PRE-THARSIS MARTIAN TECTONISM AND VOLCANISM: EVIDENCE FROM THE COPRATES REGION, R. S. Saunders, L. E. Roth, G. S. Downs, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91103; G. Schubert, Department of Earth and Space Sciences, University of California, Los Angeles, CA 90024.

An elevated ridge of ancient cratered terrain that extends to the south from the Coprates Chasma at 60° W longitude marks the eastern edge of a 1500km diameter semi-circular ring of such terrain. The ring of elevated terrain ranges from 100km to 600km across. It is comprised of ancient cratered terrain that is generally fractured and channeled. On the south and west the fracture systems in the terrain include the Thaumasia Fossae and the Claritas Fossae. Interior to the ring are ridged plains and the volcanic plains of Syria Planum, Sinai Planum, and Solis Planum.

Features of the elevated region south of Coprates Chasma may have implications for regional volcanic and tectonic history. The elevated region lies south of Coprates Chasma and near the eastern margin of the ridged plains [1] of Coprates quadrangle (MC-18). McCauley [2] has recognized the existence of this region and considered it to comprise a geologic unit equivalent to the cratered plateau material which underlies the Ridge Plains material and is exposed to the east. The region coincides with the crest of a topographic high recently identified [3] in the Goldstone Mars radar scans [4] extending between longitudes 57° and 80° (here termed the Coprates Rise, see Fig. 1). Within this elevated region a possible volcanic feature occurs at -18.4° latitude and 59.7° longitude. The illumination and shadowing (Viking Orbiter frames 610A24, 26) reveal an impact modified conical mountain 80km in diameter with a 22km diameter summit crater. The flanks display a sinuously channeled texture. We would interpret this feature as a shield volcano with radiating lava channels on its flanks. A similar feature occurs about 200km south (-20.5° lat., 60.5° long.). This mountain is more irregular than the first one. It is about 60km in diameter and has an indistinct summit caldera.

The elevated region is embayed by material of the Ridged Plains and apparently existed as a topographic high prior to emplacement of that material. The east side of the rise is marked by a steep linear ridge that extends from near the rim of Coprates Chasma for approximately 1000km to the south along longitude 57° W. The eastern slope drops 2km to the east over a distance of some of which may have carried the material (presumably as lava) that formed the ridged plains. The steepest slopes here contain numerous aligned triangular facets that point uphill. There appears to be a structural control, but in many places the alignment of the facets suggests that resistant layers such as those exposed in Coprates Chasma to the north have been etched out by some erosional process.

If the faces on the slope result from erosion of layered material, then the layers dip in the same direction as the slope at an angle that somewhat exceeds the slope. This would indicate that the topographic rise in this part of the ring is tectonic in origin, possibly a monoclinal fold, rather than a volcanic pile.

References

[1] Scott, D. H. and Carr, M. H. (1978). Geologic Map of Mars. USGS Map 1-1083. Scale 1:25,000,000.
[2] McCauley, J. F. (1978). Geologic map of the Coprates Quadrangle of Mars. USGS Map 1-897. Scale 1:5,000,000.

MARS: COPRATES REGION

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[3] Roth, L. E. Downs, G. S., Saunders, R. S., and Schubert, G. (1979). Submitted to Icarus.
[4] Downs, G. S., Reichley, P. E., and Green, R. R. (1975). Icarus 26, 273-312.

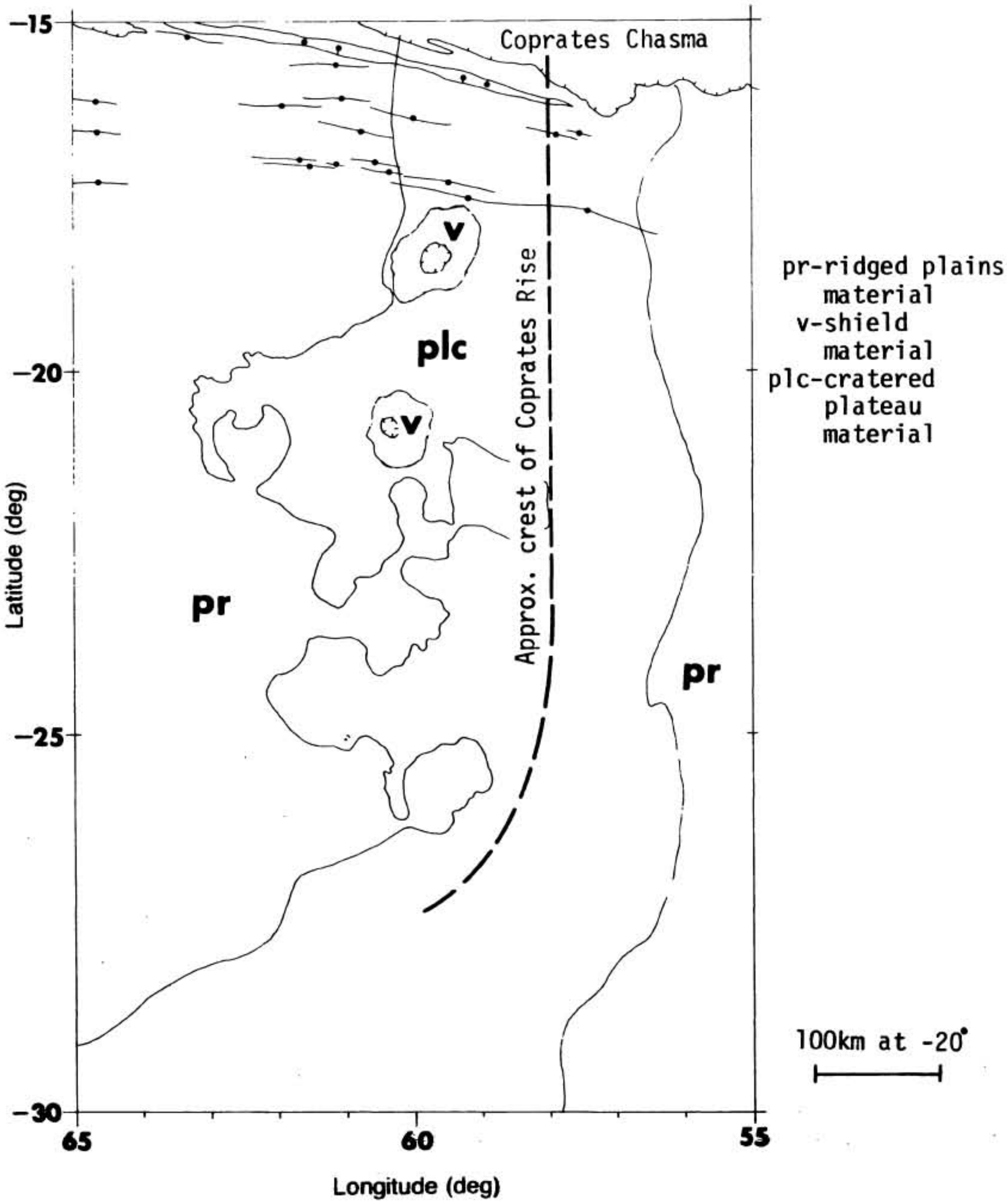

Fig. 1. Geology of the Coprates Southeast Quadrangle of Mars. (USGS Map, 1979, 1-1184, MC-18 SE).

EXPERIMENTAL SHOCK LITHIFICATION OF LUNAR SOIL; Rand B. Schaal, Lockheed Engineering and Management Services Co., Inc., Houston, TX 77058, and Friedrich Hörz, NASA-Johnson Space Center, Houston, TX 77058

INTRODUCTION: Previous shock experiments employing mixtures of particulate terrestrial minerals (1,2,3), granulated lunar basalt (4), and lunar soil (5,6) effectively transformed loose particulate material into well indurated breccias by irreversible compaction, glass welding, or total fusion and, thus, made it possible to interpret the formation of lunar soil breccias through meteoroid impact upon lunar regolith. This experimental study is designed to duplicate lunar impact conditions by (a) using a large number of experiments over a broad pressure range with small pressure increments to monitor better the variation of shock effects along the pressure decay profile through a model crater, (b) utilizing both unsieved and sieved samples for a comparative study of the role of grain size in shock metamorphism in soils, (c) using genuine lunar soil, 15101, containing a variety of lithologic components including agglutinates, glass spherules, and lithic fragments, which were exposed to solar wind and irradiation, and (d) performing the experiments in a carefully controlled atmosphere in order to minimize the oxygen fugacity. Examination of shock metamorphic and lithification features in the shocked samples will provide a better understanding for interpreting the formation of lunar soils and soil breccias.

EXPERIMENTS: A total of 25 shock experiments were performed on unsieved and sieved aliquants of lunar soil 15101 with a 20 mm caliber powder gun. A flat metal flyer plate was launched at velocities between 1.2 and 1.7 km/sec attaining peak shock pressures between 15 and 73 GPa (1 GPa = 10 kbar) in the target. Two sieved grain size fractions were used: 45-75 μm and 100-150 μm. Targets were prepared by packing 14-18 mg aliquants of loose sample into cylindrical metal capsules to attain calculated initial packing densities between 1.3 and 1.8 g/cm^3. The capsules were loaded into larger metal target assemblies and transferred to the impact chamber while in N_2 atmosphere. The impact chamber was flushed four times with a gas mixture of equal proportions of CO and CO_2 and evacuated to 6 to 12 μtorr prior to impact in order to approximate lunar atmospheric conditions. Other experimental conditions were described previously (4,7).

OBSERVATIONS: The 125-250 μm grain size fraction of lunar soil 15101 consists of 42% agglutinate, 7% microbreccia, 9% angular glass fragments, 8% green glass spherules, 12% pyroxene, 2% olivine, 12% plagioclase, and 7% basalt or anorthosite fragments (8).

Petrographic descriptions of shock and lithification features in shocked samples are summarized in Table 1. Shock features were sufficiently distintive to define five shock classes with specific pressure ranges. The diagnostic petrographic features are texture, deformation of plagioclase grains and glass spherules, abundance and type of shock glass, and abundance of vesicles. Mechanical deformation effects such as brittle concussion fractures and fragmentation characterize Class 1 samples. All pore spaces are collapsed, causing minor intergranular melting, and the sample is consolidated. In Class 2 samples solid state deformation features are most distinctive, especially the formation of diaplectic feldspar glass (maskelynite), but intergranular melting formed a dark glass halo around individual grains, indurating the sample. The onset of intragranular melting in plagioclase and the web texture characterize Class 3 samples. The "web texture" consists of flowed, vesicular glass separating rounded relict crystalline grains. Class 4 samples also display the web texture; the melting and flowing of glass spherules (in addition to plagioclase) is distinctive. Class 5 samples are frothy, vesicular