EVIDENCE OF VERY YOUNG GLACIAL PROCESSES IN CENTRAL CANDOR CHASMA, MARS. M. G. Chapman[1], L. A. Soderblom[1], and G. Cushing[1], [1] U.S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ 86001; mchapman@usgs.gov.

Introduction: A newly released Mars Express Mission anaglyph (36 m/pixel) from Orbit 334 of central Ophir and Candor Chasmata [1] shows convincing evidence of youthful glacial erosion in central Candor Chasma [2]. These features are also observable in MOLA, THEMIS, and Viking datasets, but were not interpreted as glacially related until viewed in the high resolution topographic and group image context of the HRSC anaglyph. Correlative high-resolution MOC and THEMIS images have been used to examine the features in greater detail.

Discussion: The anaglyph (courtesy of MEX HRSC team, FU Berlin, and DLR [1]) shows 2 levels of dark floor material that form cirques ('a' & 'b' on Fig. 1) at the head of a valley ('1' on Fig. 1) leading into the central floor of Candor Chasma; dark floor material is very young and basaltic in composition [2,3]. The MOLA dataset shows the topographically higher cirque (marked 'a' on Fig. 1) located about 2 km above the floor of central Candor Chasma. On THEMIS image IO5757016, another adjacent canyon to the south ('2' on Fig. 1) has a low cirque headwall ('c' on Fig. 1) about the height of the lower scarp ('b' on Fig. 1). Where canyons #1 and #2 abut along a dividing wallrock spur, the dark material has accumulated in 2 lateral ridges that drape the spur ('d' on Fig. 1). On the south side of the canyon #2 is another lateral ridge of dark material (marked 'e') that is plastered along another longer wallrock spur. The anaglyph, THEMIS, and MOC images show 2 interior layered deposit (ILD) mounds (downslope from the cirques) that have been sheared off ('f' on Fig. 1) at elevations close to those of the lower cirques ('b' & 'c'). This shearing is depicted nicely in THEMIS image V10551002 and MOC images: E1700142 and E1900200 (Fig. 2). Between the sheared mounds, both the ILD and dark materials on the floor of canyon #1 are cut by grooves that are parallel to the canyon trend. An area of pits, possible kettles formed in dark material, is marked by 'g' (Fig. 1) and shown best on THEMIS image V11175002. Taken together cirques, level shearing of ILD rock materials, lateral ridges, parallel grooves, and pits suggest ice erosion and therefore are very convincing evidence of glacial processes.

Another ILD mound, bordering the north canyon farther downslope (east of canyon marked '1'), shows an abrupt flank termination and damming of material, rather than flank scour (marked 'h'). The HRSC anaglyph shows the dammed material to be brighter layers piled up in a ridge at the ILD base. This relation can also be observed on MOC images E0101343 and E201146. A possible terrestrial volcanic analog is the Hegafell hyaloclasitic ridge (tindar) in Iceland, whose eastern flank has a linear termination interpreted as largely unmodified and caused by hyalotuff material banked against a former ice wall that has since melted away. Glacial shearing of some ILDs and confined banking of another ILD may indicate that these mounds formed at different times and that the confined ILD may be very young. Alternatively, the banking may have been due to lack of shear forces and confined post-depositional avalanche deposits. However, exposed in the banked cliff faces are near horizontal bedding planes that can be traced upslope into angled flank layers—a relation that may suggest ice concurrent with volcanic ILD formation.

Other deep canyons, floored by dark material, that fed into central Candor Chasma, may have held ice. These canyons are marked '3-5' on figure 1. Canyon #3 east of Baetis Mensa shows numerous grooves cut into its floor and what appear to be wind-eroded and desiccated, stair-stepped terminal ridges of dark material marked 'i' on figure 1. These types of terminal ridges form as terrestrial glaciers shrink and recess back from a point of maximum extent, each ridge is a deposit that marks a hiatus in the recession. These putative terminal ridges are shown on the HRSC image and 3-dimensional Viking mosaics (available on the PDS Planetary Photojournal website). Canyon #4 between Baetis and Candor Mensae shows possible lateral moraines marked 'j' on figure 1. THEMIS image V08030001 shows the lateral moraines and also possible medial moraines at the head of this canyon. Canyon #5 shows a possible lateral moraine on the west side of the southern horn of Candor Mensa.

Conclusion: Apparently, ice-formed features occur on the floor of Valles Marineris. The observation that they are associated with dark floor material indicates that the glacier(s?) was relatively young--suggesting late-stage surface ice in equatorial Mars. We are currently exploring deconvolution of THEMIS images into topographic components to attempt to more accurately measure the heights of cirques, shear levels, and medial ridges.

References: [1] http://berlinadmin.dlr.de/Missions/express/first/27.09.2004_eng.shtml. [2] Chapman et al, 2004. *GSA abs. with prog.*

36, no. 5, p. 139, #52-5. [3] Geissler et al., 1990. *JGR* 95, 14,399–14,413. [4] Lucchitta, 1990. *Icarus* 86, 476–509.

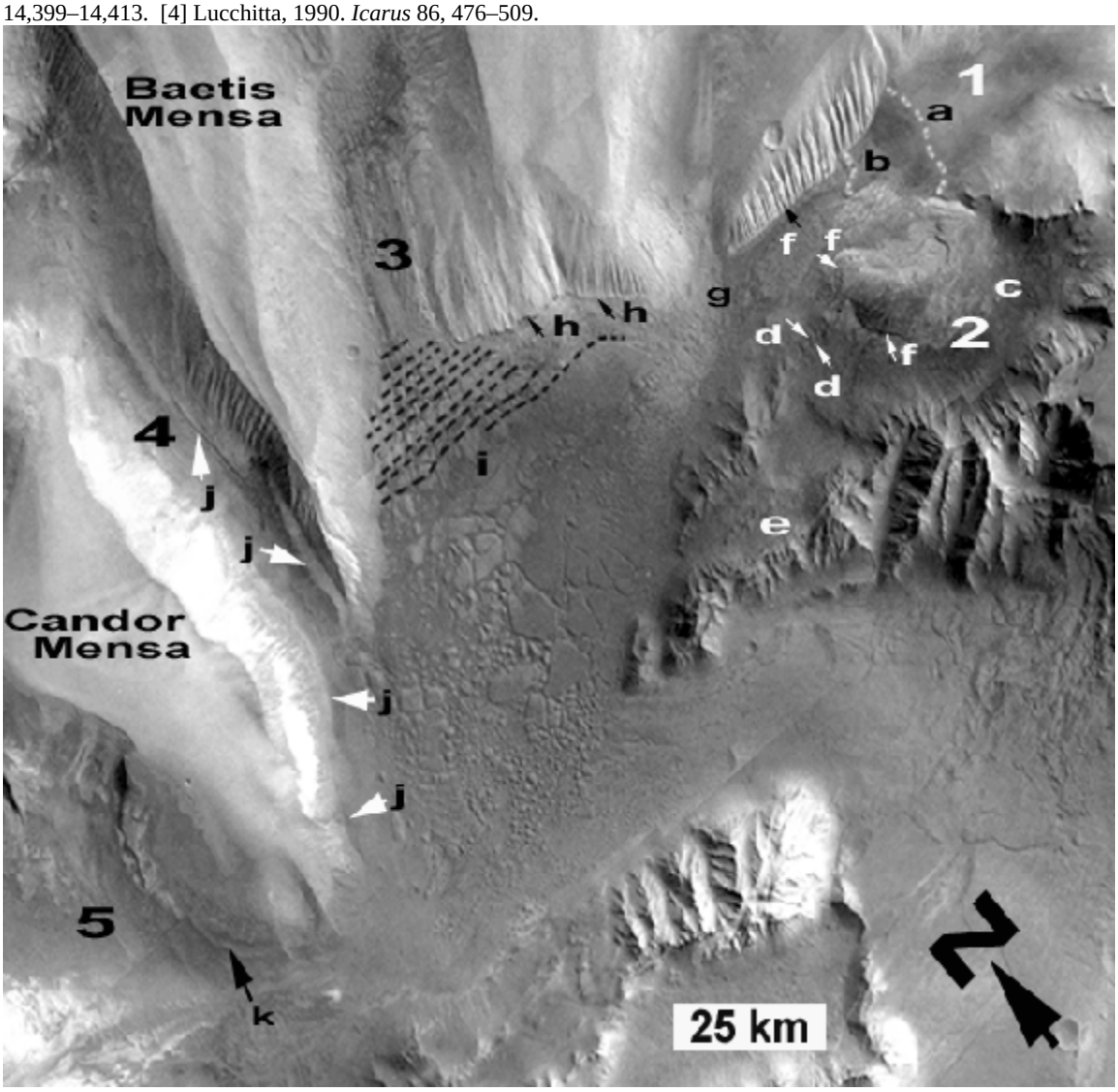

Figure 1: Central Candor Chasma.

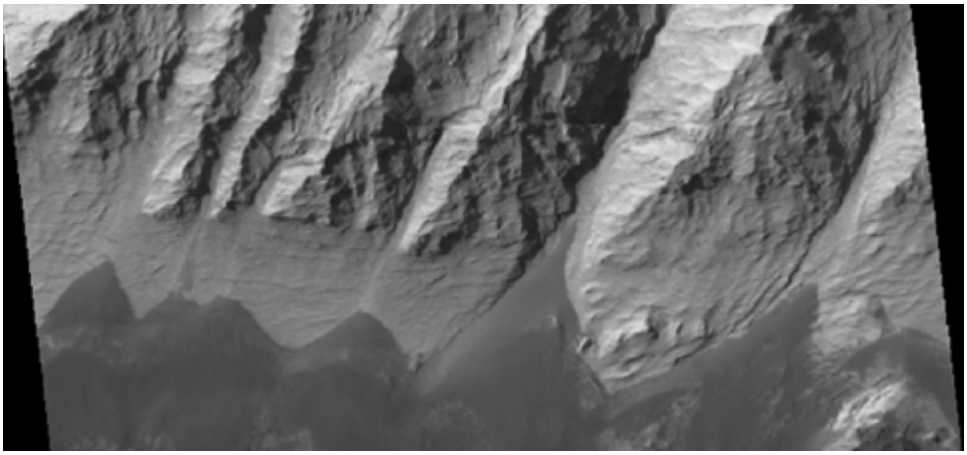

Figure 2: Part of MOC image E1900200, showing sheared off flank of ILD.