THE INTERIOR STRUCTURE AND PALEOGEOGRAPHY OF ARIEL. Olga Prieto[1] and Jeffrey S. Kargel[2], [1]Universidad Complutense de Madrid, Spain (e-mail: olgapb@eucmax.sim.ucm.es), [2]U.S. Geological Survey.

Models of the interior structure and paleogeography of Ariel are proposed. A study of the kinematics of the rigid tectonic blocks observed on Ariel's surface has been made, and in Figure 1 we show the possible original appearance of the crust and a sequence of the opening of the grabens and some strike-slip movements. Using models of the possible internal structure of Ariel (Fig. 2) we evaluate some geological and chemical aspects of this icy satellite in order to determine the geodynamical processes involved. The most probable model of Ariel, consistent with limited observations, implies substantial differentiation [1]. Ariel's structure should have a rocky core, a soft mantle dominated by ammonia dihydrate and a buoyant rigid crust/lithosphere of water ice.

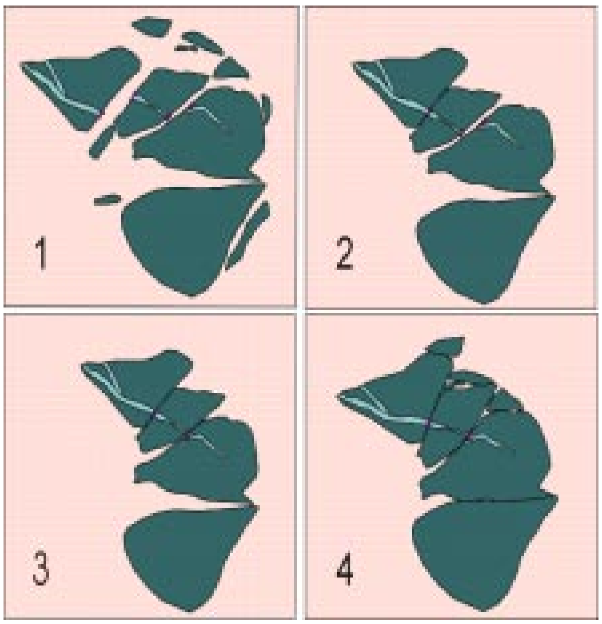

Figure 1. Block kinematics on Ariel's canyonlands.

We have applied the simple Archimedes' Principle to extract some information about the isostacy that our model with two density contrasted layers naturally should produce. The scarp heights calculated for brittle, floating blocks of the lithosphere is about 4 km. This value is similar to the results obtained by the shadow- length measurements in the canyonlands area (1.7 to 5.7 km). We also attempted the use of photoclinometry [2] to obtain scarp heights in areas where shadows are absent, but this method failed because of compositional heterogeneity and albedo contrasts across Ariel's surface. Unexpectedly, we found that the photometric profiles corrected for phase angle imply that the walls of some canyons have exposures of a highly reflective material. Bright material also is exposed in some crater ejecta blankets, and so it appears that Ariel's upper crust is made of intrinsically bright material that is covered in most places by a thin layer of dirty ice. This bright material probably is nearly pure water ice, as identified by Earth- based infrared spectroscopy of Ariel [3].

These results support our model predictions. In our preferred model, ammonia dihydrate of the mantle ascends through fractures of the rigid lithosphere. The water-ice lithospheric blocks spread apart and the gap is progressively infilled by ammonia hydrate. If this model is correct, then we predict that the smooth-floored canyons are underlain substantially by ammonia dihydrate, which potentially could be observed. The stresses responsible for the fracturing and opening of the canyons is unknown but could involve any combination of solid-state cooling and tidal deformation in the lithosphere, phase changes (such as melting) and convection in the mantle, repeated dike intrusion and crystallization, or other processes. This differentiated model of Ariel and the kinematic block model are consistent with one another, but they do not reject other possibilities.

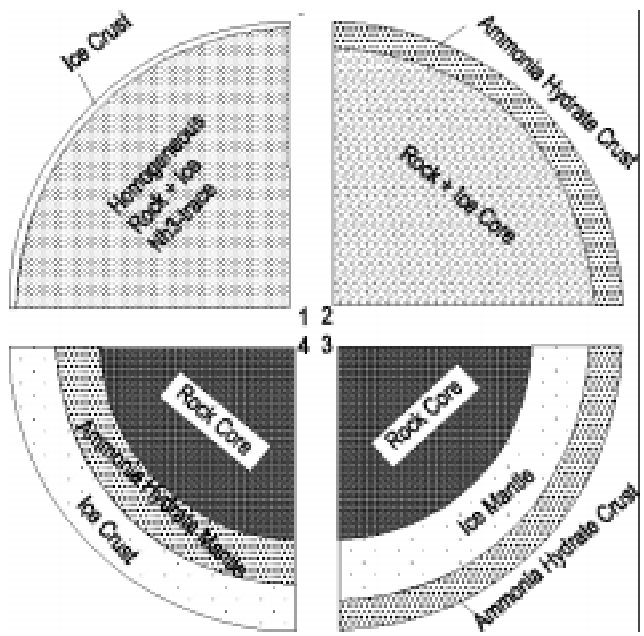

Figure 2. Interior structure models for Ariel.

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