Paleoenvironments: Geosciences

Geomorphic Relationships and Paleoenvironmental Context of Glaciers, Fluvial Deposits, and Glacial Lake Great Falls, Montana

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Glacial Lake Great Falls formed as Laurentide ice obstructed the Missouri River near present-day Great Falls, Montana (Alden 1932; Calhoun 1906). The sedimentologic dynamics associated with this geomorphic context can be interpreted based on studies by the United States Geological Survey (USGS) and, since 1995, the Museum of the Rockies Ice Age Research Program. Meltwaters from two alpine glaciers flowed into the lake. Till, glacio-fluvial, delta, and lacustrine deposits are present along the Sun River and Dearborn River drainages. These sediments record the geomorphic response connected with glaciation, fluvial aggradation and downcutting, and local base-level changes related to the lake.

Moraines within the Dearborn drainage grade to outwash terraces. Terraces are present along tributaries of the South Fork of the Dearborn (e.g., Cave Creek, Rogers Pass quadrangle). Colluvium and alluvium appear to have buried a Pleistocene entrance to Blacktail Cave. Age relationships can be determined based on travertine within Blacktail Cave. Buried cave fill contains fossils dating to about 10,270 B.P. (Hill 1996). Outside the cave, the colluvial and alluvial deposits form part of the geomorphic framework connected with the glacial, fluvial, and lake deposits of the Dearborn drainage. At least four Pleistocene terraces are present along the lower South Fork, and two higher benches exist within the Comb Rock quadrangle (Schmidt 1966).

There are parallels between the Dearborn moraine-terrace-lake geomorphology and the Sun River system to the north. They are connected by the timing of glaciation and changes in lake levels. In the Vaughn quadrangle, terraces grade to erratics interpreted as drift from grounded icebergs, indicating three shorelines between about 3,880 and 3,700 feet. Kame-delta sediments are found along the 3,800-foot lake margin. Lake sediments below

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about 3,716 feet are at about the elevation of a prominent delta. It grades laterally into outwash and lake deposits. Outwash-terrace gravels are traceable to moraines west of Augusta. The Sun River terrace grades downstream to delta sediments of the 3,480-foot lake level (Maughn 1961). Deposits of the lowest lake level are around 3,360 feet. Alluvium overlying Pinedale outwash contains Glacial Peak ash (Lemke et al. 1975).

Shorelines, lake, and terrace deposits are exposed along the Missouri River. At 3,900 feet the lake would have extended from the ice barrier near Great Falls into the Townsend Valley (Montagne 1979). At exposures along Holter Lake laminated calcareous (ca. 13–16% carbonate) silts and muds contain ostracods (Candonina sp. tentatively identified as cf. C. acuminata or cf. C. Acuta, the specimens are juvenile and rather difficult to identify to species level) as well as diatoms (order Centrales diatoms, tentative identification Stephano-discus sp. and some in the order Pennales diatoms, tentative identification Navicula sp.). Five bench surfaces of the “Old Terrace Gravels” and four bench surfaces of the “Younger Terrace Gravels” constrain the age of the lake deposits (Schmidt 1972). Shorelines in the Helena quadrangle at 3,900 feet (Stickney 1987) were being destroyed by development around the Helena airport in 1996. Within the Hauser Lake quadrangle, shore features are present at slightly lower than 3,800 to possibly as high as 4,000 feet. Lake rhythms are exposed along the northeast shoreline of Lake Hauser and along the Missouri River at elevations of less than 3,800 feet (Schmidt 1986).

Based on ice sheet dynamics it seems likely glacial lakes existed around Great Falls during the middle and late Pleistocene (during deposition of the Havre, Herring Park and Fort Assiniboine tills, cf. Fullerton and Colton 1986; Schmidt 1986; Stickney 1987; Vuke et al. 1995). The laminated lake sands and silts may provide absolute ages for these lakes using TL and OSL measurements, while chemical and isotopic studies of the ostracods could contribute detailed paleoenvironmental data. Other paleobiotic indicators are useful for inferring Pleistocene environments connected with the sedimentologic, stratigraphic and geomorphic records. Silty clay glacial lake sediment from near Cascade (Lemke et al. 1975: H23-H26) contained Pinus (pine), Juniperus (juniper), Pseudotsuga taxifolia (Douglas fir), Artemisia (sagebrush, wormwood), and Compositae (Composite family) (Leopold 1958b; pers. comm. to CLH 1997). Lake clays from below 3,360 ft (in the Benton Lake basin, USGS Paleobot Loc. No. D1241) reflect a coniferous assemblage dominated by pine but also containing forbs and grass. These assemblages suggest a forest landscape similar to what is now present at middle to low elevations in the region (Leopold 1958a; pers. comm. to CLH 1997). Extinct fauna from the Dearborn drainage include Arctodus simus (giant short-furred bear), Lepus arcticus (Arctic hare), Equus cf. conversidens (horse), Bootherium bombifrons (musk ox) and Microtus cf. paroperarius (Hibbard’s tundra vole) (Davis et al. 1996), while mammoth remains have been found along the Sun River. These geologic and paleobiologic records provide an opportunity to develop detailed paleoclimatic and paleoclimatologic inferences of the Rocky Mountains and northern Great Plains during the Pleistocene.

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