A NEW GEOLOGIC MAP OF THE HALE-BOND REGION, NORTHERN ARGYRE BASIN. H. Hiesinger[1], H. Lehmann[2], S. Gehrke [2], F. Scholten[3], and G. Neukum[4]. [1]Inst. für Planetologie, Westfälische Wilhelms-Universität, Münster, Germany, Hiesinger@uni-muenster.de; [2]Inst. für Geodäsie and Geoinformationstechnik, TU Berlin, Germany; [3]DLR Inst. für Planetenforschung, Berlin, Germany; [4]Inst. für Geologische Wissenschaften, FU Berlin, Germany.

Introduction: The Argyre Basin, located at 51°S and 317°E, is one of the most prominent impact basins on Mars [1-4]. Among various scenarios for its geologic evolution, it has long been speculated that water might have accumulated within the Argyre Basin to a point where spillover occurred that carved the large northern outflow channel Uzboi Vallis [5-9]. Testing such a hypothesis is complicated by the fact that this spillover most likely, if at all, occurred very early in Martian history with ample time for subsequent modification of the terrain by erosional and depositional processes, as well as by two large impacts, Hale and Bond (Fig. 1). Based on a detailed investigation of the Argyre Basin with Viking, MOLA and MOC data, evidence for such spillover remained elusive [10]. Here we use data from the High Resolution Stereo Camera (HRSC) and other modern data to re-investigate and map in detail the Hale-Bond area in order to newly assess the evidence for the putative spillover.

The topographic base map of the Hale-Bond Region is derived from an HRSC orthoimage and a Digital Terrain Model (DTM). Following the cartographic concept of the large-scale series *Topographic Image Map Mars 1:200,000* as a guideline, our map is based on the technical specifications concerning reference bodies, map projection and many aspects with regard to the grid systems and nomenclature [11-13].

Background: Several outflow channels (Surius Vallis, Dzígai Vallis, Pallacopas Vallis), presumably fed by meltwater from the South Pole, empty into the Argyre Basin from the south [14-16]. The large drainage area of the Argyre Basin of 20 x 10^6 km^2 [17], its location in the vicinity and downslope from regions of ancient polar ice deposits that underwent extensive melting in middle Mars history [14-15], and the three channels that empty into the basin suggest that if there ever were large volumes of water flowing across the surface of Mars, the Argyre Basin might be a good candidate for the accumulation of water. According to Parker et al. [16], the water would have completely filled the basin during the Noachian and then flowed, in at least two catastrophic flood events, through Uzboi Vallis and the Chryse trough [18-19] towards the northern lowlands. However, as there have been other models that propose a partial fill of the Argyre Basin [10, 20] one of the still open questions is to what extent the basin was filled and whether spillover occurred.

Cartographic Concept and Map Sheet Generation: In addition to the need for high-quality topographic image maps a continuously increasing requirement for thematic maps is evident. The geologic map sheet of the Hale-Bond region is spread from 320°30' to 327°00' eastern longitude and 31°20' to 37°30' southern latitude. The map project is realized in co-operation between the Institut für Planetologie, Westfälische Wilhelms-Universität Münster, for the geoscientific interpretation, German Aerospace Center (DLR) in Berlin-Adlershof, providing photogrammetric processing [21], and the Technische Universität Berlin, responsible for all cartographic aspects and production. For the generation of the map project we used the cartographic software package *Planetary Image Mapper* (PIMap) [22]. HRSC data from orbits 511 and 533 covering the work area have been chosen for map generation. Considering the dimension of the Hale-Bond area and a variety of pragmatic aspects as well, the map scale was defined to be 1: 600,000. In addition to HRSC data, we incorporated data from several current and past space missions, including data from the Mars Orbiter Laser Altimeter (MOLA), the Mars Orbiter Camera (MOC), the Thermal Emission Imaging Systems (THEMIS), and the High Resolution Stereo Camera (HRSC). There are no high-resolution MOC images available but the image resolution of the THEMIS visible data is as high as 17 m/pixel. HRSC data have resolutions of about 25 m/pixel and THEMIS IR data of about 100 m/pixel.

Observations: On the basis of the available imaging data we make following preliminary observations. In the Hale-Bond area, the putative outflow channel Uzboi Vallis is heavily modified by the two impact craters, which postdate the Noachian ur-Uzboi Vallis of Parker [e.g., 9, 16]. The valley floor is characterized by relatively smooth terrain between morphologically sharp blocks of eroded ejecta material. In THEMIS VIS data, numerous shallow pits are visible on the smooth floor material. Some of these pits may represent older buried impact craters; other irregularly shaped pits are likely collapse pits formed by the removal of ground ice or ground water. Gullies are only present on the inward southward facing slopes of Hale crater but not on the slopes of the eroded ejecta material. Similarly, we did not find evidence for a well-developed drainage system. Fluvial features are usually short, small in scale, are particularly prominent south of about 36.5°S, were formed late in the history of this region, and drain into the basin. At the investigated scale, we did not observe features, such as streamlined islands, that would indicate fluvial flow towards the north. Throughout the investigated area, eolian dunes are rare and no prominent dune fields are visible at this resolution. Southeast of crater Hale, that is east of about 324°E and south of about 36.5°S, the terrain is characterized by numerous well-rounded hills and knobs and a soft, undulating morphology. This is in stark contrast with the terrain immediately southwest of crater Hale and the morphologially sharp rim and central peak of crater Hale. Secondary craters of Hale can be traced for at least 1-2 crater radii to the northeast and northwest, but are missing within the Argyre Basin, either due to an oblique impact from the SE (impact angle < 15°; [23]) or continued erosion and material transport to the basin floor that contributed to the obliteration of Hale secondaries. Modern Uzboi Vallis dissects the southern rim of crater Bond, but the terrain immediately inside the breach is characterized by a rough, pitted morphology rather than fluvial features (e.g., channels) indicative of water flowing north into the crater. A smooth crater-filling unit is visible on the northern and

western floor, opposite modern Uzboi Vallis, the material of which is likely derived from the erosion and modification of the crater wall or eolian input. North of crater Bond we see evidence for groundwater sapping in form of stubby valleys with few tributaries and theater-like source depressions. Here, water drains into a well-defined Uzboi Vallis that exhibits flow features, indicating flow to the north.

Conclusions: From our geologic investigation of the Hale-Bond region we conclude that: (1) the formation of Hale and Bond erased all evidence for a Noachian ur-Uzboi Vallis if it ever existed; (2) while we can not exclude the possibility that a Noachian age Uzboi Vallis might have existed, there remains no evidence for water flowing through this ur-Uzboi Vallis towards the north; (2) whether this ur-Uzboi Vallis was formed by a spillover from the Argyre Basin or from sapping/precipitation along the basin rim can not be determined unambiguously; (3) while modern Uzboi Vallis cuts the southern rim of crater Bond, unambiguous evidence for water flowing to the north only occurs north of crater Bond; (4) the interior of crater Bond does not show evidence for water entering from the south, suggesting that fluvial flow through modern Uzboi Vallis towards the north was limited, if it existed at all; (5) fluvial features visible today, including the section of Uzboi Vallis east of crater Hale, postdate the formation of Hale and Bond, were formed more recently, drain into the basin, and are not related to the proposed drainage of the Argyre Basin during the Noachian.

References: [1] Wood and Head, 1976, PLPSC 7; [2] Schultz et al., 1982, JGR 87; [3] Schultz and Frey, 1990, JGR 95; [4] Tanaka et al., 1992, Mars; [5] Hodges, 1980, USGS I-1181; [6] Scott and Tanaka, 1986, USGS I-1802; [7] Jöns, 1987, LPSC XVIII; [8] Kargel and Strom, 1992, Geology 20; [9] Parker, 1994, Diss., U. of South. Cal.; [10] Hiesinger et al., 2002, PSS 50; [11] Albertz et al., 2005, PE&RS, 71(10); [12] Lehmann et al., 1997, 18th ICC; [13] Lehmann et al., 2006, ISPRS TC IV Symposium, Goa. [14] Head, 2000a, LPSC XXXI; [15] Head and Pratt, 2001, JGR 106; [16] Parker et al., 2000, LPSC XXXI; [17] Smith et al., 1999, Science 284; [18] Saunders, 1979, USGS I-1144; [19] Phillips et al., 2001, Science 291; [20] Head, 2000b, LPSC XXXI; [21] Scholten et al., 2005, PE&RS, 71(10); [22] Gehrke et al., 2006, LPSC XXXVII; [23] Schultz and Mustard, 2001, LPSC XXXII.

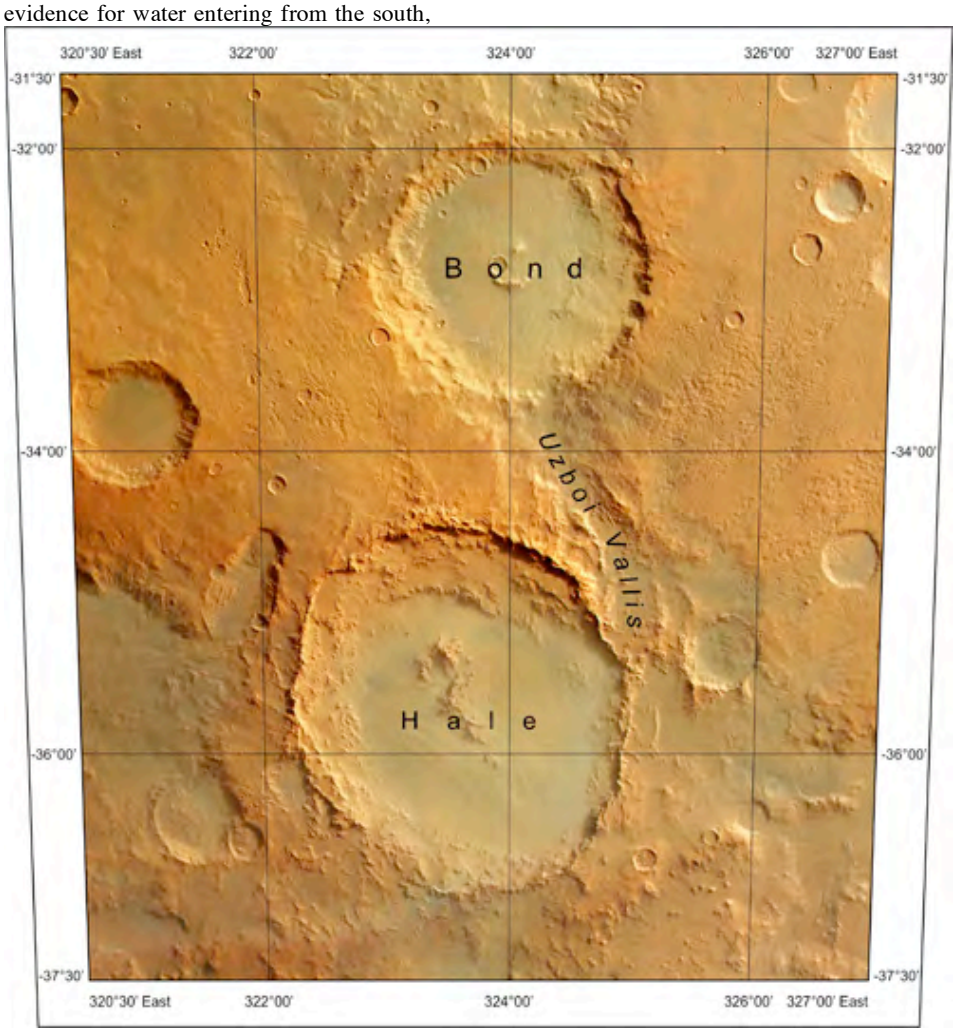

Fig.1: HRSC mosaic consisting of data from orbit 533 (East) and orbit 511 (West). The map shows two large impact craters, Hale and Bond, which are located at the northern rim of the Argyre Basin. Parts of Uzboi Vallis are visible east and northeast of crater Hale.