DEPARTMENT OF THE INTERIOR

U. S. GEOLOGICAL SURVEY

Geomorphic map of the Kyle Canyon alluvial fan, Clark County, Nevada

by

Janet M. Sowers[1]

Open-File Report 86-210

This report was prepared under contract to the U. S. Geological Survey and has not been reviewed for conformity with U. S. G. S. editorial standards or stratigraphic nomenclature. Opinions and conclusions expressed herein do not necessarily represent those of the U. S. G. S.

[1]1918 Channing Way #B, Berkeley, CA 94704, under contract #59540-0157 by the U. S. Geological Survey.

1986

Table of Contents

Figures

Plates

Geomorphic map of the Kyle Canyon alluvial fan, Clark County, Nevada

Janet M. Sowers

ABSTRACT

The Kyle Canyon alluvial fan, located on the east flank of the Spring Mountains in southern Nevada, exhibits several geomorphic surfaces, mapped as Surfaces 1, 2, 3, and 4 in order of decreasing age. Mapping criteria are surface color, desert pavement development, topographic position, microtopography, degree and nature of dissection, and soil development. Major distinguishing characteristics of the surfaces, after relative topographic position, are: Surface 1 = light color, ballena topography; Surface 2 = light color, flat smooth surface; Surface 3 = dark color, flat smooth surface; Surface 4 = bar and swale microtopography, including active channels. Approximate ages of the surfaces are: Surface 1 = >730,000 yBP (paleomagnetism of pedogenic calcrete), Surface 2 = ~120,000 yBP (^{234}U-^{230}Th ages on calcrete rinds), Surface 3 = ~5,000-35,000 yBP (C-14 ages from basin sediments), Surface 4 = < ~5,000 yBP - present (relationship to Surface 3). Mapping is presented on two plates at scales of 1:62,500 and 1:24,000.

Introduction

The Kyle Canyon alluvial fan is one of the largest fans flanking the east side of the Spring Mountains in southern Nevada (fig.1). The fan is built by two major ephemeral streams - Kyle Canyon Wash and Harris Springs Wash - and several minor washes. As these washes migrated back and forth across the fan they deposited new sediment and reworked old sediment. They built new surfaces, abandoned some surfaces, and buried others. It is this complex of abandoned fan surfaces of different age that is mapped here.

The washes drain an area of high mountains underlain by Paleozoic and Mesozoic sedimentary rocks, almost entirely limestones and dolomites. The fan sediment is composed of 90-95% carbonate clasts and occurs in gravelly, braided stream deposits.

Climate is arid to semi-arid, becoming cooler and wetter with increasing elevation. Vegetation type and density reflect this climatic gradient. The creosote bush community dominates elevations of 2000-4000 ft, and the blackbrush community dominates elevations of 4000-6000 ft.

Mapping procedure

Mapping units were defined and described in the field in specific localities, then mapped over the fan using vertical aerial photographs. The air photos used were U. S. Geological Survey panchromatic stereographic photos, primarily in the series GS-VDGE (scale=1:30,000, flown June 1973), also in the series' GS-VCMO (scale=1:24,000, May 1970) and GS-LJ (scale=1:47,000, July 1950). Follow-up field checking was done after the initial photogeologic interpretations to resolve questions in specific areas.

Two maps were made. Plate 1 is a map of the entire fan; Plate 2 is a detailed map of the apex area (fig. 1). The topographic base for Plate 1 is the Corn Creek Springs, NV, 15 minute quadrangle. The topographic base for Plate 2 is the Grapevine Springs, NV, 7.5 minute quadrangle. An orthophotoquad of the Grapevine Springs quadrangle was invaluable in transferring information from the air photos to the topographic map.

Definition of units

Bedrock -- Areas of pre-Cenozoic rock outcrop, or shallow soils over pre-Cenozoic rocks. Bedrock is mapped mainly on the hillslopes and mountain sides. Slopes are relatively steep, including vertical cliffs, and the erosion of rock material from these slopes provides material for construction of talus cones and alluvial deposits.

Talus -- Deposits of fallen debris, accumulated at the base of steep rock faces.

GEOMORPHIC SURFACES

General definition:

The geomorphic surfaces mapped are depositional and/or erosional landscape surfaces, generally underlain by alluvium. Each mapping unit has been stable (that is, negligible erosion or deposition) for an amount of time such that time-dependent surface features, such as pavement development, pavement composition, dissection, microtopography, or soil development, fall within ranges defined for that unit. Each mapping unit, or surface, also occupies a particular topographic position relative to the other surfaces (fig. 2). Relative ages are: Surfaces 1 through 4, oldest to youngest.

Surface 1 -- Areas of ballena topography (Peterson, 1981) with a light colored surface due to whitish calcrete fragments in the desert pavement. Surface 1 is an erosional surface on older alluvium. At elevations above 4000' ridges slope 3-4° downfan, crests are rounded, and side slopes lie at 12-16°. With decreasing elevation, slope angles decrease until at 3000' the ballena form is very subtle. Surface 1 is partly dissected by local washes which cut

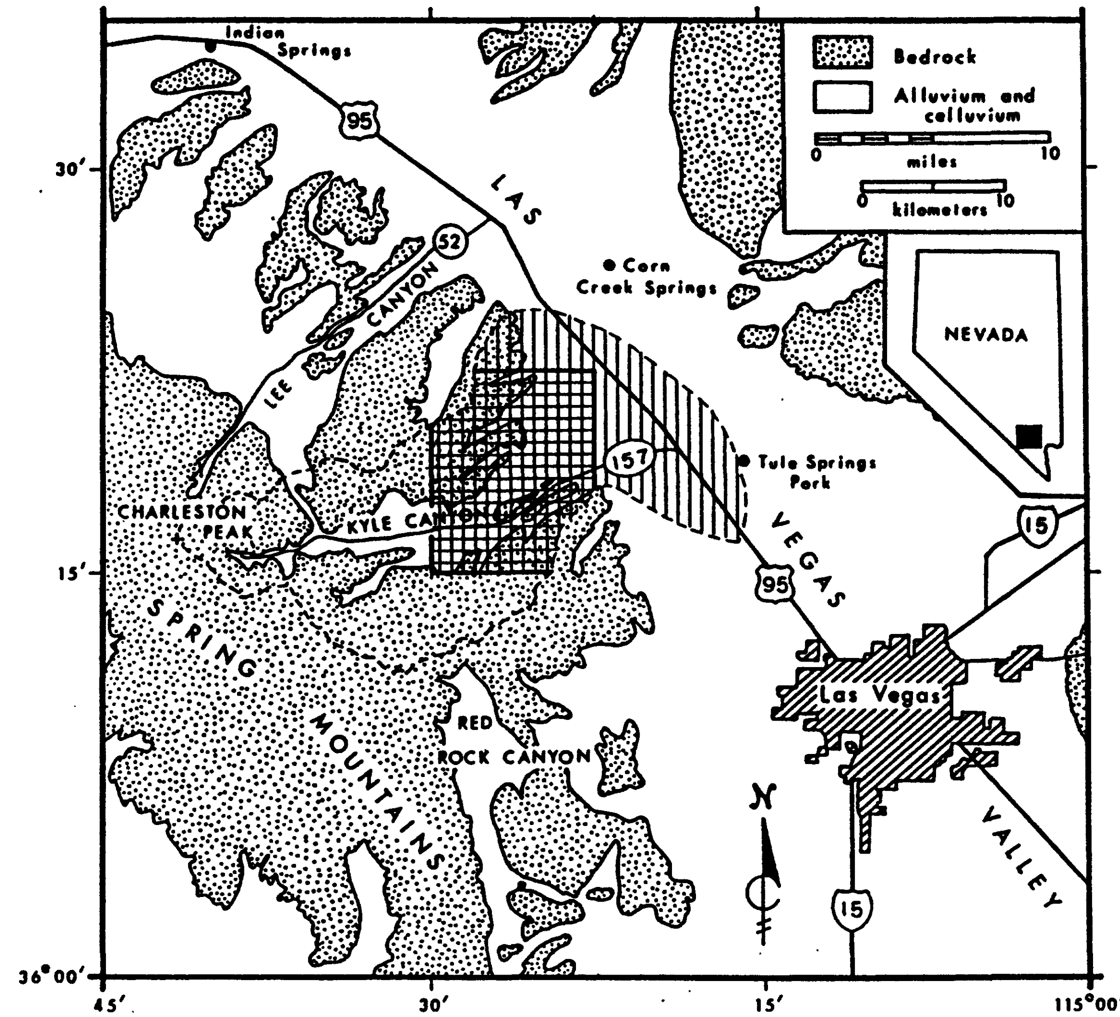

Figure 1: Location of the Kyle Canyon alluvial fan. Vertical stripes indicate area mapped on Plate 1; Horizontal stripes indicate area mapped on Plate 2. The margins of the drainage basin and the toe of the fan are marked by a dashed line.

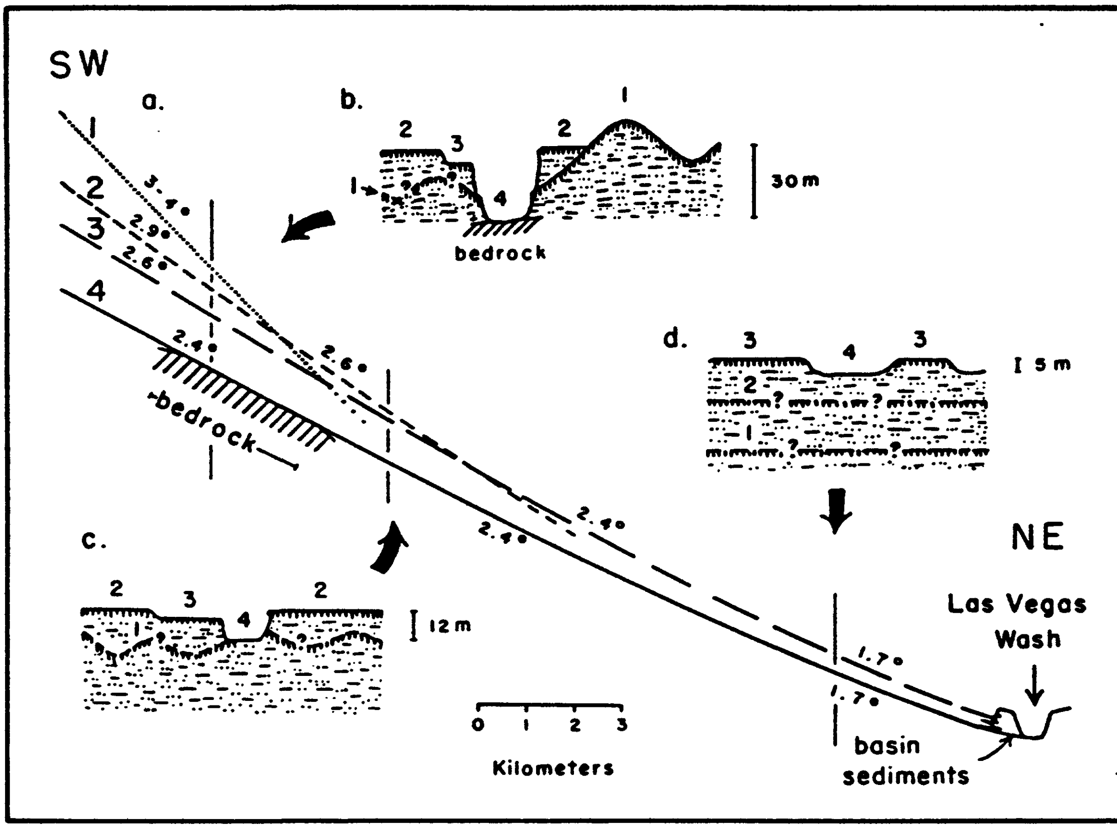

Figure 2: **a.** Schematic longitudinal profile of Surfaces 1 - 4 through study area, projected along Kyle Canyon Wash (see Plate 1), showing progradation of fan through time. Surfaces were reconstructed on the Corn Creek Springs 15' quadrangle. Surface 1 profile follows ridge tops. Relative slopes of surfaces and vertical scale are exaggerated; Actual slope values shown are averaged over approximately 5 km. Scale bar applies to horizontal direction only.

b., c., and d. Schematic cross sections at three locations along profile showing changes in soil stratigraphy with distance from the mountain. Vertical hachures represent soils. Further up canyon, west of the study area, Dolliver (1968) reports the four surfaces to be a continuous series of cut terraces. Relationships shown by **b** can be seen along Kyle Canyon Wash in Sections 23 and 28 (T19S, R58E) at locations 3, 10, and 53, by **c** north and northeast of Section 23 to approximately 4000' at locations 47 and 41, and by **d** along Highway 95 north and west of the junction with Highway 157. See Plate 2 for location numbers.

into ballena swales, and by major washes emanating from the mountains. Walls of washes are steep to vertical.

Pedogenic calcrete, Stage IV+ (Gile, Peterson, and Grossman, 1966; Bachman and Machette, 1977), underlies the ballenas, thickening in the swales between ballena ridges. Calcrete is somewhat eroded on side slopes and ridge crests. Pavement, well developed on ridge crests, is composed of extremely etched and pitted calcrete fragments and limestone clasts.

Surface 2 -- Areas of generally flat, smooth topography with a light colored surface due to whitish calcrete fragments in the desert pavement. Above about 5000' Surface 2 is a terrace inset below Surface 1; between 5000' and 3500' it is a major remnant fan surface; below 3500' it is presumed buried. Steep-walled parallel drainage arises on the surface and is graded to main wash; maximum depth of dissection in study area is about 140' decreasing downfan to zero.

Pedogenic calcrete, Stage IV+, underlies the surface at about 1-1.5' depth. Pavement, well-developed at low elevation, poorer as elevation and vegetation density increase, is composed of etched and pitted limestone clasts and calcrete fragments.

Surface 3 -- Areas of generally flat, smooth topography with a dark colored surface. Above about 4000' Surface 3 is a terrace inset below Surface 2, below 4000' it is a major remnant fan surface extending to the toe of the fan. Over most of the fan dissection is sub-parallel and braided, leaving elongate bar-shaped remnants. Maximum dissection in study area is 120' (SW) to 15' (NE, toe).

Soils generally exhibit Stage II-III carbonate accumulation. Pavement, well-developed at low elevation, patchy then poor as elevation and vegetation density increase, is composed of etched and pitted limestone clasts, well-sorted, reflecting old bars and swales.

Surface 4 -- Areas of bar and swale microtopography, including active channels and distributaries. Dark colored on air photos, except light in recently active channels.

Soil development varies from none to weak carbonate accumulation approaching Stage I. Pavement development is weak to none; surface is composed of fresh to slightly etched limestone clasts, well-sorted (eg. coarse gravel/cobbles in bars, fine gravel in swales, sand and silt in swales of recently active channels).

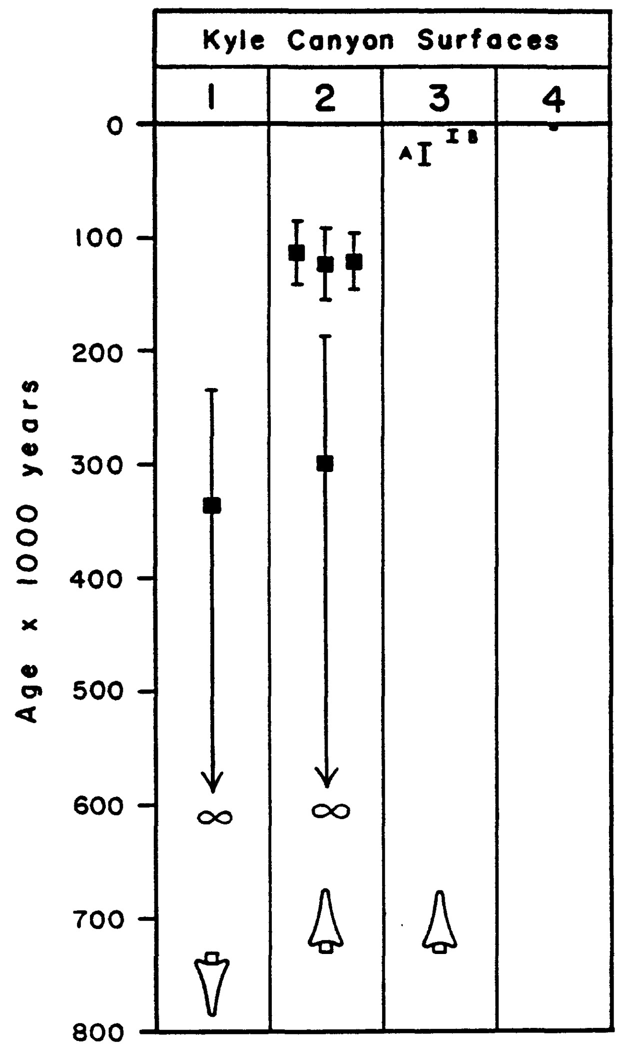

Figure 3: Age data for geomorphic surfaces.

■ =U-Th age determination, with error bars. Samples are pedogenic calcrete rinds on clasts from the soil. The upper limit of the method is ~350,000 yr., thus results close to or beyond that age have very large error.

Large arrow heads denote whether calcrete shows reversed or normal polarity (Sowers, 1985).

Solid bars show probable correlation of Surface 3 with basinal deposits dated with C-14: A, work of Haynes (1967), and B, work of Quade (1983, 1986).

Correlation with previous mapping

Mapping of geomorphic surfaces has been done previously by Dolliver (1968) in the higher elevations of Kyle Canyon, by Lattman (1973) over the entire fan, and by Haynes (1967) at the toe of the fan near Tule Springs. The designations these other workers gave the units mapped in this study are given below.

This study	Dolliver (1968)	Lattman (1973)	Haynes (1967)
1	Kyle Canyon	1	1
2	Mom's Ranch	2	--
3	Sub-Mom's Ranch Modern, Mom's Ranch	2a,2,3	2
4	Modern	3	3

Ages of Geomorphic Surfaces

Mapping units, because they are defined by broad physical characteristics, do not necessarily represent same-age surfaces. Each unit is thought to represent an age range of surfaces, similar enough to share physical characteristics. Ages cited here should be considered approximate and most applicable to sampling locations.

Surface 1 is dated primarily by the paleomagnetism of its associated calcrete. A significant number of samples of massive calcrete show a reversed component of magnetism, interpreted to indicate that calcrete formation began on Surface 1 before the last major reversal at 730,000 yBP (Sowers, 1985) (fig. 3). Samples showing the reversed component were taken from locations 3, 10 and 53 (Plate 2). A single ^{234}U-^{230}Th date on a calcrete rind from location 53 gives an age at or beyond the maximum limits of the method (~ 350,000 yBP), thus is consistent with the pre-730,000 yBP age suggested by the paleomagnetic data.

Surface 2 is dated primarily by ^{234}U-^{230}Th (analyses by T. L. Ku at University of Southern California, reported in Sowers, 1985) on calcrete rinds from the bottoms of clasts in the soil. Four samples were run, from locations 17, 82, and 22 (Plate 2). The three samples from locations 17 and 82 yield similar age estimates averaging about 120,000 yBP. Locations 17 and 82 are about 150 m apart. Because some amount of time is necessary for a rind to build up that is thick and dense enough to sample, 120,000 yBP is a minimum age for Surface 2. The one sample from location 22, several miles to the west; gives an age at or beyond the maximum limits of the method. This result may indicate Surface 2 varies in age with location, or may simply be an anomalous value.

Paleomagnetic results from Surface 2 show normal polarity, with no evidence of reversal. This result is consistent with the U-Th ages.

Surface 3 is dated by its relationship to basin sediments along Las Vegas Wash dated by C-14. Haynes (1967) and Quade (1983, 1986) studied the stratigraphy of these sediments and dated organic carbon from them. Haynes estimated an age of 17-35,000 yBP for Surface 3. More recently, however, Quade estimates Surface 3 near the fan toe to be significantly younger than Haynes, and to vary in age with location - oldest areas having a maximum age of 15,000 yBP and youngest areas having an age of about 5000 yBP. Surface 3 at higher elevations (e.g. location 55) may be older than areas near the fan toe, based on soil development.

Surface 4 is inset into Surface 3 and everywhere exhibits a more youthful character. Thus Surface 4 is presumed younger than the youngest parts of Surface 3, or younger than ~5,000 yBP.

Acknowledgements

This work was part of the author's doctoral research at the University of California-Berkeley, under the direction of R. L. Hay. The Geological Society of America Penrose Foundation, U. C. Department of Geology and Geophysics, and the U. C. Patent Grant Fund provided funding for field expenses and radiometric dating. Discussions with and reviews of T. L. Ku, K. Vincent, M. Reheis, and J. Dohrenwend are gratefully acknowledged. T. Sensmeier assisted with the drafting of Plate 1. J. Wait, H Nuckolls, and R. Williams provided able field assistance.

REFERENCES

Bachman, G. O., and Machette, M. N., 1977, Calcic soils and calcretes in the southwestern United States: United States Geological Survey Open-File Report 77-794, 163 p.

Dolliver, Claire V., 1968, Late Tertiary and Quaternary Geomorphic History of Kyle Canyon, Spring Mountains, Nevada, [Ph. D. Thesis]: University Park, The Pennsylvania State University, 95 p.

Gile, L. H., 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.

Haynes, C. Vance, 1967, Quaternary geology of the Tule Springs area, Clark County, Nevada, *in* Wormington, H. M., and Ellis, D., eds., Pleistocene studies in southern Nevada: Nevada State Museum Anthropological Papers, no. 13, p. 15-104.

Lattman, L. H., 1973, Calcium carbonate cementation of alluvial fans in southern Nevada: Geological Society of America Bulletin, v. 84, p. 3013-3028.

Peterson, Frederick, 1981, Landforms of the Basin and Range Province, defined for soil survey: Technical Bulletin 28, Nevada Agricultural Experiment Station, University of Nevada-Reno.

Quade, Jay, 1983, Quaternary geology of the Corn Creek Springs area, Clark County, Nevada [M.S. thesis]: Tucson, University of Arizona, 135 p.

Quade, Jay, 1986, Estimated age of a Late Quaternary surface, Lower Corn Creek Flat, Southern Nevada: written communication.

Sowers, J. M., 1985, Pedogenic calcretes of the Kyle Canyon alluvial fan, southern Nevada - morphology and development: [Ph. D. thesis]; Berkeley, University of California-Berkeley, 160 p.