THE CHASMA BURIED WITHIN THE NORTH POLAR LAYERED DEPOSITS, MARS. J.W. Holt[1], N.E. Putzig[2], S. Nerozzi[1], [1]Institute for Geophysics, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX (jack@ig.utexas.edu), [2]Planetary Science Institute, Denver, CO.

Introduction: During the course of mapping the radar stratigraphy of the north polar layered deposits (NPLD) of Mars, [1] discovered that a second major chasma, roughly the size of the current Chasma Boreale (Fig. 1), existed early in the evolution of Planum Boreum (PB). The two "proto-chasma" existed at the same time. Due to processes that we do not yet understand, this second chasma was eventually infilled, leaving no surface expression, unlike Chasma Boreale which persisted and became deeper as the NPLD accumulated around it.

The full extent of the buried chasma and the role of erosion associated with its existence were not established and have remained in question. Understanding this feature is important to deciphering the long-term evolution of the NPLD, long presumed to be a record of late Amazonian climate on Mars [2].

Methods: This work employs radar data obtained by the Shallow Radar (SHARAD) [3] on Mars Reconnaissance Orbiter. SHARAD has acquired over 2000 PB observations, enabling the mapping of the uppermost surface of the basal unit (BU) [4,5]. The BU has been revealed to be highly nonuniform and asymmetric about the pole. This set the stage for nonuniform deposition and potentially erosion.

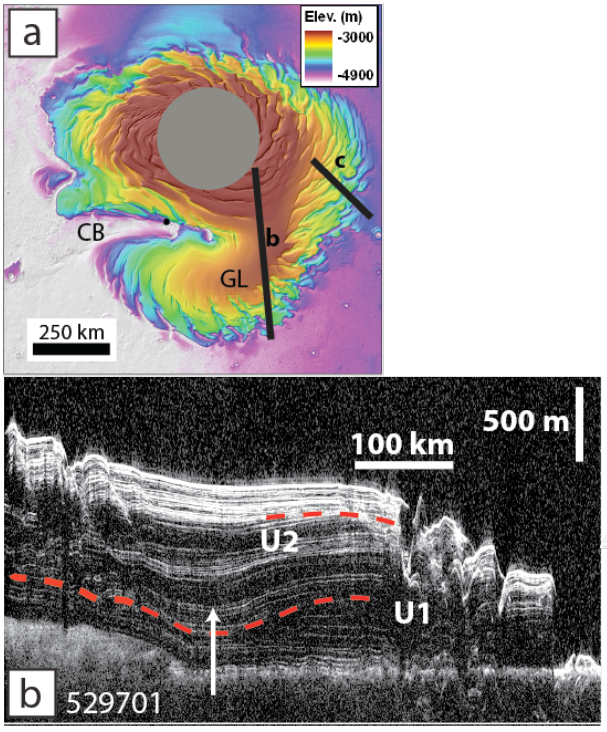

Figure 1. *(a) Planum Borkum, Mars surface topography. (b) SHARAD radargram. U1 and U2 indicate major stratigraphic unconformities. U1 is associated with the buried chasma, indicated with white arrow.*

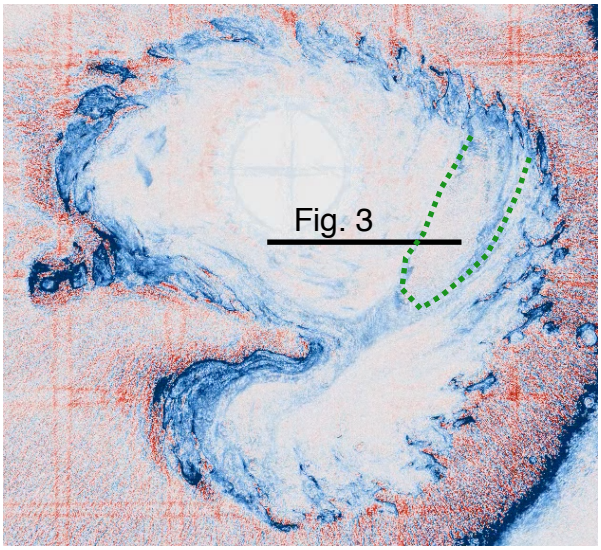

Figure 2. *Horizontal slice of Planum Boreum from 3D SHARAD volume of [7], showing the buried chasma (indicated with green dotted line).*

SHARAD also provides critical information about the internal structure and stratigraphy of the overlying NPLD [1,4,6]. Recently a 3D SHARAD data volume for Planum Boreum was produced [7] that combines thousands of SHARAD tracks to create a 3D representation of all echoes in a combined, migrated volume. This provides two primary advantages: (1) effects of surface clutter are reduced or eliminated, and (2) sampling of the data volume can occur in any orientation, completely independent of the original acquisition geometry. This has enabled a new view of the buried chasma, and we combine that here with detailed mapping of the underlying cavi unit [8] associated with the edge of the buried chasma to shed new light on this major feature.

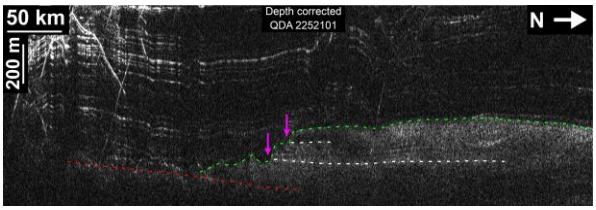

Figure 3. *SHARAD data showing erosional features in cavi unit along the northern edge of the buried chasma (purple arrows). From [8].*

Mapping of the cavi unit with detailed, standard SHARAD data products reveals a system of troughs or cuts into the cavi where it abuts the buried chasma (Fig. 3). This supports the hypothesis that this feature was at least partially erosional in origin, and that erosion removed cavi material.

The major unanswered question remains regarding the subsequent infilling of one chasma, while the other persisted to become the present-day Chasma Boreale. In order to address this question we are undertaking mesoscale modeling using the atmospheric model of the Laboratoire de Météorologie Dynamique (LMD) [9] and paleosurfaces previously mapped at this stratigraphic level as an input.

Conclusions: SHARAD reveals a large chasma that once matched Chasma Boreal in size, and was likely formed by erosional processes. Feedbacks between topogrpahy, deposition and regional winds likely resulted in the subsequent infilling of this chasma, but further mapping and modeling efforts are required to better understand this unique feature of Planum Boreum.

Acknowledgements: This work was supported by the MRO project through a JPL contract to JWH, and NASA grants NNX10AO26G and NNX09AV95G. We also thank the SHARAD team.

References: [1] Holt, J.W. et al. (2010), *Nature* 465. [2] Fishbaugh, K.E. et al. (2008) *Icarus*, 196. [3] Seu, R. et al. (2007) *JGR*, 112. [4] Putzig N. E. et al. (2009) *Icarus*, 204. [5] Brothers, T.C. et al. (2015), *JGR*, 120 [6] Phillips, R.J. et al. (2008) *Science*, 320, 1182. [7] Foss, F. et al. (2017), *Leading Edge*, 36, 43-47. [8] Nerozzi and Holt, *this conference* [9] Spiga, A. and Forget, F., (2009) *JGR* 114(E2).

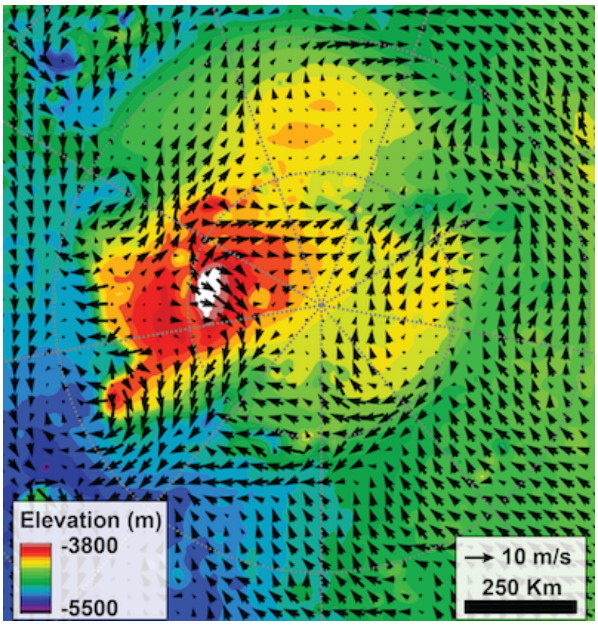

Figure 4. *Basal Unit topography with wind vectors from LMD mesoscale wind model. Wind patterns resulting from topography may have controlled subsequent deposition, infilling the buried chasma while causing Chasma Boreale to persiist.*