IDENTIFICATION OF TECTONIC TRENDS IN THE POLAR REGIONS OF THE INNER PLANETS: PRELIMINARY RESULTS FOR THE MOON AND MARS

Ted A. Maxwell, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, D. C. 20560

Studies of tectonic features on the Moon, Mars and Mercury have concentrated on the equatorial regions because of the extent of Apollo coverage (Moon), the lack of ancient crust (northern hemisphere of Mars), or lack of coverage by orbital images (less than half of each pole of Mercury). Although graben and ridges of tectonic origin have been mapped and interpreted as structures related to basin and other regional sources of stress, studies of similar relationships have not been made in the polar regions. As pointed out, however, it is here that photogeologic mapping may be able to distinguish or define the relative role of despinning, tidal deformation, and/or contraction with no rotational dynamic influence (1,2,3). Consequently, the purpose of these series of investigations is to: 1) Investigate well-defined tectonic features such as ridges and graben in the polar regions of the Moon, Mars and Mercury; 2) Identify less well-defined structures of possible tectonic origin (highland lineaments, scarps and more obscure linear features); 3) Compare the orientation and distribution of these features with those in the equatorial regions; and 4) Compare the polar region tectonic features among the inner planets, and to stress orientations predicted by geophysical models.

Both polar regions of the Moon are composed of highlands modified primarily by basin formation although a few areas of relatively pristine highlands and later mare deposits are present. In Mare Frigoris (50° to 65°N), ridges have a dominant N to NNE trend when ridge rings are subtracted from the total population. The western part of Mare Frigoris, however, is characterized by axially trending ridges parallel to the mare-highland contact, and by northerly trends that are continuous with highland scarps, which may be the result of reactivation of old fractures related to the Imbrium basin. Within Mare Australe in the southern polar region (30° to 60° S) mare ridges have a well-defined orientation of NNE (4), similar to patterns in the central parts of lunar nearside basins (5). In contrast to the presence of ridges within areas of mare fill, graben are conspicuously absent surrounding these areas, suggesting a tectonic regime somewhat different than that proposed for nearside basins.

Although several stratigraphic units of lineated materials have been mapped in the northern lunar polar regions (6), large scale furrows and smaller lineations of the highlands materials can in most cases be traced back to the Imbrium or Humboltianum basins. Only a "spine" of ancient pre-Nectarian terrain extending to the north pole from the central far side may contain vestiges of older crustal deformation. The southern polar region is likewise obscured by Australe and South Pole - Aitken basin related lineations (7), so that trends of tectonic features on the ancient crust may not represent early orbital dynamic stresses as much as those resulting from basin formation.

On Mars, the identification of structural features possibly related to early stages of planetary evolution is necessarily limited to the southern polar region because of the relatively youthful plains of the

northern hemisphere. In addition to local areas of apparently thin plains where reticulate ridge patterns are common, at least two major ridge systems are present. Dorsa Argentia is a system of parallel ridges extending for almost 400 km between 75° and 80°S Latitude, oriented at N 50-70° W. The Dorsa Brevia ridges are located between the Hellas basin and the south pole at 60° to 75°S, but are neither radial nor concentric to the basin. Near 65°S, the system consists of numerous individual ridge segments, some of which appear to be radial to a circular (volcanic?) structure at 63°S, 330°W. South of this region, the system extends for 700 km to the ESE as more discrete wide ridges with scarps on both sides. Where exposed, the interior of the large south pole impact basin displays ridges concentric to the basin center, similar to lunar and some martian impact basins. The key central part of the basin, however, is obscured by the southern polar cap.

Preliminary study of well defined features indicates that the Moon retains its dominant N-S orientation of compressional features, although not as pronounced as equatorial regions between 0° and 50°. In contrast to the northerly trends of the ridged plains of Mars (after removal of basin-and Tharsis-related trends), ridge systems near the south pole of that planet are oriented at higher angles to N. Since the orientation of individual segments within these systems may vary more than the overall trend of the system, local contributions such as ridge rings and alignment along topographic troughs need to be separated from the total population in order to have confidence in the remaining orientation data.

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