first order with a spatially uniform, Tharsis generated remote stress state in the region containing the troughs [e.g., 5]. The curving geometries of Ophir Planum grabens and trough bounding faults in Coprates both indicate that the local stress state in this area was spatially variable during the time of Valles Marineris faulting and trough growth. The cause of this spatial variability is still uncertain although stress pertubation by growing troughs that also interact mechanically is an attractive possibility.

The rich geologic history of the Ophir Planum quadrangle (Table 1) underscores the fundamental importance of faulting in the early growth of Valles Marineris.

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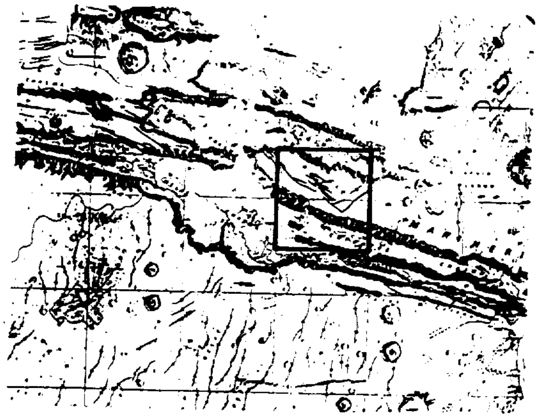

Fig. 1. Quadrangle location.

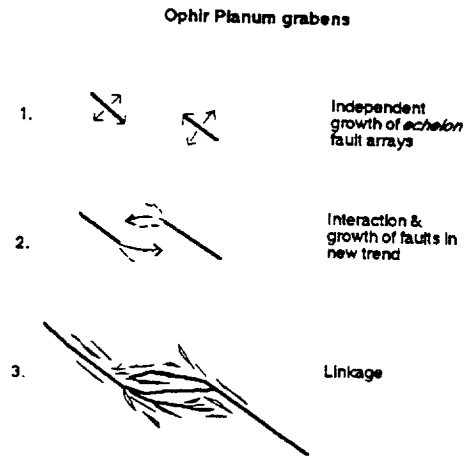

Fig. 3. Growth model for Ophir Planum grabens.

Fig. 2.

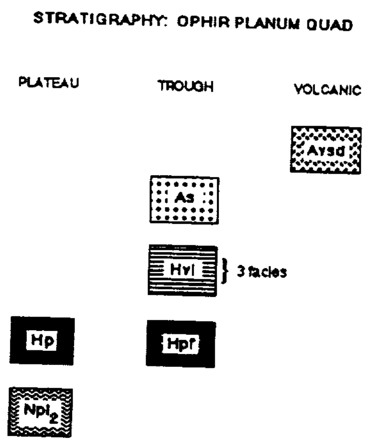

Table 1: Geologic Synopsis.

1. **FORMATION OF OLDER NOACHIAN UNITS**
   - ◊ Npl_2, Noachian wall materials
2. **DEPOSITION OF OPHIR PLANUM PLATEAU UNIT**
   - ◊ Resurface and embay Npl_2
   - ◊ No wrinkle ridges
3. **FAULTING**

   Trough Formation
   - ◊ Growth of Coprates, bounding faults- linear to concave NE
   - ◊ Ophir Planum relatively undeformed
   - ◊ Minor faulting & volcanism (pits, flows) on OP // to Coprates

   Deformation of Ophir Planum
   - ◊ Growth of oblique graben arrays on & beyond OP
   - ◊ Graben depth ~1 km < D < 5 ?? km
4. **TROUGH MODIFICATION**
   - ◊ Erosional retreat of wall scarps
   - ◊ Deposition of regional & local floor layers (Hvf)
   - ◊ Faulting of basin beds, wall scarps (?)
   - ◊ Erosion of most Hvf in Coprates, minor in Melas
   - ◊ Landslides; mafic volcanism (?)