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THE MARS ANCIENT CRATERED TERRAIN - SMOOTH PLAINS BOUNDARY: IMPLICATIONS OF VIKING COLOR DATA FOR EVOLUTION OF THE AMENTHES REGION.

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The Mars cratered terrain boundary is a highly fractured region that divides the ancient cratered terrain in the southern hemisphere of the planet from the smooth plains of the northern hemisphere. The boundary is clearly exposed in the Amenthes region which is located in the eastern hemisphere of Mars. Here, cratered terrain is elevated approximately 3 to 4 km above the northern plains, and the boundary is marked by both broad plateaus and knobby terrain. In southeastern Amenthes, in particular, there is a clear continuum between large detached plateaus, smaller smooth topped plateaus and knobby hills. Knobby terrain, however, is not restricted to areas adjacent to the boundary, but extends some 1000 km to the north where isolated knobs can be mapped. Mapping of the structural features in the Amenthes region indicates that the faults present are oriented parallel to the boundary in the eastern hemisphere, and that the orientation of elongate knobs and detached plateaus is also parallel to the cratered terrain boundary. These results imply that the evolution of the cratered terrain boundary has involved normal faulting caused by stresses acting perpendicular to the boundary.

If the knobby terrain is truly remnant of the ancient cratered terrain, then the far northerly occurrence of the knobs implies that at least part of the northern plains may be underlain by the ancient terrain. In order to look at possible compositional variations to test this hypothesis, we have investigated the global color set compiled by the Mars Consortium.

The application of the martian surface color data to geologic interpretation of the boundary has been initially confined to the Amenthes region in an attempt to limit the numerous problems inherent in the Viking II approach color data. The two most serious problems with the color data as applied to this study are atmospheric contributions that increase with latitude, and the high correlation, or interdependence, among the three color bands. Such a correlation in the color data reduces the amount of useful information. One method to reduce the correlation among the three colors (red = .59 $\pm$ .05 microns, green = .53 $\pm$ .05 and violet = .45 $\pm$ .03) has been to ratio one color to another. This method, however, does not maximize the amount of information from the data.

In order to characterize terrain units in the Amenthes region previously defined on the basis of high spatial resolution photogeologic mapping, the three colors of the Viking II approach data were used at the original (1/4 degree) resolution. The color data for this region do not differ significantly from the global color data set in that all three colors are highly correlated. In order to reduce the correlation between the three colors a principal components analysis was performed using a computer. The principal components method transforms the color data thereby reducing the interdependency of one color relative to another. This effectively maximizes the amount of useful information that can be obtained from the color data. After the principal components transformation was performed the resulting data set showed correlation values of 0.50 (red to green), 0.26 (violet to red) and 0.88 (violet to green), where a value of 1.0 indicates perfectly correlated data.

The decorrelated color data were then subjected to an unsupervised classification. Unsupervised classification is a statistical analysis, performed by the computer, in which the color data are used to generate statistically unique color groups. The advantage of using an unsupervised classification method is that it assumes nothing about the data. The result of such processing is an image in which the different areas in the Amenthes region are classified on the basis of surface color. The number of classes of the initial computer generated classified image were then interactively reduced and compared with the geologic mapping results of the Amenthes region. This allowed us to determine the geologic significance of the various color units. The final classification resulted in the definition of 13 units, 4 of which were related to atmospheric variations in northern Amenthes. In southern Amenthes the classified units show areas of possible mixing between cratered terrain and smooth plains. Consequently, despite the problems inherent in the color data, some geologically meaningful correlations exist between surface units and the transformed color data in the Amenthes region. The knobby terrain protruding through the plains units appears to be remnants of ancient cratered terrain extending northward beneath the more youthful smooth plains.