CHRYSE PLANITIA, MARS: TOPOGRAPHIC CONFIGURATION FROM MOLA DATA AND TESTS FOR HYPOTHESIZED LAKES AND SHORELINES. M. A. Ivanov[1,2] and J. W. Head[1]. [1]Department of Geological Sciences, Brown University, Providence, RI 02912 USA; [2]Permanent address: Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow, Russia

Abstract. Many of the main outflow channels on Mars debouch into the Chryse Basin and pre-Mars Global Surveyor topographic data show it to be a closed depression almost 2000 km in diameter. New MOLA laser altimeter data show: 1) that Chryse is not a locally closed basin but opens into the North Polar basin; 2) that the distinctive channel morphology of the six largest channels (Kasei, Maja, Simud, Tiu, Ares and Mawrth) disappears into the northern lowlands at elevations thal all occur within 350 m of each other over a lateral distance of 2200 km. Parker et al (1993) mapped Contact 2 in this area, a boundary interpreted by them to represent an ancient shoreline, and shown by Head et al. (1998) to lie at -3700 m. MOLA data show that the elevations where these channels disappear all fall within ~180 m of Contact 2. These observations are consistent with the hypothesis of a large standing body of water in the northern lowlands in Late Hesperian-Early Amazonian times.

Introduction. Chryse Planatia is the focal point of debouchment into the northern lowlands of many of the major outflow channels on Mars (Carr, 1996). The mouths of these broad outflow channels are wide (tens to hundreds of km), but end abruptly (within a few km) (Tanaka, 1997), leading to the hypothesis that they emptied into a standing body of water such as a large lake (Moore et al., 1995; Scott et al., 1992) or possibly an ocean (Parker et al., 1987; 1993).

We test these hypotheses using MOLA data by addressing the following questions: 1) Is there evidence for a Chryse topographic basin in the vicinity of the termini of these outflow channels, and if so, what are its dimensions? 2) Where in the northern lowlands would effluents from these channels have been deposited or accumulated? 3) What is the range of elevations of the contacts of these outflow channels with the northern lowlands? 4) What is the topographic relationship of outflow channel contacts (with the northern lowlands) and contacts proposed by Parker et al. (1989, 1993) to represent shorelines from ancient standing bodies of water?

Topographic basin within Chryse Planitia. Chryse Planitia is a topographically low indentation in the dichotomy boundary that is the locus of convergence of the largest martian outflow channels. Its general topography and setting is broadly similar to that of the Isidis basin, thought to be of impact origin (Schultz and Frey, 1990) and interpretation of Viking Orbiter data led to the hypothesis of a large impact basin underlying Chryse Planitia. In the topographic map produced by USGS (1993), two large circular depressions are visible. One is within Chryse Planitia and another to the north corresponds to Acidalia Planitia. These two topographic basins are separated by a very broad low topographic rise. The southern portion of the rise appears to be concentric to the basin in Chryse while the northern part of the rise is circumferential to the basin in Acidalia Planitia. Thus the presence of a large basin in Chryse, in excess of 500 m deep, was supported by pre-MOLA topographic data.

Regardless of its origin, the presence of such a large topographic basin in Chryse Planitia would control the distribution of effluents released from the several large circum-Chryse outflow channels. The presence of such a basin would create a closed system for possible water accumulation. The evolution of the channels, and the water budget and related hydrologic cycles, would likely be governed by the filling and emptying of the large, but local, Chryse basin (e.g., Moore et al., 1995; Craddock et al., 1997; Crumpler, 1997).

The new high resolution topographic map based on MOLA data shows a similar general distribution of the main topographic features in the uplands surrounding Chryse Planitia, but MOLA data do not show evidence for the existence of a large topographic basin within Chryse Planitia, and the basin to the north also has a different configuration. If the broad Chryse depression is indeed related to a giant impact basin (Schultz et al., 1982) its topography was nearly completely modified by the end of formation of the circum-Chryse channels, in contrast to the Utopia and Isidis basins which remain depressions today (McGill, 1989; Thomson and Head, 1999; Smith et al., 1999).

The MOLA data show that the whole area of Chryse Planitia appears to be a large gulf-like feature characterized by low and steady slopes toward the NNE, emptying toward a basin-like feature in the northern portion of Acidalia Planitia, the North Polar basin (Head et al., 1999; Thomson and Head, 1999), which has a different location, depth, and configuration than previously thought. The obvious absence of a distinct topographic low within Chryse Planitia, or barrier between the channel mouths and the northern lowlands, strongly suggests that channels emptied into and spread out into the northern lowlands with effluents eventually collecting in the North Polar basin, in contrast to the closed Chryse system favored by Moore et al. (1995). Clearly, the volume of material removed from individual channels (e.g., Carr et al., 1987) are each sufficient to fill a depression of this scale to depths of several hundred meters.

In reference to the first two questions raised in the introduction: 1) MOLA topography data reveal no evidence for a Chryse topographic depression in the vicinity of the termini of the outflow channels at present, and 2) MOLA data show that in the present topographic configuration channel effluents would flow down regional slopes of about 0.03^0 for over 2000 km and into the North Polar basin in the northern lowlands.

Elevation of channel termini at Chryse Planitia. Six major outflow channels (Kasei, Maja, Simud, Tiu, Ares and Mawrth valles) surround and empty into Chryse Planitia, extending almost radially around the basin for a distance in excess of 2000 km (Tanaka, 1997). We used MOLA data to determine the elevation at the boundaries between the termini of the channels and the adjacent plains deposits of Chryse Planitia. Although these channels are of different ages (Tanaka, 1997) and separated by hundreds of km over a total distance of more than 2000 km, we found that the elevations of the contacts of the different channels were very close to one another in elevation, all occurring within a range of less than ~350 m and the four easternmost ones occurring within less than 100 meters of each other. The maximum topographic difference between the channel mouths at Chryse is 340 m and occurs between Maja and Tiu Valles, which are separated by a lateral distance of about 900 km.

Relationship of channel termini with Contact 2 elevation. Numerous workers, assessing a variety of evidence, have found support for the presence of large standing bodies of water in the northern lowlands. In their detailed analysis of the morphology of the northern plains, Parker et al. (1989, 1993) found morphological evidence for two distinct and widespread contacts which could be traced almost completely around the margins of the northern hemisphere lowlands, and which Parker et al. interpreted to be shorelines of former large standing bodies of water. Recently, Head et al. (1998) used MOLA data from the hiatus phase orbits to test for the elevations of the contacts as a function of longitude, reasoning that if the contacts represented an approximation of an equipotential surface, contact elevations crossed by MOLA profiles would plot close to a straight line as a function of longitude.

What is the relationship of the circum-Chryse channel contacts with the elevation of Contact 2? The mean elevation of the termini of the circum-Chryse channels is about -3.82 km, with a standard deviation about 0.014 km. The altitude position of the channel termini oscillates slightly around the mean elevation of Contact 2 but is still well inside the one sigma deviation of the elevations of the contact itself. Thus, the termini of the large circum-Chryse outflow channels not only have a very similar elevation over a distance in excess of 2000 km, but this level closely corresponds to the elevation of Contact 2, interpreted by Parker et al. (1989, 1993) to demarcate the shoreline of a northern ocean in the past history of Mars.

Conclusions. MOLA data reveal that the Chryse basin seen in earlier topographic data is not a closed depression, and that circum-Chryse outflow channels empty out into a broad plain tilting toward the north and terminating in a large closed North Polar basin. The elevation of contacts between the termini of circum-Chryse channels and plains of Chryse Planitia all are within 350 m of each other over a lateral distance in excess of 2000 km. These same contacts fall very close to Contact 2 of Parker et al. (1989, 1993), which they interpreted to be the shoreline of a large ancient standing body of water occupying the northern lowlands.

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