
Cantaloupe terrain is unique to Triton. It is Triton’s oldest terrain and includes about 250,000 km sq. region displaying sparsely cratereed, closely spaced, nearly circular dimples about 30-40 km across. This terrain is found on no other planet because, only on Triton the final major global thermal pulse 1) caused completed (or nearly) interior melting resulting in a cooling history where large thermal stresses shattered and contorted a thin, weak lithosphere, and 2) occurred after heavy bombardment so that the surface features were preserved. The cantaloupe terrain is composed of intersecting sets of structures (folds and/or faults) that have developed as a result of global compression generated by volumetric changes associated with cooling of Triton’s interior. Further, it is proposed that these structures developed after the period of heavy bombardment, and resulted from the last major global thermal epoch in Triton’s unique history (either caused by tidal or radiometric heating). Initially, as the body cooled and the structures formed, their surface topography was most likely modified by thermal relaxation of the warm surface ices.

Difficulty in explaining this peculiar terrain is reflected in the number and variety of proposed origins including; a combination of viscous relaxation, collapse and sublimation (1, 2), interference pattern of intersecting structure sets (3,4), explosive volcanism (4,5,6), and diapirism (7). The lack of superposition and the uniformity in size and shape of the dimples suggest that impact cratering, collapse, sublimation or volcanism are not likely origins. Diapirism is also improbable because of 1) the necessity for major density instabilities in a highly differentiated body (ammonia-water liquid and coexisting ice phases have similar densities and are stable), 2) the lack of radial structures around the dimples, 3) the dimensions and uniformity in the spacing and size of the dimples is inconsistent with the general physical constraints of diapir formation, and 4) models for diapir development specific to Triton (8) are inconsistent with dimple size vs spacing (predicting ascent of only 1.0-1.5 times the viewing’s radius before stopping). In addition, periglacial processes that form such features as pingo, patterned ground, alasas, and ‘oriented’ lakes require freeze/thaw processes and mechanical properties of ices that are inconsistent with the large size of the features (dimples). Periglacial models raise mechanical problems with the materials involved.

Models for the early history of Triton all predict an initial period of global melting and differentiation associated with accretion. The density of Triton suggests that it formed in the solar nebula (9) though other later processes have altered its original composition (10,11,12). The peculiar orbit of Triton suggests capture (13,14,15), depending on the capture mechanism, may have resulted in substantial tidal heating during circularization of its orbit. The epoch of tidal heating may have lasted more than 500 m.y., and caused complete melting and
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extensive chemical evolution of Triton (15,16). Stevenson and Gandhi (1990) predict that, even without tidal effects, internal heating and melting would be prolonged by decay of radiogenic elements in the high rock fraction of the satellite. In either case, significant global melting of Triton is predicted to continue for several hundred million years to a billion years after accretion. Triton may still be molten layer beneath about 200 km (10,12). Lunine and Nolan (1992) suggests that the early molten state may have been prolonged further due to the insulative effects of a transient atmosphere created by out-gassing of volatiles driven out by the thermal event.

Therefore, Triton has most likely undergone significant global heating, interior melting and differentiation, stabilization of the surface and subsequent cooling well after accretion. The sparsely cratered nature of all terrains (including the cantaloupe terrain) observed on Triton (Strom et al, 1990) is consistent with formation after heavy bombardment. If this is correct, then on Triton, unlike other bodies, processes associated with the initial cooling of a molten or nearly molten body may have been recorded a the surface undestroyed by the "gardening" of heavy bombardment. (18,19,20,21) have pointed out the importance of the initial state and evolutionary path of a planet on the models of the thermal stress state. They indicate that thermal stresses are generally greater in the crust of bodies that were initially totally molten (like Triton) compared to those in bodies where only the outer portion was melted (Those that may have been accreted cold objects).

In other bodies like Mercury (22), thermal stresses generated from global cooling and contraction have resulted in widely spaced thrust faults, whereas on Triton, thermal stresses produced more closely-spaced folds and faults sets. This difference in structural style is probably due to differences in lithospheric properties (thickness, strength, etc.), the magnitude of stress (directly dependent on the thermal history), and when the structures formed, relative to the period of heavy bombardment.