XANTHE TERRA OUTFLOW CHANNEL GEOLOGY AT THE MARS PATHFINDER LANDING SITE. *D.M. Nelson, R. Greeley*. Department of Geology, Box 871404, Arizona State University, Tempe, Arizona, 85287-1404, USA. E-mail: nelson@dione.la.asu.edu

Summary. Geologic mapping of southern Chryse Planitia and the Xanthe Terra outflow channels has revealed a sequence of fluvial events which contributed sediment to the Mars Pathfinder landing site (MPLS). Three major outflow episodes are recognized: (1) broad sheetwash across Xanthe Terra during the Early Hesperian period, (2) Early to Late Hesperian channel formation of Shalbatana, Ravi, Simud, Tiu, and Ares Valles, and (3) subsequent flooding which deepened the channels to their current morphologies throughout the Late Hesperian. Materials from the most recent flooding, from Simud and Tiu Valles, and (to a lesser extent) materials from Ares Vallis, contributed the greatest amount of sediment to MPLS.

Introduction. Mars Pathfinder landed on Mars July 4, 1997, near the mouths of the outflow channels Ares and Tiu Valles at the southern margin of Chryse Planitia (19.17°N, 33.21°W [1]). The selection of the landing site was based on engineering and geologic constraints. For geology, it was desirable to land at a "grab bag" site, i.e., one that potentially contained a variety of geologic materials [2]. From MPLS, several issues could be addressed, including determining rock and soil composition, possible fluvial modification of the site, and evidence for potential exobiology. Geologic mapping and interpretation of the geologic history of the Xanthe Terra outflow channels was performed to place the sediments examined at MPLS into context.

Geology. The Xanthe Terra region was mapped at 1:2M scale, covering 30°N to 15°S, 10°W to 45°W, using the stratigraphic units developed by Scott and Tanaka [3]. High resolution Viking Orbiter images enabled further subdivisions of the units, notably the plateau cratered unit (Npl1) and subdued unit (Npl2), into facies related to erosion and deposition of the outflow channel materials.

Watersheds of the outflow channels were derived from the geologic map, based on the erosion patterns of geologic units, drainage directions of valley networks, and topography. Using both the geologic and watershed maps, a sequence of paleogeologic maps was reconstructed (Fig. 1). Following the emplacement of ridged plains material (Hr) and the initial rifting of Valles Marineris in the Early Hesperian [4] [5], deep bodies of standing water in Capri and Eos Chasmata (inferred from layered sediments [6]) were released catastrophically across Xanthe Terra, downslope to Chryse Planitia. Evidence for this flood includes subdued and buried craters adjacent to older highlands and north-south trending scour features; crater counts suggest an Early Hesperian age. Following sheetwash, Mawrth Vallis was formed, possibly resulting from the discharge of floods from Margaritifer and Iani Chaos. A broad area of subdued terrain east of Ares Vallis indicates buried and embayed craters to the south of Mawrth Vallis. Floods could have passed over this surface before excavating Mawrth, then drained downslope into Acidalia Planitia. Alternatively, the subdued area could be a spill zone formed during the early excavation of Ares Vallis. Channelization continued in the Late Hesperian with the development of Shalbatana, Ravi, Simud, Tiu, and Ares Valles. Shalbatana Vallis possibly formed by subterranean discharge from Ganges Chasmata [7], and Ravi was excavated by flooding from Aromatum Chaos. Simud and Tiu Valles then developed by floods from Hydraotes and Hydaspis Chaos, and Ares Vallis developed by flooding from Iani Chaos. Cross-cutting relationships in Ares and Tiu Valles suggest that multiple floods occurred within these channels. In the case of Ares, flood materials from Hydaspis Chaos could be responsible for etched materials on the channel floor which might ultimately have dammed the channel. As the flood trended northeast to Ares, it was redirected to the northwest. This occurred where Ares broadens from 25 km to 100 km. The change in flood direction and the widening of the flood plain could have effectively reduced the flow velocity leading to the deposition of the sediment load. Morphologically similar etched terrain is found within Chryse Planitia, but as the two deposits are not directly connected, it is uncertain whether the potential damming materials of Ares Vallis extended into the basin as a fan, or the Chryse materials were deposited from another flood. Later flooding from Aram and Iani Chaos disrupted the etched materials, reopened the channel, and carried the reworked materials into Chryse Planitia over MPLS. Concurrent to [8] or following the Ares Vallis flood, Simud and Tiu Valles discharged flood material into Chryse Planitia. Striations and erosional features within the channels and along the channel margins indicate that this was the last flood to pass over MPLS. The final flood issued from Shalbatana Vallis, as evidenced by a small flow lobe superposed over Simud Vallis. After the flood events, the primary active geologic process was wind. Windblown materials from Acidalia Planitia encroach on the northern extents of Simud, Tiu, and Ares Valles.

Contributing Sediments. Flood material from Tiu Valllis contributed the most sediment to MPLS because it was the last flood to pass over the site. This

material includes Noachian highland plains materials (Hpls). Additionaly, reworked sediments from previous floods during the Hesperian and material excavated from channel margins were deposited at MPLS. Because Simud Vallis is further west from the site, sediment from this channel would have been carried further west and north of MPLS. In addition, materials from the previous Ares Vallis flood could be present, but probably are less abundant. Underlying materials from previous floods (Early to Late Hesperian) could also be found at MPLS as ejecta from nearby impact craters.

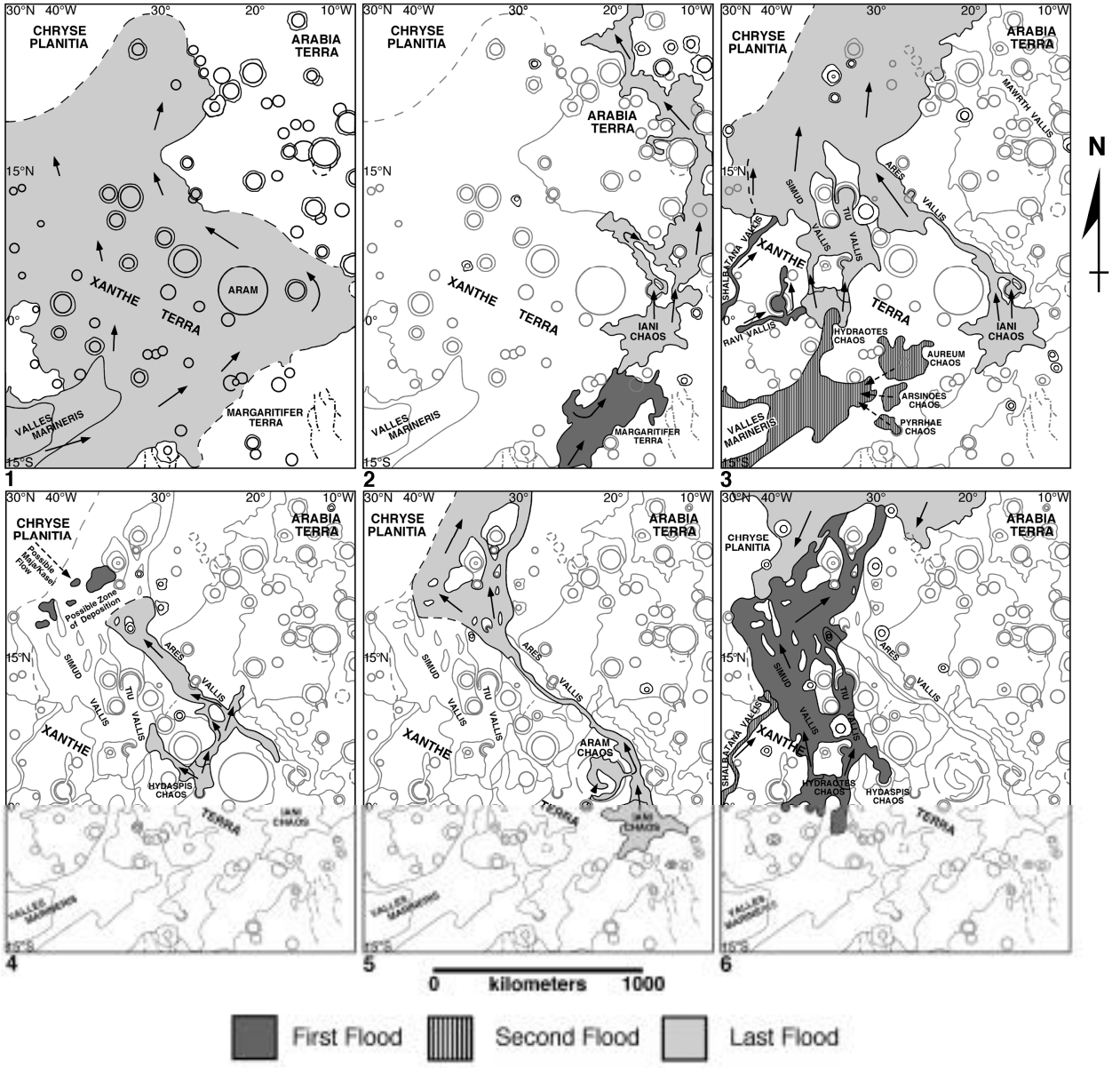

Figure 1. Paleogeologic maps of Xanthe Terra outflow channels. The Legend refers to flood event(s) for each frame (a single flood is considered "Last Flood"). (1) Sheetwash from Valles Marineris, (2) Formation of Mawrth Vallis, (3) Channelization, (4) Ares Vallis Dammed, (5) Last Ares Vallis Flood, (6) Last Flood Events and Current Geology.

References: [1] Golombek, M.P., et al, Science, 278, 1743-1748, 1997. [2] Golombek, M.P., et al., JGR, 102, 3967-2988, 1997. [3] Scott, D.H., and K.L. Tanaka, USGS Misc. Inv. Serv. Map, I-1802-A, 1986. [4] Witbek, N.E., et al., USGS Misc. Inv. Serv. Map, I-2010, 1991. [5] Tanaka, K.L., et al., in MARS, Kieffer, H.H., et al, eds., 345-382, 1992. [6,7] McCauley, J.F., USGS Misc. Inv. Serv. Map, I-897, 1978. [8] Parker, T.J., and J.W. Rice, Jr., JGR, 102, E11, 25641-25656, 1997.