



Deflation origin of Adams and Bartlett Lake basins, Vermejo Park, New Mexico

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DEFLATION ORIGIN OF ADAMS AND BARTLETT LAKE BASINS, VERMEJO PARK, NEW MEXICO

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INTRODUCTION

Two large lakes, Adams and Bartlett, fill natural depressions in a gravel-covered pediment atop a high mesa on the east flank of the Sangre de Cristo Mountains in northern New Mexico (see Pillmore and Scott, this Guidebook, Fig. 6). The lakes are about 6 mi (10 km) west of Vermejo Park in Colfax County and can be reached by private ranch roads. These lake basins are among several natural basins that occur in the Vermejo Park area, but most are shallow, small and are not surrounded by a gravel-covered bench. Adams and Bartlett Lakes are noteworthy because they are large, deep and are found on a gravel-armored surface.

The positions of these lakes, inset in a gravel-covered pediment, require an explanation. Possible origins fall into two categories: catastrophic and noncatastrophic. No evidence of a catastrophic event can be found in the area. Of noncatastrophic natural processes, deflation by wind seems to be the most likely origin.

ADAMS AND BARTLETT LAKES

Figure 1 shows the detail of the lakes and the configuration of the mesa on which they lie. Adams Lake, somewhat irregular in shape, partly fills a gourd-shaped basin that trends roughly east-west. The basin is about 3,000 ft (915 m) by 2,000 ft (610 m) and is about 55 ft (17 m) deep; it ordinarily contains 30-40 ft (9-12 m) of water. The eventual spillway of the lake is only about 15 ft (5 m) above normal water level. If the lake were ever to overflow, the spillway, a low ridge that separates the lake from the valley floor of Castle Rock Park,

would quickly be eroded. Further, the spillway is the site where stream piracy will ultimately occur.

Bartlett Lake, which is more symmetrical, occupies a slightly larger, elongated basin that is roughly 3,800 ft (1,160 m) long and 2,200 ft (670 m) wide; its long axis trends nearly east-west. The basin is about 100 ft (30 m) deep and is usually kept filled with about 50-60 ft (15-18 m) of water. Bartlett Lake does not rest so precariously near the edge of the mesa, and overflow would simply drain out of the southeast side of the lake onto the gravel of the pediment. The basins have very limited catchment areas; lake levels are maintained by means of a fill ditch from Leandro Creek (Fig. 2). Without water from the ditch the lakes would dry up; this can be seen in the aerial photograph taken in June, 1946 (Fig. 3). In both lakes the altitude of the normal water level is 8,690 ft (2,650 m) above sea level, as shown on the U.S. Geological Survey topographic map of Ash Mountain 15-minute quadrangle (1962). Altitudes on the Adams-Bartlett Mesa near the lakes range from 8,600 to about 8,800 ft (2,620 to 2,680 m).

Shallow elongated or saucer-shaped depressions are common in wide valleys and on top of ridges and mesas along the Rocky Mountain front; they also occur in the Vermejo Park area. One of the largest, Marys Lake, occupies a broad elongated basin in the north end of Van Bremmer Park, about 3 mi (5 km) south of Adams-Bartlett Mesa. About 3-4 mi (5-6 km) southeast of the mesa, at about the same elevation, lie three small shallow basins; and near the Colorado-New Mexico state line on the Spring Canyon road, about 7 mi (11 km) to the northeast, is a broad basin at about 9,050 ft (2,760 m) altitude. A small deflation basin also occurs in sandstone of the Poison Canyon Formation about 6.5 mi (10 km) northeast of Vermejo Park, along the road to Raton (Fig. 4). The broad valley of Van Bremmer Park and areas to the south contain other similar natural depressions. All of these are considered to be the result of wind scour, like the basins containing Adams and Bartlett Lakes, but none are so deep or occur in such a unique setting as the basins on the pediment.

GEOLOGIC SETTING

The basins of Adams and Bartlett Lakes were formed on a pediment that is probably related in age and origin to the San Miguel surface of Levings (1951) and the Rayado surface of Smith and Ray (1943) (see Pillmore and Scott, this Guidebook). The pediment forms a planar surface that lies about 350 ft (107 m) above the adjacent valley floor of Castle Rock Park and slopes gently east at about 2°. Altitudes on the pediment range from 9,000 ft (2,740 m) on the western end to about 8,500 ft (2,590 m) on the eastern end.

The pediment bevels tilted rocks of the Upper Cretaceous and Paleocene Raton and Poison Canyon Formations (Fig. 5), and overlies the central portion of the Castle Rock coal district of the western Raton coal field. At the western edge, the pediment gravel rests on top of a hogback formed by steeply

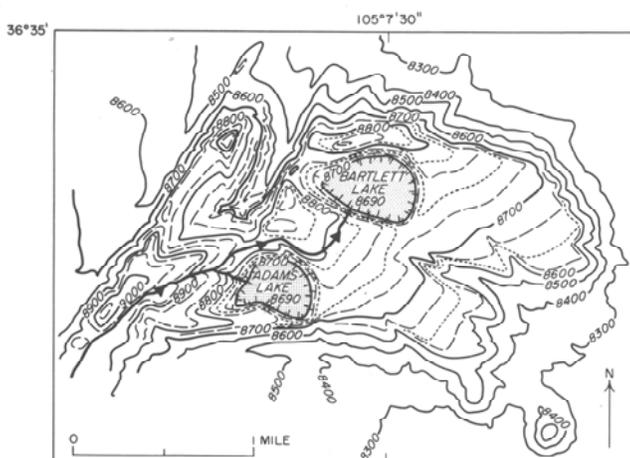


Figure 1. Contour map of Adams-Bartlett Mesa showing lakes and catchment basins. (Base from U.S. Geological Survey 1:24,000 scale preliminary topographic maps, Ute Creek 1 NE and NW.)

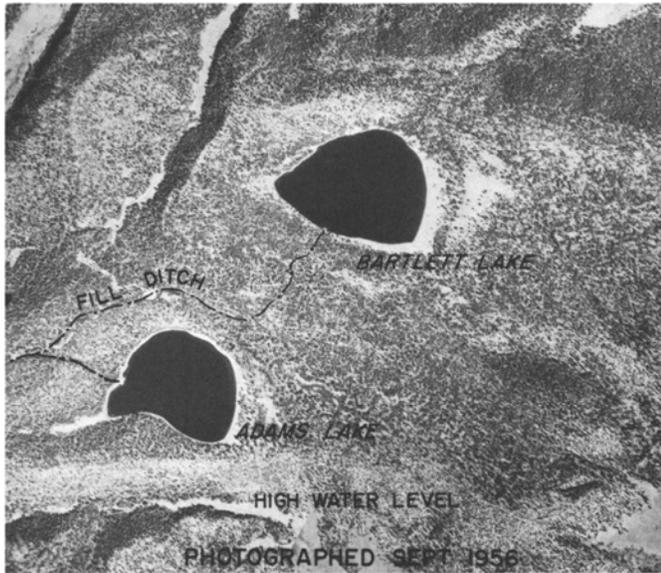


Figure 2. Aerial photograph taken in 1956 showing fill ditch and lakes full of water.



Figure 3. Aerial photograph taken in 1946 showing Bartlett Lake dry and Adams at a low water level.

dipping conglomeratic sandstone at the base of the Raton Formation. The dip flattens rapidly to the eastern margin of the mesa, where coarse-grained arkosic sandstone beds of the Poison Canyon, dipping gently to the east, nearly parallel the slopes of the pediment.

Southwest of the lakes, tilted, lenticular or pod-shaped beds of friable, very coarse grained to granule, sugary-textured, arkosic sandstone of the Poison Canyon form cavernous outcrops. The beds strike to the northeast toward the lakes and are suspected to underlie and be related to the origin of the lake basins.

Remnants of two levels of pediments can be observed on the mesa: one level capping the high point on the hogback and nearly surrounding Bartlett Lake, and a slightly lower level partially enclosing Adams Lake. The 20 or 30 ft (6 or 9 m) separating the two levels is not considered significant in regard to the origin of the lake basins.

The gravel covering the pediment appears to be mostly less than 10 ft (3 m) thick; it is composed largely of hard, extremely resistant, fine-grained, nearly porcellanitic rhyolite (Pillmore and Scott, this Guidebook). Clasts range from less than 1 in. (2.5 cm) to greater than 5 ft (1.5 m) in diameter and vary



Figure 4. View of small deflation basin cut into Poison Canyon Sandstone near mine road northeast of Vermejo Park, New Mexico.

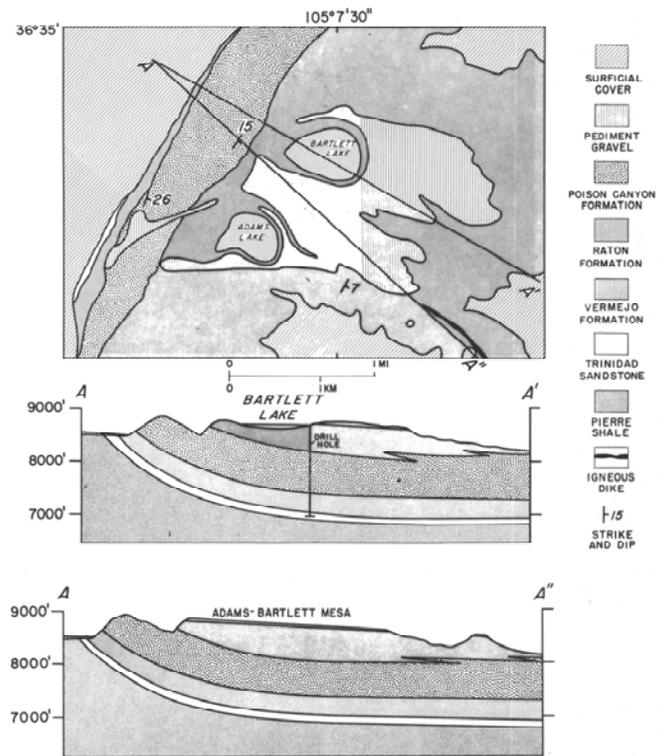


Figure 5. Geologic map and cross sections of Adams-Bartlett Mesa. (Base from U.S. Geological Survey 1:24,000 scale preliminary topographic maps, Ute Creek 1 NE and NW.)

from subround to angular. The rock develops a distinctive yellowish-orange weathering rind about 0.25 in. (0.6 cm) thick. The larger fragments commonly display cusps or concave faces that might be related to percussion during transport, but spalling during the weathering process has made it difficult to determine original shapes. Other lithologies in the gravel include arkosic sandstone and conglomerate from the Sangre de Cristo Formation, quartzitic sandstone from the Dakota Sandstone, a variety of metamorphic rocks and locally derived siltstone and sandstone. Although the pediment on which the gravel was deposited probably was uneven and channeled, the surface of the gravel cap is nearly planar—except for the lake basins.

POSSIBLE ORIGINS OF THE LAKE BASINS

Of two likely categories of origin, catastrophic and noncatastrophic, the latter appears more likely. Cratering due to catastrophic events such as meteorite impact, volcanic activity or solution-cavity collapse would have left direct evidence, and interpretation of these events would be straightforward. The complete absence of raised rims around the basins and of lithologic or structural disturbance precludes cratering by meteorite impact or volcanic action. Subsidence into caverns does not seem probable because no soluble materials occur within a reasonable depth below the surface; the nearest limestone is only about 8 ft (3 m) thick and lies several thousand feet beneath the pediment surface.

Noncatastrophic causes offer much more reasonable solutions to the problem of how the basins formed. Glaciation, piping and deflation are all natural mechanisms that could account for formation of basins or depressions such as Adams and Bartlett Lakes. Glacial action is unlikely as no moraines or till are present in the vicinity. Glacial activity sufficient to scour out the depressions would have resulted in some disruption of the pediment cover.

Piping (Wright, 1964) or removal of material by underground conduit, with accompanying surface subsidence or collapse, could be the mechanism for formation of the basins; however, evidence for removal of such a large amount of material by piping and related collapse of sufficient magnitude to have formed the lake basins is not present. The basin margins do not show structural evidence of collapse, nor does the adjacent pediment show any distortion. The mesa walls below the lakes do not show springs, landslides or any concentrations of material due to piping action. Consequently, we must turn to the remaining and, in my opinion, only reasonable mechanism—deflation.

ORIGIN BY WIND ACTION

Wind scoured out and shaped the basins; however, simple deflation cannot account for the removal of the 5-10 ft (1.5-3 m) of pediment gravel that should have covered the sites of the lake basins. To account for this absence of gravel, topographic inversion is proposed: positive areas once stood over the present depressions filled by the lakes.

Eastward-flowing streams cut the pediment surface when climatic conditions were favorable for pedimentation. The process, if completed, would have resulted in the formation of a featureless pediment apron all along the highland area; however, it was interrupted, presumably by a change in climatic conditions, and the streams again began cutting downward, probably adjacent to the pediment as we know it today. The result was that low sandstone ridges or hills lying above the

present sites of the lakes were abandoned by the streams and left standing above the surrounding pediment gravels. At a later time, wind and water removed these ridges and sculptured the basins. Alternate wetting and drying decomposed the sugary-textured arkosic sandstone (Fig. 6), and the resulting loose sand grains were easily removed by wind action to form and deepen the basins. In nearby areas, where similar armoring conditions did not exist, many shallow basins were deflated. In these areas, the depressions are mostly in easily eroded flat-lying arkosic sandstone of the Poison Canyon Formation.

Evidence of past wind action remains on the Adams-Bartlett Mesa today; an area of eolian sand is deposited over the gravel on the east side of Bartlett Lake (Fig. 7). A pit dug into this sand revealed 4 ft (1.3 m) of windblown material ranging in size from silt to coarse sand. The profile of the soil formed on the deposit shows a 4 in. (10 cm) thick, calcareous, dark organic root "A" horizon, underlain by a 20 in. (50 cm) thick, noncalcareous, dark-brown "B" horizon showing columnar structure, underlain by 24 in. (60 cm) of calcareous, white-streaked gray sand "Cca" horizon resting on cobbles of punky rotting rhyolite of the gravel cap. The degree of soil development indicates that the deposit is probably late Wisconsin or early Holocene in age and that the main sculpturing of the



Figure 6. Close-up photograph showing fragments and sand grains that have weathered out of sandstone of the Poison Canyon Formation. Light-toned areas are bedrock.

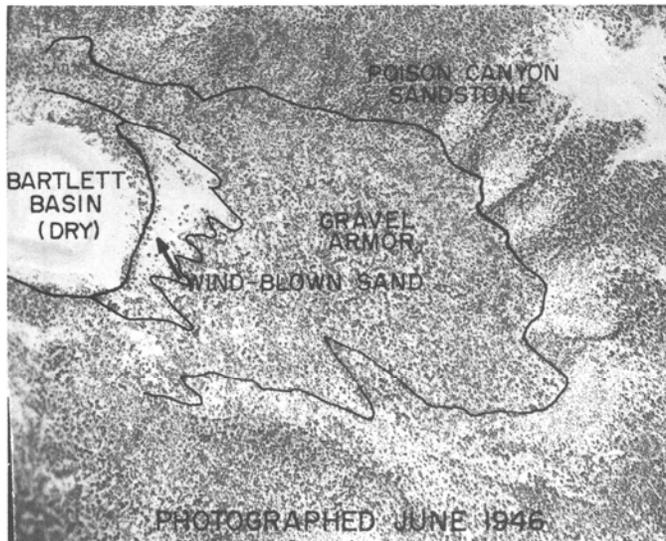


Figure 7. Aerial photograph showing windblown sand deposit on east side of Bartlett Lake.

basins occurred during the late Pleistocene. Additional evidence of wind action include striations on wind-polished surfaces of various rhyolite boulders on the east side of Bartlett Lake (Fig. 8). Spalling action due to weathering of the rhyolite tends to obliterate evidence of the striations. Where the striated surfaces are preserved, the striae indicate an easterly or southeasterly wind direction. The steep north and south sides of the basins are accounted for by wave and wind action undercutting the shores of the lakes. The basins were apparently elongated parallel to the prevalent wind direction.



Figure 8. Wind striations in rhyolite boulder.

CONCLUSIONS

A unique combination of topographic inversion, mechanical weathering and of water and wind formed the two large depressions containing Adams and Bartlett Lakes. Formation of these basins by other than these processes is discounted because of lack of evidence. Striated boulders and deposits of eolian sand support a deflation origin.

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