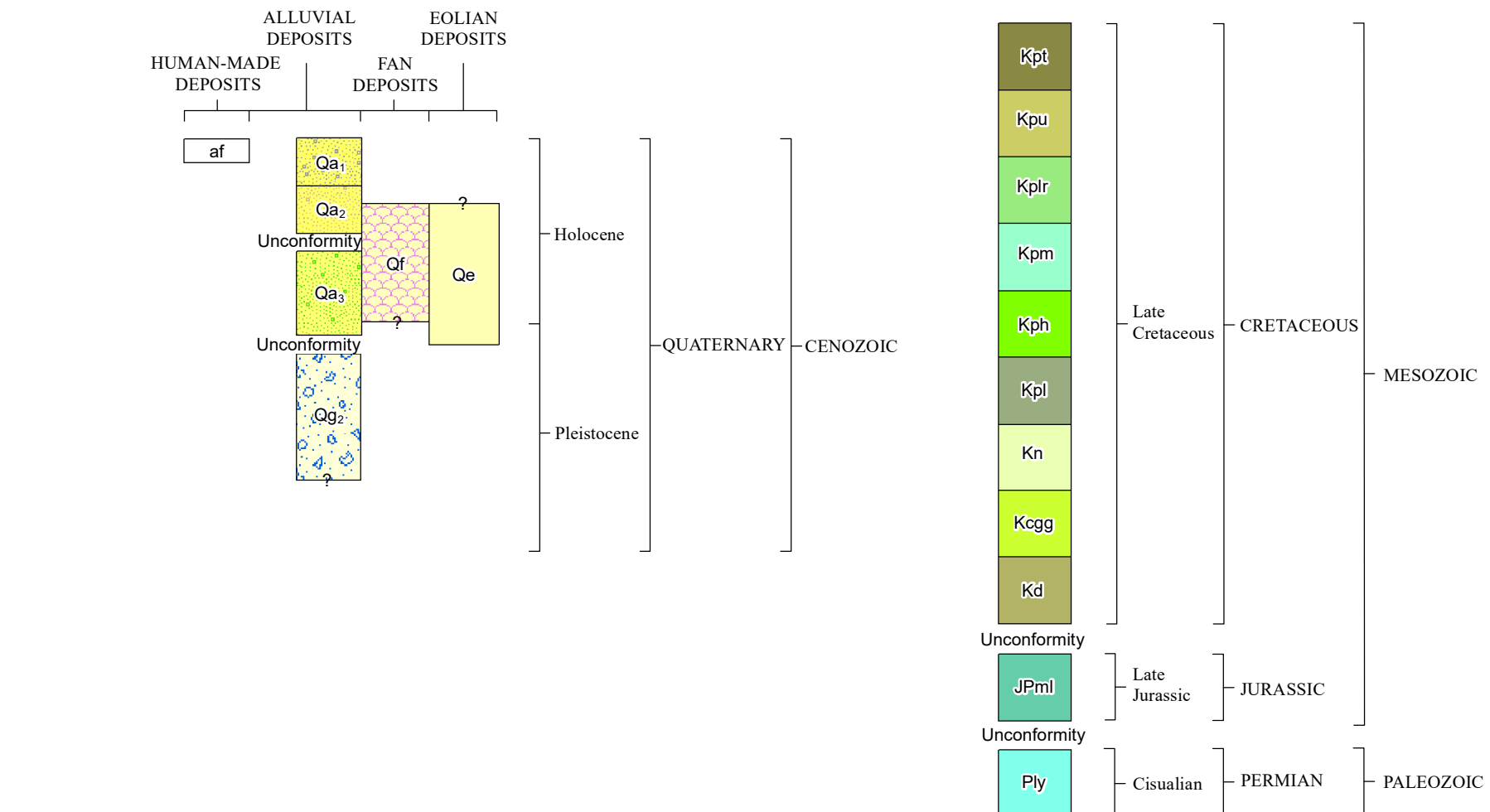
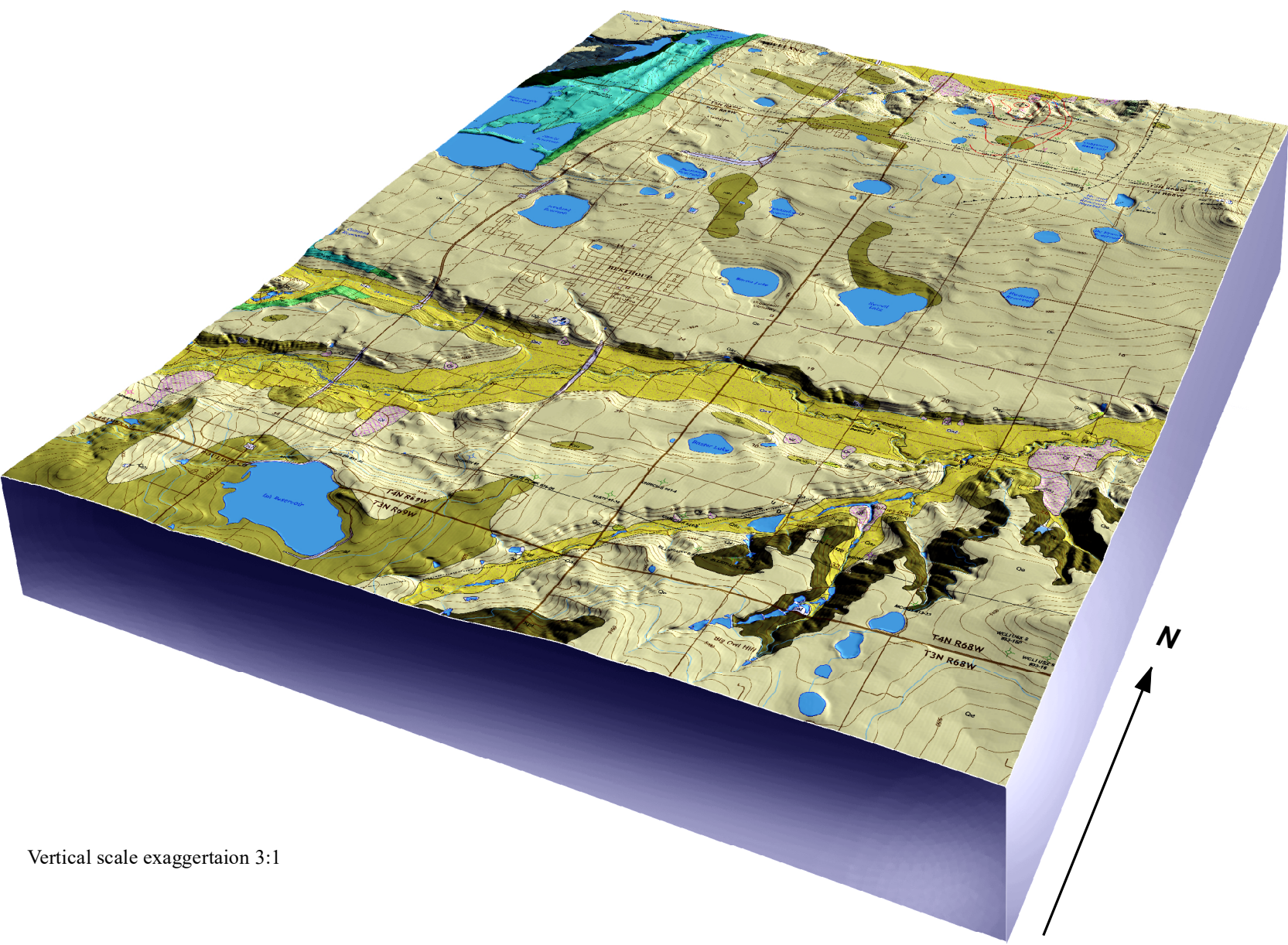


CORRELATION OF MAP UNITS



3-D OBLIQUE VIEW OF GEOLOGIC MAP



Vertical scale exaggeration 3:1

GEOLOGIC HISTORY

The Berthoud quadrangle lies in the northern part of the Colorado Piedmont, near the western margin of the Denver Basin and approximately midway along its length. Like much of the piedmont the quadrangle has low relief (365 ft, 111 m). The uppermost and youngest bedrock, underlying all of the quadrangle, is the Pierre Shale (Kp), a marine formation deposited in the Cretaceous Interior Seaway during the Late Cretaceous (100-66 Mya). Oil and gas wells in the Berthoud quadrangle have penetrated Cretaceous through Permian formations below the Kp (cross sections A-A' and B-B'), but none of these formations are exposed in the quadrangle. The Kp strata dip gently east to southeast and older Kp members are exposed in the northwestern part of the quadrangle (Scott and Cobban, 1965). Structural up-warping along the present-day Front Range occurred during the Laramide orogeny, which began 70 Mya (Weimer, 1996).

In the Berthoud quadrangle the overall structural trend is southwest to northeast, with local variations due to folding (Scott and Cobban, 1965). Dip is eastward, being moderate to steep on the quadrangle's western side and becoming gentler eastward toward the basin axis. Weimer (1996) infers that the Windsor Wrench Fault Zone (WRFZ) passes southwest to northeast through the northern part of the quadrangle. Oil and gas well data in the area of the inferred fault are very sparse, however, and the zone is not shown here. A thrust fault in the northeastern part of the quadrangle is mapped by Weimer (1996) as terminating to the south against the WRFZ. The thrust fault is confirmed by well data (examined as part of the present mapping effort) and is shown on cross section A-A' and on the map. Adjacent to the west of this fault is a minor dome structure mapped by Weimer (1996) and also indicated by well data. The dome possibly was caused by upward movement on the west side of the thrust fault. A second thrust fault is mapped by Weimer (1996) on the eastern side of the quadrangle, but is in an area of no well data and is not shown here. The Johnstown Wrench Fault Zone is an oblique-slip fault with normal vertical displacement (Weimer, 1996) and trends southwest to northeast through the southeast corner of the quadrangle. The zone is confirmed by well data and is shown on cross section B-B' and the map. Right-lateral movement along this zone occurred during Cretaceous time and was intermittent from 110 to 65 Mya (Weimer, 1996), an interval that includes the beginning of the Laramide orogeny. The east limb of the south-plunging Berthoud anticline (Scott and Cobban, 1965) is exposed between Weld and Ryan Gulch Reservoirs and also along Dry Creek at the east boundary of the quadrangle. The axis of the anticline lies west of the quadrangle.

The present-day topography results from evolution of the South Platte River and Arkansas River drainage basins during Quaternary time, beginning with removal of Miocene and older Tertiary rocks that once covered the Upper Cretaceous strata (Madsen, 1991). The dominant Quaternary deposits of the Colorado Piedmont (including the Berthoud quadrangle) are fluvial sediments of the South Platte and Arkansas Rivers and their tributaries, and also eolian sediments derived both from these stream valleys and from bedrock exposures (Madsen, 1991, 2016). The Little Thompson River in the Berthoud quadrangle lies within the South Platte drainage basin. The Quaternary history of the Berthoud quadrangle began with erosion of the Neogene landscape, likely during Gelasian and Calabrian time (2.58 to 0.781 Mya). This was followed by deposition of sand and gravel (Qg) on valley floors during the middle and late Pleistocene. Subsequent erosion during late Pleistocene time topographically inverted these ancient valleys and left isolated remnants of Qg on some uplands. The Qg exposures at Twin Mounds possibly is a deposit of an ancestral Big Thompson River. This exposure aligns geographically with and likely correlates with Qg bodies in the Johnstown quadrangle (adjacent to the east) that are mapped in a swath southwest of and parallel to the present-day river (Palkovic and Morgan, 2017). The other two Qg bodies in the Berthoud quadrangle may represent different ancient drainages. Erosion carved the Little Thompson River valley during the late Pleistocene, and deposited sand and gravel of the Holocene alluvium three (Qa3). Subsequent erosion and stream incision during Quaternary time left behind a few Qa3 deposits at elevations above the present valley floor. Beginning during the recession of the last glaciation in the late Pleistocene, and continuing into the Holocene, eolian deposits (Qe - loess) were deposited and later reworked or removed in places. Aggradation in the Little Thompson River flood plain occurred during the late Holocene, depositing Quaternary alluvium two (Qa2) in wide valley floors. Incision and some aggradation followed during the late Holocene, cutting into the Qa3 valley floors and depositing alluvium one (Qa1) in lower and narrower stream courses.

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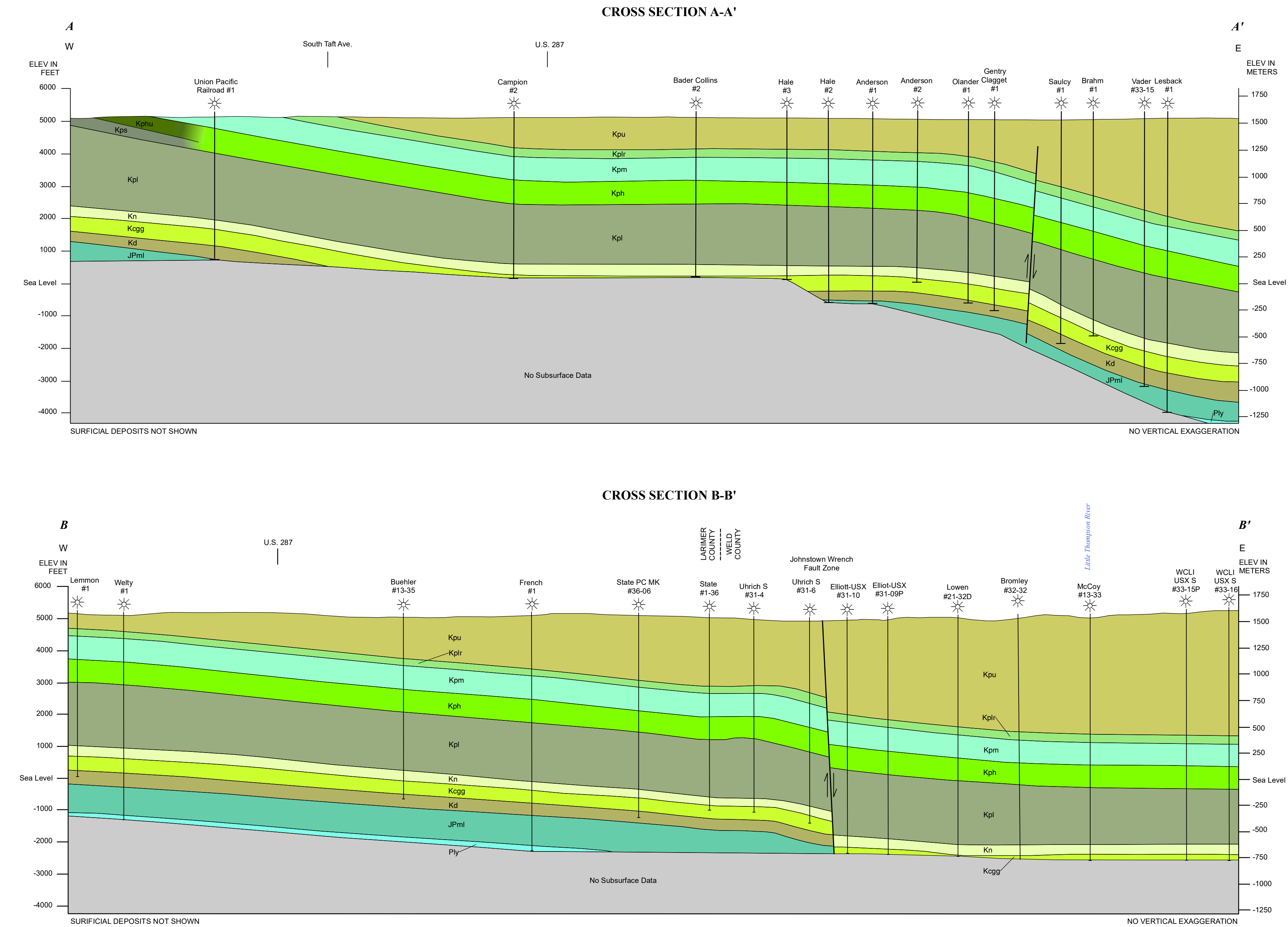
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GEOLOGIC MAP OF THE BERTHOUD QUADRANGLE, LARIMER, WELD, AND BOULDER COUNTIES, COLORADO
CORRELATION OF MAP UNITS, 3-D MAP, GEOLOGIC HISTORY, AND CROSS SECTIONS

By Stephen M. Keller, Kassandra O. Lindsey, and Matthew L. Morgan
2017