Unpublished Draft Manuscript

for the

Lincoln Point 7.5' Quadrangle

Utah County, Utah

by.

Paul D. Proctor

BYU

Date: ~ early 1999?

(UGS Contract Mapping Project)

INTRODUCTION

Lincoln Point quadrangle is in the southern part of Utah County. The northwestern part ~~of the map~~ includes a portion of the Pelican Hills and about a square mile of the eastern Lake Mountains. Several square miles of Utah Lake, including tiny Bird Island, make up the central map area, while the southern part ~~of the map area~~ includes Lincoln Point, the northern portion of West Mountain, Utah Lake on the west and some flat range and farm lands to the east.

INSERT

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Access to the northwestern part of the map area is by State Highway (73), a hard surface road from the south at Elberta, or from the north via Lehi and/or Salt lake City. This road runs ~~near~~ subparallel to the lakeshore. The Lincoln Point area is accessible via Highway, -- also hard surface and which parallels the eastern part of Lincoln Point, ~~and~~ passes around the point and thence southward to Genola. Several dirt roads lead into the mountainous areas of the quadrangle.

Elevations in the area rise to about 5430 feet in the Lake Mountain and to 5032 feet in the West Mountain portion. The mountainous terrain consists of gentle slopes throughout. ~~Surrounding~~ Land surrounding the hills is very gently sloping or flat and is devoted to fruit orchards on the gentle slopes near the hills and to grazing and farming in the flat lands. Vegetation in the mountainous areas consists mainly of grass and sagebrush with Juniper trees ~~grow~~ along the highest ridges in the Lake Mountains part. On ~~little~~ tiny Bird Island at least three varieties of deciduous trees are present. The surface elevation of Utah Lake varies depending on water usage, but is about 4490 feet (1369 meters) in a normal year. ~~Several dirt roads lead into the mountainous areas of the quadrangle.~~

The map area lies between 111 45'00" and 111 52'30" west longitude and 40 07'30" - 40 15'00" north latitude. The northwest land areas make up parts of secs 31, 32 of T6S, R1E, sections 5, 6, 7 and 18 T7S, R1E, and the southern land mass is included in parts of sections 2, 3, 9, and 16, T8S, R1E and parts of sections 6, 7 and 18 of T8S, R2E.

The climate is that of the eastern valley areas of central Utah with snow in the winter, a fairly moist spring time, and a moderately warm summer and fall with occasional rainstorms.

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Samples were collected for lake geochemical analyses both from the land areas and Utah Lake. Thirteen ~~bottom~~ samples from the lake, ~~numbering 13,~~ were obtained from a boat by driving a plastic pipe into the lake bottom sediments about one foot (0.3m) and retrieving the pipe and included samples. An east-west profile, two miles north of Bird Island, was sampled across the lake on a half mile interval. ~~One~~ One other sample was taken northwest of Bird Island about 1.5 miles, as well as two samples from Bird Island, one of the beach gravel and another of a partly altered tufa outcrop at water level. ~~Thus,~~ Sample locations ~~and others collected in~~ within the map area are

a. Index Map of Utah Lake and Lincoln Point Quadrangle.

b. %Ca. x=25.1%; S.D.=4.9%; Rge: 8.5-31.1%; -1S.D.

c. %Mg. x=1.34%, S.D.=0.16%, Rge: 0.73-1.50%.

d. %Fe. x=0.63%, S.D.=0.07%, Rge: 0.24-1.15%.

Figure ___ a, b, c, d. a. Index map showing depth of lake in feet, and location of lincoln Point Quadrangle; b. %Ca content, upper bottom lake sediments; c. %Mg content of upper bottom lake sediments; d. %Fe content, upper bottom lake sediments. Stipple pattern is above mean content for element. (Contours based on Sonerholm data, 1974).

a. %Al content: x=1.34%,S.D.=0.17%, Rge: 0.81-2.75%.

b. %Si content: x=11.83, S.D.=4.95%, Rge: 7.63-33.76%.

c. %K content: x=0.42%, S.D.=0.08%, Rge: 0.20-1.58%.

d. %Na content: x=0.10%, S.D.=0.04%, Rge: 0.06-0.33%.

Figure ___ percent content of Al, Si, K and Na in upper bottom lake sedements of Utah Lake, Lincoln Point quadrangle. Stippled pattern includes areas contaning greater than x content of element, diagonal lines: land area.

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4 4 4 6 6 6 8 8 8 10 10 10 11 11 11 11.5 11.5 12 12

N N N 0 1 2 3 4 5 Miles Miles 0 1 2 3 4 5

Revised 9.17.96 2

shown in Figure 1.

~~The~~ collected samples were analyzed geochemically by Acme Analytical Laboratories, Ltd. of Vancouver, B.C., and in the Brigham Young University Laboratories by XRF and XRD by Dave Tingey and ~~Dr.~~ Dana Griffen, respectively.

Insert p.1

Field work commenced in spring, 1995 and carried part time through 1995. Land areas were mapped by Proctor and Wang, and Utah Lake bottom samples planned and collected by Brimhall, Proctor and Wang.

Previous Work

The first known written record of the area is that of Padre Escalante and Padre Dominiguez, the Spanish priest explorers in about 1776 (Auebach, 1934). The padres entered the southeastern part of Utah Valley on 23 September 1776, and reached the shores of now named Utah Lake . They named it "Laguna de nuestra Senora de la mercedide Timpanogotypes" and wrote that the lake had an outlet to the north. A member of the party, Don Bernardode de Mieray Pacheco, made a map and showed mountains at the southeast end of the lake in a position of the present West Mountain.

The John C. Fremont party camped near the south shore of the lake (May, 1844). Earlier, other U.S. Army ~~Engineers~~ Engineer parties surveyed for possible railroad routes. The first geologic reference to the West Mountain area is an Atlas sheet of the Wheeler Survey, 1875, on which strata of West Mountain are shown as Carboniferous and the name Wasatch applied. Geologists of the Fortieth Parallel Survey (King, Vol. 1, 1878, p. 155-248) gave the name Weber to most of the Carboniferous strata of the Wasatch Mountains but Lake Mountains was not included. In a map accompanying the report, King showed the outline of the south half of Lake Bonneville from Gilbert's map of the Wheeler Survey and the north half directly from the map made by Gilbert for King.

Other publications have appeared on this part of Utah Valley since the work of Gilbert, Butler's reconnaissance geologic map of Utah (1920, pl. IV) shows northern West Moutains and Lake Mountains as all Carboniferous stratigraphy. Davis (1925) discussed features of the Basin and Range geology and commented on West Mountain structures, but did not mention stratigraphy. Some details of the geology of West Mountain are reported by Eaton (1929, p. 71-79), who describes a simple anticlinal fold structure developed in Missippian limestones bounded by block faults on the east and west. Eardley's geologic map (1933, map 11) regrettably ended 2 miles south of West Mountain.

Bullock's (1949) ~~completed his~~ dissertation on the Lake Mountains ~~and~~ describes the general stratigraphy and structure of the mountain range. Bissell (1963) reported on the geology of southern Utah Valley, and commented on the Paleozoic rock masses in this part of the county, but did not subdivide the rock units. He did describe in some detail the surficial units in the area. Lovering and his associates (1951) better defined and modified stratigraphic nomenclature in the Tintic mining district to the west, while Tooker and Roberts (1970) attempted a subidivision of the very thick Oquirrh Formation, earlier described by Gilluly (1932). This rock mass makes up a good part of West Mountain and also of the Lake Mountains to the northwest. In the Wasatch Mountains to the east Baker (1947) described the stratigraphy near Provo, Utah. More recently Brimhall (1973), Sonerholm (1974), Merrett (1980), completed detailed studies of the sediments and waters of Utah Lake. Machette (1989) mapped and compiled the surficial geology of the Wasatch Fault zone, which included a part of the quadrangle area southeast of Lincoln Point, as well as data on lake cycles and neotectonics of the younger sediments in the area (1988). About the same time (Currey et al, 1983) published a regional map showing the major levels of Great Salt Lake and Lake Bonneville including the area of the quadrangle. Price and Conroy (1980) reported on their study of the ground water resources of the southern Wasatch fault area of Utah. Miller (1982) mapped the surficial geology of the area, including Lincoln Point and modified earlier stratigraphic nomenclature. Two maps appeared in 1982 (Price and Jensen) describing the surface water resources of the southern Wasatch Fault, Utah. One showed location of stream gaging stations in Utah County and the range of dissolved solid concentrations in runoff at the indicated sites. An unnumbered site is shown on Benjamin slough near the highway to Lincoln Point. Witkin and Weiss (1991) mapped the most southern part of West Mountain, south of Lincoln Point quadrangle.

Unpublished works directly related to West Mountain are those of Nolan (1950), Swanson (1952), and White (1953).These describe the stratigraphy of the Oquirrh Formation, and details of the southern part of West Mountain and the general geology of West Mountain, respectively. Okerlund (1951) describes the calcite vein deposits and general stratigraphy just north of the map area in the Lake Mountains.

Stratigraphy

The restricted bedrock areas of the quadrangle limit the exposures of the Paleozoic rocks, the oldest exposed in the area. Only portions of known Paleozoic formations crop out, except for the Humbug Formation which is fully exposed. The Oldest Paleozoic formation exposed is the Mississippian Deseret Limestone. This is overlain by the Humbug Formation, and Great Blue Limestone in the northwest part of the quadrangle. A portion of the thick Pennsylvanian Oquirrh Group is exposed just south of Lincoln Point. South of the quadrangle boundary this rock unit is almost completely exposed. The older rocks have been folded, faulted, and eroded and overlain unconformably by Tertiary North Horn conglomerates and younger limestone of possible Flagstaff age. All of the indurated rocks are partly covered by surficial deposits of Lake Boneville and ~~younger~~ alluvial fan deposits. Utah Lake sediments and tufa cover the lower elevations. The tufa is related to thermal springs near Lincoln Point and on Bird Island ~~and is~~

~~exposed near Lincoln Point and on Bird Island~~. Relatively recent fine-grained calcareous sediments floor Utah Lake.

Paleozoic Rocks

Mississipian System

Deseret Limestone

Only a partial section of the Deseret Limestone is exposed within the map area. This section crops out in sections 6 and 31, T7S, R1E in the northwestern part of the map, and also in sec 7, just to the south. The beds trend similar to the overliying Humbug Formation in the northern outcrop area, but north northeasterly in sec 7 where **they dip moderately to steeply east. The~~y~~se ~~latter~~ ~~show~~ have a high angle of discordance to the cherty section of the Great Blue Formation, ~~and are probably separated from them by a thrust fault~~. The ~~Deseret~~ cherty limestone beds continue to the Utah Lake shoreline in sec 6. They are covered on the north by Lake Bonneville sediments in sec 7.**

The lithology of the formation is typically gray-blue cherty limestones, generally thin-bedded. Included chert masses are brownish weatheing, nodular to layered, and as thick as six inches (___cm). Strike length is several feet. The chert masses typically weather brown and show slight effervescence with HCl acid. As much as _____feet (____m) of cherty limestone are exposed in sec 7. To the north the exposed part is much thinner and is cut off on the east by a steeply dipping normal fault just north of the quadrangle boun~~d~~dary.

Humbug Formation

A complete stratigraphic section of the Humbug Formation is exposed in the northwestern part of the quadrangle on the east flank of the Lake Mountains. This section consists of sandstones, orthoquartzites, interlayered limestones and cherty dolomitic beds near the base. The lowermost beds lie directly on the Deseret Limestone, and the uppermost beds are covered by the Great Blue ledge limestones.

The Humbug Formation is about ____feet (m) in thickness as measued in section 6, T1S, R1E. The beds strike generally northwesterly and dip gently southward with outcrop development fair to good. They form a conspicous east slope of the mountains in this area.

A measured section of the formation is shown in Figure___below.

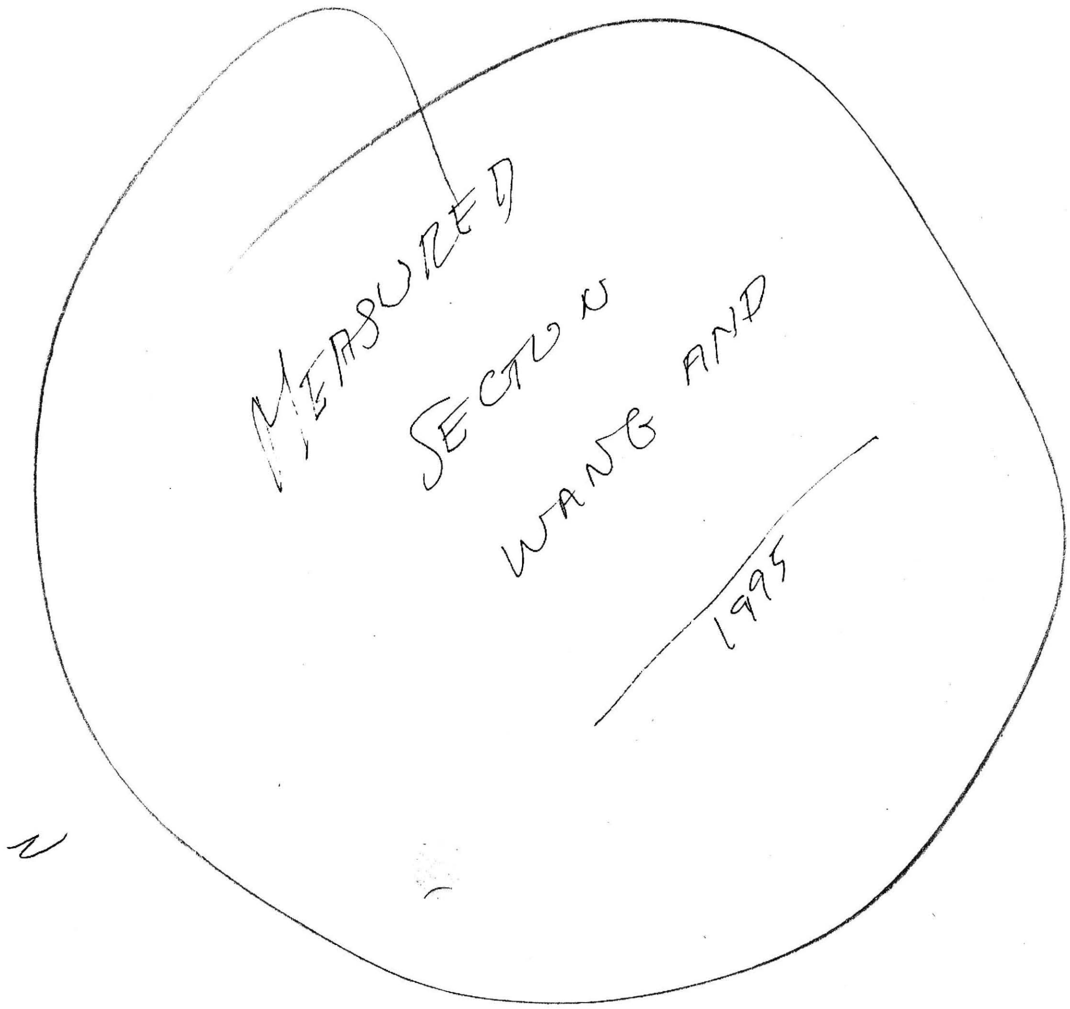
353	C39	U12	-0.01381	0.00776	0.343
354	C40	X/A	-0.02637	0.00128	0.150
355	C40	Y/B	0.36504	0.00059	-0.730
356	C40	Z/C	0.13961	0.00043	-0.501
357	C40	U11	0.07636	0.01082	-0.493
358	C40	U22	0.06726	0.00985	0.171
359	C40	U33	0.06901	0.00935	0.343
360	C40	U23	0.01933	0.00831	-0.257
361	C40	U13	-0.02357	0.00802	0.332
362	C40	U12	-0.00194	0.00896	0.027
363	C41	X/A	0.07726	0.00126	-0.228
364	C41	Y/B	0.39853	0.00053	0.368
365	C41	Z/C	0.13554	0.00041	0.177
366	C41	U11	0.07206	0.00951	0.134
367	C41	U22	0.05067	0.00811	0.696
368	C41	U33	0.06679	0.00921	-0.317
369	C41	U23	0.01408	0.00704	-1.094
370	C41	U13	0.00634	0.00812	0.653
371	C41	U12	0.00133	0.00794	0.779
372	C42	X/A	0.18028	0.00107	-0.225
373	C42	Y/B	0.38538	0.00059	-0.573
374	C42	Z/C	0.15959	0.00042	-0.545
375	C42	U11	0.03412	0.00810	-0.556
376	C42	U22	0.07825	0.01027	0.167
377	C42	U33	0.07132	0.00919	-0.157
378	C42	U23	0.01986	0.00853	-0.373
379	C42	U13	0.01006	0.00731	0.011
380	C42	U12	-0.01055	0.00736	-0.371
381	C43	ROTX	0.02546	0.00650	3.915
382	C43	ROTY	-0.00628	0.00668	-0.941
383	C43	ROTZ	-0.00481	0.00606	-0.793
384	C43	X/A	0.65657	0.00079	-1.658
385	C43	Y/B	0.12396	0.00045	1.296
386	C43	Z/C	0.20361	0.00037	-0.871
387	C43	U11	0.07168	0.00536	1.034
388	C44	U11	0.07458	0.00523	1.919
389	C45	U11	0.07162	0.00495	2.582
390	C46	U11	0.06599	0.00494	1.439
391	C47	U11	0.05934	0.00457	1.749
392	C48	U11	0.04431	0.00421	0.253
393	C49	X/A	0.51199	0.00191	-1.355
394	C49	Y/B	0.19636	0.00084	-0.030
395	C49	Z/C	0.24483	0.00063	0.559
396	C49	U11	0.06854	0.00563	-0.705
397	O50	X/A	0.58834	0.00104	-1.580
398	O50	Y/B	0.22247	0.00049	-4.234
399	O50	Z/C	0.25480	0.00038	5.929
400	O50	U11	0.06236	0.00325	0.643
401	O51	X/A	0.40340	0.00131	0.139
402	O51	Y/B	0.20850	0.00056	0.296
403	O51	Z/C	0.25134	0.00046	0.853
404	O51	U11	0.09197	0.00437	-0.291
405	O50'	U11	0.10217	0.01120	-0.670
406	C49'	U11	0.09864	0.02068	-1.285
407	C48'	U11	0.05824	0.01112	0.339
408	C45'	U11	0.06143	0.01046	1.092
409	C47'	U11	0.08523	0.01070	3.291
410	C44'	U11	0.09352	0.01059	4.111
411	C43'	U11	0.10538	0.01062	5.213
412	O51'	U11	0.10146	0.00713	7.214

MEAN AND MAXIMUM SHIFT/ESD: 0.644 7.214

CORRELATION MATRIX ELEMENTS GREATER THAN 0.5

382. 386. 0.6731 383. 384. 0.5335 383. 385. -0.6806

Figure___Measured stratigraphic section of the Humbug Formation, Sec 6, T7S, R1E, Utah County, Utah.



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Great Blue Formation

In the northwestern part of the quadrangle Two separate masses of Great Blue Formation crop out in section 6-7 and 6-31, T7S, and T6S, R1E along the east flank of the Lake Mountains. The northernmost section strikes northward and consists of prominent ledges of blue-gray massive to thick-bedded limestones. The beds dip gently westward out of the quadrangle. The southern outcrop area exposes an upper section of cherty limestones of northwesterly strike and moderately to steep southwesterly dip.

Off the quadrangle border to the west the lower ledge maker massive and thick-bedded limestones are covered by the cherty blue-gray limestone, and an interlayered section of thin beds of quartzite, shale and limestone beds of steep southwesterly dip. This ~~unit~~ latter section probably represents a part of the Long Trail Member mapped to the southwest a few miles by Proctor (1954), and by Gilluly (1932) and Bullock (1949).

The ledge limestone units probably represent the limestone beds currently being mined in the Larsen quarry just off the north edge of the map. ~~which~~ These apparently have been downdropped eastward on a normal fault.

Chip samples collected from the thick-bedded ledge limestone section were analyzed for trace metal and calcium content. Results are shown in Table ___below.

Table ___ Geochemical analyses of ledge maker beds of the lower Great Blue Formation, Sec. T R, Utah County.

Stratigraphic characteristics of the exposed Great Blue Formation are shown in the measured section ~~below~~ (Figure ~)

INSERT

Figure. Measured stratigraphic section of the lower Great Blue Formation, Lincoln Point quadrangle, Sec T R, Utah County, Utah

TO: All Math Graduate Studednts

FROM: Lonette (378-2062)

DATE: 14 March 1996

RE: Spring/Summer tuition

After reviewing our financial situation, it has been determined that we have extra money this year and hope to be able to offer tuition support to interested persons. Please list the mathematics courses you would like to take during these terms and return the form to me by Monday, 18th March or call and let me know.

Name: ____

Social Security Number: ______________________________

Courses you want to take: _________________________

____

____

____

Thanks.

~~Pennsylvanian~~ PENNSYLVANIAN

Oquirrh Group

(Richard Roberts 19

A partial section of the Oquirrh Group is exposed in the southern part of the quadrangle, where less than a square mile of Oquirrh outcrop is present in sections 15 and 16, T7S, R1E. These outcrop masses represent the northernmost exposures of the well-developed Oquirrh expos~~ures~~ed southward in the West Mountain quadangle. The Oquirrh beds are moderately to steeply inclined ~~eastward~~ westward and trend northward.

Common lithology in the westernmost outcrops south of Lincoln Point is minor orthoquartzite, then a northward bearing gently easterly inclined section of blue-gray cherty limestone of platy characteristic, ~~These limestones are~~ and locally fossilferous, containing brachipods and some fenestellid types of bryozoa. Eastward Lake Bonneville sediments cover the bedrock.

~~Eastward~~ of the cherty limestones Several hundred feet east are distinctive gray white to buff quartzite beds which strike northward and are overturned to the east. These range to 600 feet (m) thick. The lowermost quartzite beds show good cross-bedding, as well as local convoluted beds of primary origin. The uppermost beds of the quartzite section are more regularly bedded, locally laminated, and expose local fine-cross bedding. Because of ~~the~~ its distinctive lithology this quartzite section is mapped as a separate member within the Oquirrh group.

The uppermost beds of the Oquirrh Group strike northward and are strongly overturned to the east. Common lithology is minor interbedded limestone, and more ~~common~~ abundant sandstone, orthoquartzite, calcareous sandstones and arenaceous limestones. The uppermost beds are covered by Lake Bonneville sediments. Total exposed thickness of the Oquirrh Group approximates ____feet (____m). Just off the map to the south and also northwest of the mapped area, a very thick section of the Oquirrh Group is exposed. A measured section of the exposed Oquirrh group is included in Figure __.

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Fig. Measured section of exposed Oquirrh Group, Lincoln Point area, Utah County, Utah
POP in W

X-Sender: wright@hamblin.math.byu.edu
Mime-Version: 1.0
Date: Tue, 5 Mar 1996 12:02:55 -0700
To: fielding@hamblin.math.byu.edu
From: "David G. Wright" <wright@math.byu.edu>
Subject: Eric Swenson
Status:

Jill, Please make a letter for Eric Swenson for
R. Weiss, Hiring Committee Chair
Tufts University
Department of Mathematics
Medford, MA 02155

Thanks, David

Tertiary System

North Horn Formation

A distinctive conglomeratic unit ou crops out on Lincoln Point ridge near the south boundary of the qudrangle. We identify this as probable ~~possible~~ North Horn Formation. It consists of a single bold outcrop ~~zone~~ more than 25 feet thick of tannish to pinkish weathering boulder conglomerate and pebbly sandstone. Clasts range to 6 inches (cm) or more in diameter and are mainly subrounded quartzite boulders with accompanying gray-blue limestone boulders and cherty limestone clasts, with a sandy matrix. The mass crops out in sec____, T7S, R1E. In this same area, and to the north toward Lincoln Point, the surface is partly covered with large boulders of quartzite and limestone as much as 6 feet (2 m) and more in diameter. These appear to be reworked clasts from the underlying North Horn Formation. They are randomly distribted over the surface but are abundant and conspicuous.

Small bands of blue-gray limestone clasts and some quartzite clasts, cemented by calcite and/or reddish calcite, crop out in the same area. These are visible on the east side of Lincoln Point ridge, on top of the redge and a lesser number of outcrops are exposed on the western side toward the top of the ridge in sec___, T7S, R1E . Included clasts are up to six inches (___cm) or more in diameter, are are cemented by reddish to gray calcite. These low-lying outcrops probably represent bedded layers of the North Horn Formation. Most of the underlying sediments, of similar composition and texture, ~~is~~ are covered by slope wash and reworked Lake Bonneville sediments.

Thickness of the North Horn Formation is not directly available, but the scattered outcrops of the flat-lying formation, is partly reduced eastward, and residual boulders derived from it, suggest a thickness of as much as 500 feet on the northern part of West Mountain near Lincoln Point.

Quaternary System

Surficial deposits of the Lincoln Point quadrangle were deposited within the time-event framework so well described by Machette (1989). Several mappable units are identified and mapped by him, including Pre-Bonneville alluvial fan complexes, reworked by Lake Bonneville, Pre-Bonneville slope wash also reworked by Bonneville waters, Lake Bonneville gravels, post-Provo level alluvial fan sediments, Utah Lake clays and silts, tufa deposits, and the youngest sediments in Utah Lake, and alluvial deposits in small washes and in stream beds. Most of these surficial units are identified within the map area and mapped on the larger map scale.

The age relationships and character of the deposits within the map area are shown in Figure ___ below. A description of each of the mapped units follows.

TO: All Math Graduate Students

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After reviewing our financial situation, it has been determined that we have extra money this year and hope to be able to offer tuition support to interested persons. Please list the mathematics courses you would like to take during these terms and return the form to me by Monday, 18th March or call and let me know.

Name: ______________________________

Social Security Number: ______________________________

Courses you want to take: ______________________________

____

____

____

Thanks.

An older series of boulders, pebbles, sand, silt and soil occurs on both northern West Mountain and on the east flank of the Lake Mountain. On ~~the~~ north West Mountain these consist of partly reworked erosional materials of the Paleozoic bedrock, ~~and~~ Near Lincoln Point they consist of ~~the~~ Tertiary-Cretaceous North Horn Conglomerate. At this latter location large residual boulders to 6 feet (2 m) or more in diameter of quartzite, limestone and cherty limestone occur randomly distributed along the slope. These lie upon the bedrock conglomerate. Smaller size boulders, pebbles, and some sand and silt also occur in conjunction with the larger boulders. Both the larger diameter boulders and smaller diameter materials have been partly reworked by Lake Bonneville waters both above and below the prominent Provo Level terrace of the ancient lake. Former lake levels are faintly to prominently displayed in this sedimentary cover material.

Boulders of bedrock composition, and up to 6 inches in diameter, as well as pebbles, sand and silt debris occur on the east slope of the Lake Mountains in the northwest part of the map area. These sediments are derived from the underlying Paleozoic bedrock. All have been somewhat reworked by the waters of Lake Boneville both above and below the prominent Provo Level terrace of the former lake. These are mapped as re-worked Pre-Bonneville slope wash deposits.

Pre-Bonneville Alluvial Fan Deposits

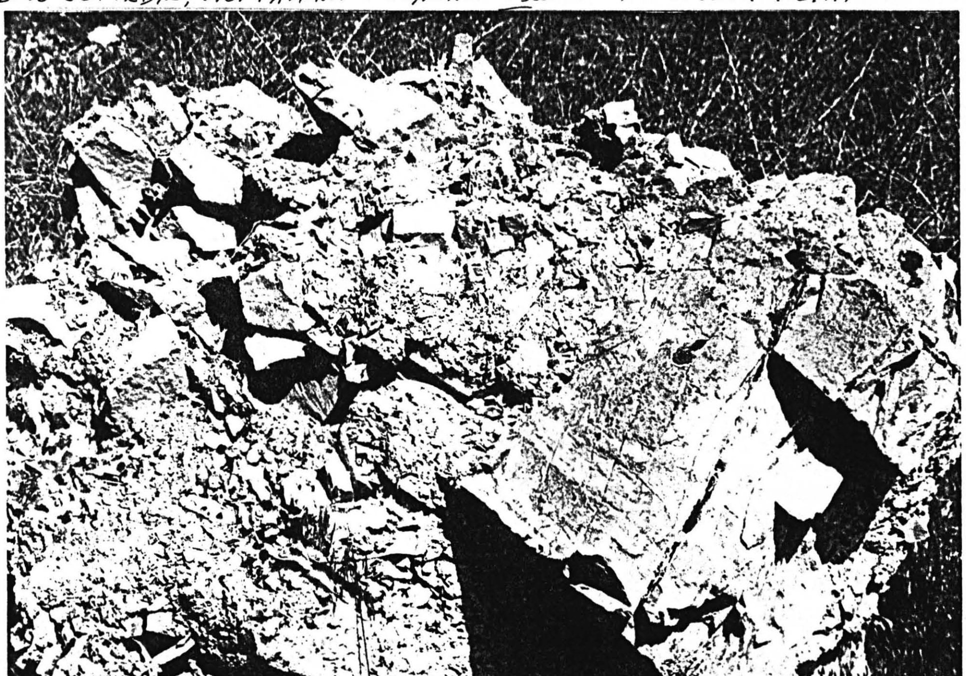
Prior to the deposition of the transgressive Lake Bonneville sediments, a series of relatively large alluvial fan complexes developed along the flanks of both the Lake Mountains and northern West Mountain. These consist of limestone, cherty limestone, orthoquartzite, and sandstone boulders, pebbles, sand and silt. They show a convex form outward from the mountain front, and are readily recognized by the geometric form of the contours. Two such older alluvial fan deposits occur along the western slope of north West Mountain in secs. 16 and 9, and in part of sec 10, T7S, R1E. Both masses are expressed top ographically by the contours which are concave to the bedrock surface and range from above 4800 feet (m) to the present level of Utah Lake at 4490 feet (___m).

Composition of these surficial sediments is that of the nearby bedrock whose derivatives ~~it is~~ they are. While thickness of the fan material is not directly observable, the sediments have an elevation difference of at least 300 feet, and if lens-shaped may be as much as ___feet thick.

Lake Bonneville Gravels, Sands and Silts

Transgressive water of the rising Lake Bonneville locally reworked colluvial materials and erosional debris from the mountains slopes. Gravels ~~were~~ consisting small cobbles, pebbles and sand were carried by and redeposit by currents at the upper levels of the lake at approximately 5125 feet (m) and below. Best exposures of thick Lake Bonneville gravel deposits are in the

BOLD OUTCROPS, North Horn Conglomerate South of Lincoln Point



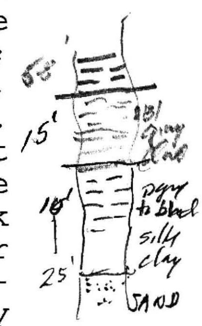
PARTLY CEMENTED BRECCIA - BONNEVILLE SHORELINE DEPOSIT — Miles Southwest of Lincoln Point, above Provo level.

STEEPLY TILTED (FAULTED) LAKE Bonneville GRAVELS, LITTLE COVE, Northeast 1/4 quadrangle.
Sec T R

Little Cove area in the Lake Mountains in the northwest part of the map area. Here up to 300 feet or more thickness of poorly layered gravels accumulated. They are restricted to the Little Cove area and clearly lie directly on the Paleozoic bedrock. Individual clasts are subrounded to discoidal and are supported by cobbles, pebbles and sand in a matrix of sand and silt. Some cementation by carbonate deposition is also present. Thin beds of sands, moderately sorted are interlayered. The grain size of the overall deposits diminishes to the east.

Utah Lake Bottom Sediments

Bissell 1963

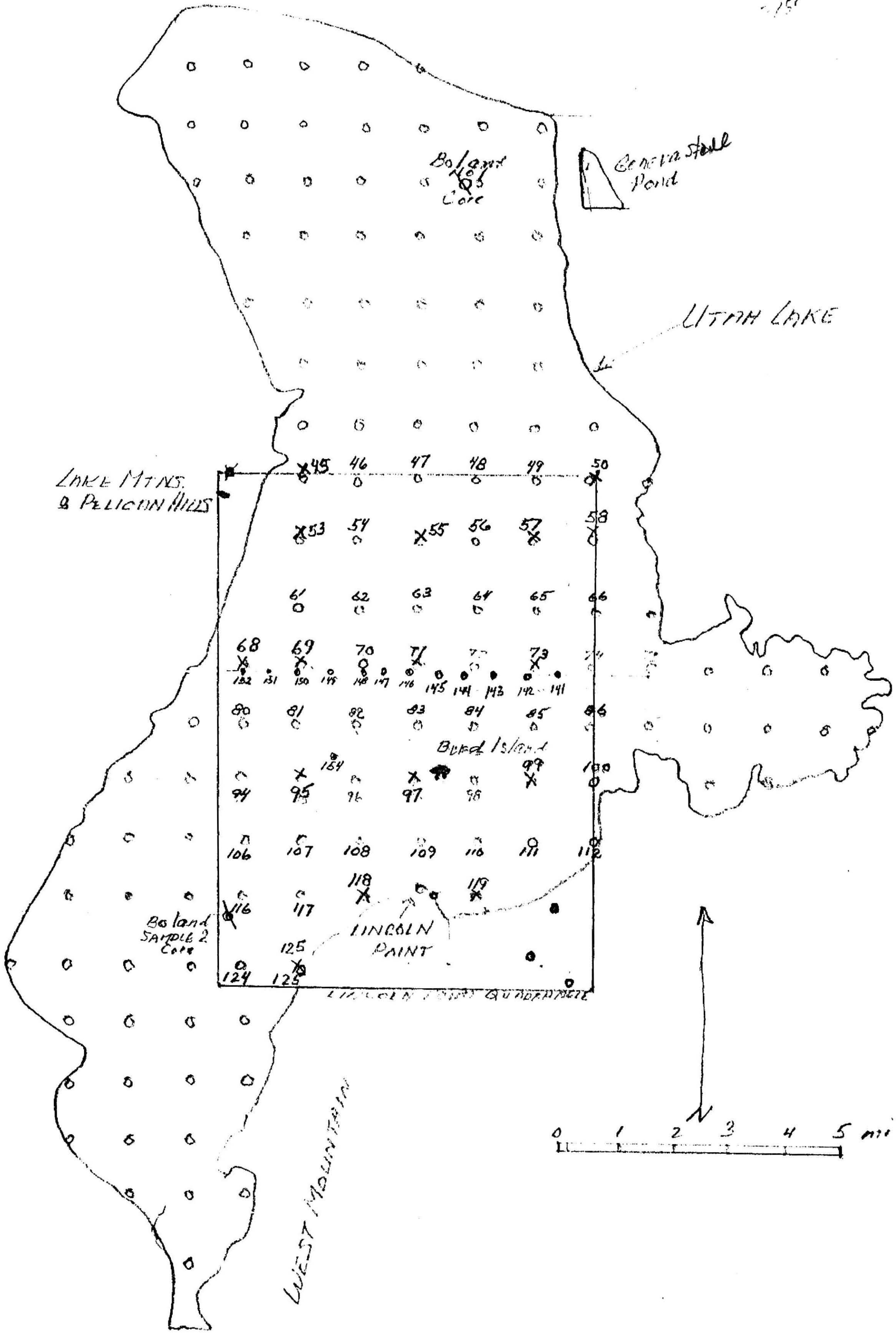


Numerous studies have been made on the bottom sediments of Utah Lake, including the part within the Lincoln Point quadrangle (Bissell, 1942, 1963; Bradshaw et al, 1969; Brimhall, 1973, 1976; Sonnerholm, 1974; Bingham, 1975; Bushman, 1980; Sundruck et al, 1970; Brimhall and Merritt, 1981; Hobson, 1994). Bissell (1963, p. 122) writes that a "clay unit almost completely borders the present edge of Utah lake and also underlies most of the present lake botttom. The clay is dark gray, dark blue gray, and locally black owing to orgnic matter....". He further records that: "The upper 5 to 8 feet of sediments on the bottom of Utah Lake is light-to-medium gray silty clay that is fairly well sorted, poorly compacted, and contains 50 to 60 percent water". This, as he notes, grades downward into the more compact medium to dark-gray clay which extends to a depth of 15 feet. Below this, he describes a 10 foot thick bed of well-sorted, dark gray to black compact silty clay with 33 to 43 percent water content, which becomes sandy at a depth of 25 feet. In addition he (op cit, p.122-3) describes a tufa unit near Lincoln Beach and along the west side of north West Mountain along the lake shore. It occurs slightly below the high-level of the lake and extends outward from the shore. The tufa also makes up the base of Bird Island, and probably occurs as a shield around it. Hobson (1994) also describes the same rock type and outlined it by sonic surveys in this part of Utah Lake. Cottam earier (1926) suggested that the tufa of Bird Island is deposited on a pedestal of quartzite.

The current geologic mapping confirms the tufa of Lincoln Beach, and that westward and southward along the shoreline. Beach gravels are also partly cemented by it. The contact mapped by Bissell (pl.) is used because he observed the deposit at a lower lake level than was available during the present field work.

A sediment sample profile was run across Utah lake two and a half miles north of Bird Island. Twelve samples were collected of the uppermost light gray clay-silt unit of the lake bottom. Individual samples were about 2000 to 2500 feet apart and were located on the map by utilizing the GPS system in a small boat. Samples were obtained by driving PVC pipe, one-inch in diameter into the sediments, then recovering the pipe and included sediment. The end of the pipe was sawed off with its contained sediment sample, and capped at both ends to preserve both water and clay-silt for analysis. Additional samples were collected about two miles WNW of Bird Island and from the bedrock tufa of the island, and from ~~the shore~~ beach gravel.

The twelve samples were analyzed by XRF in the Brigham Young University laboratory by analyst David Tingey. Results are shown in Table ______. Several of the collected samples were also analyzed for trace metal content by Acme Laboratories, Ltd., of Vancouver, B.C., a certified commercial laboratory. Analytical



Sample locations (●) within Lincoln Point quadrangle (1995), and older Utah Lake sample set (O) of Sederholm (1974) and grain-size ~~of~~ (X) of Bingham (1975), and Boland (1974) core samples (1-north and 2 south).

results are shown in Table _____.

Distribution Patterns of Major Elements in Utah Lake Sediments

Earlier, Sonnerholm (1973) carried out an extensive sampling program of Utah Lake sediments. He collected 139 samples on an approximate 1 mile (1.6km) grid. These uppermost bottom lake sediment samples were analyzed by atomic absorption for Ca, Mg, Fe, Al, Si, K and Na. Results were plotted and Trend Surface maps were prepared for each of the elemental results.

Chemical results from samples within the quadrangle boundaries were statistically reworked by the present authors for the mean (x), range, and standard deviation from the mean (Table___). Using these statistical values ~~we prepared~~ contour maps were prepared, based on one standard deviation to two standard deviations from the mean ~~as~~ threshold values, ~~and~~ greater than two standard deviations from the mean ~~as~~ are shown as anomalous contents. Individual maps for each of these seven metal content plots are included in Figures ______. The interpreted threshold and anomalous metal content areas are shown by pattern on each of the maps. Individual samples considered threshold or anomalous in metal content are ~~also~~ shown by symbol on the maps.

As a generalization, the mean contents of Ca and Mg lie mainly in the central part of the water covered area within the quadrangle. Al and Fe show a distinctive SW and south bearing pattern of lower than mean content in the same central map area. The Si, K and Na patterns resemble each other, with ~~the~~ above mean contents trending generally north and slightly eastward. All low metal contents occur in the central part of the map area. The marginal high content areas tend to parallel the Utah Lake shorelines.

Sonnerholm (1973), using the analytical chemical results of the major elements, developed nine normative minerals including calcite, magnesite, gypsum, quartz, clinochlore, illite, hematite, halite and sylvite. He concluded (1974) that normative carbonates (calcite and magnesite) are the most abundant normative mineral types, the two combined representing 90% or more of the samples collected. We concur in his assessment.

Our twelve profile samples collected on an east-west traverse two miles north of Bird Island, are shown in the profile of Figure_____. This compares the analytical results for Ca, Si, Al and Fe. The profile clearly shows the higher CaO content (most likely representing calcite content) in the central area, and ~~the~~ less abundant SiO2, mainly quartz, in the same general position as the calcite. Contents of SiO2 increase toward the west and east, or toward the shoreland areas. This correlates well with the work of Sonerholm. Alumina, probably represents clay and silt fractions of the sediments, and shows a fairly even profile, but with a slight drop in content toward the shoreland areas.

The profile set of samples also includes geochemical analyses for several trace metals and transition elements, S, F, Cl, Zn, Sr, Cu, Pb, Ni, As and Cd, analyzed in parts per million (ppm) content. These are plotted in Figure ___. Distinctive patterns are shown for S, Zn, Fe, F, and Cl contents. Each has a sharp rise toward the east. The Cd content shows a high content near the center of the profile then an abrupt rise in content among the easternmost samples. Several factors might explain these results. For example, a source to the east and north, i.e., Geneva Steel plant, or the waters draining into the lake from the east with their special metal contents such as American Fork stream, Provo River, Hobble Creek and Spanish Fork Creeks. Another factor might be metal additions from the thermal spring areas present in the lake, but the low amounts of such ~~tufa~~ metals in the tufa and calcite deposits tend to negate this as a source.

The gologic profile which accompanies the geochemical profiles shows the very shallow character of the lake, the general location of known faults in the lake sediments, and the thermal spring areas. The content of Zn, F, Cl and possibly S in the area of the thermal springs, begins to increase in content at least one half mile west of these plotted features and continues to increase at least one half mile east of them. There is a suggestion that the thermal zones are related to the increase in content of these elements.

Brimhall,

Two samples of tufa were collected from Bird Island. A third sample of tufa was obtained from the tufa outcrop on Lincoln Beach. In both areas the tufa is concluded to have been deposited from nearby thermal spring activity. The geochemical analyses show a lower content of heavy metals (___vs____). One of the Bird Island samples showed limonitic staining, possibly the result of oxidation of pyrite in the rock. The As content for this sample is about 13 times higher (189 vs 14) in this sample than the mean for the other fourteen collected samples. Other trace metals Cu, Pb, Zn, Ni, Fe, V, Cr, Ba, B are in lesser quantities than the mean for the uppermost lake sediment of the profile. Indeed, the trace metal contents of the tufa are quite similar to those known (Proctor and Wang, unpublished data) for the large calcite veins currently being mined just north of the northwest map boundary. The ~~se~~ latter are believed to be of thermal water origin..

Table

XRF Major Element Analyses of Utah lake Bottom Samples,
Profets , Lincoln Point Quadrangle, Utah Co., Utah

Sample N	SiO2	Al2O3	Fe2O3	CaO	MgO	Na2O	K2O	MnO	P2O5	TiO2	LOI
UL-141	25.09	5.37	2.42	29.00	4.06	1,05	0.92	0.03	0.02	0.33	30.19
UL-143	22.66	4.92	2.18	30.95	4.07	1.03	0.84	0.03	0	0.31	31.14
UL-144	22.86	4.88	2.16	30.77	4.03	1.01	0.85	0.03	0	0.31	31.14
UL-145	23.06	4,89	2.16	30.99	4.03	0,97	0.84	0,03	0	0.30	31.31
UL-146	22.65	4.82	2.12	31.15	4.01	0.96	0.83	0.03	0	0.30	31.09
UL-148	21.21	4.67	2.10	32.05	4.12	0.88	0.79	0.03	0	0.28	32.22
UL-150	20.37	4.56	2.13	32.66	4.11	0.92	0.76	0.03	0	0.28	32.27
UL-153	34.21	5.31	2.08	24.72	3.33	1.22	1.05	0.03	0.04	0.34	25.61
UL-154	21.95	4.80	2.15	31.39	4.02	1.01	0.81	0.03	0	0.29	31.26

Selected Minor Element XRF Analyses* or** of ~~Table~~) of Samples
Above, Lincoln Point Quadrangle, Utah Co., Utah (ppm)

Sample N	F	S	Cl	Cu	Pb	Zn	Ni	Sr	Ba	As	Ca	Zr
UL-141	397	3626	398	24	22	130	17	1089	271	13	0.9	60
UL-143	316	3176	306	25	20	109	13	1186	258	15	0.6	52
UL-144	289	3004	256	21	19	103	14	1185	260	13	0.8	53
UL-145	265	2777	250	24	20	102	13	1193	254	12	0.6	53
UL-146	260	3267	255	19	18	93	13	1188	256	16	0.5	53
UL-148	208	2751	252	19	18	88	13	1246	253	17	1	49
UL-150	194	3092	289	19	17	84	12	1258	248	14	0.2	48
UL-153	314	2789	286	27	18	87	14	971	296	11	0.4	98
UL-154	263	3401	292	25	19	96	13	1191	256	14	0.4	52

* Analyses: Department of Geology, Brigham Young Universit rsity, Pro ovo, Utah, David Tingey, analyst.
**Range(ppm) of Sc(L1), V(41-48), Cr(12-14), Ga(11-13), Rb(L1-1), Y(9-11), Nb(8-12), La(6-11), Ce(26-35), Nd(21-26), Sm(7-8), Th(6-
Sm(7-8), Th(6-7), and U(4-12) included here but not in table above.
***Analys es by Acme Analytical Labs. LTD., Vanc ncouver, B.C., Canada.

Mineralogical Characteristics - Upper Utah Lake Sediments

Fourteen upper Utah Lake sediment samples from the an E-W profile across Utah Lake were analyzed by X-R diffraction ~~fluorescence~~ analyses by Dr. Dana Griffen of the Department of Geology at Brigham Young University. Results are indicated in the x-ray patterns of figure ____. As the X-R patterns indicate, the samples consist mainly of calcite and quartz. Dr. Griffen's XRF analyses of nine of these samples confirms abundant SiO_2 and CaO content, plus a high LOI response, most likely CO_2. Griffen suggests more quartz in UL-153, the XRF analyses indicates over 34% SiO_2, all other samples ranged from ~20% to 25% SiO_2. CaO and LOI were less for UL-153 (~24.7% and 25.6%) compared to a range of (~29% - 32.6% CaO and LOI 30.15% - 32.27%). While no other specific minerals were identified, some minor XRDF peaks suggest clay. The XRF analyses confirm Al_2O_3 with a range of 4.8-5.37% and significant Fe_2O_3 (2.1-2.43%) with S from 2777-3626), possibly allied to fine-grained pyrite. Some substitution of Sr in the calcite structure is possible because of the presence of Sr in each of the samples ranging from 971 ppm to as much as 1250 ppm.

~~Relatively constant~~ Contents of MgO (3.33 (UL-153), and others 4.01-4.06%) and Na_2O (0.88-1.22%) and K_2O (0.76-1.05%) are relatively constant among the samples analyzed and probably represent dolomite and

Paul—

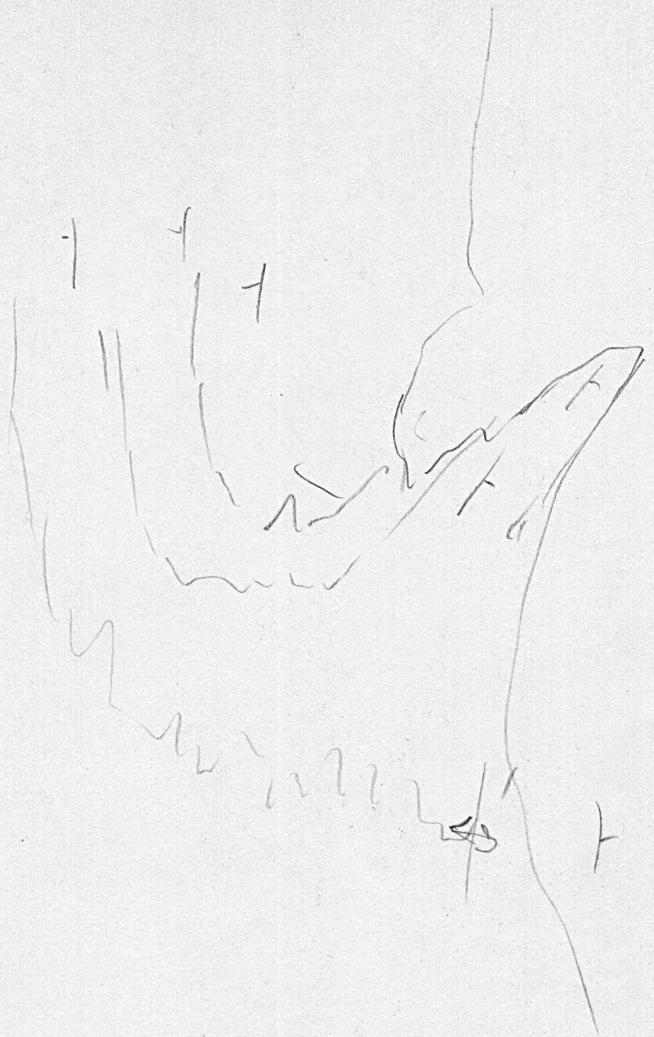
Very sorry to have taken so long to get these done, but here they are. As you can see, the sediments are virtually all calcite and quartz. Although getting quantitative about it would require substantially more work, I suspect that there is more calcite than quartz in all of the samples except UL153, which has more quartz. UL153 is also unusual in that there are two unidentified peaks at about 27° and 28° 2-theta, but with only two peaks to go on, I can't say what it is. The 28° peak shows up in UL149, also, but the 27° peaks does not, so the two might not even belong to the same mineral. Most of the patterns also have a small blip around 9°—that's about 10Å, so it could be illite, but nailing that down would take some clay work, and I don't know what is important to you for this project.

Dan

BYU Department of Geology XRF analyses – DAVID TINGEY, ANALYST
UTAH LAKE Bottom Sediments – E-W PROFILE
North of Bird Island.

	UL-141	UL-143	UL-144	UL-145	UL-146	UL-148	UL-150	UL-153	UL-154
DATE 1996	06-Mar	06-Mar	06-Mar	06-Mar	06-Mar	06-Mar	06-Mar	06-Mar	06-Mar
wt. %									
SIO2	25.09	22.66	22.86	23.06	22.65	21.21	20.37	34.21	21.95
TIO2	0.33	0.31	0.31	0.3	0.3	0.28	0.28	0.34	0.29
Al2O3	5.37	4.92	4.88	4.89	4.82	4.67	4.56	5.31	4.8
Fe2O3	2.43	2.18	2.16	2.16	2.12	2.1	2.13	2.08	2.15
MnO	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
MgO	4.06	4.07	4.03	4.03	4.01	4.12	4.11	3.33	4.02
CaO	29	30.95	30.77	30.99	31.15	32.05	32.6	24.72	31.39
Na2O	1.05	1.03	1.01	0.97	0.96	0.88	0.92	1.22	1.01
K2O	0.92	0.84	0.85	0.84	0.83	0.79	0.76	1.05	0.81
P2O5	0.02	0	0	0	0	0	0	0.04	0
sum	68.3	66.99	66.9	67.27	66.87	66.13	65.76	72.33	66.45
LOI	30.19	31.37	31.14	31.31	31.09	32.22	32.27	25.61	31.26
total	98.49	98.36	98.04	98.58	97.96	98.35	98.03	97.94	97.71
ppm									
F	397	316	289	265	260	208	194	314	263
S	3626	3176	3004	2777	3267	2751	3092	2786	3401
Cl	398	306	256	250	255	252	289	286	292
Sc	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
V	48	44	43	41	42	42	41	45	43
Cr	(14)	(13)	(13)	(13)	(12)	(12)	(12)	(13)	(14)
Ni	17	13	14	13	13	13	12	14	13
Cu	26 24	26 25	28 21	25 24	21 19	20 19	18 19	23 27	24 25
Zn	130	109	103	102	93	88	84	87	96
Ga	12	12	11	12	13	12	11	13	12
Rb	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1
Sr	1089	1186	1185	1193	1188	1246	1258	971	1191
Y	11	10	10	10	10	9	9	11	9
Zr	60	52	53	53	53	49	48	98	52
Nb	10	10	10	10	11	11	9	12	8
Ba	271	258	260	254	256	253	248	296	256
La	11	8	9	6	7	11	8	8	9
Ce	33	35	30	26	34	32	30	31	38
Nd	26	23	23	23	23	22	21	22	24
Sm	7	8	7	7	7	8	7	7	7
Pb	27 22	27 20	19	20	18	18	17	18	19
Th	7	7	7	6	6	6	6	6	6
U	7	9	10	6	5	4	8	5	12

LOI - loss on ignition (CO2, H2O)
( ) - approximate analysis



Rates and Character of Sedimentation of Utah Lake Bottom Sediments

Investigations on the rate and character of sedimentation in Utah Lake include those of Bissell (1942), Brimhall (1973), Bingham (1975), and Bushman (1980) and others. Brimhall (1973) studied a core sample taken from the lake bottom two miles west of the shoreline adjacent to Geneva Steel, (fig.) This site is north of the quadrangle. The sample came from the upper surface of the lake sediments and was 520 cm in length. He determined the variations in concentrations of Ca, Fe, P, N and Al; and suggested that the profile reflects some major historical events such as significant fluctuations of the water level and air and water pollutions of the lake. He concluded that the average sedimentation rate was 3.3 cm. per year for the past 40 years (1933-1973) and 2.6 cm per year, 1885-1935. The lower section of the core indicated that some 200-300 years ago the lake was at a very low level and had a high salinity content.

Sonerholm's study (1974), based on 139 contemporary bottom-sediment samples of the lake and collected at projected section corners, involved chemical analyses of the major elements Ca, Mg, Si, Al, Fe, Na and K and the determination of normative minerals from the chemical data. The normative minerals included calcite, magnesite, quartz, clinochore, illite and hematite. Combinin g the data into four groups: total carbonate, total clay, quartz and hematite, a sixth degree trend surface map was prepared for each of the groups. ~~Based on the map,~~ the suggested higher carbonate content in the northern and southern portions of the lake and quartz most abundant in the mid-area. Total clay and normative hematite distribution is more complex and probably reflects the influence of various streams entering the lake. He ddid not indicate rates of sedimenation.

Bingham (1975) emphasized grain-size analyses, organic carbon content, carbonate content and clay types for recent sedimentation, i.e., in the top few inches (cms) of the lake sediments. Sixty samples were collected on east-west traverses about two miles apart, with the rows two miles apart north south. About 19 of these samples fall with Lincoln Point quadrangle. He concludes that calcium carbonate is the most abundant sediment and ranges from 6-73 percent. Clastic grains "make up essentially the remainder", and these are from rare granule size, with silt the most abundant. Coarser fractions, granule to very fine sand, are near mouths of and southerly of major streams entering the lake, and silts and clay "are more abundant in the center portions of the lake (i.e., Lincoln Point quadrangle area). Illite in the form of discrete mica is the dominant clay type, with kaolinite and mixed layer illite-montmorillonite also present. Organic material is highest in isolated bays and sloughs. Much rarer sediments near river mouths include small amounts of mica, clinkers, coal, feldspars, silicified oolites, clay chunks, and small rock fragments" His trend surface maps (his figures 4-9) clearly show the weight log percent of coarse sand through clay fractions, the trend surface

ROCHELLE VAN ORMAN	ROCHELLE VAN ORMAN	ALYSHIA ALLEN	ALYSHIA ALLEN
AMANDA BUTLER	AMANDA BUTLER	LESLIE CHRISTIANSEN	LESLIE CHRISTIANSEN
JACI DAVIS	JACI DAVIS	KRISTINA FOLAUMOELOA	KRISTINA FOLAUMOELOA
DARSI JOHNSON	DARSI JOHNSON	LIESL LEGORBURU	LIESL LEGORBURU
TIFFANY PORTER	TIFFANY PORTER	JULIE RASMUSSEN	JULIE RASMUSSEN
KRISTEN SPRINGER	KRISTIN SPRINGER	BRIGETTA KOENIG	BRIGETTA KOENIG
KIM CLARKE	KIM CLARKE	ALANYA KOENIG	ALANYA KOENIG
HANNAH VAN ORMAN	HANNAH VAN ORMAN	MEAGAN BISHOP	MEAGAN BISHOP

ROCHELLE VAN ORMAN	ROCHELLE VAN ORMAN	ALYSHIA ALLEN	ALYSHIA ALLEN
AMANDA BUTLER	AMANDA BUTLER	LESLIE CHRISTIANSEN	LESLIE CHRISTIANSEN
JACI DAVIS	JACI DAVIS	KRISTINA FOLAUMOELOA	KRISTINA FOLAUMOELOA
DARSI JOHNSON	DARSI JOHNSON	LIESL LEGORBURU	LIESL LEGORBURU
TIFFANY PORTER	TIFFANY PORTER	JULIE RASMUSSEN	JULIE RASMUSSEN
KRISTEN SPRINGER	KRISTIN SPRINGER	BRIGETTA KOENIG	BRIGETTA KOENIG
KIM CLARKE	KIM CLARKE	ALANYA KOENIG	ALANYA KOENIG
HANNAH VAN ORMAN	HANNAH VAN ORMAN	MEAGAN BISHOP	MEAGAN BISHOP

maps of organic material content (his figure 10) and acid soluble (carbonate) content. He cites Brimhall (1973) on rates of sedimentation. In relationship to the Lincoln Point quadrangle lake covered area, which is mainly the central lake area of his study, he concludes that the sediments contain very minor amounts of coarse clastics, usually less than one percent, clay size fractions approximate 15-21 percent, and about 10-19 percent of silt size particles. Calcium carbonate is very abundant and makes up the major part of the sediments at 61-73 percent. This is in general agreement with our own findings.

Brimhall and Merritt (1981) indicate a transition zone of loose sediments above firm lake bottom sediments which consist of about 0.5 m of "thin to thick soup". Bushman (1981) cites Fuhriman and others (1981) and points out that near Lincoln Beach, near the southern end of the lake, the waters are almost "always milky in appearance becauseof calcium carbonante being precipitated there in the form of colloidal and silt-sized crystals that remain suspended for a long time". In this area beach gravels show a tufa-like cement~~s~~ coating, and a well-developed tufa layer is ~~present~~ exposed around Lincoln Point. Furhiman and others (1981) calculate that calcite was precipitated at the r~~r~~ate of 0.2 mm per year, and that 25 percent of the total sediments and "35 percent of the calcite was deposited in the lake by mineral precipitation."

Once a clear-water lake, in the memory of living persons (Bertrand Harrison, cited 1981), and with abundant vegetation near shore, and a carpet of vegetation growth on its bottom, the lake has changed from a "clear sulfate lake:"......to become a "bicarbonate and eutrophic to dystrophic lake, with high colloidal turbidity when ice covering is lacking." By 1926 (Cottam) notes that the "lake is astonishingly free from aquatic vegetation....The disappearance of vegetation in the lake followed the introduction of the herbivorous fish-the German carp. With no enemies to impede its enormous reproductive powers the carp was soon master of the lake."

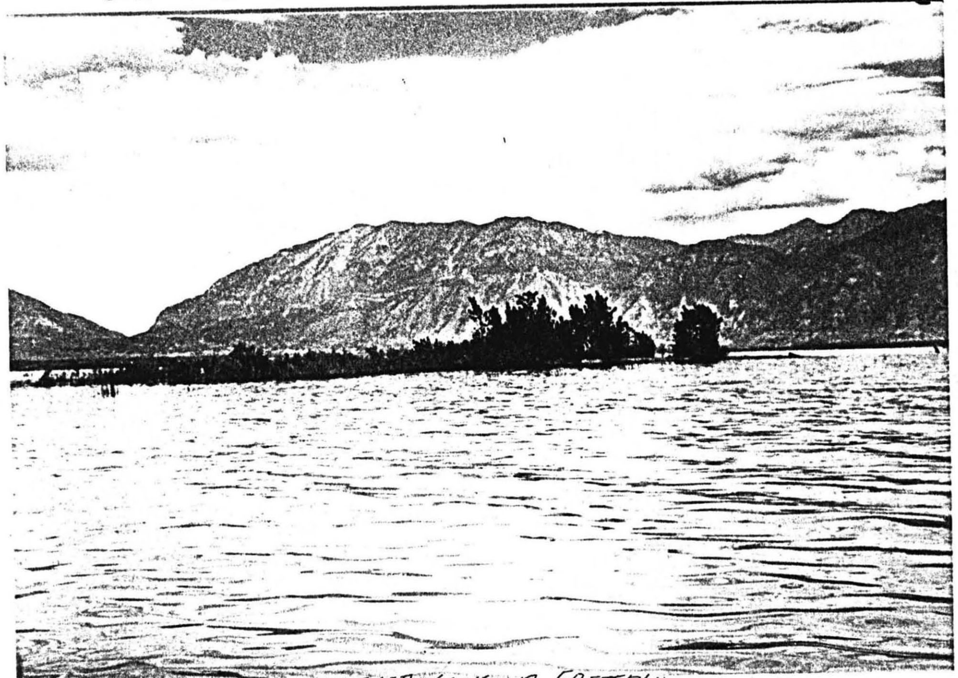
Bushman (1981) concludes that there "is good evidence that the average annual amount of detrital sediment carried into Utah Lake has increased since 1849, the time of white man's settlement of the valley. He cites deforestation and overgrazing on the eastern and western margins of Utah Valley, plus highway construction and railroad grades into Spanish Fork Canyon. Chemical changes in the lake waters have also occurred. Bissell (1942) suggests a recent increase in the amount of calcium carbonate based on its decreasing content in depth in the bottom lake sediments. Drainage canals cut in the lowlands permitted the drained water to leach salts present, decreasing salinity up to 7000 ppm (Jones, 1974) and increasing the salt content in the soils closer to the lake. Irrigation water is also cited as a major additive of salt to the lake (Turley, 1969). The latter author states that the salt content at the mouth of Spanish Fork River is three times that in the river where it is taken out for irrigation. Later Fuhriman and others (1981) suggested a range in total dissolved salts of 700 to 1000 mg/l during average inflow years ot the lake.

After careful consideration of the abundant data available Bushman (1981) cited Brimhall's rate of sedimentation (1972) at

2.6 cm/year for 1885-1935 and 3.3 cm/year for 1935-65, and a later study of Brimhall and Merritt (1981) with a revision to 2 mm/year post-settlement rate. Varves were sought by Borland (1974) as a means of yielding more precise data, but none was found. Borland?

Using pollen from 45 plants to determine the "distinctive appearance and greater likelihood of being transported into the lake", Bushman (1981) used portion of a 5 m core taken in 1972 by Robert Finley Borland, a graduate student from the University of Utah, from Goshen Bay in the southern part of the lake.
Slices of the core, 2 cm thick were cut every 10 cm, except the top 10 cm where 5 samples were cut. A total of 58 samples were cut, and 41 processed to extract pollen, with 75 thin sections prepared and 67 of these studied. He concludes, among other details, that the appearance of abundant algae in several samples, sugests an algal bloom in the past. Also, Taraxacum officinale, the common dandelion, was the plant by which an "approximate age level was determined from the core studied". This plant was considered to have been introduced in Utah Valley in 1849. Found in the upper 170-172 cm of the core, the rate of sedimenation from 1849-1972 is 1.38 cm per year. He states that this rate is probably the most reliable and suggests it is of the same magnitdude as reported in studies of lakes similar to Utah Lake, each of which experienced increased rates of sedimentation because of human activities in the environment. He also notes that the greatly increased calcium carbonate content in the uppermost sediments as cited. by Bissell (1942) and others needs further study.

SLOPE WASH GRAVELS WITH INTERCLAST SANDS, SILTS AND CLAY, FOUNDATION Cut, — miles SOUTH OF LINCOLN POINT.



BIRD ISLAND LOOKING EASTERLY

TUFA OUTCROP, BIRD ISLAND, UTAH LAKE

Tufa Deposits

H22	-0.14938	0.61366	0.09379	1.00000	0.08000						
	0.00106	0.00050	0.00039	0.00000	0.00000						
C23	0.02271	0.64673	0.08934	1.00000	0.04504	0.07267	0.03551	0.00980	0.00636	-0.00314	0.05107
	0.00102	0.00052	0.00036	0.00000	0.00761	0.00926	0.00678	0.00655	0.00639	0.00703	0.00459
H23	0.04287	0.64451	0.11976	1.00000	0.08000						
	0.00102	0.00052	0.00036	0.00000	0.00000						
C24	-0.24873	0.61162	0.01766	1.00000	0.03784	0.03719	0.09656	-0.01725	-0.01811	0.00410	0.05720
	0.00096	0.00049	0.00043	0.00000	0.00680	0.00786	0.01075	0.00729	0.00705	0.00612	0.00498
C25	-0.26030	0.61020	-0.03282	1.00000	0.08895	0.08238	0.06463	0.01041	-0.03104	-0.00873	0.07865
	0.00130	0.00061	0.00038	0.00000	0.01084	0.01073	0.00899	0.00780	0.00843	0.00895	0.00590
H25A	-0.33402	0.59072	-0.04096	1.00000	0.10000						
	0.00130	0.00061	0.00038	0.00000	0.00000						
H25B	-0.19186	0.58998	-0.04492	1.00000	0.10000						
	0.00130	0.00061	0.00038	0.00000	0.00000						
H25C	-0.26180	0.64913	-0.04379	1.00000	0.10000						
	0.00130	0.00061	0.00038	0.00000	0.00000						
C26	-0.34761	0.65215	0.03522	1.00000	0.04295	0.07575	0.14349	-0.00268	0.00242	-0.00357	0.08740
	0.00111	0.00060	0.00051	0.00000	0.00865	0.01077	0.01479	0.01027	0.00920	0.00781	0.00675
H26A	-0.42690	0.63878	0.02683	1.00000	0.10000						
	0.00111	0.00060	0.00051	0.00000	0.00000						
H26B	-0.33477	0.69044	0.02393	1.00000	0.10000						
	0.00111	0.00060	0.00051	0.00000	0.00000						
H26C	-0.34183	0.65289	0.06647	1.00000	0.10000						
	0.00111	0.00060	0.00051	0.00000	0.00000						
C27	-0.26282	0.54945	0.03426	1.00000	0.03499	0.04775	0.09192	0.00169	0.01961	-0.01058	0.05822
	0.00109	0.00052	0.00042	0.00000	0.00772	0.00870	0.00978	0.00733	0.00746	0.00733	0.00506
C28	-0.36552	0.52677	0.05402	1.00000	0.04364	0.04928	0.11085	-0.00168	0.00161	0.01622	0.06792
	0.00108	0.00055	0.00045	0.00000	0.00812	0.00905	0.01202	0.00824	0.00786	0.00697	0.00570
H28	-0.43066	0.55277	0.06121	1.00000	0.08000						
	0.00108	0.00055	0.00045	0.00000	0.00000						
C29	-0.37956	0.47051	0.06616	1.00000	0.03409	0.05380	0.13556	0.03748	0.01842	-0.00414	0.07448
	0.00110	0.00060	0.00046	0.00000	0.00784	0.01006	0.01273	0.00915	0.00791	0.00794	0.00600
H29	-0.45352	0.45723	0.07948	1.00000	0.08000						
	0.00110	0.00060	0.00046	0.00000	0.00000						
C30	-0.28734	0.43316	0.05906	1.00000	0.03940	0.04744	0.06215	0.00480	0.00320	-0.00288	0.04966
	0.00107	0.00056	0.00038	0.00000	0.00793	0.00912	0.00839	0.00683	0.00638	0.00750	0.00491
C31	-0.18385	0.45082	0.03876	1.00000	0.04304	0.04217	0.10228	0.00262	0.02145	0.00773	0.06250
	0.00112	0.00054	0.00043	0.00000	0.00873	0.00879	0.01064	0.00755	0.00797	0.00689	0.00544
H31	-0.11919	0.42397	0.03289	1.00000	0.08000						
	0.00112	0.00054	0.00043	0.00000	0.00000						
C32	-0.17102	0.50893	0.02714	1.00000	0.05230	0.04679	0.07706	0.00022	0.02110	0.01033	0.05872
	0.00111	0.00053	0.00040	0.00000	0.00892	0.00879	0.00952	0.00716	0.00711	0.00743	0.00524
H32	-0.09694	0.52164	0.01359	1.00000	0.08000						
	0.00111	0.00053	0.00040	0.00000	0.00000						
O33	-0.28789	0.37431	0.06772	1.00000	0.05788	0.05449	0.09552	0.01556	-0.00013	-0.02520	0.06930
	0.00070	0.00037	0.00028	0.00000	0.00585	0.00611	0.00691	0.00514	0.00492	0.00493	0.00364

STRUCTURES

Introduction

The Lincoln Point quadrangle consists of about 12% land area and ~~with~~ Utah Lake covering the remaining 88%. The land area consists of two parts: ~~one in~~ the northwest quarter which lies north and west of Pelican Point and is some 1.25 square miles in area; the second part is south of Lincoln Point in the southern part of the quadrangle and to the east. It comprises some six square miles. ~~There is~~ Limited exposure of bedrock occurs in each of these areas which are separated by several miles.

The geological structures in the land areas reflect earlier results of compressive stress, most likely related to the Early Cretaceous Sevier compressional orogeny. Later faults of extensional origin ~~are present~~ occur in the bedrock, ~~and~~ Very young extensional features visible in the Utah Lake bottom sediments probably related to Basin and Range faulting of Tertiary and younger age. The structural characteristics and evolutionary relations for the three different units: Pelican Point south, Lincoln Point, and the Utah Lake unit follows.

Pelican Point South

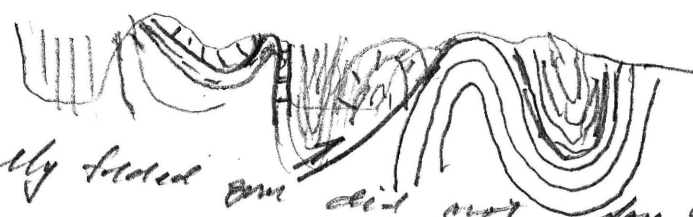
Strata of the Deseret, Humbug and Great Blue Formations of the Mississippian System are exposed in the northern part of this unit. Attitudes of the strata are fairly gentle, and range from a few degrees to locally more than ten degrees. Regionally they are part of the eastern limb of the Lake Mountain syncline (Bullock, 1949). ~~It~~ ~~Based on~~ The mapped geology indicates ~~the unit represents~~ a secondary assymetric anticline cored by Deseret Formation. The limbs consist of Humbug and Great Blue Formations. The west limb is of Great Blue and the underlying Humbug Formation. Both dip gently southwestward. The dip of the Humbug Formation gradually changes to southwesterly. The east limb is cut by a north trending, steeply east dipping longitudinal fault down to the east, ~~and~~ with the down faulted block mainly covered by surficial materials. The anticline plunges southward and the nose is cut by a fault (F1) of easterly bearing. The south block ~~consists~~ of ~~strata of the Deseret Formation and the~~ Great Blue Formation, Humbug. ~~Strata of the Deseret Formation on~~ The east limb dips 38 -68 southeast, ~~While strata of the Great Blue Formation~~ on the western limb dip southwest ~~and~~ at variable inclinations. ~~The Humbug Formation, between the Deseret and the Great Blue Formations, is not exposed because of fault displacement~~. (over)

~~The~~ Fault structures of the rock unit consists of ~~four~~ three types:

1) A transverse EW shear fault, F1, which ~~crosses~~ cuts the middle part of the fold. ~~Evidences for the~~ Fault exposures ~~are~~ not ~~readily observed~~ visible in the field, but ~~we recognize~~ the discontinuous lithizones, inconsistent bedding attitudes, ~~and~~ different patterns of structure on the two limbs, ~~The shear character of the fault is inferred on~~ and missing Humbug Formation suggests it's presence.

so the nose of the fold plunges south southwesterly.

Just southward at the Morning Canyon shale quarries, some ~~complicated~~ drag folds are visible. North of the main quarry ~~a~~ a 40-foot section of brown quartzite is folded into a syncline and anticline across a distance of —— feet. The axis of the anticline lies under the State highway. Further south a few hundred feet brown to black shale and interbedded massive blue limestone are thin-bedded limestones and shales are tightly drag folded, ~~and faulted~~ into ~~drag~~ a syncline and anticline of a few score feet size. The section below illustrates the complexity in these less competent shales and limestones and the more ~~res~~ crystalline massive limestone



this

The complexly folded zone did not fare well for mining of the shale zone in this part of the area.

~~the basis of the structural relationships among the bedding attitudes, the fault and the fold.~~

2) A ~~diagonal~~ northwest bearing fault, F2, is traceable ~~for~~ about 800 feet in the mapped area. ~~It~~ and continues northwestward into the adjoining quadrangle. A major calcite vein is well-developed along this fault. ~~On the map boundary~~ In the quarry on the map boundary, the fault plane strikes N50 W and dips 70 NE. Displacement is normal ~~and down to the north~~. In plan view the fault acutely cuts the strata, and ~~while the displacement is small, it~~ shows apparent right lateral displacement of about 500 feet.

3) A thrust fault most likely exists between the Great Blue Formation on the south structural block and the Deseret Limestone. While no fault exposures are known, some breccia zones several feet thick are present and also the omission of more than 700 feet of the Humbug Formation. In addition, only a partial thickness of the other two formations, and the contact relationships suggest a buried fault between the two formations.The thrust fault is likely the result of west to east compression related to the development of the Lake Mountain Syncline during the Sevier compressional orogeny.

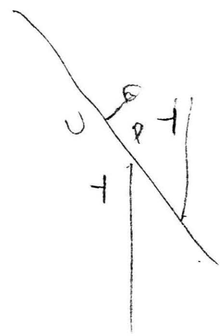
Concealed by Lake Bonneville Sediments

3) A longitudinal fault occurs ~~along~~ west of the axis of the subsidiary anticline. The main ~~length~~ extreme ~~of the fault~~ is in the quadrangle to the north. Within the map area, ~~however,~~ the western wall of the fault consists of ~~Humbug~~ Deseret Formation ~~and~~ the eastern hanging wall ~~of Great~~ Blue Formation. Displacement is normal, ~~and~~ the fault plane is vertical to steeply east dipping ~~with~~ and the east wall down~~thrown~~. Veins of calcite and aragonite to more than eight feet thick occur along this fault zone, and are the basis ~~an~~ of an underground calcite mine in the area. The north trending normal fault is not genetically related to the fold, or the ~~tear~~ shear fault ~~or the thrust fault. The normal fault appears to have~~ but developed synchronous with other Basin and Range faults at a later time.

Okerlund (1951) ~~also~~ suggested that the fault ~~which~~ hosting the calcite vein is likely associated with Basin and Range block faulting. Bullock (1949) described the Lake Mountains as a fault block range with an east-bounding fault near the shore of Utah Lake. The fault noted above is less than a mile from the lake shore and tends to parallel it. Evidence for block faulting is suggested by the relative position of the fault to Utah Lake and the uplifted mountain block to the west.

In section 6, in the Little Cove area, sec 6, T7S, R1E, a ~~gravity slide~~ fault of north trend occurs in the partly cemented Lake Bonneville gravels. They dip about 35 degrees west and strike north. The deposits appear to have been rotated westward on a listric-type fault of moderate to steep east dip. This is the latest structural dislocation noted in the area, and is probably less than 15,000 bp ~~(before present)~~.

Lincoln Point



2(

The Lincoln Point block (LPB) consists of strata of the Oquirrh Formation and is a structural segment of the large overturned West Mountain anticline (Bissell, 1948; White, 1953). The eastern part of ~~the structure~~ Lincoln Point is an overturned limb which dips westward at about 50 degrees. ~~To the South and~~ Westward the beds are upright and dip eastward about 15-30 degrees. A north-trending westward inclined reverse fault ~~may~~ lies? between the west and eastern parts of the structure ~~. If present it~~ where and is covered by Lake Bonneville deposits in the valley area. ~~Such a~~ The fault is inferred based on the lithologic differences in the units exposed in the area and the upright and overturned attitudes of the beds in the area. The northern extension of West Mountain is a horst block as shown by ~~based on the uplifted character of the mountain block,~~ the abrupt termination of bedrock on either side of the block, ~~and~~ the known faults, and associated thermal springs along faults on both sides of the mountain block.

The overturned anticline plunges ~~NNEward~~ north-northeastward under Utah Lake sediments and probably continues northward under Bird Island. ~~The latter consists of Holocene tufa.~~ Cottam (1926) suggests a quartzite pedestal is the foundation for the tufa deposits of Bird Island. Brimhall (1979) also suggests that the Bird Island Fault lies along the west side of Lincoln Point and Bird Island, and that an unnamed fault occurs east of the island and just east of Lincoln Point. He also suggests a down to the west displacement on the Bird Island Fault and down to the east movement on the unnamed eastern fault based on sonic measurements in the lake. ~~Based on~~ From these apparent displacements and the relatively recent fault displacements in Utah Lake sediments east of Lincoln Point, Brimhall (1979) ~~suggests~~ concludes that the fault block of northern West Mountain and Bird Island stands structurally high as a horst block. Known tufa deposition and thermal spring activity are probably related to these faults.

Lake Unit

In the regional setting Utah Lake is a fault basin lying between the mountain masses of Lake Mountain, West mountain, the Wasatch Mountains and the Traverse Mountains. Each of these mountain masses is considered to be a fault block range related to Basin and Range faulting produced under extensional stresses ( ). The Lake unit area covers a large part of the Lincoln Point Quadrangle. Brimhall (1979) ~~thoroughly~~ investigated this part of Utah Lake and ~~outlined~~ identified several significant structural feactures present in the relatively recent lake sediments. ~~We summarize his~~ Some of his important contributions are considered below.

Brimhall (1979) and his ~~assistants~~ associates identified on the basis of sonic surveys, a series of small step-like normal faults of north to northeast trend within the lake sediments, of the Lake unit. Th~~e normal faults show as small step faults (Fig. , 1, 3),~~ a graben (2) and a horst (4) along the northwest-southeast profile. The horst is a north extension of the Lincoln Point block under the lake. ~~Characterestics of the faults are discussed separately below.~~

Bird Island Fault ~~---~~ ~~Within the quadrangle~~ The Bird Island Fault extends northeastward from the west side of Lincoln Point to the west side of Bird Island and then north northeastward off the map area. The fault is at least ten miles in length. The ~~acoustical~~ sonic profile of Brimhall (1979) indicates the western wall of the fault is downthrown relative to the eastern wall and the displacement of the Holocene deposits is as much as two meters (6.6 ft).

Either an eastern branch or intersection of another fault occurs on the Bird Island fault about three kilometers (1.9 miles) north of Bird Island. This eastern fault extends southward and east of Bird Island toward the east side of Lincoln Point. It is possible that the fault is part of a fault zone along the east side of West Mountain and may represent relatively recent movement in this zone. The eastern block is downthrown about two meters relative to the western block. The block between the Bird Island Fault and the east fork fault thus is a structural horst.

East Goshen Bay Fault --- The southern part of the East Goshen Bay Fault (EGB) is parallel to and a few handred feet west of the Bird Island Fault. The EGB fault extends northward for about 10 miles to the quadrangle boundary. Near the center of the map a branch of the fault trends northerly to the map edge. South of thes ~~branch~~ intersection the western block is down relative to the eastern block. North of the intersection the block between two faults is downthrown or graben-like in character, Brimhall (1979) named this the Pelican Point Graben. It represents the lowest visible structure ~~of~~ in Utah Valley. The ~~acoustical~~ sonic profiling ~~(Fig.)~~ shows a displacements of at least 5 meters (16 Feet) on the EGB fault. The fault cuts the clay unit of the Lake Bonneville Provo stage ~~Provo Formation of~~ uppermost Pleistocene. ~~and is the age of the last displacement on the fault.~~

West Goshen Bay Fault --- The West Goshen Bay Fault (WGB) has a strike length of about 6 miles (9.6 km) and parallels the northwest shore of Utah Lake in the map area. It extends southwestward and northeastward into adjacent quadrangles. The eastern block of the fault is downthrown as is the fault displacement on the EGB fault and thus forms the Goshen Bay Graben (Fig.).

Each of the above faults is significant in that they indicate the recency of fault movement in ~~the~~ Utah valley and ~~the~~ amounts of measurable displacements in feet (m).

Ground Water

Price and Conway (1988) report on the ground water resources of the southern Wasatch Front area, of which Lincoln Point quadrangle is a part. Over a 20 year period, 1966-1986, the altitude of the potentiometric surface of the flowing wells rose 5 feet. However, in the basin fill near Benjamin a decline of 4 feet in the water level occurred in the same period. Apparently little change in the water level occurred to the east of Lincoln Point in the valley fill.

Cordova (1970, p. 56-57) estimates that the volume of theoretically recoverable water in the upper 400 feet of saturated basin fill in southern Utah Valley and Goshen Valley totals about 6 million acre feet. In terms of transmissivity of the basin fill the southeast Lincoln Point valley fill lies in the range of 100-10,000 feet square per day (i.e., cubic feet per day per foot). This is shown on a map by Price and Conroy (1988, Plate I). The authors (Plate 3) also suggest the dissolved solids concentration in waters in the basinfill in the same area is in the low range of 100-500 mg/l, in strong contrast to the 1000-3000 mg/l on the westside of West Mountain from Lincoln Point south to Goshen. In the Lake Mountains, ~~is~~ part of the map area, two water wells average 1525 mg/l dissolved solids. ✓

Thermal Springs-Three thermal springs ~~flow~~ are known in the map area. Two are ~~occur~~ south of Goose Point in the northwestern part of the area near the west shore of Utah Lake and about a mile apart. The third is ~~spring is~~ on Lincoln Point on the lake shore in section___T R___.Another thermal spring occurs just north of the map boundary in section __T R__. The spring flow is small, and temperatures approximate 98-100 degrees fahrenheit.

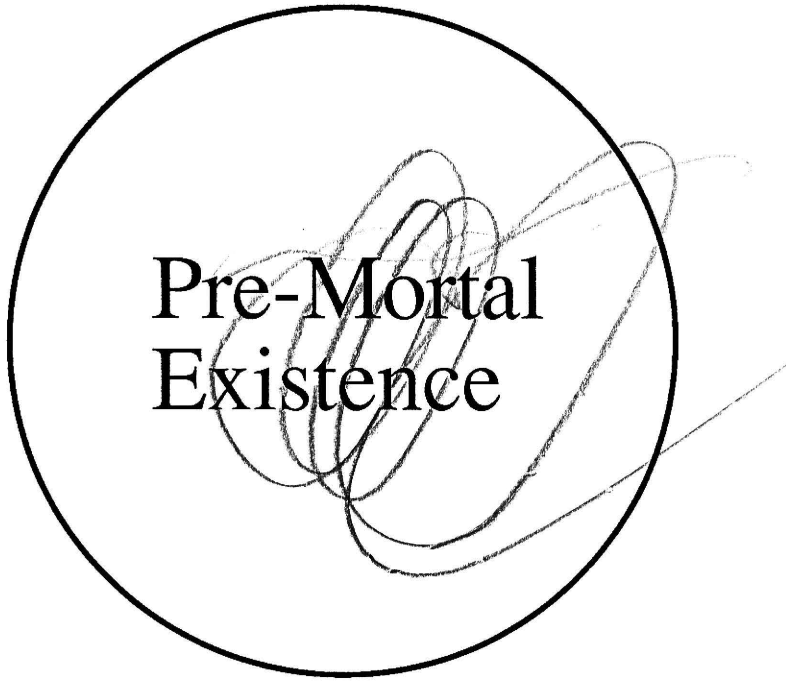
Several drilled wells also contain warm water. Figure __shows the position of __warm water wells just north of the map border. Temperatures range from __ to ___.

Composition of the warm water wells compared to fresh water wells is shown in Table __. The fresh water (Hem, 1985) contains less than 1000 mg/l of dissolved solids, and 1000-3000 mg/l is considered slightly saline, while <10,000 mg/l is moderately saline, briney is < 35000 mg/l of dissolved solids. All samples collected within the quadrangle are slightly saline or less.

Surface Water-Utah Lake has a usable storage capacity (Price and Jensen, 1982) at the highest legal storage level of 883,900 acre feet (an acre foot is 1 foot of water over 1 acre). The lake receives an average of 602,000 acre feet per year from the major in-flowing streams such as the Provo River 303,000, Spanish Fork 155,000. Gaged Wasatch Front streams 28,300 acre feet and ungaged streams 15,200 acre feet (Hyatt and others, 1969). In the lake springs supply additional water.

~~The authors conclude that the~~ Surface waters range from fresh to slightly saline (Hyatt et al, 1969). Locally some ponds and lakes on the southwest side of West Mountain may exceed 1000 mg/l, and also Utah Lake at specific times. Spanish Fork River may also exceed 1000 mg/l in its lower reaches during runoff time. This river enters Utah lake about 4 miles N70E of Lincoln Point. Benjamin Slough to the south shows a range of 500 to 1000 mg/l in runoff waters based on specific conductance reading at the measuring site slightly south of the map boundary in section 14, R1E, T8S.

Thermal Waters


Pre-Mortal
Existence


WW
WW
ZONE
B. Island
EXPOSED TUFA ZONE
WW

Economic Products

- Iceland Calcite

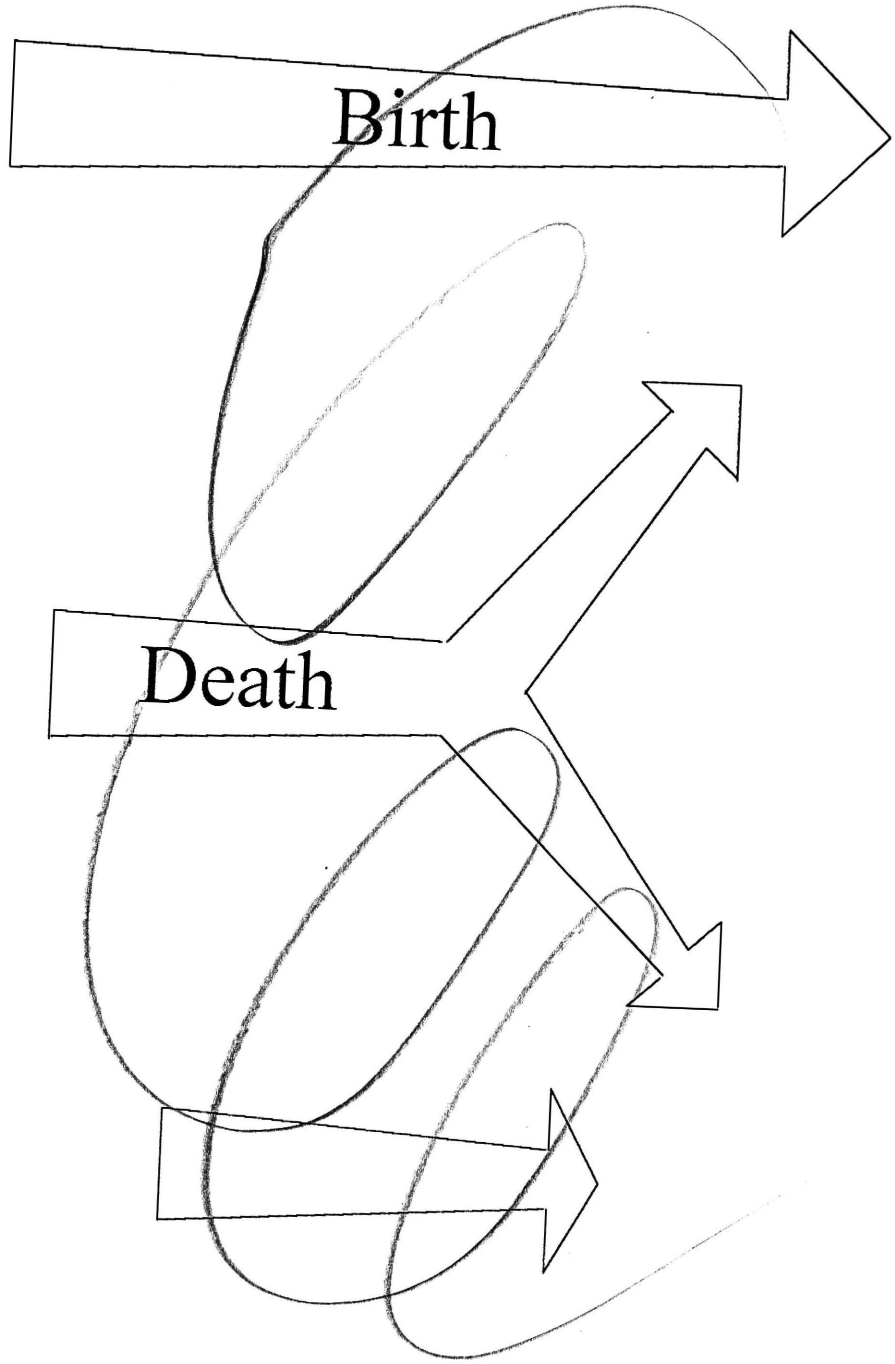
Limestone Quarry

Sand and Gravels (T.F.)

GEOLOGIC HAZZARDS

LAKE in storm

Ledges -


Birth
Death

CUT OUT
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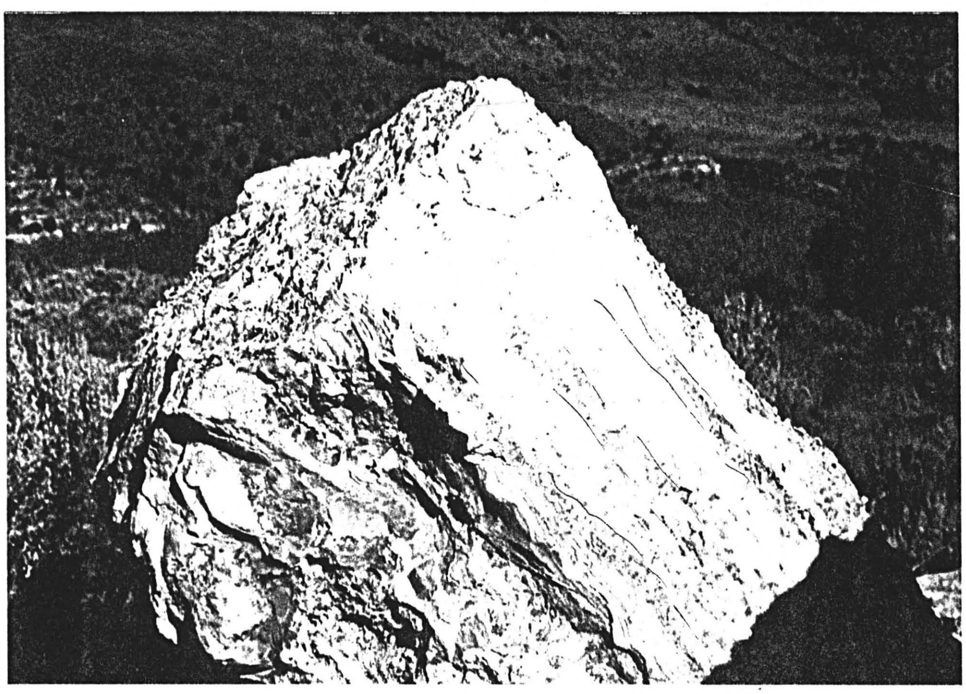

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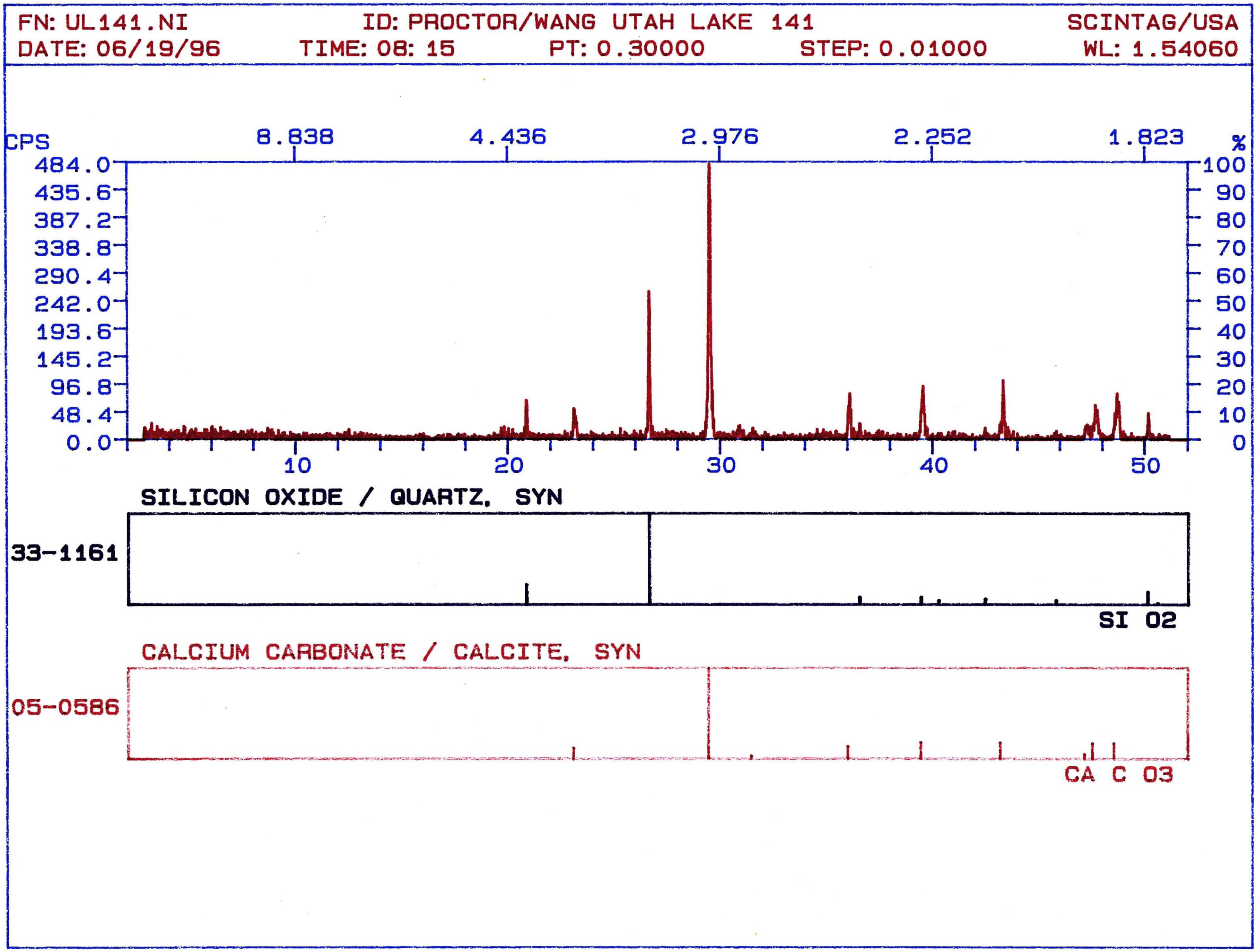
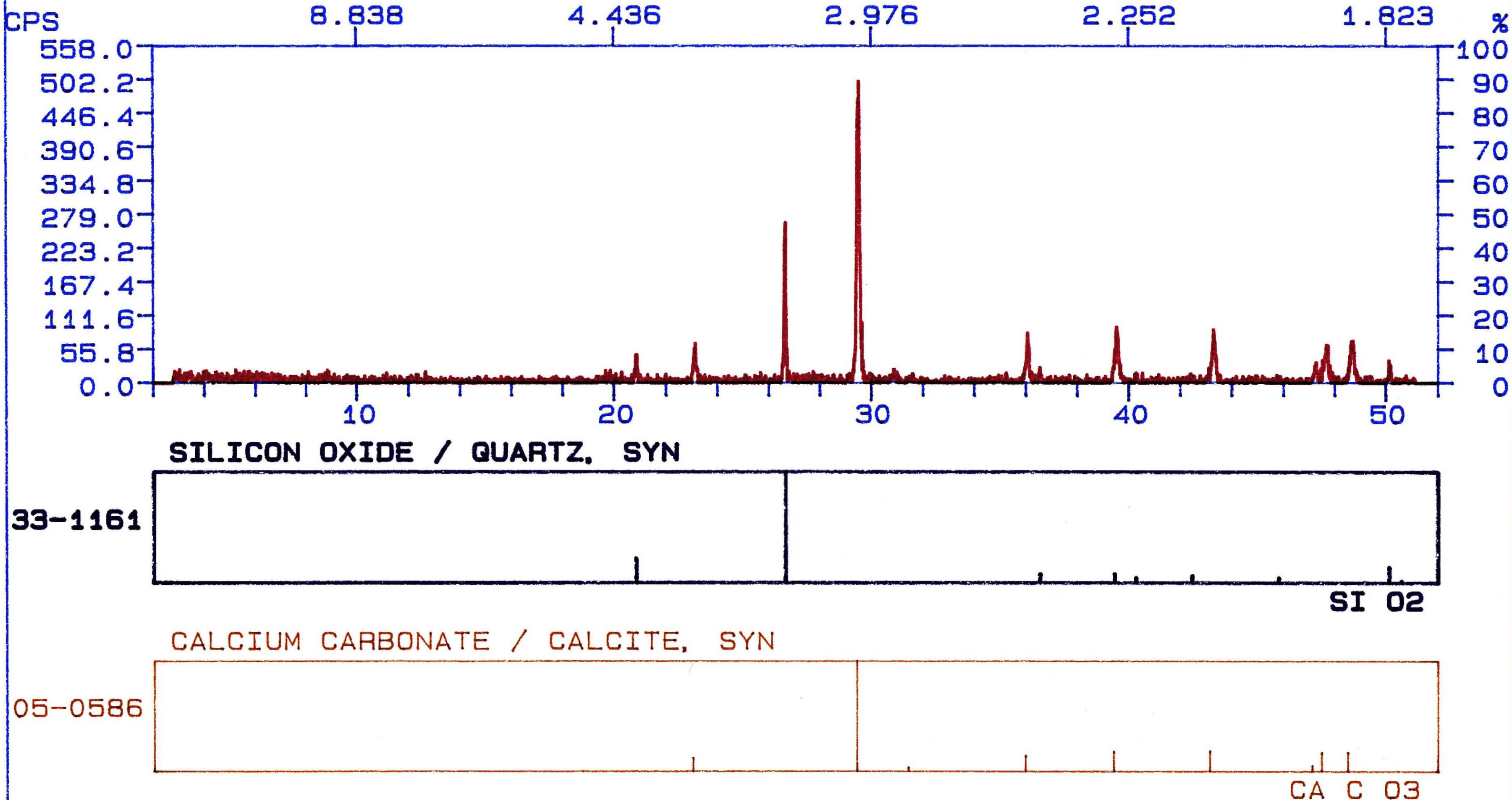
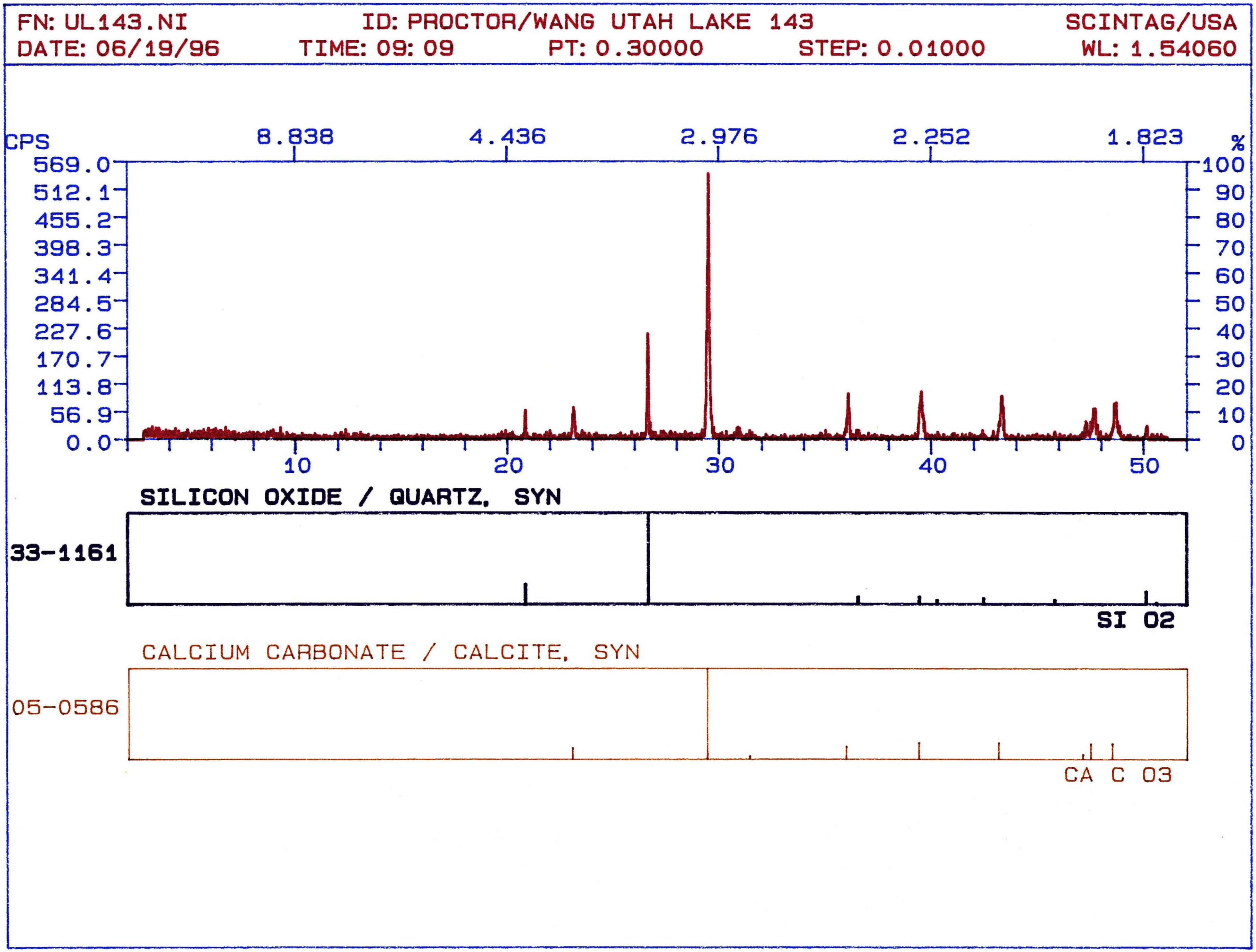

FN: UL141.NI
ID: PROCTOR/WANG UTAH LAKE 141
SCINTAG/USA
DATE: 06/19/96
TIME: 08: 15
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
484.0
435.6
387.2
338.8
290.4
242.0
193.6
145.2
96.8
48.4
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

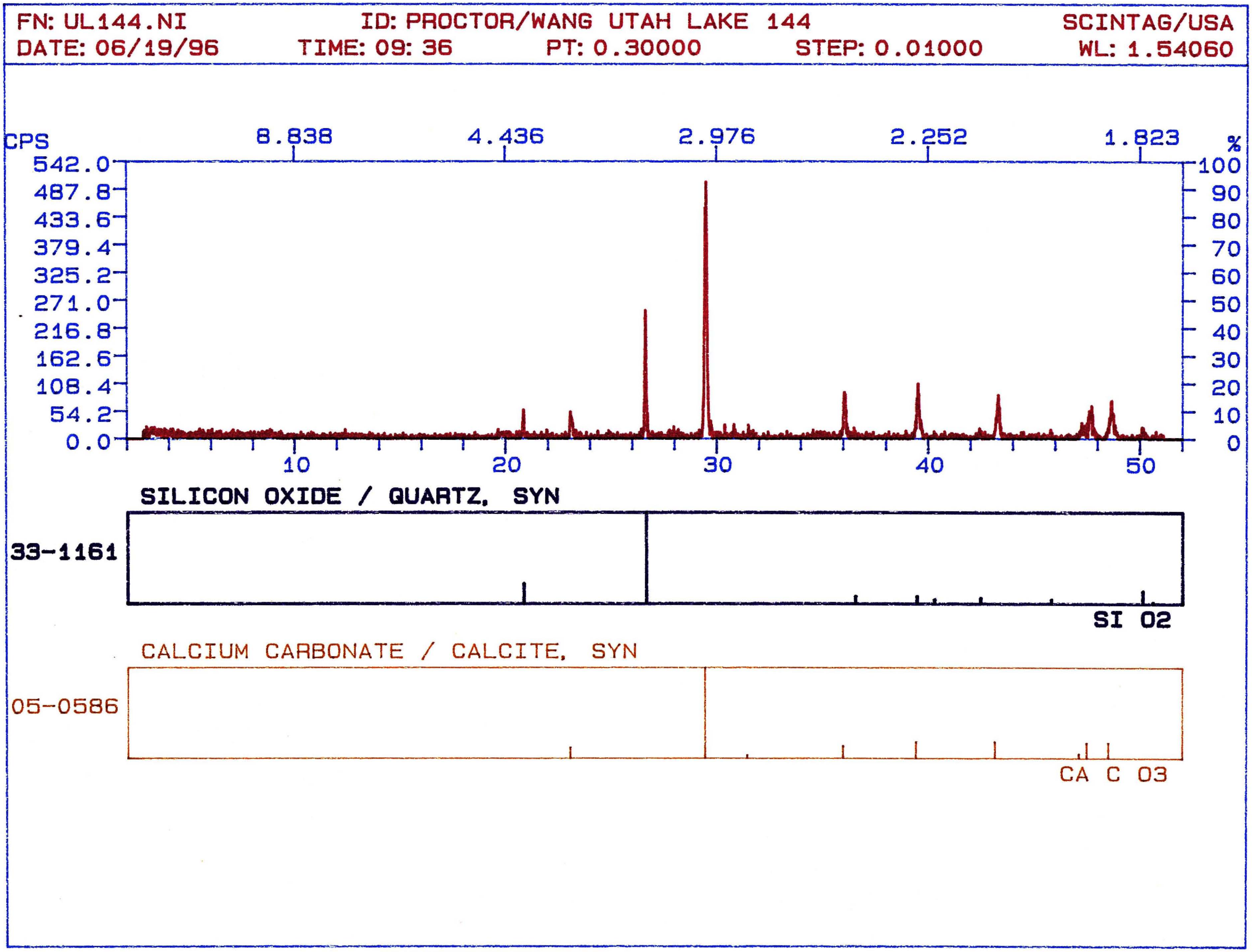
FN: UL142.NI ID: PROCTOR/WANG UTAH LAKE 142 SCINTAG/USA

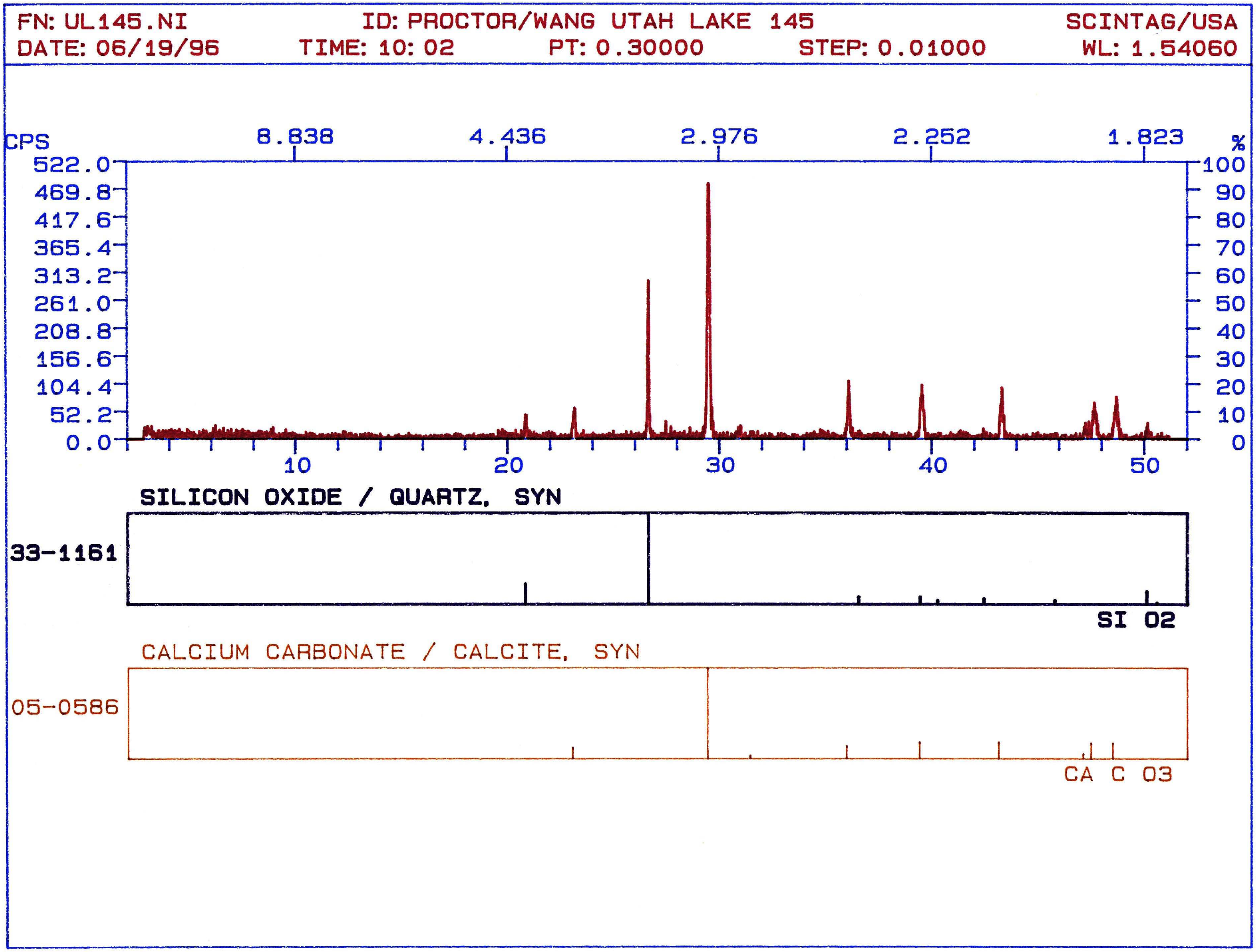
DATE: 06/19/96 TIME: 08: 42 PT: 0.30000 STEP: 0.01000 WL: 1.54060



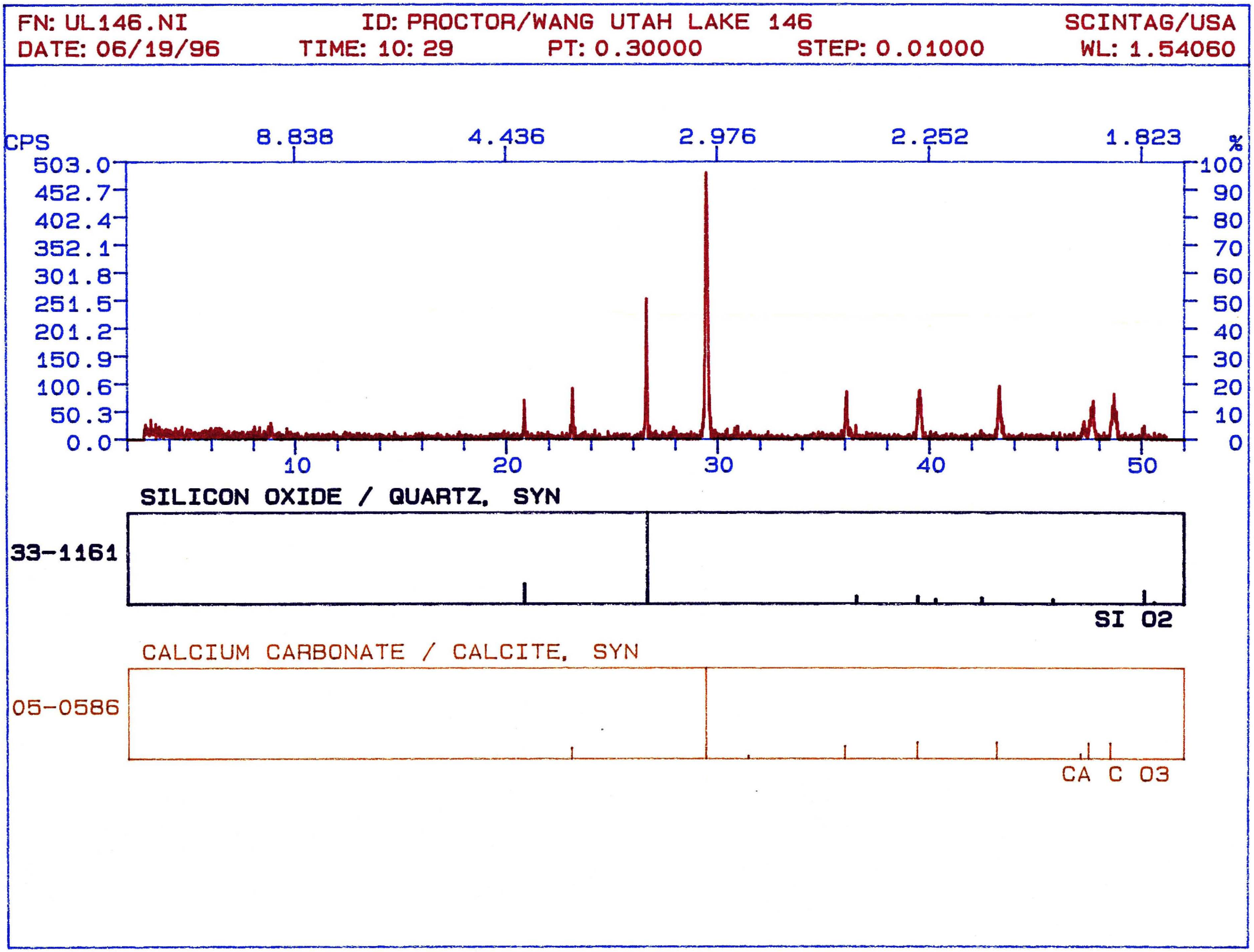


FN: UL143.NI
ID: PROCTOR/WANG UTAH LAKE 143
SCINTAG/USA
DATE: 06/19/96
TIME: 09: 09
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
569.0
512.1
455.2
398.3
341.4
284.5
227.6
170.7
113.8
56.9
0.0
8.838
4.436
2.976
2.252
1.823
%
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

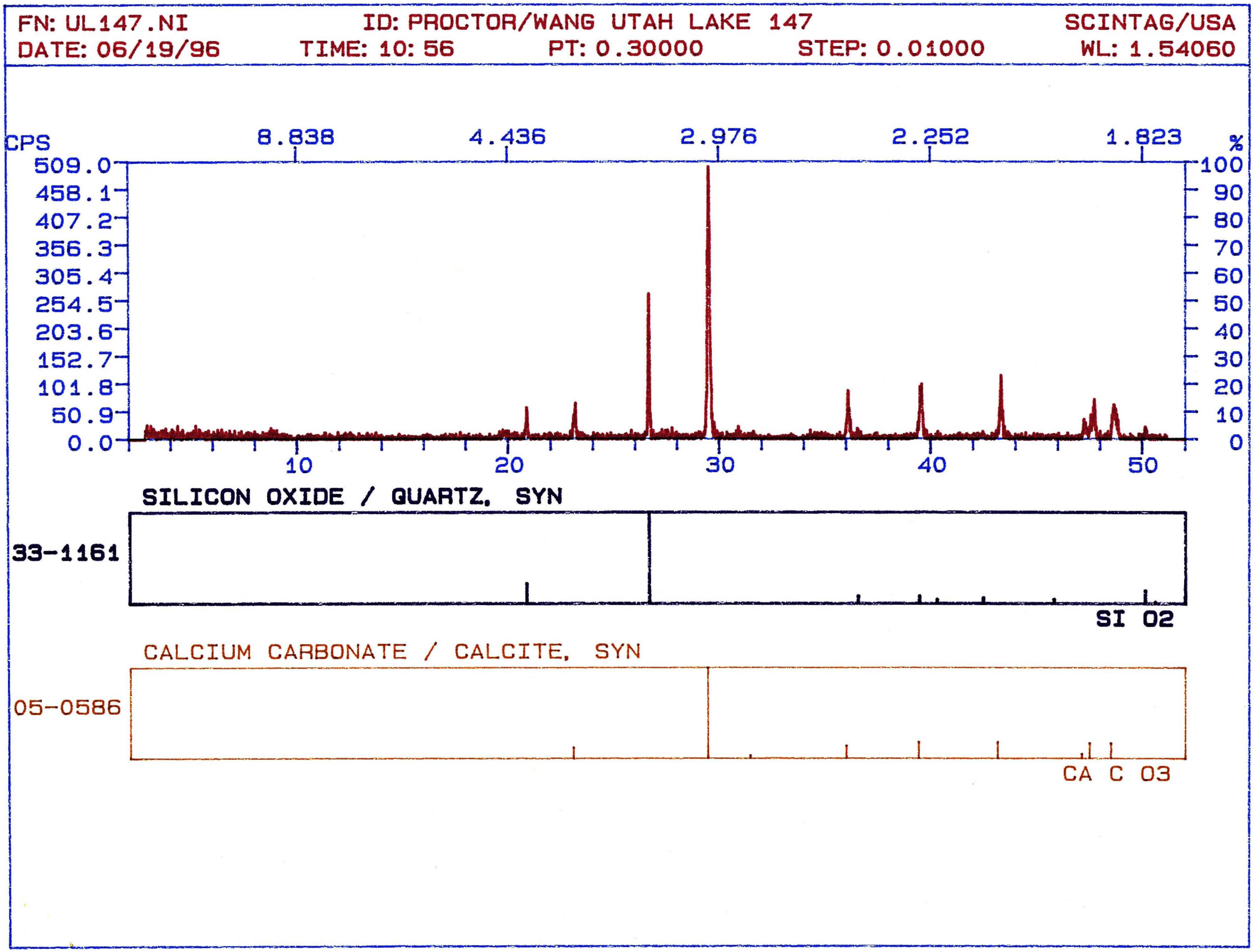

FN: UL144.NI
ID: PROCTOR/WANG UTAH LAKE 144
SCINTAG/USA
DATE: 06/19/96
TIME: 09: 36
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
542.0
487.8
433.6
379.4
325.2
271.0
216.8
162.6
108.4
54.2
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3



FN: UL145.NI
ID: PROCTOR/WANG UTAH LAKE 145
SCINTAG/USA
DATE: 06/19/96
TIME: 10: 02
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
522.0
469.8
417.6
365.4
313.2
261.0
208.8
156.6
104.4
52.2
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

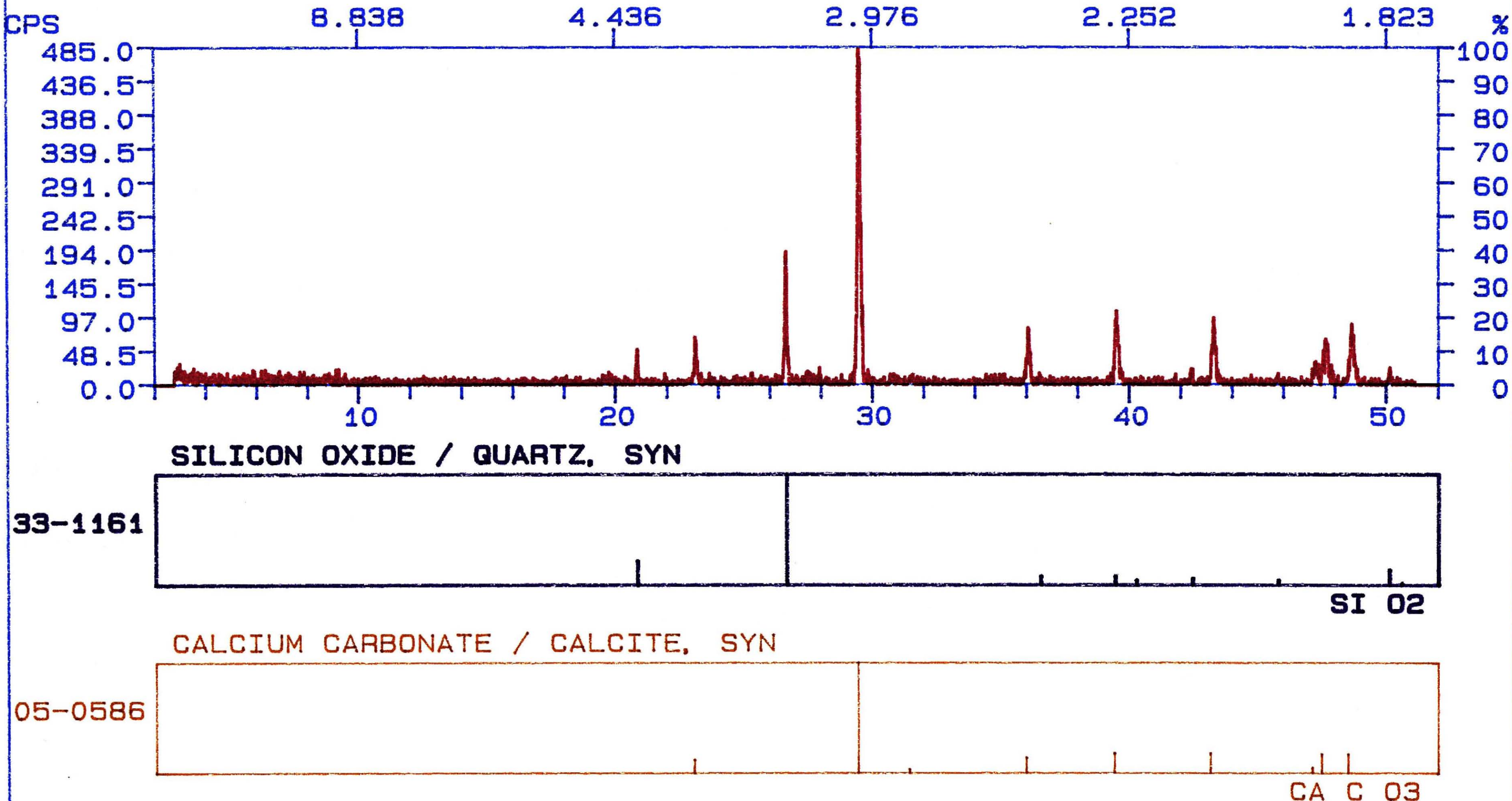


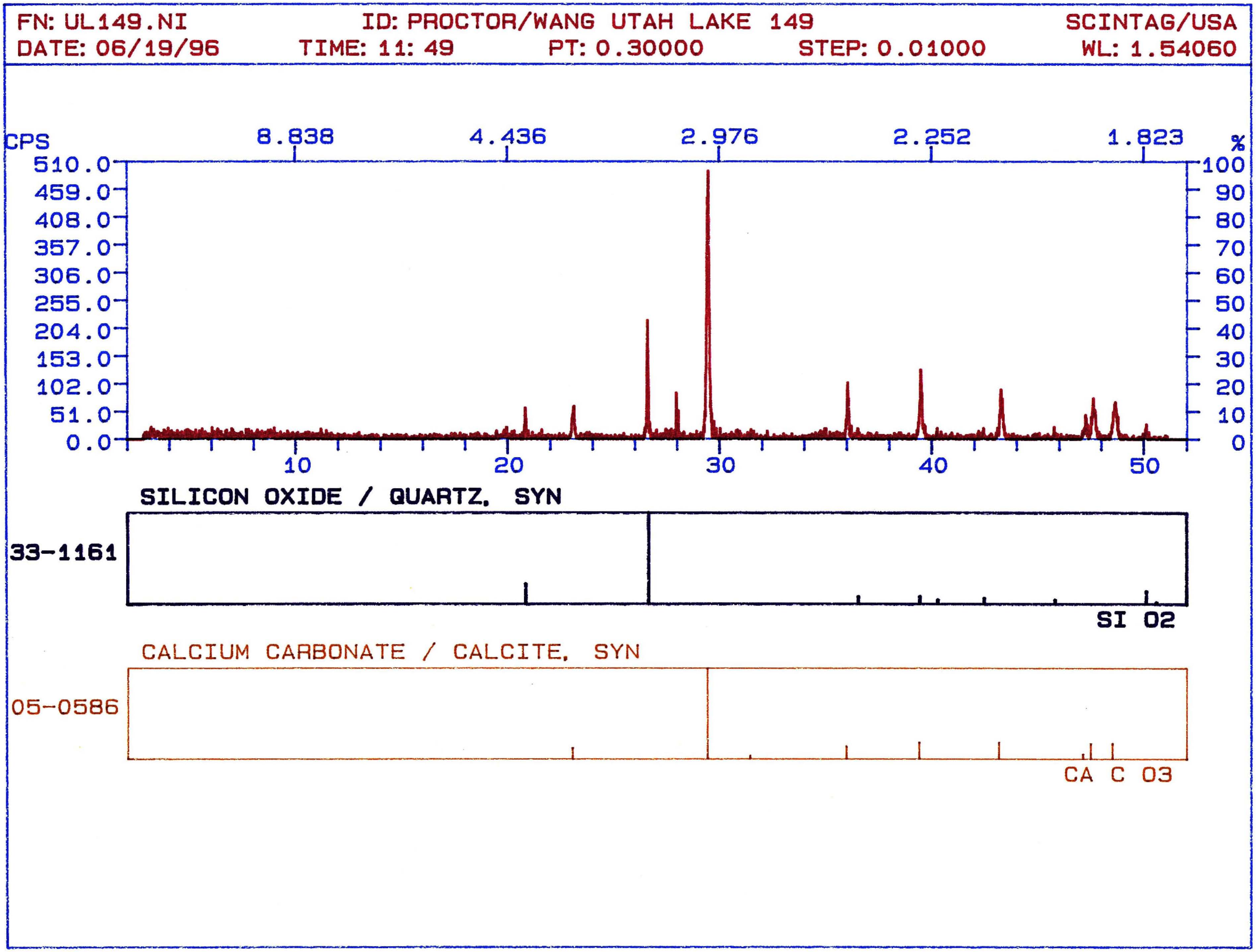
FN: UL146.NI
ID: PROCTOR/WANG UTAH LAKE 146
SCINTAG/USA
DATE: 06/19/96
TIME: 10: 29
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
503.0
452.7
402.4
352.1
301.8
251.5
201.2
150.9
100.6
50.3
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3


FN: UL147.NI
ID: PROCTOR/WANG UTAH LAKE 147
SCINTAG/USA
DATE: 06/19/96
TIME: 10: 56
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
509.0
458.1
407.2
356.3
305.4
254.5
203.6
152.7
101.8
50.9
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

FN: UL148.NI | ID: PROCTOR/WANG UTAH LAKE 148 | SCINTAG/USA

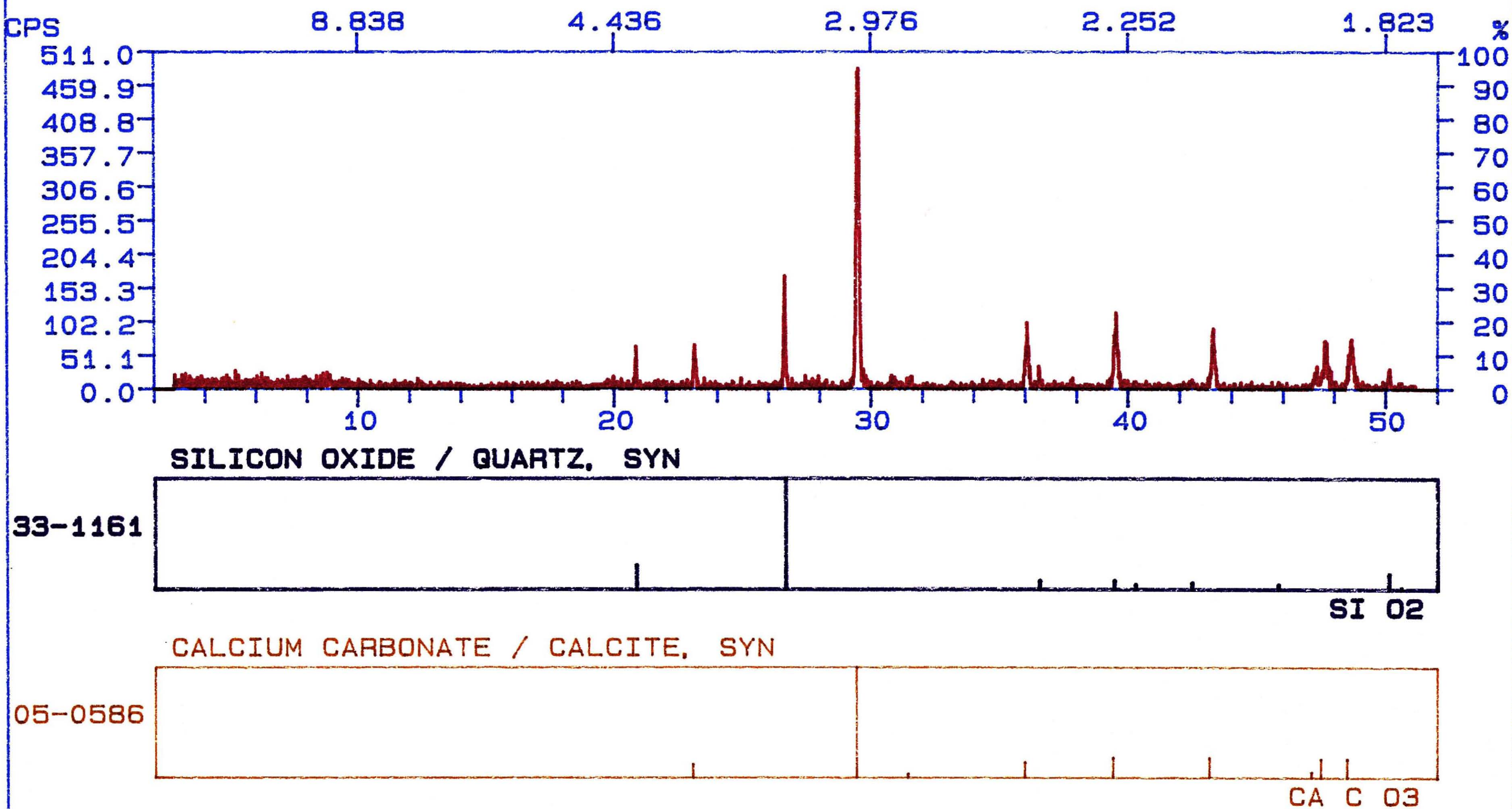
DATE: 06/19/96 | TIME: 11: 22 | PT: 0.30000 | STEP: 0.01000 | WL: 1.54060



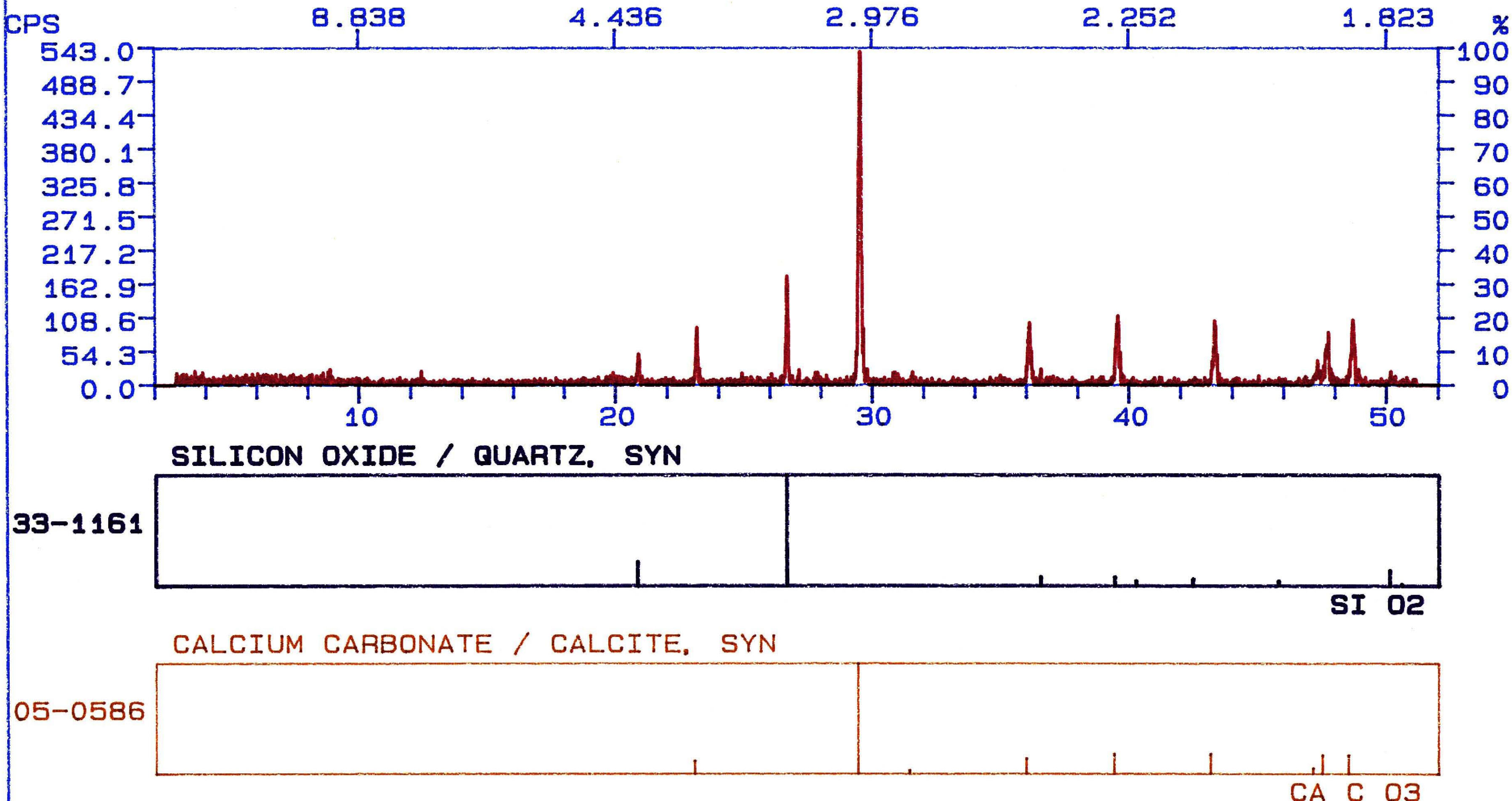


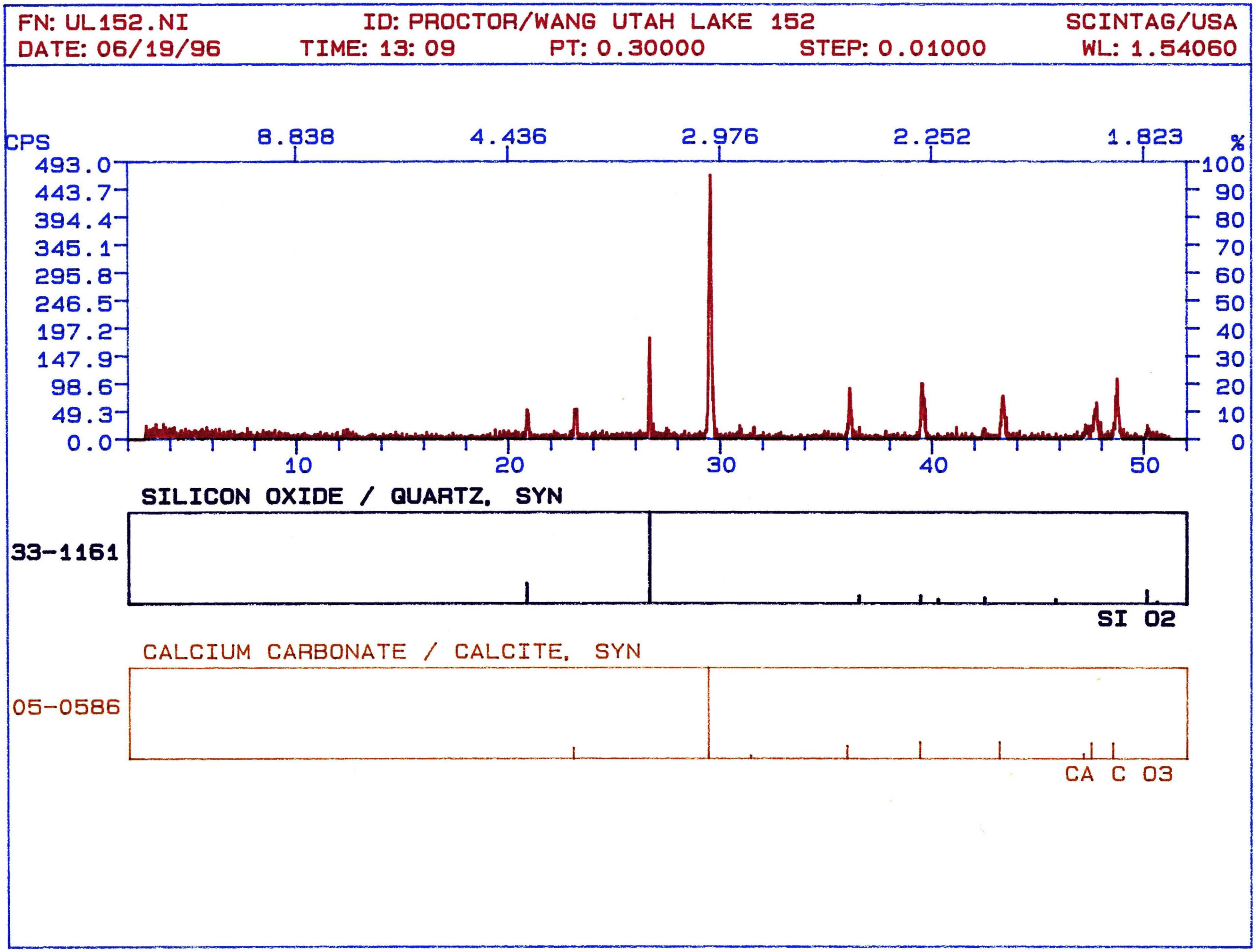
FN: UL149.NI
ID: PROCTOR/WANG UTAH LAKE 149
SCINTAG/USA
DATE: 06/19/96
TIME: 11: 49
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
510.0
459.0
408.0
357.0
306.0
255.0
204.0
153.0
102.0
51.0
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

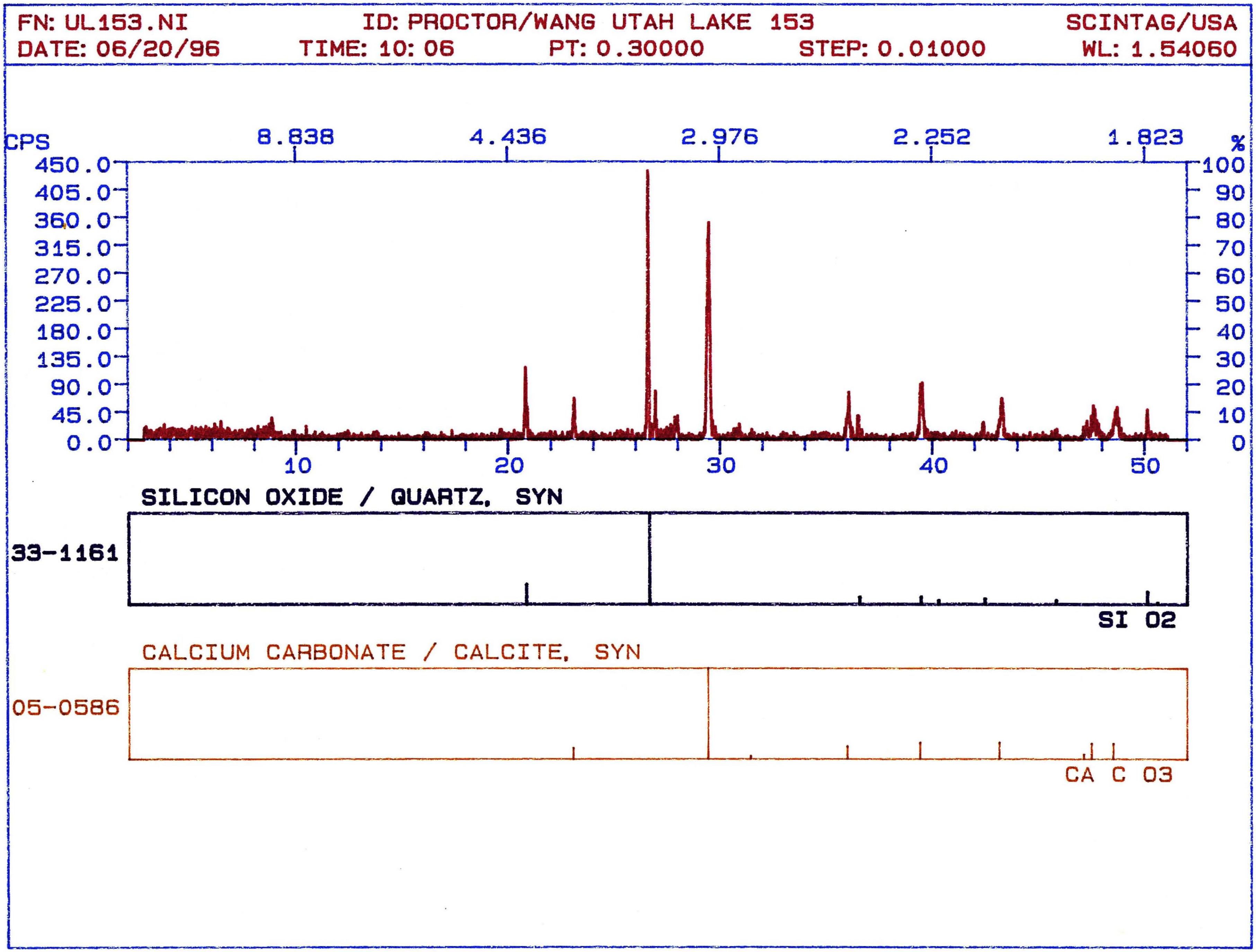
FN: UL150.NI　ID: PROCTOR/WANG UTAH LAKE 150　SCINTAG/USA
DATE: 06/19/96　TIME: 12: 16　PT: 0.30000　STEP: 0.01000　WL: 1.54060



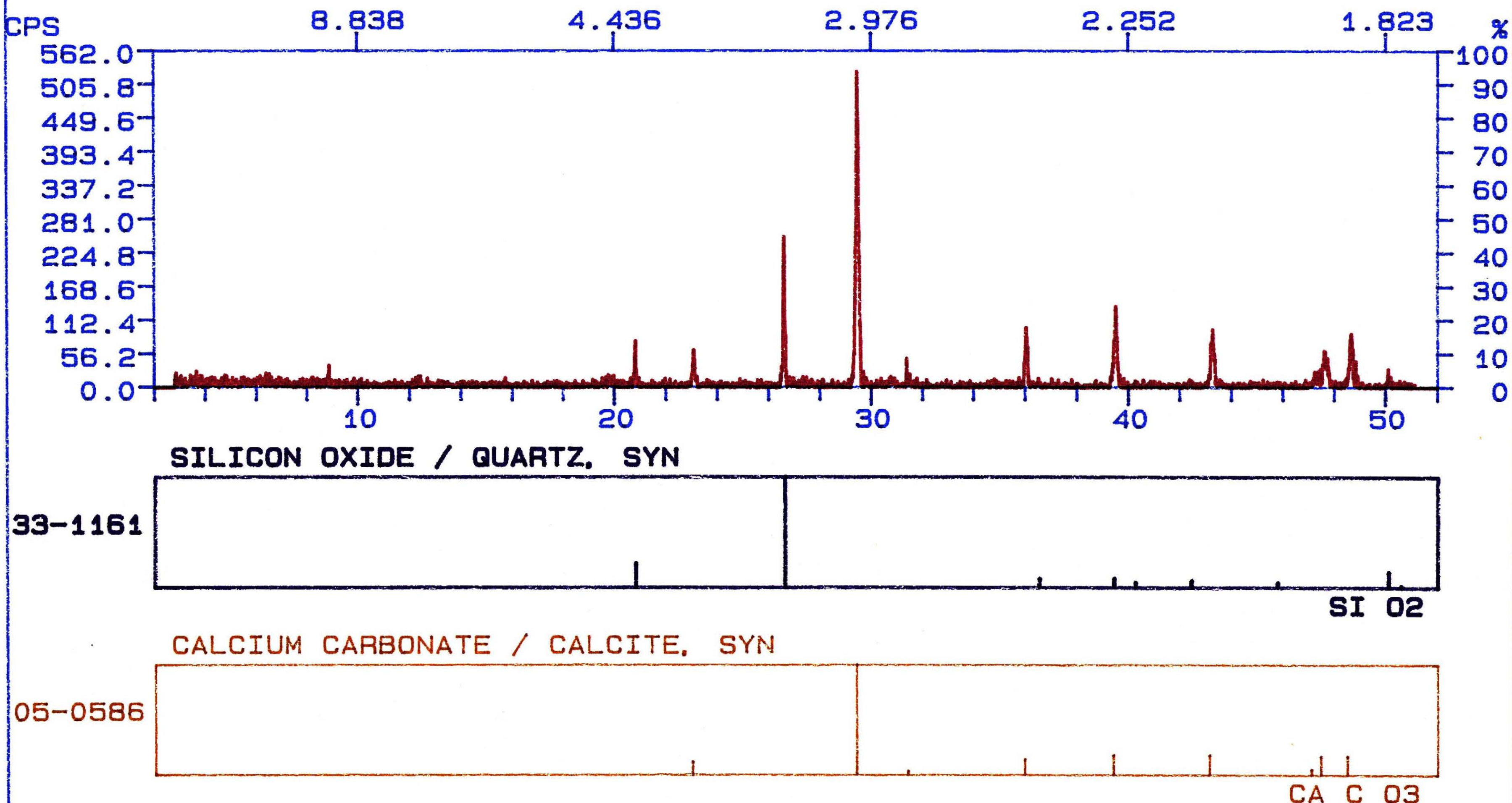
FN: UL151.NI | ID: PROCTOR/WANG UTAH LAKE 151 | SCINTAG/USA
DATE: 06/19/96 | TIME: 12: 43 | PT: 0.30000 | STEP: 0.01000 | WL: 1.54060

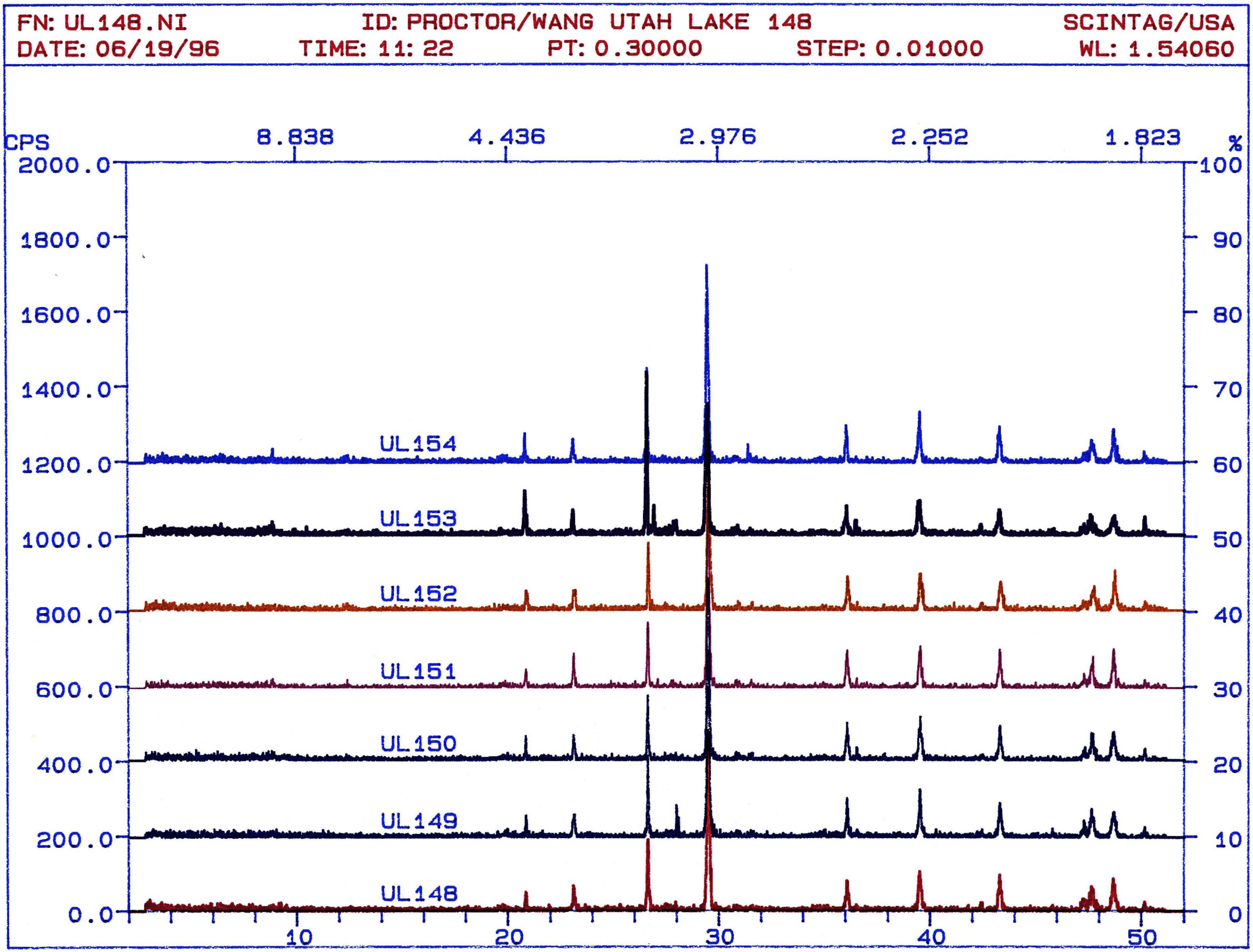


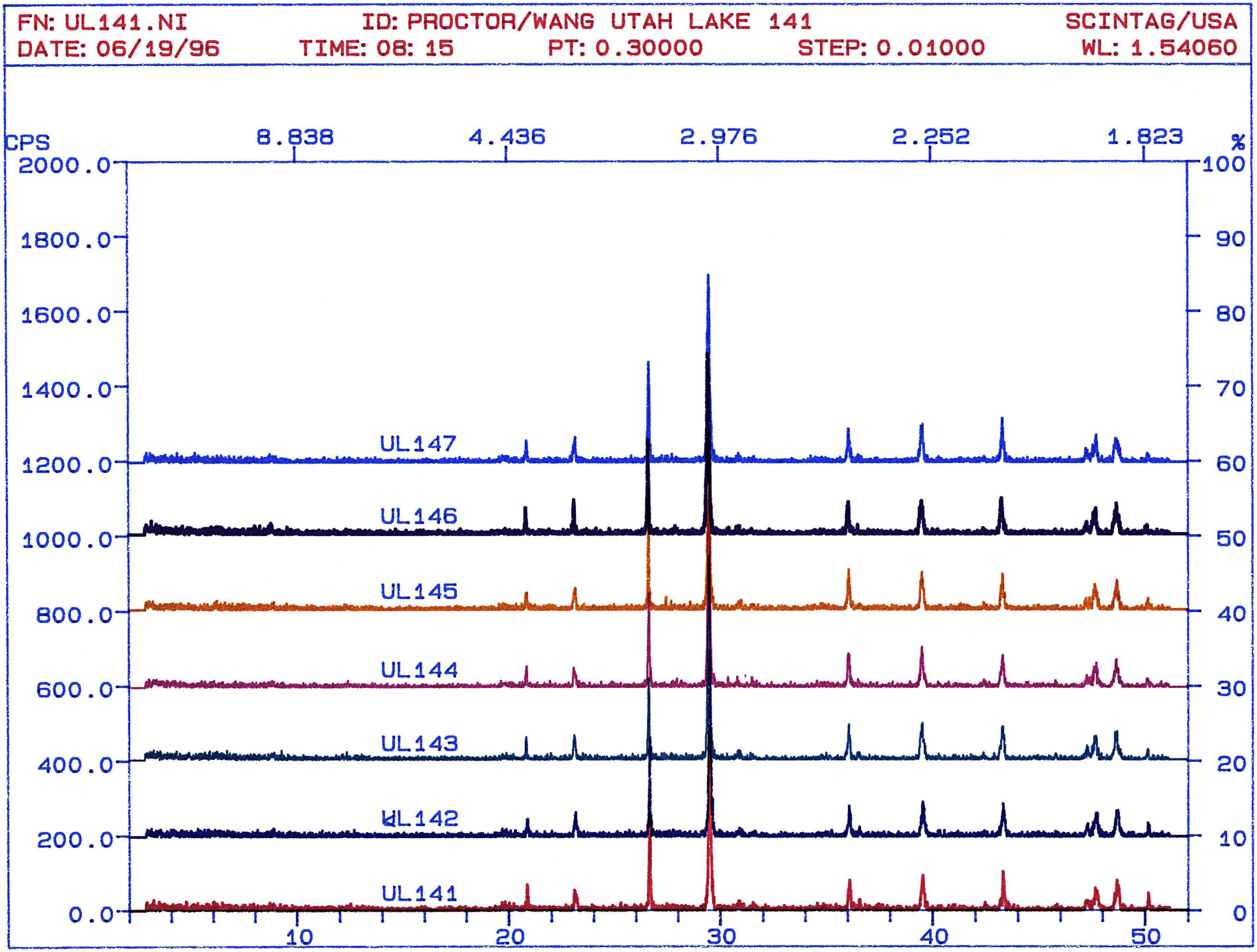

FN: UL152.NI
ID: PROCTOR/WANG UTAH LAKE 152
SCINTAG/USA
DATE: 06/19/96
TIME: 13: 09
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
493.0
443.7
394.4
345.1
295.8
246.5
197.2
147.9
98.6
49.3
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3


FN: UL153.NI
ID: PROCTOR/WANG UTAH LAKE 153
SCINTAG/USA
DATE: 06/20/96
TIME: 10: 06
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
450.0
405.0
360.0
315.0
270.0
225.0
180.0
135.0
90.0
45.0
0.0
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
SILICON OXIDE / QUARTZ, SYN
33-1161
SI O2
CALCIUM CARBONATE / CALCITE, SYN
05-0586
CA C O3

FN: UL154.NI ID: PROCTOR/WANG UTAH LAKE 154 SCINTAG/USA
DATE: 06/20/96 TIME: 10: 33 PT: 0.30000 STEP: 0.01000 WL: 1.54060




FN: UL148.NI
ID: PROCTOR/WANG UTAH LAKE 148
SCINTAG/USA
DATE: 06/19/96
TIME: 11: 22
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
100
90
80
70
60
50
40
30
20
10
0
UL154
UL153
UL152
UL151
UL150
UL149
UL148
10
20
30
40
50



FN: UL141.NI
ID: PROCTOR/WANG UTAH LAKE 141
SCINTAG/USA
DATE: 06/19/96
TIME: 08: 15
PT: 0.30000
STEP: 0.01000
WL: 1.54060
CPS
8.838
4.436
2.976
2.252
1.823
%
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
100
90
80
70
60
50
40
30
20
10
0
UL147
UL146
UL145
UL144
UL143
UL142
UL141
10
20
30
40
50

Plate III

East-West Structure Section of West Mountain, Utah through Sections 33 and 34

by

Grace M. Nolan

1950