A Test of the Martian Northern Ocean Hypothesis

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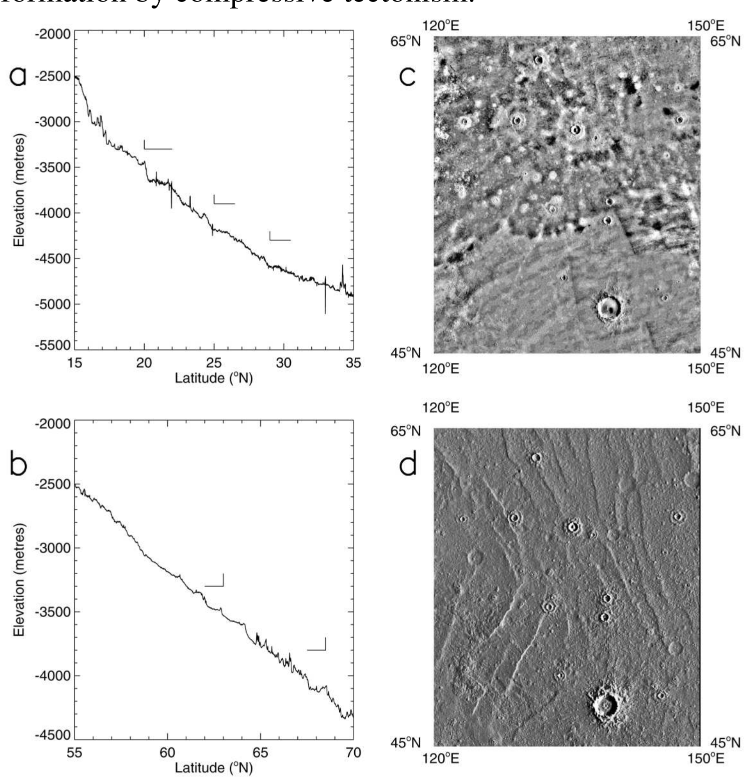
It has been proposed that the low-lying northern plains of Mars were covered by an ocean during the middle period of martian history. We examine topographic profiles of candidate shorelines and conclude that the candidate shorelines were formed by tectonic, not oceanic, processes. Linear slope changes in the northern plains were identified by Head *et al.* [*Science* **286,** 2134 — 2137 (1999)] as candidate shorelines. Figure 1a shows candidate shorelines near the Utopia impact basin. These candidate shorelines are flat terraces with a ridge of higher elevation bounding their landward, or upslope, side. Figure 1b shows candidate shorelines on the other side of the proposed ocean, near the Alba Patera volcano. These candidate shorelines are flat terraces with a ridge of higher elevation bounding their oceanward, or downslope, side. This morphology is hard to explain via a shoreline process. Even harder to explain via a shoreline process is the reversal of shoreline morphology from one side of the ocean to the other. We favour a tectonic origin for these candidate shorelines. As seen by Viking, these plains are essentially flat and featureless. However, MOLA data reveal a network of ridges spanning the northern plains, some of which are the candidate shorelines of Head *et al.* These ridges are generally perpendicular to predicted directions of maximum compressive stress, which suggests that the ridges have a tectonic origin. These ridges also have the characteristic profile of wrinkle ridges formed by compressive tectonism. Elevation offsets, seen across many ridges, may best be explained by subsurface thrust faults. Some ridges are close to known wrinkle ridge provinces, such as Lunae Planum, and have similar strikes; these clearly formed with the known wrinkle ridges. Both groups of candidate shorelines discussed here have orientations consistent with their formation by compressive tectonism.



A — MOLA profil
near Utopia basin.
B — MOLA profil
near Alba Patera.
VE ~ 400, ridges and terraces are marked by vertical and horizontal lines.
C — Viking photomosaic near Utopia.
D — MOLA shade
relief map of same region. Note ridges and additional craters.