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Terby Impact crater: Evidence for a Noachian sedimentary filling by subaqueous fan deltas

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1. Introduction

The 174 km diameter Terby impact crater (28.0°S - 74.1°E) located on the northern rim of the Hellas basin displays anomalous inner morphology [e.g. 1, 2], including a flat floor and light-toned layered deposits [e.g. 3, 4, 5].

An analysis of these deposits was performed using multiple datasets with visible images for interpretation, infrared data for mineralogic mapping, and topography for geometry.

The geometry of layered deposits was consistent with that of clastic sediments that settled mainly in a sub-aqueous environment. To the north, the thickest sediments displayed sequences for fan deltas, as identified by 100 m to 1 km long clinoforms, as defined by horizontal beds passing to foreset beds dipping by 6°-10° toward the center of the Terby crater [6].

The identification of distinct sub-aqueous fan sequences, separated by unconformities and local wedges, showed the accumulation of sediments from prograding/onlapping depositional sequences, due to lake level and sediment supply variations [6].

The mineralogy for several layers with hydrated minerals, including Fe/Mg phyllosilicates, supports this type of sedimentary environment. The volume of fan sediments was estimated as >5,000 km^3 [6] (a large amount considering classical Martian fan deltas such as Eberswalde (6 km^3, [7])) and requires sustained liquid water activity.

Such a large sedimentary deposition in Terby crater is characteristic of the Noachian/Phyllosian period [6] during which the environment favored the formation of phyllosilicates. The latter were detected by spectral data in the layered deposits of Terby crater in three distinct sequences.

During the Hesperian period, the sediments experienced strong erosion, possibly enhanced by more acidic conditions (in the Theiikian), forming the current morphology with three mesas and closed-depressions. Small fluvial valleys and alluvial fans formed subsequently, attesting to late fluvial processes dated as late Early to early Late Hesperian.

After this late fluvial episode, the Terby impact crater was submitted to aeolian processes and permanently cold conditions as confirmed by viscous flow features.

2. Conclusion

Terby impact crater displays, in a single location, geologic features that characterize the three main periods of time on Mars, with the presence of one of the thickest sub-aqueous fan deposits reported on Mars. The filling of Terby impact crater is thus one "potential reference geologic cross-section" for Mars stratigraphy.

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