the floor of the outflow channel, as well as on the scoured plains would provide insight into outflow flood hydrology and erosion processes, as well as provide an opportunity for sampling ice-rich deposits which may contain ancient flood residue. A traverse to the vent-rim glacial deposits would provide access to landforms created by volcano-ice interactions, as well as to samples of distal Tharsis volcanic deposits. On the basis of the likelihood that if life exists on Mars, it is most likely to inhabit the subsurface, a site such as Mangala would offer a unique opportunity to sample for evidence of such activity.

Arsia Mons Graben. All three of the major Tharsis Montes shield volcanoes and Olympus Mons exhibit expansive late-Amazonian glacial deposits on their northwestern flanks. The broadest of these deposits are the ones found on Arsia Mons, which show glacial deposits ~400 km to the west of the accumulation zone and cover an area of about 170,000 km^3 (Head and Marchant, 2003). These glacial deposits are found among classic volcanic and tectonic structures, so an extended mission at this location would provide a wealth of information concerning several of the fundamental questions of Martian geology during the Amazonian period.

We designed several traverses from a potential base camp set up at 8°S, 124°W (Fig. 9) that would analyze the glacial and volcanic deposits, and the complicated relationship between them. Using extended rovers human explorers would be able to ascend the western flank of the shield and systematically obtain targeted samples that elucidate the recent volcanic history of Arsia. Another traverse from the same base camp would provide access to a ~5 km wide graben that appears to have been a major accumulation zone for much of the observed glacial deposits (Shean et al., 2007). A systematic sampling strategy at this location would provide a history of the flow regime at this site, and drilling at targeted locations could provide the recent climate record for Mars.

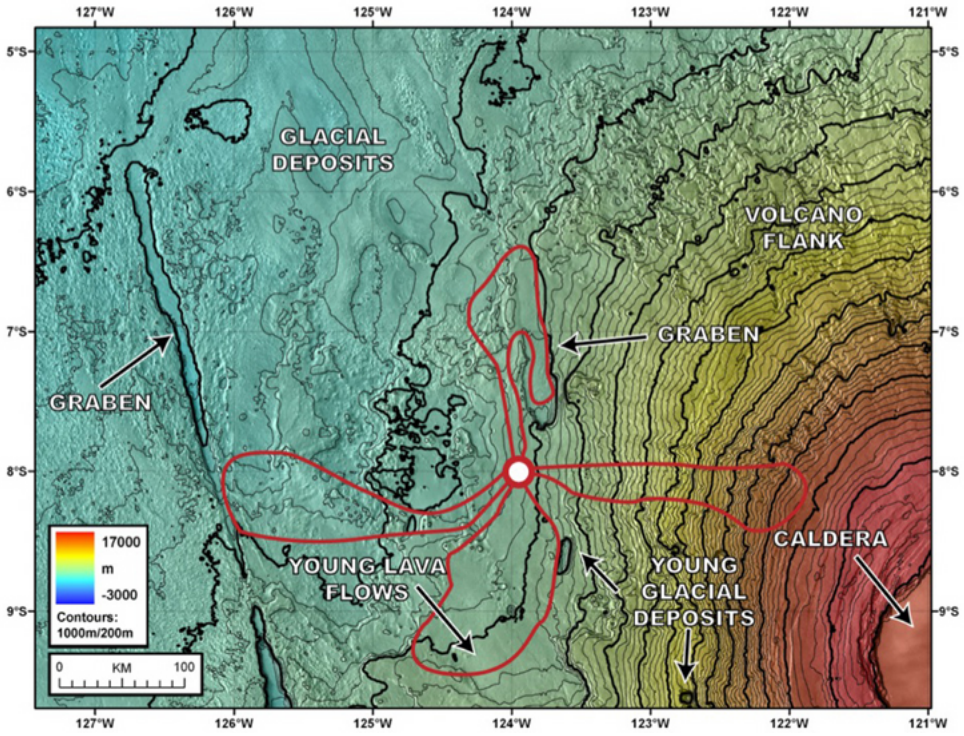

Figure 9. Potential traverses for human explorers in and around the Arsia Mons glacial deposits.

Recent General Circulation Models (GCMs) based upon global topography have revealed the Tharsis Montes to be significant cold traps for the accumulation of volatiles on the surface (Forget et al., 2006). Fieldwork at this site used in conjunction with remote sensing data would have global implications for recent climate change on Mars.

Below we assess the detailed activities that might be undertaken during these extended exploration periods, and show how they might link to MEPAG Goals and Objectives.

4. Graben and Surrounding Smooth Plains — 5 months

Geological Analysis. Analysis of glacial landforms and glacial and climatic history. Analyze the multiple drop moraines and assess sedimentary fabric, lithologic variations, search for erratics from further up the volcano. Study the processes producing drop moraines and assess similarities and differences between moraines. Dig for buried ice for ancient ice samples, and assess for ice cores for climate history. Examine the relationship to any exposed bedrock, searching for any evidence that the glacier was ever wet-based (scou in rock, drumlins, etc.). Examine thickness and fabrics of sublimation tills. Enter the major graben from the north, and traverse the ridges to the apparent base of the accumulation zone. Sample the volcanic rock suite and look