GEOLOGIC MAPPING OF VINOGRADOV CRATER ON MARS: ANCIENT PHYLLOSILICATES TO ALLUVIAL FANS. S. A. Wilson[1], J. A. Grant[1], C. M. Weitz[2] and R. P. Irwin[1] [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, 6th St. at Independence Ave. SW, Washington, DC, 20560 (wilsons@si.edu), [2]Planetary Science Institute, 1700 E Fort Lowell, Suite 106, Tucson, AZ 85719.

Introduction: Southern Margaritifer Terra on Mars preserves a long geologic history of water-related activity (**Fig. 1**). The northward-draining Uzboi–Ladon–Morava (ULM) outflow system dominates drainage in southwest Margaritifer Terra [1-4] and was incised during the Late Noachian to Hesperian [2]. Holden crater formed in the mid to Late Hesperian [5] and blocked the northern end of Uzboi, creating an enclosed basin that filled as a large paleolake [6]. The geology of Vinogradov crater and vicinity, located ~200 km west of Ladon basin and 250 km northwest of Holden crater (**Fig. 1**), is consistent with the long and diverse history of water in the region to the east [5].

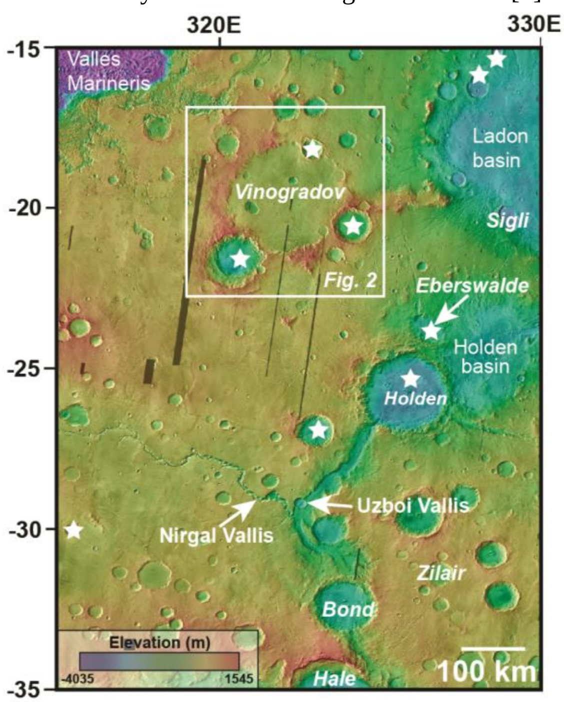

Figure 1. Southern Margaritifer Terra indicating major place names. Stars show craters containing alluvial fans [7-8]. MOLA over THEMIS daytime IR mosaic.

Phyllosilicates in Vinogradov: Vinogradov is a large (224 km-diameter), heavily degraded impact crater centered at 20°S, 322.3ºE (**Fig. 1**). Within the topographic depression between ejecta from craters Roddy and Gringauz (**Fig. 2**), there are exposures of light-toned, rough, scabby and non-layered (at CTX scale) deposits. In some places, an apparently thin, smoother, medium-toned layer is eroding to expose underlying light-toned, rough deposits (**Fig. 3**). Spectral analysis of one light-toned deposit near the

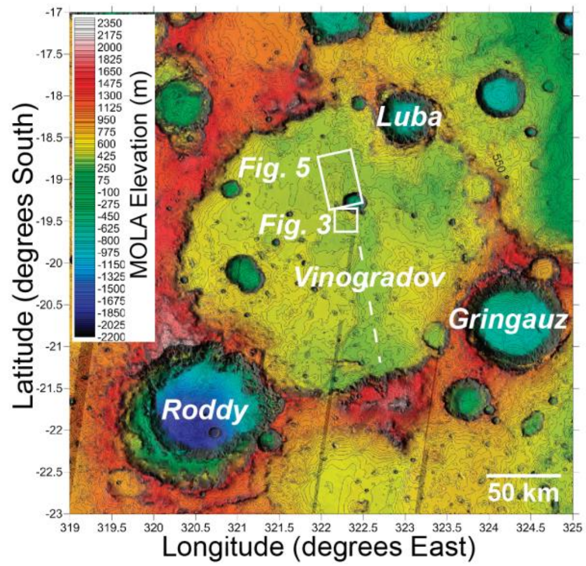

Figure 2. Vinogradov crater is flanked by fan-bearing craters Roddy (D=85.8km; 21.7ºS, 320.6ºE), Gringauz (D=71.0km; 20.7ºS, 324.3ºE) and Luba (D=38.8km, 18.3ºS, 323ºE). Phyllosilicates are found in the depression (dashed line) between ejecta from Roddy and Gringauz (**Fig. 3**). MOLA 128 pixel/degree with 25 m contours over THEMIS daytime IR mosaic.

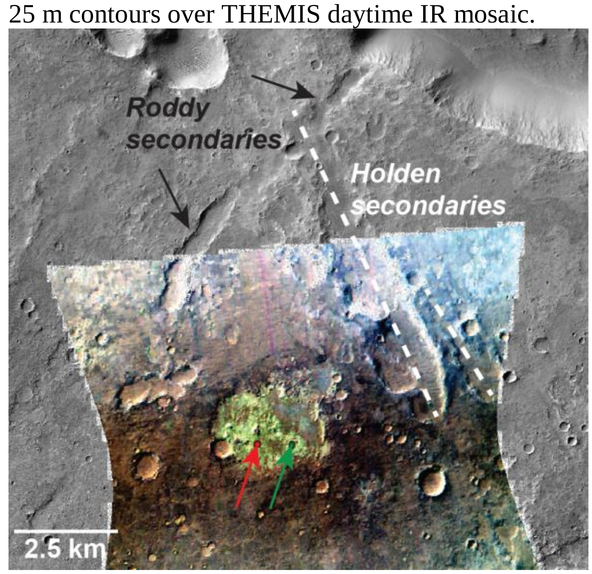

Figure 3. Clays (green) in small depression in center of Vinogradov (~19.5°S, 322.3°E). Red and green arrows indicate locations of extracted spectra in Fig. 4. Holden secondary craters cross-cut secondaries from Roddy. CRISM color (red is 2.5 µm, green is 1.5 µm, blue is 1.08 µm) (FRT 24626) draped on CTX G22_026825_ 1604.

middle of Vinogradov (**Fig. 3**) indicates the material is hydrated, with 1.4, 1.9 and ~2.3 µm absorptions that are consistent with laboratory spectra of Fe/Mg-smectites, such as nontronite and (or) saponite (**Fig. 4**).

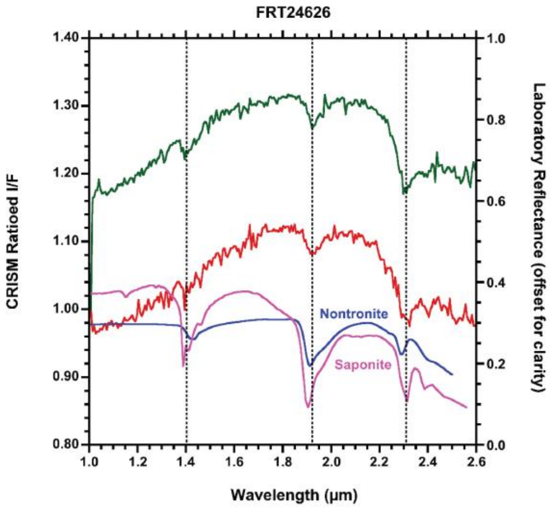

Figure 4. CRISM FRT24626 spectra with 1.4, 1.9 and ~2.3 µm absorptions, consistent with laboratory spectra of Fe/Mg-smectites (e.g., nontronite, saponite).

Discussion: Fe/Mg phyllosilicates have been identified in this region as a continuous, near-surface, extensive layer in NW Noachis Terra [10-12], deposits in Ladon basin [13] and in craters such as Ritchey, Holden and Eberswalde [14], but it is not clear if the clays in Vinogradov are related in time or origin. Vinogradov impacted into a relatively high-standing region and lacks large contributing valleys. The clays in the middle of this large basin could have been deposited in an ancient crater lake, but other origins such as alteration related to impact cannot be ruled out. Although uncertain due to limited CRISM data, deposits with similar morphology exist at comparable elevations along Vinogradov's relatively flat crater floor in the gap between ejecta from craters Roddy and Gringauz, suggesting that the clays could be more widespread and continuous beneath the ejecta.

Local Geologic History: Vinogradov formed in the Noachian [15] and was filled with sediment, some of which likely included phyllosilicates. Roddy and Gringauz formed and their ejecta was deposited on the floor of Vinogradov crater. Holden crater formed ~3.0-3.5Ga [5] and emplaced a large field of secondary craters to the north and west. Secondary craters from Holden are preserved on the floor of Vinogradov, ejecta from Roddy, (**Fig. 3**), and the floor and rim of crater Gringauz. Luba crater formed after Holden, as Luba's ejecta mutes underlying secondaries from Holden. Crater statistics from Luba's continuous ejecta indicate that it is contemporary with Holden, yielding a mid to Late Hesperian age. The fluidized/lobate ejecta from Luba suggests the presence of subsurface liquid water [16] (**Fig. 5**). Ejecta from Luba was deposited in northern Vinogradov, and water draining from the outer margin of Luba's continuous ejecta may have formed the channel and lobe-like deposit in a 14.5 km-diameter crater on Vinogradov's floor (**Fig. 5**). The alluvial fans in craters Roddy, Gringauz and Luba [7] lack Holden secondaries, providing further evidence for a gap in time between the formation of Holden and the development of alluvial fans [9]. Fans in Roddy and Gringauz formed in the Amazonian or near the Amazonian-Hesperian boundary [8], and crater count statistics of fans in Luba yield an equivalent age.

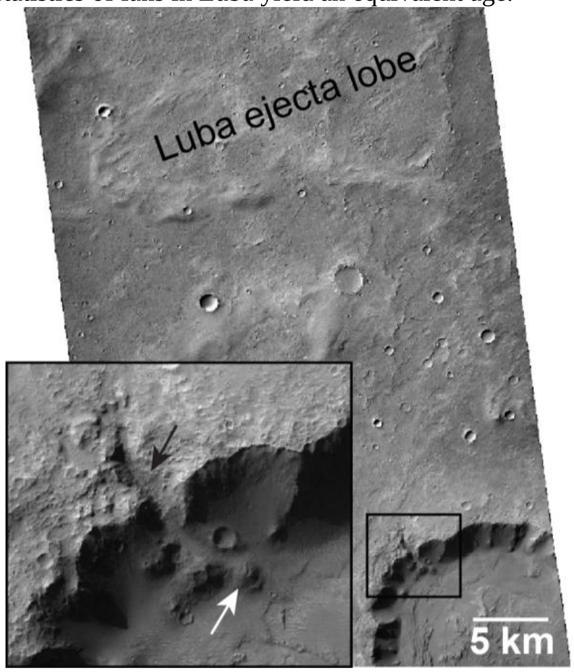

Figure 5. Water from margin of Luba's lobate ejecta may have formed channel (black arrow) and small delta (white arrow). CTX G22_026825_ 1604.

References: [**1**] Grant, J.A., 1987, *NASA Tech. Memo*. *89871*, 1–268 [**2**] Grant, J.A., T.J. Parker, 2002, *JGR*, *107*, doi:10.1029/2001JE001678 [**3**] Parker, T.J., 1985, M.S. Thesis, Cal. State Univ. [**4**] Saunders S.R., 1979, USGS Map I-1144 [**5**] Irwin, R P., J.A. Grant, 2013, USGS Map I-3209 [**6**] Grant, J.A. et al., 2011, *Icarus*, *212*, doi:10.1016/j.icarus.2010.11.024 [**7**] Moore, J.M., A.D. Howard, 2005, J*GR*, *110*, doi:10.1 029/2005JE002352 [**8**] Grant, J.A., S.A. Wilson, 2011, *GRL*, *38*, L08201, doi:10.1029/2011GL046844. [**9**] Grant, J.A., S.A. Wilson, 2012, *PSS*, *72*, 44–52 [**10**] Buczkowski, D.L. et al., 2010, *LPS 41*, Abs. 1458 [**11**] LeDeit, L. et al., 2012, *JGR*, *117*, doi:10.10 29/2011JE 003983 [**12**] Buckowski D.L. et al., 2013, *LPS 43*, Abs. 2331 [**13**] Weitz, C.M. et al., 2013, *LPS 43*, Abs. 2081 [**14**] Milliken, R.E., D.L. Bish, 2010, *Philos. Mag*., 1–16 [**15**] Scott, D.H., M.H. Carr, 1978, USGS Map I-1083 [**16**] Melosh, H.J., 1989, *Impact Cratering*, Oxford Univ. Press.