

ORIGIN, EVOLUTION AND DEMISE OF THE EBERSWALDE CRATER LAKE

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Introduction: Since its initial discovery in 2003, the timing of the Eberswalde fan has been referred to as Late Noachian linked to a warm and wet climatic period [1,2,3]. Although it is recognized that the fan and drainage system was formed on a Noachian aged landscape, pinning the timing of its formation and demise remains elusive.

A stratigraphic chart was assembled from several studies that summarizes the relative timing of deposition between several adjacent craters. Placing the Eberswalde fan into this framework allows for an understanding of its evolution and relative timing within the context of the broader evolution of the Uzboi-Holden-Landon-Margaritifer drainage system. It is postulated that the Eberswalde fan may be Hesperian in age.

Origin: The Eberswalde fan and its drainage system is short lived [3,4] and is primarily spawned from a highland source terrain of the Holden Crater rim. It is a secondary system to the adjacent longer lived Uzboi-Holden-Landon-Margaritifer drainage system. Reconstruction of the lake levels and headland drainage suggest a local source that likely involved snowmelt. A Hesperian proposed timing, although younger than earlier estimates, is not definitive. It does fit a time of shift in climate and depositional response inferred within other segments of the broader drainage system.

Evolution: Several authors have described the depositional history illustrating 5 lobes of fan deposition [3,5,6,7]. Lake persistence estimates have ranged from short lived (yrs), with dry periods, to a long lived standing body of water of 1-2MM yrs [3,5,8].

Despite no clear evidence, by simply reversing the order of lobes 3 and 4 of Woods (2006), a simple 3 stage, initiation, peak and waning phase model arises. Under this scenario the peak phase lobes form during a declining water body. Episodic pulses of higher supply during this phase would raise lake level and account for the observed aggradational stacking patterns [6,7]. The waning phase is punctuated with brief high velocity floods that entered a highly depleted lake.

Demise: A headland source terrain of limited extent and replenishment likely led to the ultimate demise of the lake. Two elevation levels are observed for the headland drainage. The lower elevation system (~50m) drained a broader area but appears short lived. The upper elevation system (~400m) truncates the lower and appears longer lived. It is postulated that the different headwater elevations reflect retreat of a snowpack. It is assumed that atmospheric pressure declined

to the point that conditions no longer supported a surface aqueous phase for the drainage and fan elevations.

Regional Stratigraphic Fit: The relative timing of events in Argyre, Hale, Bond, Holden and Eberswalde craters can be inferred and placed into a generalized stratigraphic framework. The lines of evidence for timing of features in each area are weak on their own, but collectively suggest a common pattern that might offer some constraint on the timing of the Eberswalde fan.

Relationship to Argyre: The later phase of inward flowing drainage and sedimentation at Argyre may be equivalent to the Eberswalde fan when both reflect a last gasp climate of surface aqueous favored conditions. A portion of Argyre lake deposition is earlier.

Argyre rim collapse may explain the displacement of lake water and the connection and catastrophic flow events through Uzboi during the Noachian. This process may also explain the shift from outward to inward flow for this crater.

Relationship to Hale and Bond: Deposition in these post Uzboi craters likely occupies the equivalent of the waning phase of Eberswalde fan deposition or younger. The absence of fluvial features in these craters is consistent with the termination of outflow from Argyre and a shift to a glacial and surface aqueous depleted setting [9].

Relationship to Holden: Eberswalde fan duration may correspond to the unconformity time period between lacustrine cycles or during the second cycle recognized in this crater. Similar crater histories [10] and flow decline within Uzboi canyon and Nirgal Vallis would fit the history and common demise of these two lakes [6].

Summary: Although the Eberswalde pre-fan history is unknown it is clear that the depositional and lake history was relatively short lived and formed during a waning phase of regional water supply. Eberswalde low may have been dry throughout most of its history.

References:

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