THE CIRCUM-HELLAS VOLCANIC PROVINCE, MARS: DETAILED AREA-AGE ESTIMATES AND PHYSICAL-COMPOSITIONAL PROPERTIES OF THE SURFACE.

D. A. Williams[1], R. Greeley[1], L. Manfredi[1], R. L. Fergason[2], J-Ph. Combe[3], F. Poulet[4], P. Pinet[5], C. Rosemberg[5], H. Clenet[5], T. B. McCord[3], J. Raitala[6], G. Neukum[7], and the HRSC Co-Investigator Team, [1]School of Earth & Space Exploration, Arizona State University, Tempe, Arizona 85287-1404, USA (David.Williams@asu.edu); [2]Astrogeology Team, U.S. Geological Survey, Flagstaff, Arizona, USA, [3]Bear Fight Center, Winthrope, Washington, [4]Institut d'Astrophysique Spatiale, Université Paris-Sud, Orsay Cedex, France, [5]Observatoire Midi-Pyrénées, Laboratoire Dynamique Terrestre et Planétaire, Université Paul-Sabatier, Toulouse, France, [6]Planetology Group, University of Oulu, Oulu, Finland, [7]Institute of Geosciences, Free University, Berlin, Germany.

Summary: We constructed THEMIS daytime-infrared mosaics (spatial resolution 100 m/pixel) of several regions of wrinkle-ridged plains bounding the Circum-Hellas Volcanic Province (CHVP), and performed crater counts to assess whether these plains were associated with volcanism in the CHVP. We determined cratering model formation ages of 3.4-3.7 Ga for SE Malea Planum, 3.6-3.7 Ga for W Promethei Terra, 3.5-3.7 Ga for Hesperia Planum, and 3.6-3.8 Ga for the eastern Hellas basin floor, all of which are consistent with the formation of the major volcanic edifices (3.6-3.8 Ga) in the CHVP. The inclusion of these regions brings the size of the CHVP to >4.86 x 10^6 km^2, comparable in size to the Elysium Volcanic Province. Additionally, we used TES, THEMIS, HRSC, and OMEGA data to assess the physical and compositional properties of the Malea Planum (MP) portion of the CHVP. Our analysis of surface materials shows that the thermal inertia decreases from north to south, suggesting that the surface is composed of coarse silt to very coarse sand, and that there is greater dust cover on the flanks of the CHVP volcanoes than in their putative calderas. Local variations in thermal inertia in MP are likely due to variations in surface material caused by aeolian and periglacial/permafrost processes, whereas regional variations are likely due to seasonal deposition and sublimation of ice at higher latitudes. A new HRSC color mosaic reveals the extent of dark material in MP. Spectral analysis of OMEGA data indicates the widespread presence of pyroxenes ± olivine, particularly exposed in crater rims indicative of excavation of underlying volcanic materials. Dark materials occur throughout the CHVP, but are concentrated in topographic lows such as crater and caldera floors. Derivation of modal mineralogies from OMEGA data show a variation in composition of dark materials across MP: eastern dark deposits have higher olivine and low-calcium pyroxene contents, lower high-calcium pyroxene contents, and higher ratios of low-calcium to total pyroxene, relative to western dark deposits. Correlation with cratering model age estimates suggests that the western deposits are associated with older features (3.8 Ga) than the eastern deposits (3.6 Ga), but these ages differences are within uncertainties. Nevertheless, our results indicate a potential change in composition of volcanic materials in the Malea Planum portion of the CHVP with space, and possibly time.

New Age Estimates: Our previous paper defining the CHVP [1] included an initial estimate of its area (>2.1 million km^2), based on the recognition of distinct volcanic edifices (Tyrrhena, Hadriaca, Amphitrites, Peneus, Malea, and Pityusa Paterae) and their associated deposits. Since then, additional regions of wrinkle-ridged plains on the margins of the Hellas basin were suggested to be part of the CHVP (e.g., *L.P.Keszthelyi*, pers. comm., 2008). We assessed and compared the areas and the cratering model ages of several of these regions (SE Malea Planum, W Promethei Terra [2, 3], Hesperia Planum, and the eastern Hellas basin floor). The correlation of crater count formation ages [method of 4, 5] between the volcanic edifices and the adjacent ridged plains (**Fig. 1**) indicates the widespread occurrence of volcanism in the circum-Hellas region, resulting in a volcanic region comparable in size (if not diversity) to the Elysium Volcanic Province, as first suggested by [6].

Physical Properties:

We used TES and THEMIS data to determine the thermal inertia and particle sizes of surface materials of putative volcanoes in Malea Planum, using the procedures of [7, 8] (**Table 1**). Local variations in thermal inertia are due to variations in surface material caused by aeolian and periglacial/permafrost processes, whereas regional variations are due to seasonal deposition and sublimation of ice at higher latitudes. We will discuss the compositional properties of this region in the presentation.

References:

[1] Williams, D.A., and 14 coauthors (2009) *PSS, in press,* http://dx.doi.org/10.1016/j.pss.2008.08.010. [2] Raitala, J. et al. (2007) European Mars Science and Exploration Conference: Mars Express and ExoMars, Abstract #1118199, ESTEC, Noordwijk, The Netherlands. [3] Ivanov et al. (2009) *in review*. [4] Hartmann, W. K. and Neukum, G. (2001) *Space Sci. Rev. 96*, 165-194. [5] Michael, G. and Neukum, G. (2008) *LPS XXXIX*, Abstract #1780. [6] Peterson, J.E. (1978) *Proc.*

9th LPSC, 3411-3432. [7] Fergason, R.L. et al. (2006) *JGR 111*, E12004, doi:10.1029/2006JE002735. [8] Presley, M.A. & Christensen, P.R. (1997) *JGR 102 (E3)*, 6551-6566.

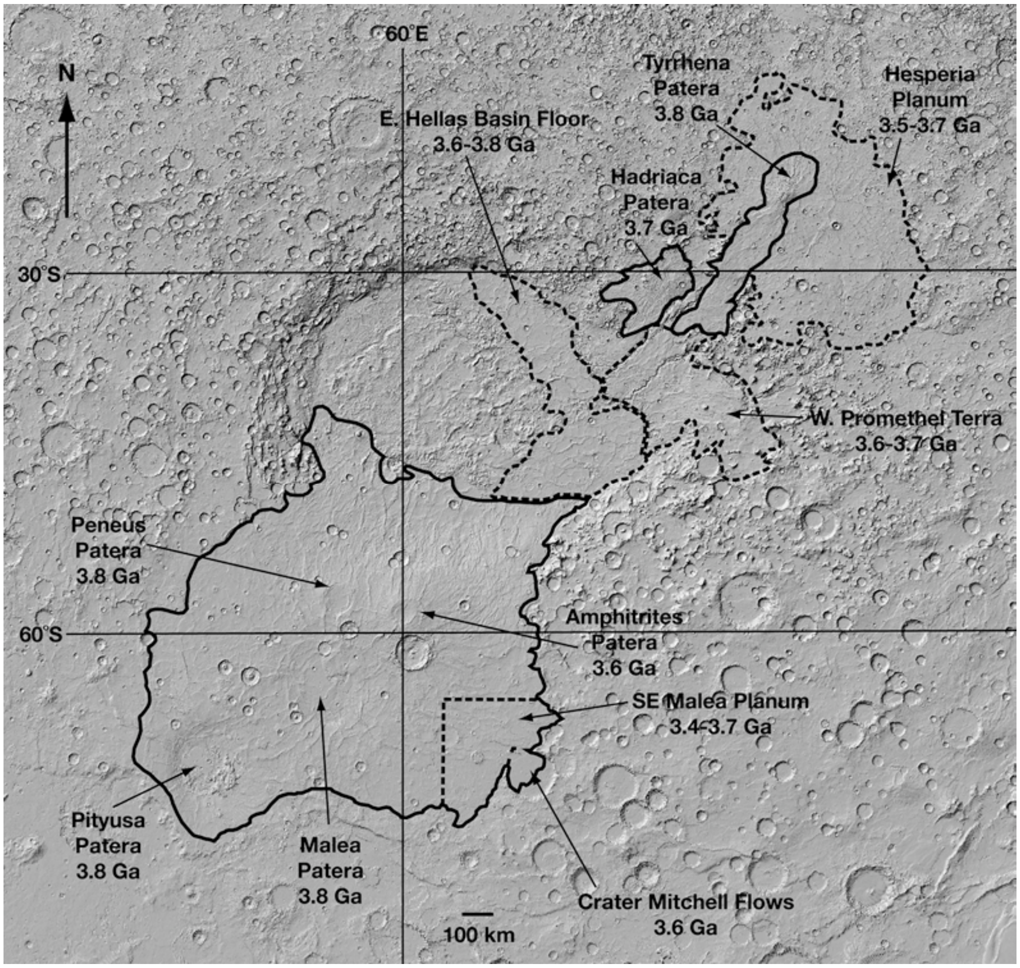

Figure 1. MOLA shaded relief sketchmap showing the original (solid) and new (dashed) boundaries of the Circum-Hellas Volcanic Province, including cratering model formation age estimates of key volcanic features.

Table 1. Thermophysical properties of volcanoes in the Malea Planum portion of the CHVP.

Feature	TES Thermal Inertia $J\ m^{-2}\ K^{-1}\ s^{-1/2}$	TES Albedo	TES Dust Cover Index	Estimated Particle Size (μm)	Wentworth Particle Size
Amphitrites					
Caldera	220-270	0.16-0.18	0.96-0.97	100-725	VF-C Sand
Flank	180-290	0.18-0.19	0.95-0.97	>100	> F Sand
Peneus					
Caldera	210-270	0.17-0.19	0.95-0.97	150-575	F-C Sand
Flank	160-290	0.18-0.22	0.95-0.97	60-970	C Silt-C Sand
Malea					
Caldera	155-270	0.12-0.19	0.95-0.97	40-1,500	C Silt-VC Sand
Flank	100-275	0.18-0.19	0.95-0.97	40-1,500	C Silt-VC Sand
Pityusa North					
Caldera	175-265	0.10-0.12	0.98-0.99	90-530	VF-C Sand
Flank	210-290	0.10-0.12	0.98-0.99	150-725	F-C Sand
Pityusa South					
Caldera	140-250	0.17-0.19	0.93-0.97	40-415	C Silt-M Sand
Flank	80-100	0.17-0.19	0.93-0.97	<40	< C Silt

Note: VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse.