DEUCALIONIS REGIO, MARS: EVIDENCE FOR A UNIQUE MINERALOGIC ENDMEMBER AND A CRUSTED SURFACE; E. Merényi[1], K. S. Edgett[2], R. B. Singer[1]; [1]University of Arizona, LPL, PIRL, Tucson, AZ 85721; [2]Department of Geology, Arizona State University, Tempe, AZ 85287-1404

A small equatorial region south of Sinus Meridiani, Deucalionis Regio, has been found spectrally distinct from other regions as seen in a high spectral resolution telescopic image of the meridian hemisphere of Mars. Analysis of Viking IRTM and other related data suggest that Deucalionis Regio has a crusted surface. The crust-bonding minerals may contribute to the spectral uniqueness of this region.

Deucalionis Regio is a cigar-shaped, moderate-albedo region which runs nearly parallel to the Martian equator, just south of Sinus Meridiani and Sinus Sabaeus. Its main body extends from about 10W to 340W and between 13S and 17S. The western end has a narrow continuation which curves to the northwest at a nearly right-angle toward Oxia, to form the southern and western borders of Sinus Meridiani. Deucalionis Regio was frequently observed throughout the 19th and early 20th centuries, during which time it often appeared to change color, and showed occasional dark streaks [1]. This relatively non-descript region has received little attention in the spacecraft-era Mars literature because, it has not seemed as interesting as the surrounding regions such as Arabia, Sinus Meridiani, or Oxia.

Owing to a near-infrared, multispectral image we found that this region was worth more attention. The spectral image was obtained during the 1988 Mars opposition, 26 September, by the 1.5 m telescope at the University of Arizona's Catalina Station near Tucson, Arizona. It is centered south of Sinus Meridiani, has 280 x 150 km/pixel resolution at sub-earth point, and 300 spectral channels in the 0.44 to 1.04 μm range. The data are described by [2].

Two independent analyses of the above spectral image, linear spectral mixing and supervised classification based on the spectral shapes, showed that in addition to the well-known spectral endmember regions in this image (western Arabia, south Acidalia, and Sinus Meridiani), Deucalionis Regio has spectral properties that are unique enough to make it a principle endmember unit [3] [4]. In those earlier works, Deucalionis Regio was referred to as "Meridiani Border."

Analysis of thermal inertia, rock abundance, and albedo information derived from Viking images and Infrared Thermal Mapper (IRTM) data obtained 1977-80 also indicate that Deucalionis Regio has a surface of distinctly different physical properties when compared to Arabia, Sinus Meridiani, and Acidalia. Deucalionis Regio has a thermal inertia equivalent to the Martian average (5.1-6.9), a low rock abundance (<5%), and an intermediate albedo and color. Considerable effort by previous investigators has revealed a consistent model for the surface (upper few cm) properties of the endmember regions Arabia, Sinus Meridiani, and Acidalia (e.g. [5] [6] [7] [8] [9]). Compared with these regions, we consider that Deucalionis Regio is not a region of either 1) unconsolidated, fine bright dust like Arabia, 2) considerable windblown unconsolidated sand like Sinus Meridiani, or 3) a rocky-and-sandy surface like Acidalia. Thus, we are forced to consider that either the surface of Deucalionis Regio is made of unconsolidated fine to medium sand (about 250 μm) of an unusual and previously unreported color and albedo, or that the surface is crusted, fine-grained weathered soil, and the thermal inertia is an indicator of the degree to which the surface sediments have become indurated. We favor the latter.

Crust, or "duricrust," was observed at the Viking lander sites. It may consist largely of dust- and silt-sized grains bonded by Cl- and S-rich salts, and may be an ubiquitous feature of the Martian surface layer, especially where not currently covered by loose aeolian debris [10]. Deucalionis Regio may indeed be a southern extension of a set of proposed crust layers of differing degrees of induration that are semi-concentric to Arabia, seen in Oxia (a similar arrangement semi-concentric to Tharsis is seen on Lunae Planum) [11] [12].

Deucalionis Regio, though probably crusted, is not entirely without wind-worked unconsolidated sediment, as evidenced by the occasional dark streaking seen by earlier astronomers [1], and evidenced by small (relative to other medium-thermal inertia regions) amounts of dark, perhaps sandy [13] sediment on a few crater floors. However, for the most part, Deucalionis Regio appears to be devoid of loose material. This is interesting, because wind shear stress patterns derived from General Circulation Model results for present climate conditions [14] [15] suggest that Deucalionis Regio is fairly windy compared to Arabia, Sinus Sabaeus, and Sinus Meridiani. That the surface of Deucalionis Regio is not made up of loose material is bolstered by the observation that none of the localized dust storms catalogued by Peterfreund [16] for the period of 1914-1980 originated in this region, though many formed in the surrounding, lower-albedo regions.

We propose that much of the Deucalionis Regio surface, particularly a region approximately 200 km in diameter near 15S, 350W, has a well-exposed, crusted surface. We speculate that the endmember spectral character of this surface may be an indicator of the crust-bonding minerals (salts), or at least serve as an indicator that the proposed indurated sediments have certain minerals that are not apparent in regions of thick unconsolidated sand or dust cover. It is interesting to note that the "brown" unit in Oxia, also proposed to be an exposure of duricrust [8] covers 50 to 80% of the Oxia surface, and in the mixture model of the 1988 spectral image of Mars, referred above, Oxia has over 50% contribution from the Deucalionis Regio endmember.

The ratio of averaged Deucalionis Regio spectra to averaged spectra of other type regions can provide key information on the mineralogic uniqueness of Deucalionis Regio. In particular, comparision to Arabia might give the best clue if we accept the working hypothesis that these two regions originally consisted of the same material and crust formation added new component(s) to Deucalionis Regio. However, such comparision may be complicated by large-scale areal mixing or non-linear mixing and scattering differences of the pure mineral spectra that constitute the type region spectra. Further analysis concerning possible mineralogy will be forthcoming. In addition, we anticipate that Mars Observer Thermal Emission Spectrometer mid-infrared spectra that will be obtained for this region should be able to provide further constraints on the proposed Deucalionis Regio crust and crust-bonding-agent mineralogy.

REFERENCES:

[1] Antoniadi, E.M. (1930), La Planète Mars, Hermann et Cie, Paris.
[2] Singer, R. B., J. S. Miller, W. K. Wells, E. S. Bus, (1990), *Lunar and Planetary Sci XXI*, 1164-1165
[3] Merényi, E., J. S. Miller, R. B. Singer (1992), *Lunar and Planetary Sci. XXIII*, 897-898
[4] Merényi, E., R. B. Singer, J. S. Miller (1992), *Bull. A.A.S., 24* No. 3 979
[5] Zimbelman, J.R. and H.H. Kieffer (1979) *J. Geophys. Res., 84*, 8239-8251.
[6] Christensen, P.R. (1986) *J. Geophys. Res., 91*, 3533-3546.
[7] Christensen, P.R. (1986) *Icarus, 68*, 217-238.
[8] Presley, M.A. and R.E. Arvidson (1988) *Icarus, 75*, 499-517.
[9] Arvidson, R.E. *et al.* (1989) *J. Geophys. Res., 94*, 1573-1587.
[10] Jakosky, B.M. and P.R. Christensen (1986) *J. Geophys. Res., 91*, 3547-3560.
[11] Christensen, P.R. and M.C. Malin (1988) *Lunar and Planetary Sci. XIX*, 180-181.
[12] Christensen, P.R. and H.J. Moore (1992) In *MARS*, Univ. Arizona Press, 686-729.
[13] Edgett, K.S. and P.R. Christensen (1993) *J. Geophys. Res.* (submitted, in review).
[14] Skypeck, A.P. (1989) M.S. Thesis, Ariz. State Univ., Tempe, 78p.
[15] Pollack, J.B. et al. (1990) *J. Geophys. Res., 95*, 1447-1473.
[16] Peterfreund, A.R. (1985) PhD Thesis, Ariz. State Univ., Tempe, 246p.