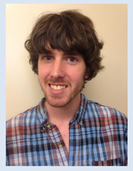
HIGH-RESOLUTION EXAMINATION OF THE GEOMORPHOLOGY OF PROPOSED OCEAN SHORELINES ON MARS



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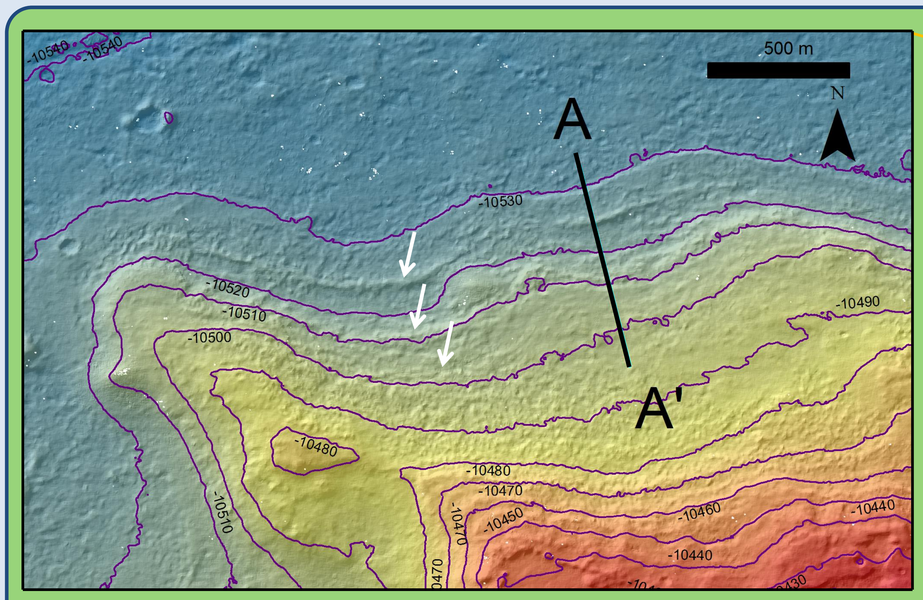
Can new high-resolution imagery and topographic analyses provide evidence of coastal features on Mars?

Introduction

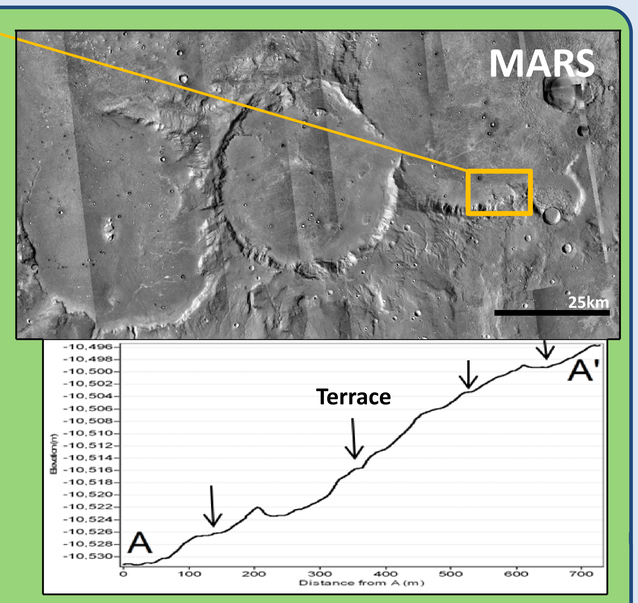
- Mars is marked by a **striking topographic dichotomy** between the northern plains and the southern highlands
- These contacts have widely been attributed to be **possible paleo-shorelines of an ancient ocean**, possibly in the Hesperian (3.0-3.7 Ga) or earlier during the Noachian (4.1-3.7 Ga)
- **Previous work** identifying these contacts have relied on Viking, THEMIS (Thermal Emission Imaging System), MOC (Mars Orbiter Camera) with **resolutions of 2-200 m/px**
- The **genetic origins of these features are still unknown**

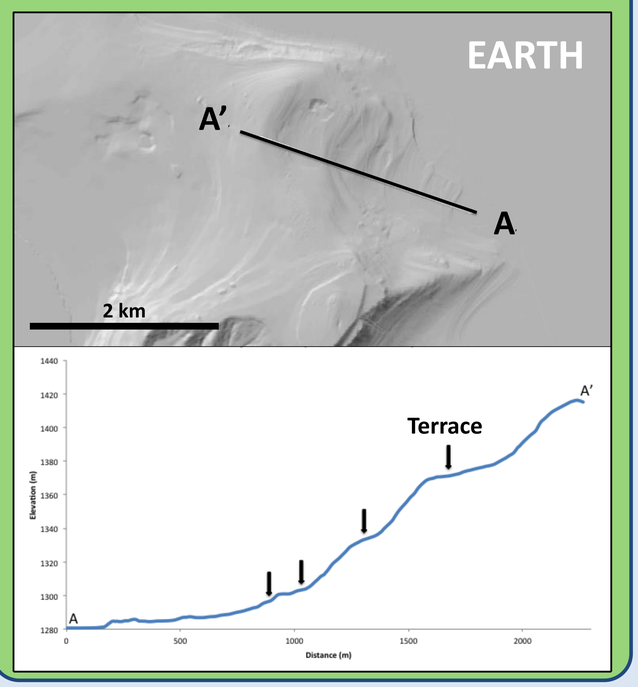
Methods

- 34 previously published features identified as plausible shorelines were reinvestigated. We used HiRISE (High-Resolution Imaging Science Experiment) imagery to **reclassify the features based on the high-resolution data.**
- Features were grouped into one or more of five broad categories with characteristic landforms:
  - **Coastal** – marine terraces, strandlines, deltas, berms…
  - **Volcanic** – overlapping lobate flows, pressure ridges…
  - **Glacial** – lineations, moraines, hummocky terrain, drumlins…
  - **Impact** – craters, ejecta blankets…
  - **"Other"** – faults, albedo contacts, mass wasting…
- Using stereo pair images and NASA's Ames Stereo Pipeline (ASP), we built digital elevation models (**DEMs) with a lateral resolution of ~1m/px**



Digital Elevation Model: These strandline features (like bathtub rings; white arrows) form an equipotential surface and terraces (black arrows) in a similar fashion to the ancient strandlines of Lake Bonneville, Utah (lower right figs.), which mark the old lake levels.



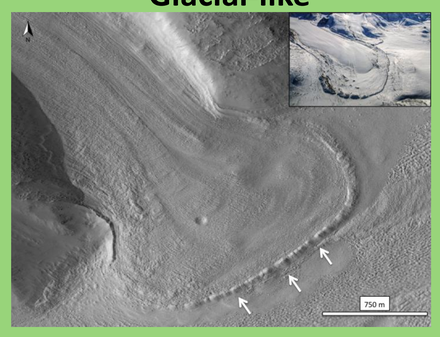


Results

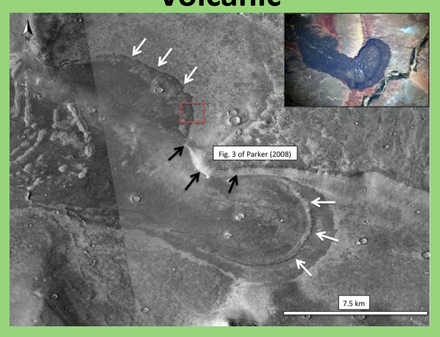
- **Most** of the reinvestigated features displayed characteristics **indicative of** having an origin consistent with:
  - **Volcanism**
  - **Albedo contrasts**
  - Mass wasting
  - Glacial-like
- **One feature** (see Figs. above) is found to have **coastal-like morphologies**, namely **strandlines** – landforms that mark the extent of past water levels
- Topographic data show these strandline-like features were **consistent with a local equipotential surface**
- Cross sections show features **resembling terraces or wave-cut platforms**, similar to paleo-coastal features such as Lake Bonneville, UT

Hypothesized shorelines found to be more consistent with other geomorphology:

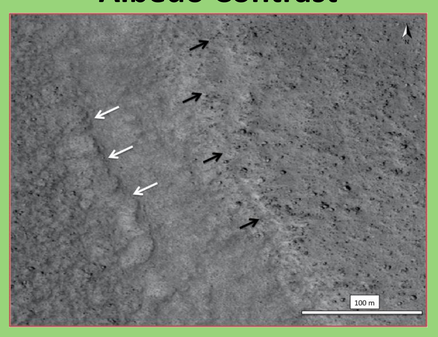
Glacial-like



Volcanic



Albedo Contrast



Conclusions & Future Work

- The **majority** of putative Martian shorelines analyzed **do not resemble coastal morphologies**
- Further analyses will give way to determining **differences between wave-cut terraces and weathering** of stratified sediments and allow more precise grouping of features
- Future thermal inertia maps will assist geomorphic interpretations

[1] Parker, T.J. et al. in Cabrol and Grin, Eds. (2010) Lakes on Mars (Elsevier), 249-273. [2] Cllifford S.M. and Parker, T.J. (2001) Icarus 154, 40-79. [3] Carr, M.H. and Head, J.W. (2010) EPSL 294, 185-203. [4] Di Achille, G. and Hynek, B.M. Nat. Geosci. 3, 459-463. [5] Parker, T.J. et al. (1989) Icarus 82, 111-145. [6] Parker, T.J. et al. (1993) JGRE 98, 11061-11078. [7] Perron, T. et al. (2007) Nature 447, 840-843. [8] Moratto, Z.M. et al. (2010) LPSC XLI, Abstract #2364. [9] Carr, M.H. and Head, J.W. (2003) JGRE 108, 8. [10] Malin, M.C. and Edgett, K.S. (1999) GRL 26, 3049-3052.