STRATIGRAPHY OF THE AMENTHES REGION, MARS: TIME LIMITS FOR THE FORMATION OF VOLCANIC AND WATER-RELATED DEPOSITS G. Erkeling[1], H. Hiesinger[1], D. Reiss[1], F. J. Hielscher[1], M. A. Ivanov[2] [1]Institut für Planetologie, Wilhelm-Klemm-Straße 10, 48149 Münster, Westfälische Wilhelms-Universität Münster, Germany, (gino.erkeling@uni-muenster.de / +49-251-8336376) [2] Vernadsky Inst. RAS, Moscow, Russia

Introduction: The Amenthes region, located in northern Tyrrhena Terra between 95˚/115˚E and 15˚N/5˚S, has been affected by a large variety of geologic processes. It consists of a broad trough-like topographic depression that shows evidence for a tectonic origin [1] and represents a transition between the topographically higher northern edge of the volcanic province of Hesperia Planum and the low-lying plains of the Isidis impact basin. The relief of the Amenthes region indicates that the trough connects Hesperia Planum and the Isidis basin and could have served as the main path of distibution for various types of materials from the neighboring cratered terrains and Hesperia Planum to Isidis Planitia [2,3].

We present the first results of our morphologic and stratigraphic investigations (Fig.1+2) in the northwestern part of the Amenthes region where our observations suggest, that volcanic and possibly water-related processes (including the deposition of ice-saturated materials [3]) appeared either simultaneously or sequentially. Our study of the Amenthes region aims to address the following questions: 1) What are the time constraints for the formation of volcanic and fluvial deposits in the Amenthes region? 2) How do they relate to major episodes of the neighboring volcanism (e.g. Syrtis Major [4]), the geologic history of Isidis [5] and water activity (e.g., Libya Montes [6,7])?

Data sets and methods: Our morphologic mapping and the crater counts were performed on High Resolution Stereo Camera (HRSC) [8] and Context Camera (CTX) images [9]. Our morphologic mapping builds on the classification of [10]. Absolute model ages for the surfaces were derived from the current Mars cratering chronology model of [11].

Morphology: The cratered highlands south of the Amenthes trough consist of Noachian mountains (Nm) that are made of prominent mountainuous ridges, 10 km or more in length, Noachian plateau material with rough surfaces (Npl_1) and Noachian plateau material of smooth character (Npl_2). Widespread dendritic valley networks (Nd) in the Noachian cratered terrain south of the Amenthes trough towards the Libya Montes region indicate that the study area was influenced by fluvial activity [6,7,12]. The channels abruptly disappear when entering the Amenthes trough at its southern edge.

In several places in the highlands south of the trough, we identified intermontane plains of volcanic origin (Hps). The graben-like features of Amenthes Fossae further suggest that Amenthes Planum underwent widespread episodes of tectonism [2].

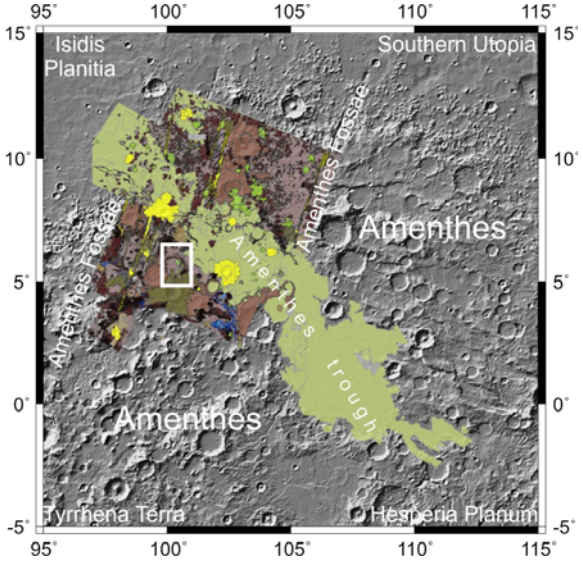

Fig. 1: Regional context of the Amenthes region. Our morphologic map (in progress) is superposed on MOLA shaded relief. The Amenthes trough corresponds to the green unit (AHs). The white box outlined (~101˚E/~6˚N) shows the location of Fig. 3.

The floor of the Amenthes trough is mainly covered by smooth plains (AHs) that consist of lava plains covered with a discontinuous veneer of eolian deposits (Aps). The identification of wrinkle ridges on the floor of the Amenthes trough indicates thick layered volcanic flows that infilled the depression [3]. The plain materials embay the adjacent highlands south and north of the trough and are superposed on material that might have been transported from the highlands by fluvial activity. In addition, plain materials transported through the Amenthes trough have entered the graben of the Amenthes Fossae that crop out in the highlands on both sides of the trough.

The floor of the Amenthes trough is dissected by numerous channels which can be identified within the whole trough from its southeastern part near the Tinto Vallis/Palos crater region to its mouth region near Isidis in the northwest. The channels are interrupted several times by aeolian deposits (Aps) or buried by large impact craters (Ac) and show different morphologies than the dendritic networks in the southern highlands.

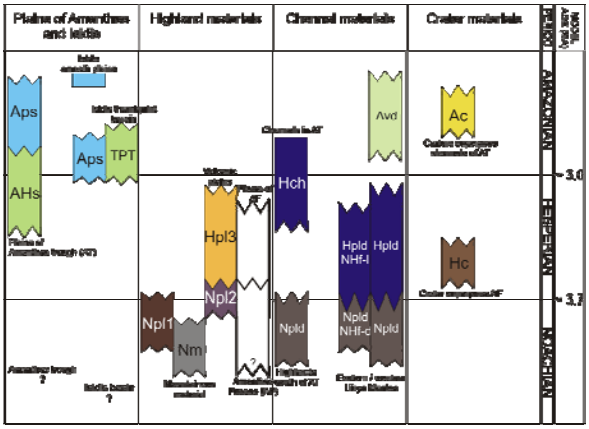

Fig. 2: Stratigraphy of the Amenthes region and time constraints for the formation of surfaces in the Libya Montes [6,7] and the Isidis basin [13].

Palos crater and Tinto Vallis, which are interpreted as an open crater-lake system [14], are connected with the valleys within the Amenthes trough and support a formation by fluvial activity. However, alternative interpretations are consistent with a volcanic-tectonic scenario [15].

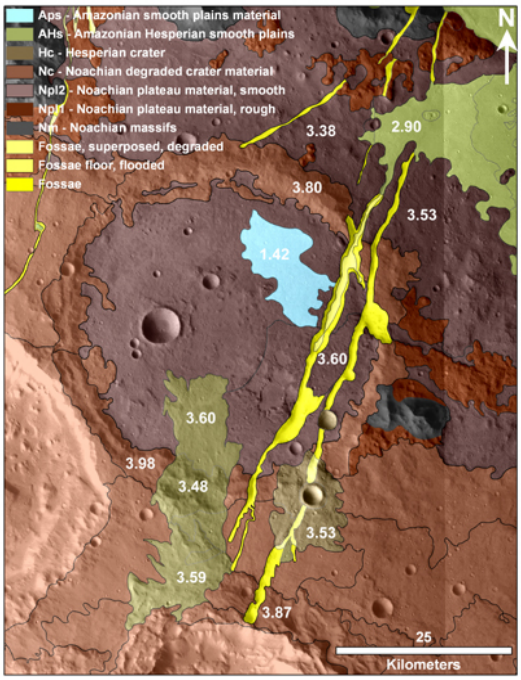

Fig. 3: The morphologic map shows parts of Amenthes Fossae region in the highlands south of the Amenthes trough. The Amenthes Fossae cross-cuts Noachian surfaces and craters (>~3.6 Ga) and is superposed by a Hesperian crater (~3.53 Ga) and the smooth plains of the Amenthes trough (~2.90 Ga).

Stratigraphy: The surface units in the highlands south of the Amenthes trough show the highest model ages in the study area. Both the mountainous ridges (Nm) and the Noachian craters (Nc) are older than ~3.7 Ga. The oldest units have been degraded by dendritic valleys (Nd) between ~3.5 and ~3.9 Ga, which is approximately contemporaneous with the fluvial activity in adjacent areas [6,7]. The graben of the Amenthes Fossae cross-cut units that show model ages older than ~3.6 Ga. As shown in Fig. 3, units that are younger than ~3.6 Ga, e.g. Hesperian impact craters (Hc) and ejecta layers as well as smooth lava plains, are superposed or bury parts of Amenthes Fossae. The floors of Amenthes Fossae have been filled between ~3.4 and ~3.7 Ga. The formation of Amenthes Fossae likely took place in the Noachian (>~3.7 Ga). Smooth volcanic plain materials of the Amenthes trough (AHs) were transported into the graben of Amenthes Fossae between ~2.7 and 3.3 Ga and are superposed on older floor material. Those parts of the Amenthes trough that are dissected by channels show ages of ~3.0 Ga. Amazonian impact craters (Ac) with model ages between ~2.6 and ~2.7 Ga are superposed on valleys incised into smooth plains of the Amenthes trough (AHs) and therefore represent the end of valley formation. Youngest (Upper Amazonian) model ages in our study area are attributed to aeolian resurfacing.

Summary: Based on the morphology and our crater counts, we propose that

1) the Amenthes trough and the surrounding highlands were formed in the Noachian and modified by tectonic processes (Amenthes Fossae),

2) the formation of the Amenthes Fossae occurred before ~3.6 Ga,

3) the surfaces of the Amenthes trough were formed between ~3.3 and ~2.7 Ga, are most likely of volcanic origin and are superposed on Amenthes Fossae as well as fluvial deposits from the highlands south of the trough,

4) the channels identified in the trough are formed between ~3.0 and ~2.7 Ga and indicate Late Hesperian to Early Amazonian fluvial activity that postdates the formation of the Amenthes volcanic plains.

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