Ancient Oceans and Long-Wavelength Shoreline Deformation on Mars

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A number of geologic and topographic features within the northern plains of Mars have been interpreted as shorelines formed by ancient oceans. Several recent studies have challenged this interpretation, arguing that the present topographic profiles do not appear to follow surfaces of equal gravitational potential. Elevations along the "shorelines" are especially variable at long wavelengths (thousands of km), with amplitudes of hundreds of meters to kilometers. To test the hypothesis that the features in the northern plains are deformed shorelines, we compare the long-wavelength topography (solid surface position relative to the areoid) of the two most prominent shorelines (the Arabia and Deuteronilus contacts of Clifford and Parker [*Icarus*, 154, 40–79, 2001]) with the deformation expected for: (1) flexural response of the lithosphere to surface loading from the growth of the Tharsis volcanic province or ocean redistribution, (2) true polar wander (TPW), and (3) dynamic topography linked to internal convective flow. We find that TPW and dynamic topography are both capable of reconciling the longest-wavelength variation in topography. We discuss the implications of these deformation mechanisms for the location and volume of an ancient ocean.