

UC Merced

Journal of California and Great Basin Anthropology

Title

Spatial Interpretation of Site Formation Processes Using Soil Stratigraphic Relationships:
An Example from North-Central Nevada, U.S.A.

Permalink

<https://escholarship.org/uc/item/74n3q9xx>

Journal

Journal of California and Great Basin Anthropology, 23(2)

ISSN

0191-3557

Author

Dugas, Daniel P

Publication Date

2001

Copyright Information

Copyright 2001 by the author(s). All rights reserved unless otherwise indicated. Contact the author(s) for any necessary permissions. Learn more at <https://escholarship.org/terms>

Spatial Interpretation of Site Formation Processes Using Soil Stratigraphic Relationships: An Example from North-Central Nevada, U.S.A.

DANIEL P. DUGAS

Department of Geography, New Mexico State University, P.O. Box 30001, Las Cruces, New Mexico 88003

The clear determination of soil stratigraphic relationships is critical to understanding artifact contexts. This perspective is best achieved by the precise, 3-dimensional, spatial delineation of soil/sediment bodies across the site, including compilation of a master soil stratigraphic sequence that reconciles both sedimentary and pedologic events and features. This study investigates these contexts at a site occupying alluvial terrace surfaces at the confluence of three ephemeral stream channels. Geoarchaeological investigation reveals 26 stratigraphic units, comprised of alluvial sediments, aeolian silts, volcanic ash, the horizons of five paleosols, and a recent surface soil. In addition to detailed stratigraphic descriptions, the construction of an isopach map reveals the complex character of the site's formation processes, and the resultant archaeological setting. The combination of terrace surfaces and at least three major depositional events, alternating with four individual soil episodes, allows for several artifact contexts to exist.

Artifact contexts are influenced to a large degree by geomorphic processes as a site's physical setting evolves over time. The following discussion focuses on a geoarchaeological interpretation that emphasized analysis of soil

stratigraphic relationships from a spatial perspective. This analysis can be viewed as part of an overall landform taphonomy approach to site formation processes, whereby both the surface and subsurface distribution of artifacts is understood to be the dynamic result of both cultural processes and geomorphic burial, preservation, and exposure. Interpreting landform taphonomy involves several systematic aspects, from initial geomorphic reconnaissance, through site mapping and detailed recording of profiles, to final geoarchaeological integration. A fundamental step is the precise, 3-dimensional, spatial delineation of soil/sediment bodies across the site.

SITE DESCRIPTION

This study was conducted at site 26Ek5040, a workshop/campsite where the manufacture of lithic bifaces was a major activity (Ataman et al. 1995). The bifaces and most of the other lithic artifacts present were made of high quality opalite toolstone from the nearby prehistoric Tosawihi Quarries, located 3 km to the east. The study area was in a mid-elevation upland (1400-2300 m AMSL) of the Sheep Creek Range, north of the Humboldt River. This area is part of a region ascribed by Steward (see esp. 1938) to the Tosawihi (White Knives) Western Shoshone. Previous investigations in the Tosawihi area have disclosed a 10,000-year history of human occupation, with particular intensification of use over the past 1,500 years (Budy 1988; Elston 1988; Elston and Raven 1992a, 1992b; Elston, Raven, and Budy 1987; Raven 1988; Leach and Botkin 1992). 26Ek5040 was occupied primarily in the Middle Archaic (Ataman et al. 1995).

Covering an area of just under 33,000 m.², the site occupies the bottom of a small drainage near 1,700 m. elevation. A mosaic of tall sage (*Artemisia tridentata*), low sage (*A. arbuscula*), and native perennial bunchgrasses (*Elymus cinereus*, *Agropyron spicatum*, *Sitanion hystrix*, *Festuca idahoensis*) covers much of the site (Ataman et al. 1995).

Geomorphically, this site lies in a small valley bottom at the confluence of three ephemeral

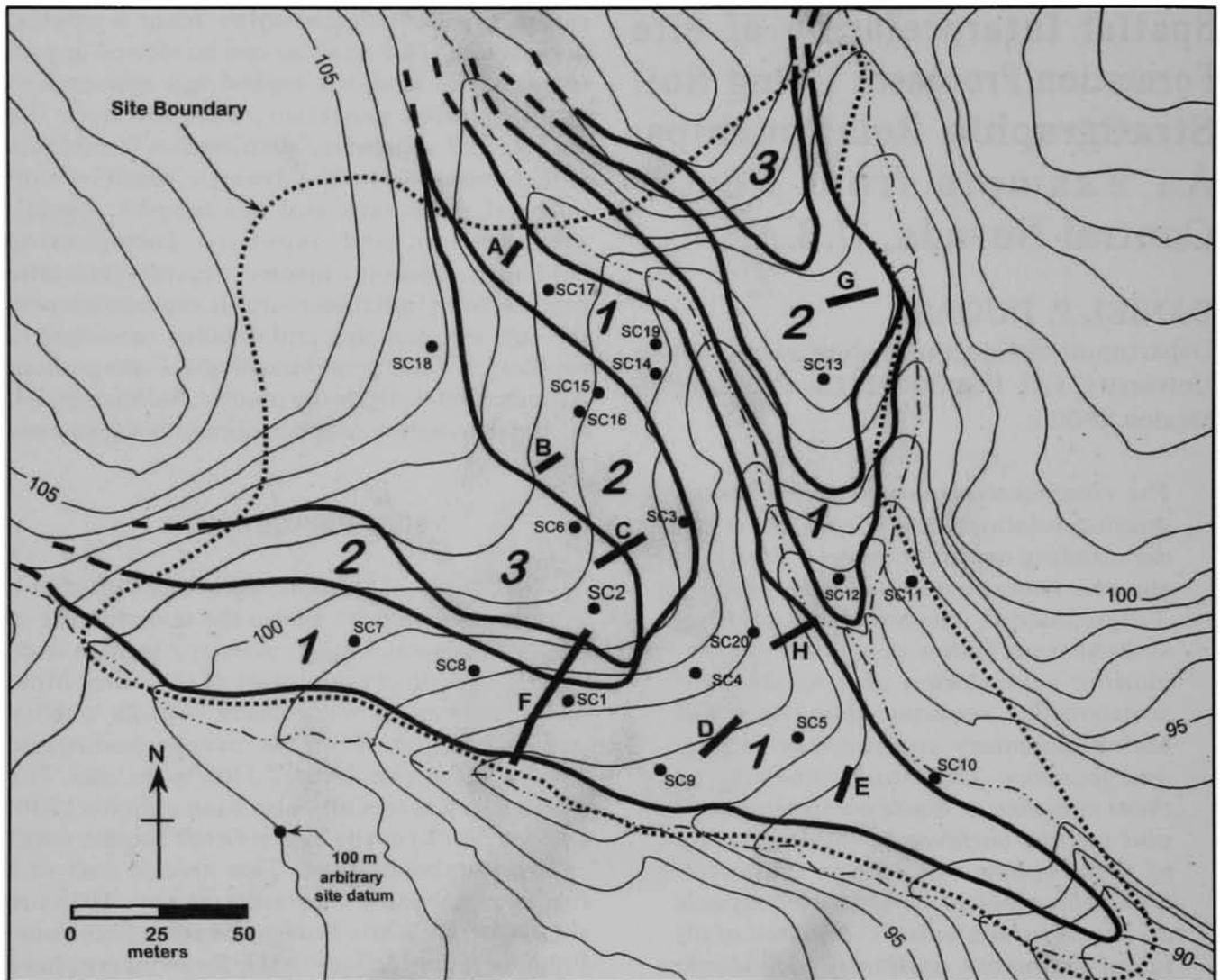


Figure 1. Geomorphic surface map of 26EK5040 showing terraces (1, 2, and 3), backhoe trenches (A-H), and soil core locations (SC1-SC20); contour interval is 1 meter. (after Ataman et al. 1995).

stream channels surrounded by low hills of andesite and rhyolitic tuffs. The channels have isolated two interfluves within the site. At their northwestern ends, the interfluves show fairly low relief with rounded crests between moderately incised channels. To the southeast, the drainages are cutting progressively headward and the interfluves are more dissected. The site occupies three main terrace surfaces (1, 2, and 3) on the interfluvial landforms (Figure 1); much smaller, intermittent terraces also appear adjacent to the channels but are too localized to correlate or map. Spatial delineation of the larger terraces was based on morphology and topographic position relative

to the modern drainage. Most of the site area was comprised of the Terrace 1 surface. Terrace 2 occupies the intermediate topographic position just off the interfluvial ridges. Terrace 3 occurs along the interfluvial crests and is best demarcated by exposed or very near-surface Tertiary-age volcanoclastic bedrock that underwent pre-Holocene fluvial erosion prior to burial.

METHODS

Several backhoe trenches, soil cores, excavation unit exposures, and a large "gully section" exposure below an earthen dam

disclosed stratigraphic relationships across the site. Correlation between these exposures revealed at least 26 stratigraphic units, representing sediments (coarse and fine grained alluvium, aeolian silts, and volcanic ash), the horizons of five paleosols, and the modern surface soil. Stratigraphic exposures were recorded in detailed measured profiles. Figures 2 and 3 provide examples. Soil and sediment descriptions followed, in part, U.S. Department of Agriculture Soil Conservation Service terminology (Soil Survey Staff 1975, 1990), including color, texture, structure, consistence, depositional geometry and structures, HCL effervescence, and other relevant soil and sediment features. An isopach map of sediment thickness (see below) was constructed using stratigraphic data from the trench profiles and soil cores.

LANDFORM TAPHONOMY

An important issue in the interpretation of the geomorphic contexts of site formation processes is the recognition that soil horizon development occurs within sediments at some time after their initial deposition but in coincident positions in the stratigraphic profile. In this study, the interpretation of soil and sediment bodies was facilitated by the use of vertical subdivision designators (Soil Survey Staff 1975, 1990). Subdivision designators provide a method for creating a systematic nomenclature that results in a master soil stratigraphic sequence that reconciles both sedimentary and pedologic events and features. Depositional sedimentary layers and soil horizons are described simultaneously, yet retain stratigraphic distinction in the same descriptive system and a true temporal sequence of stratigraphic events in the profile is indicated. A master soil stratigraphic sequence using vertical subdivision appears in Figure 4.

Briefly, the designator system can be described as follows. Proceeding from left to right at each vertical subdivision, the first number (e.g., 1a, 1b, 2a, etc.) refers to each parent material consecutively encountered from the

surface downward. Capitalized letters refer to standard master soil horizons (i.e., "A", typically organic-rich, surficial soil horizons; "B", pedogenically-altered subsurface soil horizons; and "C", non-pedogenic subsurface horizons). A master designation with a virgule, such as A/C, refers to a horizon with characteristics of both A and C. A master horizon "E" refers to a zone slightly leached of silicate clay, iron, and aluminum.

Lower case letters that follow master horizon letters refer to subordinate horizon distinctions. For example, "c" for accumulation of concretions (in this case manganese), "g" for gleying (a reduction of iron by water saturation), "k" for accumulation of carbonates, "t" for accumulation of silicate clay, and "w" for development of color or structure in a B horizon, but with no illuvial accumulation of materials. Where numbers follow either master or subordinate horizon letters, these refer to additional divisions of the horizon due to evident changes in structure, color, or texture that otherwise would not qualify them to be separated by some other element of the vertical subdivision name. Finally, the "b" at the end of the subdivision name designates portions of buried soils within the stratigraphic sequence. The "b" is followed by a number that refers to which consecutive buried soil the stratum is part of in a sequence from the surface downward.

STRATIGRAPHIC SEQUENCE

Using figures 2, 3, and 4 as guides, the master stratigraphic sequence can be described as follows:

A (Stratum 1a) is the dark grayish brown aeolian and slopewashed silt loam surface component of the site. A limiting date for the deposition of Stratum 1a is given by a hearth found at the surface of 1b in Trench B, which has been dated at 850 ± 200 B.P. (Beta 74722)(Ataman et al. 1995). 2A/Eb1(Stratum 1b) is part of both a buried (b1) soil and the modern soil. Notable changes in the vertical distribution of lithic material qualities and types, occurring in several excavation units near the surface of

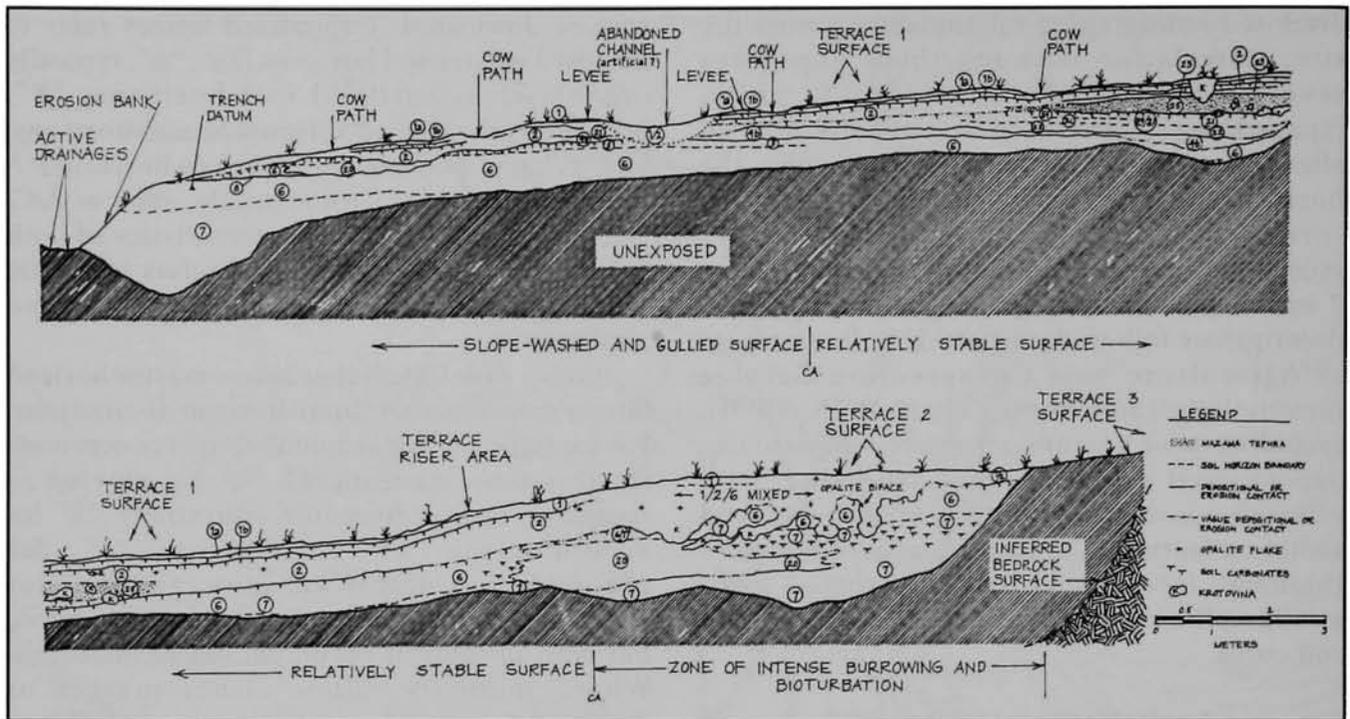


Figure 2. Trench F stratigraphic profile; west wall (after Ataman et al. 1995).

Stratum 1b (see below) probably are related to the depositional break between Stratum 1a and Stratum 1b. 2B/Cb1 (Stratum 1c) is a dark reddish brown, sandy alluvial gravel buried (b1) soil horizon, exposed only in the gully section below the earthen dam. 3Ab2 (Stratum 2a) is a dark brown, moderately sorted, very fine silty clay loam which marks the buried surface of the b2 paleosol. In places, it is also part of the B horizon of the modern soil. 3Bwb2 (Stratum 2b), a dark brown, moderately sorted, very fine silty clay loam, is the buried B horizon of the b2 paleosol as well as part of the modern soil B horizon. 3Ab2 (Stratum 3a) and 3Bwb2 (Stratum 3b) are dark reddish brown to yellowish brown, poorly sorted, sandy clay loams that are equivalent to Stratum 2, but confined to the gully section; they are derived from alluvium parent material rather than from aeolian or slopewashed silts. Stratum 3a is part of the b2 paleosol in the gully section and has been radiocarbon dated by soil carbon average mean residence time to 4,380+90 B.P. (Beta-71239). 4Cb2 (Stratum 23) is a dark reddish brown to reddish brown, poorly sorted, coarse-to-fine sandy clay loam with

gravel. This layer is comprised of clay-rich slopewashed sediments derived from erosion of strata 5/6 and 21 materials. 4Cb2 (Stratum 4a) is a reddish brown to yellowish red, gravelly, poorly sorted, very-coarse-to-fine sandy clay loam. As with Stratum 23, it is derived from eroded soil clasts and gravelly slopewash sediments. It is a transitional soil horizon to the 5Cb2 (Stratum 25) ash layer. 5Cb2 (Stratum 25) is a pale brown to yellowish brown, moderately sorted, fine-to-very-fine loam composed of mixed silt and volcanic Mazama ash (6850 B.P.) (Ataman et al. 1995.) It typically appears throughout the site as a turbated and pedogenic mixture of ash and aeolian silt, often difficult to recognize as a separate stratum. The best preservation of Mazama ash (5Cb2) is limited to the area below Terrace 1 above the southern drainage where it is distinctly more ashy in appearance. While 5Cb2 and 6B/Cb3 contained archaeological materials in some excavation units, these sediments are extensively turbated by insect burrowing and an assumed Mazama or pre-Mazama age for accompanying artifacts is only speculative. 6A/Bb3 (Stratum 24) is a dark

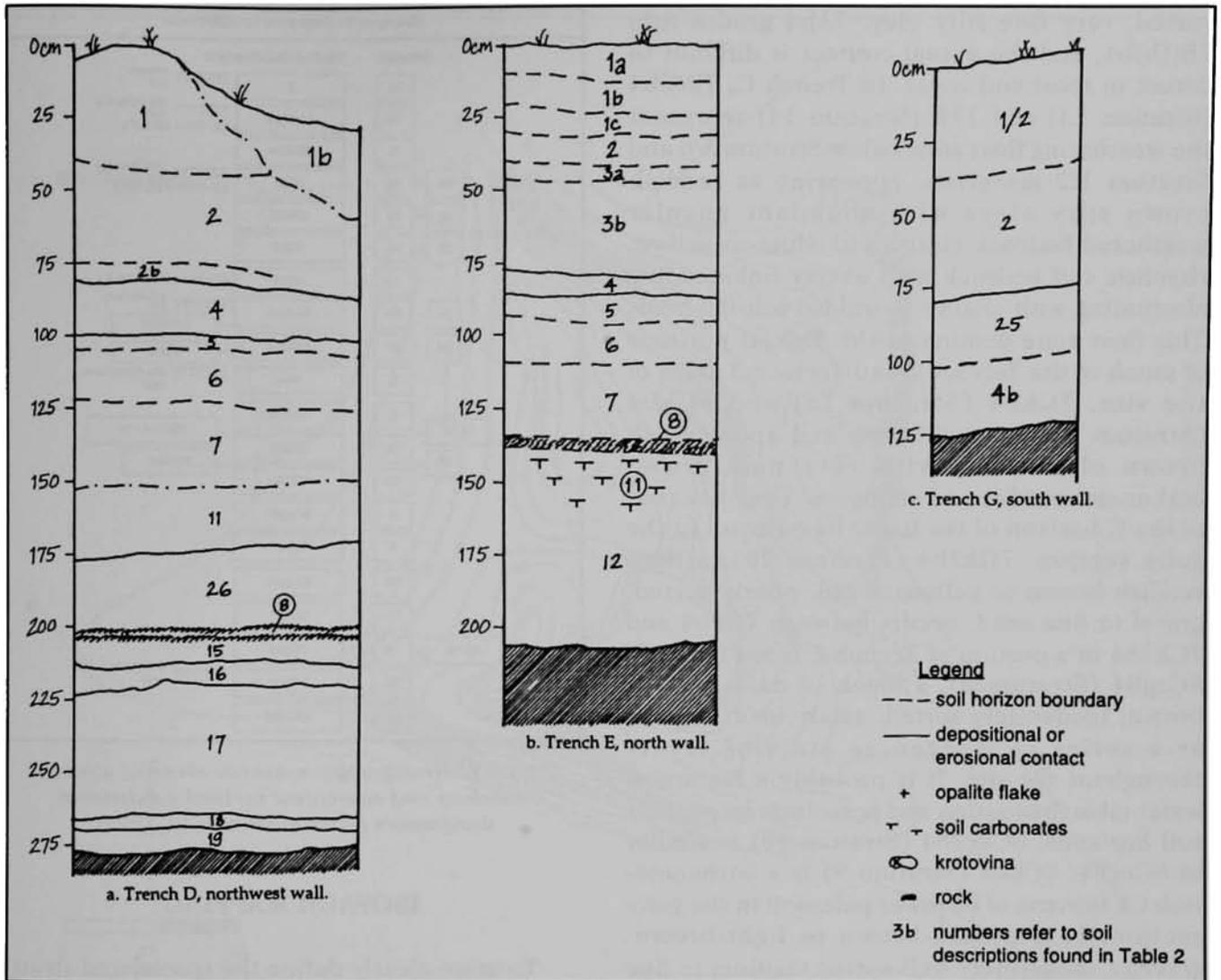


Figure 3. Selected trench profiles (after Ataman et al. 1995).

reddish brown to reddish brown, poorly-sorted, coarse to fine sandy clay loam with common gravel. This layer may represent intervals of reddish sediment slopewash derived from erosion of 7Ab4/7Bt(k)b4 or 6A/Bb3 materials. 6A/B2b3 (Stratum 21) and 6Btb3 (Stratum 22) are both dark reddish brown silty clay loams that occur between 6A/Bb3 and 6Btb3. They represent the pre-Mazama b3 paleosol, found only in the Trench F exposure (see Figure 2) and adjacent soil cores. 6B/Cb3 (Stratum 4b) is a dark brown, gravelly, moderately-sorted, coarse to fine sandy clay loam with pinkish gray (7.5YR 7/2 moist) spotty mottling. In Trench F (see

Figure 2), 6B/Cb3 is part of the b3 buried soil which underlies 6A/B2b3 and possibly part of a cummulic-mollic surface horizon or an extremely eroded duric debris derived from the b4 paleosol. 7Ab4 (Stratum 5), a black-to-dark-reddish brown, slightly gravelly, well-sorted, very fine silty clay, comprises the organic-rich upper portion of the Pleistocene-age (Soil Survey Staff 1980), b4 lower paleosol in the gully section. 7Bt(k)b4 (Stratum 6) is the subsoil of the b4 paleosol and is a yellowish red to strong brown-to-dark-yellowish-brown (colors varying according to degree of oxidation relative to local groundwater levels), slightly gravelly, well-

sorted, very fine silty clay. 7Ab4 grades into 7Bt(k)b4, and the actual contact is difficult to detect in most soil cores. In Trench C, 7B/Cb4 (Stratum 13) and 11R (Stratum 14) represent the weathering float zone below Stratum 5/6 and Stratum 1/2 materials; appearing as reddish brown silty clays with abundant angular weathered bedrock clasts, and white-to-yellow, rhyolitic tuff bedrock with cherty fine-bedding alternating with chalky-to-welded ash-fall beds. This float zone dominates the highest portions of much of the Terrace 2 and Terrace 3 areas of the site. 7Ckb4 (Stratum 7a) and 7Ckb4 (Stratum 7b), are yellowish red and reddish brown clay loams with very pale brown carbonate mottles and stringers. They are part of the C horizon of the lower b4 paleosol in the gully section. 7Ck2b4 (Stratum 20), a dark reddish brown to yellowish red, poorly sorted, gravel to fine sand, occurs between 7Ckb4 and 7Ck3b4 in a portion of Trench F (see Figure 2). 8Ccg4 (Stratum 8), a black to dark reddish brown, moderately-sorted, sandy loam, occurs as a series of manganese staining layers throughout the site. It is probably a feature of water table fluctuation and post-dates most other soil horizons. 8Ccg2b4 (Stratum 10) is similar to 8Ccg4. 8Ckb4 (Stratum 9) is a carbonate-rich Ck horizon of b4 lower paleosol in the gully section. It is a dark-brown to light-brown, gravelly, moderately well-sorted medium to fine sandy clay loam with very pale brown carbonate stringers and mottled patches. 8Cck2b4 (Stratum 11) is similar to 8Ckb4. 8Cg3b4 (Stratum 12) is a dark-brown-to-light-brown, gravelly, moderately sorted, medium-to-fine sandy clay loam and is part of the gravel-rich C/R buried b4 soil of the gully section. Strata 15 through 19 (8Cg4), which are equivalent to Stratum 12, are dark brown, to light brown gravelly, moderately well-sorted, medium to fine sandy clay loams found variously throughout the site. 9Btb5 (Stratum 26) is an olive colored clay loam with very distinct yellowish red root mottling and root traces. This is the gleyed b5 paleosol found near the base of gully section. 10Cbb5 (Stratum 12b) is similar to Stratum 12 but is part of the b5 paleosol.

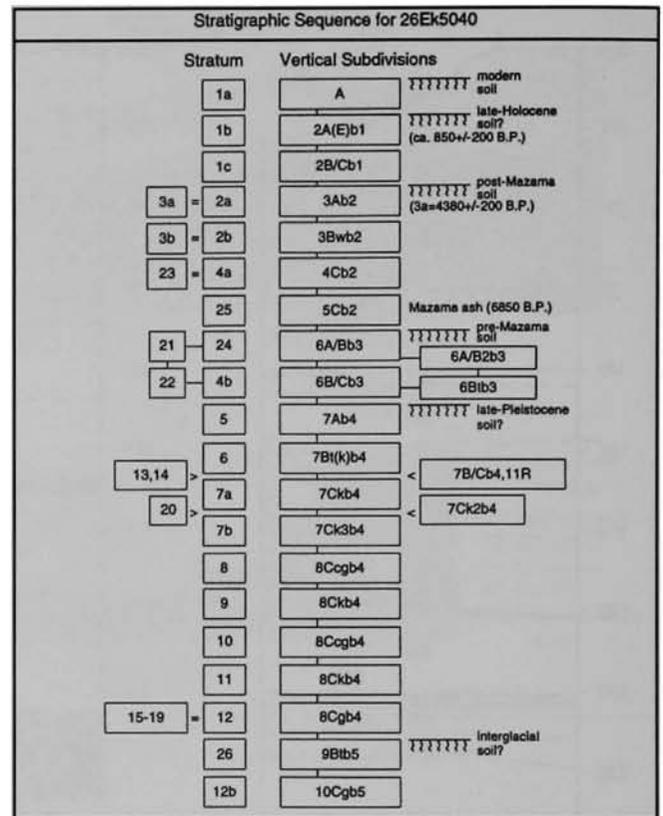


Figure 4. Stratigraphic sequence showing stratum numbers and equivalent vertical subdivision designators (after Ataman et al. 1995).

ISOPACH MAPPING

To more clearly define the spatial and stratigraphic extent of artifact-bearing sediments, an isopach (thickness) map (Figure 5) was constructed showing the distribution and thickness of Holocene-age sediments and soils which overlie the b4 Pleistocene-age paleosol. It was constructed coincident with data recovery excavations, based on stratigraphy revealed in trenches, soil cores, and on-going excavation units, recognizing that further excavation unit placement would, in part, be based on early recognition of the varying thickness of archaeologically significant, Holocene sediments. Comparison of the isopach map and terrace extent also served to illustrate the dynamic nature of the geomorphic processes that had affected the site's taphonomy.

Typically, the thickest areas of Holocene fill occurred below the Terrace 1 surface, especially

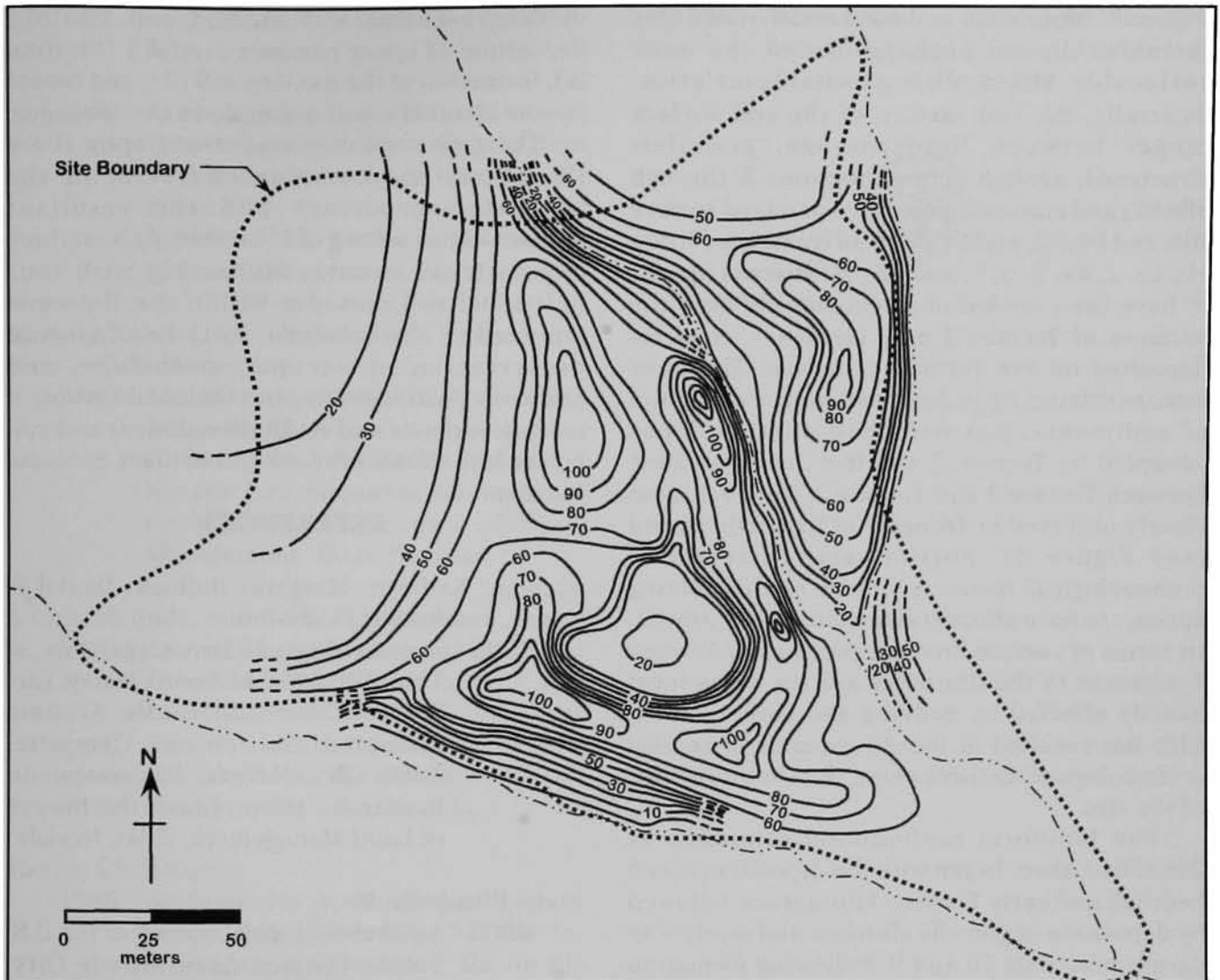


Figure 5. Isopach map of 26EK5040 showing thickness of Holocene-age sediment fill between the modern soil surface and the top of 7Ab4/7Bt(k)b4 horizon; contour interval is 10 cm. (after Ataman et al. 1995).

along the southern flank of the south ridge. Deep sediments also appeared below the Terrace 2 surface on the northern flank of the south ridge. The deeper Holocene fill areas northwest and southeast of Trench B, for example, suggested that the northern stream channel may have traversed the site at this point in the past. This channel cutting has, in the process, isolated a small, shallowly buried, bedrock knoll south of Trench C and east of Trench F (see Figure 1 and 5). This remnant bedrock highly influenced site taphonomy by limiting the thickness of Holocene sediments accumulating in its proximity.

SITE TAPHONOMY SUMMARY

Using the information given by geomorphic mapping, soil stratigraphic analysis, and isopach mapping, a reconstruction of this site's taphonomy is now possible. In general, stream alluviation and erosion appear to have been the dominant geomorphic processes during the Pleistocene. During the Holocene, aeolian silt and volcanic ash accretion, colluvial slopewash, and bioturbation become more important site formation processes. Soil textural variation, due to a combination of locally intense bioturbation (see Figure 2, north end of Trench F), movement

of fines by slopewash and wind activity, and clay shrink/swell, are perhaps one of the most noticeable site sediment characteristics. Generally, the soil texture of the soil surface ranges between Holocene-age, granular-structured, aeolian silts of horizons A through 3Bwb2; and clay-rich exposures of mixed surface silts and b4, b2, and b1 paleosol materials (Strata 1b, 1c, 2, 4a, 5, 6, 7, and 25). Sediments appear to have been eroded most extensively from the surfaces of Terrace 2 and Terrace 3, then re-deposited on the Terrace 1 surface. The most intense mixing, by pedogenesis and bioturbation of sediments, has occurred on the slopes occupied by Terrace 2 and the transition zone between Terrace 2 and Terrace 3. This was most clearly observed in Trench F at its northern end (see Figure 2). Fortunately, in terms of archaeological recovery, much of this mixing appears to have affected sediments below 3Bwb2. In terms of surface erosion, portions of Terrace 1 adjacent to the drainages are the areas most heavily affected by gullying and surface wash. This has resulted in the disturbance of several archaeological features along the southern edge of the site.

The landform taphonomic sequence at 26Ek5040, then, began with the deposition of tuff bedrock and early Terrace 3 formation, followed by deposition of gravelly alluvium and sandy clay parent materials 10 and 9. Following formation of the b5 soil (9Btb5 and 10Cgb5), deposition of alluvial parent materials 8 and 7 occurred, into which formation of the b4 paleosol (7Ab4, 7Btkb4, 7B/Cb4, 7Ckb4, 7Ck2b4, 7Ck3b4, 8Ccgb4, 8Ckb4, 8Ccgb4, and 8Ckb4) proceeded. Erosion of the Terrace 2 landform, and deposition of parent material 3, and the beginning of Terrace 1 accretion then took place. Formation of the b3 soil (6ABb3, 6A/B2b3, 6Btb3, and 6B/Cb3) then proceeded. Deposition of Mazama ash (parent material 5) followed. Erosion of Terrace 1 landform and deposition of parent material 4, and then deposition of parent material 3 occurred. Formation of the b2 paleosol (3Ab2, 3Bwb2, 4Cb2, and 5Cb2) on these parent materials then proceeded. Deposition of lower parent material 1 (Strata 1b and 1c), formation

of the b1 buried soil (2A/Eb1 and 2B/Cb1), deposition of upper parent material 1 (Stratum la), formation of the modern soil (A), and recent stream channel erosion completes the sequence.

The geomorphology and stratigraphy above illustrates the complex character of the formation processes and the resultant archaeological setting of 26Ek5040. At least three depositional events alternating with four individual soil episodes within the Holocene (including the modern soil) has fostered preservation of occupation surfaces and archaeological features, and the combination of terrace surfaces and multiple sediment and soil layers has allowed for several artifact contexts to exist.

REFERENCES

- Ataman, Kathryn, Margaret Bullock, Daniel P. Dugas, and Robert G. Elston
 1995 Archaeological Investigations at Tosawihi, A Great Basin Quarry, Part 7: 26EK5040, A Middle Archaic Reduction Station and Campsite. Silver City, Nevada: Intermountain Research. MS on file at the Bureau of Land Management, Elko, Nevada.
- Budy, Elizabeth. E.
 1988 An Archaeological Survey of the U.S. Steele Project Area. Silver City, Nevada: Intermountain Research. MS on file at the Bureau of Land Management, Elko, Nevada.
- Elston, R. G.
 1988 A Theoretical Approach to the Archaeology of the Tosawihi Quarries. Silver City, Nevada. Intermountain Research: MS on file at the Bureau of Land Management, Elko, Nevada.
- Elston, Robert, G. and Christopher Raven
 1992a Archaeological Investigations at Tosawihi, a Great Basin Quarry, Part 1: The Periphery. Silver City, Nevada: Intermountain Research. MS on file

at the Bureau of Land Management,
Elko, Nevada.

1992b Archaeological Investigations at
Tosawihi, a Great Basin Quarry, Part
3: A Perspective from Locality 36.
Silver City, Nevada: Intermountain
Research. MS on file at the Bureau
of Land Management, Elko, Nevada.

Elston, Robert, G., Christopher Raven, and
Elizabeth E. Budy

1987 An Intensive Reconnaissance of the
Tosawihi Quarries Archaeological
District (Site 26EK3032). Silver City,
Nevada: Intermountain Research. MS
on file at the Bureau of Land
Management, Elko, Nevada.

Leach, Melinda, and Steve G. Botkin

1992 Archaeological Investigations at
Tosawihi, a Great Basin Quarry, Part
2: A Regional Survey. Silver City,
Nevada: Intermountain Research.
MS on file at the Bureau of Land
Management, Elko, Nevada.

Raven, Christopher

1988 An Intensive Archaeological Survey
of USX-East. Silver City, Nevada: In-
termountain Research. MS on file
at the Bureau of Land Management,
Elko, Nevada.

Soil Survey Staff

1975 Soil Taxonomy: A Basic System of
Soil Classification for Making and
Interpreting Soil Surveys. Washing-
ton D.C.: Agricultural Handbook,
U.S. Department of Agriculture 436.

Soil Survey Staff

1990 Key to Soil Taxonomy: Soil Manage-
ment Support Service Technical
Monograph. Washington D.C.: U.S.
Department of Agriculture 19.

Steward, J. H.

1938 Basin-Plateau Aboriginal Sociopo-
litical Groups. Bureau of American
Ethnology Bulletin 120.



