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Field-trip guide to the Quaternary stratigraphy and faulting in the area north of the mouth of Big Cottonwood Canyon, Salt Lake County, Utah

by

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FIELD-TRIP GUIDE TO THE QUATERNARY STRATIGRAPHY AND FAULTING IN THE AREA NORTH OF THE MOUTH OF BIG COTTONWOOD CANYON, SALT LAKE COUNTY, UTAH

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This field-trip guide describes the Quaternary stratigraphy and faulting in a small area (about 1 km^2) undergoing intensive gravel-mining operations north of the mouth of Big Cottonwood Canyon, about 15 km south of Salt Lake City (fig. 1). The area lies in the Sugar House and very northern part of the Draper, Utah, 7 1/2-min quadrangles (fig. 2). Mapping of surficial deposits in this area has been published by Morrison (1965) and by Van Horn (1972).

The trip log begins on the exit off eastbound I-80 onto southbound I-215, about 1 km west of the mouth of Parleys Canyon.

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0.0 Exit off eastbound I-80 onto southbound I-215. Bonneville shoreline (altitude about 5,200 ft) is visible on the mountain front.

0.2 View on right of the valley of Parleys Creek. Scattered outcrops expose fine-grained lacustrine deposits of the last and possibly of the next-to-the-last (penultimate) lake cycles, which are overlain by deltaic gravels deposited at the Provo shoreline (altitude about 4,820 ft) and alluvial gravel graded to this delta. These gravels are exposed in the abandoned gravel pit at 2 o'clock.

0.7 View on the right of the valley of Parleys Creek.

1.1 Crossing the valley of Parleys Creek at the mouth of Parleys Canyon.On the left are steeply north-dipping redbeds of the Triassic Ankareh Formation and quartzite of the Gartra Grit Member of the Ankareh. Pale-orange Nugget Sandstone (Triassic ? and Jurassic ?) overlies the Ankareh on the north canyon wall. To the right of the highway, gullies and excavations expose, in descending order, (1) coarse-grained alluvial gravel graded to the Provo shoreline; (2) lacustrine silt, sand, and gravel of the last lake cycle; (3) buried soil developed in alluvium and loess(?); (4) lacustrine deposits of the penultimate lake cycle; (5) alluvium; and (6) shattered bedrock. The K-horizon of the buried soil, which dips to the south and defines the north wall of a paleovalley, is well exposed in the gully closest to the highway. Apparently, the ancestral valley of Parleys Creek lay south of the present valley during the interpluvial preceding the last lake cycle.

1.7 The uppermost row of houses lies just below the Bonneville shoreline, which here is composed of a small gravel embankment and minor eroded cliff.

2.5 Valley of Mill Creek. Alluvial strath terraces are cut into deposits of Lake Bonneville.

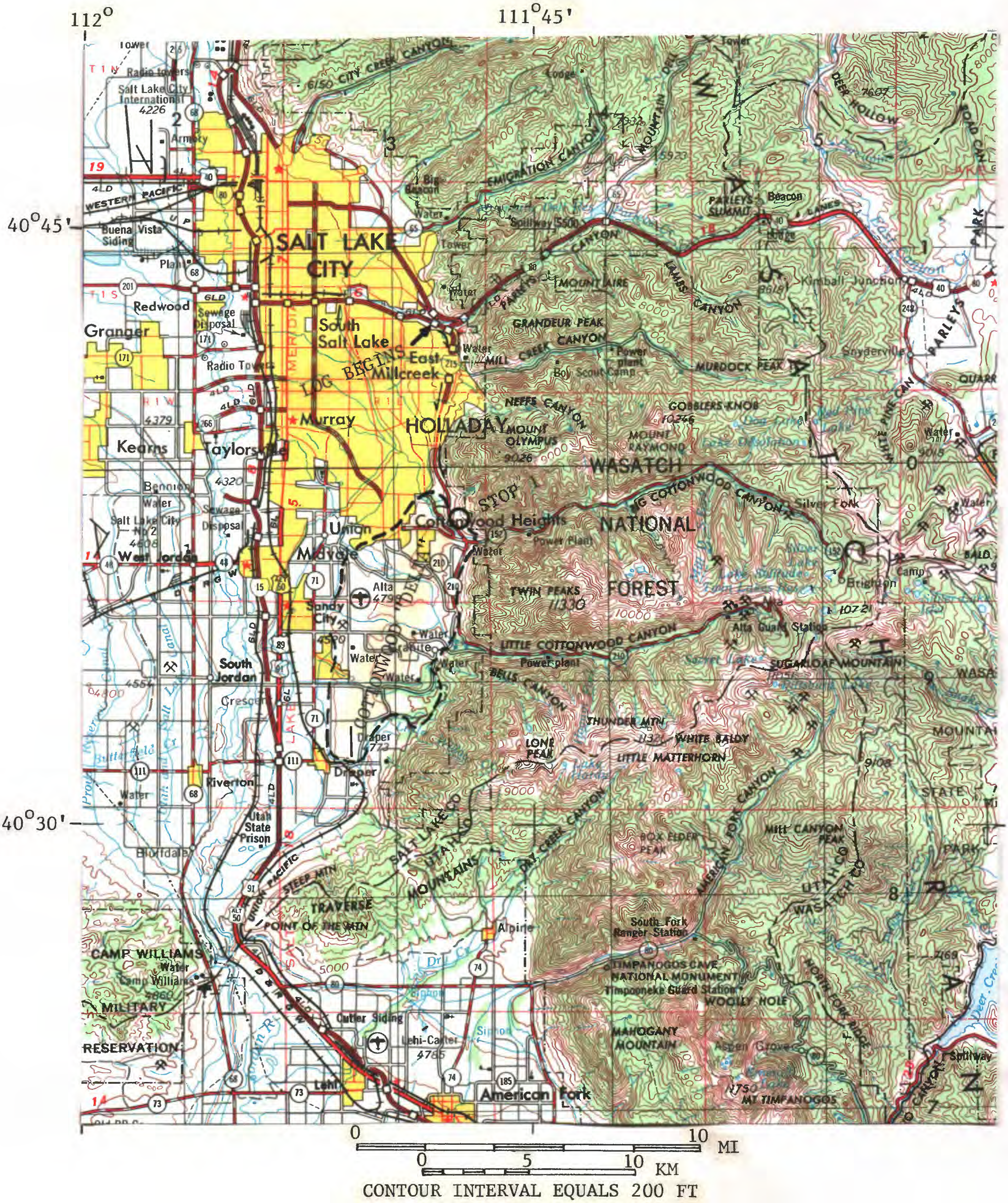
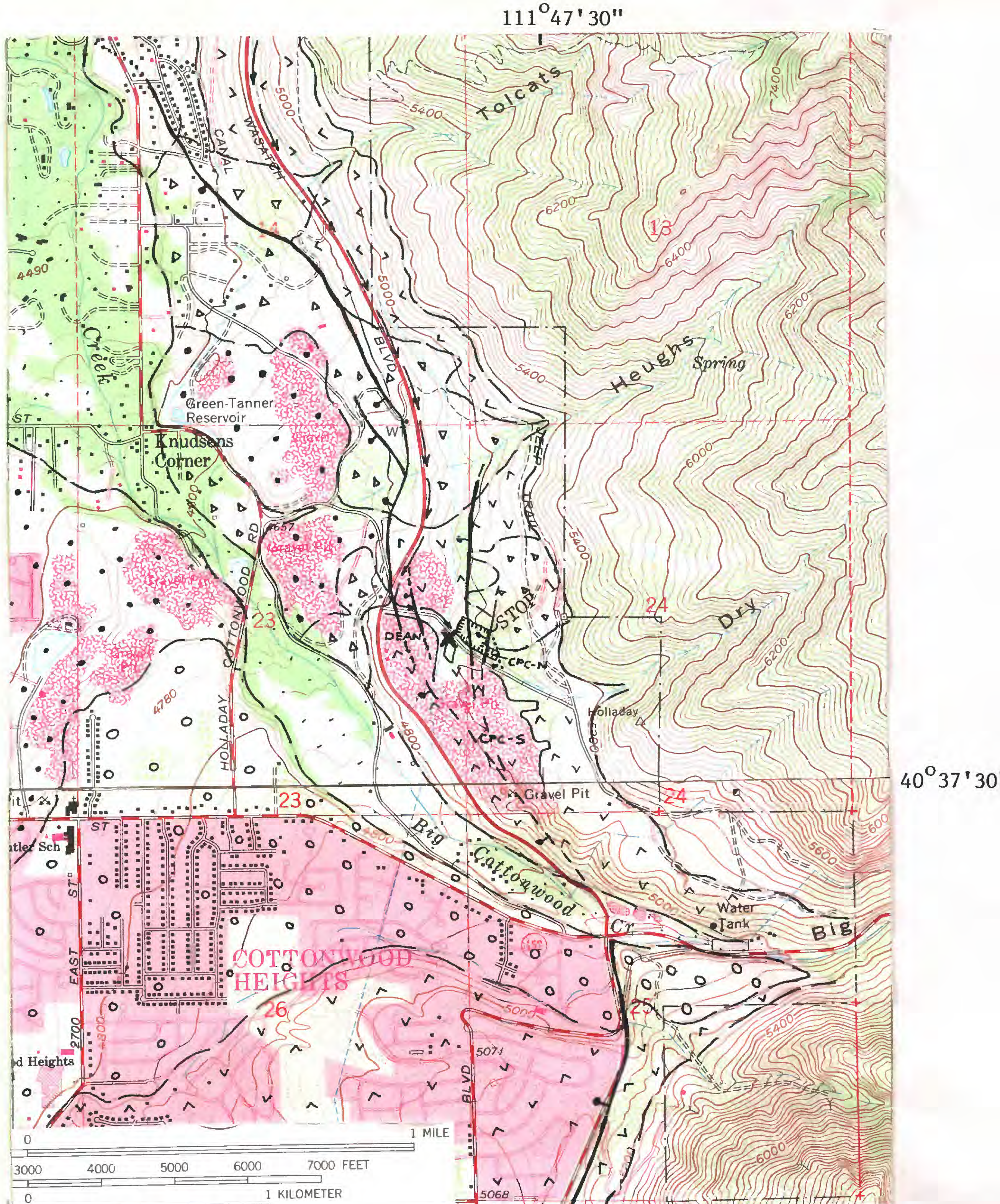
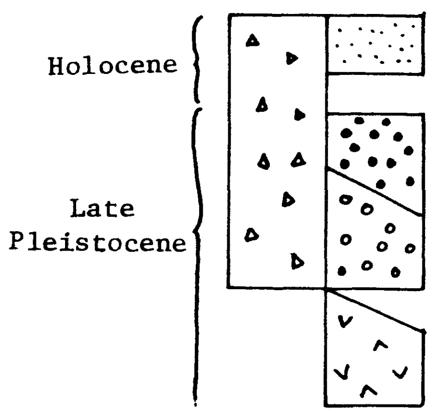


Figure 1. Field-trip route shown on a portion of the Salt Lake City $1^{\circ} \times 2^{\circ}$ quadrangle.



Contour interval equals 40 ft

Figure 2. Generalized surficial geologic map of the area at the mouth of Big Cottonwood Canyon. Explanation of map units is on following page.



Alluvium of low terraces and flood plain of Big Cottonwood Creek

Fan alluvium

Deltaic gravel deposited at and below Provo shoreline

Alluvium of terraces graded to deltas at and below Provo shoreline

Sediments of outwash-fan-and-delta complex deposited during lake transgression to and stand at Bonneville shoreline

Fault, ball and bar on downthrown side; dashed where approximately located

Contact

Correlation and explanation of map units shown on geologic map (fig. 2).

2.9 Olympus Hills Shopping Mall, on left, is located on fan gravels derived from Neffs Canyon (10 o'clock). The steep slope ahead is the north face of Mt. Olympus, which is composed of quartzite of Cambrian and Precambrian age.

3.6 Exposures on right are of lacustrine sand of the last lake cycle.

4.1 End of I-215; merge onto Wasatch Blvd. On the left and ahead, the Bonneville shoreline is visible on Mt. Olympus. The lake deposits here consist largely of coarse-grained gravel.

4.7 View to the right of the Jordan Valley and Oquirrh Range.

5.7 Views ahead are of the combined outwash fans and deltas of Big and Little Cottonwood Creeks (fig. 1). The highest surface is of the outwash-fan-and-delta complex that was deposited during Pinedale Glaciation and during the transgression to and the stand at the Bonneville shoreline. This landform was incised by Big Cottonwood Creek during the rapid fall of the lake from Bonneville to Provo levels during the Bonneville flood. Straths cut at this time can be seen on the south side of Big Cottonwood Creek. Classic Gilbert-type deltas, deposited at and below the Provo shoreline by the streams that cut the strath terraces, are being mined for gravel. The long, steep foresets of these deltas are visible in a few of the pits. The great bulk of deposits at the Provo shoreline is due to the large volume of sediments in the high-shore zone at the mouths of major streams that were available for erosion and redeposition following the rapid lake-level change.

6.1 The steep slope on the right, beyond the line of telephone poles, is a fault scarp formed in lacustrine sand and gravel of the last lake cycle and overlying alluvial-fan gravel of Holocene age. The scarp runs subparallel with Wasatch Blvd. up to our turnoff ahead. The maximum scarp height is about 24 m; the maximum net tectonic offset is about 13 m.

6.3 On the left, the Bonneville shoreline is visible on the slope above the white wall. Drive onto the fan of Heughs Canyon, which is composed of poorly sorted, coarse-grained, gravelly alluvium of latest Pleistocene and Holocene age.

6.8 On the left, old gravel pits expose lacustrine gravel, silt, and sand of the last lake cycle (north end) and outwash of Pinedale age from Big Cottonwood Creek (south end).

7.1 Turn left onto the road to the Holladay Gun Club. Altitude at turnoff is about 4,835 ft. Gravel pits on the right (Deane and Sons) expose outwash of Pinedale age that was deposited in a fan graded to a rising Lake Bonneville. Two faults cut through this pit and account for a net displacement of about 3 m.

7.3 Road grade levels off; park on turnout on right.

STOP 1

Gravel-mining operations have caused substantial topographic inversion here. The road ahead follows the bottom of the valley that drains Dry Hollow, a small, steep basin on the mountain front. The parking turnout is on a bench that is formed by an outwash fan blanketed with lacustrine deposits. The slope ahead is bounded by a fault scarp; its relief is the product of faulting that occurred primarily prior to the last lake cycle. The Bonneville shoreline is not easily discernible ahead, but lies at the base of the bedrock outcrops on the mountain front. The shoreline is visible to the north just above the roof line of the brown house.

The bedrock in the local drainages on the mountain front consists of quartzite, shale, and siltstone; clasts in alluvium derived from these drainages are almost all of rusty-brown to buff quartzite. Lacustrine gravel in this area was mostly transported from the north and is composed almost entirely of varicolored quartzite. Outwash from the Big Cottonwood drainage consists predominantly of quartzite with some carbonate rocks and a small but conspicuous component of plutonic rocks of Tertiary age.

In the gravel pit on the right, lacustrine sand, fine gravel, and silty sand overlie a discontinuous stone line formed on lacustrine gravel with long northwest-dipping beds. The base of the lacustrine gravel is characterized by a nearly continuous stone line formed on outwash of Pinedale age.

In the main pit and trench on the east end of the pit on the north side of the road, we will examine:

1) Outwash and lacustrine deposits of the last glacial/lacustrine cycle.
2) Outwash and lacustrine deposits of the penultimate glacial/lacustrine cycle.
3) The deposits, soils, and unconformity between these units.
4) Disruption of these units by faulting.

<u>CAUTION:</u> This pit was only recently abandoned and the walls are unstable. Material is constantly raveling and slumping. Be aware of others below you and above you when walking on slopes covered with loose material.

The main part of the pit exposes three conspicuous units that record, directly or indirectly, the transgression of Lake Bonneville. In the lower half, outwash of Pinedale age from Big Cottonwood Creek consists of poorly sorted gravel and sand with lenses of sand. Bedding is generally planar with some low-angle cross-stratification. A finer grained unit overlies the outwash. It consists of laterally continuous beds and discontinuous lenses of laminated to thickly bedded marly silt and plant imprints, fine sand, and minor silty clay, interbedded with lenses and beds of cross-stratified sand and fine gravel. In the fine-grained beds, ripple-drift, cross-laminated fine sand is common. The upper few meters of the northeast corner of the pit consist of lacustrine gravel, characterized by good rounding and sorting and inclined stratification.

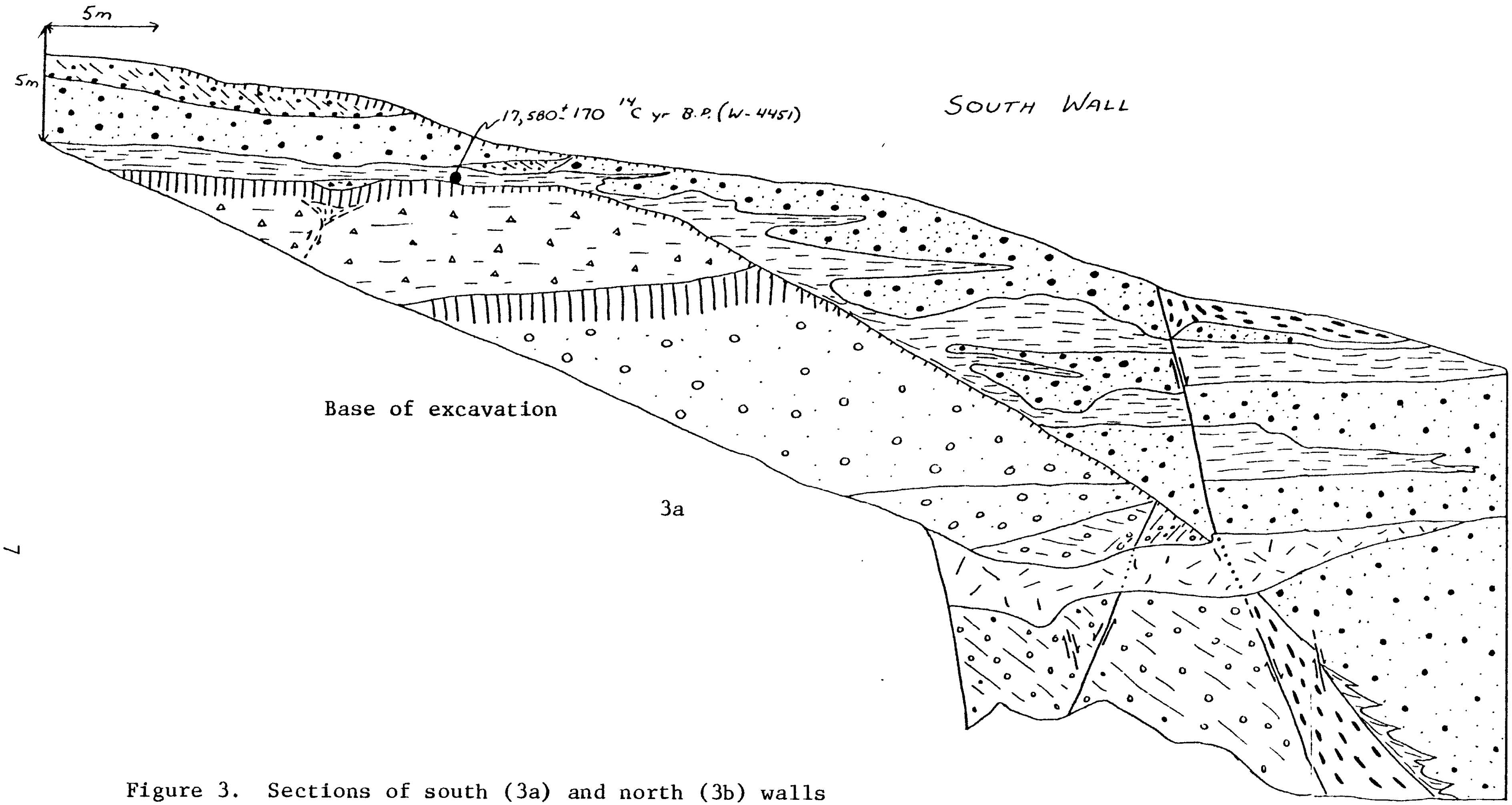
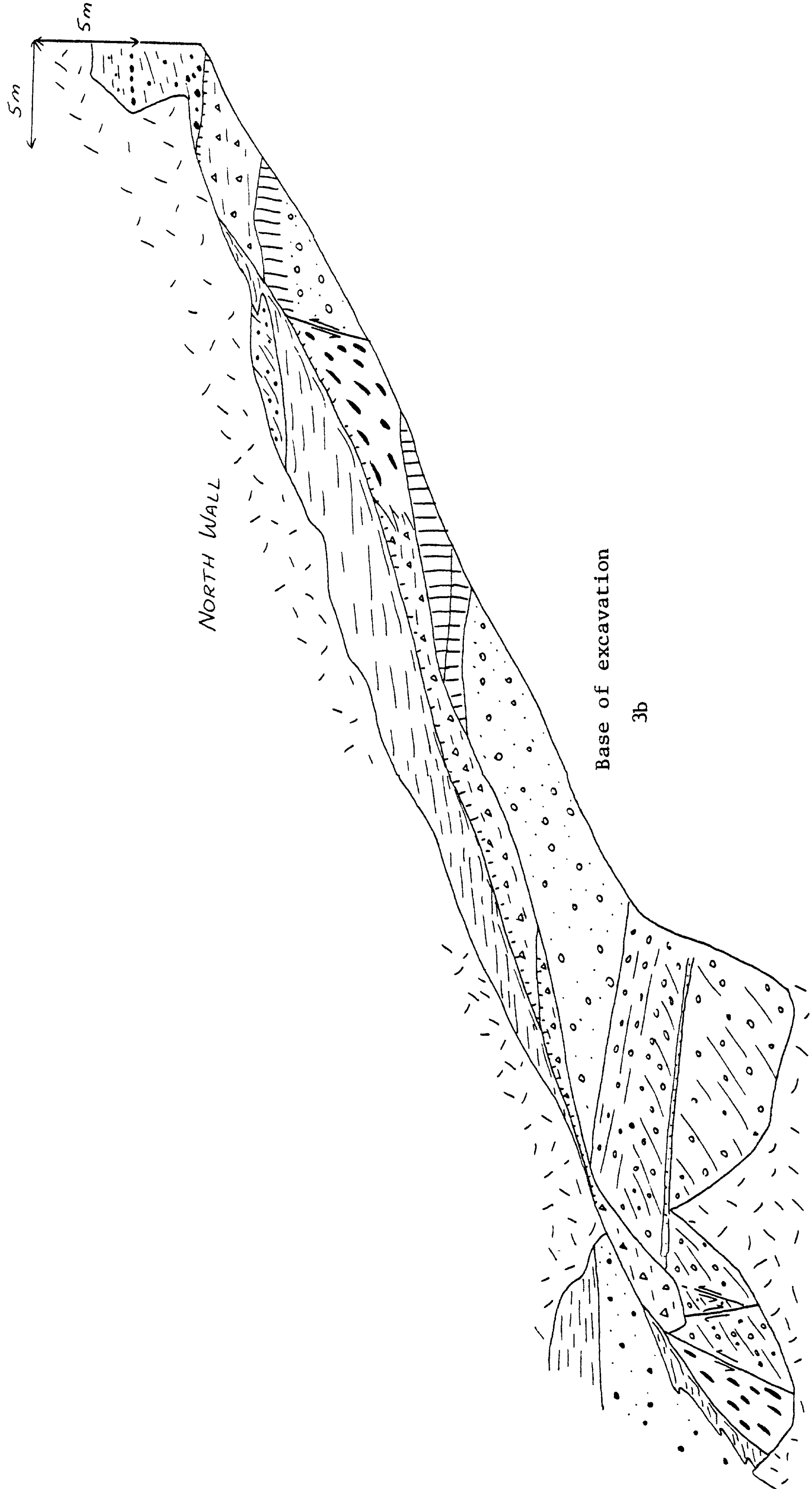
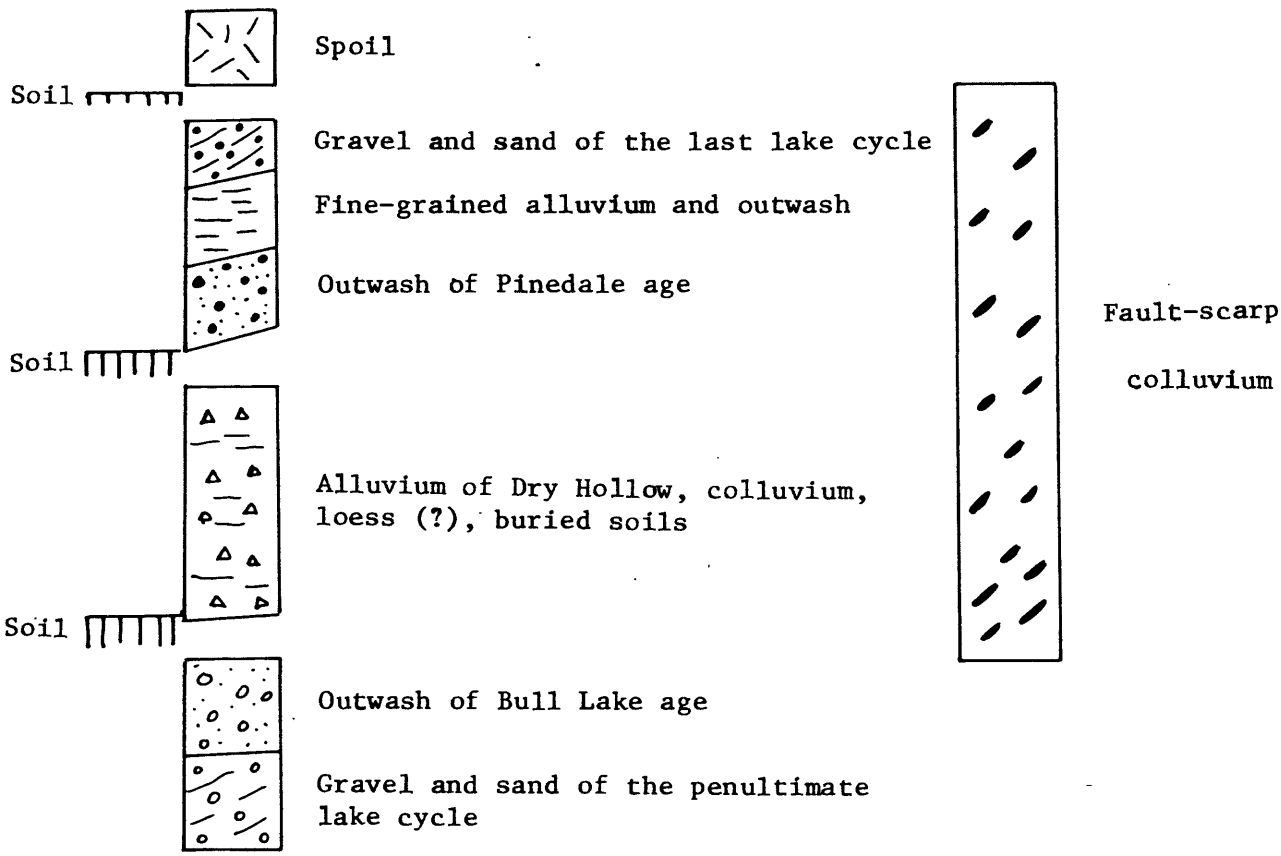


Figure 3. Sections of south (3a) and north (3b) walls of trench at east end of pit on north side of road to gun club.



3b



Correlation of units shown on trench sections (fig. 3). Thin deposits of colluvium are included in soils. Age relationships of fault-scarp colluvium may become more tightly constrained by future studies.

The trench (fig. 3) on the east end of the pit exposes a portion of the landscape that was buried by outwash and lacustrine sediments. Older outwash (Bull Lake), lacustrine gravel (penultimate lake cycle or Alpine Formation of previous workers), alluvium from local drainages, loess(?), and soils underlie the old faulted and gullied terrain. These deposits are overlain by a transgressive sequence which is similar to that exposed in the main pit.

The lacustrine gravel and sand of the penultimate lake cycle (considered to be about 140,000 yr old; isotope stage 6 of the marine record) grade upward into coarse-grained outwash, similar in composition to but coarser grained than the outwash of Pinedale age. The brown and reddish-brown unit that overlies the outwash consists of soils, fan alluvium from local drainages, and loess(?). This unit represents the time between about 125,000 and 18,000 yr ago; beginning about 18,000 yr ago, the old surface was buried by outwash and lacustrine sediments. At the east end of the trench, lacustrine gravel and fines that were deposited during the last lake cycle, which are underlain by a stone line, are best exposed on the north wall of the trench. This is the highest site in the Bonneville basin at which I have found lacustrine deposits that are demonstrably of the penultimate lake cycle. The top of the lacustrine deposits is at about 5,000 ft, about halfway between the levels of the Bonneville and Provo shorelines; because of faulting their original altitude of deposition cannot be determined. Previous workers have mapped pre-last-lake-cycle deposits to within about 12 m of the Bonneville shoreline, and in some instances at altitudes above the Bonneville shoreline. However, I believe that these sediments were deposited during the last lake cycle, as in none of these localities is there evidence of a major unconformity.

Charcoal fragments from an organic-rich sandy silt about 30 cm above the top of the uppermost buried soil in the middle part of the trench (this section has since been removed) was dated at 17,580 $\pm$ 170 ^{14}C yr B. P. (W-4451). Apparently, the lake did not reach this altitude during the last lake cycle until about 18,000 yr ago or later, depending on the interpretation of the environment of deposition of the enclosing sediments. This suggests that the remaining rise to and formation of the Bonneville shoreline occurred between about 18,000 yr ago and at the time of the Bonneville flood, about 14,000 yr ago.

By using the ages of these deposits and their tectonic offset, an estimate can be made of rates of tectonism at this site (fig. 4). The rate of offset of deposits of the last lake cycle, if constant in the past, suggests that the 140,000-yr-old datum should have an offset of about 80 m. Rates of this order or larger have been obtained by Woodward-Clyde (Swan and others, 1979; Schwartz and others, 1979) for deposits of latest Pleistocene and Holocene age (0.8 to 2.0 m/Kyr) and by Naeser and others (1980) for the late Cenozoic (0.42 m/Kyr). The lower value of offset measured for the old datum at this site may indicate a lower rate of tectonism between 140,000 and 20,000 yr ago than during the last 20,000 yr. A more likely cause is additional offset on faults that lie west of the trench, as there are at least three faults between the trench and Wasatch Blvd. that displace deposits of the last lake cycle. Drilling will be necessary to determine whether or not the older datum is offset along these faults.

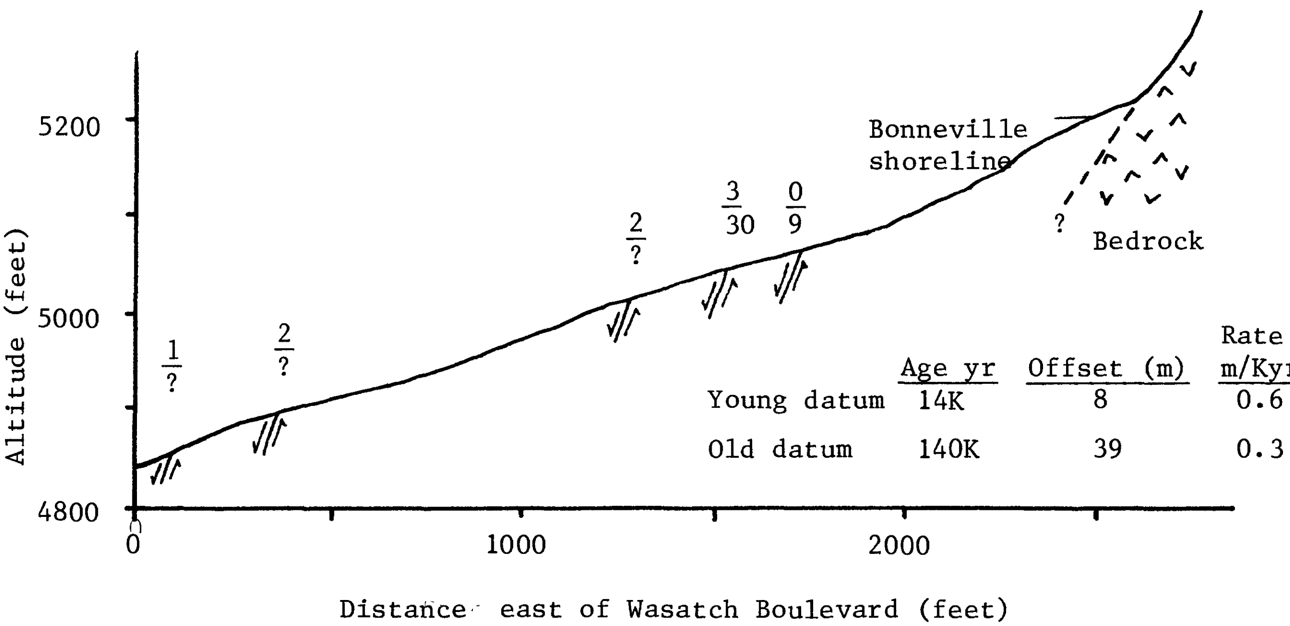


Figure 4. Faults exposed in gravel pits (CPC-N and Dean) on the road to the Holladay Gun Club. Upper number above faults is the offset (in meters) of deposits of the last glacial/lacustrine cycle. Lower number is the offset of deposits and soils that pre-date the last glacial/lacustrine cycle, which has a maximum age of 140,000 yr. Queries (?) indicate that old datum is not seen in exposure.

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