HIGH-RESOLUTION MAPPING OF THE PALOS OUTFLOW CHANNEL: PRELIMINARY RESULTS.

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Introduction: The ~350 km long "Palos outflow channel" (POC) incises the volcanic plains of Amenthes Planum and seems to originate from Palos crater (2.7°S, 110.8°E) [1], a candidate open-basin paleolake in the northern Tyrrhena Terra [1–2]. The general morphology of the POC is similar to many other outflow channels found on Mars and it is consistent with fluvial origin [1]. It was also proposed that multiple overspills from Palos crater could be responsible for the formation of the POC [1].

We have undertaken a high-resolution geomorphological mapping of the POC using CTX and HiRISE imagery. Geomorphological analysis is complemented with crater counting measurements. The aim is to further characterize and date the paleofluvial activity in the Amenthes region.

General Morphology: After leaving Palos crater, the first ~70 km of the upstream section of the channel is confined by a ~15–20 km wide northwest-trending trough (Fig. 1). After the trough opens to the broad main parts of the Amenthes plains, the POC has almost parallel edges and a width of ~15 km. Some 80 km to the northwest, the midstream section of the POC is superposed by a ~7 km impact crater, after which the appearance of the channel soon changes from a shallow and sheetlike into a more deeply entrenched, chaotic, and braiding. Individual anabranches tend to be few hundred to few thousand meters wide and few tens of meters deep.

Around 90 km further to the northwest, the POC divides into two separate downstream sections. The northeastern section breaches a small highland barrier before dividing again and fading into the plains of Amenthes Planum. The northwestern section continues ~90 km to the northwest, although the deep and clearly incised channel anabranches disappear temporarily, only to emerge again before terminating as what seems to be an alluvial fan.

Closer inspection of the POC reveals multiple instances of terraces, complex hanging-relationships, and channels cutting older meanders (Fig. 2 & 3). These all point towards a complex history of catastrophic flooding, discharge variations, and/or multiple scenarios. Mesas in the midstream section of the POC are much more streamlined than their downstream counterparts. Mesa tops in the midstream section also show the signs of fluvial activity. Mesas in the downstream section are generally more irregular in shape and they may represent the original pre-fluvial terrain.

Preliminary Results: The presented geomorphological map (Fig. 1) divides the POC into 1) incised channels, 2) "fluvial plains" characterized by fluvial erosion and/or deposition, 3) erosional/depositional mesas atop of the fluvial plains, and 4) impact craters (and ejectas) that are superposed on the aforementioned units and are significant in size or position. Our crater counting measurements, on the other hand, naturally use all superposed primary craters above the chosen cutoff size (50 m). Similar measurements for Amenthes Planum and large ejecta fields superposed on the channel have been previously used to constrain the age of the POC to ~3.26–3.53 Ga ("Neukum Chronology") [1]. Our preliminary crater counting results for the whole mapped channel area indicate a similar age of ~3.42–3.49 Ga, depending on whether the large ~7 km crater superposed in the midstream section is included or not. Since this estimate also includes surfaces that are only marginally affected by fluvial erosion, the acquired result should be considered as a maximum age and the actual time of formation of the POC is likely $\lesssim$3.4 Ga.

Since it was predominantly incised into the relatively smooth, uniform, and low gradient Amenthes Planum, the POC might be a good example of a Martian outflow channel which encountered relatively little structural control from pre-existing landforms and topography. Furthermore, the channel also seems to has formed relatively shortly after the formation of the Amenthes volcanic plains, which means that structural control from pre-existing craters would also have been low. Thus the tendency of the channels to anabranch with increasing distal length might be attributed to initial increase in boundary resistance due to channel widening. Anabranching could also be associated with ice-dams diverging the stream; similar phenomenom is observed for example in Siberian outburst rivers [3].

Conclusion: Palos outflow channel seems to have formed $\lesssim$3.4 Ga ago; the morphology hints of complex history of flooding, discharge variations, and/or possibly multiple fluvial scenarios.

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References: [1] Erkeling G. et al. (2011) *Icarus, 215*, 128-152. [2] Fassett C. I. and Head J. W. (2008) *Icarus*, *198*, 37-56. [3] Costard F. et al. (2007) in *The Geology of Mars*, 279-296, Cambridge University Press.

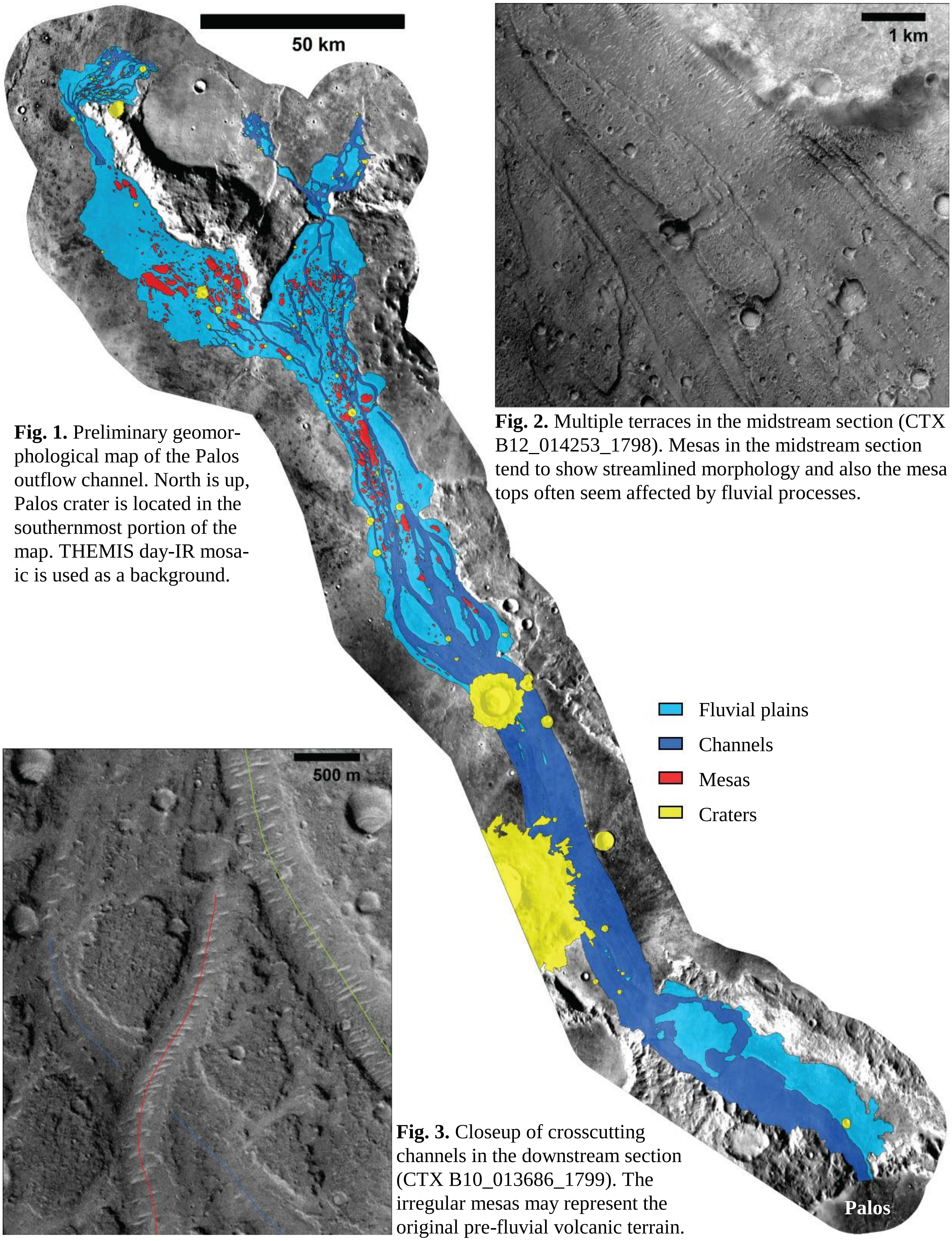

Fig. 1. Preliminary geomorphological map of the Palos outflow channel. North is up, Palos crater is located in the southernmost portion of the map. THEMIS day-IR mosaic is used as a background.

Fig. 2. Multiple terraces in the midstream section (CTX B12_014253_1798). Mesas in the midstream section tend to show streamlined morphology and also the mesa tops often seem affected by fluvial processes.

Fig. 3. Closeup of crosscutting channels in the downstream section (CTX B10_013686_1799). The irregular mesas may represent the original pre-fluvial volcanic terrain.