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THE WATER CANYON/TIMBER CANYON FAN COMPLEX ON THE SOUTHEAST FLANK OF MOUNT TAYLOR, NEW MEXICO

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ABSTRACT—The Water–Timber Canyon fan complex is an example of a highly dissected fan comprising predominantly early to middle Pleistocene fan deposits on the piedmont southeast of Mt. Taylor. Deposition of the oldest, early Pleistocene fan unit (Qf0) records breaching of the Mt. Taylor amphitheater by erosion into the volcanic edifice. Deposition of multiple inset fan deposits (Qf1 through Qf3) was in response to episodic pulses of sediment, combined with regional incision, from early through middle Pleistocene time. Eruption of the 0.38 to 0.128 Ma Laguna basalt, which flowed along the Rio San Jose drainage, created a stable base level south of the Water–Timber Canyon fan complex and has resulted in piedmont aggradation or minimal incision into middle Pleistocene Qf3 surfaces. Holocene fan deposits (Qf4) have prograded over Qf3 surfaces in proximal fan areas or are inset against Qf3 in some distal fan areas.

INTRODUCTION

Water Canyon drains the erosional amphitheater of the Mt. Taylor stratovolcano in west central New Mexico (Fig. 1). The drainage flows east, then abruptly south, and has deposited a highly dissected fan forming a constructional piedmont on the southeast side of Mt. Taylor and north of the Rio San Jose. Timber Canyon and Castillo Creek, which head on the south flank of Mt. Taylor and are the drainages west of Water Canyon (Fig. 2;), have deposited smaller fans that have formed geomorphic surfaces and deposits correlative with the Water Canyon fan. These drainages have produced a coalescing fan complex mapped by the authors in the southeast corner of the Mt. Taylor Quadrangle (Osburn et al., 2009) and the southwest corner of the Seboyeta Quadrangle (Skotnicki et al., 2012), referred to herein as the Water-Timber Canyon fan complex.

Mapping of surficial deposits follows the style and terminology developed in the Mt. Taylor area by Grimm (1983), Drake et al. (1991), Osburn et al. (2009), and Skotnicki et al. (2012).

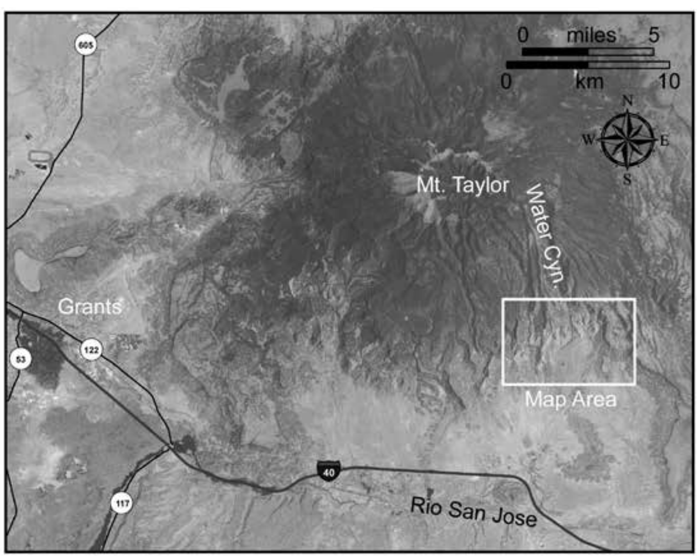

FIGURE 1. Location of map area, west-central New Mexico. The 7 ½ minute quadrangles in the map area include Mt. Taylor (west half of outlined area) and Seboyeta (east half). The Water Canyon drainage on Mount Taylor is shown, as it drains toward the Rio San Jose.

The Plio-Pleistocene stratigraphy in the Mt. Taylor area includes two Pliocene to early Pleistocene units and multiple younger Quaternary units that lie above the modern flood plains or arroyo floors. Pliocene deposits are limited to pediment and axial gravel deposits that cap erosional surfaces cut on Cretaceous sedimentary rocks, and are typically overlain by volcanic units (e.g., the erosional surface overlain by basalt on the informally named Mesita Encinal; Fig. 2). The overlying “high mesa basalts” were erupted from about 3.1 to 2.5 Ma (Lipman and Moench, 1972; Lipman and Mehnert, 1979; Skotnicki et al., 2012). Pliocene deposits are generally coarse-grained and contain greater proportions of granite and quartzite clasts than are observed in Quaternary deposits. Quaternary sediments include fluvial terrace and alluvial fan deposits, and valley floor alluvium. Quaternary deposits contain a predominance of volcanic clasts of mixed lithologies, secondary Cretaceous sandstone clasts, and minor chert pebbles. Water-Timber Canyon fan units are differentiated based on height above base level, soil characteristics, and clast lithology/stratigraphy. Soil descriptions were based on methodology described in Birkeland (1999); soil carbonate morphology nomenclature is from Gile et al. (1966).

FAN STRATIGRAPHY

The Water-Timber Canyon fan complex includes five mapped units, from oldest to youngest designated Qf0-Qf4. Quaternary deposits overlie Mesozoic sedimentary rocks that include Mancos Shale throughout most of the piedmont, and Gallup Sandstone and Crevasse Canyon Formation siltstone, sandstone, and coal beds in the upper parts of the drainages shown in Figure 2. Qf0 surfaces lie approximately 60 m above local base level (Fig. 3). Qf0 deposits are approximately 20 m thick and contain multiple well-developed buried soils and a surficial soil with Stage III carbonate (Fig. 4), indicating aggradation of this deposit was episodic and likely occurred over a period of more than 100 ka. Qf1 and Qf2 surfaces are generally preserved as small erosional remnants 15 to 20 m and 10 to 12 m above local base level, respectively (Figs. 2 and 3). Qf1 and Qf2 are bouldery deposits with a predominance of volcanic clasts and a maximum thickness of 12 m. Soils are stripped, although stage I-II carbonate morphology is locally preserved. Qf3 surfaces form part of the

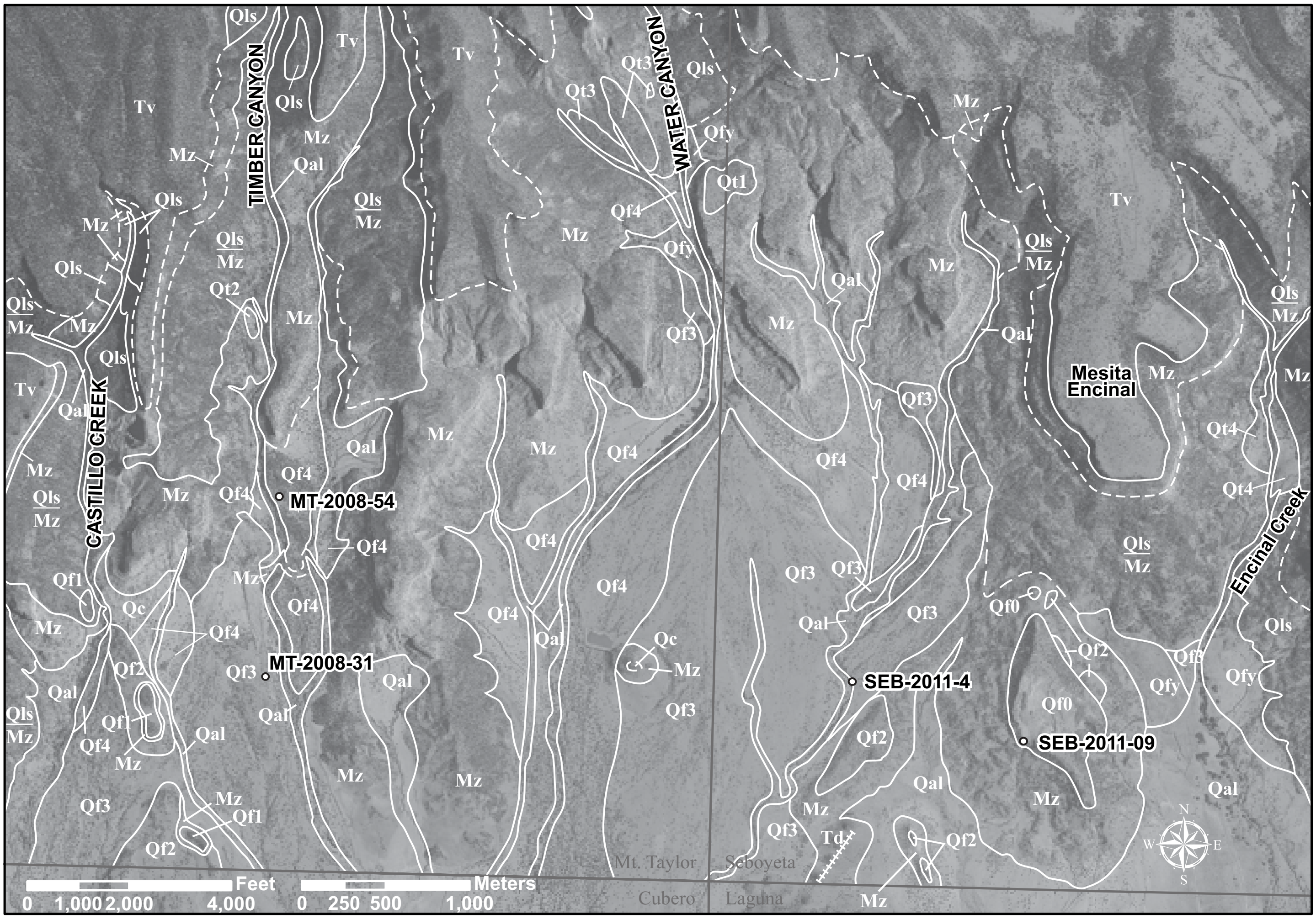

FIGURE 2. Map showing geomorphic surfaces associated with the Water Canyon fan on the Mt. Taylor and Seboyeta quadrangles and locations of stratigraphic sections presented in this paper. See text for description of Units Qf0-Qf4. Qfy = young (active) fan deposits from small side drainages; Qal = Quaternary alluvium; Qt1-Qt3 = Quaternary terrace deposits; Qls = landslide deposits; Tv = Tertiary volcanic rocks; Td = Tertiary dike; Mz = Mesozoic sedimentary rocks. (See also Color Plate 14)

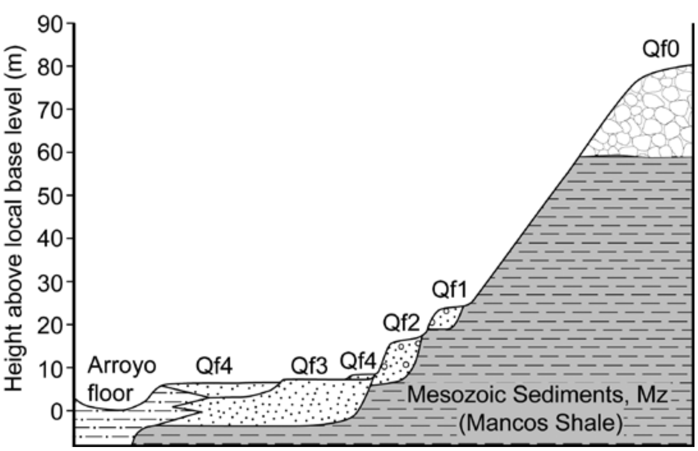

FIGURE 3. Schematic diagram of Water–Timber Canyon fan units and height above base level.

modern piedmont and are located within 7 m of active arroyo floors (Figs. 2 and 3). Qf3 deposits range in thickness from 4.5 to greater than 7 m (Fig. 5). Soils are partially eroded, but exhibit Stage III carbonate morphology, and a Bt horizon with 5YR to 7.5YR color where preserved (Figs. 5 and 6). Qf4 surfaces also form part of the modern piedmont, and include deposits of interbedded fine to medium sand and imbricated cobble-to-boulder-size gravel with individual gravel beds 1-3 m thick. Qf4 deposits often bury Qf3 deposits, which are recognized by buried soils with Bt and Bk horizon development (Fig. 7). Where present, Qf3 buried soils are 1 to 5 m below the Qf4 surface. Qf4 soils are characterized by A-Bw-C or A-Bk-C profiles with maximum Stage I carbonate morphology (Fig. 7).

DISCUSSION

Deposition of the Water–Timber Canyon fan complex began by early Pleistocene time (correlative fine-grained deposits exhibit reversed polarity; Drake et al. (1991)). The fan deposits provide a record of incision into the volcanic edifice, erosion of the amphitheater on Mt. Taylor and episodic piedmont aggradation, incision, and stabilization. Fan deposition occurred in the context of incision along the Rio San Jose between 2.5 Ma

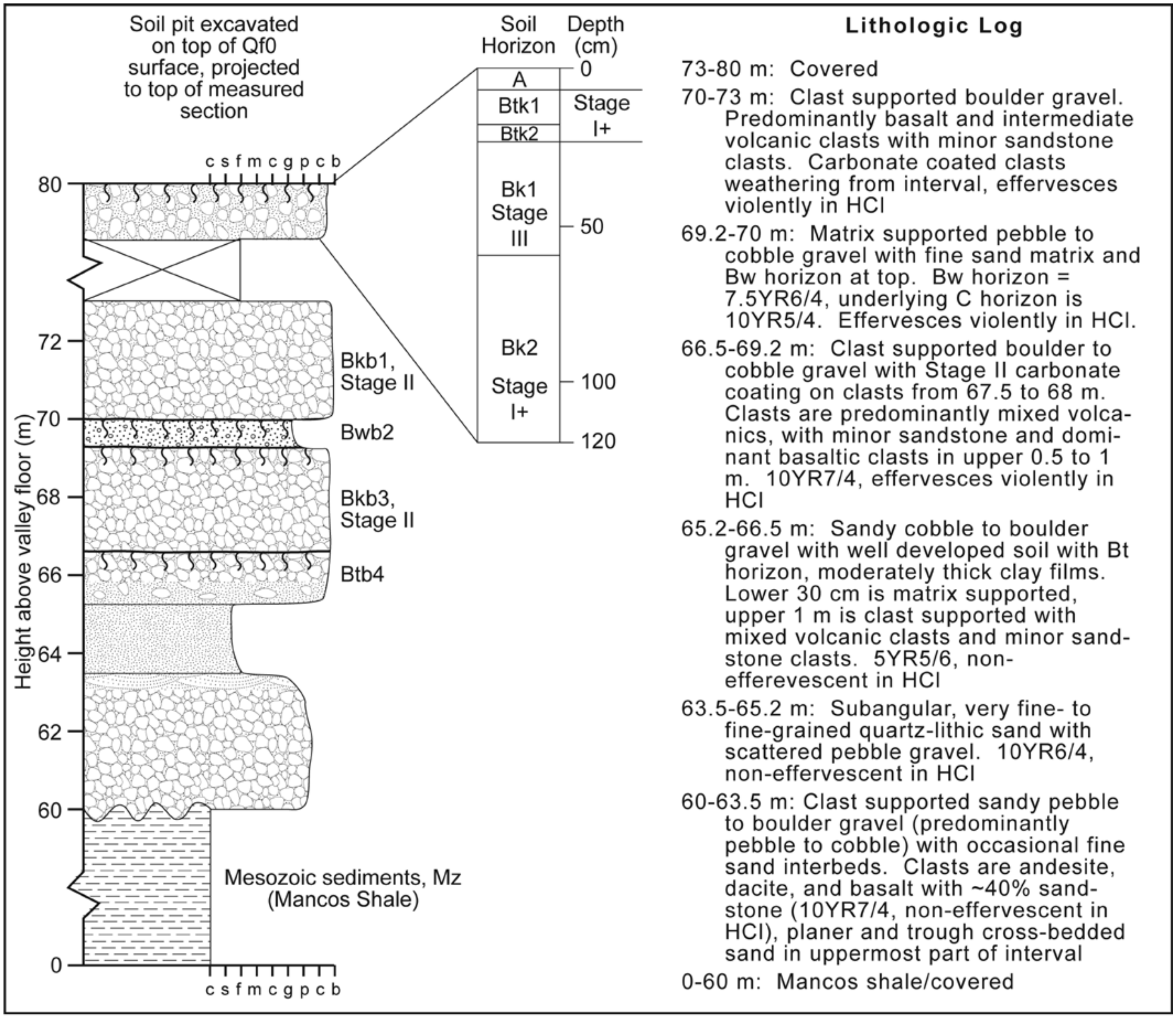

FIGURE 4. Stratigraphic section SEB-2011-09 measured through fan unit Qf0. Location of the base of the measured section is shown on Figure 2. Grain size abbreviations: c = clay, s = silt, f = fine sand, m = medium sand, c = coarse sand, g = granule, p = pebble, c = cobble, b = boulder.

and approximately 0.5 to 0.4 Ma, likely in response to regional uplift (Drake et al., 1991), and the episodic aggradation resulted from pulses of sediment associated with periods of accelerated erosion in up-canyon areas on Mt. Taylor. The piedmont has been extensively dissected since Qf0 deposition due to regional uplift and/or falling base level prior to eruption of the Laguna lava flow. This dissection has resulted in Qf0 through Qf2 surfaces that are preserved as relatively small remnants above the modern piedmont. Much of the modern piedmont in the vicinity of the Water Canyon fan is composed of the middle to late Pleistocene Qf3 surface, overlain in places by younger deposits. Qf3 stage III carbonate morphology is consistent with a middle Pleistocene age for this deposit (Machette, 1985). The presence of a well-developed Bt horizon in Qf3 deposits suggests deposition of Qf3 occurred during Bull Lake pluvial conditions ca. 0.15 to 0.13 Ma (Shroba, 1987). The absence of significant incision below the level of Qf3 is likely in response to local base level stability following eruption of the Laguna flow at 0.38 to 0.128 Ma (Lipman and Mehnert, 1979; Champion et al., 1988), which followed the Rio San Jose drainage. Disruption of the drainage resulted in aggradation and burial of the upstream (western) end of the Laguna flow. The Rio San Jose has subsequently incised though the eastern end of the Laguna flow but the western part of the flow remains buried beneath the valley floor south of the Water-Timber Canyon fan complex. Progradation of Qf4 deposits, overlying Qf3 units in many locations (particularly proximal fan areas) or inset into Qf3 in distal fan areas represents continued aggradation of the piedmont during the Holocene.

Fluvial terraces, graded to fan surfaces, are locally preserved along Timber and Water Canyons upstream of the piedmont (Fig. 2). However, older terrace deposits in these steep-sided canyons are generally eroded and/or buried by colluvium, in part derived from reworking of the volcaniclastic apron surrounding Mt. Taylor. The valley floor alluvium is composed primarily of fine-grained sand, silt and clay with gravel lenses. Drill log data indicate a thickness of valley floor alluvium of 11 m along Encinal Creek (Risser and Lyford, 1983).

CONCLUSIONS

The Water–Timber Canyon fan complex is a highly dissected fan comprising predominantly early to middle Pleistocene fan deposits, mapped as units Qf0-Qf3 on the piedmont south of Mt. Taylor. Large areas of the modern piedmont landscape are composed of middle Pleistocene Qf3 surfaces or Holocene Qf4 surfaces. Holocene Qf4 deposits overlie Qf3 surfaces in proximal fan areas or are inset against Qf3 in some distal fan areas. The absence of significant incision below the level of Qf3 is likely in response to local base level stability following aggradation along the Rio San Jose associated with eruption of the Laguna lava flow at 0.38 to 0.128 Ma. The Rio San Jose has incised though the eastern portion of the Laguna flow, but in the area south of the Water–Timber Canyon fan complex the Laguna flow remains buried within the valley floor alluvium. The piedmont in this area is a relatively old landscape with stripped or partially stripped soils, erosional remnants of older fan units, and old soils developed in many areas of the modern valley floor.

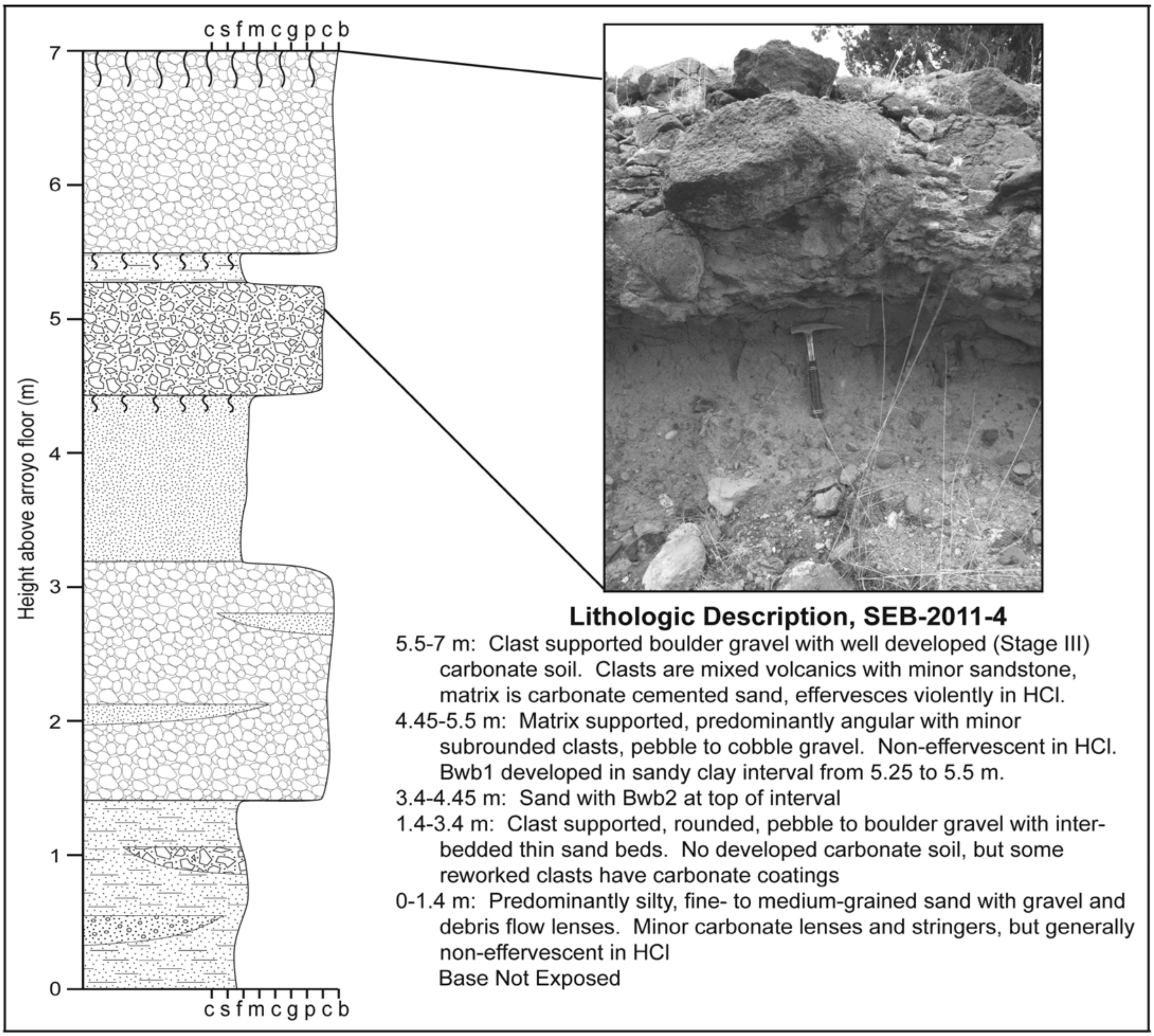

FIGURE 5. Stratigraphic section SEB-2011-4 measured through fan unit Qf3. Location of the base of the measured section is shown on Figure 2. Grain size abbreviations: c = clay, s = silt, f = fine sand, m = medium sand, c = coarse sand, g = granule, p = pebble, c = cobble, b = boulder.

FIGURE 6. Photograph of soil developed in Qf3 deposits at location MT-2008-31. Bt horizon is partially stripped; A horizon is derived in part from weathered Bt, plus eolian fine sand. Location of photograph is shown on Figure 2.

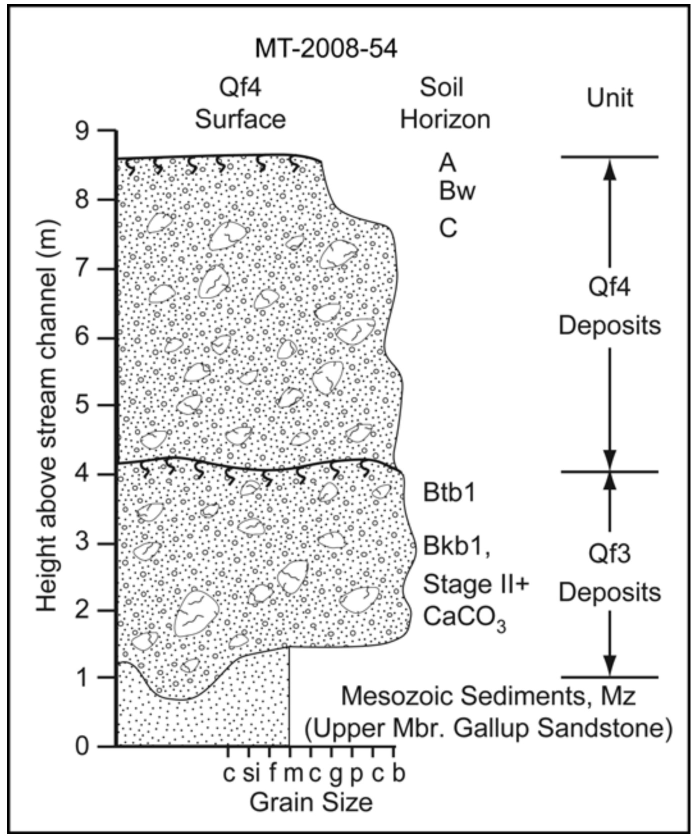

FIGURE 7. Sketch of fan stratigraphy underlying Qf4 surface at location MT-2008-54. Location of section is shown on Figure 2. Grain size abbreviations: c = clay, s = silt, f = fine sand, m = medium sand, c = coarse sand, g = granule, p = pebble, c = cobble, b = boulder.

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REFERENCES

Birkeland, P.W., 1999, Soils and Geomorphology, Third Edition: Oxford, Oxford University Press, 430 p.

Drake [Drakos], P.G., Harrington, C.D., Wells, S.G., Perry, F.V., and Laughlin, A.W., 1991, Late Cenozoic geomorphic and tectonic evolution of the Rio San Jose and tributary drainages within the Basin and Range/Colorado Plateau transition zone in west-central New Mexico, in Julian, B. and Zidek, J., eds, Field guide to excursions in New Mexico and adjacent areas of Texas and Colorado: NM Bureau of Mines and Mineral Resources Bulletin 137, p.149-157.

Champion, D.E., Lanphere, M.A., Kuntz, M.A., 1988, Evidence for a new geomagnetic reversal from lava flows in Idaho: Discussion of short polarity reversals in the Brunhes and late Matuyama polarity chrons: Journal of Geophysical Research, v. 93, p. 11667-11680.

Gile, L., Peterson, F. F., and Grossman, R.B., 1966, Morphologic and genetic sequences of carbonate accumulation in desert soils: Soil Science, v. 101, p. 347-360.

Grimm, J.P., 1983, The late Cenozoic history of the Lobo Canyon drainage basin, Mount Taylor volcanic field, New Mexico, in Wells, S.G., Love, D.W., and Gardner, T.W., eds., Chaco Canyon Country, American Geomorphological Field Group Field Trip Guidebook, p. 45-50.

Lipman, P.W., and Moench, R.H., 1972, Basalts of the Mt. Taylor volcanic field, New Mexico: Geological Society of America Bulletin, v. 83, p. 1335-1344.

Lipman, P.W., and Mehnert, H.H., 1979, Potassium-argon ages from the Mount Taylor volcanic field, New Mexico: U.S. Geological Survey, Professional Paper 1124-B, 8 pp.

Machette, M.N., 1985, Calcic Soils of the Southwestern United States, in Weide, D.L., ed., Soils and Quaternary Geology of the Southwestern United States, GSA Special Paper 203, p. 1-22.

Osburn, G.R., Kelley, S.A., Goff, F., Drakos, P.G. and Ferguson, C.A., 2009, Preliminary geologic map of the Mount Taylor quadrangle, Cibola County, New Mexico: NM Bureau of Geology and Mineral Resources Open-file Map 186, 1:24,000 scale.

Risser, D.W. and Lyford, F.P., 1983, Water Resources on the Pueblo of Laguna, West-Central New Mexico: U.S. Geological Survey Water-Resources Investigations Report 83-4038, 308 p.

Shroba, R.R., 1987, Trends in B-horizon development and soil-clay mineralogy in late Quaternary tills and periglacial deposits at Lake Peak, southern Sangre de Cristo Range, New Mexico, in Menges, C., ed,, Quaternary Tectonics, Landform Evolution, Soil Chronologies and Glacial Deposits – Northern Rio Grande Rift of New Mexico: Friends of the Pleistocene – Rocky Mountain Cell fieldtrip guidebook, p. 193-194.

Skotnicki, S.J., Drakos, P.G., Goff, F.E., Goff, C.J., and Riesterer, J., 2012, Geologic map of the Seboyeta 7.5' Quadrangle, Cibola County, NM: NM Bureau of Geology and Mineral Resources Open-file Map 226, 1:24,000 scale.