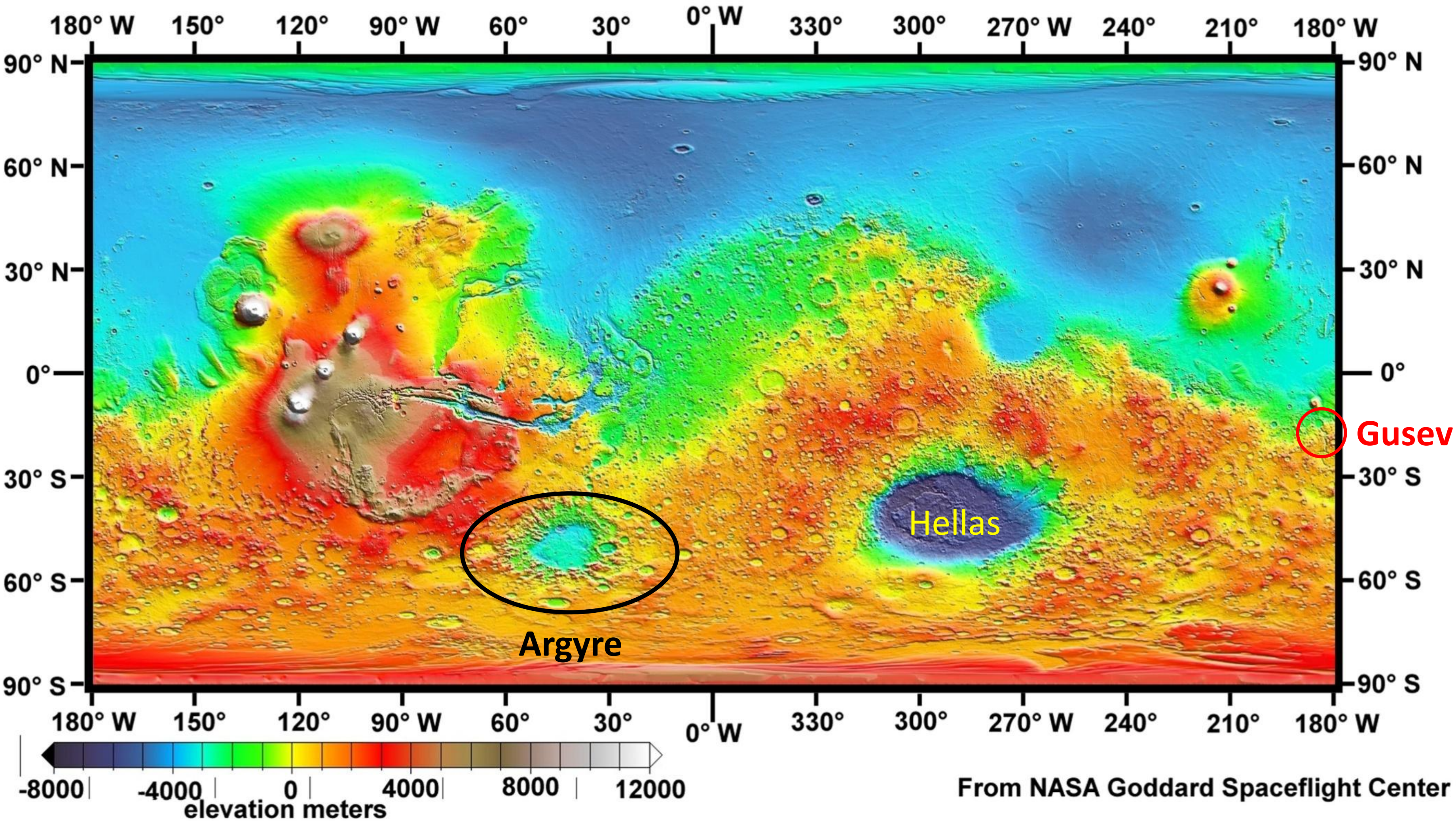
ARGYRE FROM LHB

Natalia Zalewska

Space Research Center PAS

Color-coded Elevations on Mars, MOLA Altimeter, MGS Mission



From NASA Goddard Spaceflight Center

Investigation of an Argyre basin ring structure using Mars Reconnaissance Orbiter/Compact Reconnaissance Imaging Spectrometer for Mars
Debra L. Buczkowski,1 Scott Murchie,1 Roger Clark,2 Kim Seelos,1 Frank Seelos,1
Erick Malaret,3 and Christopher Hash3. JGR (2010)

PHYLLOSILICATES IN THE ARGYRE BASIN, MARS. D. L. Buczkowski1, S. Murchie1, R. Clark2, F. See-los1, E. Malaret3, C. Hash3 and the CRISM Science Team, Martian Phyllosilicates: Recorders of Aqueous Processes (2008)

Topography and morphology of the Argyre Basin, Mars: implications for its geologic and hydrologic history
H. Hiesinger, J.W. Head III / Planetary and Space Science 50 (2002) 939 – 981

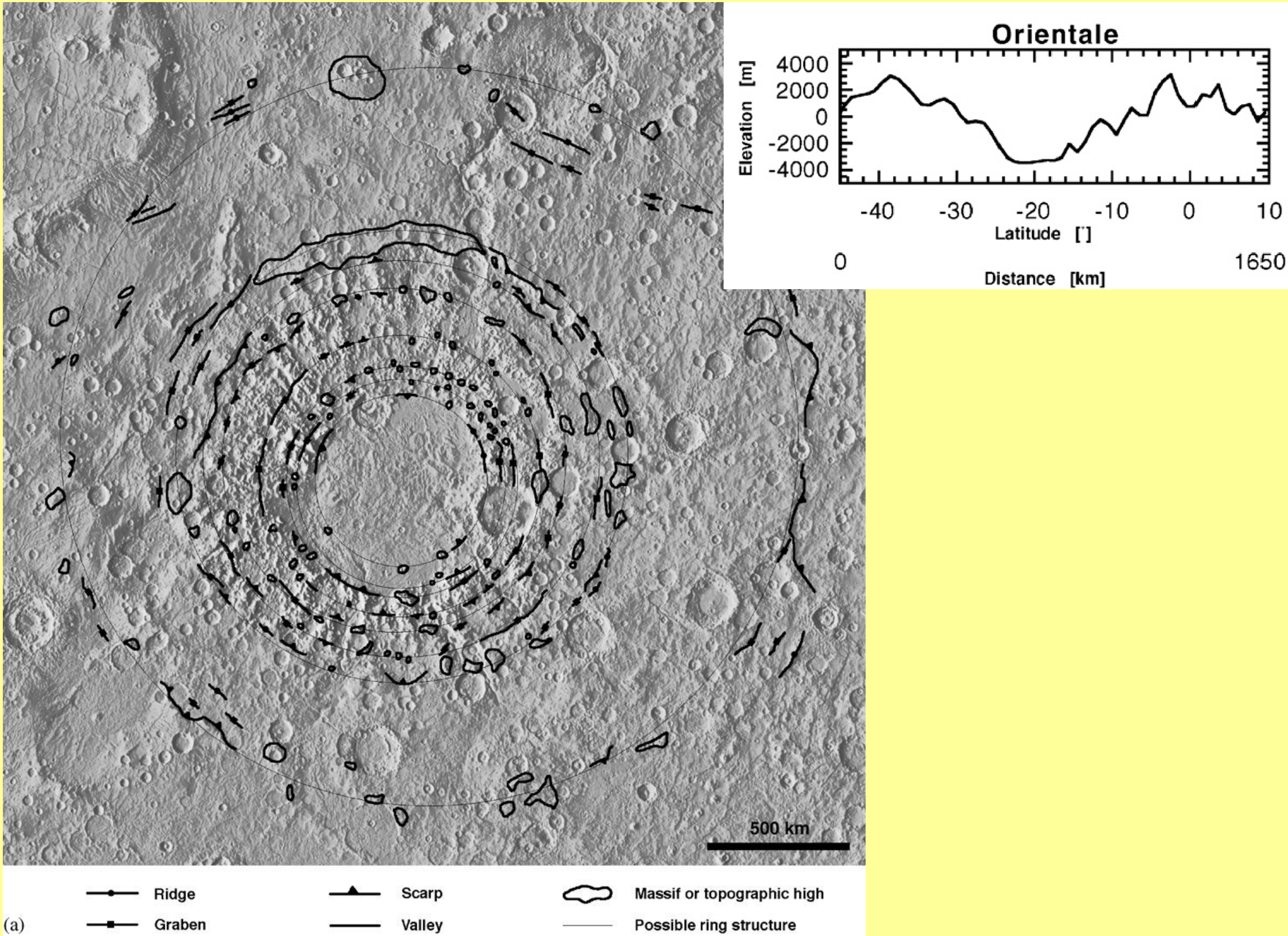
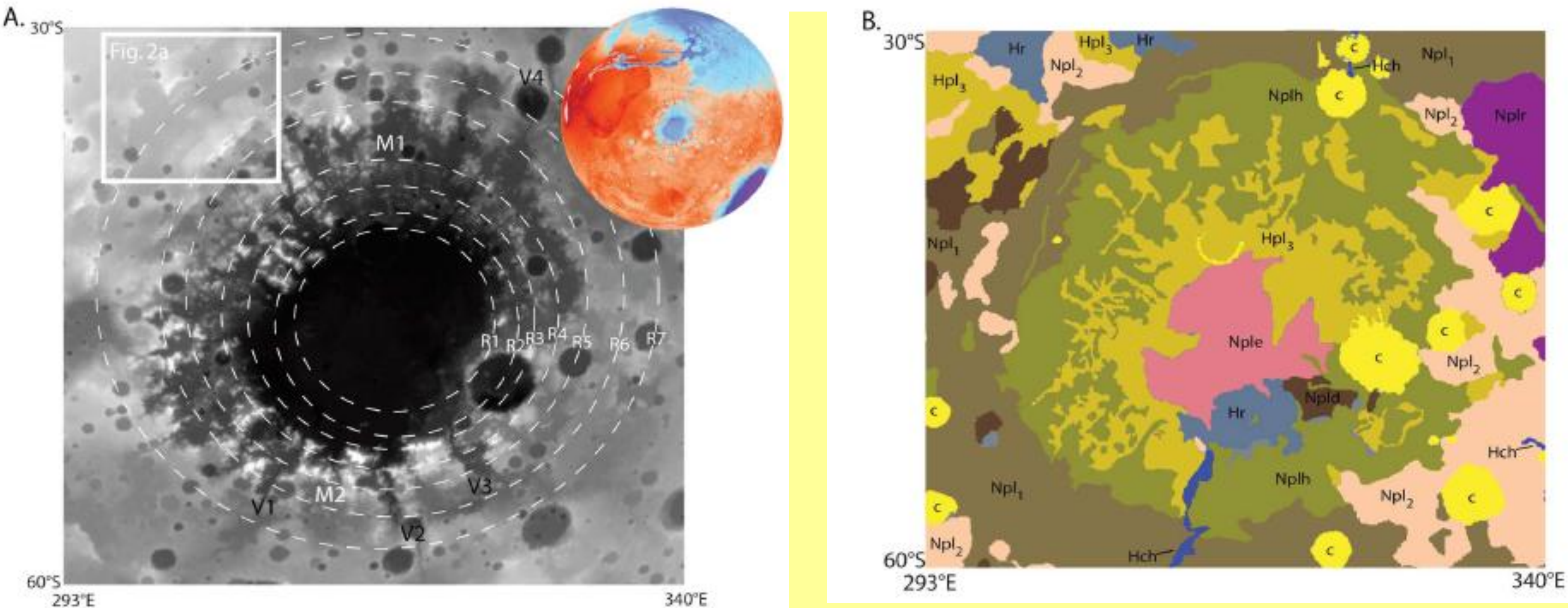
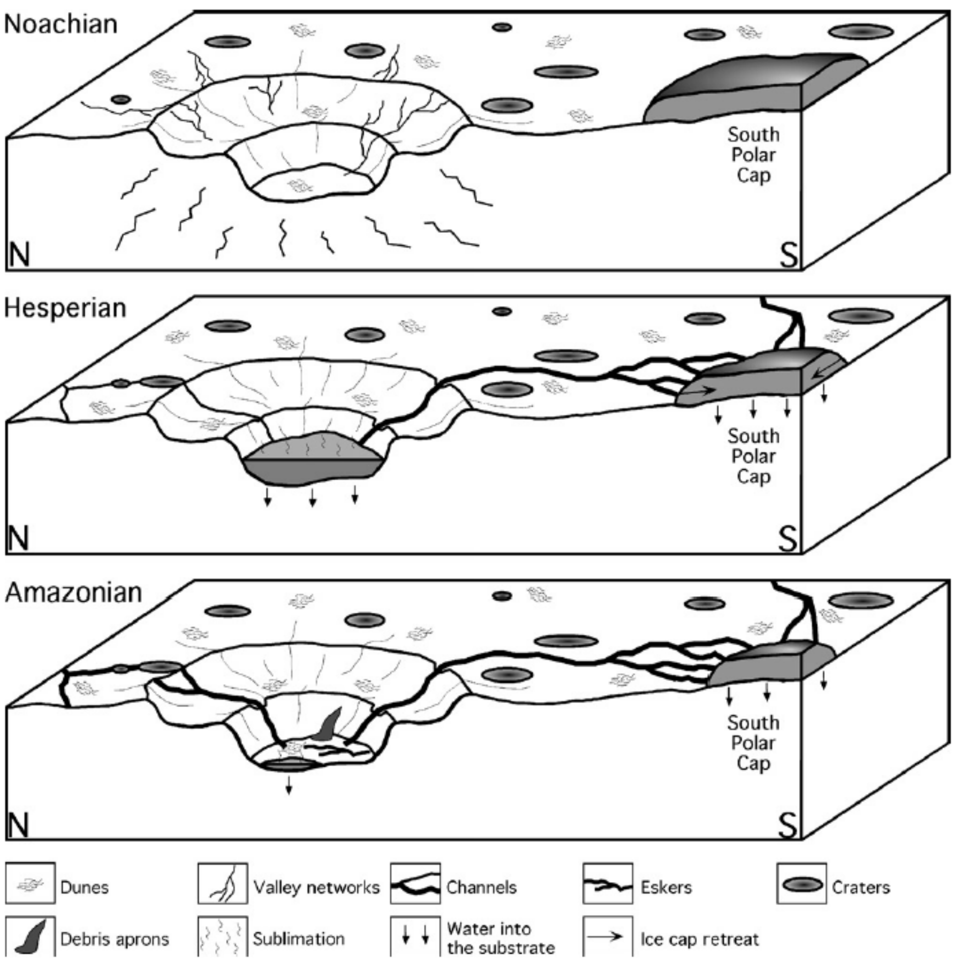

Orientale
Elevation [m]
4000
2000
0
-2000
-4000
-40
-30
-20
-10
0
10
Latitude [˚]
0
1650
Distance [km]
500 km
Ridge
Graben
Scarp
Valley
Massif or topographic high
Possible ring structure
(a)

Table 1. Name, Symbol Abbreviation, and Description of Geologic Units From the Surrounding Argyre Basin, From the Geological Map of the Western Equatorial Region of Mars[a]

Unit Symbol	Unit Name	Description
c	Craters	Floors and rims of both younger superposed and older partially buried craters
Hch	Older channel materials	Channel deposits that are longitudinally striated and include large, well-developed, teardrop-shaped channel bars
Hpl_3	Smooth unit	Lava flows and eolian deposits that bury most of the underlying rocks, forming large, flat, relatively featureless plains
Hr	Ridged plains material	Low-viscosity lava with small ridges (volcanic constructs or compressional features) spaced 30–70 km apart
Npl_2	Subdued cratered unit	Thin interbedded lava flows and eolian deposits that partly bury underlying rocks
Nplr	Ridged unit	Low-viscosity lava with large ridges formed mainly by normal faulting spaced >70 km apart
Npl_1	Cratered unit	A mixture of lava flows, pyroclastic material, and impact breccia formed during a period of high-impact flux
Npld	Dissected unit	Npl_1 cratered material eroded by fluvial processes
Nple	Etched unit	Npl_1 cratered material degraded by wind erosion, the decay and collapse of ground ice, and minor fluvial processes
Nplh	Hilly unit	Ancient volcanic rocks and impact breccia uplifted by tectonism and impact basin formation

[a]Data are from *Scott and Tanaka* [1986].





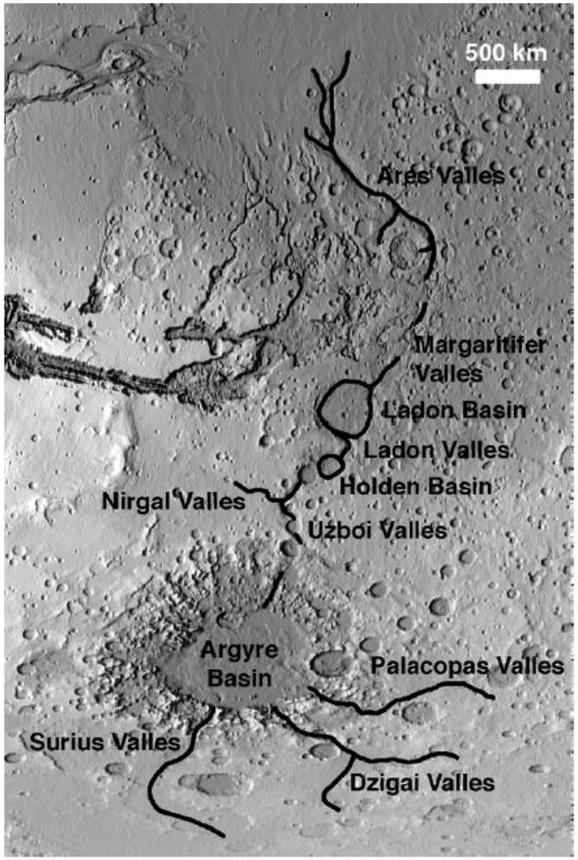


Fig. 19. Shaded relief map of the Argyre region and the Chryse trough. Alignment of several valleys and basins along the Chryse trough system were cited as evidence for water flow from the south polar regions, through the Argyre basin to the northern lowlands (e.g., Parker et al., 000). Simple cylindrical map projection.

The great river flowed through Argyre

Fig. 24. Sketch diagram of the geologic history of the Argyre basin. During the Early Noachian, the Argyre basin was formed by a meteor impact, which fractured the crust and excavated the basin. During the later Noachian the basin was modified by tectonic and erosional processes. If the climate was warmer and wetter, than it is likely that valley networks were associated with the Argyre basin, as elsewhere on Mars. We assume that the south polar ice cap was in place and that eolian processes redistributed material across the surface. During the Hesperian the south polar ice cap retreated (Head and Pratt, 2001), releasing large amounts of water. Portions of this water went into the substrate, other portions ran across the surface towards the north and into the Argyre basin, carving prominent channels. Within the Argyre basin the incoming water formed a lake, which froze over. Some water of this lake sublimated, some water percolated into the substrate. The channel in the north appears to have entered from that direction, in contrast to the hypothesis of Clifford and Parker (2001) that the basin was filled from the south and overflowed to the north. By the Amazonian, the ice in the Argyre basin had been removed, eskers became visible, and debris aprons formed at the base of steep mountain slopes. Eolian processes continued to be active as indicated by numerous dune fields visible in MOC images.

Hale crater

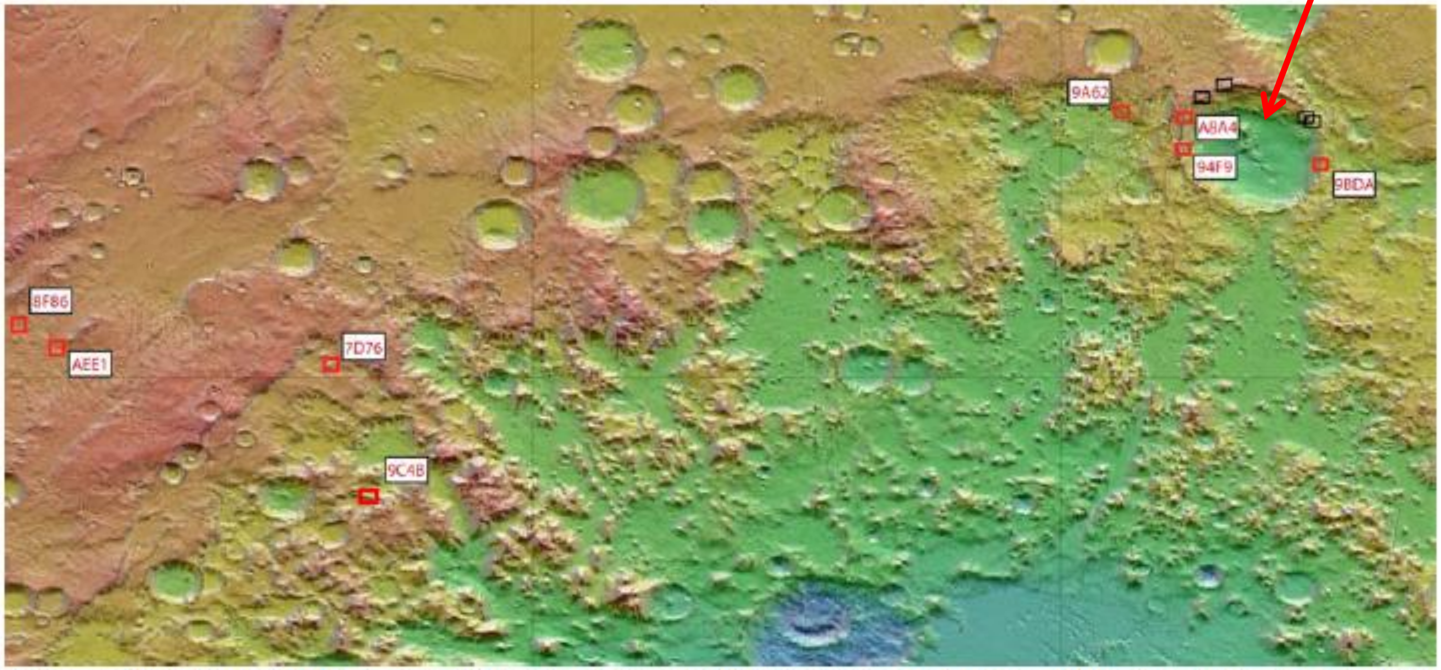
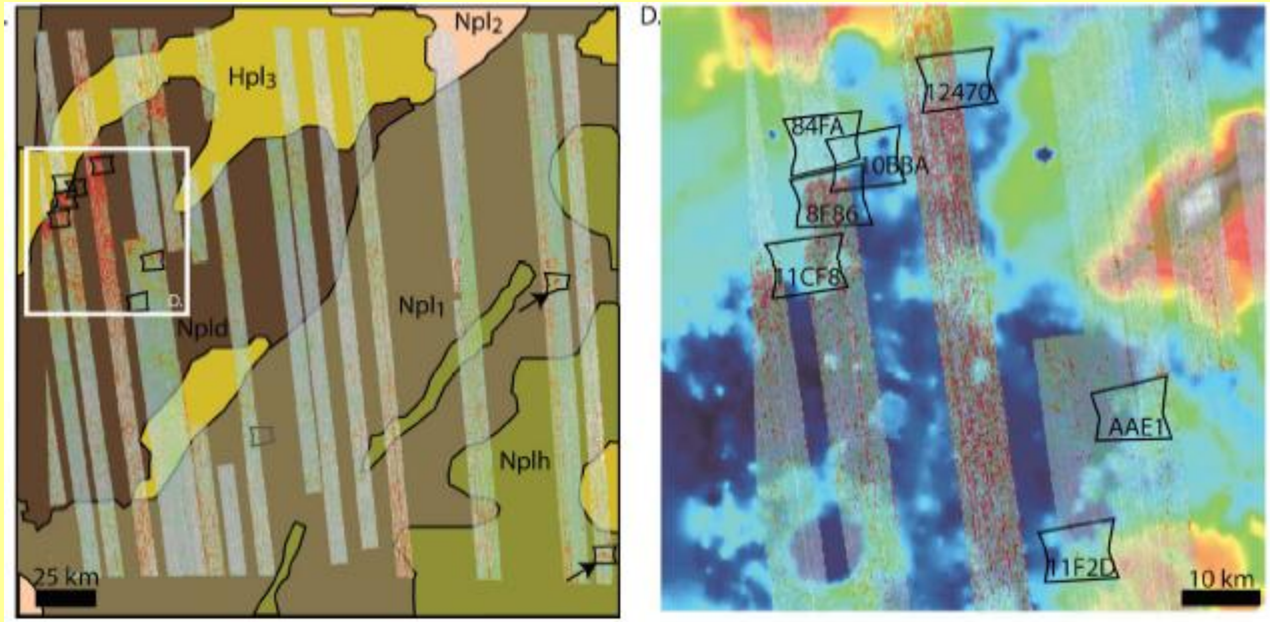
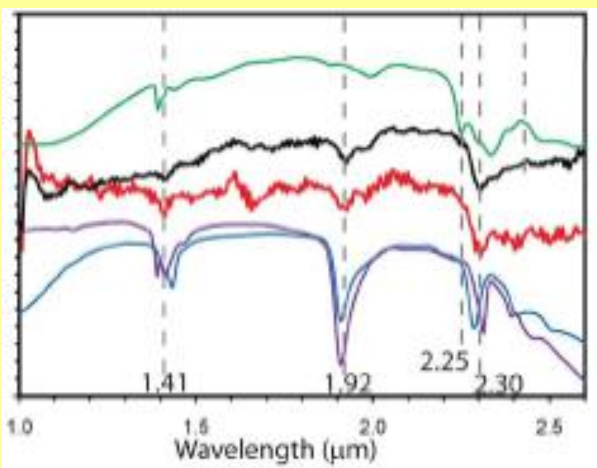
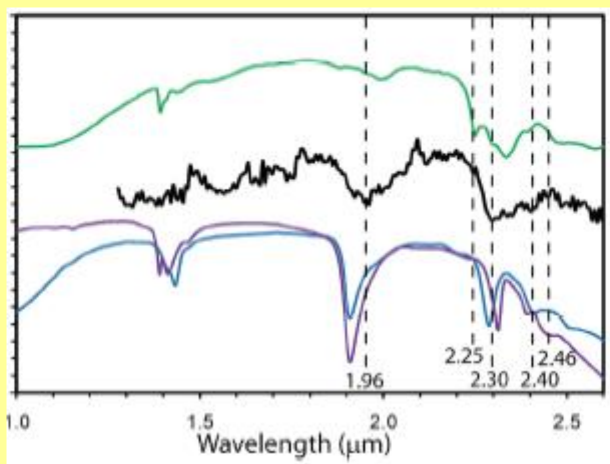


Figure 2. Colorized MOLA topography draped over THEMIS daytime infrared mosaic of north-western Argyre. Red boxes show the location of CRISM targeted observations that show phyllosilicates. Black boxes indicate CRISM targeted observations of the Hale crater rim that do not show phyllosilicates.





The 8F86 spectra compared to library spectra of Fe-Mg smectitesand chlorite. Red, possible 8F86 Fe-Mg smectite; black, possible 8F86 chlorite/smectite mixture; blue,nontronite(BKR1JB175); purple, hectorite (BKR1JB172); green, Mg-rich chlorite (BKR1JB738 clinochlore21C). Dashed lines show how 8F86 absorptions correspond to library spectra.



The 12470 spectrum (3 3 pixel average, three-point boxcar median smoothed) compared to library spectra of Fe/Mg smectites and chlorite. The y axis is the ratio of corrected I/F for CRISM spectrum and scaled reflectance for library spectra. Black, possible 12470 chlorite/ smectite mixture; blue, nontronite (BKR1JB175); purple, hectorite (BKR1JB172); green, Mg-rich chlorite (BKR1JB738 clinochlore 21C). Dashed lines show how 12470 absorptions correspond to library spectra.

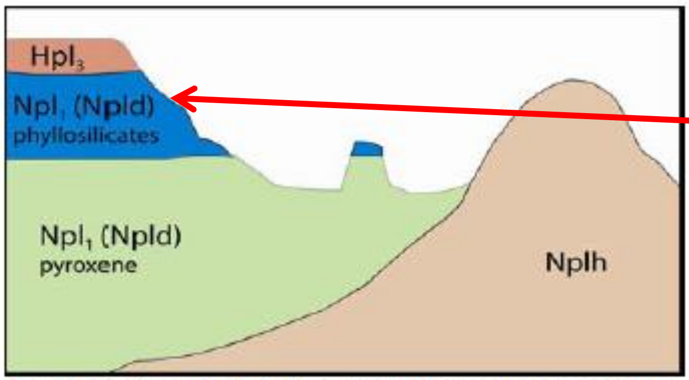
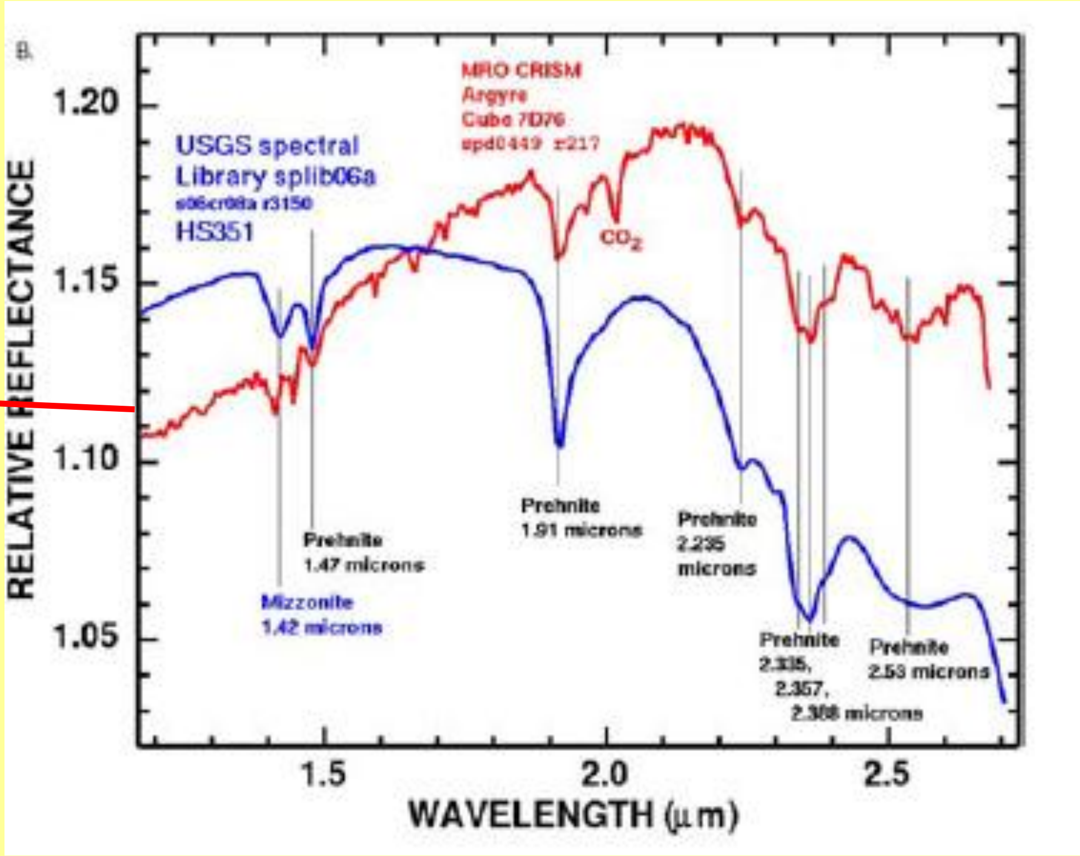


Figure 4. Proposed Argyre stratigraphic cross-section.



- Prehnite is a phyllosilicate of calcium and aluminium with the formula: $Ca_2Al(AlSi_3O_{10})(OH)_2$. Limited Fe^{3+} substitutes for aluminium in the structure. it is found associated with minerals such as datolite, calcite, apophyllite, stilbite, laumontite, heulandite etc. in veins and cavities of basaltic rocks, sometimes in granites, syenites, or gneisses

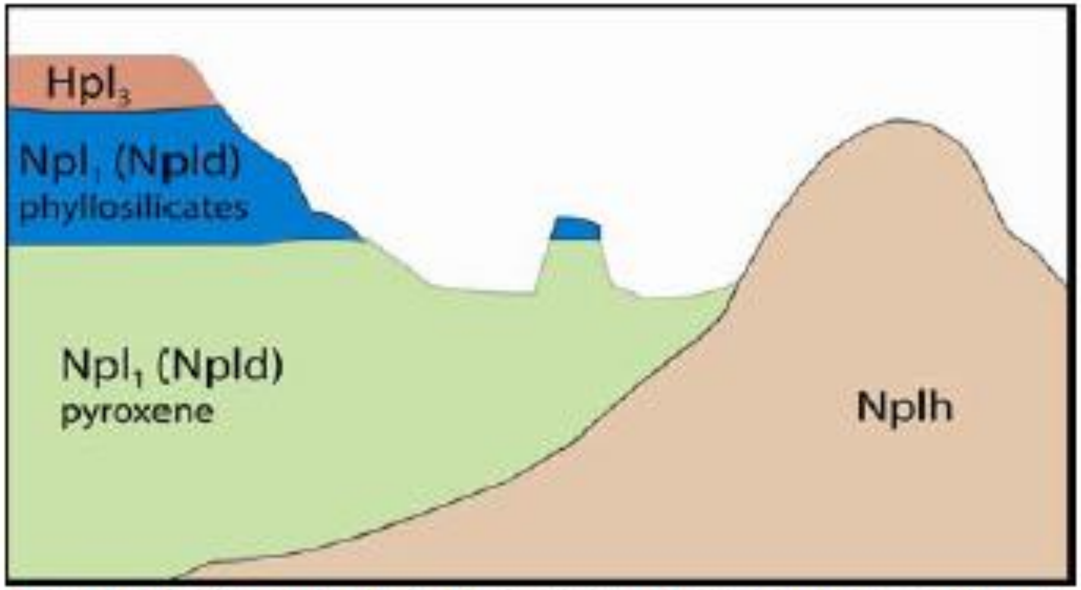
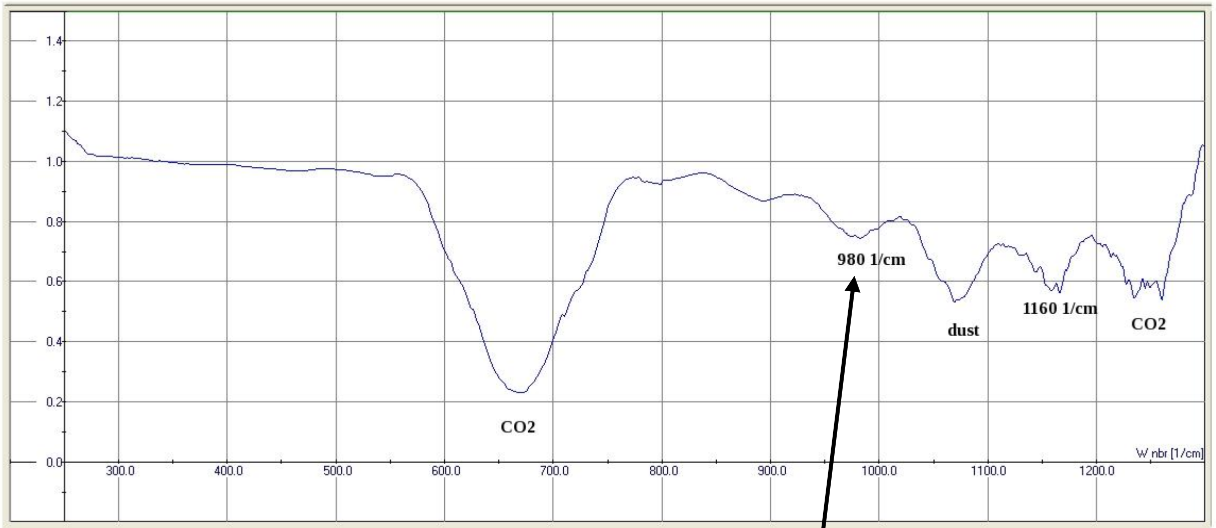


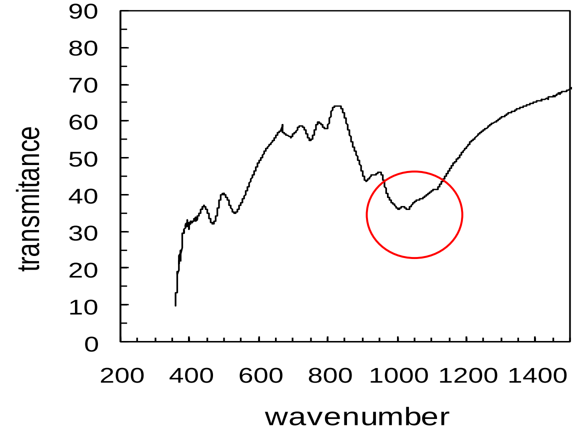
Figure 4. Proposed Argyre stratigraphic cross-section.

At the bottom of the stratigraphic column are olivine and **low-Ca pyroxene** associated with uplifted ancient volcanic rocks (unit Nplh). Above these deposits are high-Ca pyroxenes associated with lavas and impact-formed materials (unit Npl$_1$ and Npld). The **phyllosilicates** we've observed appear within the same units as the high-Ca pyroxene, but stratigraphically above it, preserved both in freestand-ing knobs and along scarp walls. At the top of the stratigraphic column in northwest Argyre is **olivine** associated with the early Hesperian Hpl$_3$ unit.

PFS averaged spectra from Hellas, orbit nr 284 (emissivity)



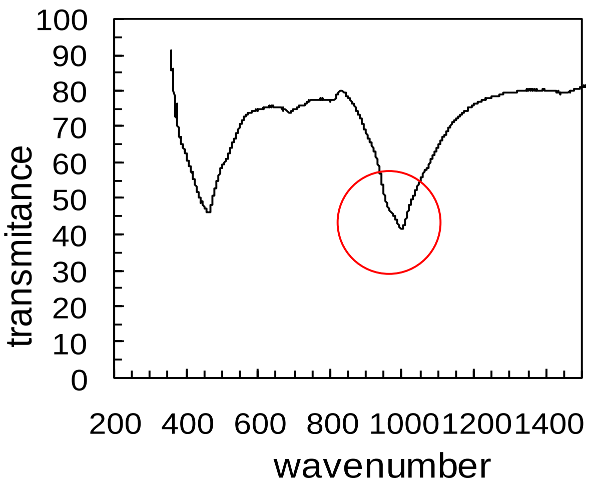
Polish muscovite <30 microm Katowice



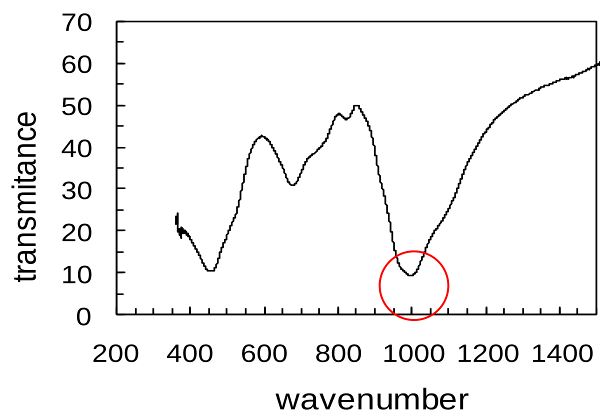
Phyllosilicates ???

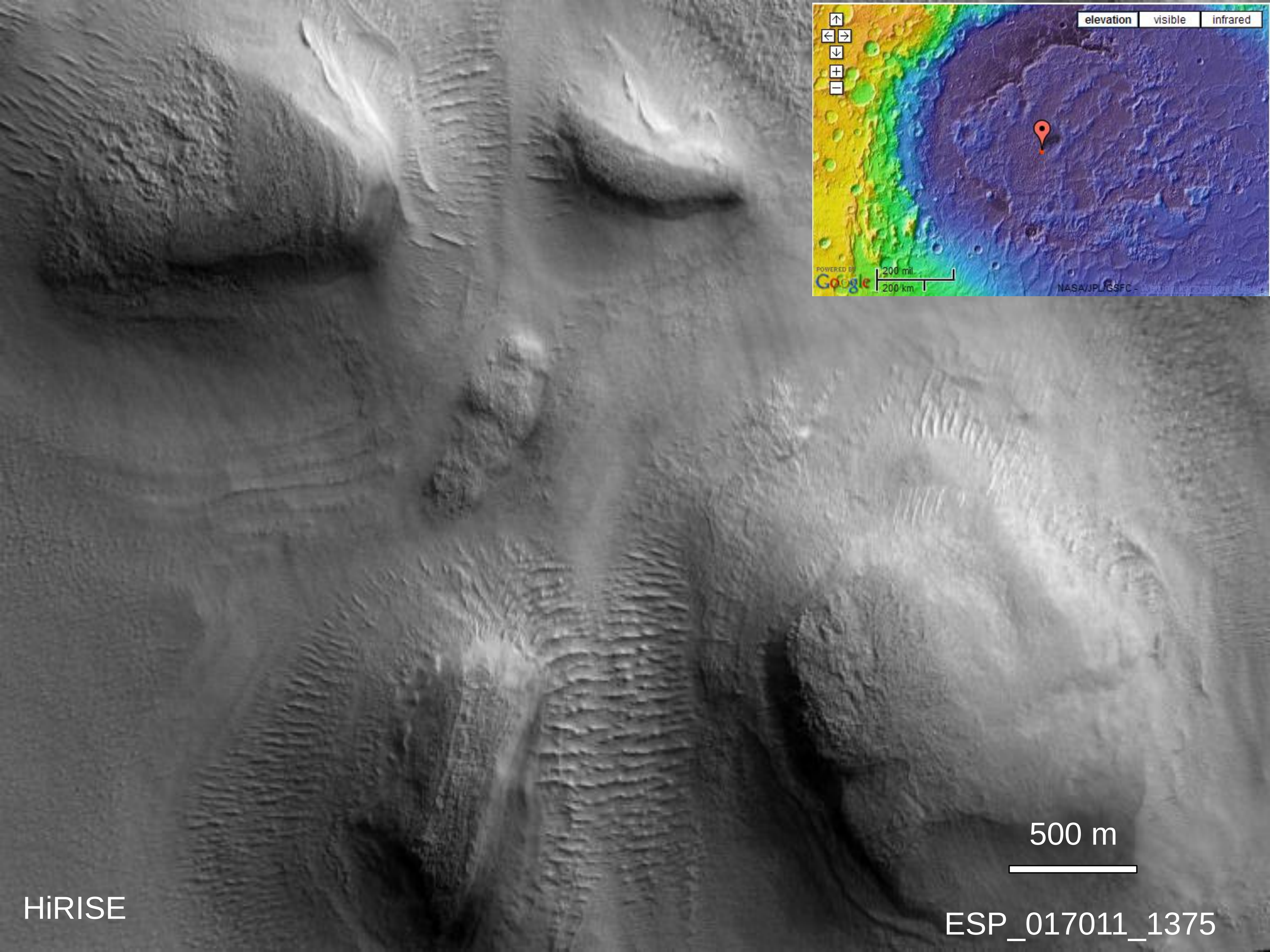
980 cm^{-1}

Polish flogopite <30 microm Katowice



Polish vermiculite <30 microm. Katowice



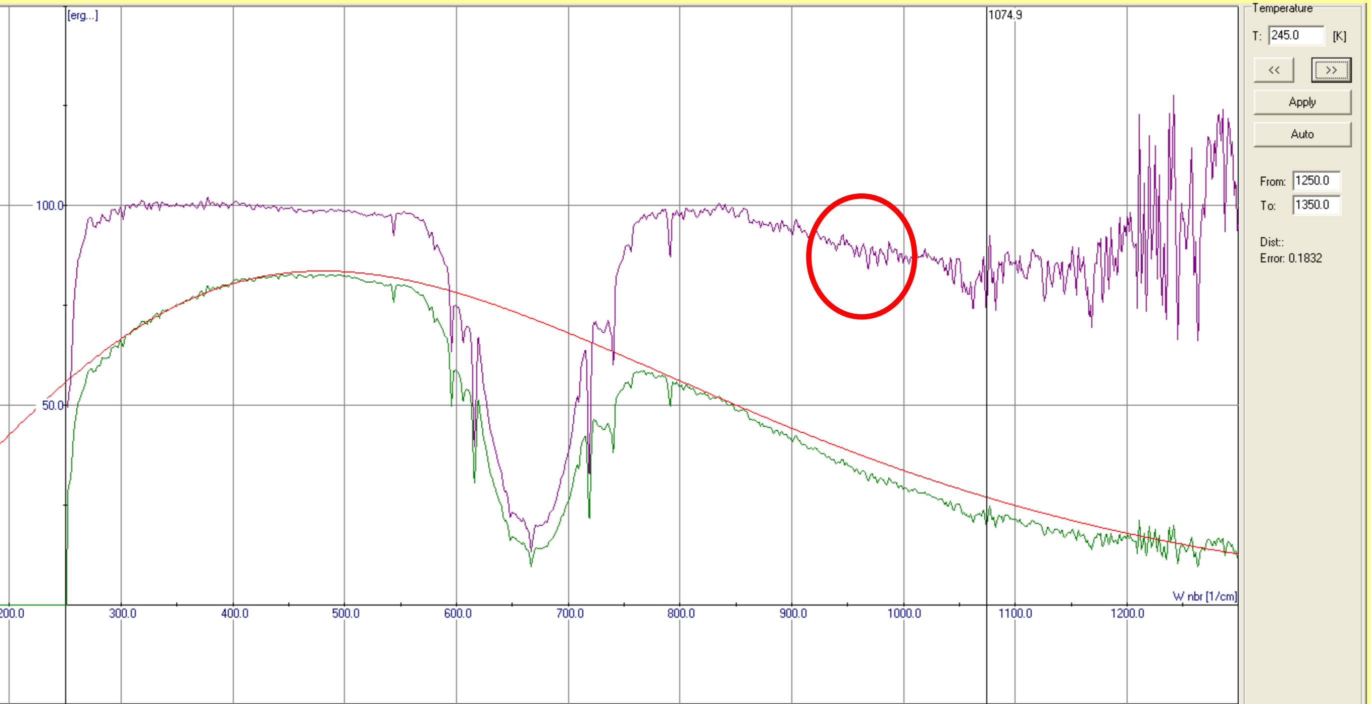


elevation
visible
infrared
POWERED BY Google
200 mi
200 km
NASA/JPL/GSFC
500 m
HiRISE
ESP_017011_1375


Utah- mesy - pobyt na MDRS 2005
Fot. Natalia Zalewska

North slope of Argyre

PFS orbit nr 61

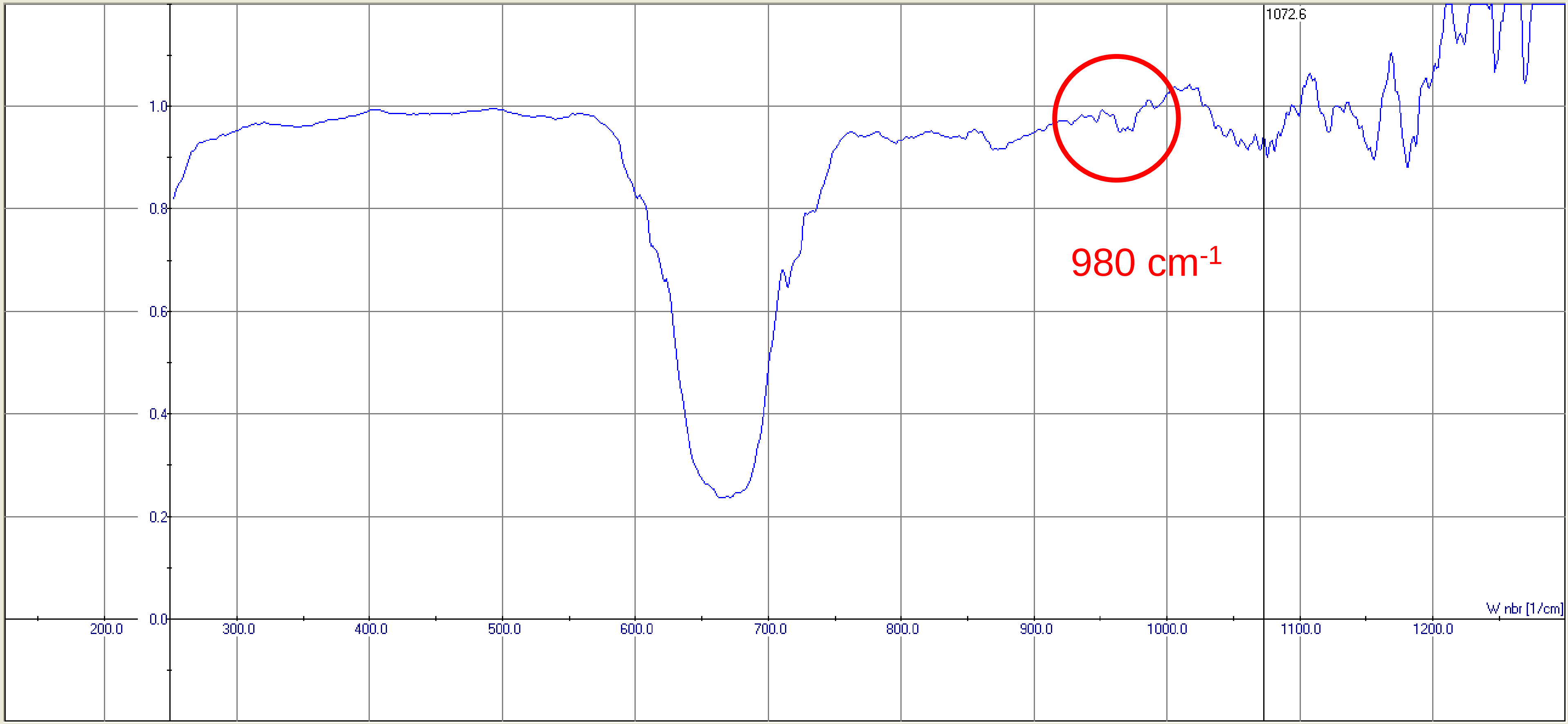


The center of Argyre

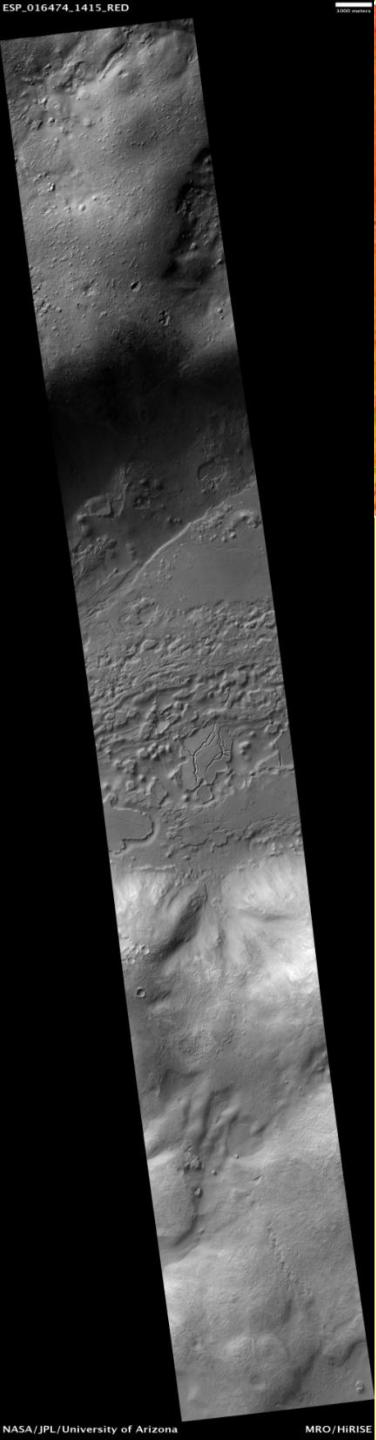
PFS orbit nr 61

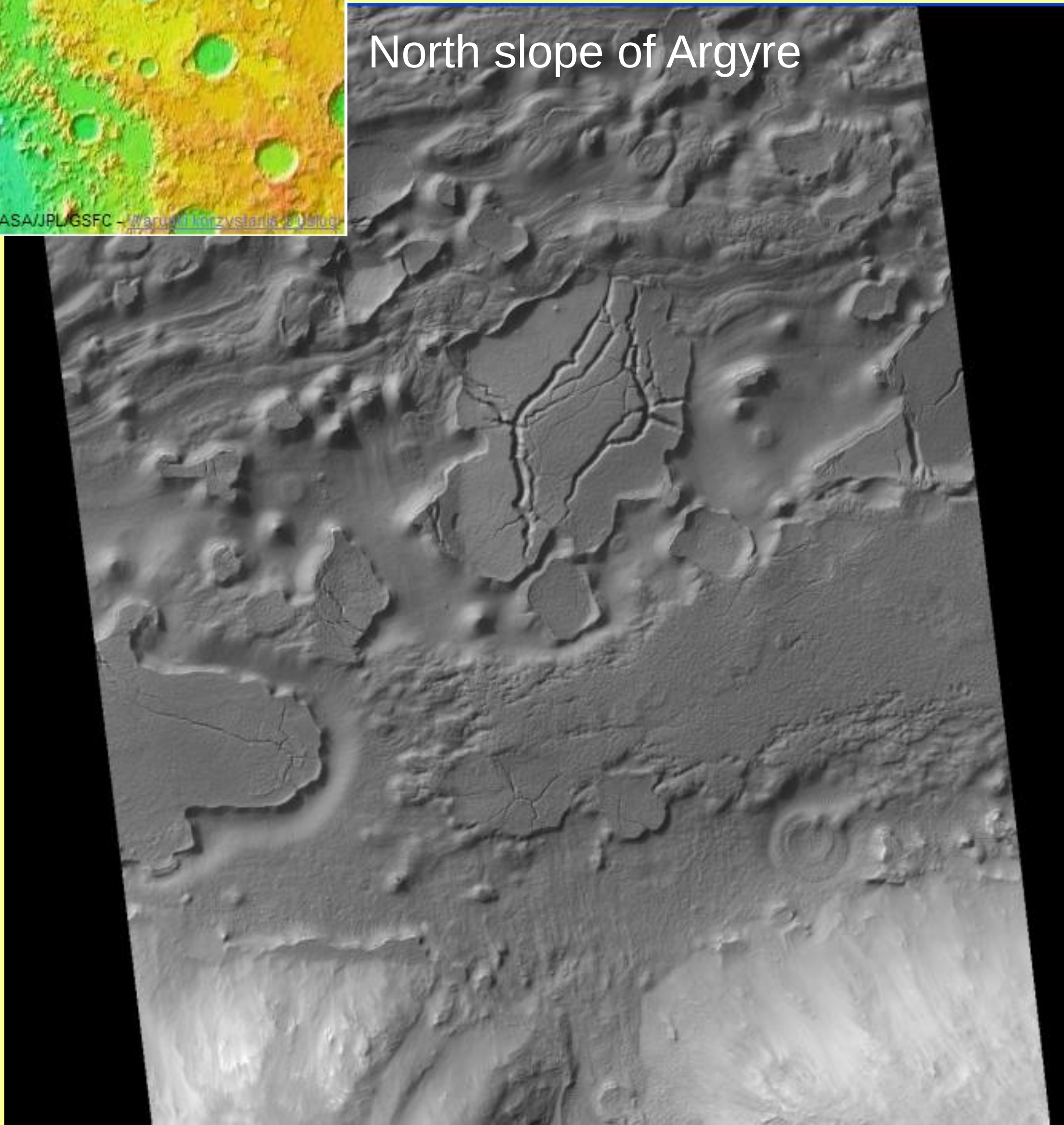
North slope of Argyre

PFS orbit nr 311

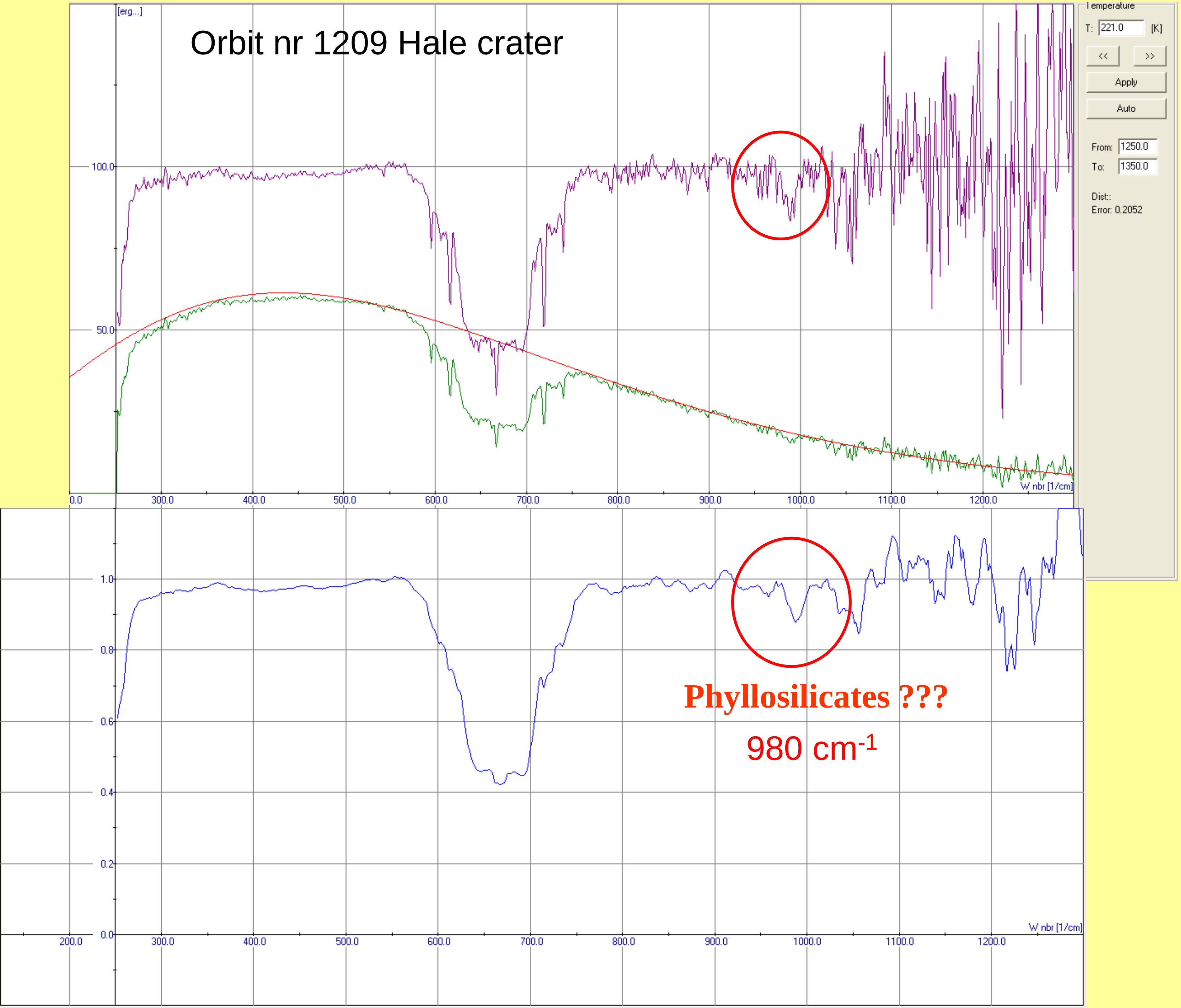


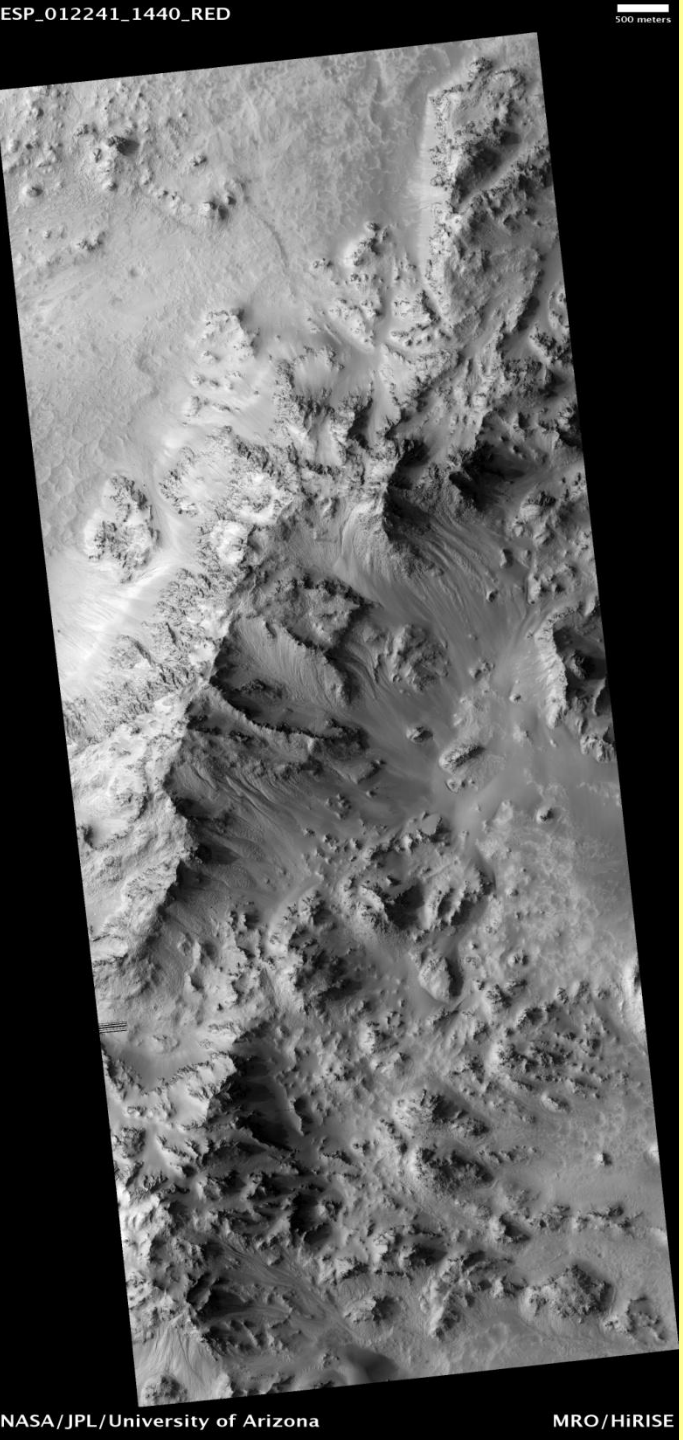
North slope of Argyre

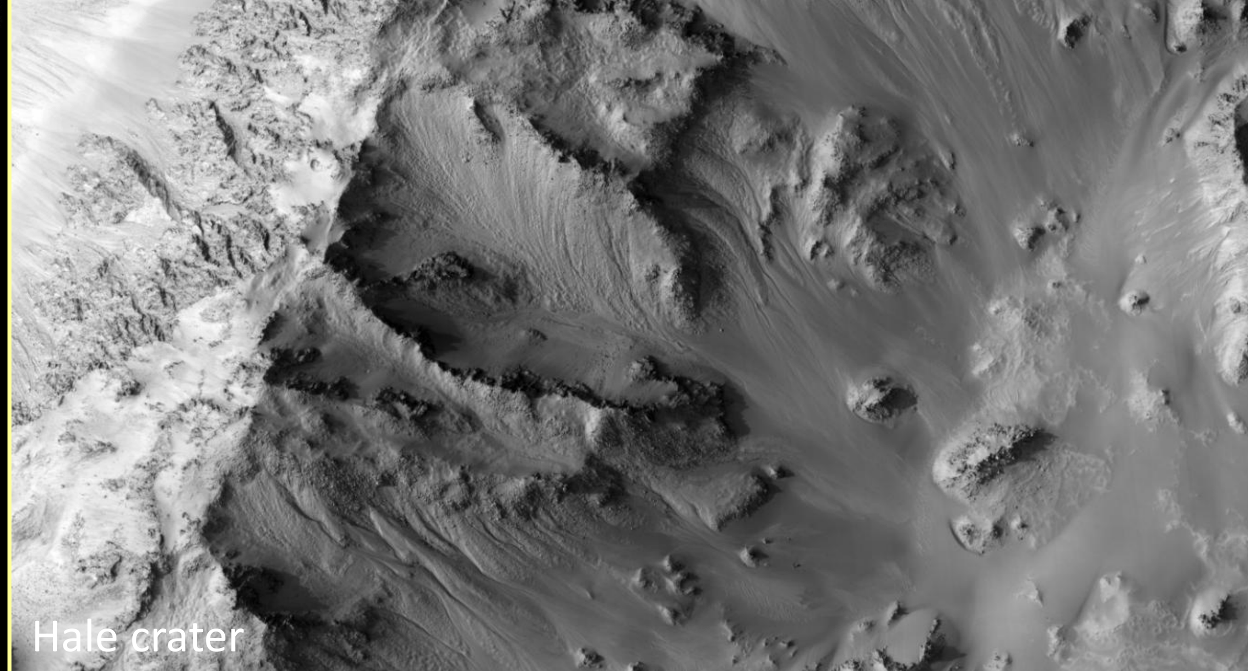




Orbit nr 1209 Hale crater




ESP_012241_1440_RED
500 meters
NASA/JPL/University of Arizona
MRO/HiRISE


Hale crater


elevation
visible
infrared
POWERED BY
Google
20 mil
50 km
NASA/JPL/GSFC -

Summary ⬄ questions

-If Argyre originates from LHB how clay minerals appear as a layer before the impact ?

-Argyre may not be from the period of LHB ?

-Clay minerals can occur only on the surface of the slope and not as a layer ?

-Is the clay minerals were formed during the Noachian era only?

-Hellas is older than Argyre due to stronger erosion?

(Hellas –at the beginning of LHB but Argyre at the end of LHB ?)

Responses from the article

Despite the apparently excellent preservation state of the basin, there is no evidence that Argyre is significantly younger than any large basin on Mars [Parker, 1996a, 1996b].

From these observations, we suggest that an extensive layer of phyllosilicates underlying a layer of high-Ca pyroxene-bearing rock existed in the region prior to the Argyre impact. These materials were thrown up by the impact event and deposited as an inverted flap. This inverted flap of ejecta was then cut by the circumferential graben that formed as the transient Argyre crater collapsed, exposing the materials.

Outcrops of phyllosilicates high on this ridge would support the **inverted-flap hypothesis**

Stratigraphy in this region displays an inverted flap of pre-Argyre materials and thus that the phyllosilicates observed in the northwest ring graben were not formed as a result of the impact, but rather represent a **preexisting material.**

Thank you for your attention