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GEOLOGICAL SURVEY

TECHNICAL REPORT, FINAL

NEARFIELD INVESTIGATIONS OF CRUSTAL MOVEMENTS, SOUTHERN CALIFORNIA

By

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Sponsored by the U.S. Geological Survey

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TECHNICAL REPORT, FINAL

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TECHNICAL REPORT, FINAL, 1985-1987

Nearfield Geodetic Investigations of Crustal Movements in Southern California

USGS Grant No. 14-08-0001-G1081

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INTRODUCTION

This report summarizes the principal facts for precise leveling arrays established across active or potentially active faults by my students and me under contracts or grants from the U.S. Geological Survey, or arrays established by the U. S. Geological Survey or U. S. Coast and Geodetic Survey (now National Geodetic Survey - NGS) and resurveyed by us, also under contracts or grants from the U. S. Geological Survey. All of the leveling arrays described herein are located in the south half of California with exception of MINA which is in western Nevada (Fig. 1).

Although the report is intended to cover contract years 1986 and 1987, it presents relative height data for each array pertaining to the first stable survey, no matter when that survey occurred, to the most recent one. Nearly all of the arrays were resurveyed at least once in 1986 and 1987, but JUNCAL has not been resurveyed since 1980, and most in the Santa Barbara area have not been resurveyed since 1982. The names, locations, dates of establishment, the date of the most recent survey, and the total number of surveys are given in Table I.

During the contract period 1986-87, we resurveyed all pre-existing arrays from one to five times each; we established three new arrays (WHITEWATER; KERN FRONT, SILVER CANYON); and did initial surveys on three new U.S.G.S. arrays in the Parkfield area (CAR HILL, TURKEY FLAT, GOLD HILL).

SCOPE AND PURPOSE

The stated and fixed objective of this investigation is to determine the spatial and temporal nature of nearfield strain accumulation and release, if any, across several kinds of active and potentially active faults in diverse tectonic regions of California.

Since 1970 my students and I have searched for vertical fault movements in southern California. Our investigations are intermediate in scale between the infrequent regional geodetic surveys traditionally done by the National Geodetic Survey, and the point measurements obtained by continually recording instruments such as creepmeters, borehole tiltmeters, and strainmeters.

RATIONAL

Seismologists have been intrigued with aseismic creep on faults ever since the phenomenon was discovered and documented on the central segment of the San Andreas fault in 1956 (Steinbrugge and others, 1960; Burford and Harsh, 1980; Wesson, unpub. ms). In view of the youthful tectonics in California, creep might be expected on other faults as well. But in spite of careful searches, fault creep (not including afterslip - see Sylvester, 1986) is limited to *horizontal* movement along faults related to the San Andreas fault in the San Francisco Bay area (Radbruch, Bonilla, and others, 1966; Evans and others, 1981; Galehouse and others, 1984) and to the southern end of the San Andreas fault (Goulty and others, 1978; Louie and others, 1985). In the latter instance, it is not clearly established whether creep is aseismic or episodic or dynamically triggered (see Sylvester, 1986, and Wesson, unpub. ms for reviews). As commonplace as horizontal fault creep is on parts of the San Andreas fault system, it has been found on only one other fault in the world: The North Anatolian fault, Turkey (Aytun, 1980). Only in Djibouti, East Africa, has one possible instance of vertical creep ever been reported (Ruegg and others, 1984).

Fault creep rates are so low that detection of creep requires the favorable circumstances of periodic observation of a reference marker, such as a road stripe, by an individual which has a keen eye for small changes over a long time period. In uninhabited areas, such as deserts and forests, only repeated precise surveys will reveal the phenomenon where instrumental endeavors required electric power are lacking or unfeasible (Sylvester, 1986).

METHODS AND PROCEDURES

We have established 60 short leveling arrays in California (Fig. 1, Table I) ranging in length from 250 m to 4000 m and which range in geometry from straight lines to L-, Z-, W-, and box-shapes. Choices of array locations and geometry are dictated by how well located is the fault, by limitations imposed by local topography, by access and property ownership, and by the presence, or anticipated presence of instrumental installations.

All of our leveling is done according to First Order, Class II standards (Federal Geodetic Commission, 1984) with an accepted error of 1.0 mm per km, but with an observed sensitivity of 0.5 mm per kilometer (Sylvester, 1984). Bench marks are Class B rod marks (Floyd, 1978) or stainless steel plugs cemented in large boulders embedded deeply in alluvium or moraine (Sylvester, 1984), spaced no more than 50 m apart. Most are 40 m apart. Where the arrays cross faults, bench marks may be spaced as closely as 3 m to determine details of vertical displacement within the fault zone itself. The data are adjusted for closure, but we make no corrections for temperature, gravity, or magnetic effects, because over line lengths and shot lengths as short as these, the corrections are small enough to be neglected (Stein and others, 1986).

All data presented in this report were obtained with a shaded Wild N3 precision tilting level up to 1979 when we acquired a Wild NAK2 precision automatic level with optical micrometer. We have used strut-supported, matched GPL-3 precise invar leveling rods, serial numbers 2207A/B, for most of the leveling until 1987. Subsequently the pair 4003 A/B was used more frequently because of cumulative wear and tear to the former pair.

The leveling rods have been calibrated annually since 1978 by the U.S. Navy Gage and Standards Laboratory, Pomona, and until 1986, they met First Order standards. Cumulative damage to marks in the centers of the rods made their accurate calibration uncertain at that time, although comparisons of field data among surveys over several years show that errors due to change of rod length or poor sighting of marks by the observer are smaller than the changes which may be attributed to instability of the benchmarks themselves, or even to tectonic and non-tectonic movements. Thus, we continued to achieve First Order, Class II results even though the calibration data suggested that the rods, themselves could not yield such data.

We learned that the cumulative damage to the marks was caused by the rodmen gripping the rods on the invar strip during transit from one bench mark to another. We have changed our procedure in 1988 and have acquired a new pair of rods.

HISTORY

Our search for creep and investigation of vertical movement associated with southern California faults began in Death Valley in 1970 when we established four short lines across three faults in the central part of the valley with funds from a Presidents' Undergraduate Research Grant to Tom Foster from the University of California, Santa Barbara. Those lines were resurveyed in 1971 and a fifth line was established across the Furnace Creek fault in Fish Lake Valley by Fred Keller with the same kind of funds.

With Sea Grant funds from the National Science Foundation, we established a small array across the San Fernando fault to monitor afterslip following the 9 February 1971 San Fernando earthquake (Sylvester and Pollard, 1975).

President's Undergraduate Research Grants to Rick Keller in 1974 and to Chuck Meertens in 1975 made possible establishment of longer and more sophisticated leveling arrays across the Duravan fault in the Mojave Desert and across the San Andreas fault in San Juan Bautista, respectively.

In 1982 we received funds for a systematic study of vertical movements related to active and potentially active faults in southern California. My students and I established a number of arrays that year and in each of the following years to 1987. The array at Pinyon Flat was funded for four years under a separate USGS contract. Arrays JUNCAL, SNORT, AIRFIELD, and KERN FRONT were funded privately in response to problems raised by the individual property owners.

DATA

Data pertaining to site location, establishment date, date of most recent survey, and total number of surveys to March 1988 are presented in Table I according to location relative to the principal fault being monitored or to physiographic province.

The data in Appendix II are those which are deemed necessary and sufficient for future investigators to locate each array, to find the bench marks, and to compare future survey data with our own. Thus, each array is presented in alphabetical order and contains site description data, exclusive of descriptions for individual bench marks; the location of the array on a standard topographic map; a site map; a graph which compares our first good survey with the most recent good survey; and listings of bench mark height differences for the earliest and most recent good surveys. Data for some of the arrays in the Santa Barbara area are not presented, because many of the bench marks have been, or will soon be, obliterated by realignment and construction of the crosstown freeway.

NOTEWORTHY RESULTS

POST-SEISMIC STUDIES

Resurveys were done across the Hilton Creek fault in McGee Creek and across the Furnace Creek fault in Fish Lake Valley (Fig. 1) following the Chalfant Valley earthquake of 21 July 1986. A resurvey at McGee Creek on 22 July 1986 showed that the earthquake triggered no vertical movement on the fault greater than 0.5 mm relative to a survey in July 1985. Relevelings were also done on 24 July and on 3-5 September 1986 at McGee Creek to bracket a swarm of earthquakes which occurred in Chalfant Valley in the period 22-24 July. The surveys failed to detect any changes whatsoever here or in Fish Lake Valley where a 250 m-long array was surveyed in September 1986 and compared to a survey in July 1985. These results are not surprising, given the relatively small magnitude of the earthquake (M 6) and the fact that our arrays across the Hilton Creek fault and across the Furnace Creek fault are 35 km and 50 km, respectively, from the epicentral area in Chalfant Valley. In anticipation of future seismic activity in the Chalfant Valley, we established in 1987 a 605 m-long leveling array across the White Mountains fault zone where it crosses Silver Canyon east of Laws and Bishop.

Leveling arrays in Coachella Valley (Fig. 1) were releveled in the period 14-16 July after the North Palm Springs earthquake of 8 July 1986. Each array comprises from 22 to 53 permanent bench marks in a line oriented nearly perpendicular to the fault it straddles. Array lengths, numbers of bench marks, and distances from the epicentral area are as follows: MIRACLE HILL (726 m;

22; 5 km), PAINTED CANYON (1505m; 44; 60 km), NORTH SHORE (871 m; 28; 75 km), and BAT CAVES (1537 m; 44; 92 km). No height changes greater than 0.5 mm were detected in any of the arrays relative to surveys done in September 1985, which is not surprising given the relative small magnitude of the earthquake (M 5.9) and how far three of the arrays are from the epicentral area. Our measurements show that vertical movement was *not* triggered on the Mission Creek strand of the San Andreas fault by the earthquake on the nearby Banning fault. Arrays on the San Jacinto fault at similar epicentral distances (ANZA - 43 km; SBVC - 78 km) also showed no changes relative to surveys done from five days (ANZA) to seven months (SBVC) prior to the earthquake.

The BAT CAVES, NORTH SHORE, and PAINTED CANYON arrays were releveled in the period 3-7 September 1987 prior to the earthquakes of 23 and 24 November, 1987, on the Elmore Ranch and Superstition Hills faults, respectively. They were releveled again 8-10 December 1987 to determined if the earthquake pair noticeably perturbed the San Andreas fault on the opposite site of the Salton Trough. The height changes among bench marks in the three lines were negligible. Those three lines, together with MIRACLE HILL, WHITEWATER, and SBVC were resurveyed in the period 20-24 March 1988 to see if there were a delayed perturbation. The data show that the Durmid anticline grew nearly two millimeters beneath the BAT CAVES line northeast of the San Andreas fault, whereas the previous growth concentrated southwest of the fault. This is comparable to its annual rate of growth of 1-2 mm/yr in Holocene time, which may be calculated from geomorphic evidence and from the method of Rockwell and others (1988).

ASEISMIC CEEP

PARKFIELD - The USGS established a 4326 m-long leveling array, herein called PARKFIELD CROSSTOWN, across the San Andreas fault in Parkfield in central California (Fig. 1) to determine if vertical movement accompanies the 13 mm/yr horizontal creep there which is documented by creepmeters (Schulz, Mavko and Brown, 1988). We began observations of the array in 1984 at the request of the USGS. The cumulative vertical separation across the fault is nearly 15 mm from 1980 to 1985, and nearly all of that uplift took place at the surface trace of the fault. Two relevelings of the array in 1986 show that the northeast fault block ceased its 3 mm/yr rise relative to the southwest block. Allan Lindh (USGS) is suspicious that the height change across the fault may be due to subsidence related to groundwater withdrawal for agriculture on a nearby ranch. Future resurveys relative to better documentation of the pumping history may resolve his suspicions.

PASADENA - Three relevelings of the JPL array across the Sierra Madre fault in Arroyo Seco, Pasadena (Fig. 1), showed that the mountain side (north) of the fault subsided 6 mm relative to the valley side (south) between January and August 1986 after having risen 9 mm between June 1984 and August 1985 without accompanying detectable earthquake activity. The array is 1900 m-long with 43 permanent bench marks. The height changes occur over a zone about 500 m-wide; they do not extend as far west as SAN FERNANDO or as far east as SANTA ANITA CANYON, judging by the lack of significant height changes in those arrays across the same fault.

BAKERSFIELD - A large box-shaped leveling array was established across the surface trace of the Kern Front fault near Bakersfield (Fig. 1) in August 1986 at the request of, and with partial support from Texaco, USA. We also emplaced a new tilt beam across the surface trace of the fault on November 19, 1986, to replace that which operated there in 1968-1972 (Nason and others, 1974), and which has been long since vandalized and stolen. The south leg of the array was resurveyed in March, June and July, 1987. Analysis of that data shows that 6 mm of relative down-to-the-west separation occurred between the two bench marks which straddle the fault.

The rate and direction of movement - about 7 m/yr, down to the west - are the same as were measured by the tilt beam in 1969-74 (Nason and others, 1974) and determined by Castle and others (1983) from geologic evidence and visual recollections of geologists who first noted the surface fractures in 1949. If the maximum offsets measured by Castle and others (1983) are inverted against the vertical rate of change across the fault, then the present historic episode of movement began in the late 1920's when both the nearby Kern River and Kern Front oil fields came into significant production. This is one of the reasons Castle and others (1983) maintained that the movement across the fault is induced primarily by withdrawal of fluids by pumping in those two oil fields. They emphasized that even if the movement is tectonic or has a tectonic component, it will be very hard to determine or separate it from non-tectonic movements simply because of the potential for subsidence, given the great magnitude of fluids that are exracted annually. During the last two years, however, the nearby wells have been shut in, yet the movement across the fault continues. Indeed, the fault has the most throw - 4 m - of any of the faults in the oil field, and it cuts Pleistocene strata, so it is a very young fault. From our monitoring to date, in contrast to Castle and others (1983), I conclude that the displacements are probably tectonic, but I cannot rule out that they are due to subsidence. Time may tell.

CENTRAL SAN ANDREAS FAULT - Aseismic horizontal fault creep reaches a maximum of 35 mm/yr in the central part of the San Andreas fault between Cholame and San Juan Bautista (Burford and Harsh, 1980). We established the leveling array LEWIS CREEK across the fault to determine the vertical component of creep there, if any. Three levelings through 1987 show that the northeast block rises at a rate of 3 mm/yr relative to the southwest block, but only over a zone about 500 m wide on the northeast side of the fault. This uplift rate is comparable to that we measure at PARKFIELD CROSSTOWN, but an intervening array, MUSTANG GRADE, shows no clear uplift. This may be related to the degree of transpression along the fault between the three sites, or to the suspicion that the height changes at PARKFIELD CROSSTOWN may be related to groundwater withdrawal.

PALMDALE - The northeast block of the Nadeau sub-strand of the San Andreas fault near

Palmdale rose a few millimeters relative to the southwest block over the last few years. The 47th STREET EAST array was established to search for vertical aseismic creep associated with recent en echelon cracks nearby in the pavement of 47th St. East.

ACKNOWLEDGMENTS

I acknowledge with pleasure the assistance of a select group of nearly 60 undergraduate students who have worked diligently over the many years of this project, often in some pretty miserable conditions, particularly in the Salton Trough. Ken Gester deserves special mention and my thanks for his perseverance and attention to details during his three-year tenure on the crew. A complete list of student assistants is given in Appendix I.

I am grateful to the cooperation of the owners of various ranches and properties for permission to work on their land.

George Hughes and Bill Bushnell in the Geological Sciences Department's machine shop have kept our efforts on schedule when we have had mechanical breakdowns of our equipment. The University's office of Transportation Services outfitted one of its vehicles with a special rack for transporting our otherwise unwieldy level rods.

The University has provided pecuniary and intellectual stimulus for students with President's Undergraduate Research Grants to Tom Foster (1970), Fred Keller (1971), Rick Keller (1974), Chuck Meertens (1975), John Byrd (1977), and Scott Bie (1985).

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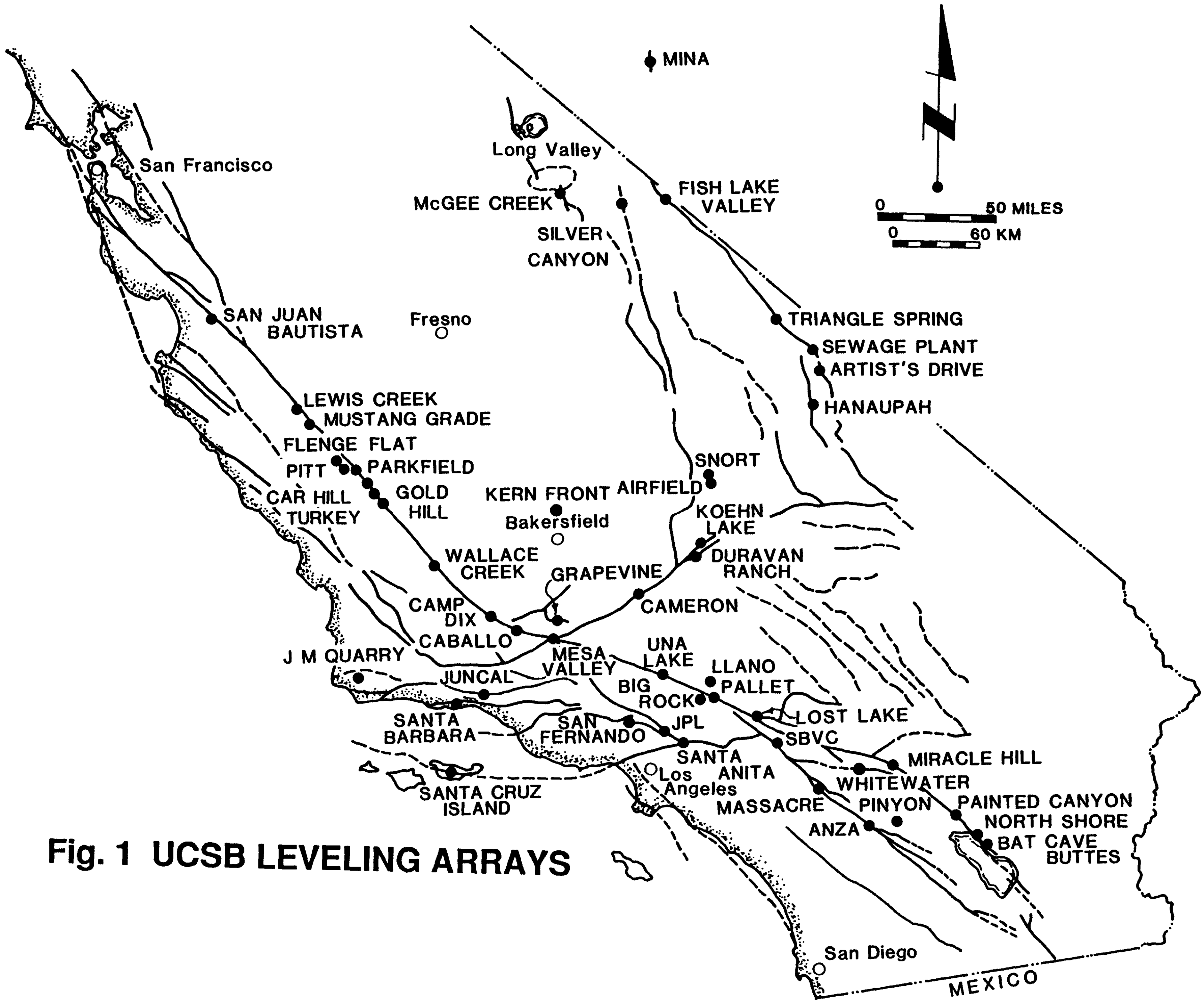


Fig. 1 UCSB LEVELING ARRAYS

TABLE I. UCSB LEVELING ARRAYS

LOCATION	LATITUDE	LONGITUDE	QUADRANGLE	INITIAL SURVEY	MOST RECENT SURVEY	TOTAL # SURVEYS
SANTA BARBARA						
Cook	34°25'10"	119°43'00"	Santa Barbara	8/70	8/82	11
Cabrillo	34°22'20"	119°41'25"	Santa Barbara	9/70	6/82	16
Lorinda	34°25'20"	119°43'25"	Santa Barbara	8/70	8/82	7
Castillo Connect	34°25'00"	119°43'25"	Santa Barbara	10/73	8/82	5
Portesuelo	34°25'20"	119°43'35"	Santa Barbara	8/70	6/84	9
Bath	34°24'10"	119°24'10"	Santa Barbara	4/71	8/82	8
Chapala	34°24'50"	119°41'30"	Santa Barbara	4/71	8/82	8
Natoma	34°24'50"	119°41'25"	Santa Barbara	8/70	6/82	8
Castillo	34°24'50"	119°41'35"	Santa Barbara	2/72	8/82	6
Yanonali	34°25'00"	119°41'10"	Santa Barbara	7/70	8/82	8
State	34°24'55"	119°41'55"	Santa Barbara	10/70	8/82	8
SAN ANDREAS FAULT ZONE						
San Juan Bautista	36°50'48"	121°32'00"	San Juan Bautista	9/75	8/83	16
Lewis Creek	36°17'42"	120°52'30"	Lonoak, Hepsedam	8/85	8/87	3
Mustang Grade	36°11'35"	120°46'12"	Monarch Peak	8/85	8/87	3
Flenge Flat	35°55'55"	120°31'18"	Stockdale Mtn.	4/82	8/87	4
Pitt Ranch	35°55'08"	120°28'56"	Parkfield	4/82	2/88	7
Parkfield	35°53'42"	120°26'02"	Parkfield	4/82	2/88	7
Car Hill	35°53'05"	120°25'31"	Parkfield	8/87	8/87	1
Turkey Flat	35°52'36"	120°24'57"	Parkfield	8/87	8/87	1
Gold Hill	35°48'04"	120°21'48"	Cholame Valley	8/87	8/87	1
Wallace Creek	35°16'09"	119°49'27"	McKittrick Summit	7/83	8/87	3
Camp Dix	34°57'48"	119°26'41"	Ballinger Canyon	7/82	7/82	1
Caballo	34°52'07"	119°13'02"	Sawmill Mountain	8/82	7/87	6
Mesa Valley	34°48'46"	118°54'20"	Frazier Mountain	2/77	7/87	21
Una Lake	34°33'00"	118°02'47"	Palmdale	8/79	8/84	5
47th St. East	34°31'03"	118°02'47"	Palmdale	12/76	9/86	13
Big Rock Springs	34°26'04"	117°50'00"	Valyermo	10/80	7/84	9
Pallett Creek	34°25'10"	117°54'00"	Juniper Hills	6/78	9/86	15
Llano	34°31'06"	117°47'53"	Lovejoy Buttes	3/81	9/86	6
Lost Lake	34°16'34"	117°28'00"	Cajon	8/85	7/87	4
Whitewater	33°56'47"	116°38'01"	Whitewater	8/86	6/87	2
Miracle Hill	33°56'03"	116°28'00"	Seven Palms Valley	9/85	6/87	4
North Shore	33°35'02"	115°55'57"	Mortmar	9/85	12/87	4
Painted Canyon	33°36'15"	116°01'20"	Mecca	9/83	12/87	6
Bat Caves	33°25'26"	115°49'04"	Durmid	9/85	12/87	4
DEATH VALLEY						
Triangle Spring	36°42'40"	117°07'20"	Stovepipe Wells	10/70	12/85	6
Sewage Treatment	36°30'20"	115°52'25"	Chloride Cliff	10/70	12/85	6
Artists Drive	36°25'00"	116°51'00"	Fumace Creek	4/70	12/85	10
Hanupah	36°14'05"	116°53'00"	Bennett's Well	10/70	12/85	9
Fish Lake Valley	37°24'28"	117°51'47"	Soldier Pass	9/71	9/86	7
SAN JACINTO FAULT ZONE						
SBValley College	34°05'08"	117°18'37"	San Bernardino S	7/85	6/87	6
Massacre Canyon	33°50'35"	116°59'45"	San Jacinto	8/85	7/87	5
Pinyon Flat	33°35'00"	116°26'00"	Palm Desert	10/79	9/87	19
Anza	34°35'00"	116°39'35"	Idyllwild	1/81	9/87	29

TRANSVERSE RANGES						
JM Quarry	34°36'30"	120°26'44"	Lompoc Hills	8/81	6/85	8
Juncal	34°29'00"	119°30'15"	Carpinteria	8/70	8/80	7
Grapevine	34°55'30"	118°55'30"	Grapevine	7/79	7/87	11
San Fernando	34°18'03"	118°25'35"	San Fernando	2/71	8/85	10
JPL	34°12'05"	118°09'52"	Pasadena	5/84	7/87	7
Santa Anita Canyon	34°10'05"	118°01'03"	Mt. Wilson	8/84	7/87	5
SAN JOAQUIN VALLEY						
Kern Front	35°27'55"	119°00'20"	Oildale	8/86	7/87	4
LONG VALLEY AND OWENS VALLEY						
YMCA	37°37'34"	118°55'37"	Mt. Morrison	7/83	7/84	1
McGee Creek	37°33'29"	118°47'08"	Mt. Morrison	7/82	8/87	10
Silver Canyon	37°24'16"	118°18'46"	Bishop	7/87	7/87	1
MOJAVE DESERT						
SNORT	35°44'52"	117°45'00"	White Hills	7/83	2/87	6
Airport	35°42'41"	117°43'16"	Ridgecrest North	7/83	2/87	6
Cameron	35°05'37"	118°18'16"	Monolith	8/85	7/87	3
Koehn Lake	35°22'16"	117°51'03"	Saltdale SE	8/84	7/87	4
Duravan	35°17'05"	117°53'25"	Cantil	9/74	8/86	13
NEVADA						
Mina	38°21'58"	118°03'08"	Sodaville	7/85	7/86	2

Current to 23 March 1988

APPENDIX I

Student Assistants, in alphabetical order

- Rocky Angelini
- Todd Battey
- Scott Bie
- Bob Blackmur
- Bob Brenneman
- Alan Brown
- Margaret Burke
- Mike Bunds
- John Byrd
- Duane Chase
- Fred Chester
- Gayle Cekada
- Jeff Cole
- Jim Coss
- Donette Dunaway
- David Fisher
- Tom Foster
- Susan Frischer
- Mike Gagan
- Ken Gester
- David Goodrich
- Karl Gross
- Roger Griffiths
- Beverly Halliwell
- Peter Hill
- Jim Hollis
- Mike Hurd
- Jeff Jordan
- John Kammer
- Fred Keller
- Rick Keller
- Dean Kubani
- Nat Lifton
- Andy Lush
- Dave Mann
- Jim Mathieu
- Kris McClellan
- Ross McNeil
- Chuck Meertens
- Joel Metcalf
- Scott Minor
- Frank Moreland
- Dave Mowles
- Elizabeth Nixon
- Randall Parker
- David Parkinson
- Ken Perez
- Dwight Pollard
- Matt Ralston
- Leslie Ransbottom
- Stephanie Riess
- Nancy Riggs
- Dar Roberts
- Tom Rockwell
- Pat Shourds
- Mandy Spencer
- Chris Taylor
- Larry Voors
- Frank Webb
- Mike Wightman
- Chris Wilson
- Lowell Woodbury
- Jane Woodward
- Jim Wright

APPENDIX II

LOCATION AND MEASUREMENT DATA

Data are arranged alphabetically by array name and are considered necessary and sufficient to find each array, recover bench marks, and compare future measurement data with our own.

Data for each array include site access and trespass information; its location on a topographic map; a site map; line graphs which compare results of various surveys; and bench mark height differences for the earliest and most recent good surveys.

Data pertaining to intermediate resurveys, as well as for surveys done after the data of this report, may be obtained on request from the author.

AIRFIELD Leveling Array

Latitude:	35°42'41"	**Length:**	1255.2m
Longitude:	117°43'16"	**Number of Bench marks:**	37
Date of Initial Survey:	11 July, 1983	**Number of Surveys to 1988:**	6

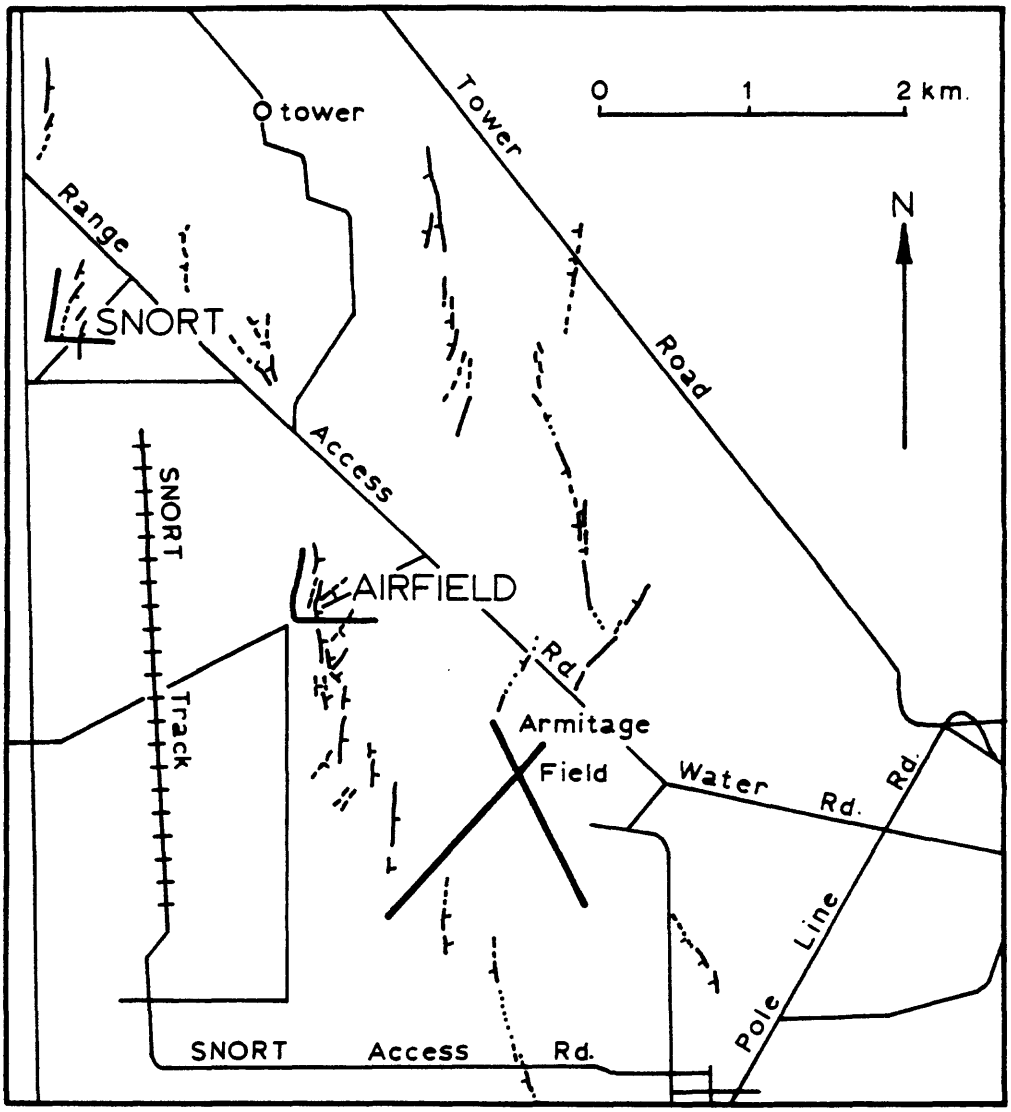
Trespass Permission: Contact in Advance
Dr. Glenn Roquemore or John Zellmer
Research Department
Naval Weapons Center
China Lake, CA 93555

Comments:

This is one of two L-shaped arrays across one of the N-S normal faults evincing surface rupture following an earthquake swarm in Indian Wells Valley in 1982 (Roquemore and Zellmer, 1983). It is located five and one-half miles NNW of the town of Ridgecrest.

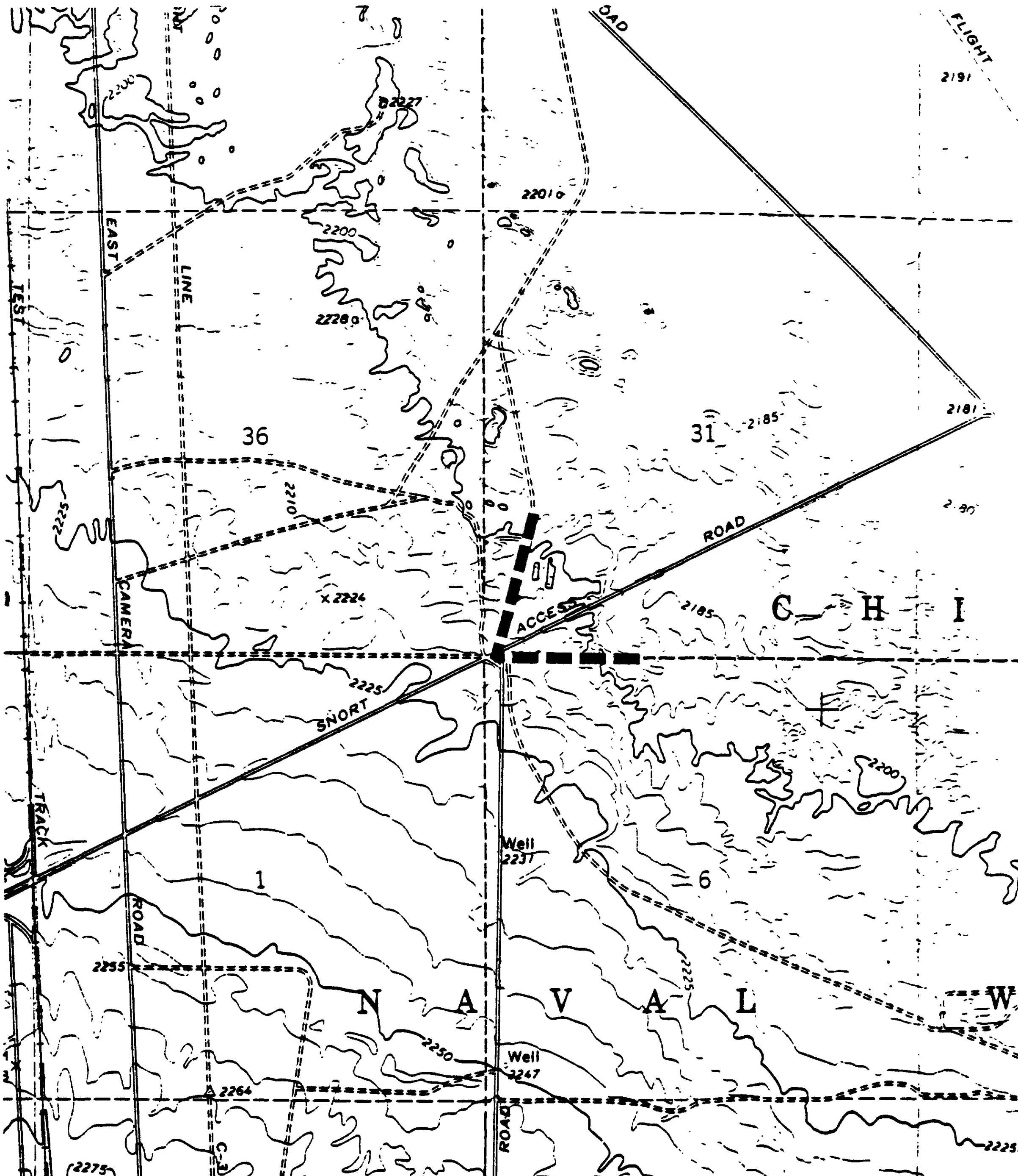
Five levelings from July, 1983 to February, 1987 show nonsystematic fluctuations of less than 1mm among the bench marks, which is nearly equal to the allowable closure error.

Reference cited: Roquemore, G. R., and J. T. Zellmer, 1983. Ground cracking associated with the 1982 magnitude 5.2 Indian Wells Valley earthquake. California Geology 30 (9), 197-200.



Map showing locations of UCSB precise leveling arrays across faults on China Lake Naval Weapons Center, Indian Wells Valley, Mojave Desert.

RIDGECREST NORTH QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



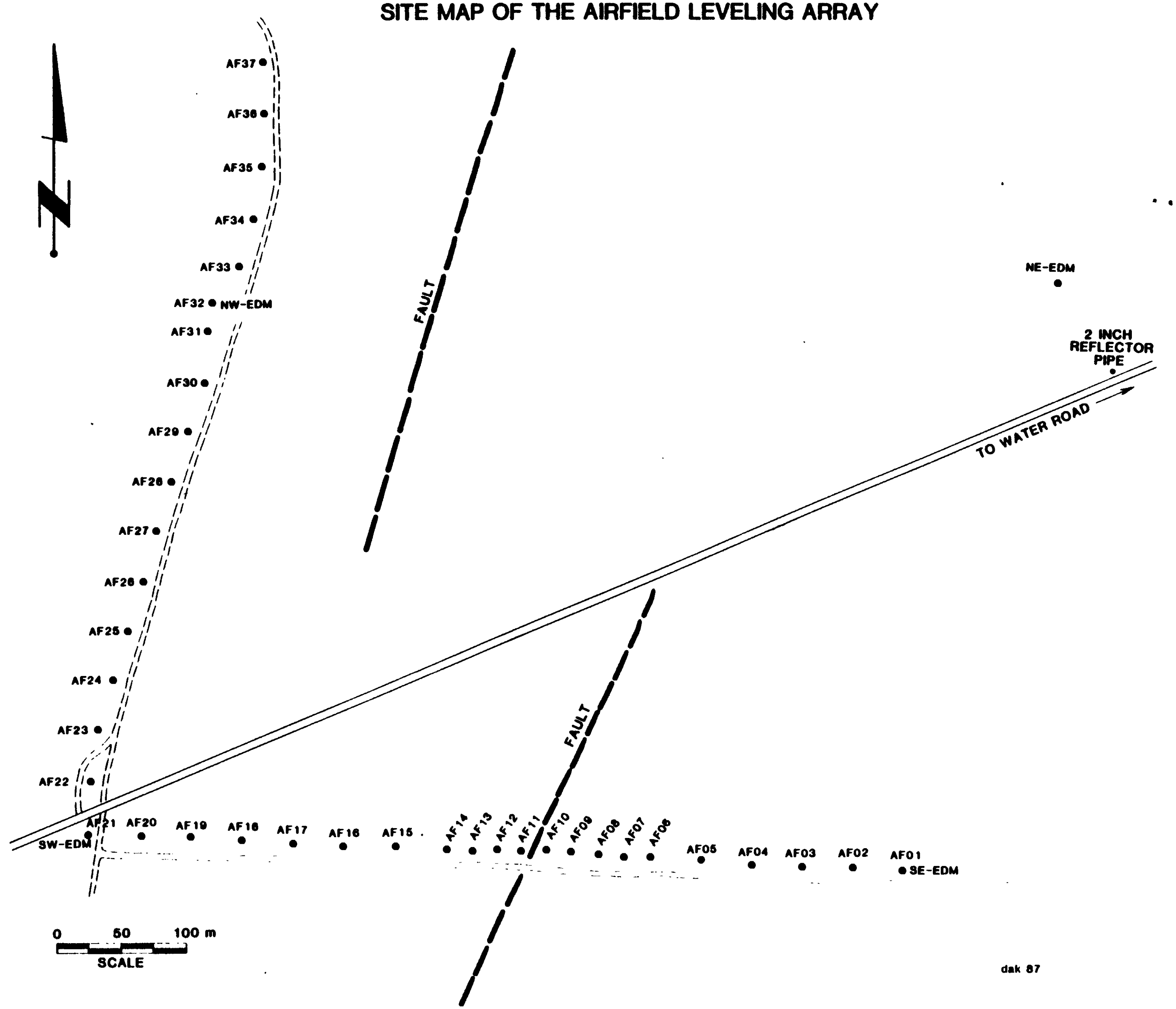
SCALE 1:24 000

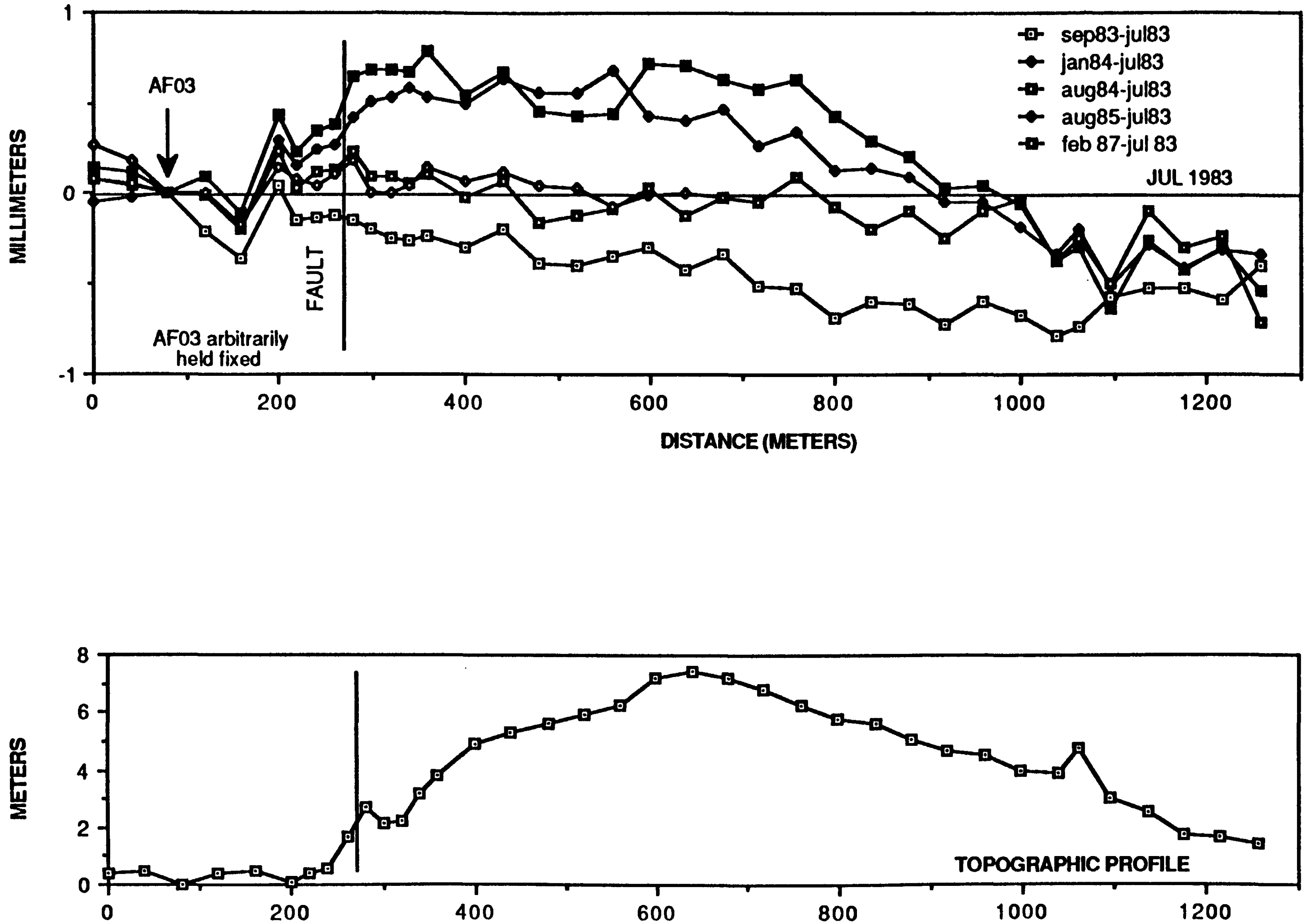
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SITE MAP OF THE AIRFIELD LEVELING ARRAY





Height changes of bench marks in the Airfield leveling array for six surveys from July 1983 to February 1987.

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
AF01	AF02	10.055
AF02	AF03	-46.570
AF03	AF04	37.774
AF04	AF05	7.838
AF05	AF06	-37.617
AF06	AF07	30.732
AF07	AF08	20.625
AF08	AF09	108.594
AF09	AF10	103.685
AF10	AF11	-60.045
AF11	AF12	13.270
AF12	AF13	90.455
AF13	AF14	62.918
AF14	AF15	115.905
AF15	AF16	33.374
AF16	AF17	37.736
AF17	AF18	26.972
AF18	AF19	34.122
AF19	AF20	92.227
AF20	AF21	24.986
AF21	AF22	-20.244
AF22	AF23	-41.511
AF23	AF24	-53.672
AF24	AF25	-53.307
AF25	AF26	-11.239
AF26	AF27	-58.207
AF27	AF28	-35.850
AF28	AF29	-18.656
AF29	AF30	-55.346
AF30	A31A	-10.146
A31A	A31B	58.815
A31B	AF32	27.450
AF32	AF33	-173.504
AF33	AF34	-42.709
AF34	AF35	-80.507
AF35	AF36	-12.072
AF36	AF37	-21.697

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
AF01	AF02	10.053
AF02	AF03	-46.582
AF03	AF04	37.783
AF04	AF05	7.818
AF05	AF06	-37.583
AF06	AF07	30.731
AF07	AF08	20.637
AF08	AF09	108.601
AF09	AF10	103.709
AF10	AF11	-60.043
AF11	AF12	13.271
AF12	AF13	90.453
AF13	AF14	62.929
AF14	AF15	115.882
AF15	AF16	33.386
AF16	AF17	37.715
AF17	AF18	26.970
AF18	AF19	34.124
AF19	AF20	92.252
AF20	AF21	24.985
AF21	AF22	-20.253
AF22	AF23	-41.516
AF23	AF24	-53.666
AF24	AF25	-53.327
AF25	AF26	-11.253
AF26	AF27	-58.216
AF27	AF28	-35.868
AF28	AF29	-18.654
AF29	AF30	-55.357
AF30	AF31A	-10.177
AF31A	AF32	86.272
AF32	AF33	-173.538
AF33	AF34	-42.672
AF34	AF35	-80.523
AF35	AF36	-12.060
AF36	AF37	-21.722

ANZA Leveling Array

Latitude:	34°35'00"	**Length:**	792.0m
Longitude:	116°39'35"	**Number of Bench marks:**	32
Date of Initial Survey:	24 January 1981	**Number of Surveys to 1988:**	29

Trespass Permission:

Most of the array is on private property with limited access to authorized persons. It is a good idea to notify in advance Mr. Larry Muzzall who owns the adjacent property to the southeast at :

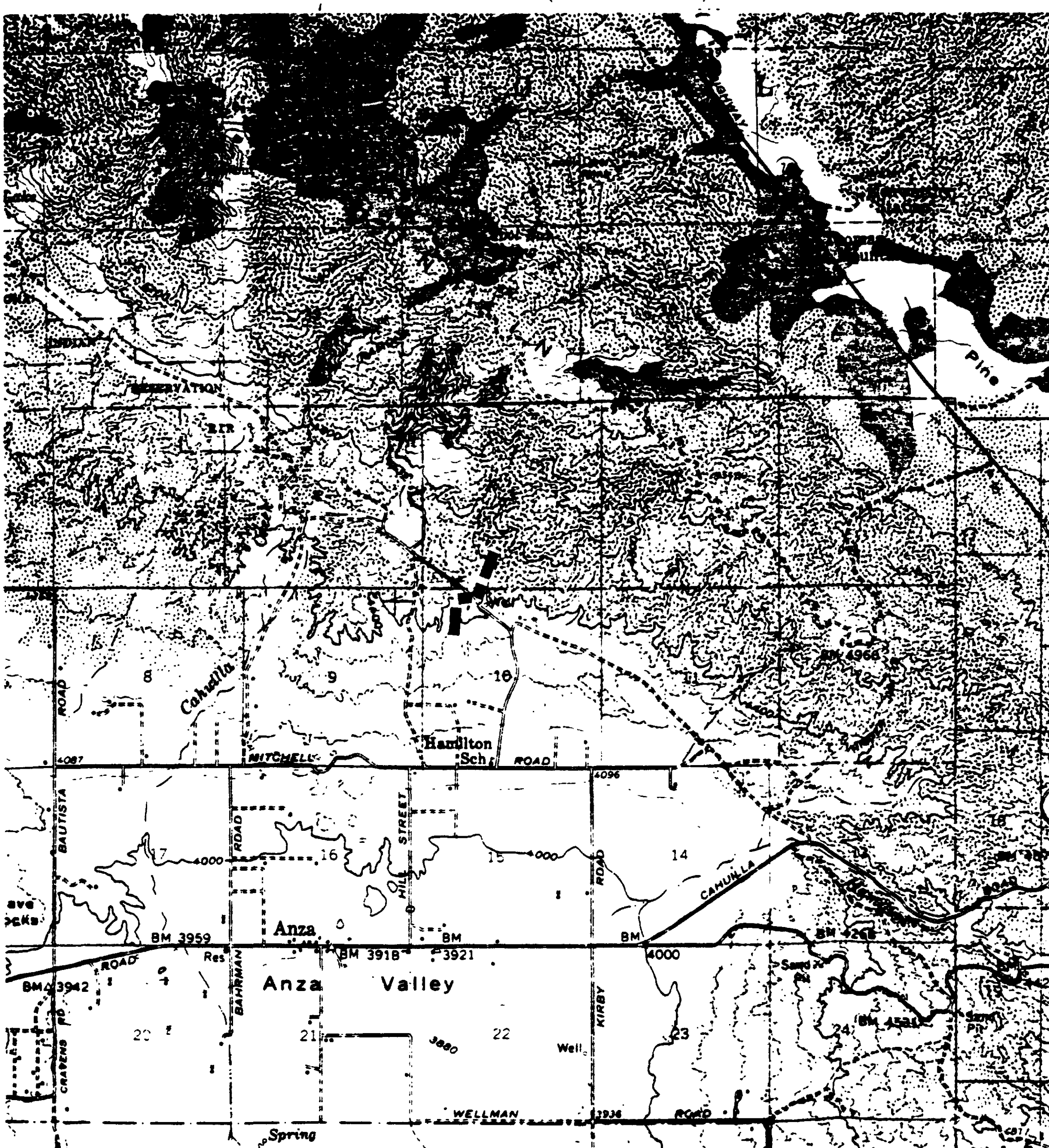
P.O. Box 76, Union Oil Research
376 Valencia Canyon
Brea, CA 92621

Comments:

This irregular-shaped line conforms, in part, to the physiography of a right-offset canyon across the San Jacinto fault, two miles from Anza.

Relative to one of the first levelings, that of April 1981, a representative leveing in January 1984 and the most recent in September 1987 show no significant height changes that can be attributed to displacement along the fault.

IDYLLWILD QUADRANGLE
CALIFORNIA–RIVERSIDE CO.
15 MINUTE SERIES (TOPOGRAPHIC)



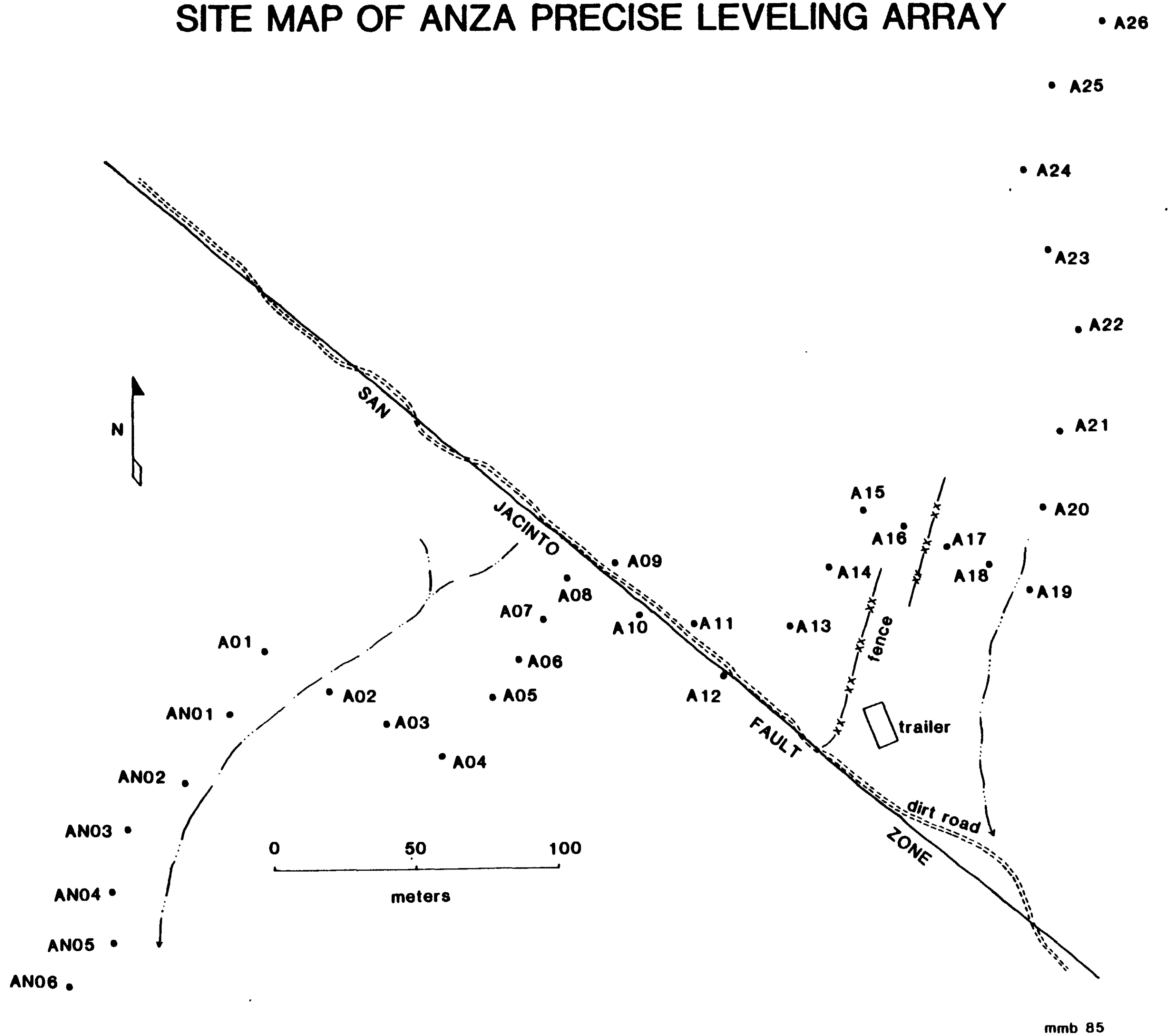
SCALE 1:62500

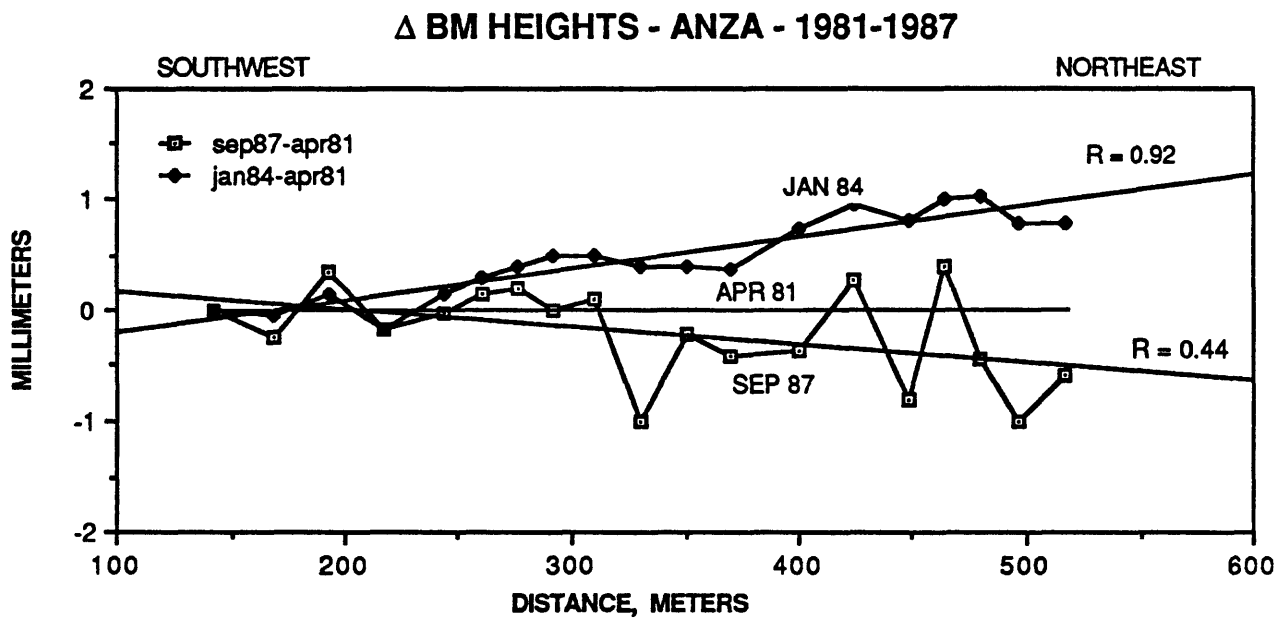
1 ½ 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS

SITE MAP OF ANZA PRECISE LEVELING ARRAY




Δ BM HEIGHTS - ANZA - 1981-1987
SOUTHWEST
NORTHEAST
sep87-apr81
jan84-apr81
R = 0.92
JAN 84
APR 81
R = 0.44
SEP 87
MILLIMETERS
DISTANCE, METERS
2
1
0
-1
-2
100
200
300
400
500
600

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
AN06	AN05	36.228
AN05	AN04	224.193
AN04	AN03	206.807
AN03	AN02	-18.747
AN02	AN01	151.896
AN01	A01	166.830
A01	A02	-186.080
A02	A03	-135.015
A03	A04	-117.550
A04	A05	180.712
A05	A06	117.242
A06	A07	130.713
A07	A08	65.239
A08	A09	7.069
A09	A10	-150.846
A10	A11	-55.791
A11	A12	-122.362
A12	A13	21.645
A13	A14	107.926
A14	A15	132.486
A15	A16	-87.793
A16	A17	27.140
A17	A18	30.981
A18	A19	-75.242
A19	A20	229.096
A20	A21	224.754
A21	A22	193.929
A22	A23	209.159
A23	A24	235.058
A24	A25	86.273
A25	A26	129.420

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
A26	A25	-129.409
A25	A24	-86.283
A24	A23	-235.079
A23	A22	-209.162
A22	A21	-193.927
A21	A20	-224.801
A20	A19	-229.089
A19	A18	75.202
A18	A17	-30.940
A17	A16	-27.086
A16	A15	87.713
A15	A14	-132.414
A14	A13	-107.940
A13	A12	-21.637
A12	A11	122.398
A11	A10	55.688
A10	A09	150.953
A09	A08	-7.093
A08	A07	-65.225
A07	A06	-130.713
A06	A05	-127.241
A05	A04	-180.729
A04	A03	117.583
A03	A02	134.971
A02	A01	186.103
A01	AN01	-166.850
AN01	AN02	-151.929
AN02	AN03	18.727
AN03	AN04	-206.748
AN04	AN05	-224.216
AN05	AN06	-36.237

ARTISTS DRIVE Level Line (Line 50)

Latitude:	36°25'00"	**Length:**	273.0m
Longitude:	116°51'00"	**Number of Bench marks:**	10
Date of Initial Survey:	3 October 1970	**Number of Surveys to 1988:**	10

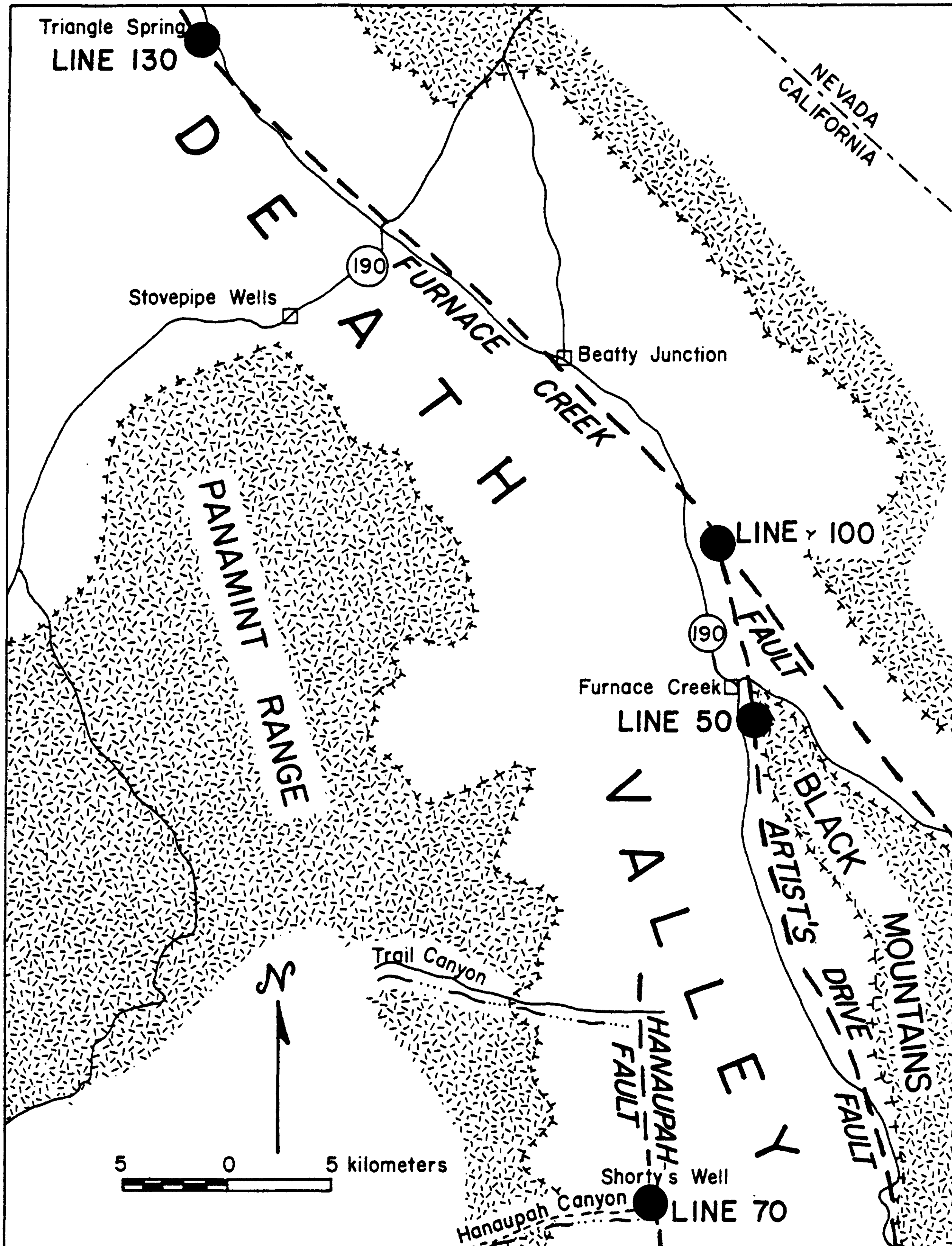
Trespass Permission: Notify in Advance
Chief Ranger
National Park Service
Death Valley National Monument
Death Valley, CA 92328

Vehicles must not be driven off the paved road. They may be parked on the highway shoulder at the west end of the level line.

Comments:

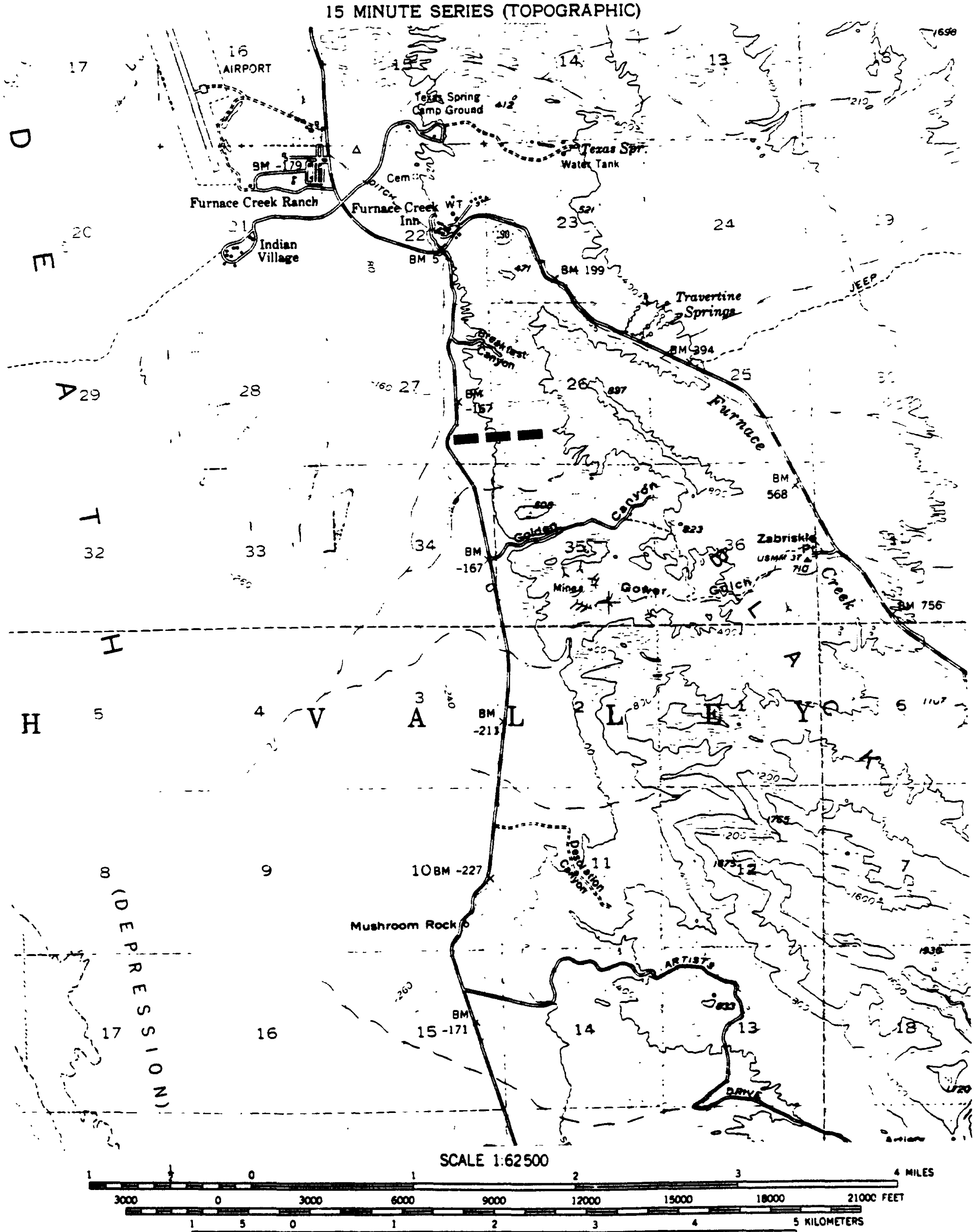
The line was placed across the Artist Drive fault on the east side of Death Valley one and one-half miles south of Furnace Creek Inn. It was extended an additional 47m by adding two more bench marks at the east end of the line in 1985. This was done to have control east of bench mark 544 which, since 1970, rose 7mm relative to the rest of the bench marks in the array (Sylvester and Bie, 1986).

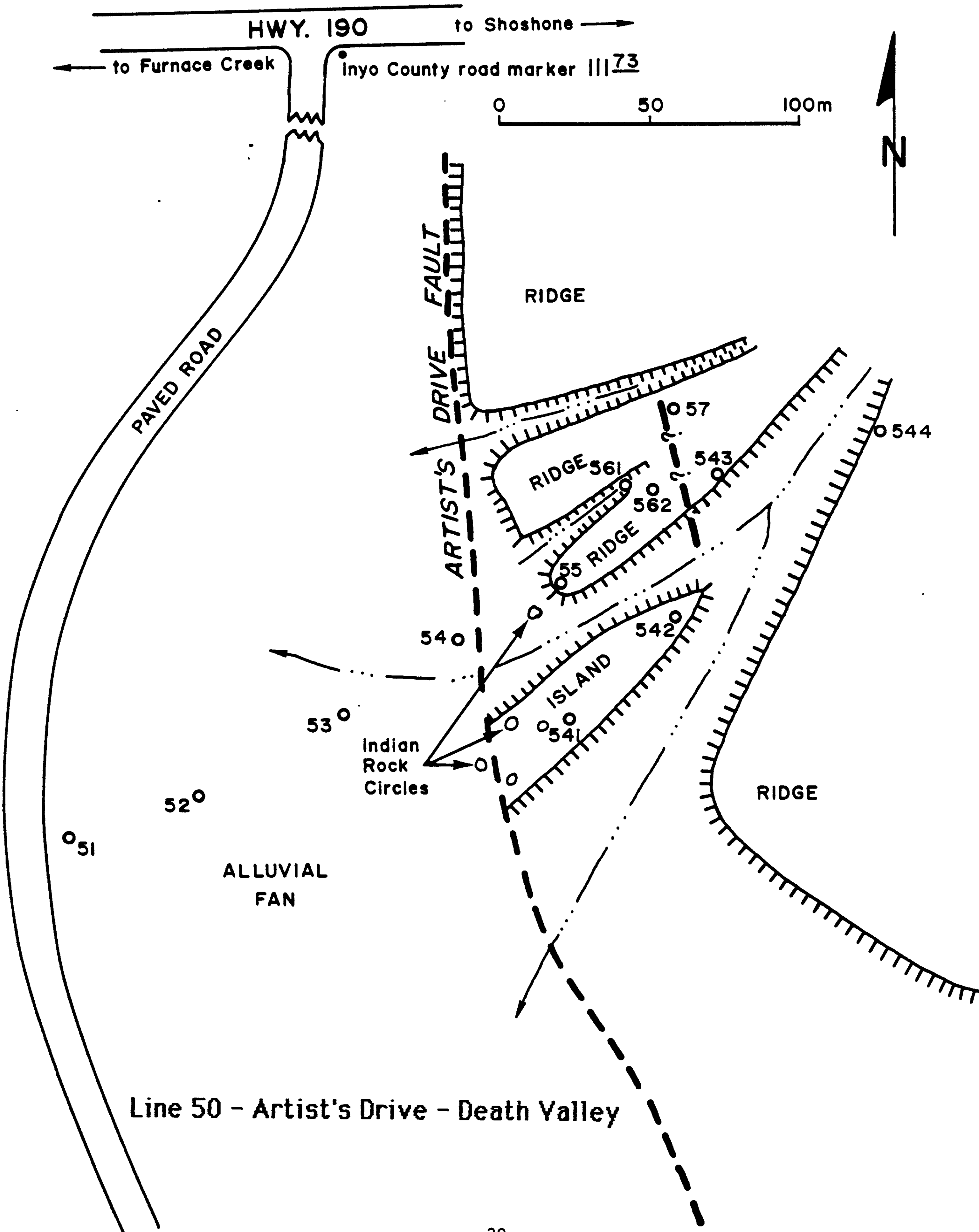
Reference cited: Sylvester, A. G., and S. W. Bie, 1986. Geodetic monitoring of fault movements in Death Valley, 1970-1985, pp. 41-44, *in* Troxel, B. W., *editor*, Quaternary Tectonics of Southern Death Valley. Field Guide, Pacific Cell, Friends of the Pleistocene, 44 p.



Locations of short leveling arrays in Death Valley.

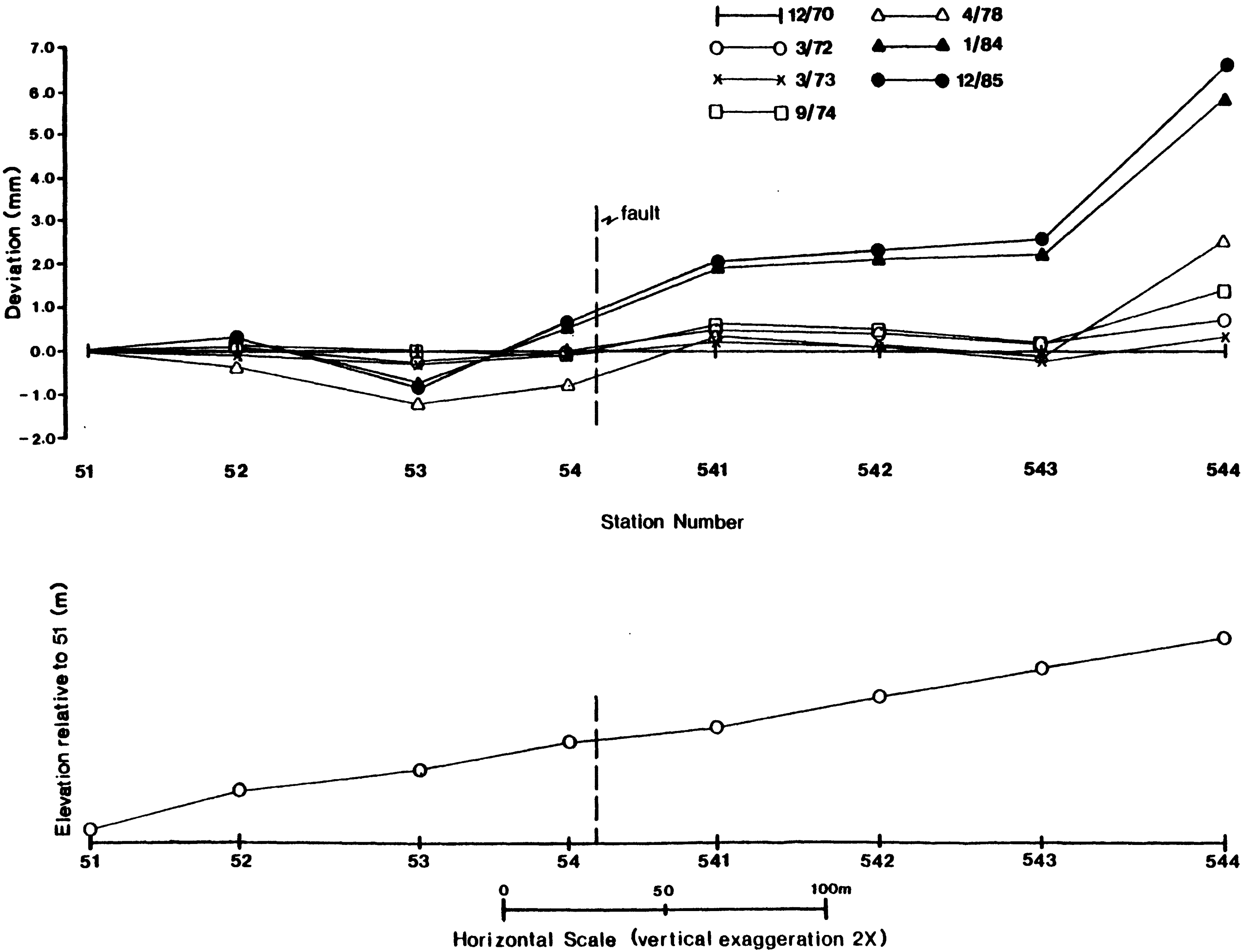
FURNACE CREEK QUADRANGLE
CALIFORNIA-INYO CO.
15 MINUTE SERIES (TOPOGRAPHIC)





Line 50 - Artist's Drive - Death Valley

Line 50 - Artist's Drive - Death Valley



Line 50 - Artist's Drive - Death Valley

Relative elevation and elevation deviation from base line data collected Dec., 1970 (in cm). A - base line data, B - adjusted elevation relative to station 51, C - deviation of elevation from base line data, D - datum elevation.

Station and			Mar., 1972		Mar., 1973		Sept., 1974		Apr., 1978		Jan., 1984	
Monument	Type	A	B	C	B	C	B	C	B	C	B	C
51D	B	1000.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00
52	B	1377.29	1377.30	+0.01	1377.28	-0.01	1377.30	+0.01	1377.26	-0.03	1377.31	+0.02
53	B	1965.22	1965.24	-0.02	1965.19	-0.03	1965.22	0.00	1965.10	-0.12	1965.15	-0.07
54	B	2358.55	2358.55	0.00	2358.54	-0.01	2358.54	-0.01	2358.47	-0.08	2358.60	+0.05
541	A	2580.18	2580.23	+0.05	2580.20	+0.02	2580.24	+0.06	2580.21	+0.03	2580.37	+0.19
542	A	3044.28	3044.32	+0.04	3044.29	+0.01	3044.33	+0.05	3044.29	+0.01	3044.49	+0.21
543	A	3501.91	3501.93	+0.02	3501.89	-0.02	3501.93	+0.02	3501.90	-0.01	3502.13	+0.22
544	A	3940.24	3940.31	+0.07	3940.27	+0.03	3940.38	+0.14	3940.49	+0.25	3940.82	+0.58

		Dec., 1985	
		B	C
51D	B	1000.00	0.00
52	B	1377.32	+0.03
53	B	1965.14	-0.08
54	B	2358.62	+0.07
541	A	2580.39	+0.21
542	A	3044.51	+0.23
543	A	3502.17	+0.26
544	A	3940.90	+0.66

BAT CAVES Level Line

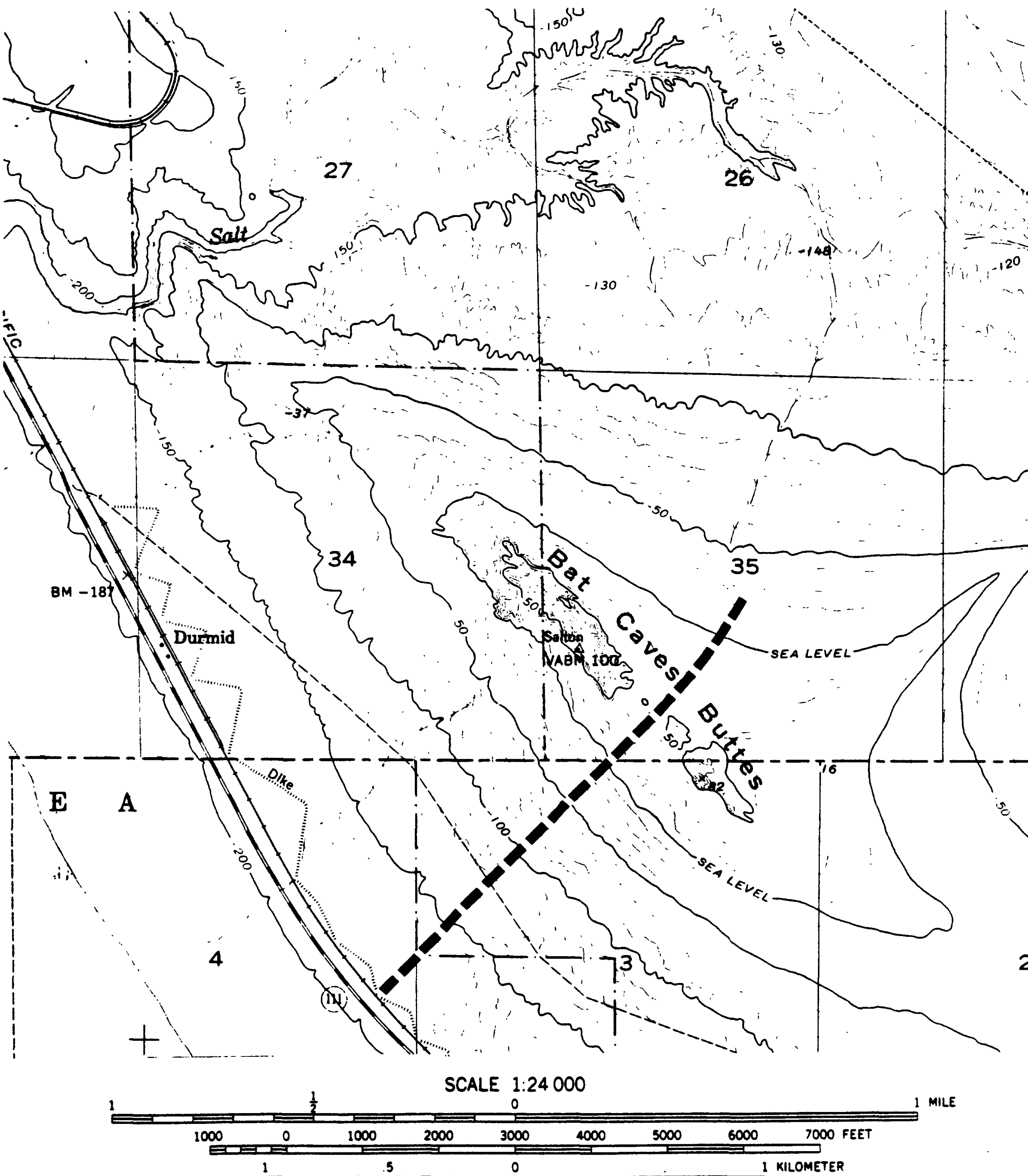
Latitude:	33°25'26"	**Length:**	2268.1m
Longitude:	115°49'04"	**Number of Bench marks:**	62
Date of Initial Survey:	9 September 1985	**Number of Surveys to 1988:**	4
Trespass Permission:	None Needed		

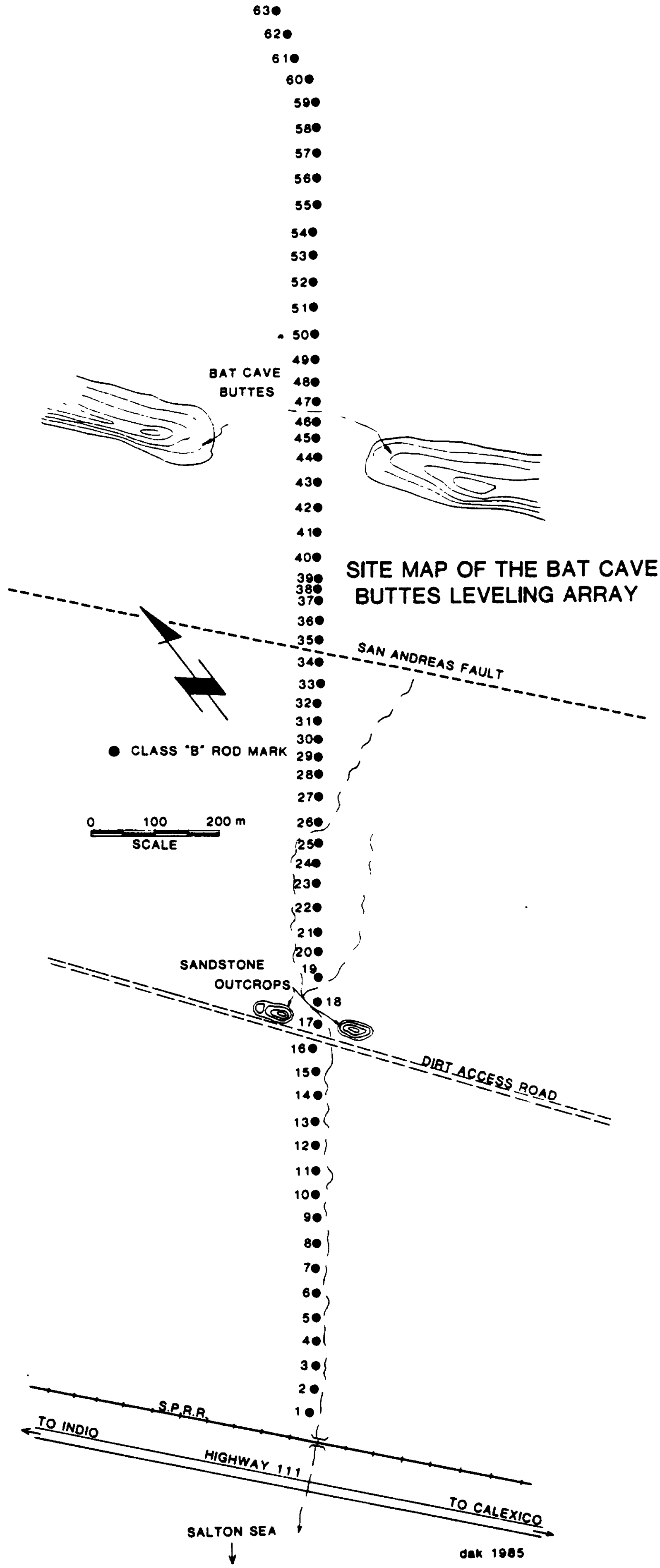
Comments:

This line crosses the San Andreas fault and the crest of Bat Caves Butte, one and one-half miles northeast of the Salton Sea. It was established to determine if the buttes, which surmount Durmid Hill, are rising due to shortening related to the transpression on the San Andreas fault.

Relative to the first leveling in September 1985 the southwest flank of Durmid Hill, southeast of the San Andreas fault, has arched upward about 2mm. No vertical displacement is apparent across the San Andreas fault itself.

DURMID QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 DURMID 15' QUADRANGLE




SITE MAP OF THE BAT CAVE BUTTES LEVELING ARRAY
BAT CAVE BUTTES
SAN ANDREAS FAULT
CLASS "B" ROD MARK
0 100 200 m
SCALE
SANDSTONE OUTCROPS
DIRT ACCESS ROAD
S.P.R.R.
TO INDIO
HIGHWAY 111
TO CALEXICO
SALTON SEA
dak 1985
63
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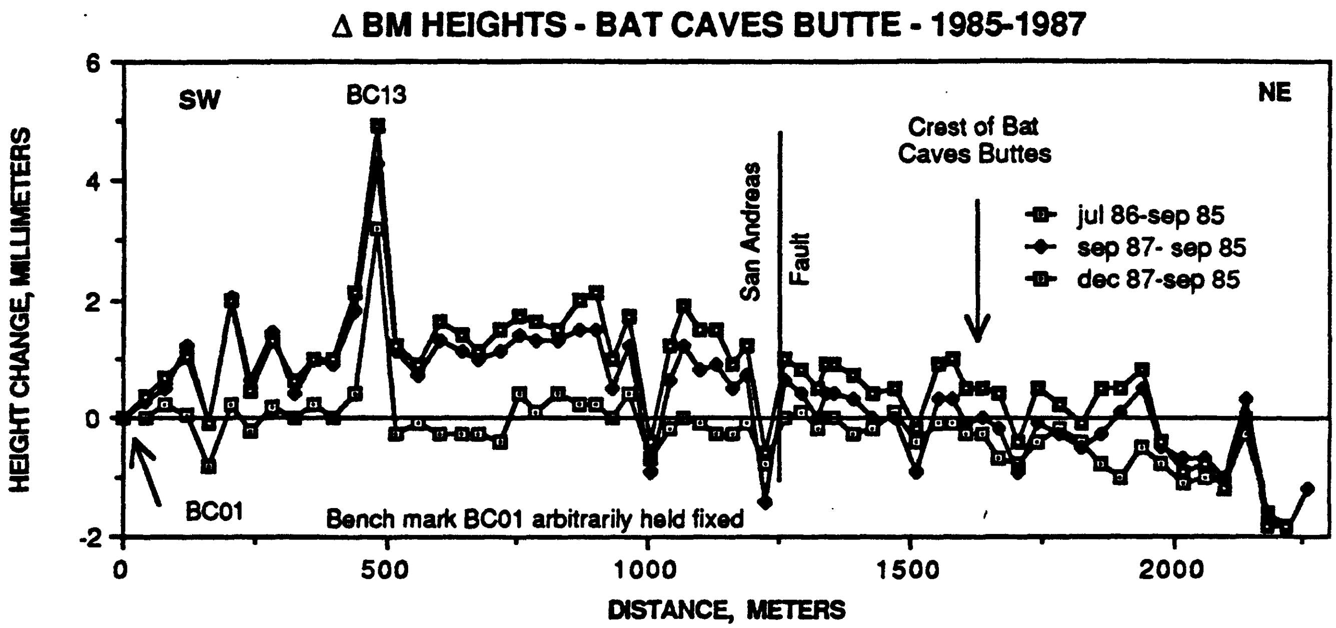
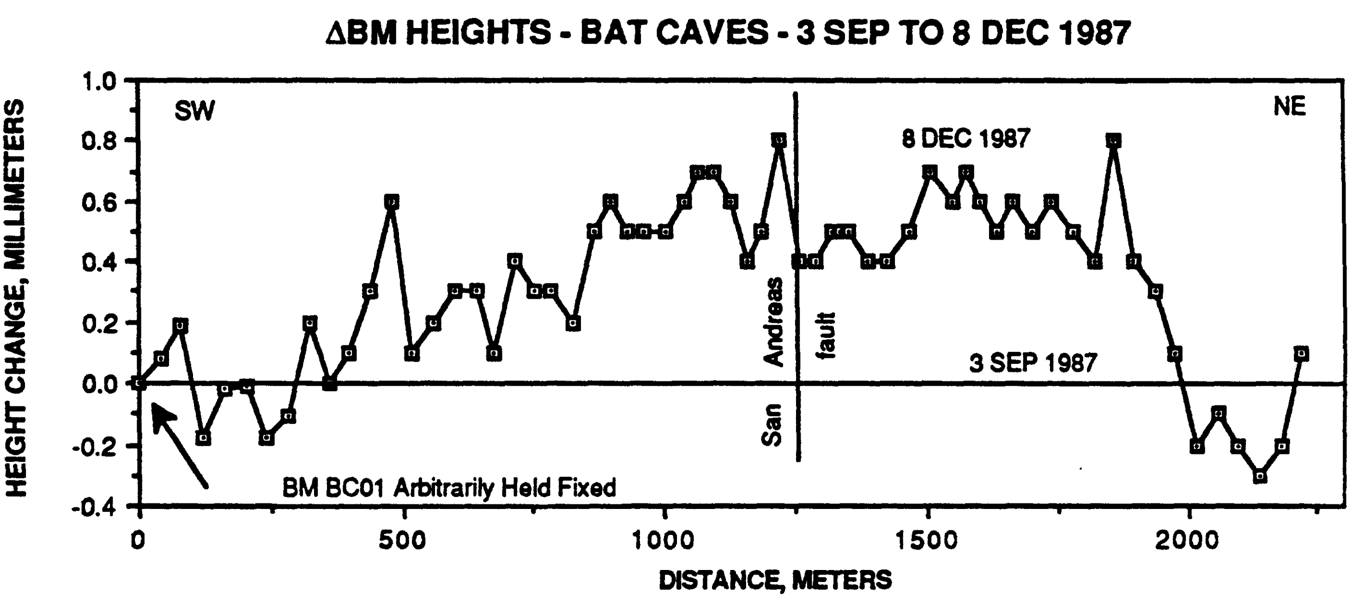
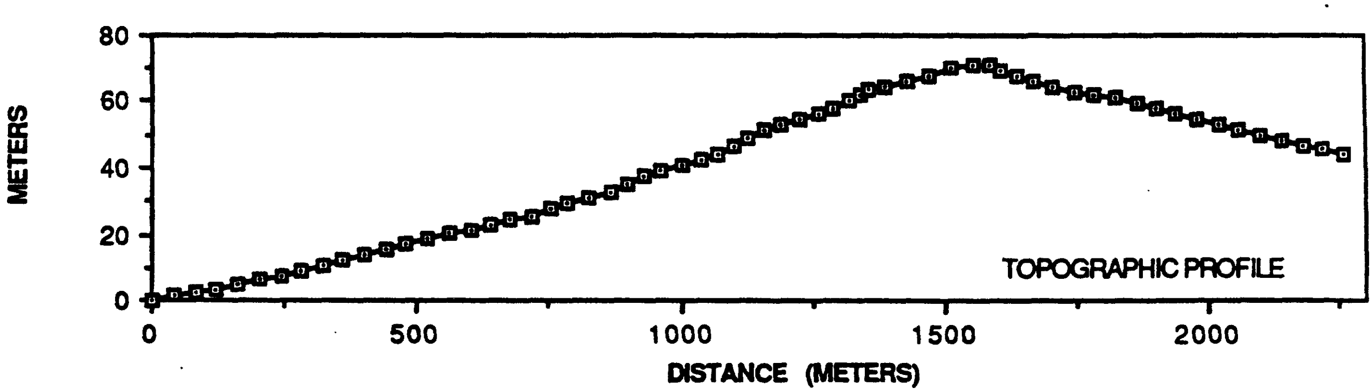

Δ BM HEIGHTS - BAT CAVES BUTTE - 1985-1987
SW
BC13
NE
Crest of Bat Caves Buttes
San Andreas
Fault
jul 86-sep 85
sep 87- sep 85
dec 87-sep 85
BC01
Bench mark BC01 arbitrarily held fixed
HEIGHT CHANGE, MILLIMETERS
DISTANCE, METERS


ΔBM HEIGHTS - BAT CAVES - 3 SEP TO 8 DEC 1987
SW
NE
8 DEC 1987
San Andreas
fault
3 SEP 1987
BM BC01 Arbitrarily Held Fixed
HEIGHT CHANGE, MILLIMETERS
DISTANCE, METERS


METERS
TOPOGRAPHIC PROFILE
DISTANCE (METERS)

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
BC01	BC02	134.814
BC02	BC03	113.038
BC03	BC04	89.871
BC04	BC05	113.260
BC05	BC06	172.821
BC06	BC07	117.127
BC07	BC08	151.042
BC08	BC09	161.446
BC09	BC10	136.854
BC10	BC11	161.538
BC11	BC12	185.173
BC12	BC13	192.400
BC13	BC14	158.401
BC14	BC15	143.629
BC15	BC16	123.298
BC16	BC17	134.046
BC17	BC18	140.420
BC18	BC19	141.283
BC19	BC20	174.690
BC20	BC21	186.745
BC21	BC22	163.530
BC22	BC23	182.023
BC23	BC24	230.850
BC24	BC25	245.545
BC25	BC26	195.538
BC26	BC27	127.785
BC27	BC28	194.337
BC28	BC29	169.411
BC29	BC30	221.464
BC30	BC31	231.825
BC31	BC32	228.698
BC32	BC33	156.383
BC33	BC34	187.662
BC34	BC35	166.787
BC35	BC36	181.530
BC36	BC37	210.044
BC37	BC38	217.866
BC38	BC39	138.994
BC39	BC40	74.431
BC40	BC41	159.312
BC41	BC42	167.009
BC42	BC43	216.478
BC43	BC44	126.330
BC44	BC45	-15.084
BC45	BC46	-171.984
BC46	BC47	-182.165
BC47	BC48	-166.103
BC48	BC49	-155.494
BC49	BC50	-132.559
BC50	BC51	-88.039

BC51	BC52	-117.603
BC52	BC53	-145.781
BC53	BC54	-174.029
BC54	BC55	-119.671
BC55	BC56	-167.849
BC56	BC57	-185.590
BC57	BC58	-144.933
BC58	BC59	-171.934
BC59	BC60	-140.084
BC60	BC61	-168.932
BC61	BC62	-140.336
BC62	BC63	-133.055

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
BC01	BC02	134.847
BC02	BC03	113.072
BC03	BC04	89.905
BC04	BC05	113.147
BC05	BC06	173.032
BC06	BC07	116.972
BC07	BC08	151.130
BC08	BC09	161.378
BC09	BC10	136.889
BC10	BC11	161.537
BC11	BC12	185.281
BC12	BC13	192.681
BC13	BC14	158.030
BC14	BC15	143.603
BC15	BC16	123.361
BC16	BC17	134.036
BC17	BC18	140.393
BC18	BC19	141.312
BC19	BC20	174.712
BC20	BC21	186.745
BC21	BC22	163.516
BC22	BC23	182.072
BC23	BC24	230.859
BC24	BC25	245.434
BC25	BC26	195.606
BC26	BC27	127.576
BC27	BC28	194.491
BC28	BC29	169.487
BC29	BC30	221.428
BC30	BC31	231.814
BC31	BC32	228.639
BC32	BC33	156.417
BC33	BC34	187.491
BC34	BC35	166.933
BC35	BC36	181.516
BC36	BC37	210.021
BC37	BC38	217.900
BC38	BC39	138.991
BC39	BC40	74.412
BC40	BC41	159.280
BC41	BC42	167.026
BC42	BC43	216.409
BC43	BC44	126.441
BC44	BC45	-15.087
BC45	BC46	-172.025
BC46	BC47	-182.159
BC47	BC48	-166.125
BC48	BC49	-155.570
BC49	BC50	-132.472
BC50	BC51	-88.066

BC51	BC52	-117.632
BC52	BC53	-145.717
BC53	BC54	-174.029
BC54	BC55	-119.643
BC55	BC56	-167.969
BC56	BC57	-185.639
BC57	BC58	-144.928
BC58	BC59	-171.976
BC59	BC60	-139.952
BC60	BC61	-169.126
BC61	BC62	-140.323

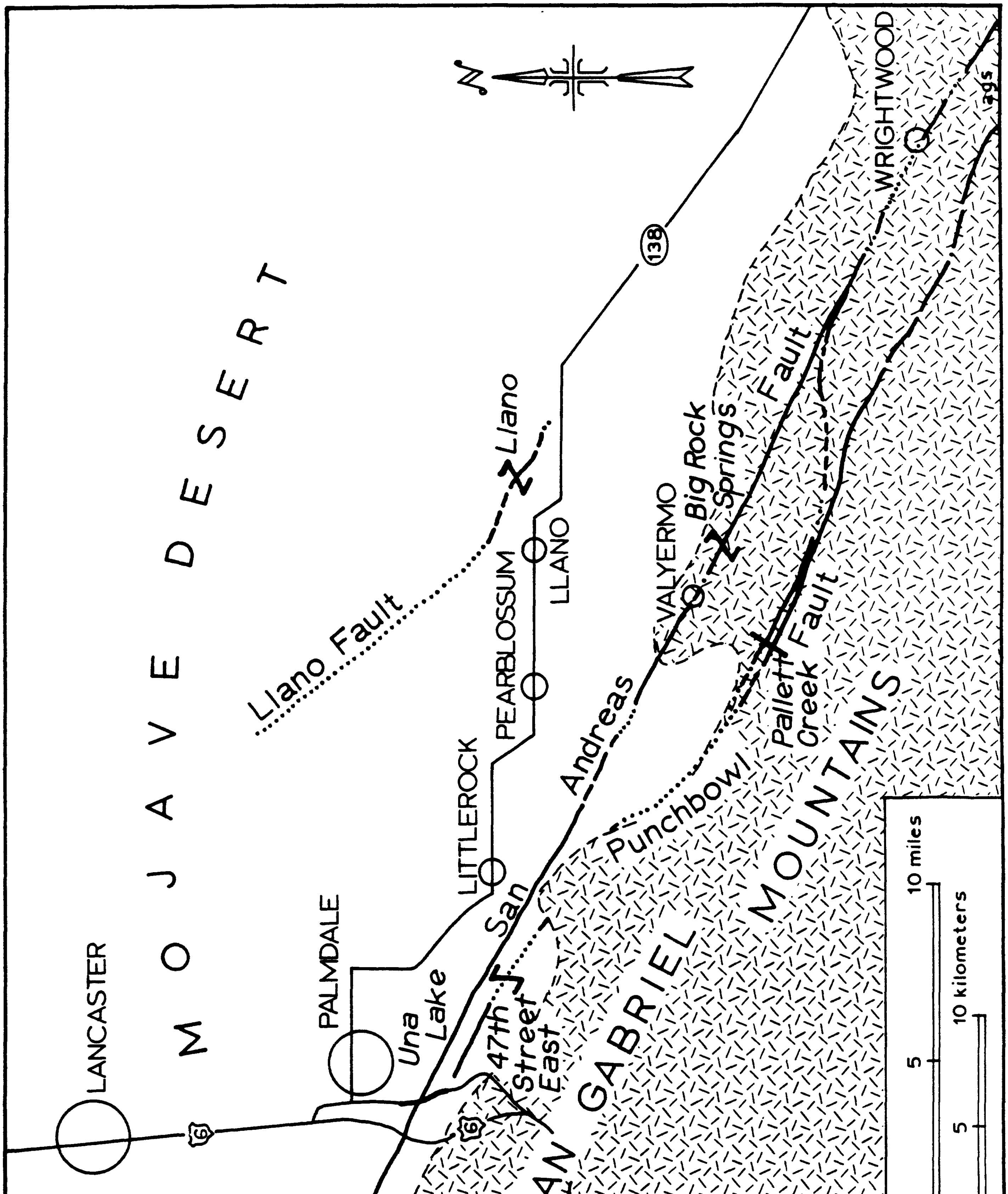
BIG ROCK SPRINGS Leveling Array

Latitude:	34°26'04"	**Length:**	394.0m
Longitude:	117°50'00"	**Number of Bench marks:**	24
Date of Initial Survey:	25 October 1980	**Number of Surveys to 1988:**	9
Trespass Permission:	Bench mark #24 is on private property. Contact property owner Barbara Frazier before surveying. Ph# (805) 944-1822.		

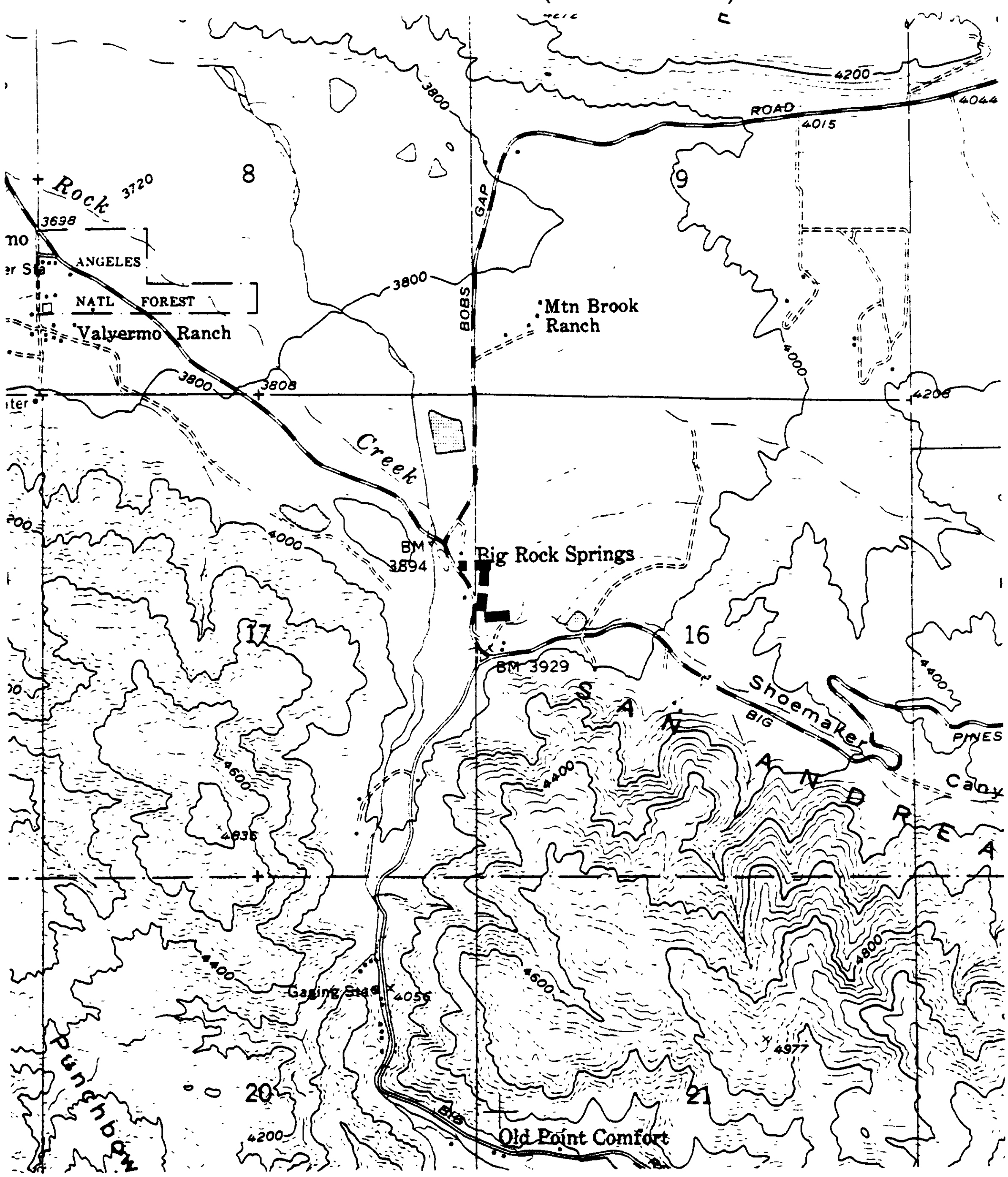
Comments:

This is a Z-shaped array across the San Andreas fault at the mouth of Big Rock Creek, one mile southeast of Valyermo.

With the exception of bench mark 1, no significant height changes have occurred among the 24 bench marks in 4 years to 1984 as is shown in an accompanying figure.


LANCASTER
PALMDALE
LITTLEROCK
PEARBLOSSUM
LLANO
VALYERMO
WRIGHTWOOD
M O J A V E D E S E R T
Llano Fault
Llano
Una Lake
47th Street East
San Andreas Fault
Big Rock Springs
Punchbowl Fault
Pallett Creek
SAN GABRIEL MOUNTAINS
138
6
395
0
5
10 miles
10 kilometers

VALYERMO QUADRANGLE
CALIFORNIA-LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



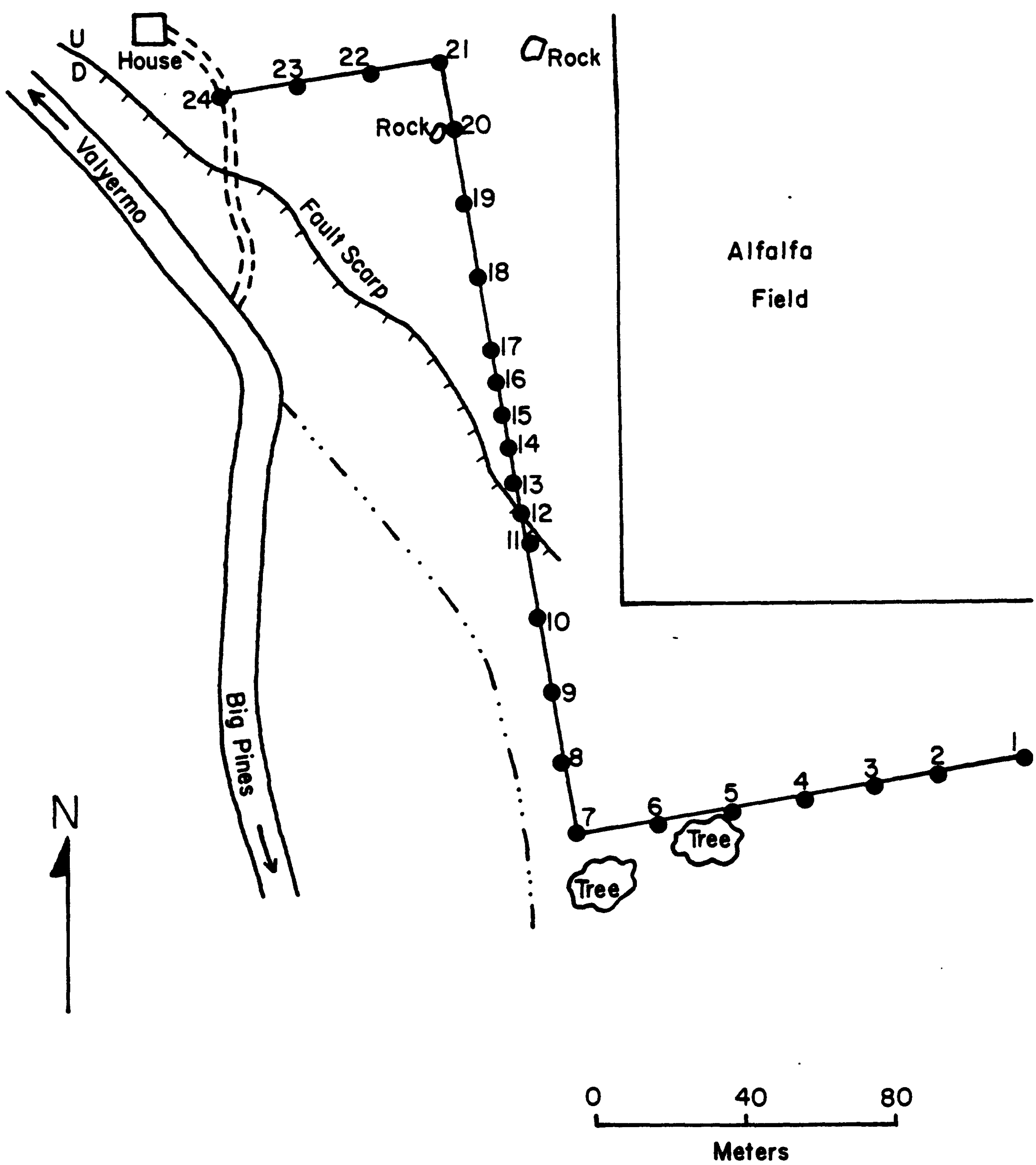
SCALE 1:24 000

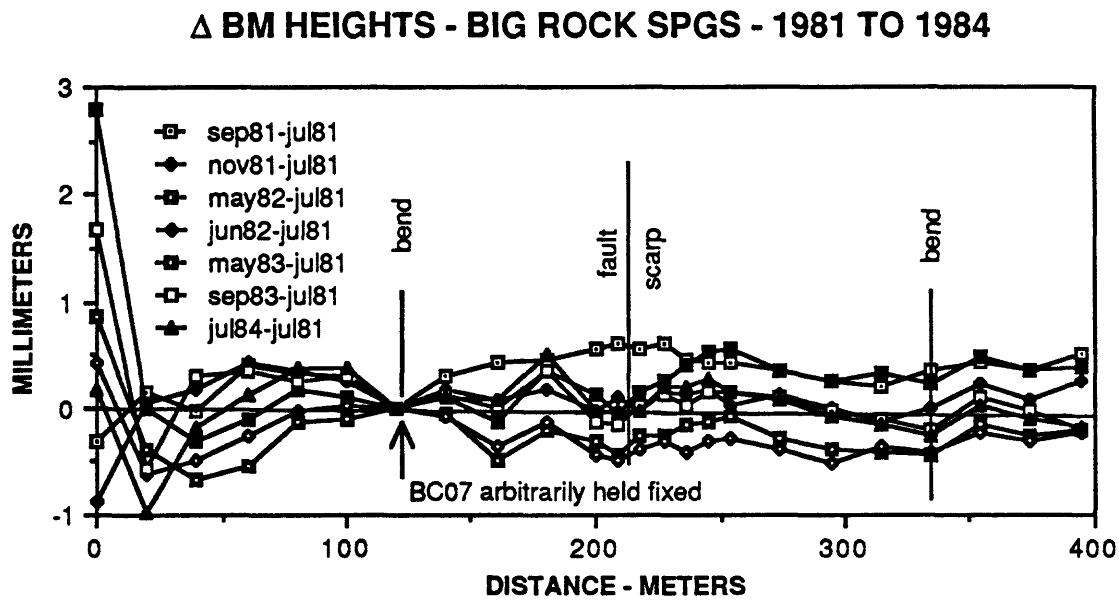
1 ½ 0 1 MILE

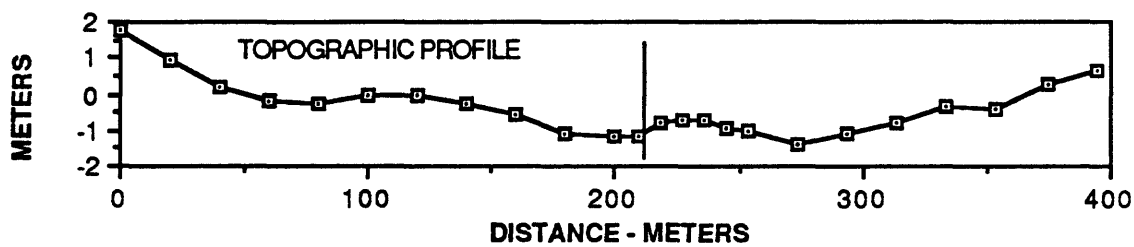
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

BIG ROCK SPRINGS LEVELING ARRAY




Δ BM HEIGHTS - BIG ROCK SPGS - 1981 TO 1984
MILLIMETERS
sep81-jul81
nov81-jul81
may82-jul81
jun82-jul81
may83-jul81
sep83-jul81
jul84-jul81
bend
fault
scarp
bend
BC07 arbitrarily held fixed
DISTANCE - METERS


METERS
TOPOGRAPHIC PROFILE
DISTANCE - METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
BR1	BR2	-85.435
BR2	BR3	-71.261
BR3	BR4	-39.322
BR4	BR5	-10.591
BR5	BR6	23.009
BR6	BR7	7.001
BR7	BR8	-29.858
BR8	BR9	-26.244
BR9	BR10	-51.454
BR10	BR11	-12.492
BR11	BR12	1.935
BR12	BR13	35.767
BR13	BR14	11.700
BR14	BR15	-2.457
BR15	BR16	-19.617
BR16	BR17	-12.345
BR17	BR18	-35.041
BR18	BR19	33.458
BR19	BR20	28.482
BR20	BR21	45.616
BR21	BR22	-11.489
BR22	BR23	73.996
BR23	BR24	35.510

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
BR01	BR02	-85.500
BR02	BR03	-71.188
BR03	BR04	-39.307
BR04	BR05	-10.584
BR05	BR06	23.025
BR06	BR07	6.953
BR07	BR08	-29.837
BR08	BR09	-26.241
BR09	BR10	-51.410
BR10	BR11	-12.548
BR11	BR12	1.929
BR12	BR13	35.769
BR13	BR14	11.726
BR14	BR15	-2.473
BR15	BR16	-19.582
BR16	BR17	-12.375
BR17	BR18	-35.032
BR18	BR19	33.484
BR19	BR20	28.479
BR20	BR21	45.607
BR21	BR22	-11.451
BR22	BR23	73.989
BR23	BR24	35.502

CABALLO Level Line

Latitude:	34°52'07"	**Length:**	1159.1m
Longitude:	119°13'02"	**Number of Bench marks:**	31
Date of Initial Survey:	11 August 1982	**Number of Surveys to 1988:**	6
Trespass Permission:	None Needed		

Comments:

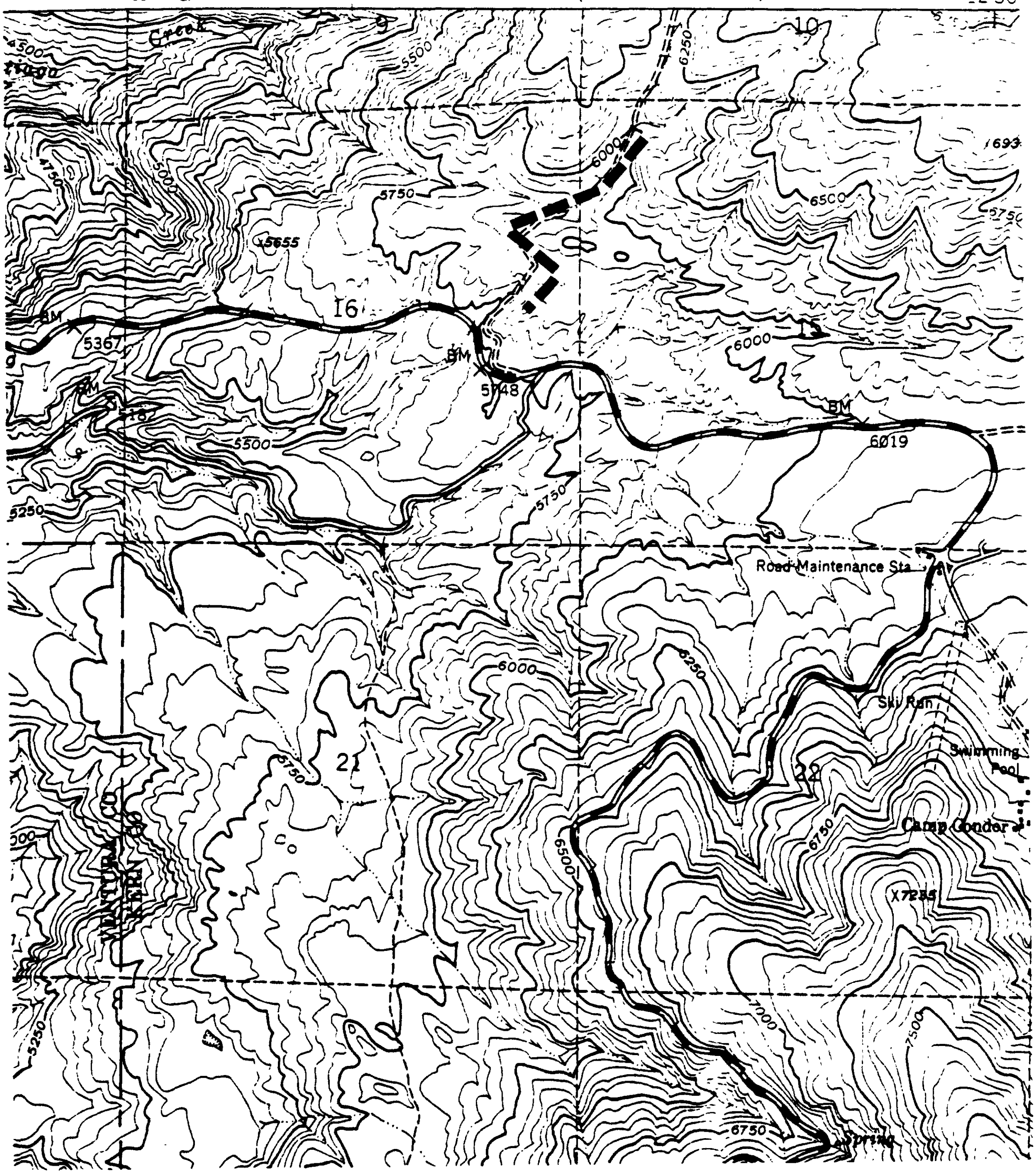
This irregular-shaped array crosses a fault-bounded pressure ridge in the San Andreas fault zone, 19 miles west of Frazier Mountain.

The character of bench mark height changes is different on each side of the San Andreas fault. Bench marks northeast of the fault are Class B rods driven into the canyon alluvium above igneous and metamorphic basement rocks, whereas bench marks southwest of the fault are also Class B rodmarks in crushed and sheared Tertiary sedimentary rocks. It is simple to say that the latter group of bench marks is not uniformly and solidly established, but it is curious that it should be nearly every other bench mark that rises or subsides relative to its neighbor. The best interpretation is that the June 1985 survey is plagued with errors, but that the 1986 and 1987 surveys are good, because they are so similar to each other, and that between those two surveys, no significant vertical displacement has occurred across the fault zone.

SAWMILL MOUNTAIN QUADRANGLE

CALIFORNIA

7.5 MINUTE SERIES (TOPOGRAPHIC)



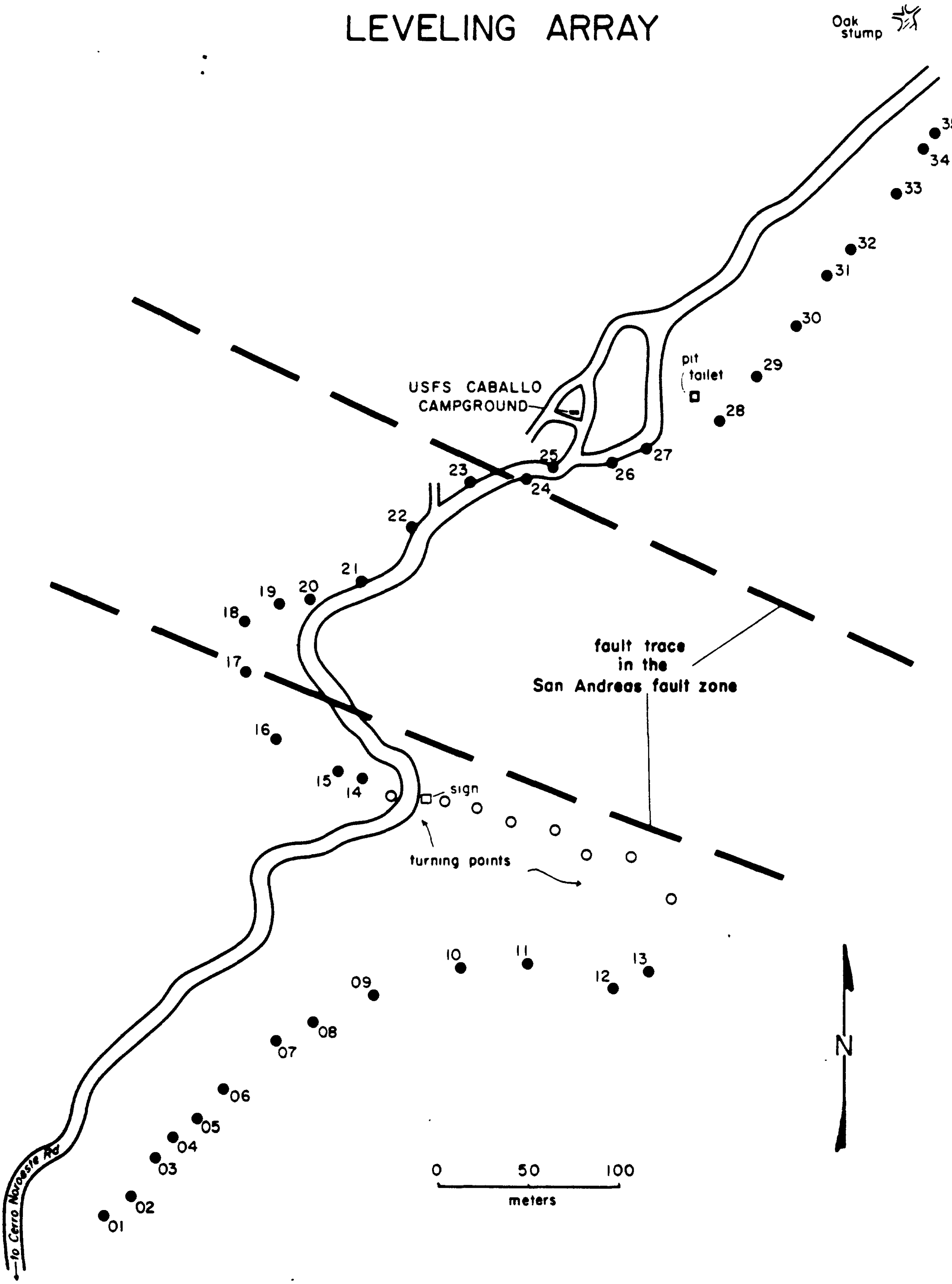
SCALE 1:24 000

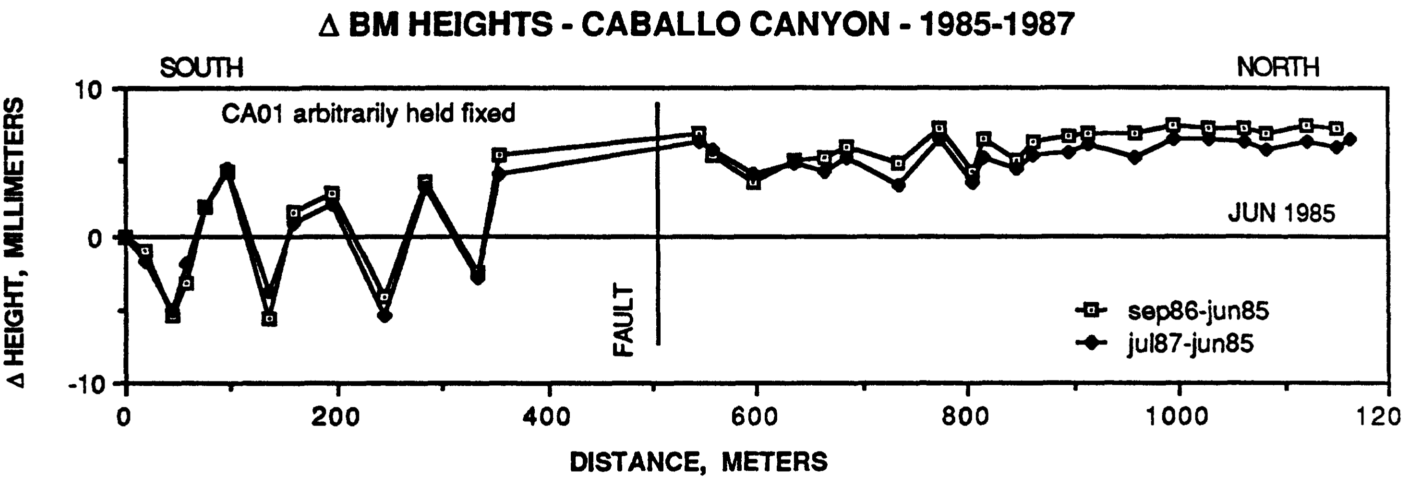
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

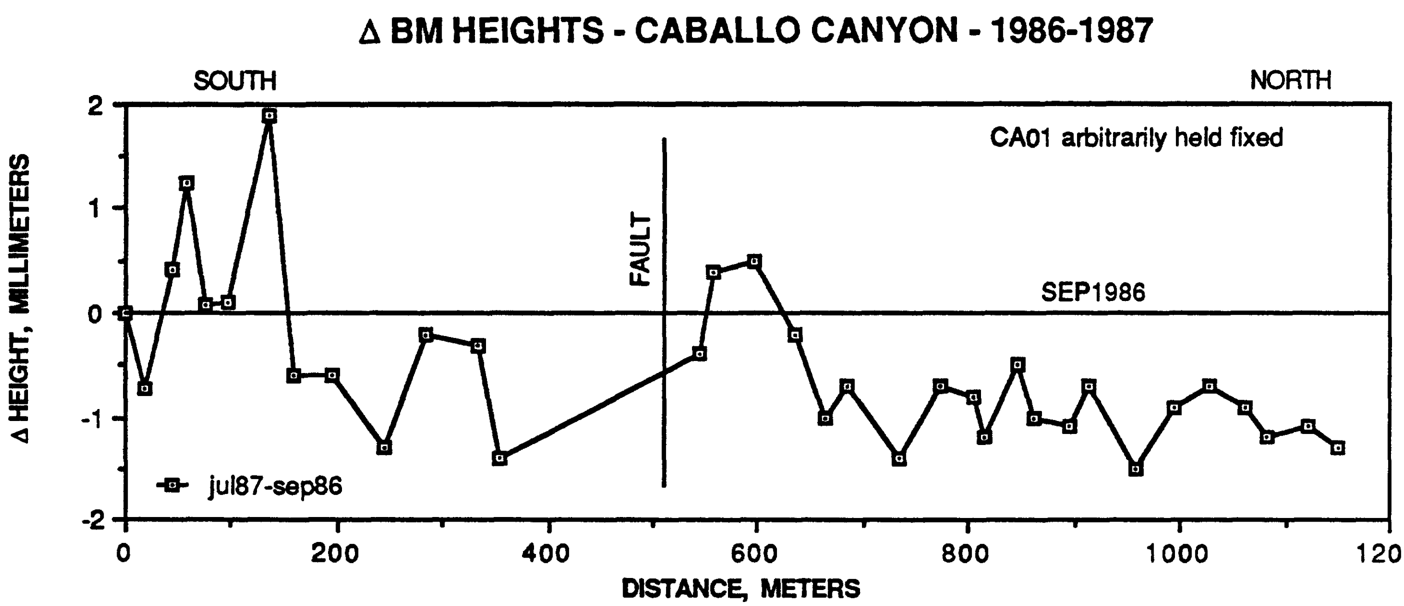
1 .5 0 1 KILOMETER

SITE MAP OF CABALLO LEVELING ARRAY

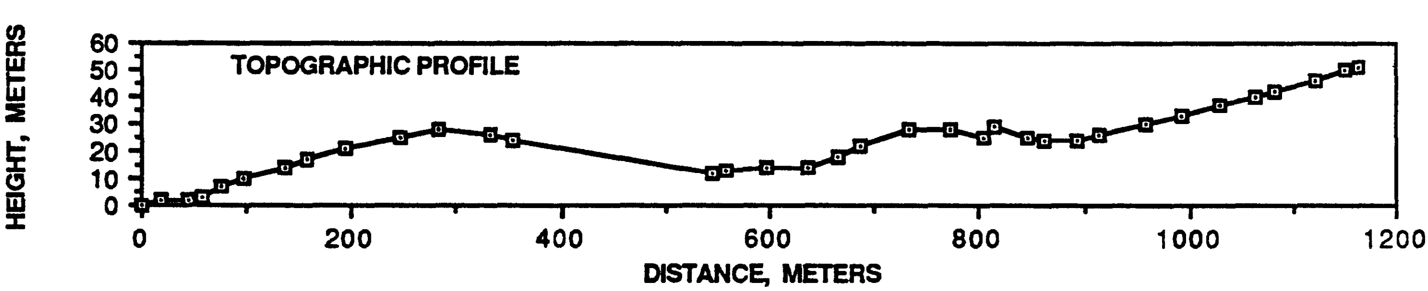




Δ BM HEIGHTS - CABALLO CANYON - 1985-1987
SOUTH
NORTH
CA01 arbitrarily held fixed
JUN 1985
FAULT
sep86-jun85
jul87-jun85
Δ HEIGHT, MILLIMETERS
DISTANCE, METERS



Δ BM HEIGHTS - CABALLO CANYON - 1986-1987
SOUTH
NORTH
CA01 arbitrarily held fixed
FAULT
SEP1986
jul87-sep86
Δ HEIGHT, MILLIMETERS
DISTANCE, METERS



TOPOGRAPHIC PROFILE
HEIGHT, METERS
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
CA01	CA02	148.865
CA02	CA03	8.048
CA03	CA04	170.079
CA04	TP01	167.492
TP01	CA05	168.233
CA05	TP02	174.555
TP02	CA06	171.597
CA06	TP03	182.920
TP03	CA07	198.940
CA07	TP04	180.854
TP04	CA08	166.123
CA08	TP05	188.435
TP05	CA09	190.937
CA09	TP06	207.905
TP06	CA10	203.740
CA10	TP07	158.184
TP07	CA11	113.075
CA11	TP08	-51.177
TP08	CA12	-136.055
CA12	CA13	-177.944
CA13	TP09	-149.309
TP09	TP10	-163.585
TP10	TP11	-191.905
TP11	TP12	-191.404
TP12	TP13	-193.694
TP13	TP14	-167.725
TP14	TP15	-191.900
TP15	TP16	-169.045
TP16	CA14	138.818
CA14	CA15	133.101
CA15	CA16	77.405
CA16	CA17	70.805
CA17	TP17	186.972
TP17	CA18	190.699
CA18	TP18	153.192
TP18	CA19	180.090
CA19	TP19	157.739
TP19	CA20	140.136
CA20	TP20	179.705
TP20	CA21	206.913
CA21	TP21	167.443
TP21	CA22	-193.455
CA22	CA23	42.126
CA23	TP22	-204.928
TP22	CA24	-175.896
CA24	CA25	-113.372
CA25	CA26	20.576
CA26	CA27	193.315
CA27	TP23	183.112
TP23	CA28	202.831

CA28	TP24	171.022
TP24	CA29	157.364
CA29	TP25	176.780
TP25	CA30	188.446
CA30	TP26	197.379
TP26	CA31	182.632
CA31	CA32	191.979
CA32	TP27	184.486
TP27	CA33	228.563
CA33	TP28	171.395
TP28	CA34	164.824
CA34	CA35	155.133

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
CA01	CA02	148.850
CA02	CA03	7.775
CA03	CA04	170.357
CA04	TP01	186.056
TP01	CA05	149.830
CA05	TP02	165.414
TP02	CA06	180.876
CA06	TP03	183.176
TP03	CA07	198.263
CA07	TP04	177.745
TP04	CA08	169.543
CA08	TP05	166.830
TP05	CA09	212.582
CA09	TP06	200.861
TP06	CA10	210.310
CA10	TP07	146.464
TP07	CA11	125.234
CA11	TP08	-52.777
TP08	CA12	-134.650
CA12	CA13	-177.724
CA13	TP09	-149.221
TP09	TP10	-163.653
TP10	TP11	-191.757
TP11	TP12	-191.434
TP12	TP13	-193.719
TP13	TP14	-167.874
TP14	TP15	-191.785
TP15	TP16	-169.002
TP16	CA14	138.743
CA14	CA15	133.046
CA15	CA16	77.343
CA16	CA17	70.933
CA17	TP17	187.446
TP17	CA18	190.098
CA18	TP18	159.387
TP18	CA19	174.010
CA19	TP19	156.512
TP19	CA20	141.348
CA20	TP20	180.167
TP20	CA21	206.348
CA21	CA22	-26.066
CA22	CA23	42.192
CA23	TP21	-200.888
TP21	CA24	-179.865
CA24	CA25	-113.409
CA25	CA26	20.610
CA26	CA27	193.462
CA27	TP22	188.914
TP22	CA28	196.841
CA28	TP23	171.974
TP23	CA29	156.501

CA29	TP24	177.848
TP24	CA30	187.373
CA30	TP25	215.991
TP25	CA31	164.027
CA31	CA32	191.894
CA32	TP26	171.539
TP26	CA33	241.550
CA33	TP27	172.654
TP27	CA34	163.513
CA34	CA35	155.204

CAMP DIX Level Line

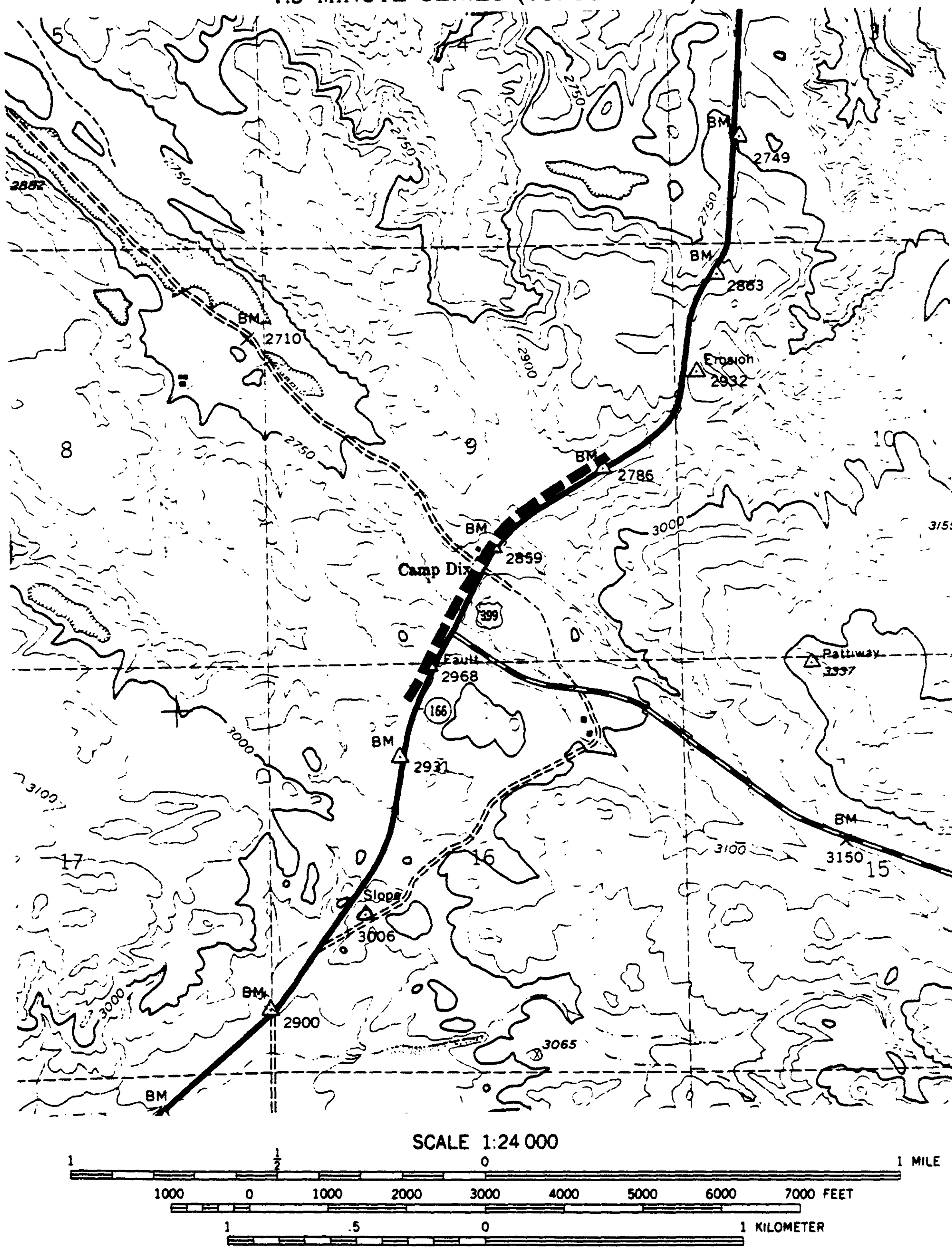
Latitude:	34°57'48"	**Length:**	1376.0m
Longitude:	119°26'41"	**Number of Bench marks:**	26
Date of Initial Survey:	20 July 1982	**Number of Surveys to 1988:**	1
Trespass Permission:	None needed.		

Comments:

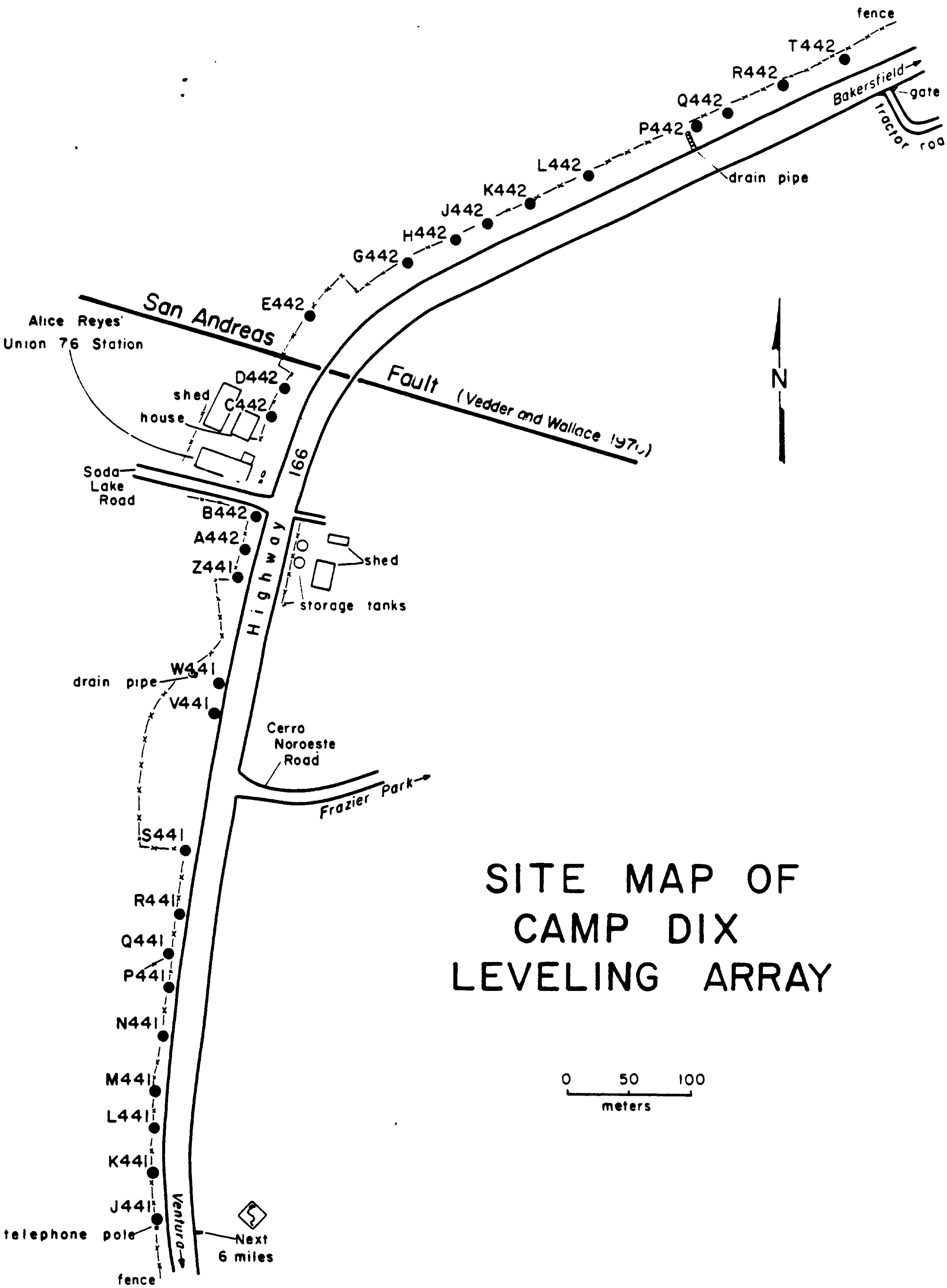
This is part of a longer line of fault-crossing bench marks established by the U.S. Coast and Geodetic Survey in 1935. UCSB has done only one survey here. Several bench marks have subsided relative to others by downslope creep. Others have been obliterated.

This is a particularly hazardous line to survey owing to the heavy truck traffic and the narrow highway shoulder.

BALLINGER CANYON QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



SCALE 1:24 000



SITE MAP OF CAMP DIX LEVELING ARRAY

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
J441	K441	135.067
K441	L441	70.582
L441	M441	-224.974
M441	TP01	124.949
TP01	N441	188.170
N441	TP02	279.841
TP02	P441	186.928
P441	Q441	-19.950
Q441	TP03	-207.741
TP03	R441	-189.874
R441	TP04	-231.940
TP04	TP05	-229.717
TP05	S441	-213.776
S441	TP06	-166.499
TP06	TP07	-189.528
TP07	TP08	-119.093
TP08	TP09	-182.047
TP09	TP10	-78.307
TP10	V441	-137.888
V441	W441	-206.105
W441	TP11	-171.939
TP11	TP12	-165.137
TP12	Z441	63.742
Z441	A442	-10.947
A442	TP13	-56.811
TP13	B442	-142.983
B442	TP14	-171.883
TP14	TP15	-194.640
TP15	TP16	-180.678
TP16	TP17	32.825
TP17	TP18	-25.725
TP18	TP19	147.141
TP19	C442	-21.423
C442	D442	-242.202
D442	TP20	-192.284
TP20	TP21	-236.757
TP21	TP22	-214.009
TP22	TP23	-240.571
TP23	E442	-115.349
E442	TP24	115.344
TP24	TP25	200.719
TP25	TP26	-134.739
TP26	TP27	220.813
TP27	G442	169.976
G442	TP28	-207.673
TP28	TP29	-149.797
TP29	TP30	-126.541
TP30	H442	-108.559

H442	TP31	-157.617
TP31	J442	-139.482
J442	K442	-151.340
K442	TP32	-221.619
TP32	TP33	-209.833
TP33	TP34	-201.913
TP34	TP35	-217.878
TP35	L442	-58.044
L442	TP36	-147.169
TP36	TP37	-237.716
TP37	P442	62.442
P442	Q442	121.875
Q442	TP38	172.055
TP38	R442	179.304
R442	TP39	78.735
TP39	T442	197.350

CAMERON Leveling Array

Latitude:	35°05'37"	**Length:**	738.5m
Longitude:	118°18'16"	**Number of Bench marks:**	24
Date of Initial Survey:	13 August 1985	**Number of Surveys to 1988:**	3

Trespass Permission: Permission and proof of liability insurance required by the landowner:

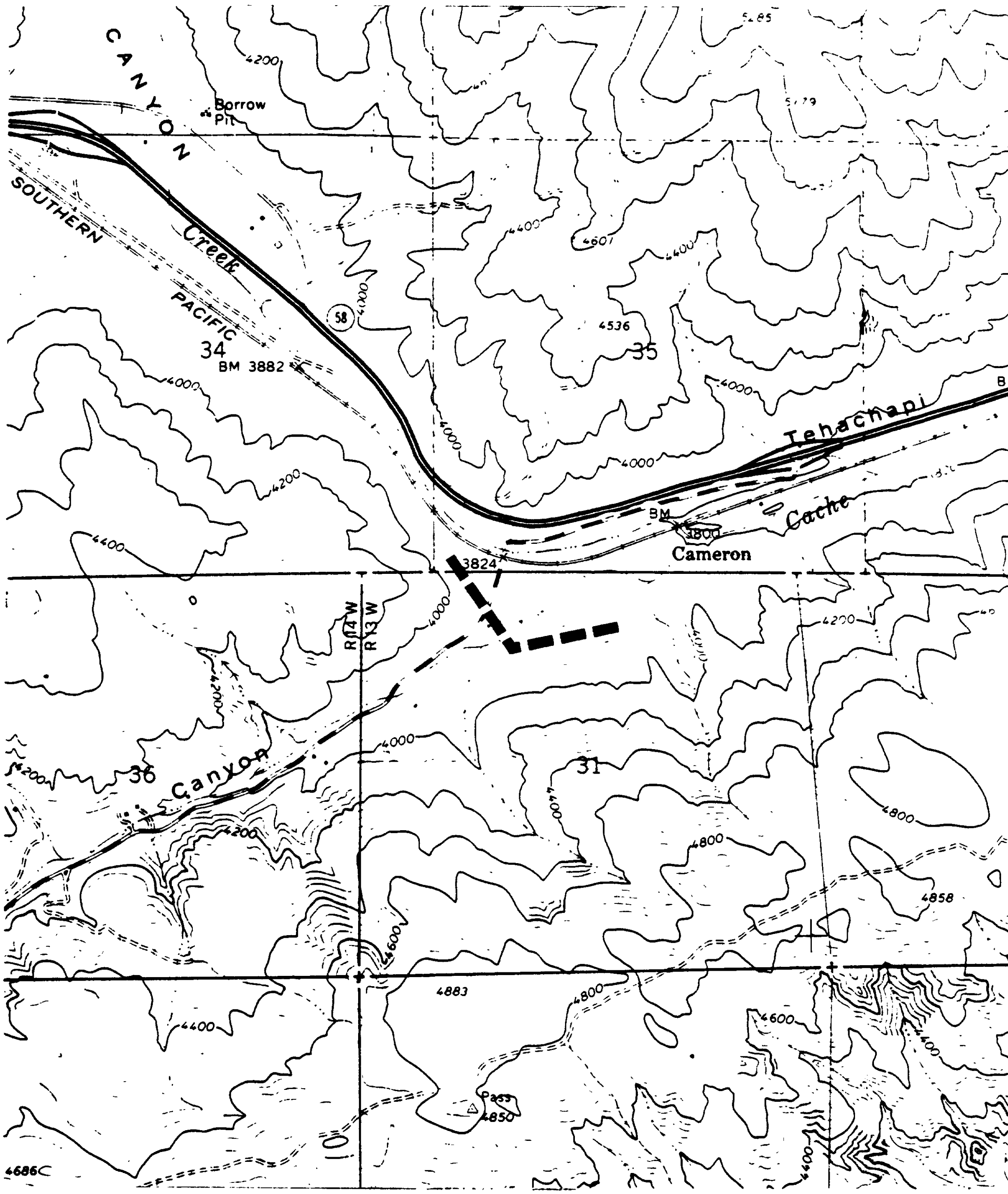
Mr. John Wuerth
P.O. Box 2596
Oak Bluff, MA 02557

Comments:

This is an L-shaped array across the Garlock fault near the Cameron railway siding, four miles ESE of the town of Monolith.

Bench mark height changes from 1986 to 1985 are insignificant relative to the allowable closure error. Bench mark CM10 may be unstable.

MONOLITH QUADRANGLE
CALIFORNIA–KERN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



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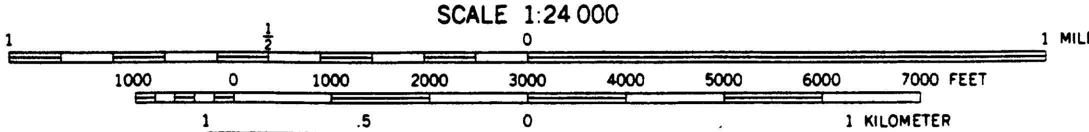
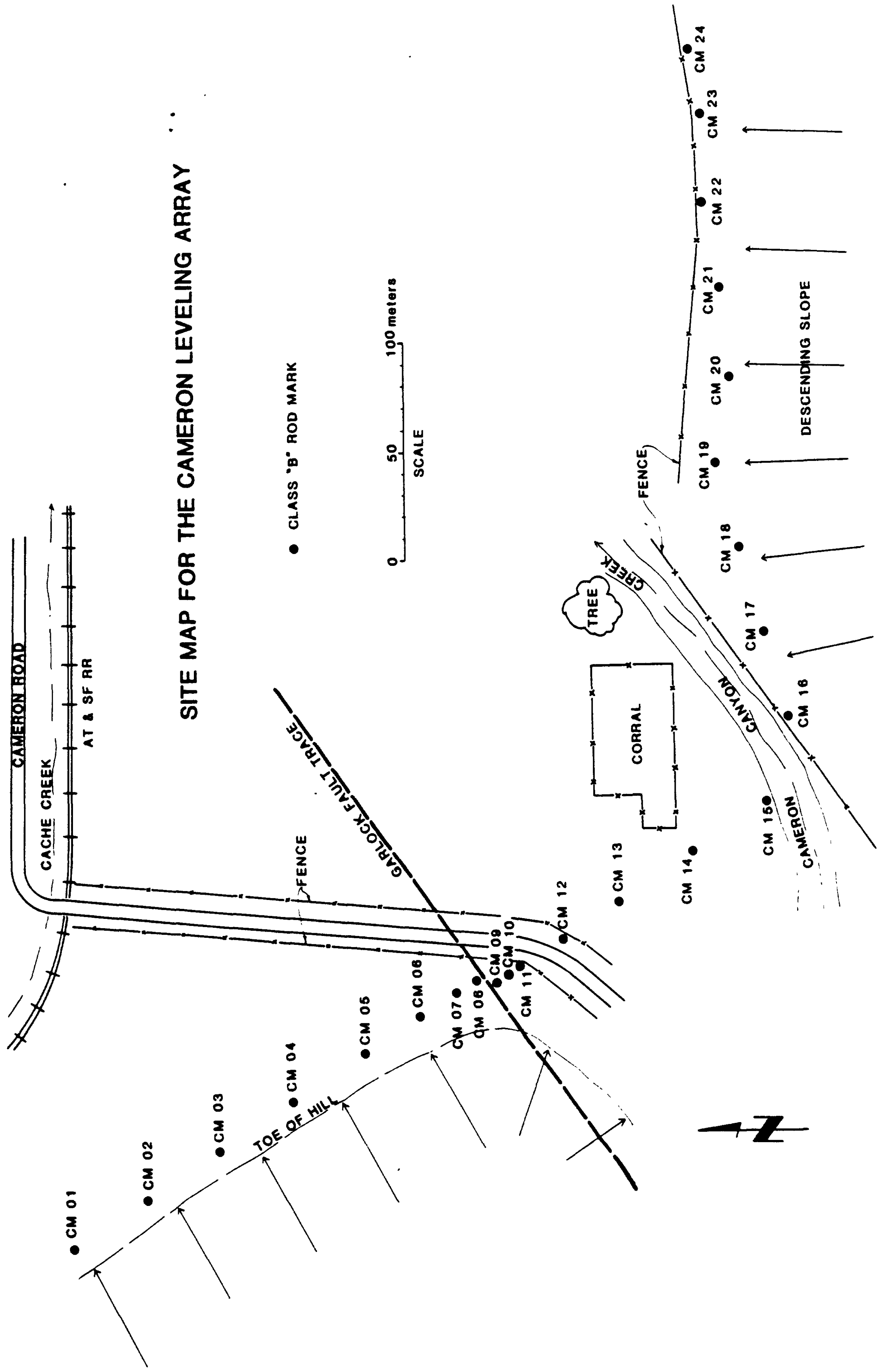
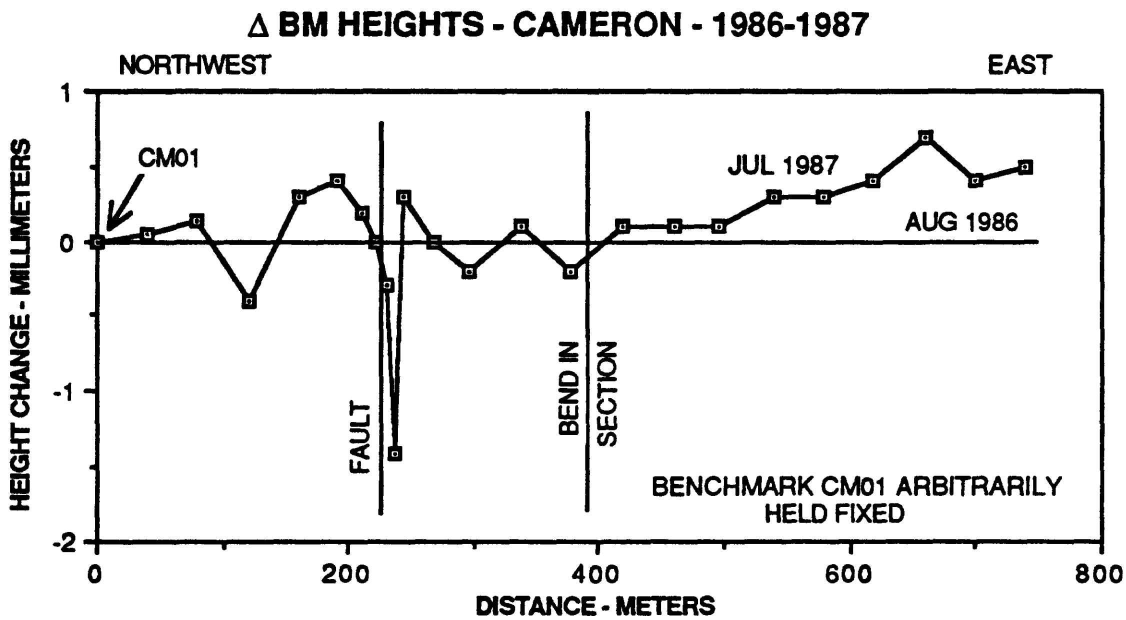
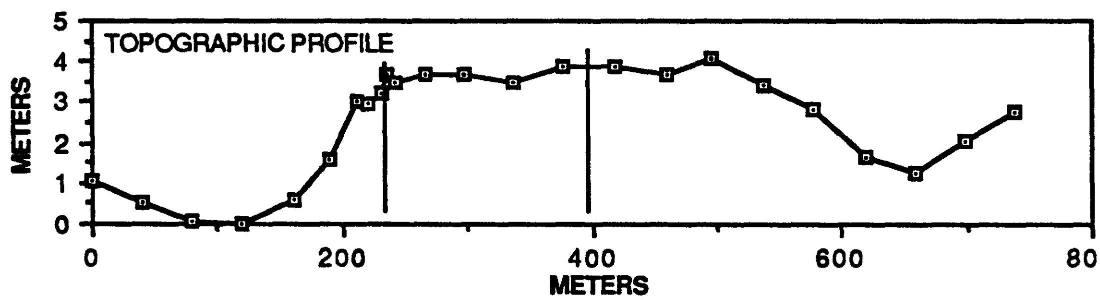



SITE MAP FOR THE CAMERON LEVELING ARRAY
CLASS "B" ROD MARK
0 50 100 meters
SCALE
CAMERON ROAD
CACHE CREEK
AT & SF RR
FENCE
GARLOCK FAULT TRACE
TOE OF HILL
CM 01
CM 02
CM 03
CM 04
CM 05
CM 06
CM 07
CM 08
CM 09
CM 10
CM 11
CM 12
CM 13
CM 14
CM 15
CM 16
CM 17
CM 18
CM 19
CM 20
CM 21
CM 22
CM 23
CM 24
CORRAL
TREE
CAMERON CANYON CREEK
FENCE
DESCENDING SLOPE
N
dak 1985


Δ BM HEIGHTS - CAMERON - 1986-1987
NORTHWEST
EAST
CM01
JUL 1987
AUG 1986
FAULT
BEND IN SECTION
BENCHMARK CM01 ARBITRARILY HELD FIXED
HEIGHT CHANGE - MILLIMETERS
1
0
-1
-2
0
200
400
600
800
DISTANCE - METERS


TOPOGRAPHIC PROFILE
METERS
5
4
3
2
1
0
0
200
400
600
80(
METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
CM01	CM02	-53.151
CM02	CM03	-45.745
CM03	CM04	-8.014
CM04	CM05	58.069
CM05	CM06	96.823
CM06	CM07	149.514
CM07	CM08	-11.256
CM08	CM09	29.004
CM09	CM10	48.087
CM10	CM11	-25.642
CM11	CM12	25.656
CM12	CM13	-3.197
CM13	CM14	-19.582
CM14	CM15	40.844
CM15	CM16	1.460
CM16	CM17	-20.021
CM17	CM18	38.144
CM18	CM19	-69.556
CM19	CM20	-57.339
CM20	CM21	-116.770
CM21	CM22	-38.121
CM22	CM23	74.330
CM23	CM24	76.030

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
CM01	CM02	-53.129
CM02	CM03	-45.745
CM03	CM04	-8.946
CM04	CM05	59.016
CM05	CM06	96.811
CM06	CM07	149.492
CM07	CM08	-11.264
CM08	CM09	28.945
CM09	CM10	47.964
CM10	CM11	-25.475
CM11	CM12	25.618
CM12	CM13	-3.231
CM13	CM14	-19.565
CM14	CM15	40.822
CM15	CM16	1.498
CM16	CM17	-20.023
CM17	CM18	38.147
CM18	CM19	-69.564
CM19	CM20	-57.315
CM20	CM21	-116.767
CM21	CM22	-38.091
CM22	CM23	74.326
CM23	CM24	76.033

CAR HILL Level Line

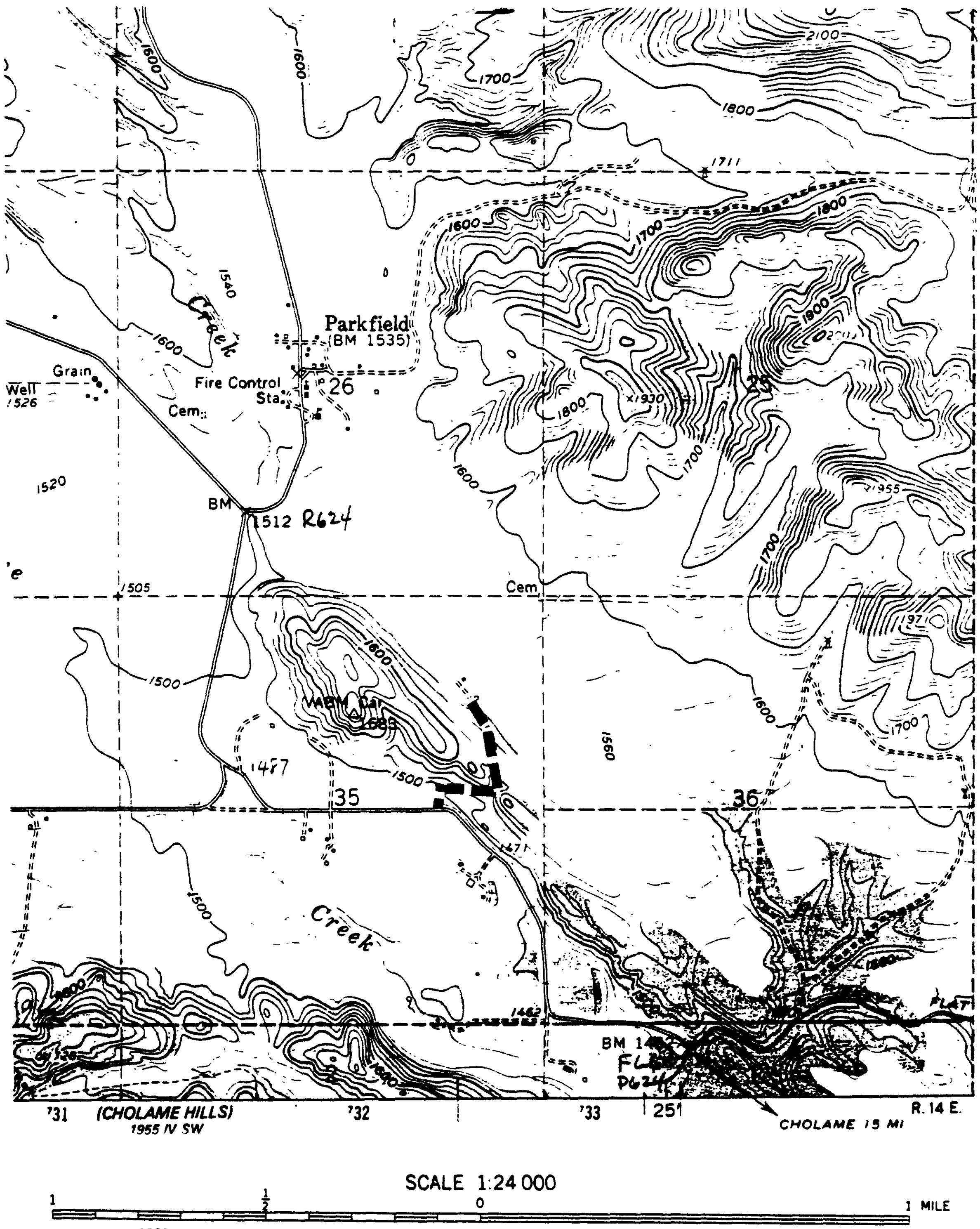
Latitude:	35°53'05"	**Length:**	751.9m
Longitude:	120°25'31"	**Number of Bench marks:**	8
Date of Initial Survey:	23 August 1987	**Number of Surveys to 1988:**	1
Trespass Permission:	It is best to notify the U.S. Geological Survey in advance because much of the line is on private property behind a locked gate.		

Comments:

This leveling array was established by John Estrem of the U.S. Geological Survey across the San Andreas fault at Car Hill, three-fourths of a mile SSE of Parkfield.

It has been surveyed only once.

PARKFIELD QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW 4 PARKFIELD 15' QUADRANGLE



******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
Y1390	TP01	141.625
TP01	TP02	185.112
TP02	TP03	151.076
TP03	TP04	184.411
TP04	TP05	123.489
TP05	TP06	155.193
TP06	TP07	189.624
TP07	KH1	39.167
KH1	TP08	202.791
TP08	TP09	189.259
TP09	TP10	131.041
TP10	KH2	160.409
KH2	TP11	189.758
TP11	TP12	178.954
TP12	KH3	121.372
KH3	TP13	122.155
TP13	TP14	179.019
TP14	KH4	184.615
KH4	TP15	30.962
TP15	KH5	-79.813
KH5	TP16	-119.821
TP16	TP17	-120.080
TP17	KH6	-147.137
KH6	TP18	-179.248
TP18	TP19	-136.796
TP19	TP20	-145.259
TP20	TP21	-131.530
TP21	TP22	-126.680
TP22	TP23	-99.134
TP23	TP24	-34.473
TP24	TP25	16.286
TP25	TP26	-112.009
TP26	KH7	-73.533

COOK ST. Level Line

Latitude: 34°25'06" **Length:** 292.0 m

Longitude: 119°43'00" **Number of Bench marks:** 8

Date of Initial Survey: 2 February 1972 **Number of Surveys to 1988:** 11

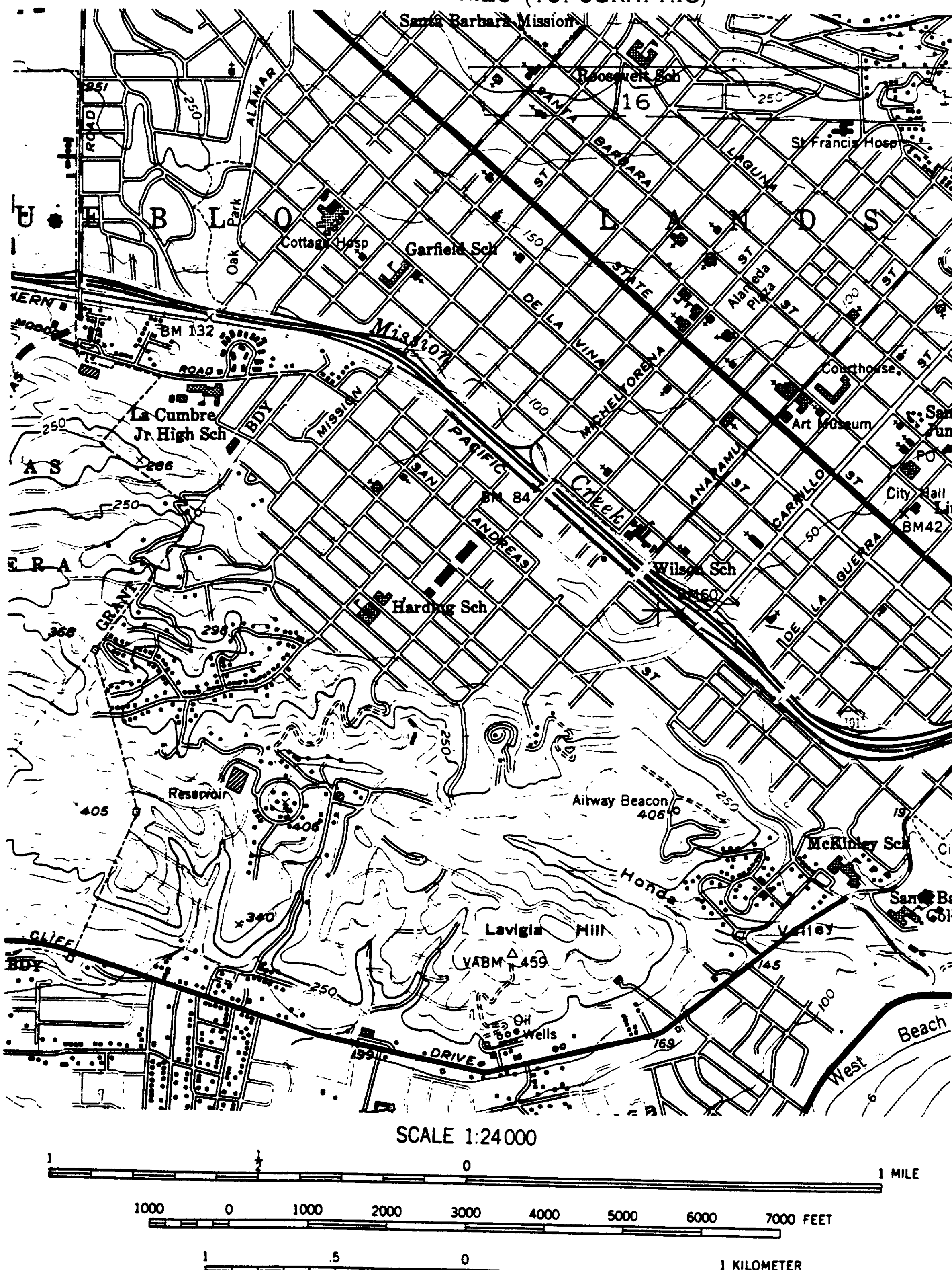
Trespass Permission: Permit required from the Department of Public Works, City of Santa Barbara.

Comments:

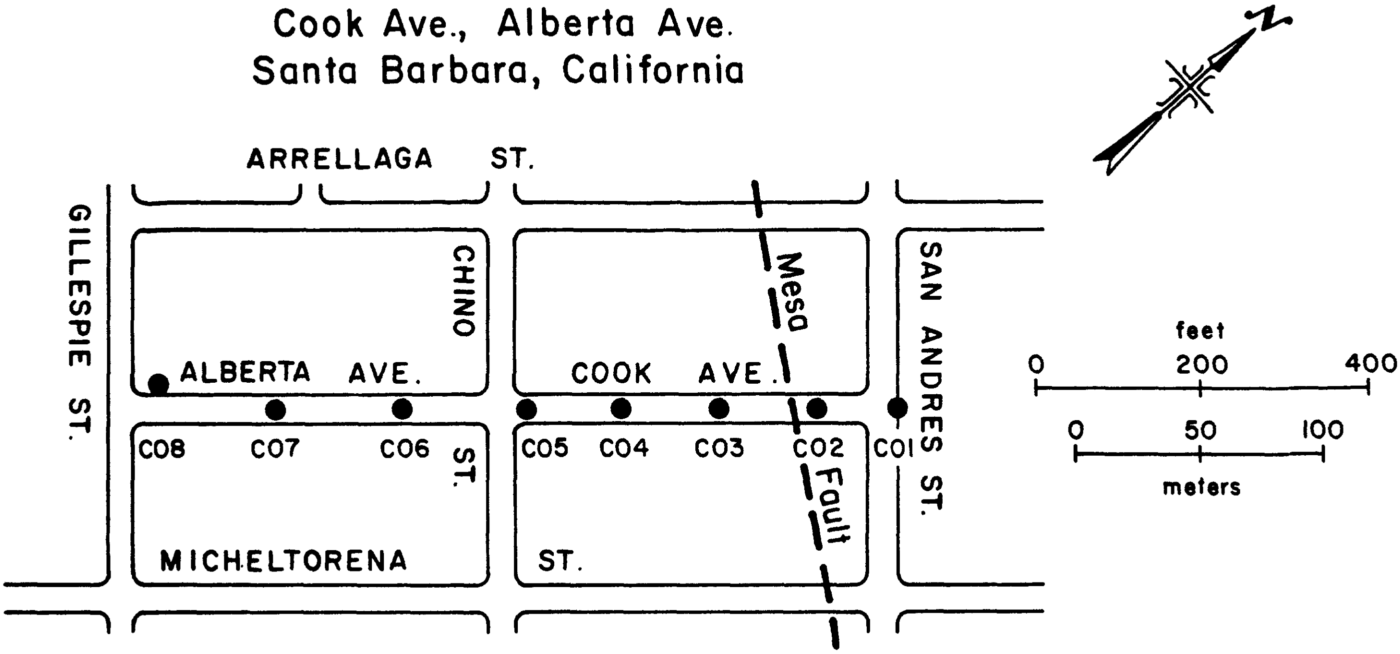
This is a short line that crosses a low hill and the Mesa fault. It was thought that the low hill may be a pressure ridge along the fault, and the purpose of the array is to determine if the hill is rising. The fault was exposed in a construction trench in 1975 about 30 m southwest of the intersection of Cook and San Andres streets. Bench marks C02 and C07 are PK nails driven into the asphalt street.

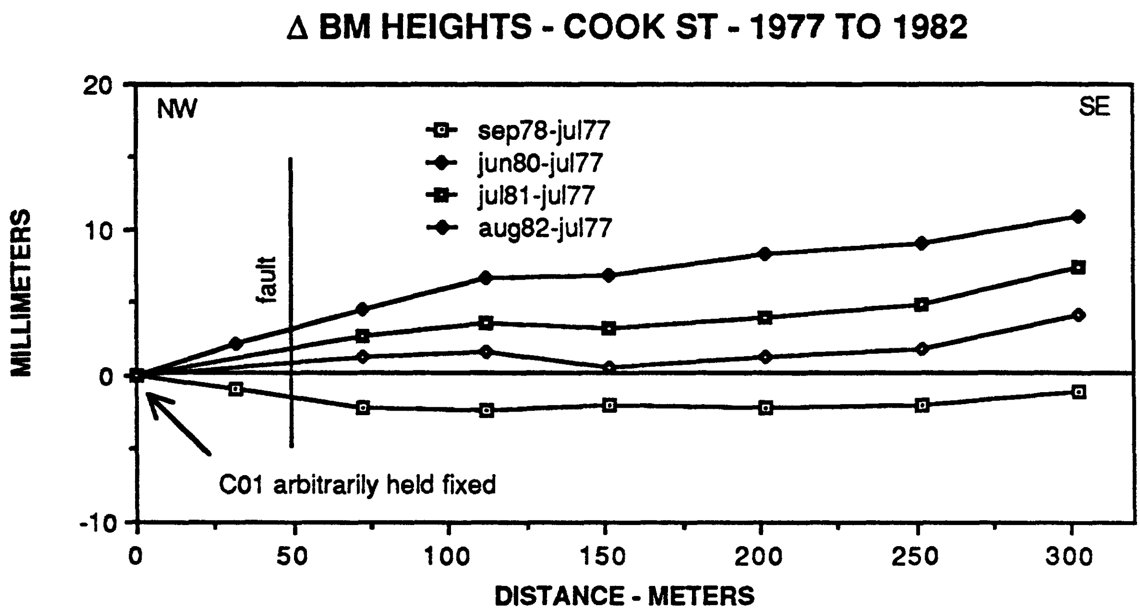
Five levelings in the period 1977-1982 are compared in an accompanying figure. They show fairly substantial height changes relatively to a bench mark in a curb, but the earliest and most recent surveys show little difference, and suggest that the hill is not growing, and the fault has no vertical movement associated with it. The fluctuations from year to year may be blamed on the inadequacy of bench marks in curbs for precision geodesy.

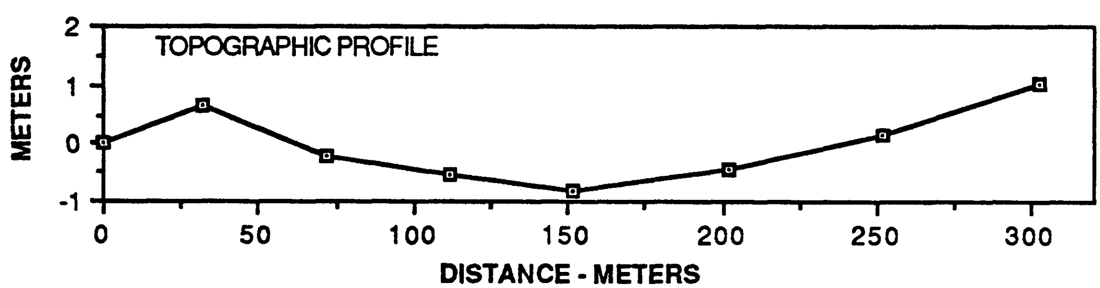
SANTA BARBARA QUADRANGLE
CALIFORNIA—SANTA BARBARA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



Cook Ave., Alberta Ave.
Santa Barbara, California




Δ BM HEIGHTS - COOK ST - 1977 TO 1982
NW
SE
sep78-jul77
jun80-jul77
jul81-jul77
aug82-jul77
fault
C01 arbitrarily held fixed
MILLIMETERS
DISTANCE - METERS
20
10
0
-10
0
50
100
150
200
250
300


TOPOGRAPHIC PROFILE
METERS
DISTANCE - METERS
2
1
0
-1
0
50
100
150
200
250
300

SANTA BARBARA, CALIFORNIA COOK STREET FEBRUARY 2, 1972

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
C001	C002	66.0038
C002	C003	-88.7950
C003	C004	-33.2673
C004	C005	-26.5238
C005	C006	36.8740
C006	C007	60.2688
C007	C008	88.3555

SANTA BARBARA, CALIFORNIA COOK STREET AUGUST 30, 1982

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
C001	TP01	72.8152
TP01	C003	-95.6222
C003	C004	-32.5470
C004	C005	-27.1938
C005	C006	37.4478
C006	C007	60.3992
C007	C008	88.6910

DURAVAN Leveling Array

Latitude:	35°17'05"	**Length:**	766.0m
Longitude:	117°53'25"	**Number of Bench marks:**	23
Date of Initial Survey:	25 September 1974	**Number of Surveys to 1988:**	13

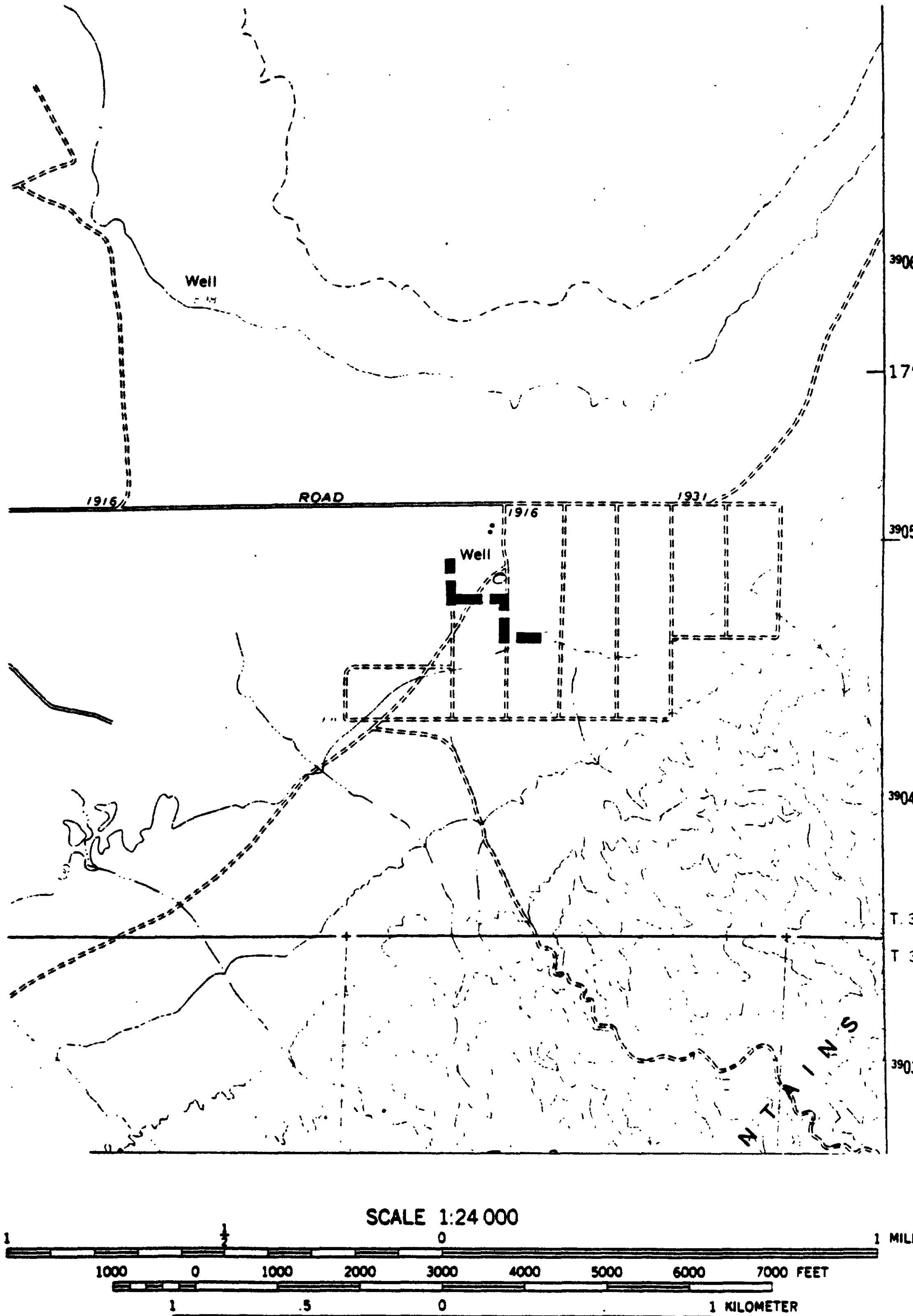
Trespass Permission: None required, however, it is best to access the array by a road along the east side of Duravan Ranch rather than through the ranch itself. Beware of desert tortoises and rattlesnakes.

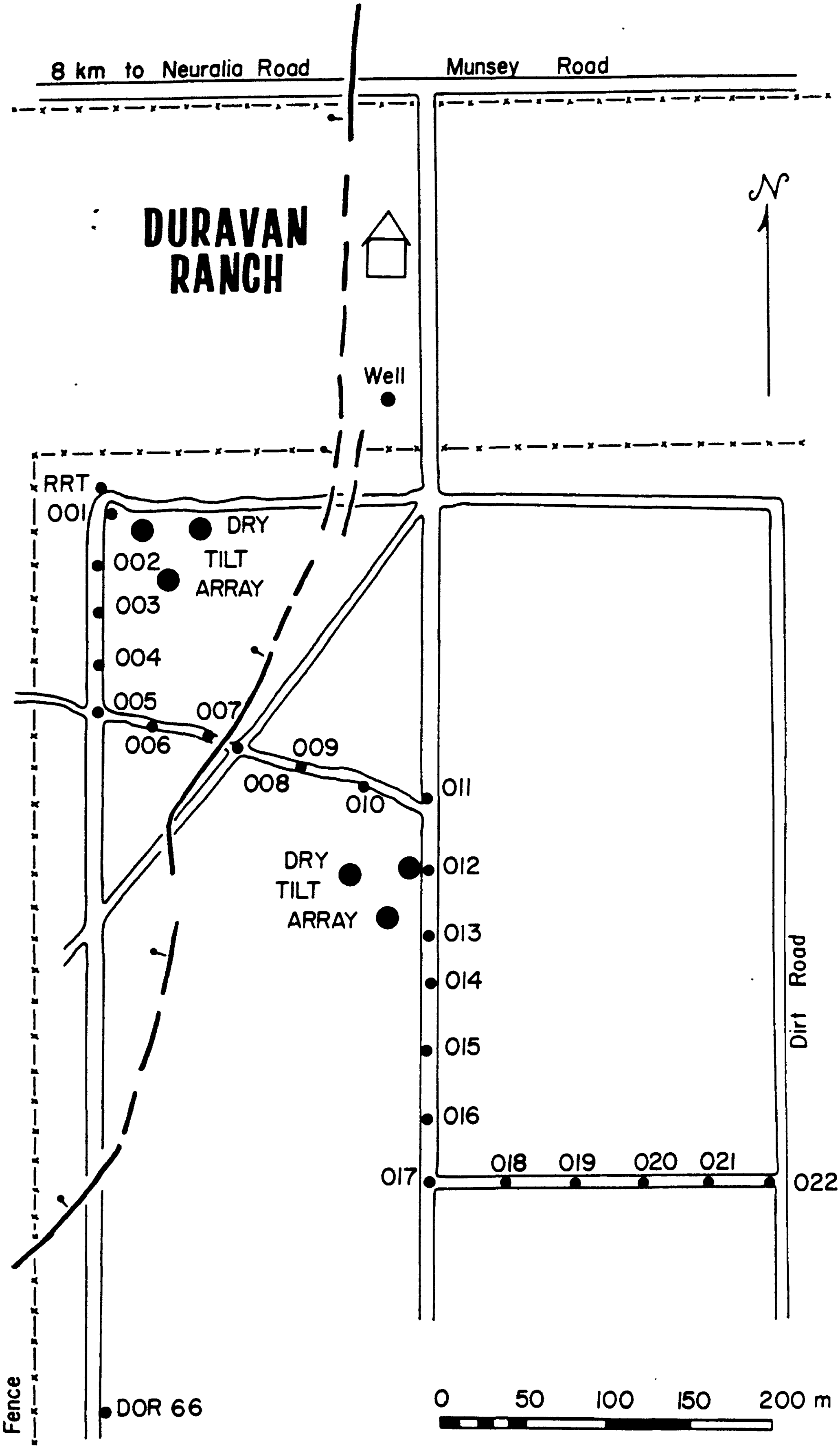
Comments:

This W-shaped array was established across one of the main active scarps related to subsidence caused by ground water withdrawal on the floor of Fremont Valley, Mojave Desert. It is located 5 miles east of Cantil.

From 1974 to 1983 vertical displacement across the fault exceeded 300mm and proceeded episodically at an annual rate of 38 mm/yr.

CANTIL QUADRANGLE
CALIFORNIA – KERN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)




8 km to Neuralia Road
Munsey Road
DURAVAN RANCH
N
Well
RRT
001
DRY TILT ARRAY
002
003
004
005
006
007
008
009
010
011
DRY TILT ARRAY
012
013
014
015
016
017
018
019
020
021
022
Dirt Road
Fence
DOR 66
0 50 100 150 200 m

Δ HEIGHT - DURAVAN 1974-1983

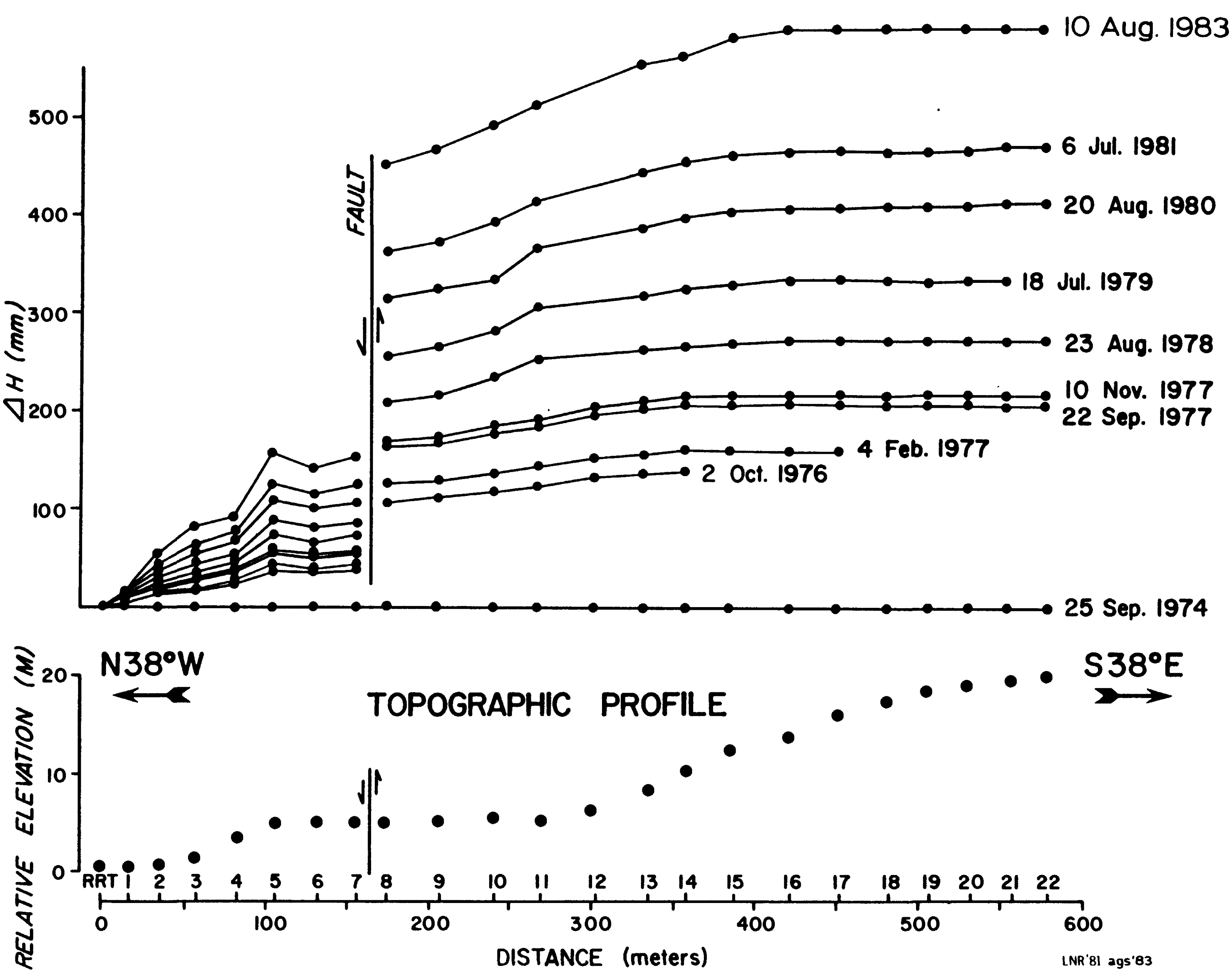


Fig. 11

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
RRT	001	-4.692
001	002	130.608
002	003	156.443
003	004	152.810
004	005	122.090
005	006	-13.460
006	007	27.666
007	008	60.497
008	009	-24.959
009	010	29.339
010	011	-28.836
011	012	172.939
012	013	224.382
013	014	172.445
014	015	167.696
015	016	158.031
016	017	205.060
017	018	124.043
018	019	51.905
019	020	61.072
020	021	31.198
021	022	50.837

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
RRT	001	6.608
001	002	125.486
002	003	158.121
003	004	153.987
004	005	132.192
005	006	-0.112
006	007	5.047
007	008	104.773
008	009	-22.371
009	010	14.796
010	011	-29.621
011	012	181.987
012	013	219.373
013	014	172.630
014	015	168.939
015	016	159.006
016	017	205.224
017	018	123.920
018	019	51.900
019	020	61.124
020	021	31.358
021	022	50.927

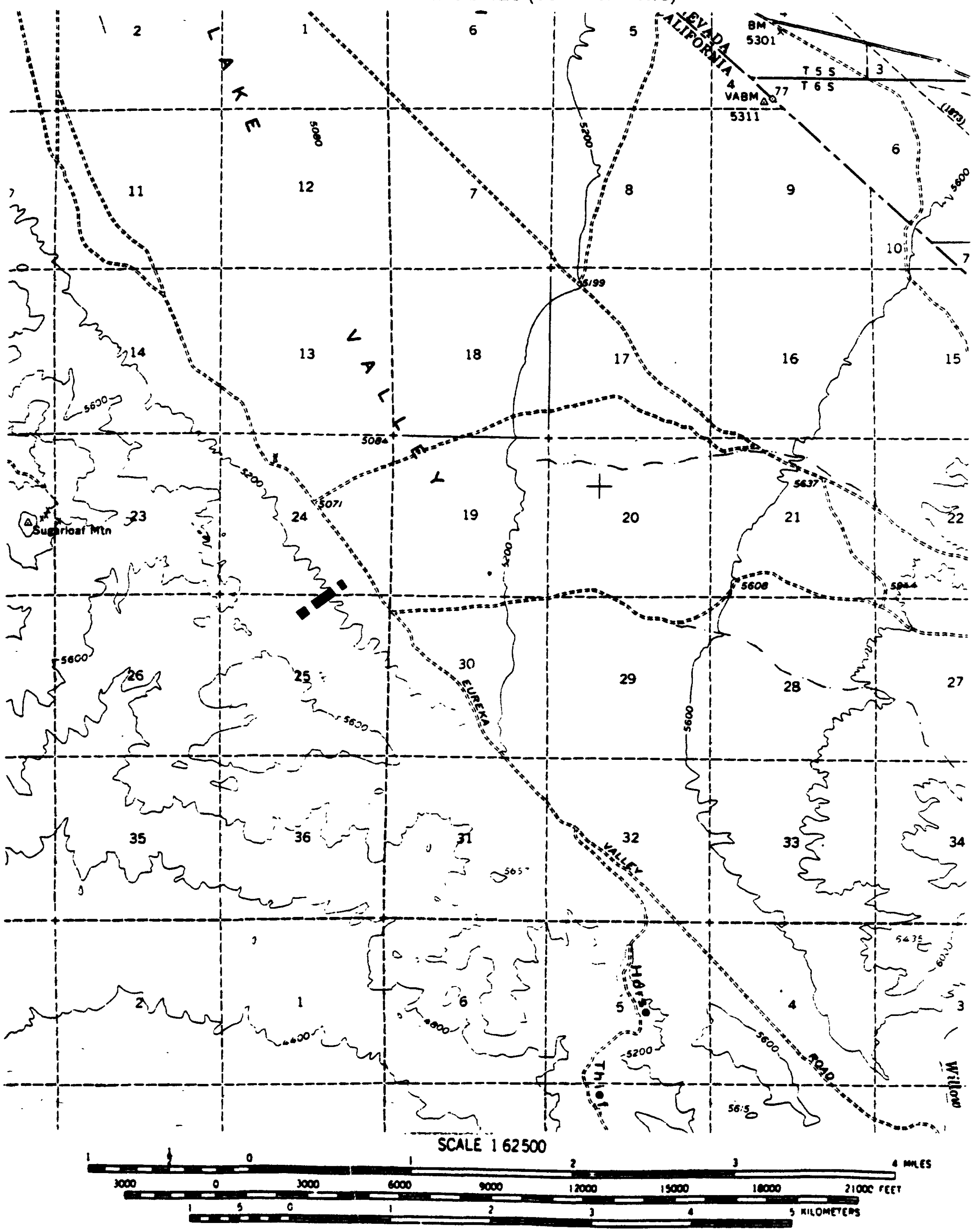
FISH LAKE VALLEY Level Line

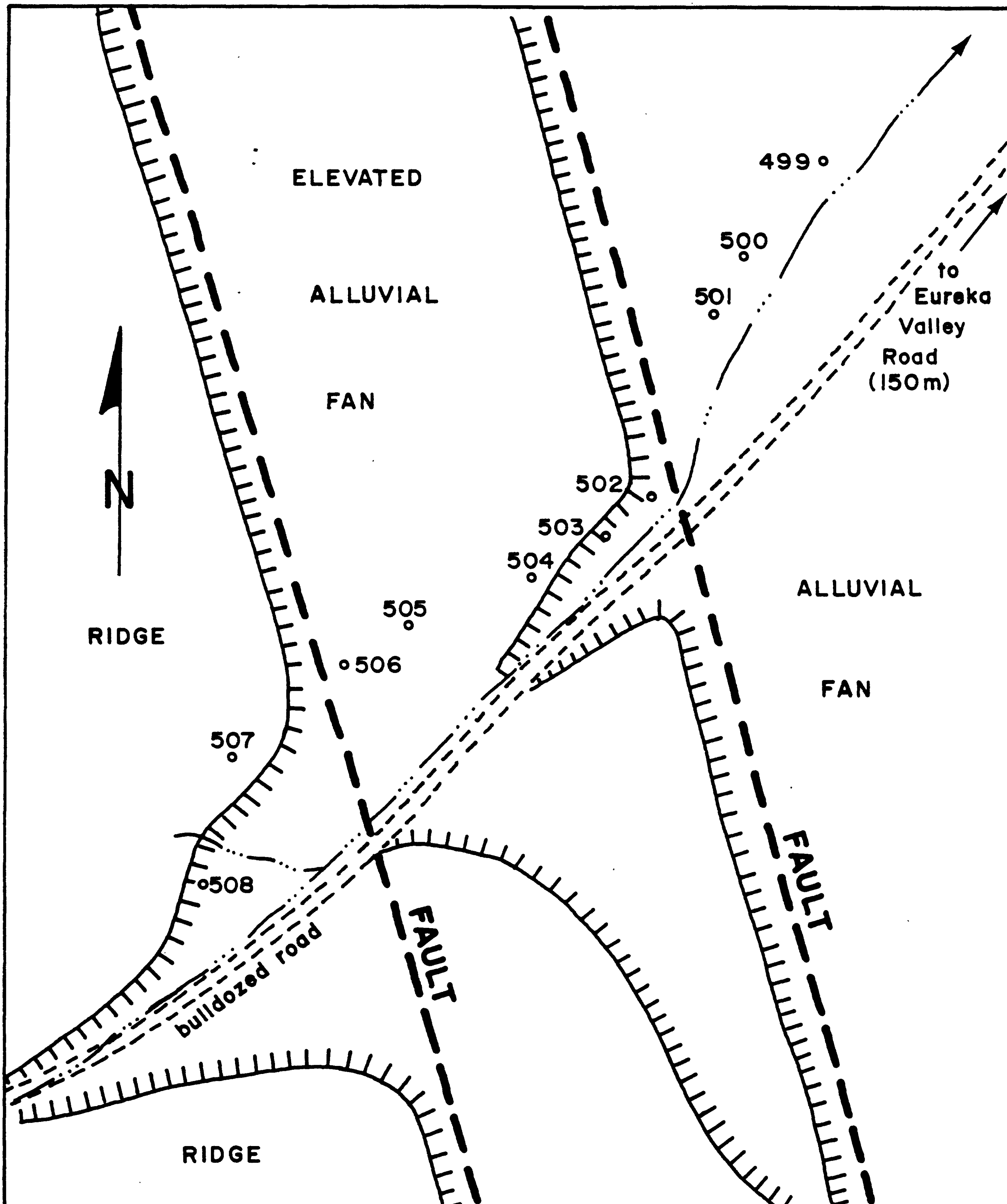
Latitude:	37°24'28"	**Length:**	275.0m
Longitude:	117°51'47"	**Number of Bench marks:**	10
Date of Initial Survey:	30 September 1971	**Number of Surveys to 1988:**	7
Trespass Permission:	None needed		

Comments:

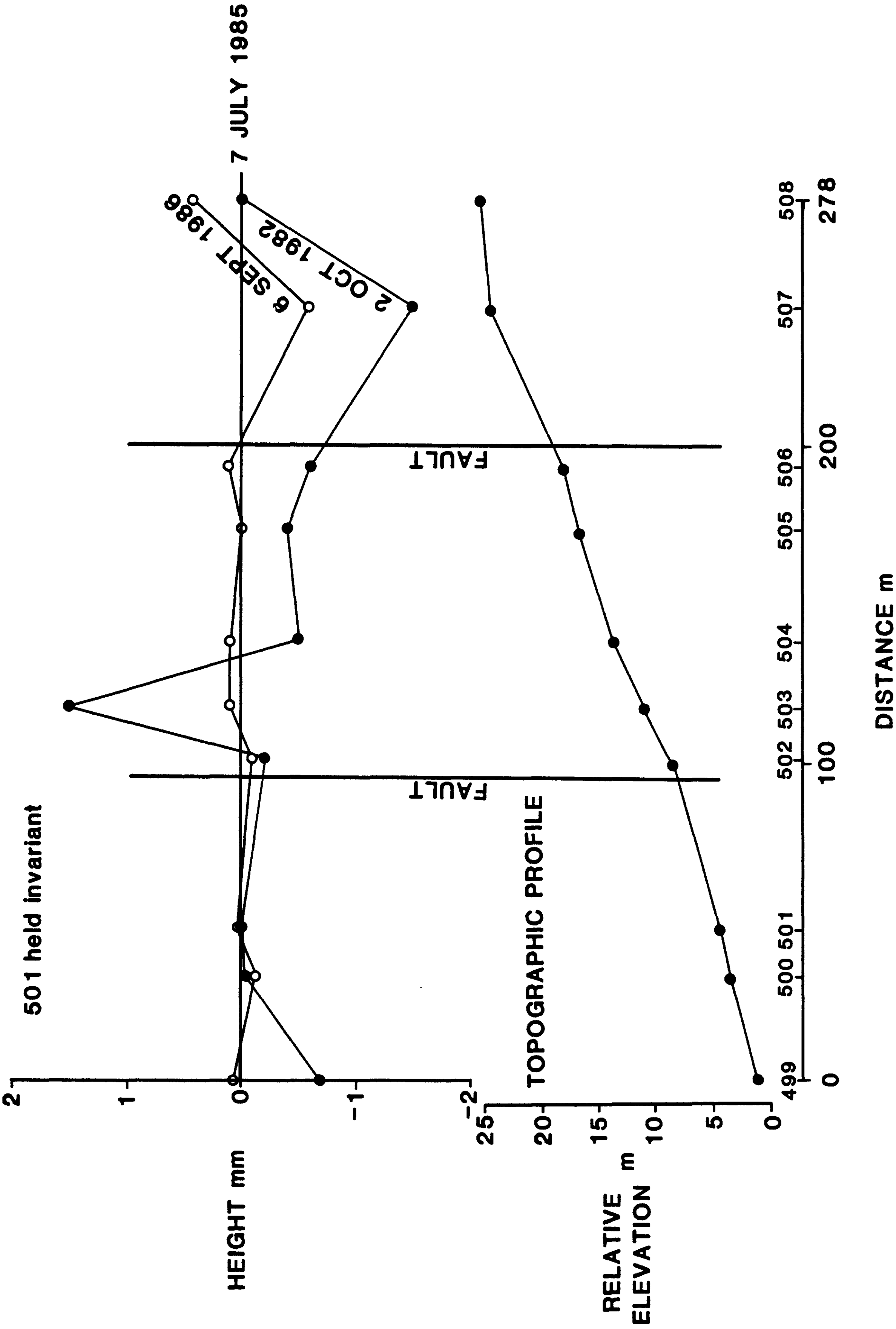
This line crosses the Furnace Creek fault on the west side of Fish Lake Valley, 4 miles SSW of the Esmeralda, Mono, and Inyo counties intersection. The line has been surveyed several times following earthquakes in the Bishop and Mammoth areas to determine if those earthquakes triggered vertical displacement on the Furnace Creek fault. The most recent surveys are plotted in an accompanying diagram and show such small variations of bench mark heights, that one may conclude the recent earthquakes had no vertical effects on the fault.

SOLDIER PASS QUADRANGLE
CALIFORNIA–NEVADA
15 MINUTE SERIES (TOPOGRAPHIC)





Fish Lake Valley



501 held invariant
HEIGHT mm
2
1
0
-1
-2
7 JULY 1985
6 SEPT 1986
2 OCT 1982
FAULT
FAULT
TOPOGRAPHIC PROFILE
RELATIVE ELEVATION m
25
20
15
10
5
0
499
500
501
502
503
504
505
506
507
508
0
100
200
278
DISTANCE m

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
499	500	236.880
500	501	112.238
501	TP1	120.440
TP1	TP2	120.977
TP2	502	168.899
502	503	214.041
503	504	285.803
504	TP2A	119.467
TP2A	505	173.620
505	506	152.083
506	TP3	240.105
TP3	TP4	210.528
TP4	507	190.552
507	508	42.246

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
499	500	236.706
500	501	112.282
501	TP01	117.166
TP01	TP02	123.515
TP02	502	169.633
502	503	213.691
503	504	286.158
504	TP2A	193.110
TP2A	505	99.997
505	506	152.089
506	TP03	241.611
TP03	TP04	209.604
TP04	507	190.038
507	508	42.152

FLENGE FLAT Leveling Array

Latitude:	35°55'55"	**Length:**	1039.4m
Longitude:	120°31'18"	**Number of Bench marks:**	19
Date of Initial Survey:	26 June 1984 (UCSB)	**Number of Surveys to 1988:**	4
Trespass Permission:	None needed		

Comments:

The L-shaped array was established by the U.S. Geological Survey as a tilt array on the southwest side of the San Andreas fault northwest of Parkfield.

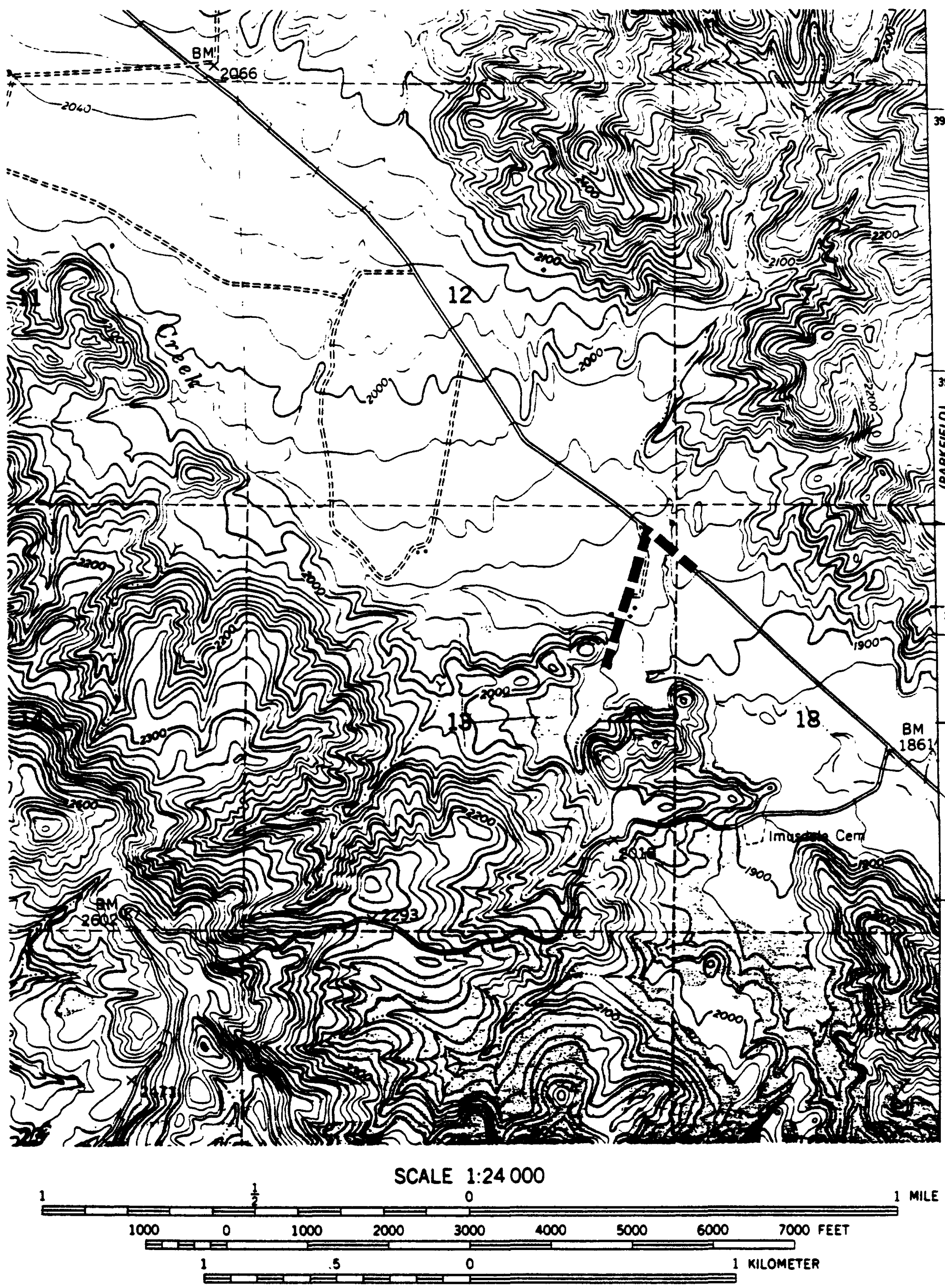
From 1984 to 1987, bench mark heights have varied as much as one millimeter, but the entire array has shown no overall tilit greater than one microradian.

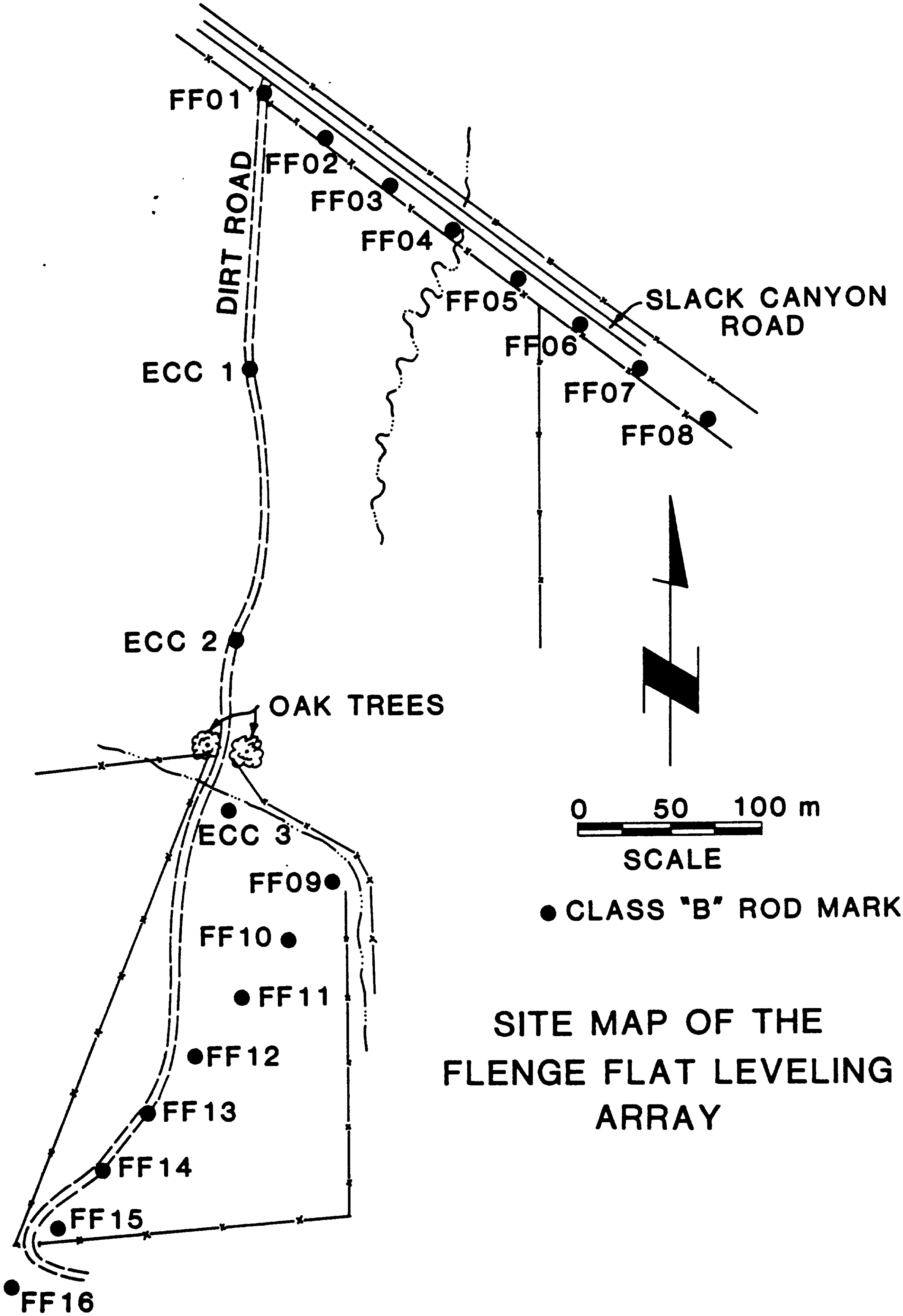
STOCKDALE MOUNTAIN QUADRANGLE

CALIFORNIA-MONTEREY CO.

7.5 MINUTE SERIES (TOPOGRAPHIC)

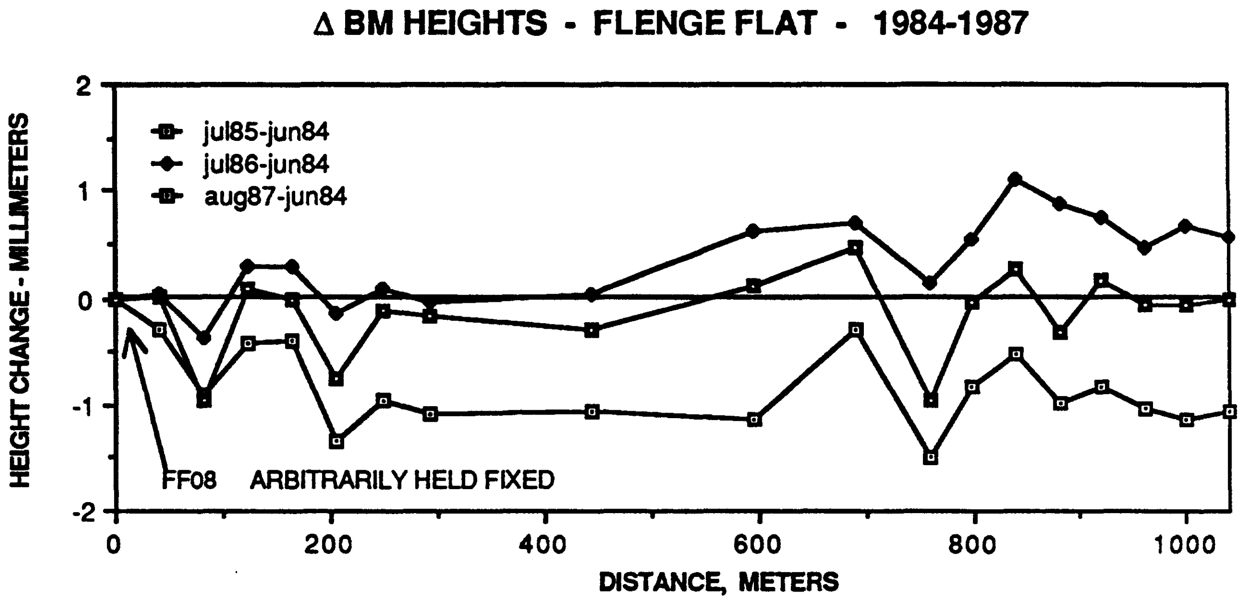
NE/4 SAN MIGUEL 15' QUADRANGLE

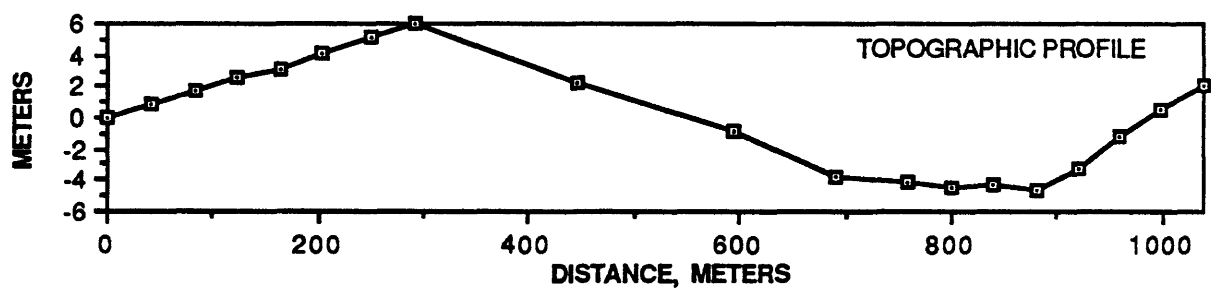




SITE MAP OF THE
FLENGE FLAT LEVELING
ARRAY

DAK '86


Δ BM HEIGHTS - FLENGE FLAT - 1984-1987
jul85-jun84
jul86-jun84
aug87-jun84
FF08 ARBITRARILY HELD FIXED
HEIGHT CHANGE - MILLIMETERS
DISTANCE, METERS
2
1
0
-1
-2
0
200
400
600
800
1000


TOPOGRAPHIC PROFILE
METERS
DISTANCE, METERS
6
4
2
0
-2
-4
-6
0
200
400
600
800
1000

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
FF08	FF07	91.603
FF07	FF06	85.564
FF06	FF05	86.780
FF05	FF04	46.327
FF04	FF03	97.435
FF03	FF02	109.845
FF02	FF01	81.021
FF01	TP01	-91.929
TP01	TP02	-77.843
TP02	TP03	-95.507
TP03	ECC1	-113.756
ECC1	TP04	-36.054
TP04	TP05	-87.401
TP05	TP06	-76.023
TP06	ECC2	-113.045
ECC2	TP07	-58.083
TP07	TP08	-69.082
TP08	ECC3	-149.780
ECC3	TP09	-28.643
TP09	FF09	-15.904
FF09	FF10	-27.305
FF10	FF11	21.271
FF11	FF12	-41.855
FF12	FF13	140.118
FF13	FF14	197.582
FF14	FF15	174.412
FF15	FF16	160.561

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
FF08	FF07	91.604
FF07	FF06	85.469
FF06	FF05	86.882
FF05	FF04	46.318
FF04	FF03	97.361
FF03	FF02	109.910
FF02	FF01	81.015
FF01	TP01	-99.206
TP01	TP02	-77.158
TP02	TP03	-107.012
TP03	ECC1	-95.672
ECC1	TP04	-61.436
TP04	TP05	-83.190
TP05	TP06	-71.427
TP06	ECC2	-96.430
ECC2	TP07	-99.341
TP07	TP08	-40.895
TP08	ECC3	-136.674
ECC3	TP09	-11.550
TP09	FF09	-33.137
FF09	FF10	-27.215
FF10	FF11	21.304
FF11	FF12	-41.914
FF12	FF13	140.167
FF13	FF14	197.558
FF14	FF15	174.413
FF15	FF16	160.566

GOLD HILL Level Line

Latitude:	35°48'04"	**Length:**	6718m
Longitude:	120°21'48"	**Number of Bench marks:**	28
Date of Initial Survey:	16 August 1987	**Number of Surveys to 1988:**	1

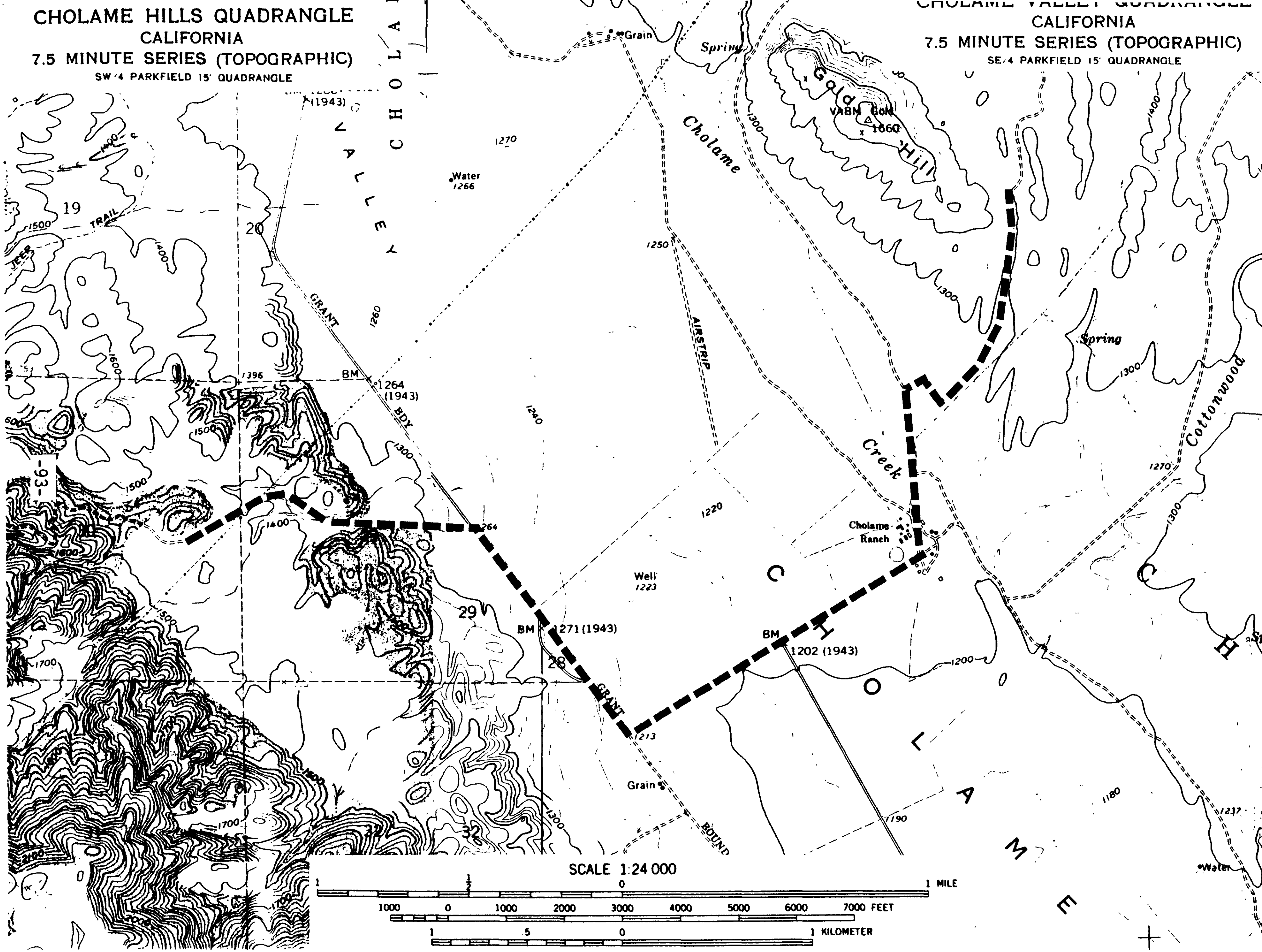
Trespass Permission: Permission is needed. Before surveying inform ranch foreman of Jack Ranch that a survey is in process.

When surveying the west half of the line, contact
Mr. & Mrs. Foard
P.O. Box 37
Cholame, CA 93431

Comments:

This line was established across the San Andreas fault and the Cholame pull-apart valley by the U.S. Geological Survey in 1987.

It has been partially surveyed only once.



CHOLAME HILLS QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 PARKFIELD 15' QUADRANGLE
CHOLAME VALLEY QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 PARKFIELD 15' QUADRANGLE
CHOLAME VALLEY
CHOLAME
Cholame Creek
Gold Hill
VABM Gold
1660
Cottonwood
Spring
Grain
Water 1266
Well 1223
Cholame Ranch
AIRSTRIP
GRANT BDY
GRANT BOUND
BM 1264 (1943)
BM 1271 (1943)
BM 1202 (1943)
TRAIL
JEEP
SCALE 1:24 000
1 MILE
7000 FEET
1 KILOMETER

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
GLDAZ1	TP104	23.317
TP104	TP105	-13.279
TP105	TP106	18.066
TP106	TP107	15.812
TP107	TP108	11.245
TP108	TP109	6.407
TP109	TP110	-3.333
TP110	TP111	9.633
TP111	TP112	6.951
TP112	TP113	-12.633
TP113	AGL1	-24.430
AGL1	TP114	43.045
TP114	TP115	34.691
TP115	TP116	60.548
TP116	TP117	25.022
TP117	TP118	45.560
TP118	TP119	65.290
TP119	TP120	63.923
TP120	TP121	45.859
TP121	TP122	62.182
TP122	TP123	76.832
TP123	TP124	94.320
TP124	TP125	103.506
TP125	TP126	42.346
TP126	AGL2	-49.643
AGL2	TP127	70.231
TP127	TP128	92.734
TP128	TP129	35.081
TP129	TP130	19.589
TP130	TP131	-25.368
TP131	TP132	-66.235
TP132	TP133	-73.677
TP133	AGL3	-86.560
AGL3	TP134	-53.224
TP134	TP135	-148.079
TP135	TP136	-39.425
TP136	TP137	-82.642
TP137	TP138	-76.000
TP138	TP139	108.463
TP139	AGL4	64.715
AGL4	TP140	33.935
TP140	TP141	9.446
TP141	TP142	15.821
TP142	TP143	17.772
TP143	TP144	22.412
TP144	AGL5	7.239
AGL5	TP145	1.587
TP145	TP146	-2.522
TP146	AGL6	-37.116
AGL6	TP147	-3.436
TP147	TP148	-23.343
TP148	AGL7	23.975
AGL7	TP149	141.742
TP149	TP150	102.648
TP150	TP151	79.630
TP151	AGL8	186.740

AGL8	TP152	130.019
TP152	TP153	35.511
TP153	TP154	96.487
TP154	TP155	90.662
TP155	AGL9	38.622
AGL9	TP156	95.149
TP156	TP157	81.586
TP157	TP158	81.132
TP158	TP159	92.977
TP159	AGL10	47.956
AGL10	TP160	96.083
TP160	TP161	118.096
TP161	TP162	110.247
TP162	TP163	119.396
TP163	TP164	83.825
TP164	TP165	66.344
TP165	TP166	81.450
TP166	AGL11	40.496
AGL11	TP167	64.026
TP167	TP168	77.635
TP168	TP169	81.748
TP169	TP170	77.534
TP170	TP171	67.936
TP171	TP172	42.859
TP172	AGL12	102.550
AGL12	TP173	100.323
TP173	TP174	28.341
TP174	TP175	107.526
TP175	TP176	120.038
TP176	TP177	52.580
TP177	TP178	67.633
TP178	AGL13	134.809
AGL13	TP179	33.728
TP179	TP180	71.276
TP180	TP181	73.163
TP181	TP182	98.935
TP182	TP183	70.377
TP183	AGL14	122.061

GRAPEVINE Level Line

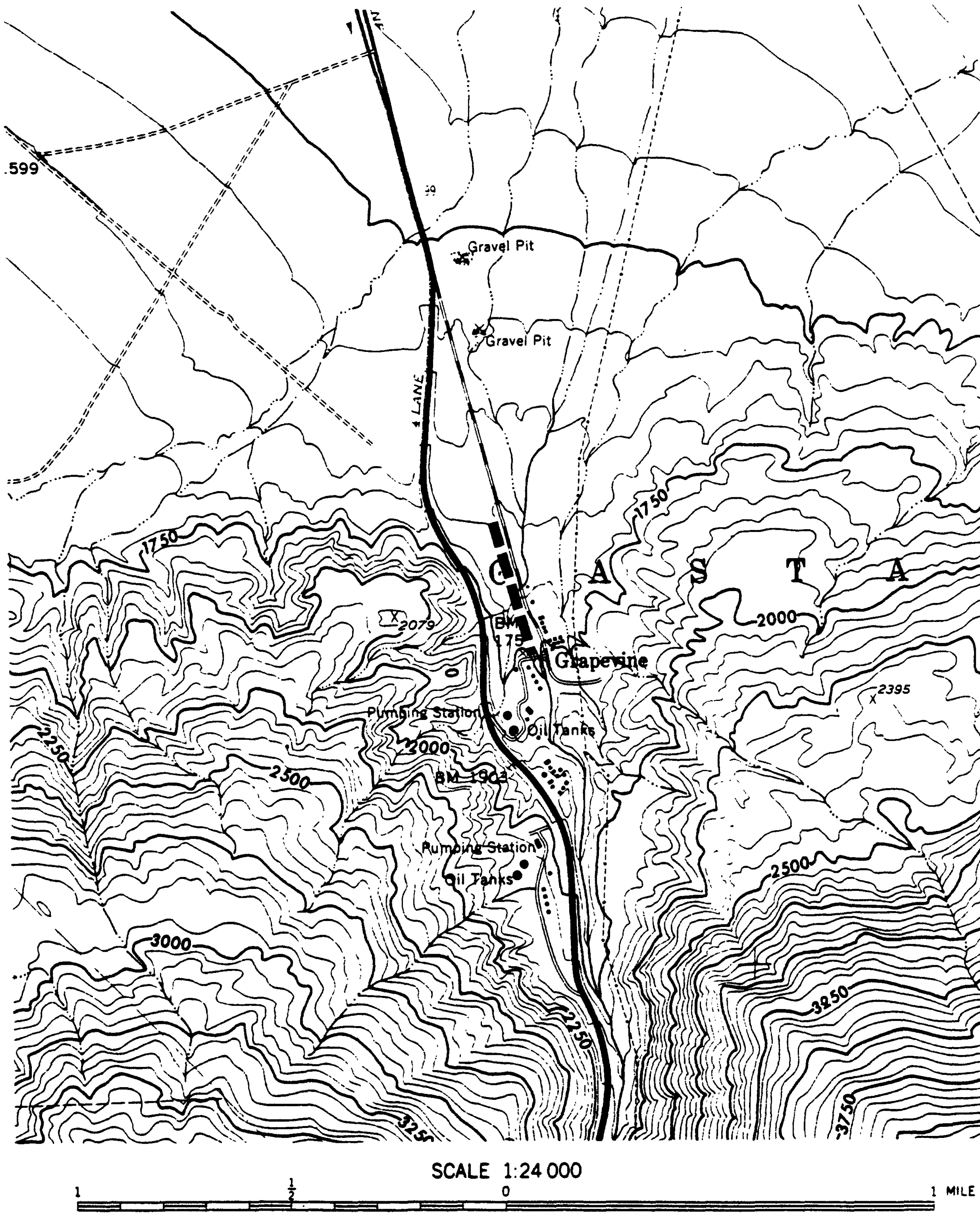
Latitude:	34°55'30"	**Length:**	798.3m
Longitude:	118°55'30"	**Number of Bench marks:**	25
Date of Initial Survey:	27 July 1979	**Number of Surveys to 1988:**	11
Trespass Permission:	No permission required		

Comments:

This line crosses the most recent scarp of the Pleito fault adjacent to the old highway at the old townsite of Grapevine. It ties into three bench marks of a regional NGS line.

Five surveys are compared in an accompanying figure which suggest that over a period of six years the south block of the fault has risen 2mm relative to the north block, and that it has also tilted northward about one microradian.

GRAPEVINE QUADRANGLE
CALIFORNIA–KERN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

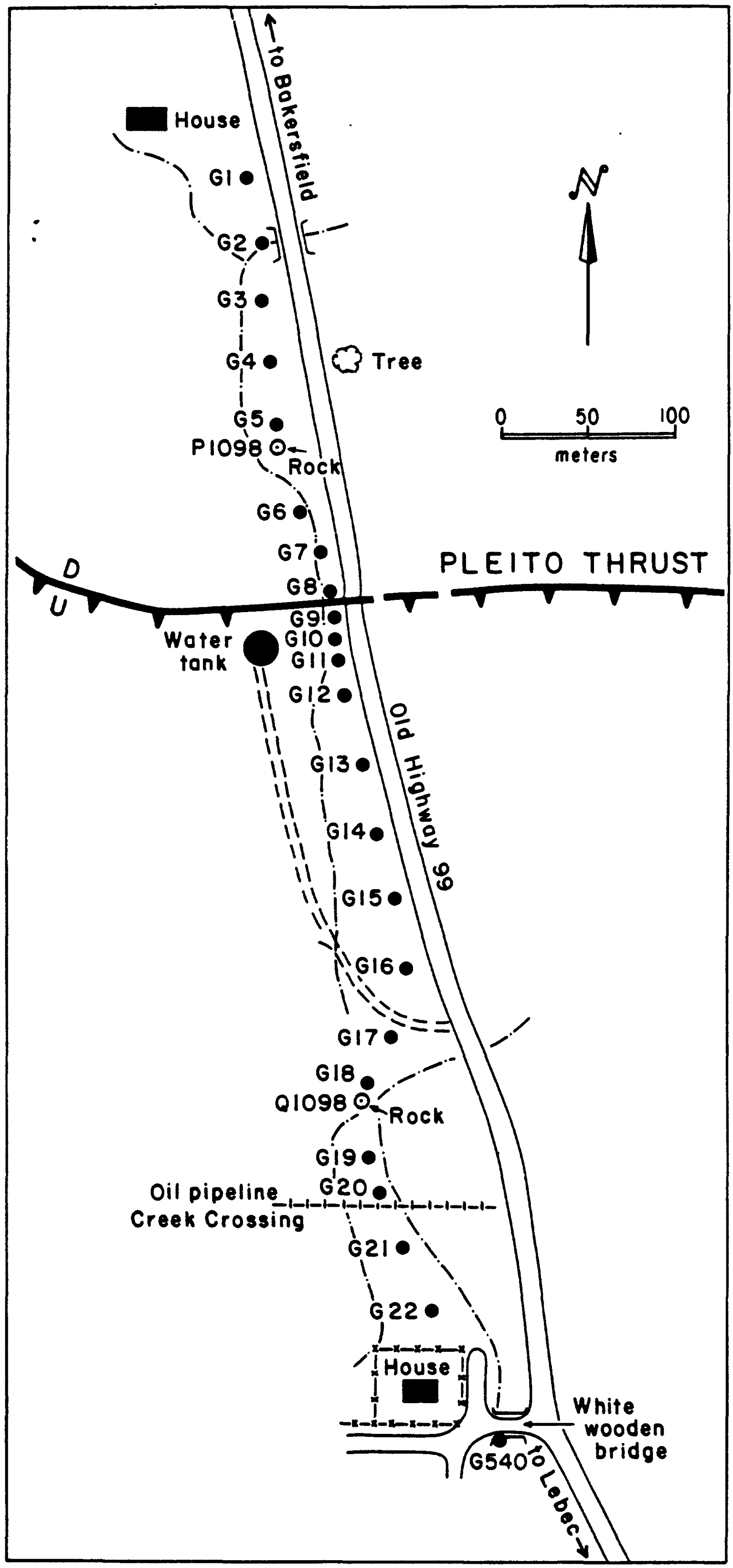


SCALE 1:24 000

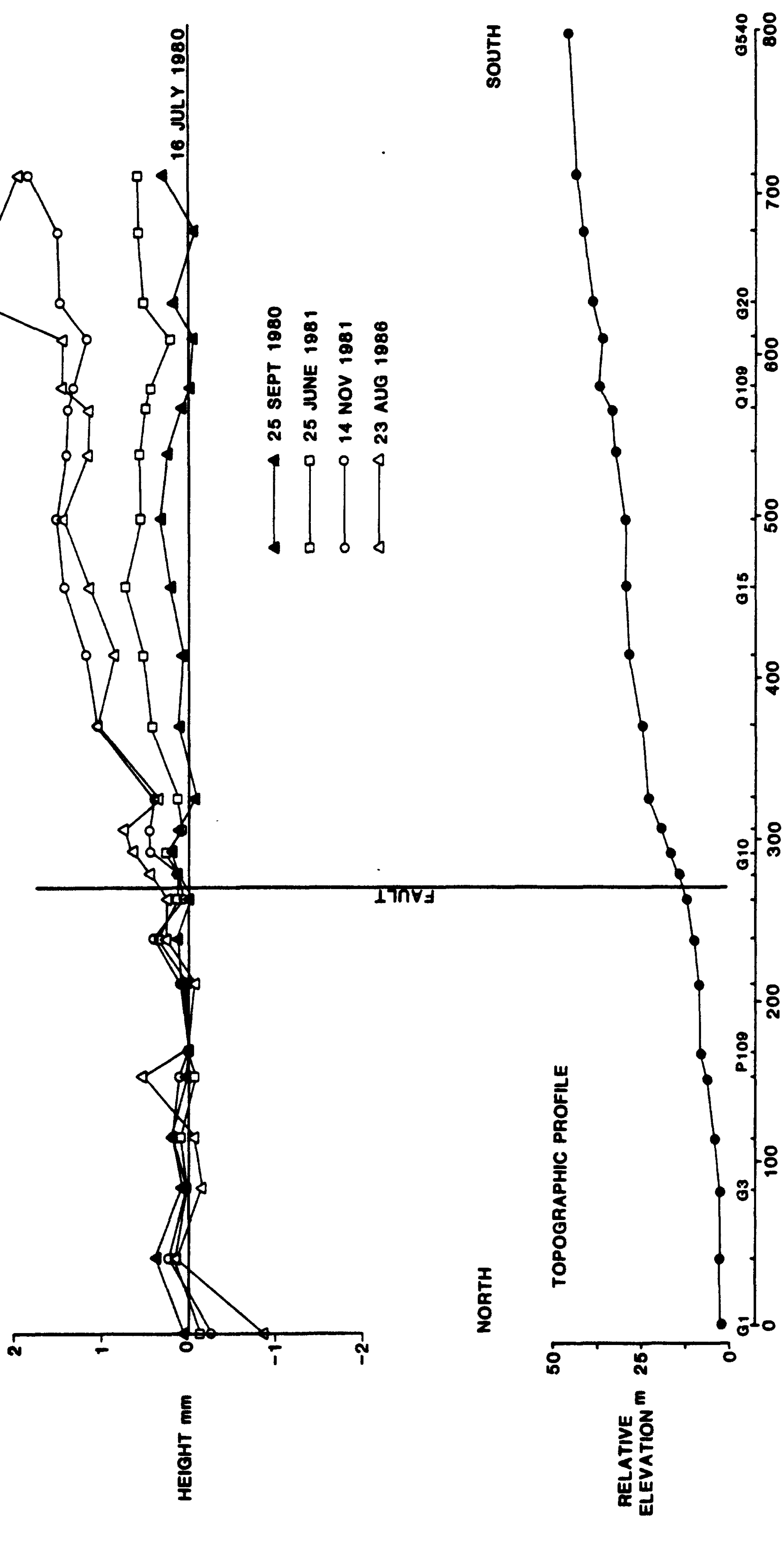
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER



to Bakersfield
House
G1
G2
G3
G4
Tree
G5
P1098
Rock
0
50
100
meters
G6
G7
D
U
PLEITO THRUST
G8
G9
G10
G11
G12
Water tank
Old Highway 99
G13
G14
G15
G16
G17
G18
Q1098
Rock
G19
G20
Oil pipeline
Creek Crossing
G21
G22
House
White wooden bridge
G540
to Lebec


HEIGHT mm
2
1
0
-1
-2
16 JULY 1980
25 SEPT 1980
25 JUNE 1981
14 NOV 1981
23 AUG 1986
FAULT
NORTH
SOUTH
TOPOGRAPHIC PROFILE
RELATIVE ELEVATION m
50
25
0
DISTANCE m
G1
0
G3
100
P109
200
G10
300
400
G15
500
Q109
600
G20
700
G540
800

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
G01	G02	116.765
G02	G03	182.901
G03	G04	183.395
G04	G05	203.938
G05	1098	187.613
1098	G06	20.428
G06	G07	155.661
G07	G08	164.189
G08	G09	223.064
G09	G10	200.663
G10	G11	182.999
G11	G12	173.448
G12	G13	217.399
G13	G14	165.319
G14	G15	165.448
G15	G16	107.699
G16	G17	133.719
G17	G18	115.776
G18	Q1098	207.260
Q1098	G19	67.402
G19	G20	158.815
G20	G21	222.067
G21	G22	235.634
G22	TP1	152.350
TP1	TP2	192.173
TP2	G540	-50.248

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
G01	G02	116.863
G02	G03	182.888
G03	G04	183.389
G04	G05	203.984
G05	P1098	187.549
P1098	G06	20.439
G06	G07	155.710
G07	G08	164.146
G08	G09	223.077
G09	G10	200.677
G10	G11	183.009
G11	G12	173.426
G12	G13	217.466
G13	G14	165.281
G14	G15	165.485
G15	G16	107.708
G16	G17	133.689
G17	G18	115.772
G18	Q1098	207.293
Q1098	G19	67.412
G19	G20	158.892
G20	G21	222.040
G21	G22	235.609
G22	TP01	79.132
TP01	TP02	203.629
TP02	G540	11.761

HANAUPAH CANYON Level Line (Line 70)

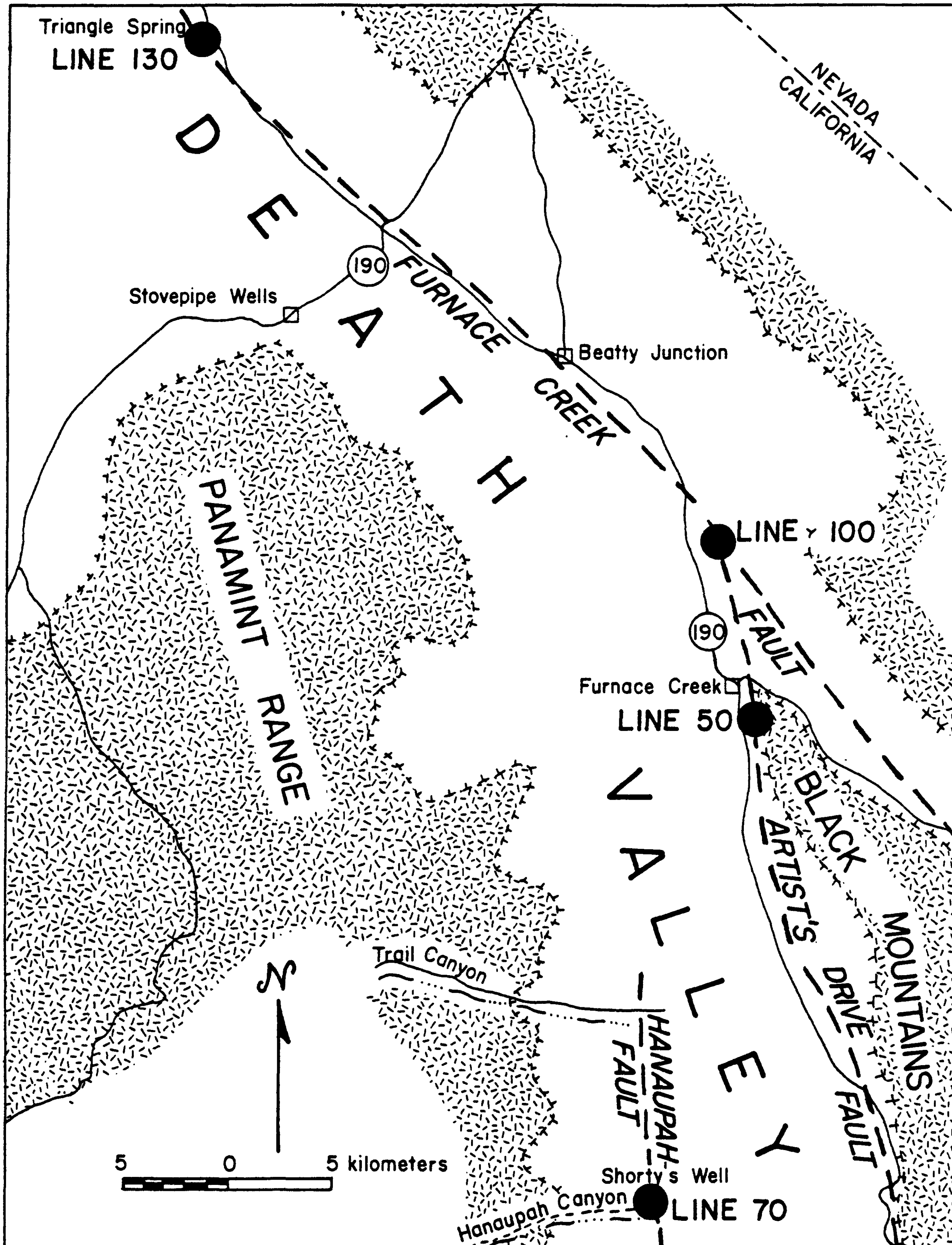
Latitude:	36°14'05"	**Length:**	198.5m
Longitude:	116°53'00"	**Number of Bench marks:**	8
Date of Initial Survey:	2 October 1970	**Number of Surveys to 1988:**	9
Trespass Permission:	Notify in advance the Chief Ranger National Park Service Death Valley National Monument Death Valley, CA 92328		

Comments:

This short line crosses the Hanaupah fault west of Shorty's Well on the west side of Death Valley.

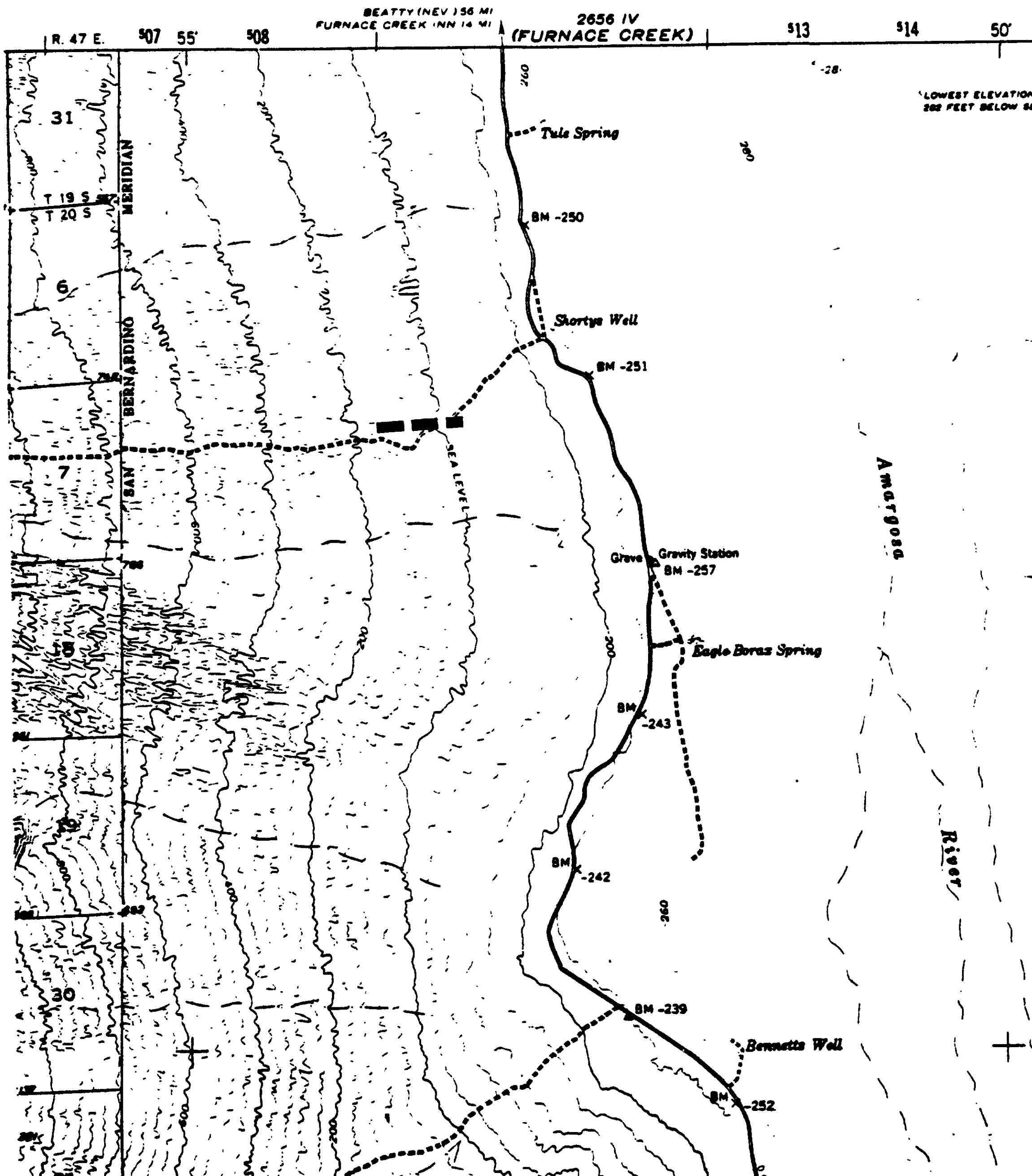
Seven levelings from 1971 to 1985 show no height changes among the eight bench marks greater than 1mm (Sylvester and Bie, 1986).

Reference cited: Sylvester, A. G., and S. W. Bie, 1986. Geodetic monitoring of fault movements in Death Valley, 1970-1985, pp. 41-44, *in* Troxel, B. W., *editor*, Quaternary Tectonics of Southern Death Valley. Field Guide, Pacific Cell, Friends of the Pleistocene, 44 p.

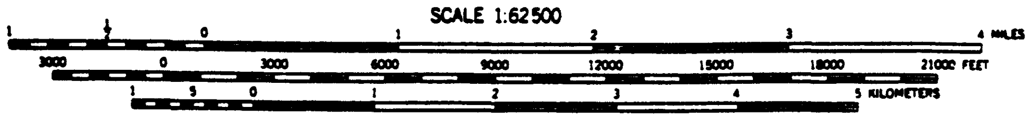


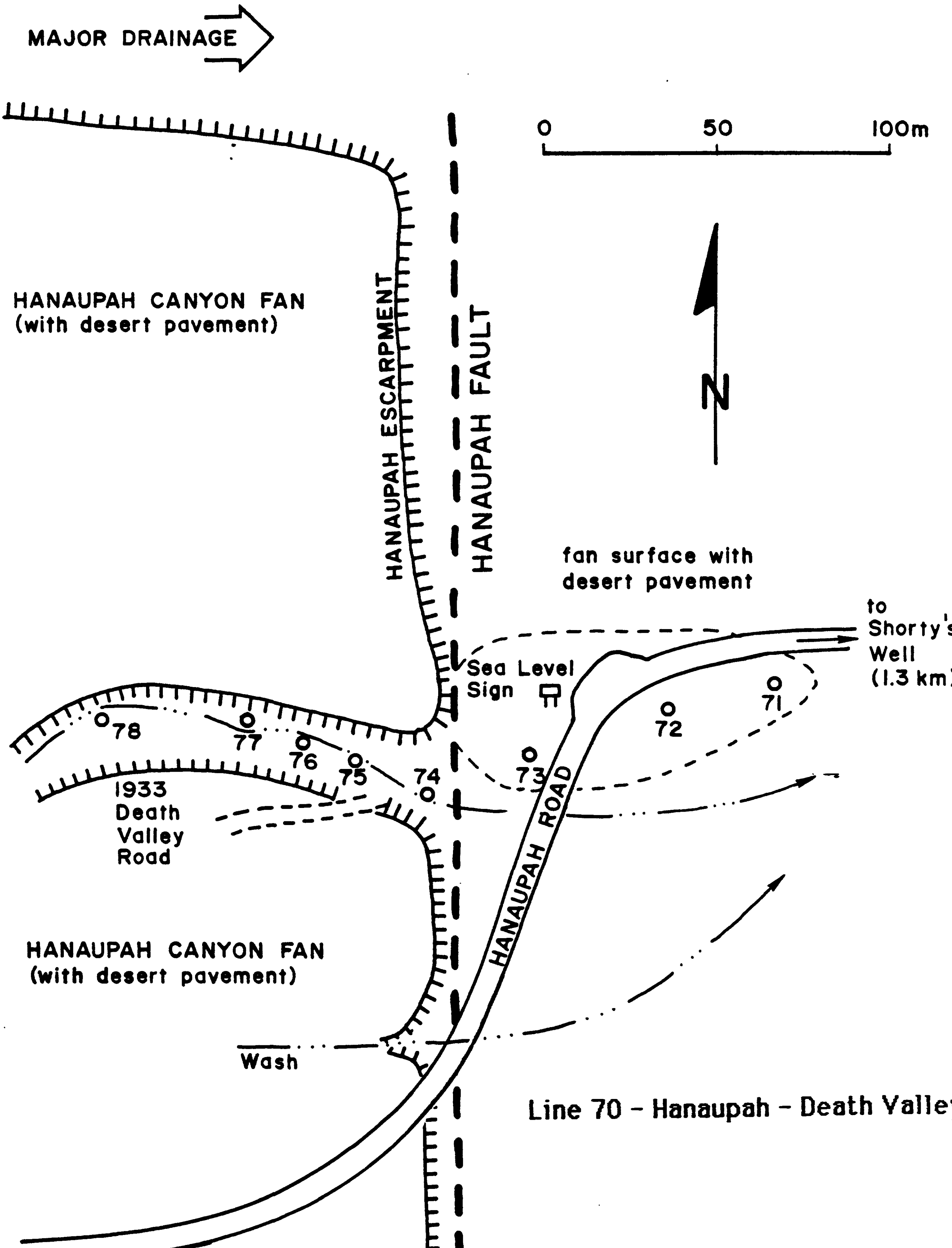
Locations of short leveling arrays in Death Valley.

BENNETTS WELL QUADRANGLE
CALIFORNIA-INYO CO.
15 MINUTE SERIES (TOPOGRAPHIC)



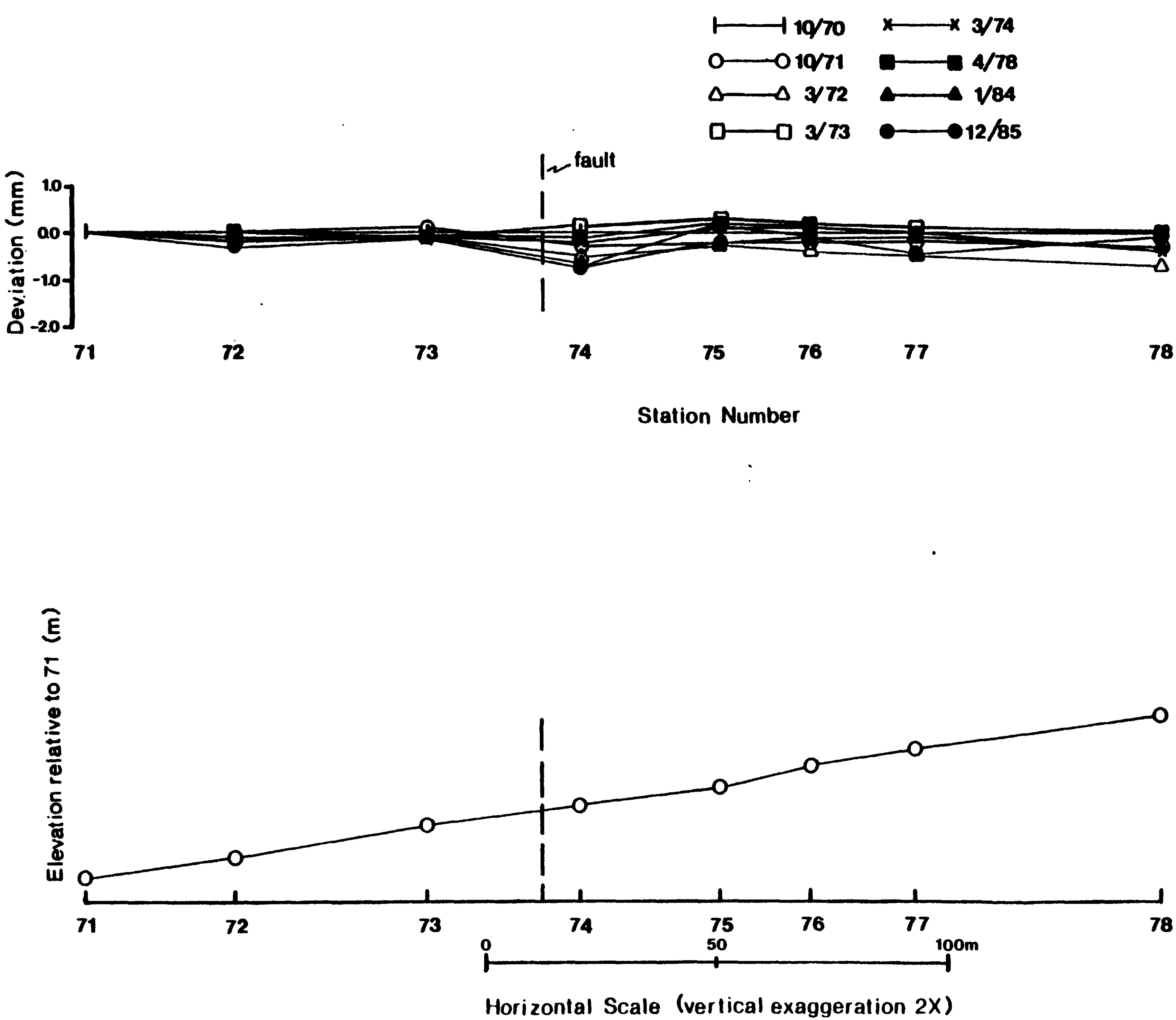
SCALE 1:62500





Line 70 - Hanaupah - Death Valley

Line 70 - Hanaupah - Death Valley



Line 70 - Hanaupah - Death Valley

Relative elevation and elevation deviation from base line data collected Oct., 1970 (in cm). A - base line data, B - adjusted elevation relative to station 71, C - deviation of elevation from base line data, D - datum elevation.

Station and			Oct., 1971		Mar., 1972		Mar., 1973		Mar., 1974		Apr., 1978	
Monument	Type	A	B	C	B	C	B	C	B	C	B	C
71D	B	1000.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00
72	B	1234.86	1234.86	0.00	1234.84	-0.02	1234.85	-0.01	1234.86	0.00	1234.86	0.00
73	B	1548.08	1548.09	+0.01	1548.07	-0.01	1548.07	-0.01	1548.07	-0.01	1548.07	-0.01
74	B	1783.75	1783.72	-0.03	1783.70	-0.05	1783.76	+0.01	1783.73	-0.02	1783.74	-0.01
75	B	1971.56	1971.54	-0.02	1971.53	-0.03	1971.59	+0.03	1971.57	+0.01	1971.58	+0.02
76	B	2195.52	2195.50	-0.02	2195.48	-0.04	2195.54	+0.02	2195.53	+0.01	2195.54	+0.02
77	B	2377.26	2377.24	-0.02	2377.21	-0.05	2377.27	+0.01	2377.26	0.00	2377.26	0.00
78	B	2750.55	2750.52	-0.03	2750.48	-0.07	2750.55	0.00	2750.51	-0.04	2750.55	0.00

		Jan., 1984		Dec., 1985	
		B	C	B	C
71D	B	1000.00	0.00	1000.00	0.00
72	B	1234.85	-0.01	1234.84	-0.02
73	B	1548.07	-0.01	1548.07	-0.01
74	B	1783.68	-0.07	1783.65	-0.10
75	B	1971.57	+0.01	1971.54	-0.02
76	B	2195.51	-0.01	2195.51	-0.01
77	B	2377.25	-0.01	2377.23	-0.03
78	B	2750.52	-0.03	2750.54	-0.01

JM QUARRY Leveling Array

Latitude:	34°36'30"	**Length:**	746.0m
Longitude:	120°26'44"	**Number of Bench marks:**	26
Date of Initial Survey:	13 August 1981	**Number of Surveys to 1988:**	8

Trespass Permission: Contact quarry supervisor Frederick Wright for permission to survey. Ph.# (805) 736-1221. Hard hats, hard-toed shoes are required for entry onto the premises.

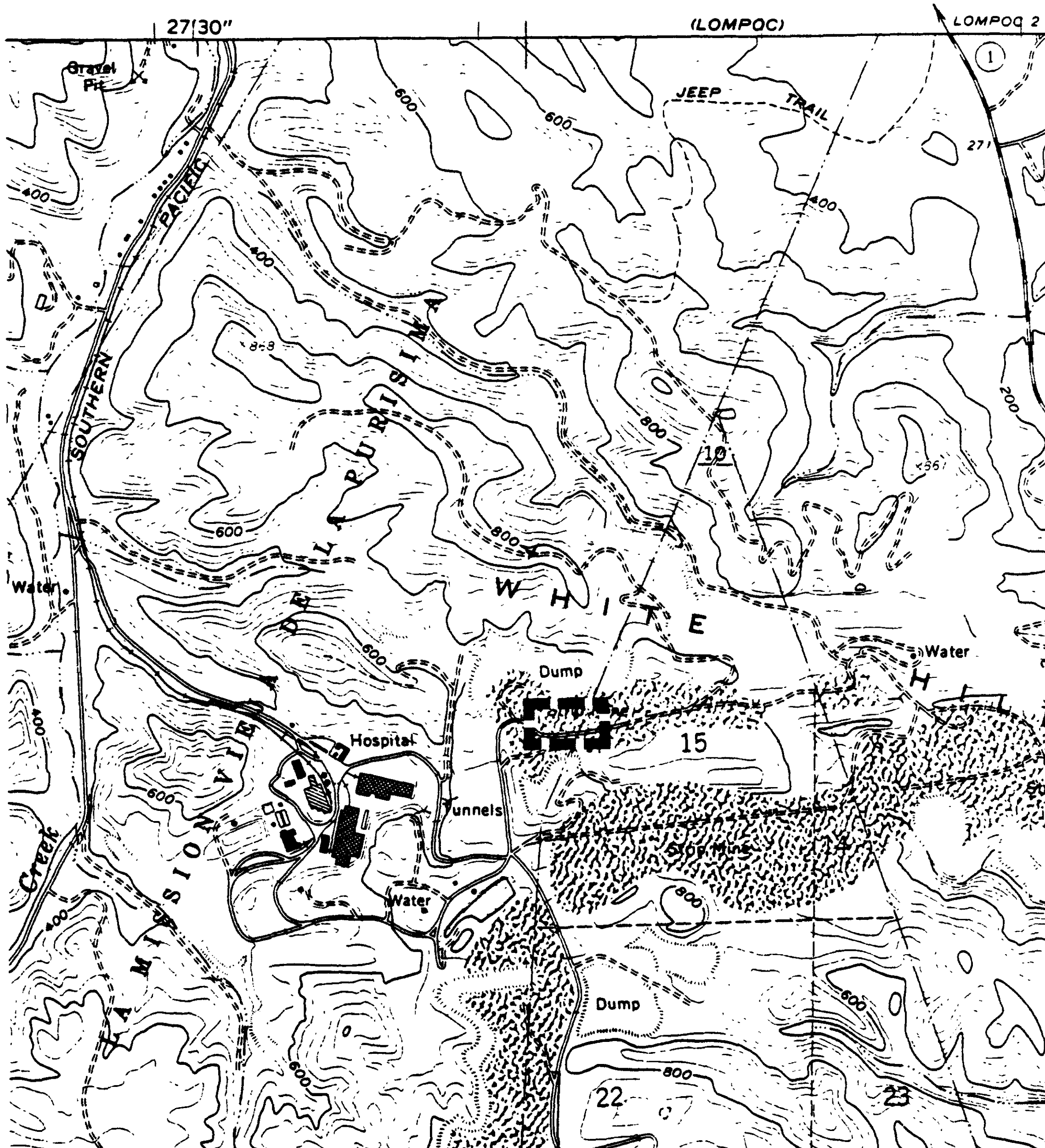
Comments:

This U-shaped array was established across the surface rupture of a bedding plane reverse fault in the floor of a diatomite quarry two miles south of Lompoc. The surface rupture accompanied a minor earthquake in April 1981 (Yerkes and others, 1983).

Eight levelings to 1985 are compared in an accompanying diagram which shows that the floor of the quarry is tilting down to the west and rising where the active mining occurs. The tilt rate is about 50 microradians/yr. Vertical displacement is negligible across the fault.

Reference Cited: Yerkes, R.F., W.L. Ellsworth, and J.C. Tinsley. 1983. Triggered reverse fault and earthquake due to crustal unloading, northwest Transverse Ranges, California. Geology 11, 287-291.

LOMPOC HILLS QUADRANGLE
CALIFORNIA–SANTA BARBARA CO.
7.5 MINUTE SERIES TOPOGRAPHIC



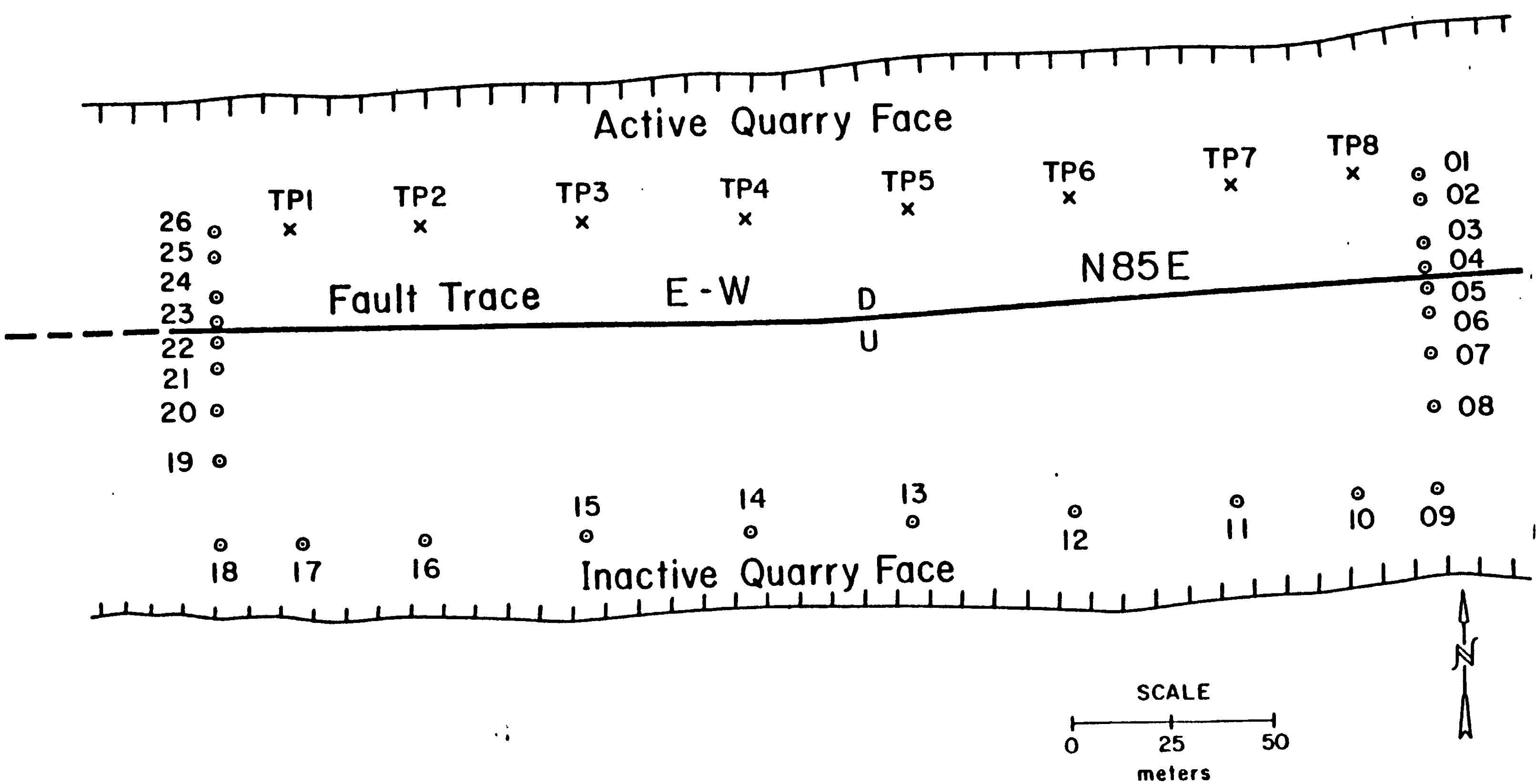
SCALE 1:24 000

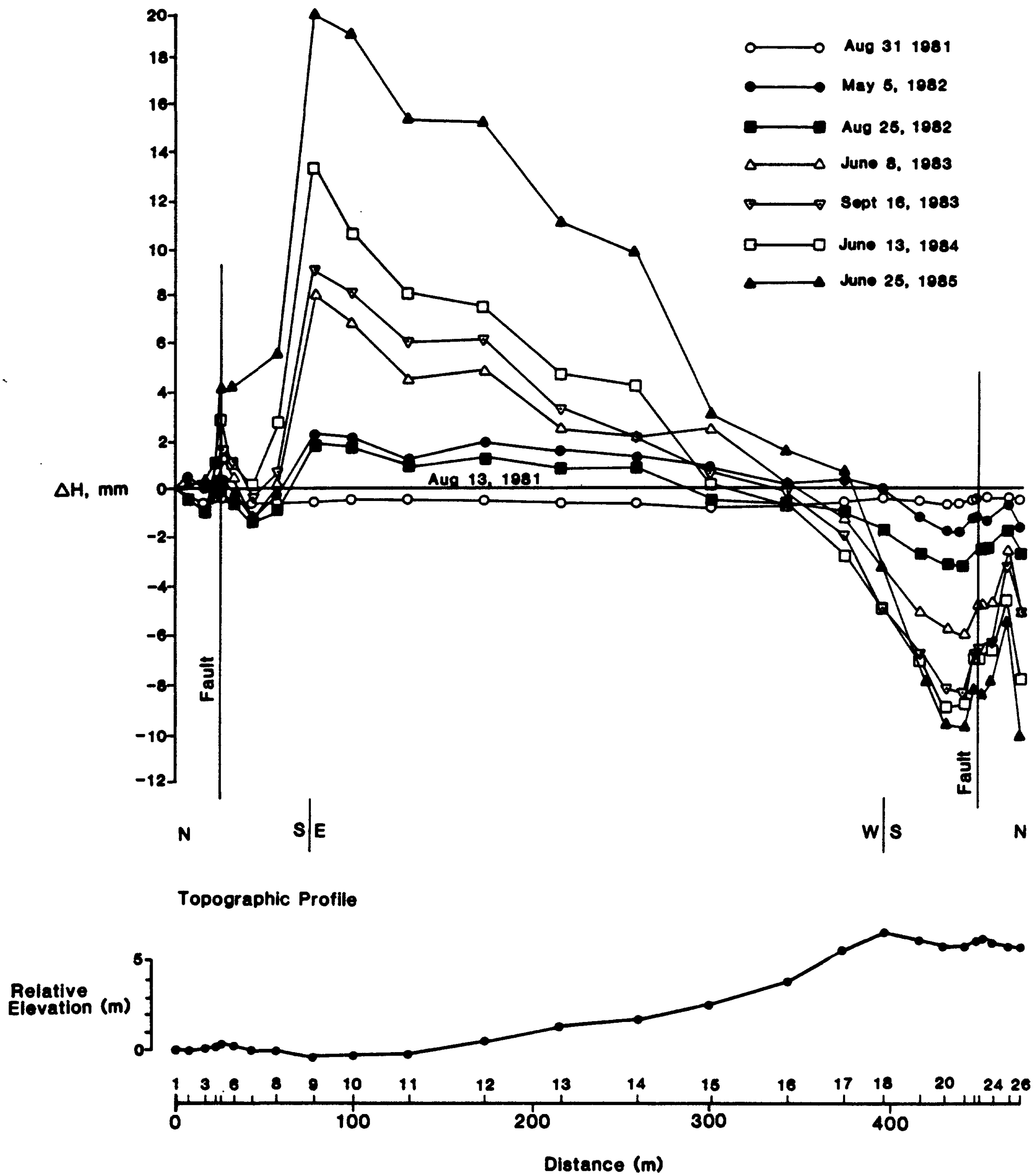
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SITE MAP OF JM QUARRY LEVELING ARRAY





Aug 31 1981
May 5, 1982
Aug 25, 1982
June 8, 1983
Sept 16, 1983
June 13, 1984
June 25, 1985
ΔH, mm
Aug 13, 1981
Fault
Fault
N
S|E
W|S
N
Topographic Profile
Relative Elevation (m)
Distance (m)

LOMPOC, CALIFORNIA   JM QUARRY   AUGUST 13, 1981

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LQ01	LQ02	1.595
LQ02	LQ03	-9.659
LQ03	LQ04	16.515
LQ04	LQ05	24.232
LQ05	LQ06	-12.488
LQ06	LQ07	-16.480
LQ07	LQ08	-10.407
LQ08	LQ09	-37.702
LQ09	LQ10	19.251
LQ10	LQ11	15.237
LQ11	LQ12	59.945
LQ12	LQ13	74.330
LQ13	LQ14	66.897
LQ14	LQ15	76.569
LQ15	LQ16	132.863
LQ16	LQ17	155.246
LQ17	LQ18	98.303
LQ18	LQ19	-45.700
LQ19	LQ20	-27.372
LQ20	LQ21	3.209
LQ21	LQ22	23.127
LQ22	LQ23	5.659
LQ23	LQ24	-16.332
LQ24	LQ25	-18.178
LQ25	LQ26	3.029
LQ26	TP01	-88.641

LOMPOC, CALIFORNIA JM QUARRY JUNE 25, 1985

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LQ01	LQ02	1.629
LQ02	LQ03	-9.649
LQ03	LQ04	16.604
LQ04	LQ05	24.524
LQ05	LQ06	-12.685
LQ06	LQ07	-16.557
LQ07	LQ08	-9.998
LQ08	LQ09	-36.207
LQ09	LQ10	19.095
LQ10	LQ11	14.871
LQ11	LQ12	59.932
LQ12	LQ13	73.923
LQ13	LQ14	66.779
LQ14	LQ15	75.909
LQ15	LQ16	132.806
LQ16	LQ17	155.056
LQ17	LQ18	97.944
LQ18	LQ19	-46.227
LQ19	LQ20	-27.532
LQ20	LQ21	3.176
LQ21	LQ22	23.284
LQ22	LQ23	5.629
LQ23	LQ24	-16.259
LQ24	LQ25	-17.945
LQ25	LQ26	2.575
LQ26	TP01	-102.006

JPL Level Line

Latitude:	34°12'05"	**Length:**	1900 m
Longitude:	118°09'52"	**Number of Bench marks:**	41
Date of Initial Survey:	14 June 1984	**Number of Surveys to 1988:**	7

Trespass Permission: Current permits needed from:

Mr. Larry Harsha, Supervising Civil Engineer
Water and Power Department
City of Pasadena
Room 323, City Hall
100 North Garfield Avenue
Pasadena, CA 91109

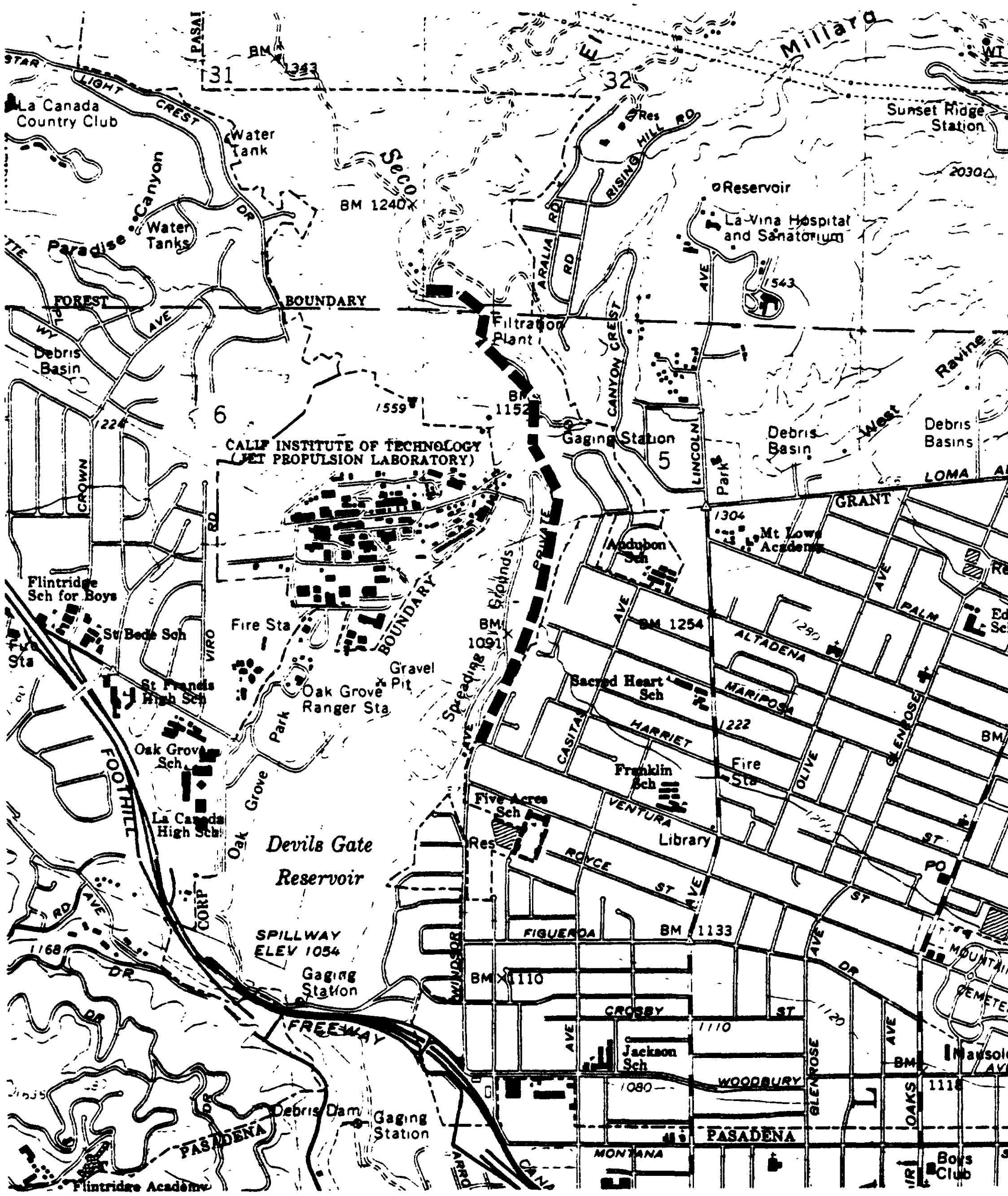
District Ranger
U.S. Forest Service
Angeles National Forest
Arroyo Seco Ranger District
Oak Grove Park
Flintridge, CA 91011

Comments:

This line was established across the Sierra Madre fault in Arroyo Seco adjacent to the Jet Propulsion Laboratory, two miles east of La Canada. A key and permits are required to drive a vehicle beyond the locked gate at the entrance to the access road.

Seven levelings from 1984 to 1987 show that, relative to the mountain block (north), the block south of the fault subsided and then rose as much as 8mm. Rather than discrete displacement across a narrowly-defined fault, the displacement occurs across a zone about 200m wide. Bench mark JP19 is in that zone, but its variation relative to other bench marks is due to vandalism.

PASADENA QUADRANGLE
CALIFORNIA–LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

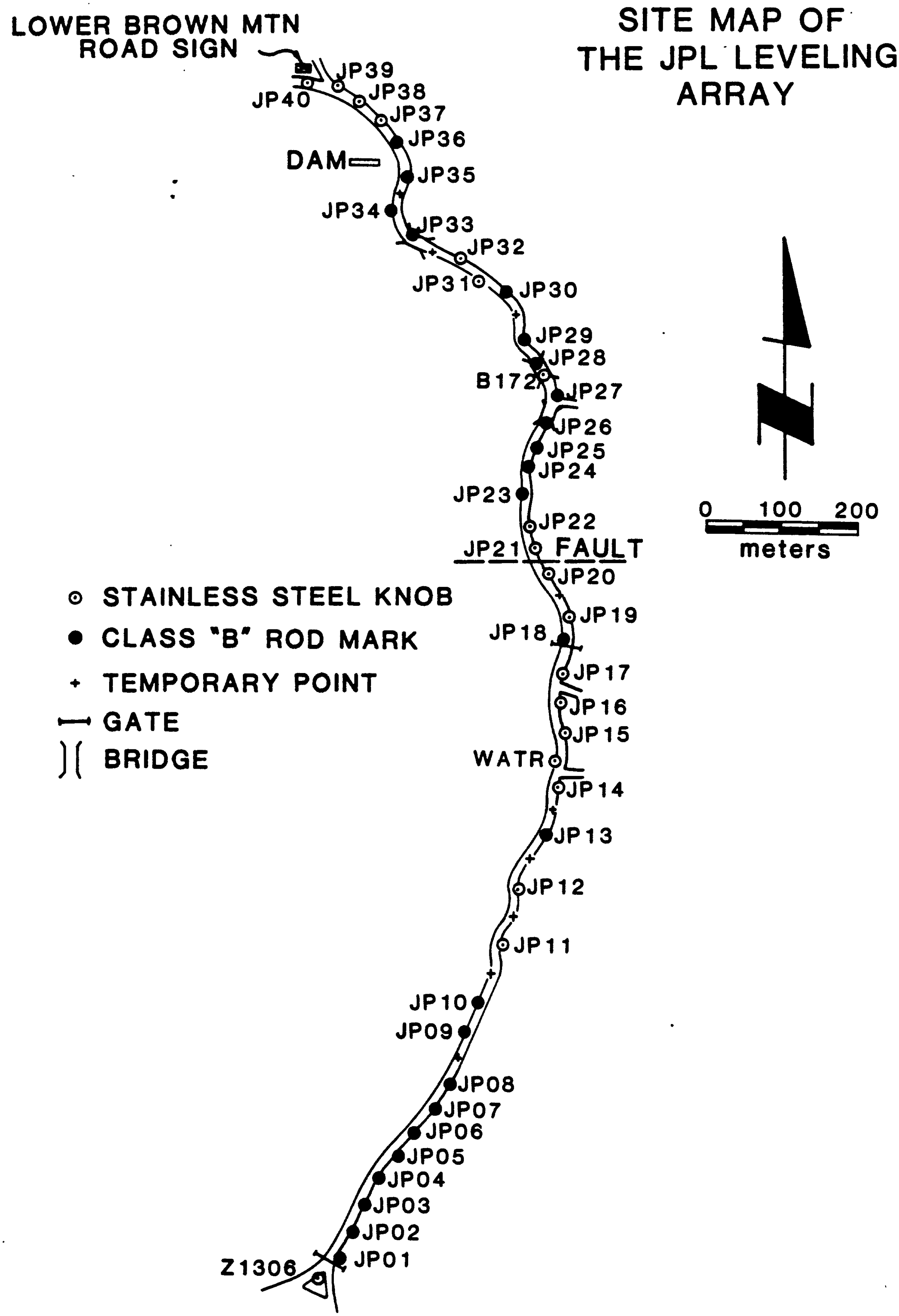


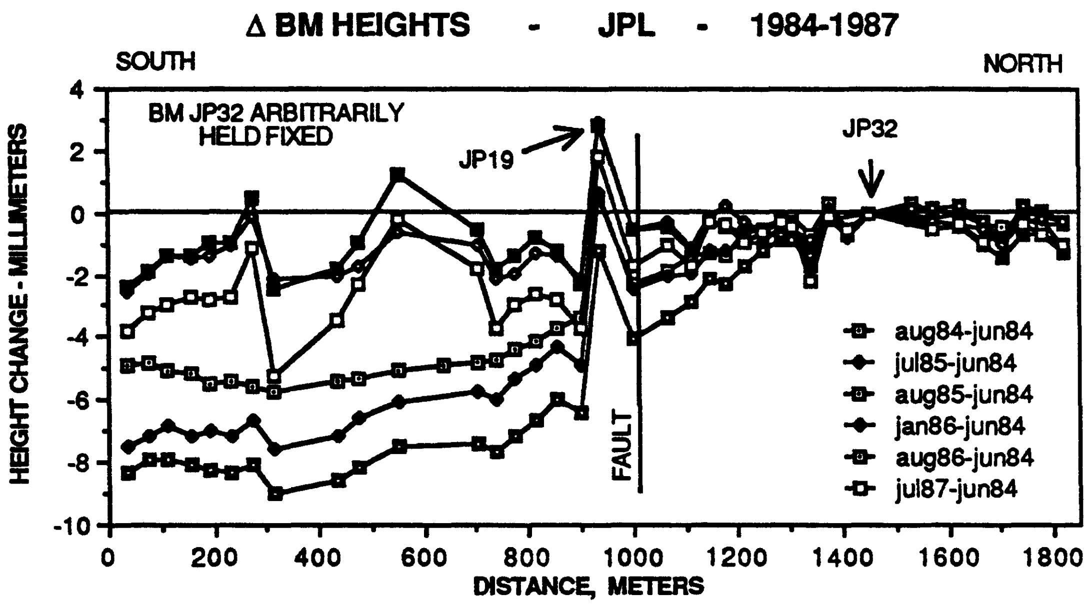
SCALE 1:24 000

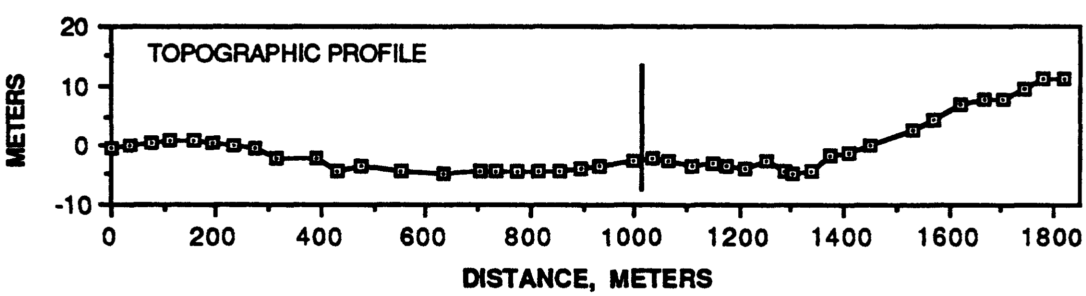
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER


SITE MAP OF THE JPL LEVELING ARRAY
LOWER BROWN MTN ROAD SIGN
DAM
JP40
JP39
JP38
JP37
JP36
JP35
JP34
JP33
JP32
JP31
JP30
JP29
JP28
B172
JP27
JP26
JP25
JP24
JP23
JP22
JP21
FAULT
JP20
JP19
JP18
JP17
JP16
JP15
WATR
JP14
JP13
JP12
JP11
JP10
JP09
JP08
JP07
JP06
JP05
JP04
JP03
JP02
JP01
Z1306
0 100 200
meters
STAINLESS STEEL KNOB
CLASS "B" ROD MARK
TEMPORARY POINT
GATE
BRIDGE


Δ BM HEIGHTS - JPL - 1984-1987
SOUTH
NORTH
BM JP32 ARBITRARILY HELD FIXED
JP19
JP32
FAULT
HEIGHT CHANGE - MILLIMETERS
DISTANCE, METERS
aug84-jun84
jul85-jun84
aug85-jun84
jan86-jun84
aug86-jun84
jul87-jun84
4
2
0
-2
-4
-6
-8
-10
0
200
400
600
800
1000
1200
1400
1600
1800


TOPOGRAPHIC PROFILE
METERS
DISTANCE, METERS
20
10
0
-10
0
200
400
600
800
1000
1200
1400
1600
1800

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
1306	JP01	17.764
JP01	JP02	69.825
JP02	JP03	26.658
JP03	JP04	23.589
JP04	JP05	-40.218
JP05	JP06	-47.761
JP06	JP07	-52.624
JP07	JP08	-156.904
JP08	TP01	19.217
TP01	JP09	-49.083
JP09	JP10	-187.419
JP10	TP02	6.449
TP02	JP11	46.732
JP11	TP03	-82.469
TP03	JP12	23.618
JP12	TP04	-26.635
TP04	JP13	-27.679
JP13	TP05	36.124
TP05	JP14	2.291
JP14	WATR	-14.170
WATR	JP15	31.951
JP15	JP16	0.983
JP16	JP17	0.945
JP17	JP18	18.278
JP18	JP19	33.631
JP19	TP06	26.128
TP06	JP20	59.325
JP20	JP21	42.997
JP21	JP22	-30.753
JP22	JP23	-77.803
JP23	JP24	60.588
JP24	JP25	-49.160
JP25	JP26	-65.389
JP26	JP27	127.341
JP27	B172	-141.644
B172	JP28	-67.674
JP28	JP29	29.423
JP29	TP07	177.064
TP07	JP30	96.743
JP30	JP31	48.539
JP31	JP32	128.966
JP32	TP09	132.388
TP09	JP33	110.227
JP33	JP34	182.473
JP34	TP10	113.257
TP10	JP35	155.137
JP35	JP36	74.879
JP36	JP37	31.096
JP37	JP38	174.535
JP38	JP39	141.478
JP39	JP40	10.956

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
Z1306	JP01	18.754
JP01	JP02	69.882
JP02	JP03	26.681
JP03	JP04	23.614
JP04	JP05	-40.226
JP05	JP06	-47.747
JP06	JP07	-52.468
JP07	JP08	-157.316
JP08	TP01	23.479
TP01	JP09A	-61.358
JP09A	JP10	-179.232
JP10	TP02	6.373
TP02	JP11	46.929
JP11	TP03	-82.982
TP03	JP12	24.337
JP12	TP04	-27.403
TP04	TP05	-25.221
TP05	TP06	34.206
TP06	JP14	2.363
JP14	WATER	-14.366
WATER	JP15	32.027
JP15	JP16	1.019
JP16	JP17	0.931
JP17	JP18	18.188
JP18	JP19	34.180
JP19	TP07	22.036
TP07	JP20	63.067
JP20	JP21A	15.202
JP21A	JP22	-2.896
JP22	JP23	-77.865
JP23	JP24	60.733
JP24	JP25	-49.170
JP25	JP26	-65.448
JP26	JP27	127.372
JP27	B172	-141.610
B172	JP28	-67.690
JP28	JP29	29.248
JP29	TP08	177.188
TP08	JP30	96.826
JP30	JP31	48.501
JP31	JP32	129.016
JP32	TP09	132.215
TP09	JP33	110.378
JP33	JP34	182.445
JP34	TP10	113.134
TP10	JP35	155.273
JP35	JP36	74.826
JP36	TP11	22.526
TP11	JP38	183.163
JP38	JP39	141.444
JP39	JP40	10.927

JUNCAL Level Line

Latitude:	34°29'00"	**Length:**	138m
Longitude:	119°30'15"	**Number of Bench marks:**	8
Date of Initial Survey:	17 September 1975	**Number of Surveys to 1988:**	4
Trespass Permission:	Contact: Montecito Water District 583 San Ysidro Road Montecito, CA 93108		

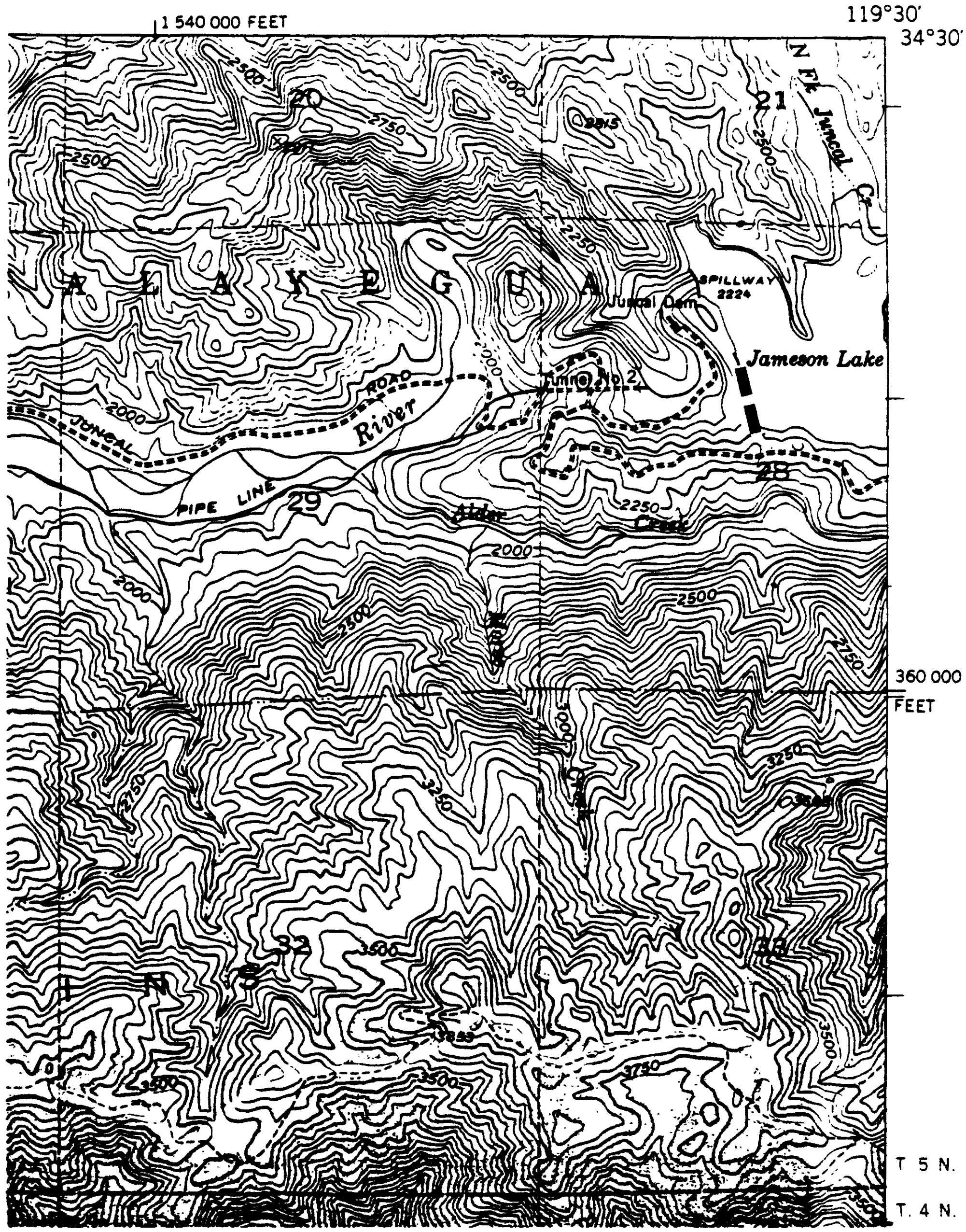
Comments:

This is a short line of 8 bronze pins on the top of a wing dam section of Juncal Reservoir, 16 miles north of Carpinteria. According to Dibblee (1966) the wing dam is constructed across at least one of the main traces of the Santa Ynez fault.

Three levelings are plotted in an accompanying figure and show that the north part of the wing dam has risen relatively to the south part at a rate of nearly 2mm/yr. This is opposite to the geomorphic sense of vertical separation visible across the fault.

Reference cited: Dibblee, T.W. Jr., 1966. Geologic map of the Little Pine Mountain, Hildreth Park, Santa Barbara and Carpinteria 7 1/2 minute quadrangles, Santa Barbara County, California, Scale 1:31,680. California Division of Mines and Geology Bulletin 186, 99 p.

CARPINTERIA QUADRANGLE
CALIFORNIA-SANTA BARBARA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

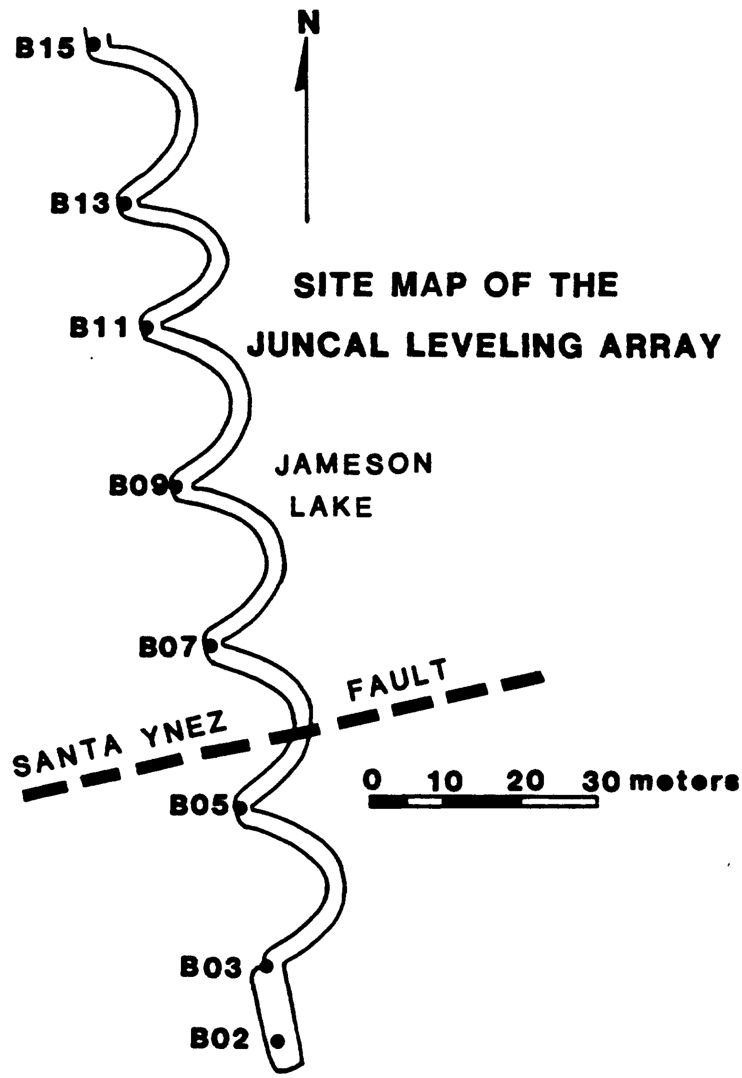


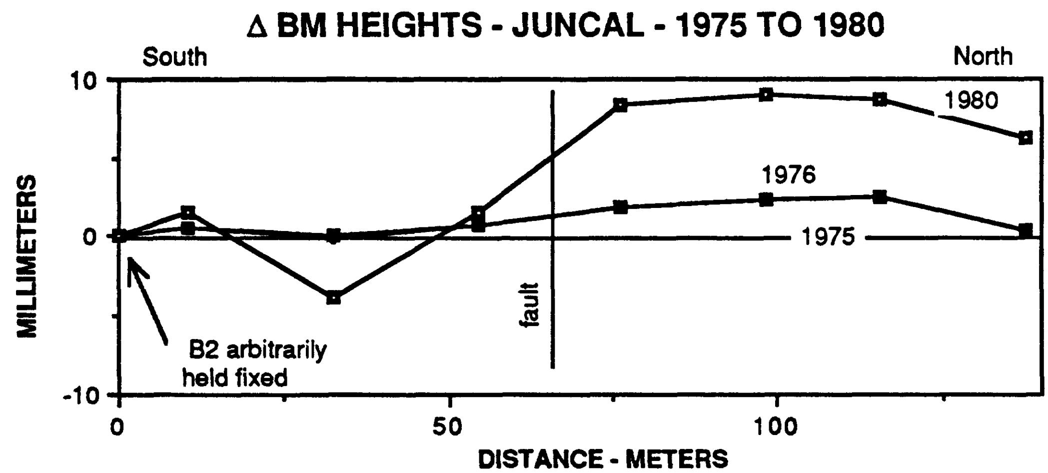
SCALE 1:24 000

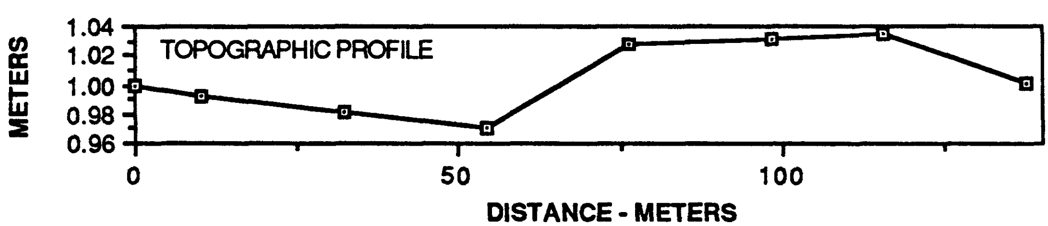
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER


N
SITE MAP OF THE
JUNCAL LEVELING ARRAY
B15
B13
B11
B09
JAMESON
LAKE
B07
SANTA YNEZ
FAULT
B05
0 10 20 30 meters
B03
B02


Δ BM HEIGHTS - JUNCAL - 1975 TO 1980
South
North
10
0
-10
MILLIMETERS
1980
1976
1975
fault
B2 arbitrarily
held fixed
0
50
100
DISTANCE - METERS


1.04
1.02
1.00
0.98
0.96
METERS
TOPOGRAPHIC PROFILE
0
50
100
DISTANCE - METERS

JAMESON LAKE, CALIFORNIA   JUNCAL   SEPTEMBER 17, 1975

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
B2	B3	-0.8413
B3	B5	-0.9757
B5	B7	-1.2003
B7	B9	5.5728
B9	B11	0.3347
B11	B13	0.3017
B13	B15	-3.1305

JAMESON LAKE, CALIFORNIA   JUNCAL   AUGUST 13, 1980

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
B2	B3	-0.6808
B3	B5	-1.5138
B5	B7	-0.6615
B7	B9	6.2458
B9	B11	0.4083
B11	B13	0.2572
B13	B15	-3.3702

KERN FRONT Leveling Array

Latitude:	35°27'55"	**Length:**	1306m
Longitude:	119°00'20"	**Number of Bench marks:**	106
Date of Initial Survey:	19 August 1986	**Number of Surveys to 1988:**	4

Trespass Permission:

Contact:
Steve Bergath or Rich Cullip Ph.# (805) 399-2961
Texaco, U.S.A.
Bakersfield District
P.O. Box 5197X
Kern River Oilfield
Bakersfield, CA 93388

A key is required for entrance into the shed built over two bench marks that straddle the fault on the south leg of the array, and a security pass is required before entry to the property.

Comments:

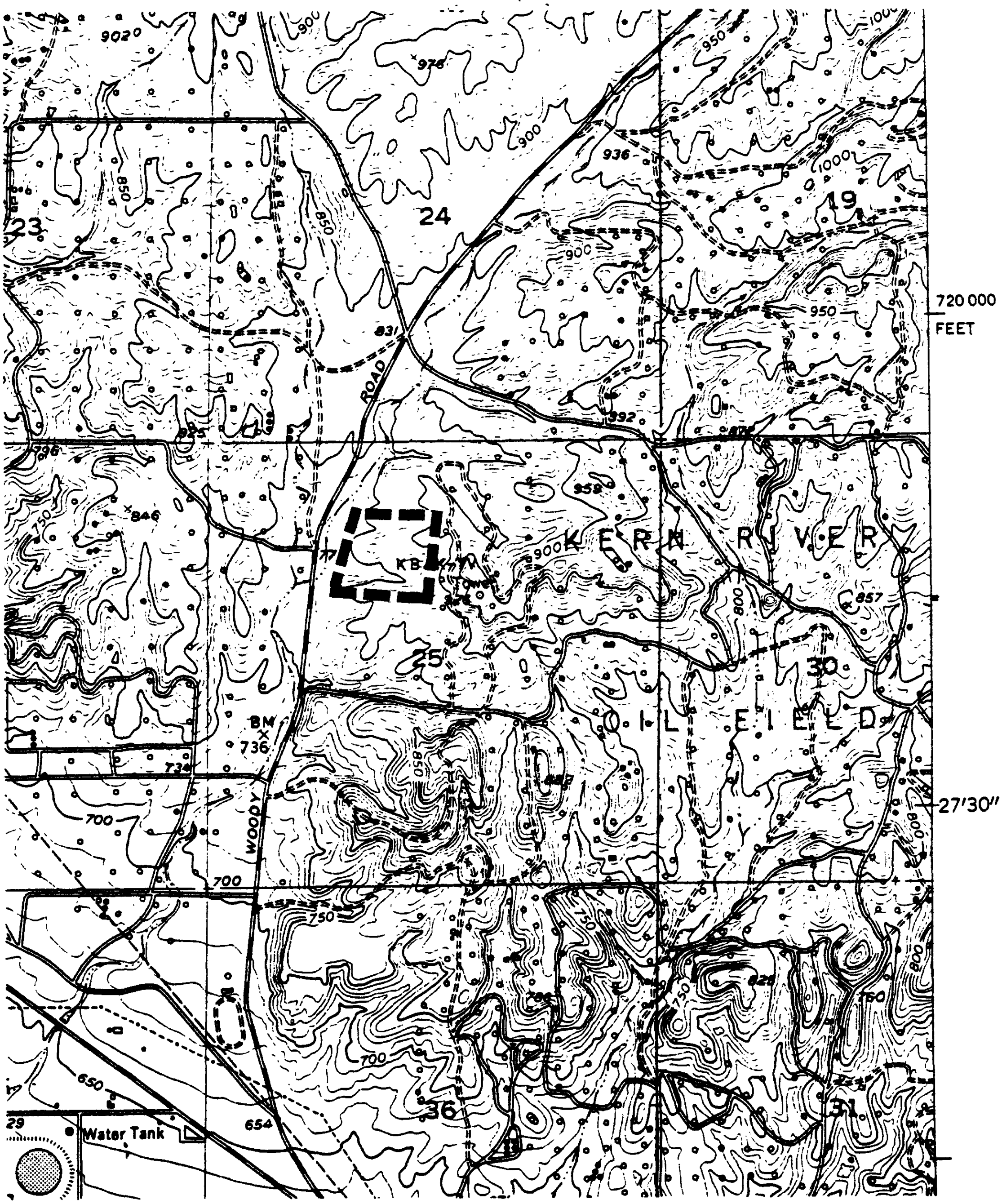
This box-shaped array was established two miles north of Oildale at the request of Texaco USA to monitor the Kern Front fault which Castle and others (1983) showed was active. Castle and others (1983) were not able to determine with confidence whether the movement was tectonic or due to subsidence owing to withdrawal of oil and water from the shallow reservoir, but they favored the latter explanation.

Three levelings in the period August 1986 to June 1987 are compared in an accompanying figure and show 6mm of displacement across the fault. This is nearly the same rate that Nason and others (1974) found using a tiltbeam at the same site.

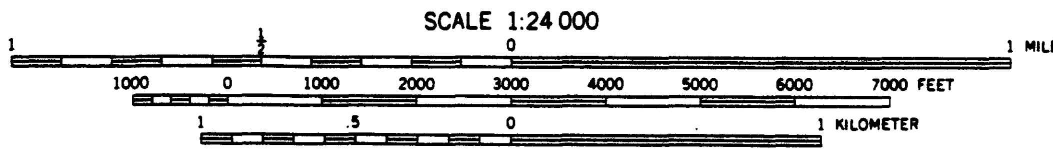
References: Castle, R.O., J.P. Church, R.F. Yerkes and J.C. Manning. 1983. Historical surface deformation near Oildale, California. U.S. Geological Survey Professional Paper 1245, 42 p.

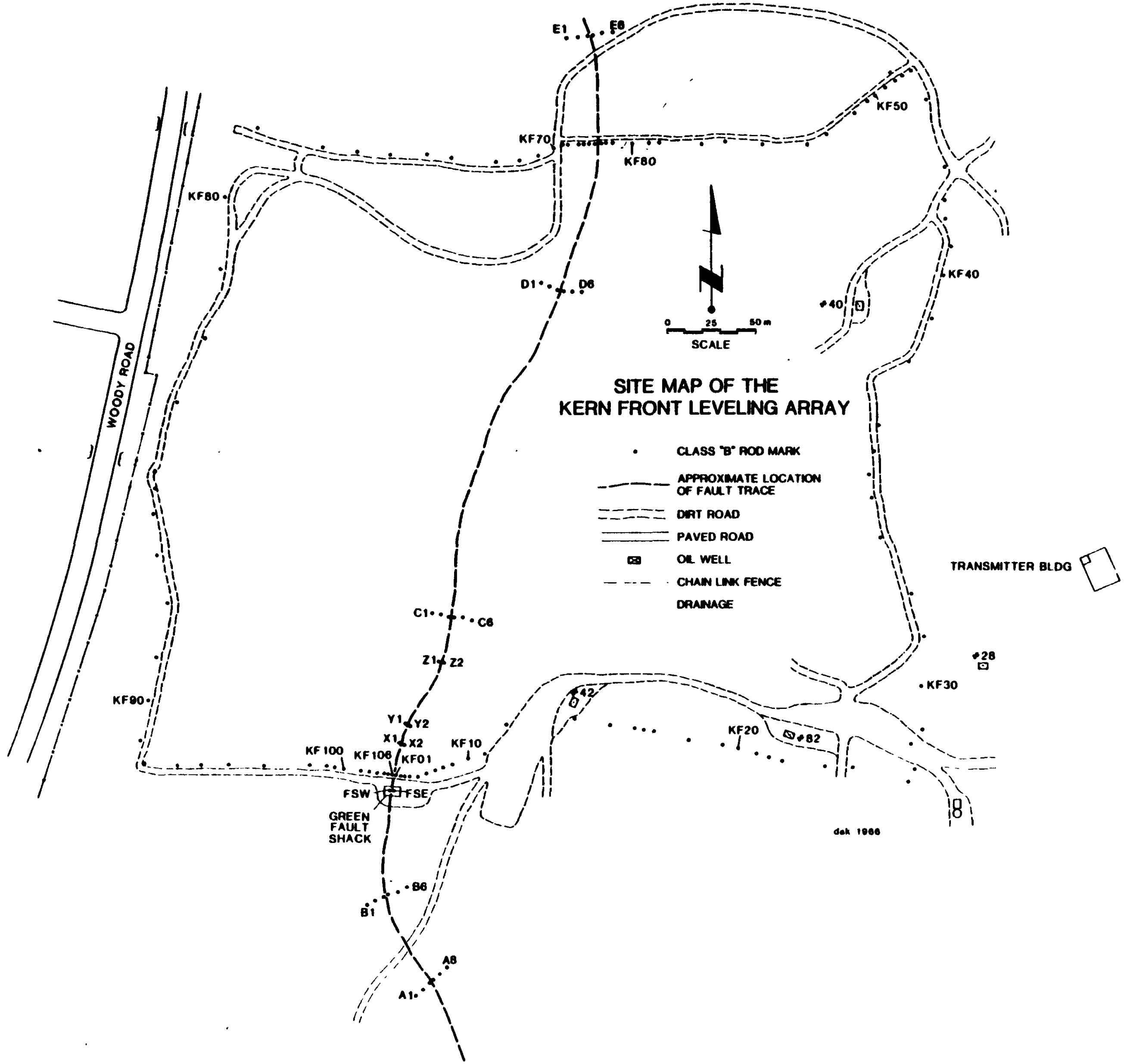
Nason, R.D., F.R. Philippsborn and P.A. Yamashita. 1974. Catalog of creepmeter measurements in central California from 1968 to 1972. U.S. Geological Survey Open File Report 74-31, 387 p.

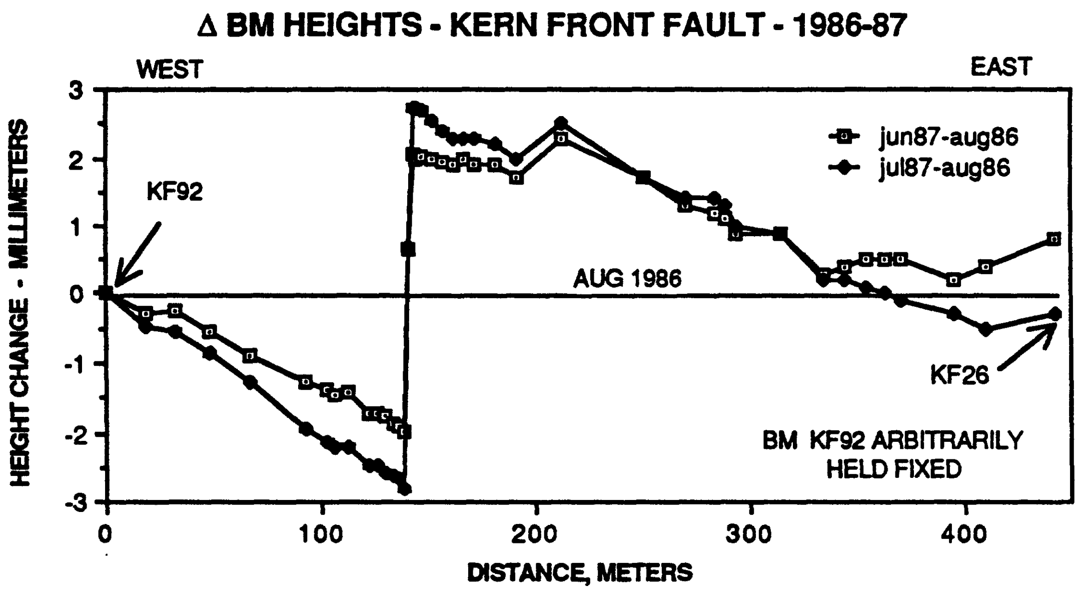
OILDALE QUADRANGLE
CALIFORNIA—KERN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

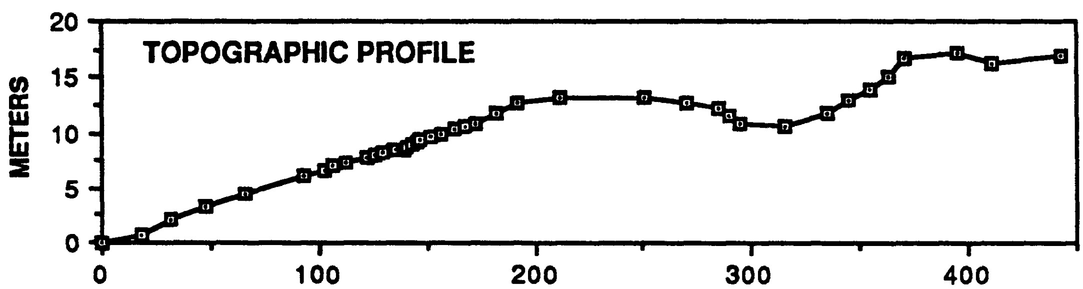


SCALE 1:24 000




SITE MAP OF THE
KERN FRONT LEVELING ARRAY
CLASS "B" ROD MARK
APPROXIMATE LOCATION OF FAULT TRACE
DIRT ROAD
PAVED ROAD
OIL WELL
CHAIN LINK FENCE
DRAINAGE
SCALE
0
25
50 m
WOODY ROAD
TRANSMITTER BLDG
GREEN FAULT SHACK
FSW
FSE
E1
E6
D1
D6
C1
C6
Z1
Z2
Y1
Y2
X1
X2
B1
B6
A1
A6
KF01
KF10
KF20
KF30
KF40
KF50
KF60
KF70
KF80
KF90
KF100
KF106
#28
#40
#42
#82
dek 1986


Δ BM HEIGHTS - KERN FRONT FAULT - 1986-87
WEST
EAST
jun87-aug86
jul87-aug86
KF92
AUG 1986
KF26
BM KF92 ARBITRARILY HELD FIXED
HEIGHT CHANGE - MILLIMETERS
DISTANCE, METERS
3
2
1
0
-1
-2
-3
0
100
200
300
400


TOPOGRAPHIC PROFILE
METERS
20
15
10
5
0
0
100
200
300
400

OILDALE, CALIFORNIA KERN FRONT AUGUST 19, 1986

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
KF01	KF02	42.950
KF02	KF03	13.043
KF03	KF04	23.090
KF04	KF05	25.682
KF05	KF06	18.739
KF06	KF07	42.869
KF07	KF08	30.827
KF08	KF09	37.457
KF09	KF10	86.244
KF10	KF11	80.956
KF11	KF12	58.203
KF12	KF13	4.425
KF13	KF14	-44.834
KF14	KF15	-52.025
KF15	KF16	-64.076
KF16	KF17	-89.248
KF17	KF18	-25.199
KF18	KF19	117.611
KF19	KF20	135.377
KF20	KF21	96.856
KF21	KF22	111.511
KF22	KF23	151.955
KF23	KF24	59.630
KF24	KF25	-104.595
KF25	KF26	81.690
KF26	KF27	95.901
KF27	KF28	173.450
KF28	KF29	171.516
KF29	KF30	47.856
KF30	KF34	-167.456
KF34	KF35	-165.500
KF35	KF39	23.190
KF39	KF40	129.875
KF40	KF41	157.972
KF41	KF42	164.595
KF42	KF43	133.018
KF43	KF44	96.072
KF44	KF45	40.319
KF45	KF46	-75.473
KF46	KF47	-117.480
KF47	KF48	-75.288
KF48	KF49	-80.620
KF49	KF50	-91.791
KF50	KF51	-84.044
KF51	KF52	-119.444
KF52	KF53	-211.099
KF53	KF54	-116.035
KF54	KF55	-130.358
KF55	KF56	-123.459
KF56	KF57	-120.323

KF57	KF58	-117.232
KF58	KF59	-38.958
KF59	KF60	-9.908
KF60	KF61	-0.354
KF61	KF62	9.538
KF62	KF63	6.572
KF63	KF64	10.485
KF64	KF65	-39.505
KF65	KF66	-7.126
KF66	KF67	0.425
KF67	KF68	-10.539
KF68	KF69	-15.378
KF69	KF70	-63.732
KF70	KF71	-68.738
KF71	KF72	-108.665
KF72	KF73	-106.525
KF73	KF74	-132.440
KF74	KF75	-108.491
KF75	KF76	-115.616
KF76	KF77	-96.449
KF77	KF78	-145.588
KF78	KF79	-161.172
KF79	KF80	-97.182
KF80	KF81	-65.435
KF81	KF82	-68.999
KF82	KF83	-33.837
KF83	KF84	-65.322
KF84	KF85	146.559
KF85	KF86	117.930
KF86	KF87	102.147
KF87	KF88	97.539
KF88	KF89	-116.834
KF89	KF90	-113.800
KF90	KF91	48.871
KF91	KF92	114.175
KF92	KF93	78.686
KF93	KF94	140.069
KF94	KF95	121.966
KF95	KF96	104.154
KF96	KF97	171.957
KF97	KF98	46.484
KF98	KF99	35.253
KF99	KF100	24.165
KF100	KF101	58.214
KF101	KF102	22.803
KF102	KF103	9.774
KF103	KF104	25.553
KF104	KF105	5.863
KF105	KF106	-1.360

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
KF92	KF93	78.639	
KF93	KF94	140.063	
KF94	KF95	121.933	
KF95	KF96	104.113	
KF96	KF97	171.889	
KF97	KF98	46.466	
KF98	KF99	35.246	
KF99	KF100	24.164	
KF100	KF101	58.186	
KF101	KF102	22.803	
KF102	KF103	9.767	
KF103	KF104	25.547	
KF104	KF105	5.859	
KF105	KF106	-1.375	
KF106	KF01	15.805	
KF01	FSW	11.591	single run, 1 shots.
KF01	KF02	43.153	
KF02	KF03	13.045	
KF03	KF04	23.085	
KF04	KF05	25.665	
KF05	KF06	18.727	
KF06	KF07	42.861	
KF07	KF08	30.823	
KF08	KF09	37.453	
KF09	KF10	86.246	
KF10	KF11	80.925	
KF11	KF12	58.249	
KF12	KF13	4.359	
KF13	KF14	-44.868	
KF14	KF15	-52.031	
KF15	KF16	-64.084	
KF16	KF17	-89.274	
KF17	KF18	-25.213	
KF18	KF19	117.542	
KF19	KF20	135.376	
KF20	KF21	96.847	
KF21	KF22	111.499	
KF22	KF23	151.956	
KF23	KF24	59.606	
KF24	KF25	-104.617	
KF25	KF26	81.702	

KOEHN LAKE Leveling Array

Latitude:	35°22'16"	**Length:**	1002.7m
Longitude:	117°51'03"	**Number of Bench marks:**	60
Date of Initial Survey:	30 August 1984	**Number of Surveys to 1988:**	4
Trespass Permission:	None needed.		

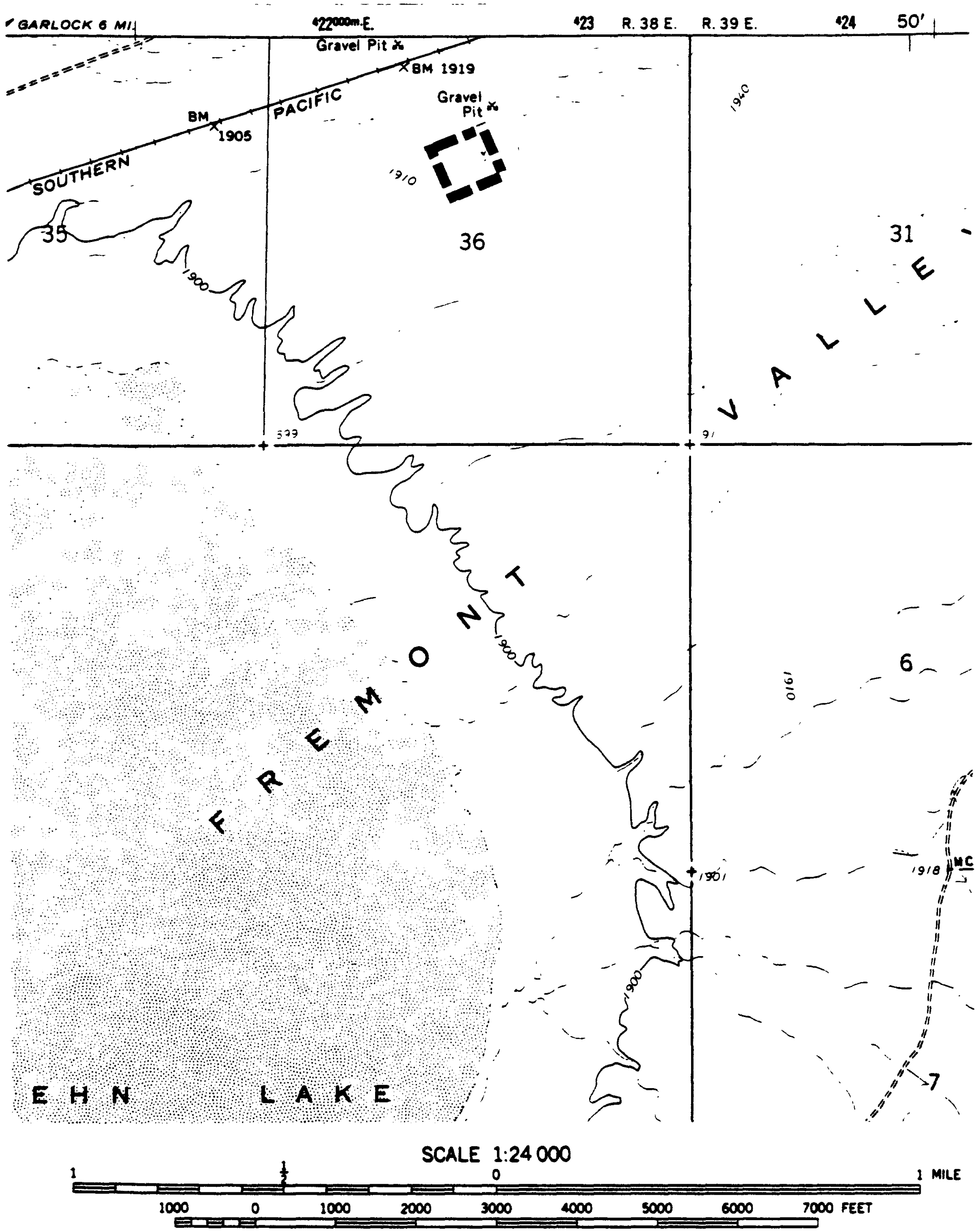
Comments:

This is a box-shaped array across the Garlock fault, one mile southeast of Saltdale. The southwest leg of the array is adjacent to the trench site described by Burke (1979).

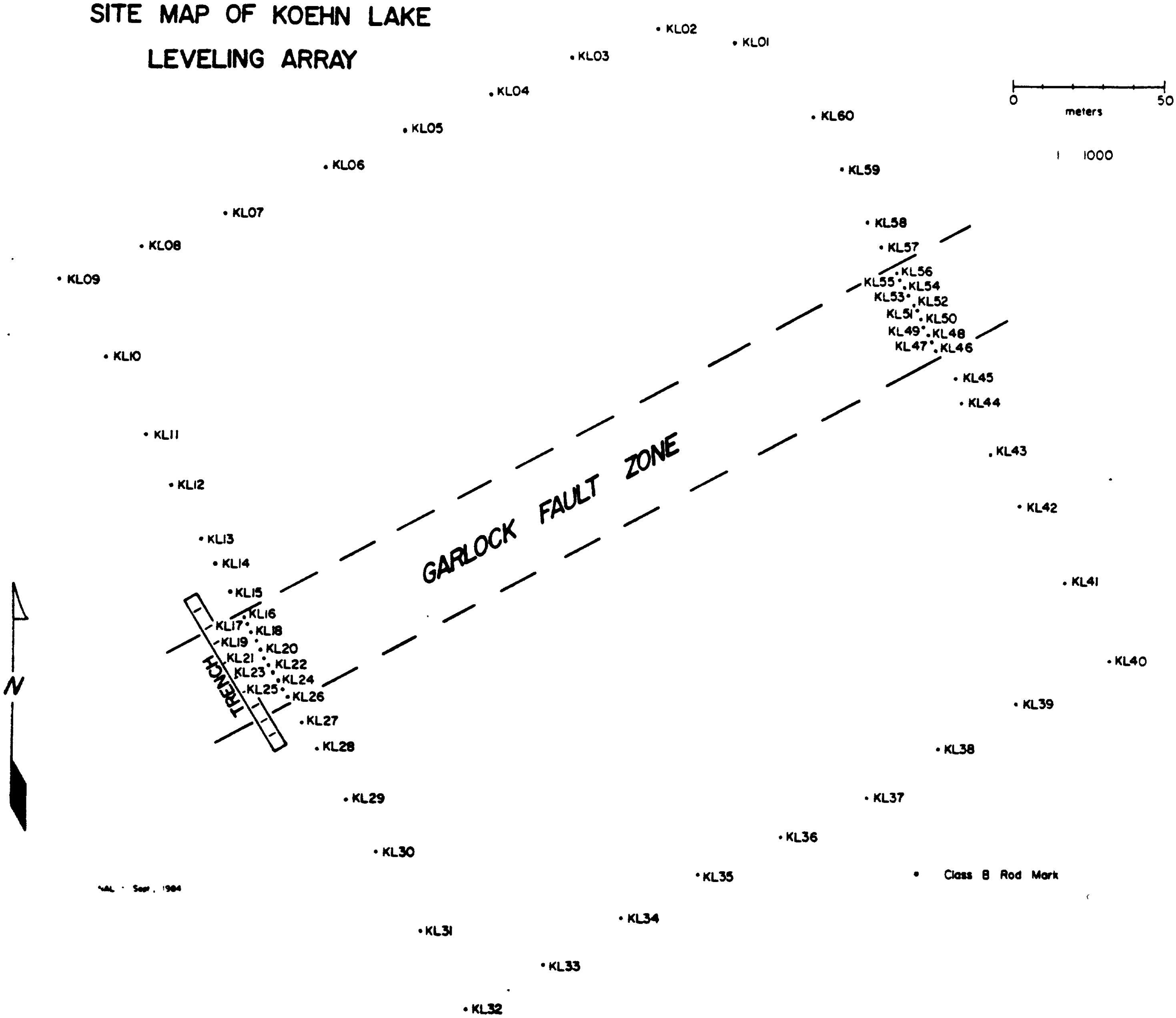
Four levelings in the period 1984 - 1987 reveal nearly 5mm of subsidence of the southeast block relative to the northwest block across a zone about 30m wide. The subsidence of bench marks in the southeast leg of the array may be due to the fact that these bench marks are located in a thick sequence of unconsolidated lake beds.

Reference cited: Burke, D.B. 1979. Log of a trench in the Garlock fault zone, Fremont Valley, California. U.S. Geological Survey Map MF 1028.

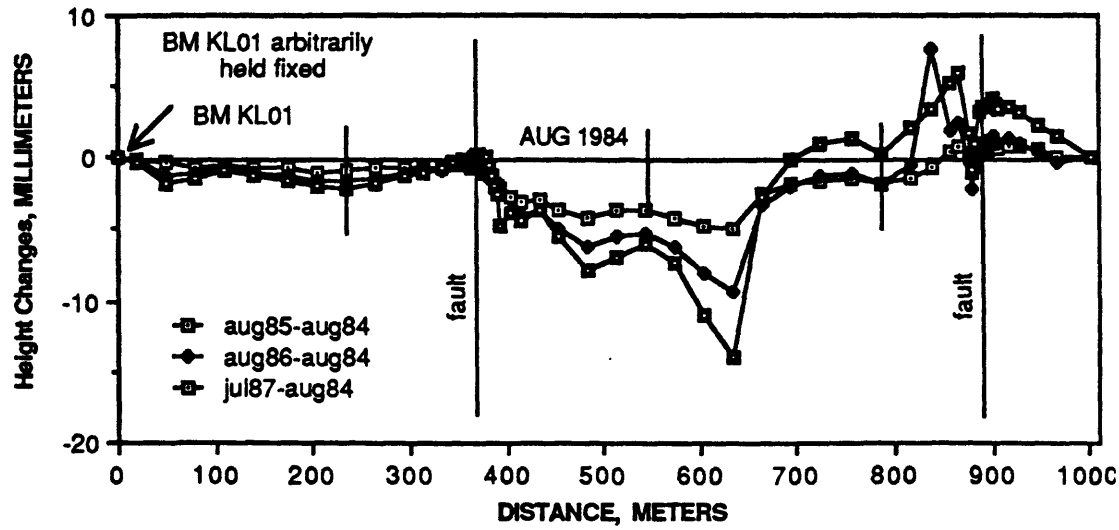
SALTDALE SE QUADRANGLE
CALIFORNIA–KERN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

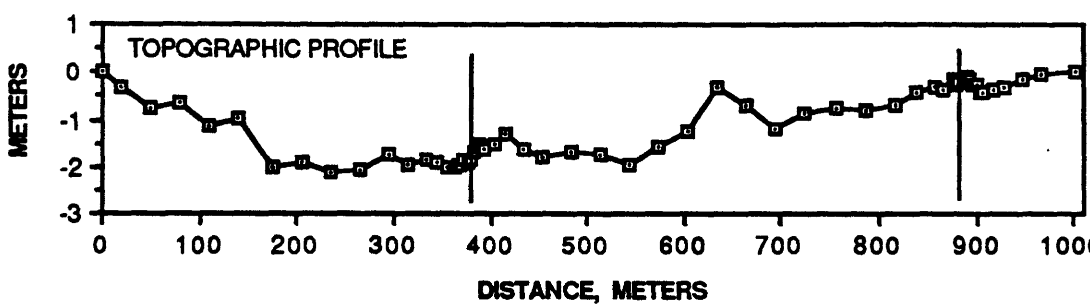


SITE MAP OF KOEHN LAKE LEVELING ARRAY



Δ BM HEIGHTS - KOEHN LAKE - 1984-1987





******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
KL01	KL02	-33.317
KL02	KL03	-43.871
KL03	KL04	10.977
KL04	KL05	-46.230
KL05	KL06	15.205
KL06	KL07	-103.522
KL07	KL08	8.254
KL08	KL09	-22.222
KL09	KL10	6.634
KL10	KL11	32.072
KL11	KL12	-18.694
KL12	KL13	8.631
KL13	KL14	-2.500
KL14	KL15	-10.407
KL15	KL16	-4.950
KL16	KL17	10.285
KL17	KL18	-2.703
KL18	KL19	9.258
KL19	KL20	-3.057
KL20	KL21	5.212
KL21	KL22	14.136
KL22	KL23	12.078
KL23	KL24	6.926
KL24	KL25	-4.201
KL25	KL26	-6.112
KL26	KL27	10.091
KL27	KL28	22.224
KL28	KL29	-33.504
KL29	KL30	-13.960
KL30	KL31	11.200
KL31	KL32	-9.792
KL32	KL33	-19.819
KL33	KL34	38.505
KL34	KL35	30.374
KL35	KL36	95.863
KL36	KL37	-40.031
KL37	KL38	-45.549
KL38	KL39	31.031
KL39	KL40	9.298
KL40	KL41	-5.157

KL41	KL42	12.776
KL42	KL43	24.605
KL43	KL44	13.137
KL44	KL45	-7.303
KL45	KL46	23.788
KL46	KL47	-11.742
KL47	KL48	6.720
KL48	KL49	3.178
KL49	KL50	4.220
KL50	KL51	-2.686
KL51	KL52	-11.928
KL52	KL53	0.541
KL53	KL54	2.495
KL54	KL55	-19.457
KL55	KL56	1.894
KL56	KL57	2.956
KL57	KL58	4.462
KL58	KL59	15.871
KL59	KL60	15.155

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
KL01	KL02	-33.346
KL02	KL03	-44.023
KL03	KL04	11.024
KL04	KL05	-46.189
KL05	KL06	15.182
KL06	KL07	-103.565
KL07	KL08	8.213
KL08	KL09	-22.232
KL09	KL10	6.668
KL10	KL11	32.121
KL11	KL12	-18.665
KL12	KL13	8.663
KL13	KL14	-2.464
KL14	KL15	-10.389
KL15	KL16	-4.947
KL16	KL17	10.305
KL17	KL18	-2.692
KL18	KL19	9.249
KL19	KL20	-3.071
KL20	KL21	5.209
KL21	KL22	14.089
KL22	KL23	12.012
KL23	KL24	6.840
KL24	KL25	-4.245
KL25	KL26	-6.337
KL26	KL27	10.189
KL27	KL28	22.160
KL28	KL29	-33.420
KL29	KL30	-14.151
KL30	KL31	10.961
KL31	KL32	-9.700
KL32	KL33	-19.730
KL33	KL34	38.369
KL34	KL35	30.026
KL35	KL36	95.570
KL36	KL37	-38.929
KL37	KL38	-45.287
KL38	KL39	31.132
KL39	KL40	9.347
KL40	KL41	-5.266

KL41	KL42	12.955
KL42	KL43	24.733
KL43	KL44	13.326
KL44	KL45	-7.224
KL45	KL46	23.363
KL46	KL47	-12.004
KL47	KL48	6.909
KL48	KL49	3.398
KL49	KL50	4.249
KL50	KL51	-2.674
KL51	KL52	-11.924
KL52	KL53	0.554
KL53	KL54	2.517
KL54	KL55	-19.488
KL55	KL56	1.856
KL56	KL57	2.980
KL57	KL58	4.420
KL58	KL59	15.788
KL59	KL60	15.088

LEWIS CREEK Level Line

Latitude:	36°17'42"	**Length:**	1715m
Longitude:	120°52'30"	**Number of Bench marks:**	49
Date of Initial Survey:	31 July 1985	**Number of Surveys to 1988:**	3
Trespass Permission:	Contact: Armand Rist P.O. Box 26 Lonoak Route King City, CA 93930 Level line is on a private ranch.		

Comments:

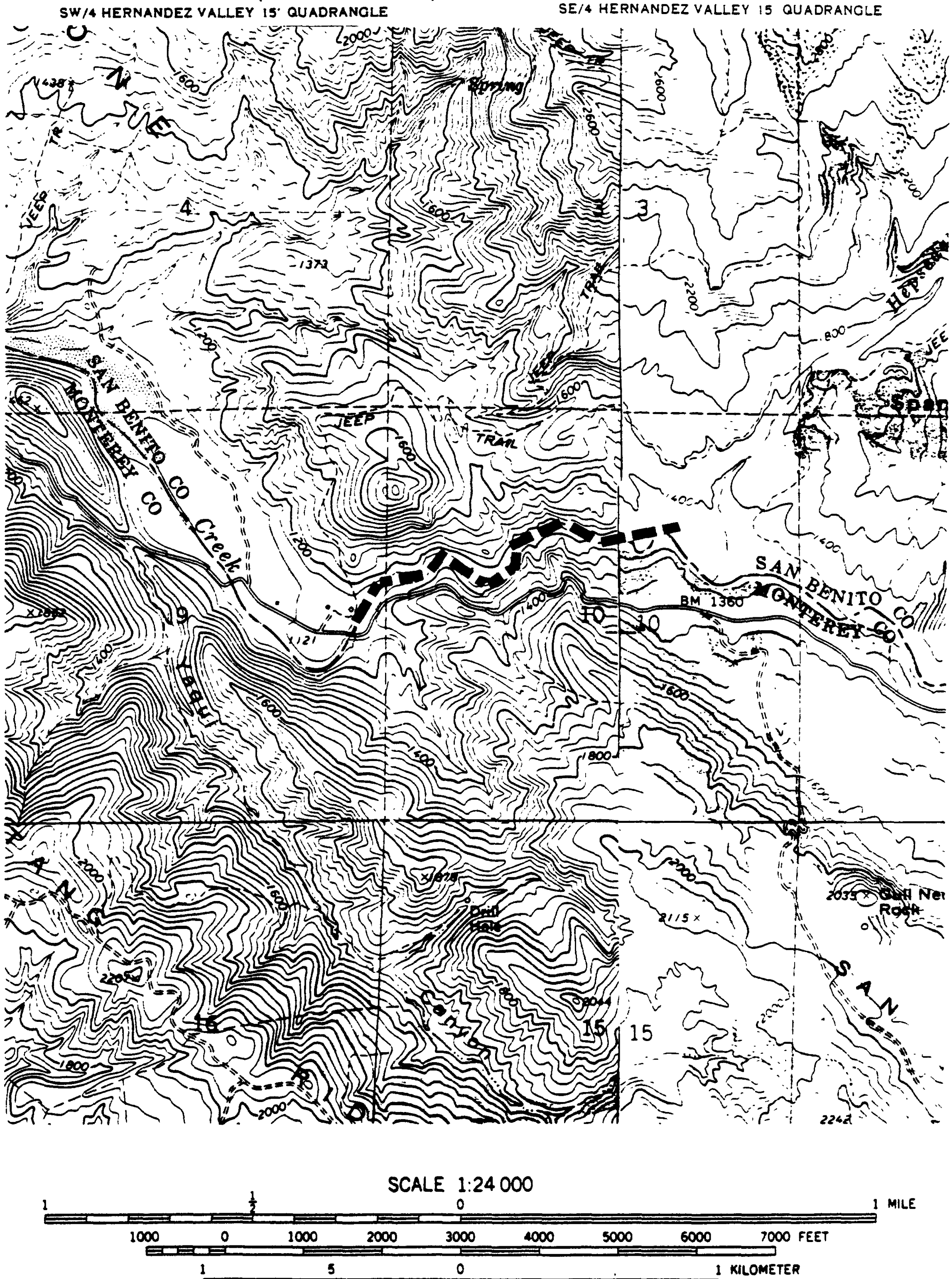
This line follows the floor of Lewis Creek across the San Andreas fault three and one-half miles east of Lonoak, on the San Benito-Monterey County line. Several of the bench marks are considered as little more than temporary, because they are in rather small boulders that may be dislodged during a flood.

Three levelings are graphed in an accompanying figure, and show that four Bench marks on the east side of the fault have risen progressively about 3mm/yr. The data suggest that a tectonic wedge perhaps 200m wide is rising relative to the remainer of the land. The horizontal creep in this segment of the fault is nearly 30mm/yr. (Burford and Harsh, 1980).

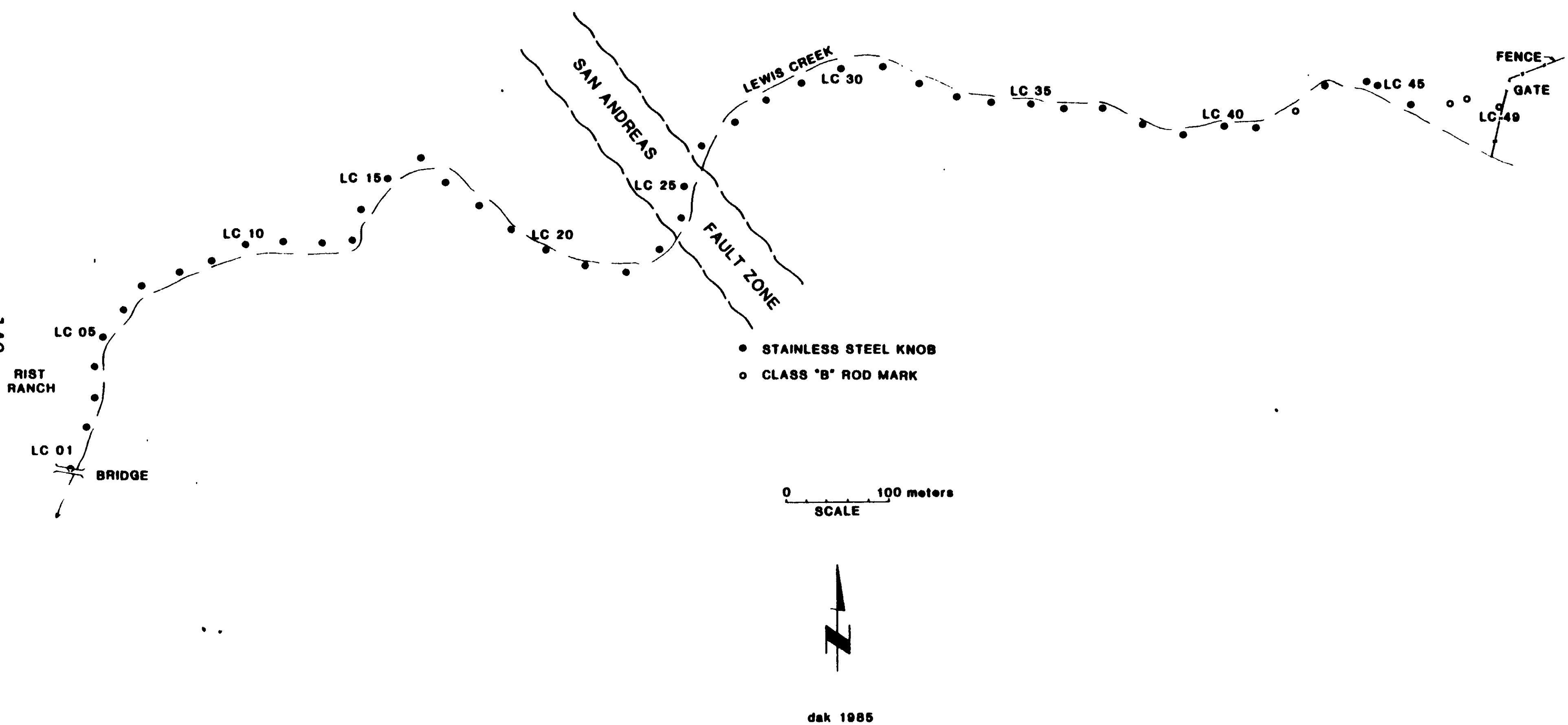
Reference Cited: Burford, R.O., and P.W. Harsh., 1980. Slip on the San Andreas fault from alignment array surveys. Seismological Society of America Bulletin 70, 1233-1262.

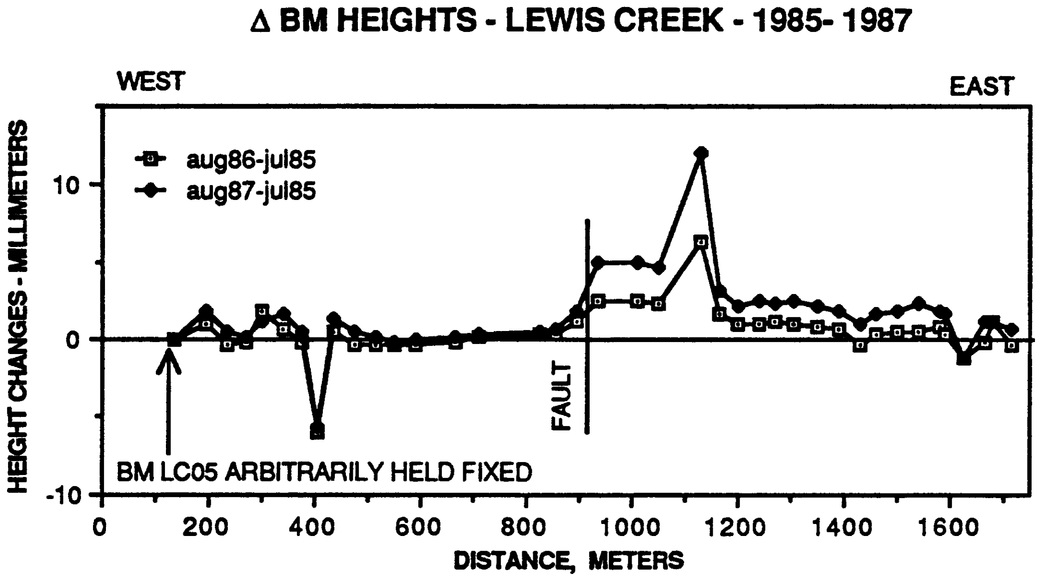
LONOAK QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 HERNANDEZ VALLEY 15' QUADRANGLE

HEPSEDAM PEAK QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 HERNANDEZ VALLEY 15 QUADRANGLE



SITE MAP OF THE LEWIS CREEK LEVELING ARRAY




Δ BM HEIGHTS - LEWIS CREEK - 1985- 1987
WEST
EAST
aug86-jul85
aug87-jul85
HEIGHT CHANGES - MILLIMETERS
10
0
-10
FAULT
BM LC05 ARBITRARILY HELD FIXED
0
200
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800
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1200
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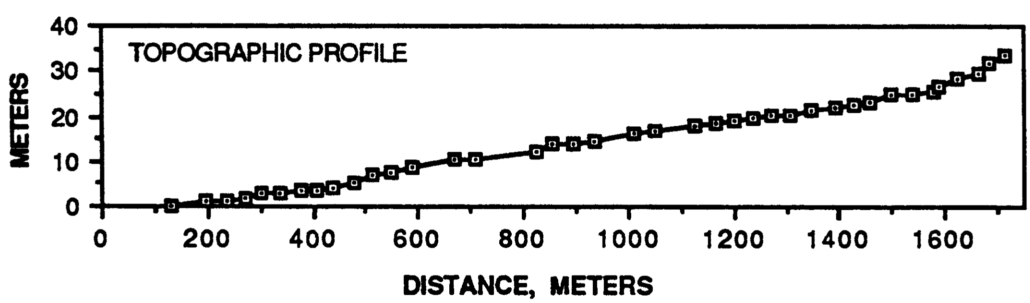
1600
DISTANCE, METERS


TOPOGRAPHIC PROFILE
METERS
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LC01	LC02	63.394
LC02	LC03	-17.101
LC03	LC04	74.823
LC04	LC05	106.537
LC05	LC06	76.830
LC06	LC07	35.531
LC07	LC08	12.593
LC08	LC09	43.826
LC09	LC10	134.167
LC10	LC11	-25.798
LC11	LC12	54.881
LC12	LC13	40.368
LC13	LC14	46.338
LC14	LC15	107.290
LC15	LC16	172.514
LC16	LC17	58.325
LC17	LC18	93.129
LC18	LC19	50.069
LC19	LC20	143.834
LC20	LC21	6.377
LC21	LC22	116.403
LC22	LC23	-4.875
LC23	LC24	69.057
LC24	LC25	139.766
LC25	LC26	19.779
LC26	LC27	78.602
LC27	LC28	15.583
LC28	LC29	132.278
LC29	LC30	73.409
LC30	LC31	103.142
LC31	LC32	17.513
LC32	LC33	64.578
LC33	LC34	21.423
LC34	LC35	51.544
LC35	LC36	62.039
LC36	LC37	22.313
LC37	LC38	104.351
LC38	LC39	81.679
LC39	LC40	66.581
LC40	LC41	52.815
LC41	LC42	127.769
LC42	LC43	44.567
LC43	LC44	14.362
LC44	LC45	142.406
LC45	LC46	182.662
LC46	LC47	87.432
LC47	LC48	223.668
LC48	LC49	226.676

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LC05	TP01	10.556
TP01	LC07	101.984
LC07	LC08	12.466
LC08	LC09	43.791
LC09	LC10	134.270
LC10	LC11	-25.743
LC11	LC12	54.758
LC12	LC13	39.744
LC13	LC14	47.044
LC14	LC15	107.197
LC15	LC16	172.482
LC16	LC17	58.302
LC17	LC18	93.135
LC18	TP02	57.835
TP02	LC20	136.095
LC20	LC21	6.402
LC21	LC22	81.761
LC22	TP03	-12.440
TP03	LC24	111.268
LC24	LC25	139.784
LC25	LC26	19.888
LC26	LC27	78.930
LC27	TP04	-46.299
TP04	LC29	194.155
LC29	LC30	73.385
LC30	LC31	107.093
LC31	LC32	14.310
LC32	LC33	63.673
LC33	LC34	21.322
LC34	LC35	51.576
LC35	LC36	62.030
LC36	LC37	22.318
LC37	LC38	104.316
LC38	LC39	81.645
LC39	LC40	66.503
LC40	LC41	52.878
LC41	LC42	127.794
LC42	LC43	44.621
LC43	LC44	14.308
LC44	LC45	142.379
LC45	LC46	182.393
LC46	LC47	87.654
LC47	LC48	223.677
LC48	LC49	226.614

LLANO Leveling Array

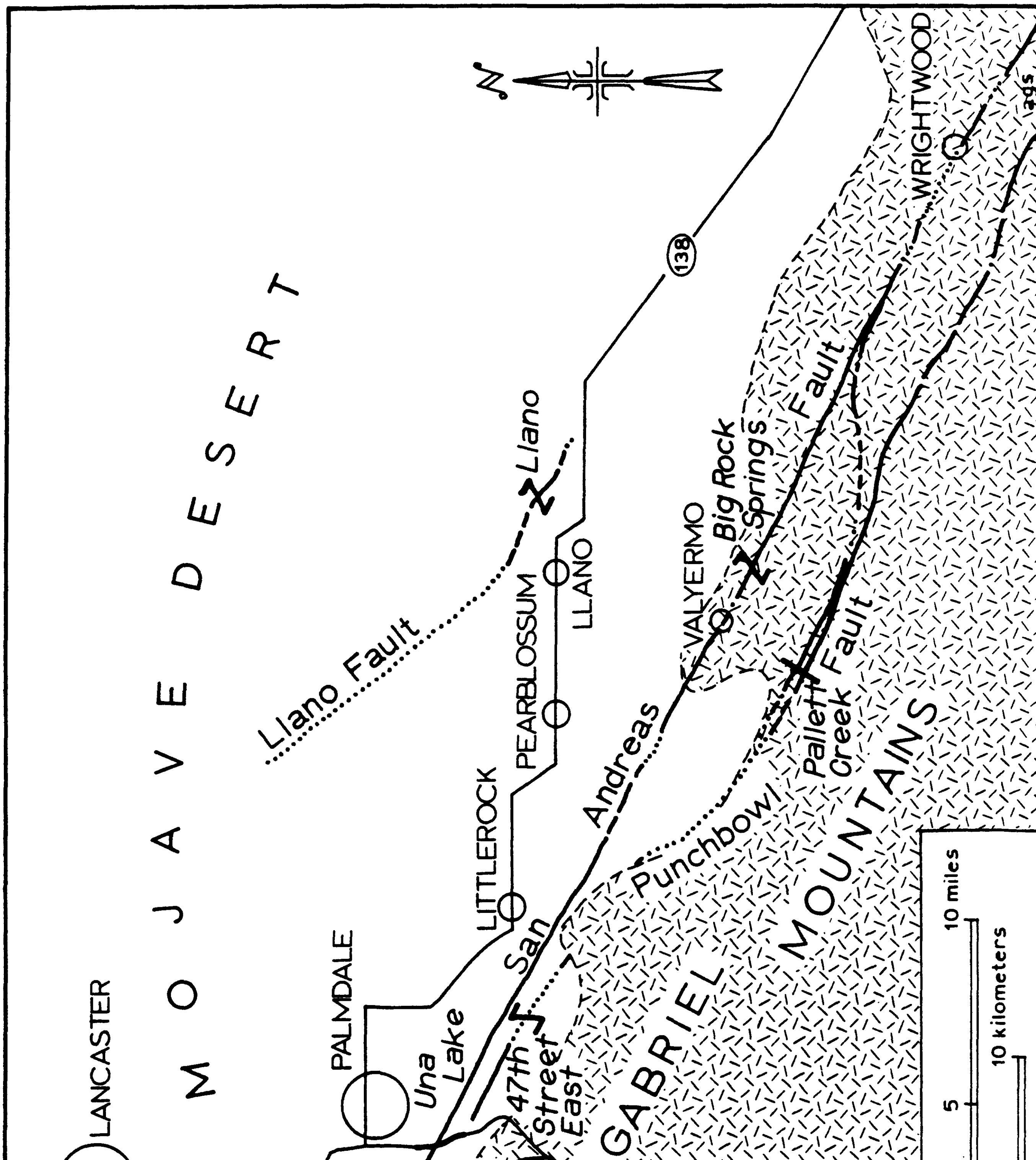
Latitude:	34°31'06"	**Length:**	619.1m
Longitude:	117°47'53"	**Number of Bench marks:**	26
Date of Initial Survey:	3 March 1981	**Number of Surveys to 1988:**	6
Trespass Permission:	None needed.		

Comments:

This is a Z-shaped array across the Llano fault described by Guptill and others (1979) 10 miles east of Littlerock. The bench marks have been subjected to considerable vandalism, especially those near the fault trace.

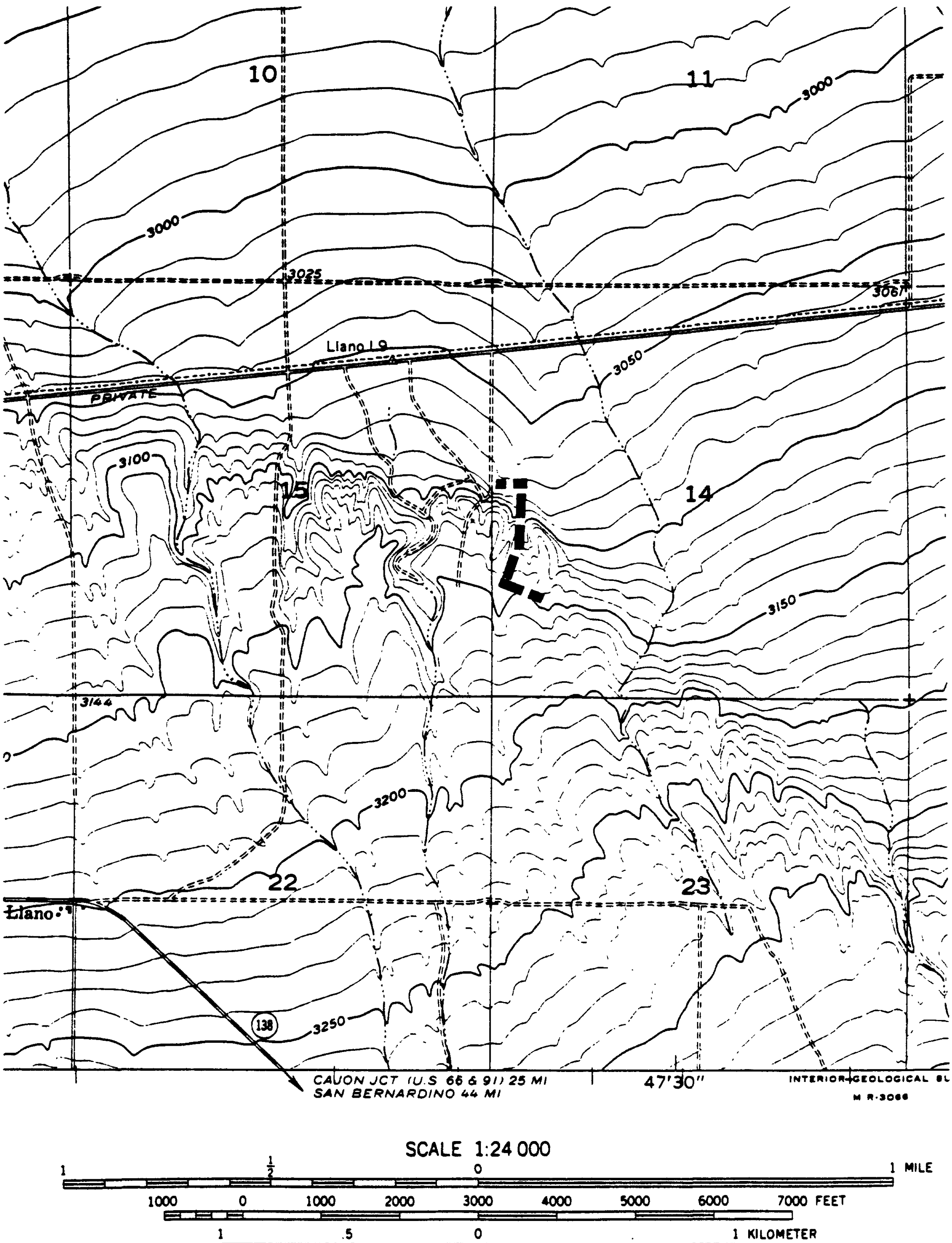
The most recent survey is plotted against the first survey in an accompanying graph, showing insignificant height changes of bench marks along the entire length of the line.

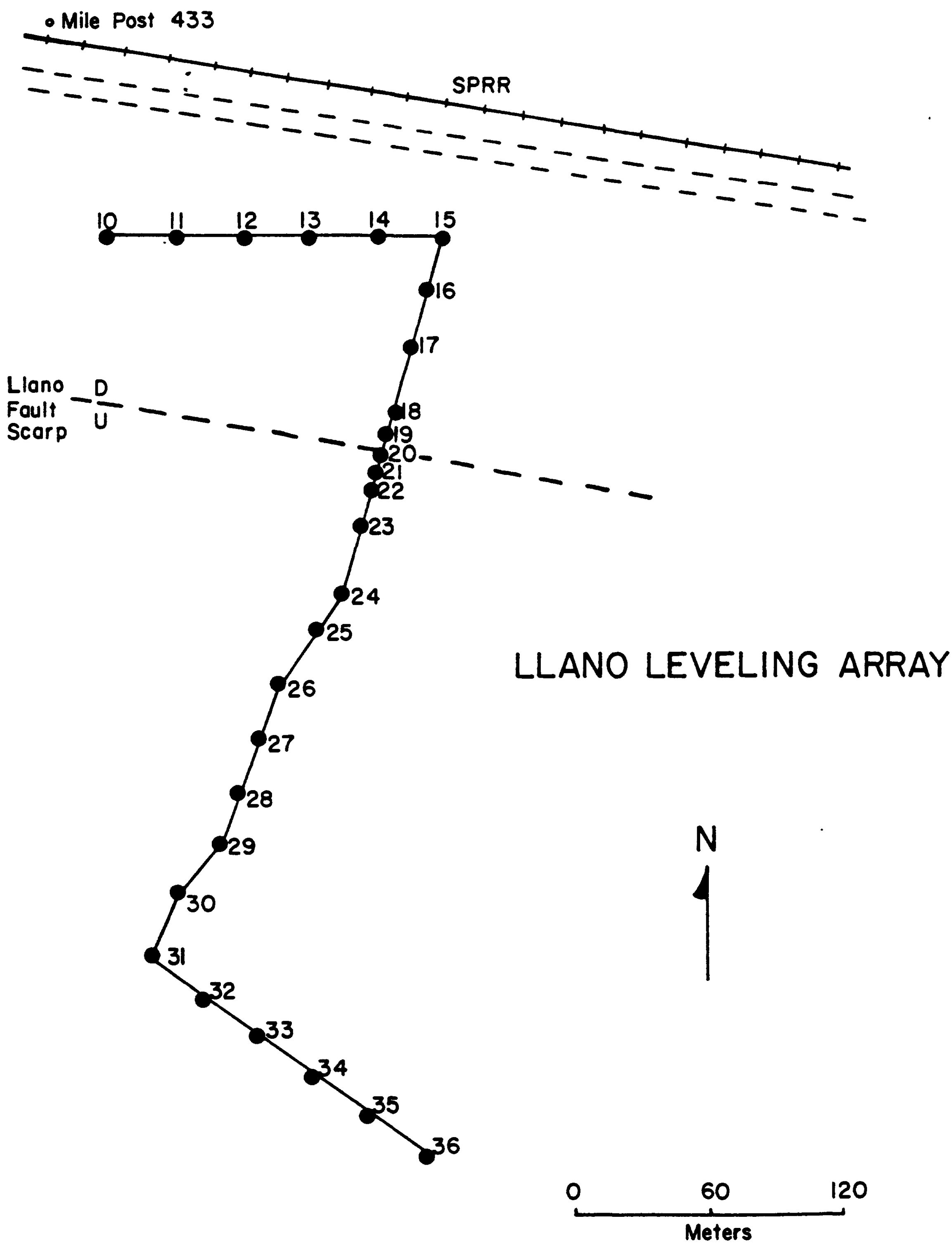
Reference cited: Guptill, P., D. Collins, R. Sugiura, and P. Birkhahn, 1979. Quaternary deformation along the Llano fault, southern Antelope Valley, California. Geological Society of America Abstracts with Programs (Cordilleran Section 11 (3), 81.



MOJAVE DESERT
LANCASTER
PALMDALE
LITTLEROCK
PEARBLOSSUM
LLANO
VALYERMO
WRIGHTWOOD
Llano Fault
Llano
Una Lake
47th Street East
San Andreas Fault
Big Rock Springs
Pallett Creek
Punchbowl Fault
SAN GABRIEL MOUNTAINS
138
6
N
0 5 10 miles
0 5 10 kilometers

LOVEJOY BUTTES QUADRANGLE
CALIFORNIA–LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 ALPINE BUTTE 15' QUADRANGLE





Mile Post 433
SPRR
10
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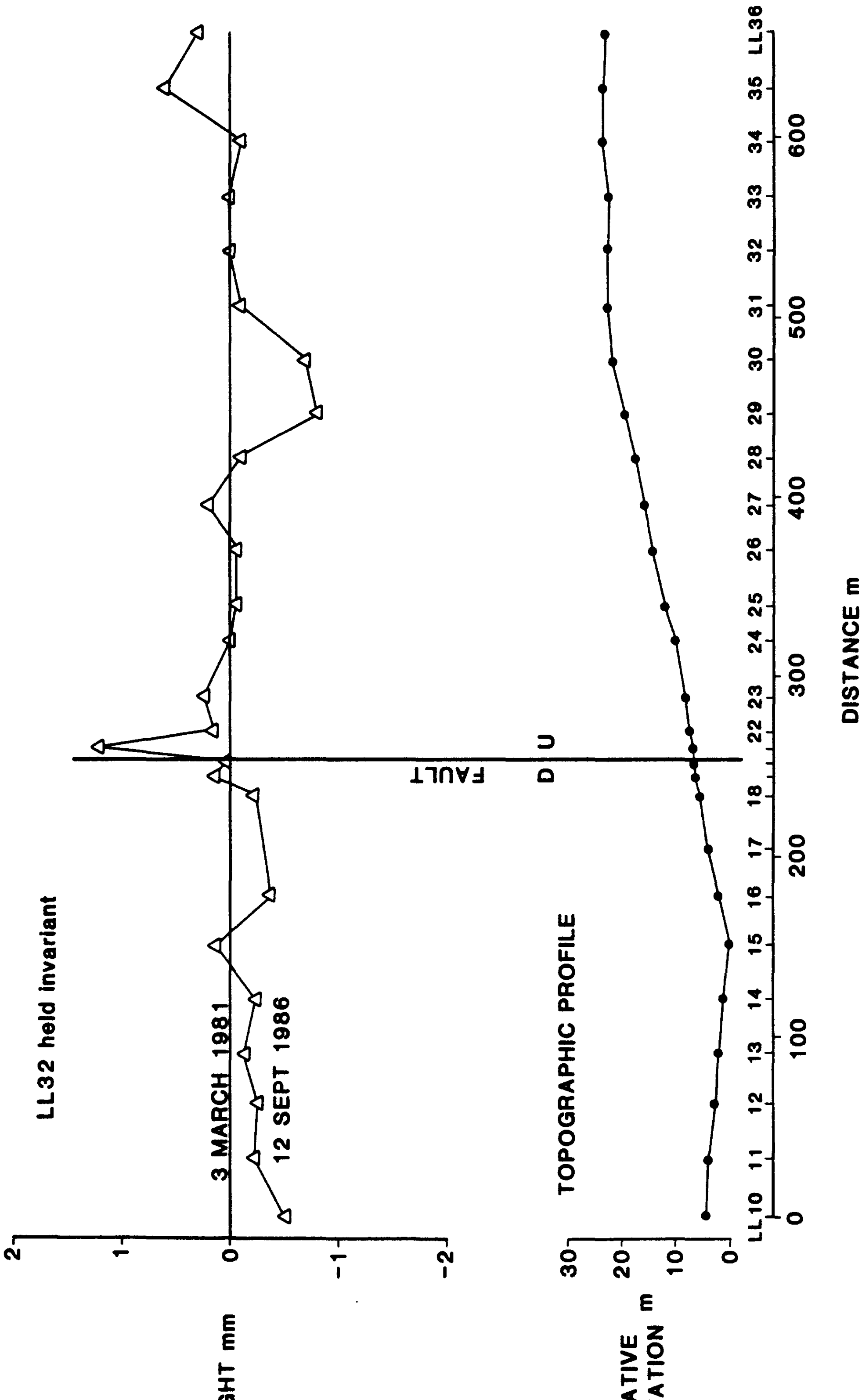
36
Llano
Fault
Scarp
D
U
LLANO LEVELING ARRAY
N
0
60
120
Meters


LL32 held invariant
3 MARCH 1981
12 SEPT 1986
Δ HEIGHT mm
2
1
0
-1
-2
FAULT
D U
D
TOPOGRAPHIC PROFILE
RELATIVE ELEVATION m
30
20
10
0
LL10
11
12
13
14
15
16
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23
24
25
26
27
28
29
30
31
32
33
34
35
LL36
0
100
200
300
400
500
600
DISTANCE m

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LL10	LL11	-77.578
LL11	LL12	-111.384
LL12	LL13	-91.933
LL13	LL14	-71.056
LL14	LL15	-42.949
LL15	LL16	114.215
LL16	LL17	183.398
LL17	LL18	188.248
LL18	LL19	61.097
LL19	LL20	29.392
LL20	LL21	59.710
LL21	LL22	53.796
LL22	LL23	113.110
LL23	LL24	158.241
LL24	LL25	157.107
LL25	LL26	196.600
LL26	LL27	190.805
LL27	LL28	165.478
LL28	LL29	183.475
LL29	LL30	191.194
LL30	LL31	144.232
LL31	LL32	39.447
LL32	LL33	1.896
LL33	LL34	39.744
LL34	LL35	-12.235
LL35	LL36	-11.457

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LL10	LL11	-77.550
LL11	LL12	-111.386
LL12	LL13	-91.919
LL13	LL14	-71.068
LL14	LL15	-42.939
LL15	LL16	114.190
LL16	LL17	182.658
LL17	LL18	189.005
LL18	LL19	61.131
LL19	LL20	29.380
LL20	LL21	59.766
LL21	LL22	53.756
LL22	LL23	113.116
LL23	LL24	158.218
LL24	LL25	157.117
LL25	LL26	196.584
LL26	LL27	190.830
LL27	LL28	165.448
LL28	LL29	183.402
LL29	LL30	191.208
LL30	LL31	144.297
LL31	LL32	39.456
LL32	LL33	1.894
LL33	LL34	39.740
LL34	LL35	-12.176
LL35	LL36	-11.489

LOST LAKE Leveling Array

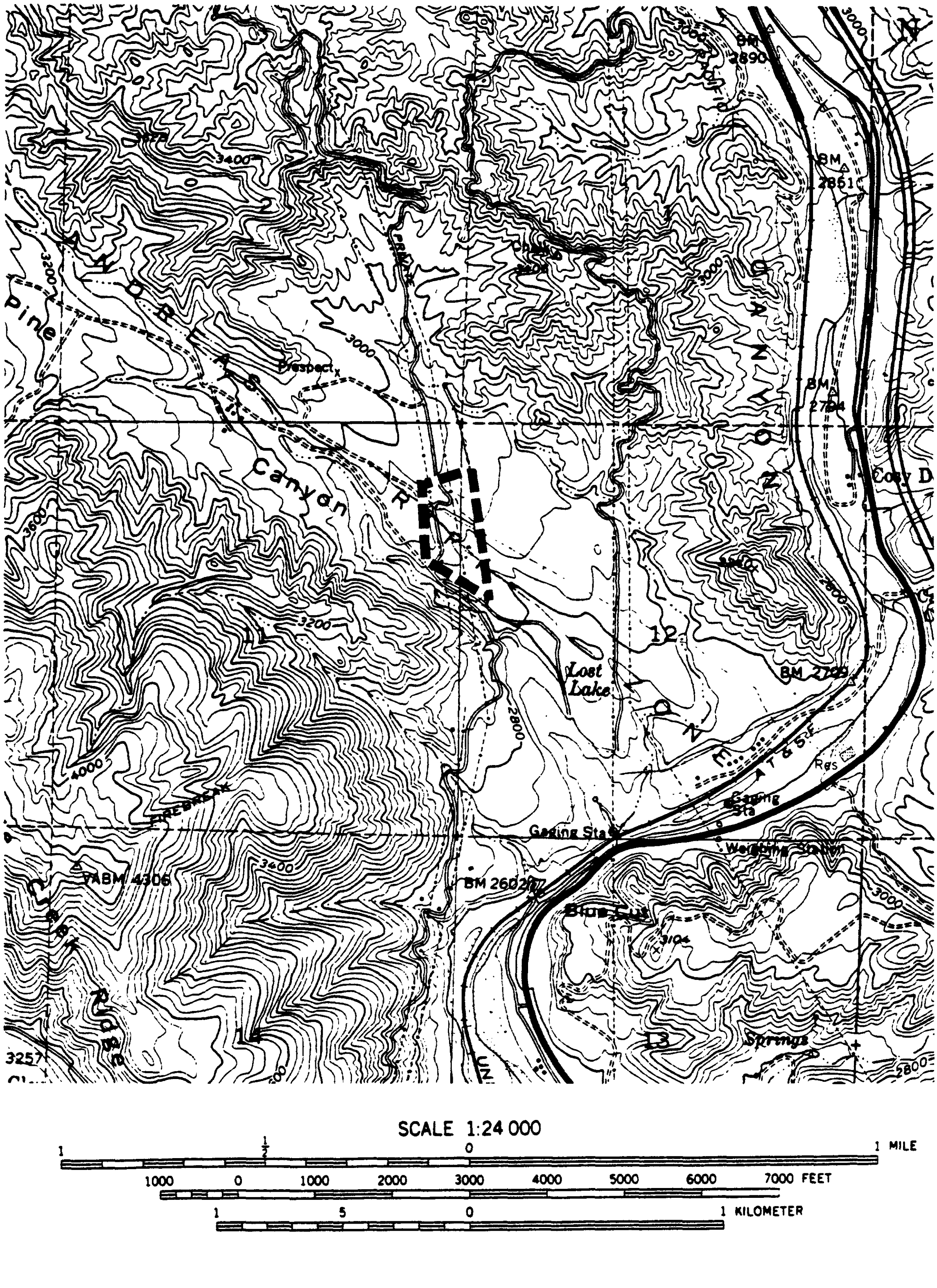
Latitude:	34°16'34"	**Length:**	1169.7m
Longitude:	117°28'00"	**Number of Bench marks:**	33
Date of Initial Survey:	18 July 1985	**Number of Surveys to 1988:**	4
Trespass Permission:	None needed.		

Comments:

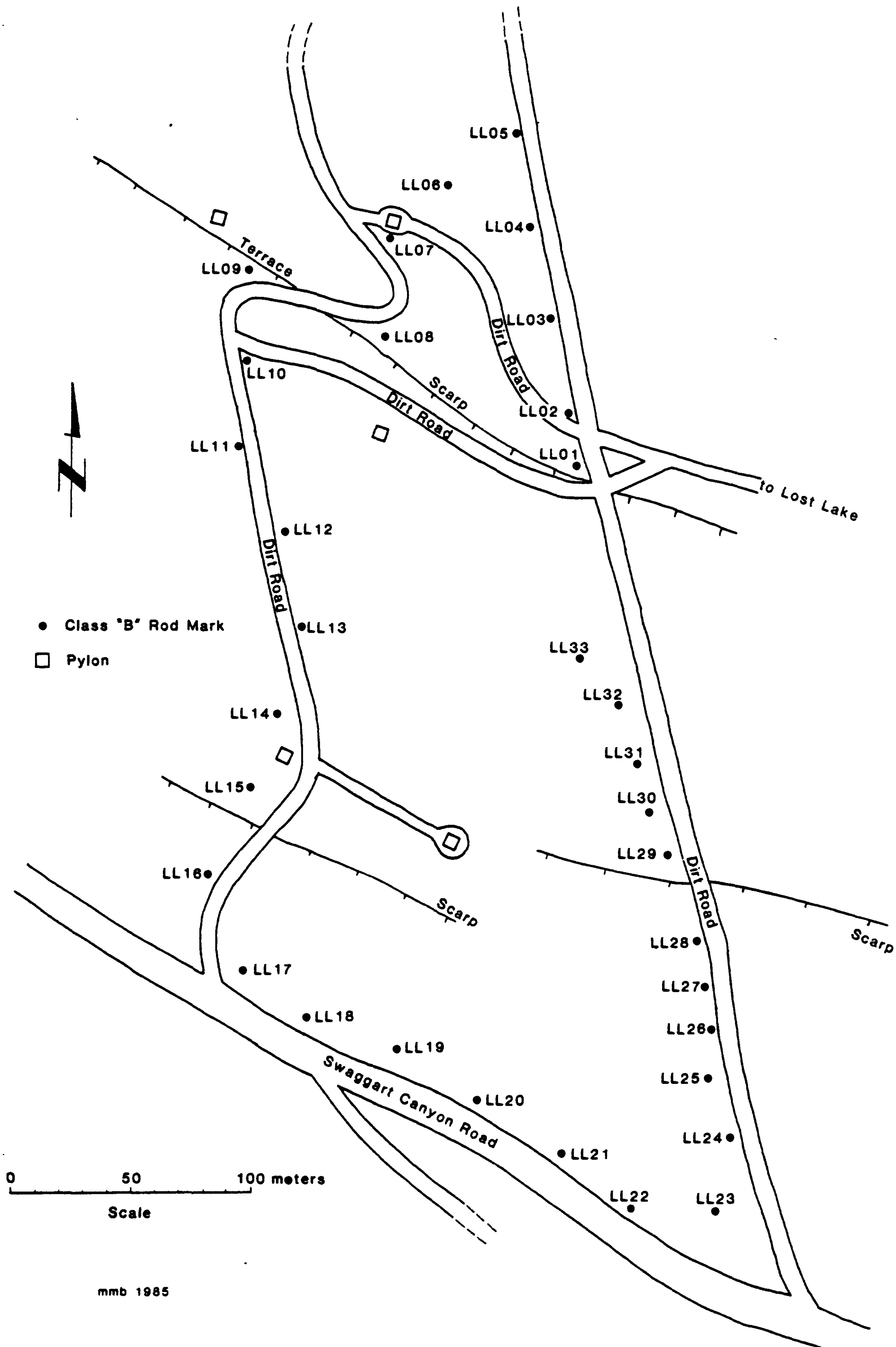
This is a box-shaped array across the San Andreas fault 100m northwest of Lost Lake and 1 mile south of Cajon Junction, in Cajon Pass.

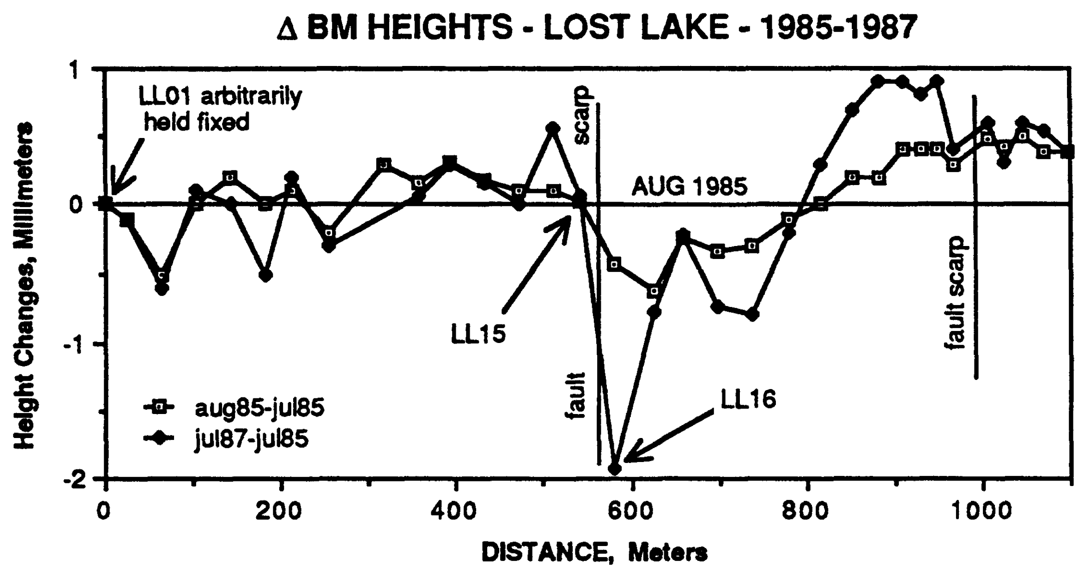
Three levelings of the array are compared in an accompanying graph. Two of the levelings were done one month apart in 1985 and show little variation among bench mark heights. The leveling two years later shows that bench marks on the relatively down dropped block southwest of the San Andreas fault scarp subsided as much as 2mm.

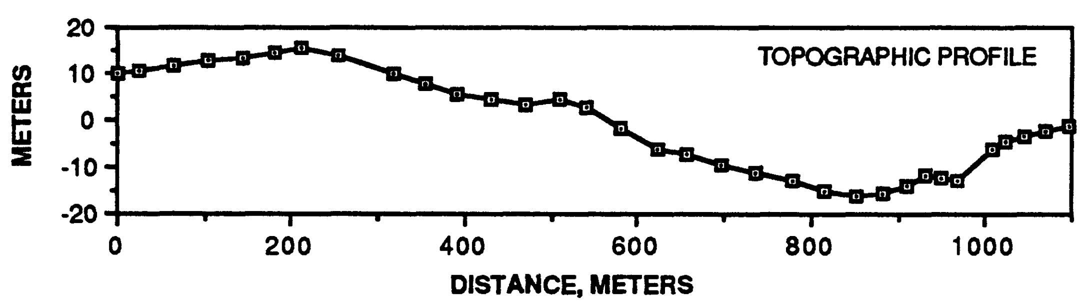
CAJON QUADRANGLE
CALIFORNIA–SAN BERNARDINO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



SITE MAP FOR THE LOST LAKE LEVELING ARRAY




Δ BM HEIGHTS - LOST LAKE - 1985-1987
LL01 arbitrarily held fixed
scarp
AUG 1985
LL15
fault
LL16
fault scarp
aug85-jul85
jul87-jul85
Height Changes, Millimeters
1
0
-1
-2
0
200
400
600
800
1000
DISTANCE, Meters


TOPOGRAPHIC PROFILE
METERS
20
10
0
-10
-20
0
200
400
600
800
1000
DISTANCE, METERS

SAN BERNARDINO, CALIFORNIA LOST LAKE AUGUST 29, 1985

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
LL01	LL02	74.215
LL02	LL03	72.842
LL03	LL04	129.463
LL04	LL05	65.050
LL05	LL06	127.578
LL06	LL07	79.234
LL07	LL08	-173.380
LL08	TP01	-162.724
TP01	TP02	-167.091
TP02	LL09	-41.623
LL09	LL10	-248.296
LL10	LL11	-181.571
LL11	LL12	-117.918
LL12	LL13	-139.608
LL13	LL14	121.326
LL14	LL15	-152.122
LL15	TP03	-239.629
TP03	LL16	-217.449
LL16	TP04	-203.457
TP04	LL17	-231.734
LL17	LL18	-123.573
LL18	LL19	-212.676
LL19	LL20	-184.388
LL20	LL21	-173.787
LL21	LL22	-198.248
LL22	LL23	-124.645
LL23	LL24	92.512
LL24	LL25	142.598
LL25	LL26	231.728
LL26	LL27	-58.714
LL27	LL28	-67.013
LL28	TP05	252.898
TP05	TP06	253.823
TP06	LL29	173.812
LL29	LL30	154.035
LL30	LL31	130.505
LL31	LL32	75.867
LL32	LL33	122.463
LL33	TP07	115.360
TP07	TP08	276.063
TP08	TP09	278.644
TP09	TP10	242.401

SAN BERNARDINO, CALIFORNIA   LOST LAKE   JULY 10, 1987

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
LL01	LL02	74.221	
LL02	LL03	72.793	
LL03	LL04	129.515	
LL04	LL05	65.025	
LL05	LL06	127.550	
LL06	L25D	10.507	single run, 1 shots.
LL06	LL07	79.286	
LL07	LL08	-173.401	
LL08	TP01	-190.687	
TP01	TP02	-170.797	
TP02	TP03	-143.688	
TP03	LL10	-114.556	
LL10	LL11	-181.562	
LL11	LL12	-117.920	
LL12	LL13	-139.617	
LL13	LL14	121.383	
LL14	LL15	-152.164	
LL15	TP04	-290.488	
TP04	LL16	-166.743	
LL16	TP05	-240.844	
TP05	LL17	-194.213	
LL17	LL18	-123.557	
LL18	LL19	-212.717	
LL19	LL20	-184.400	
LL20	LL21	-173.752	
LL21	LL22	-198.211	
LL22	LL23	-124.620	
LL23	LL24	92.536	
LL24	LL25	142.577	
LL25	LL26	231.725	
LL26	LL27	-58.710	
LL27	LL28	-67.057	
LL28	TP06	207.160	
TP06	TP07	269.015	
TP07	LL29	204.363	
LL29	LL30	154.014	
LL30	LL31	130.526	
LL31	LL32	75.872	
LL32	LL33	122.447	
LL33	TP08	137.016	
TP08	TP09	240.860	
TP09	TP10	282.573	
TP10	TP11	260.981	

MASSACRE CANYON Level Line

Latitude:	33°50'35"	**Length:**	989.4m
Longitude:	116°59'45"	**Number of Bench marks:**	29
Date of Initial Survey:	28 August 1985	**Number of Surveys to 1988:**	5
Trespass Permission:	None needed.		

Comments:

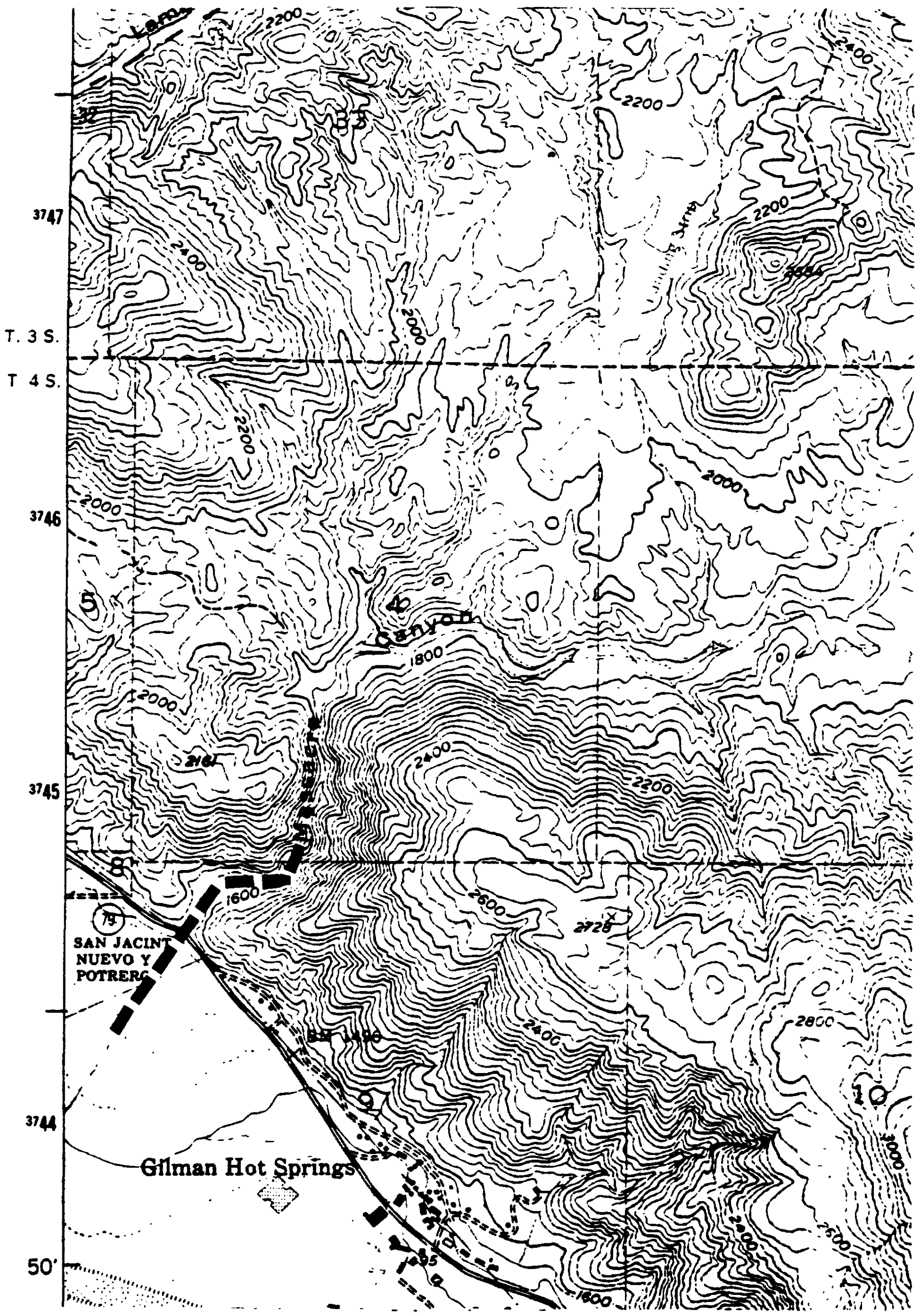
This line crosses the main strands of the San Jacinto fault on the northeast side of San Jacinto Valley, 2 miles north of San Jacinto, although the exact location of the fault is not known here owing to alluvial cover. The bench marks north of Gilman Road have been subjected to considerable vandalism.

Five levelings of the line in the time period August 1985 to July 1987 are compared in an accompanying figure. The bench marks established northeast of the fault in the mountain block vary insignificantly relative to one another, where those southwest of the fault in the San Jacinto Valley show a systematic change in height across a distance of about 300m. The maximum change is about 25mm. The fluctuations southwest of the fault may be due to seasonal withdrawal of water for irrigation.

SAN JACINTO QUADRANGLE

CALIFORNIA-RIVERSIDE CO.

7.5 MINUTE SERIES (TOPOGRAPHIC)

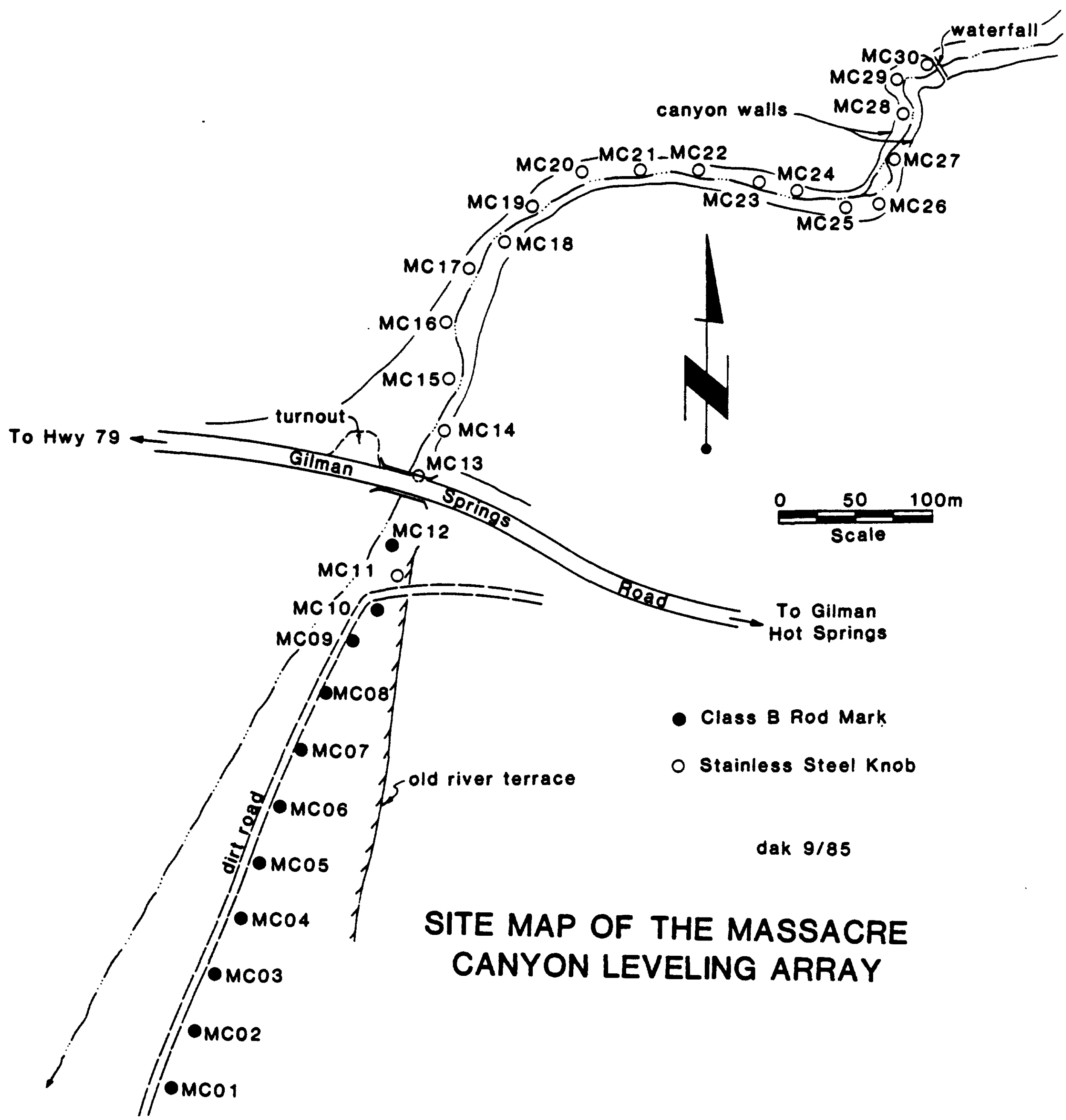


SCALE 1:24 000

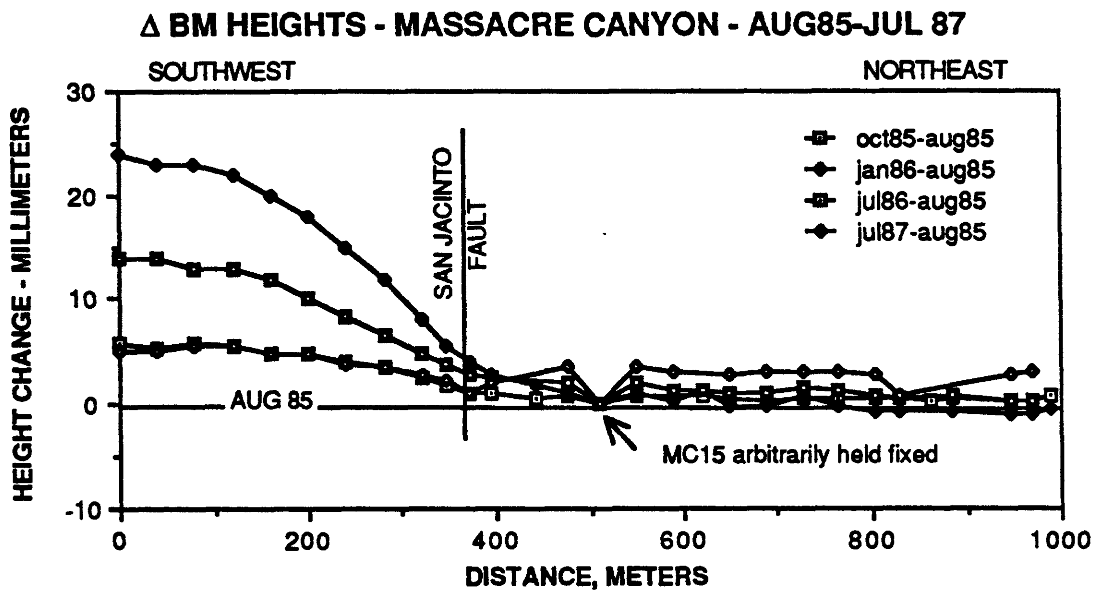
1 ½ 0 1 MILE

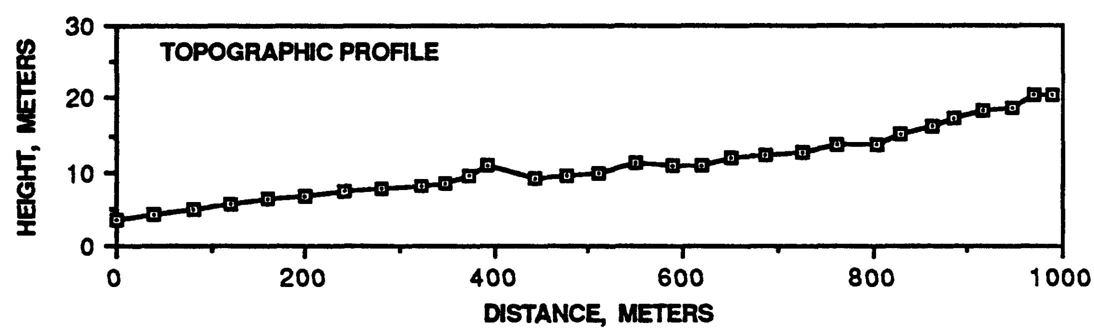
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER



SITE MAP OF THE MASSACRE CANYON LEVELING ARRAY


Δ BM HEIGHTS - MASSACRE CANYON - AUG85-JUL 87
SOUTHWEST
NORTHEAST
HEIGHT CHANGE - MILLIMETERS
30
20
10
0
-10
SAN JACINTO FAULT
oct85-aug85
jan86-aug85
jul86-aug85
jul87-aug85
AUG 85
MC15 arbitrarily held fixed
0
200
400
600
800
1000
DISTANCE, METERS


TOPOGRAPHIC PROFILE
HEIGHT, METERS
30
20
10
0
0
200
400
600
800
1000
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MA01	MA02	51.275
MA02	MA03	79.367
MA03	MA04	71.953
MA04	MA05	60.288
MA05	MA06	59.184
MA06	MA07	54.371
MA07	MA08	38.054
MA08	MA09	29.257
MA09	MA10	40.415
MA10	MA11	95.779
MA11	MA12	141.619
MA12	TP01	-236.577
TP01	TP02	21.764
TP02	MA13	50.853
MA13	MA14	52.617
MA14	MA15	32.553
MA15	MA16	114.288
MA16	MA17	-32.722
MA17	MA18	8.746
MA18	MA19	116.525
MA19	MA20	34.789
MA20	MA21	45.585
MA21	MA22	74.758
MA22	MA23	29.287
MA23	MA24	117.713
MA24	MA25	109.424
MA25	MA26	96.004
MA26	MA27	125.023
MA27	MA28	47.167
MA28	MA29	145.383
MA29	MA30	6.876

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MA01	MA02	51.299
MA02	MA03	79.398
MA03	MA04	71.954
MA04	MA05	60.218
MA05	MA06	59.177
MA06	MA07	54.289
MA07	MA08	38.032
MA08	MA09	29.180
MA09	MA10	40.362
MA10	MA11	95.651
MA11	MA12	141.716
MA12	TP01	-246.895
TP01	TP02	32.173
TP02	TPA	17.677
TPA	MA14	85.844
MA14	MA15	32.202
MA15	MA16	114.663
MA16	MA17	-32.796
MA17	TP03	-25.478
TP03	MA19	150.742
MA19	MA20	34.803
MA20	MA21	45.590
MA21	MA22	74.761
MA22	MA23	29.258
MA23	MA24	117.519
MA24	TP04	67.260
TP04	TP05	107.059
TP05	TP06	140.626
TP06	MA28	62.867
MA28	MA29	145.414

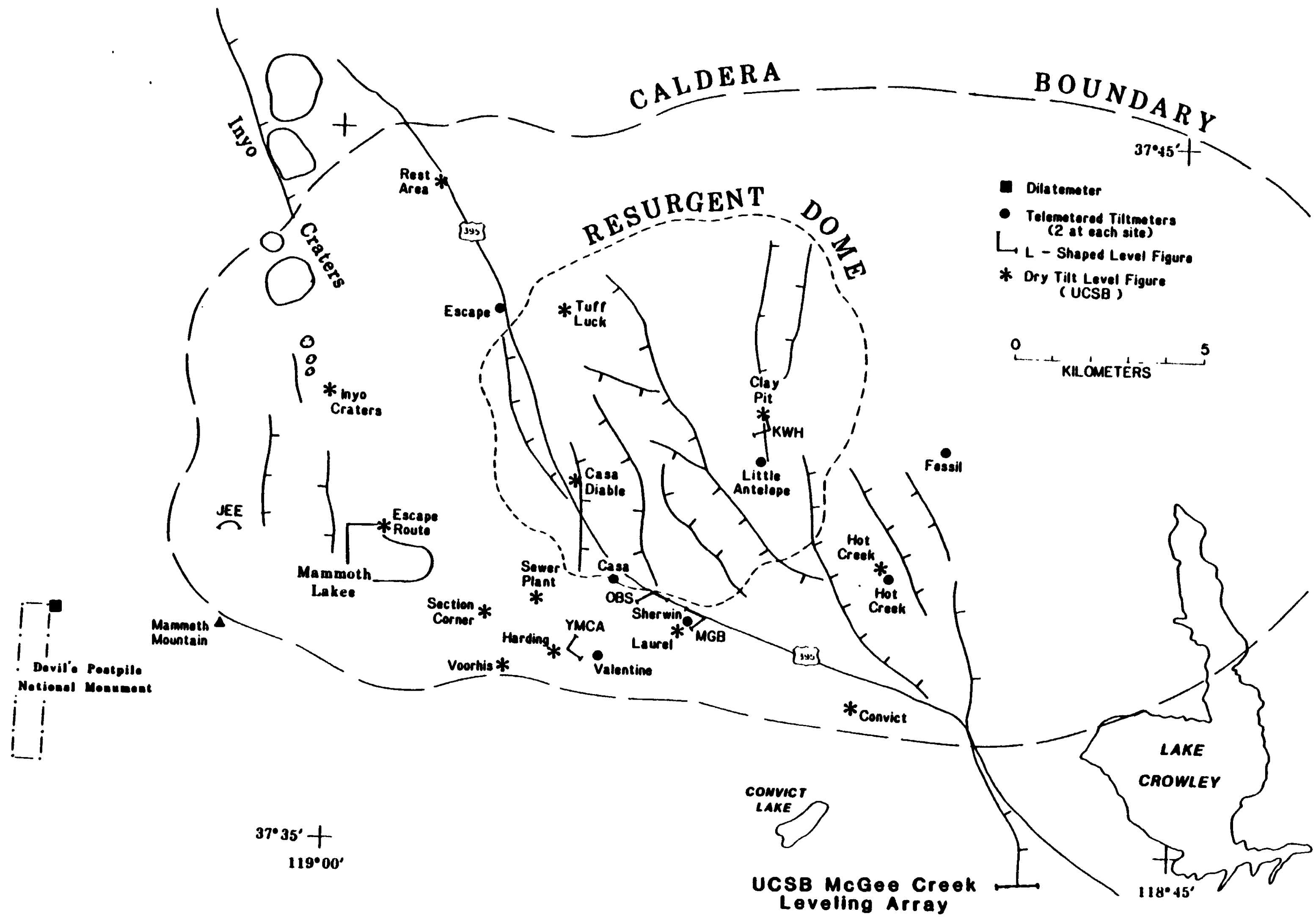
McGEE CREEK Level Line

Latitude:	37°33'29"	**Length:**	627.8m
Longitude:	118°47'08"	**Number of Bench marks:**	29
Date of Initial Survey:	9 July 1982	**Number of Surveys to 1988:**	10
Trespass Permission:	None needed.		

Comments:

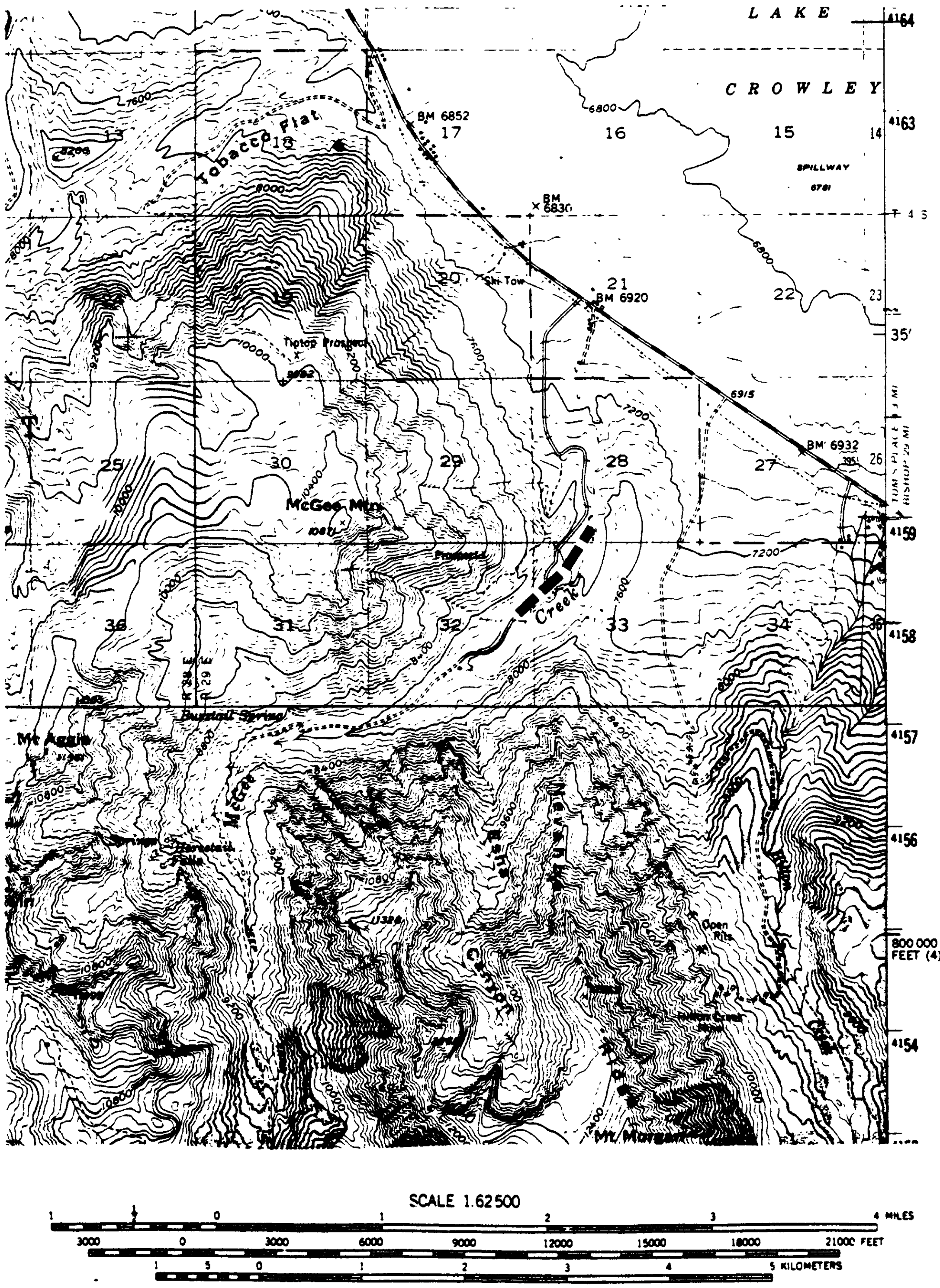
This line crosses the Hilton Creek fault, 12 miles ESE of Mammoth Lakes and its 15m high scarp in the McGee Creek campground. The fault had 10cm of vertical displacement after the May 1980 Mammoth Lakes earthquakes.

Six levelings of this line in the period July 1982 to August 1987 are compared in an accompanying figure. Early surveys showed that the south block rose almost 2mm relative to the north block, but in recent years it subsided by half that amount. The subsidence of the several bench marks in the central part of the line demonstrates the slow but inexorable creep of boulder bench marks down the face of the steep fault scarp, due largely to seasonal freeze-thaw heaving.

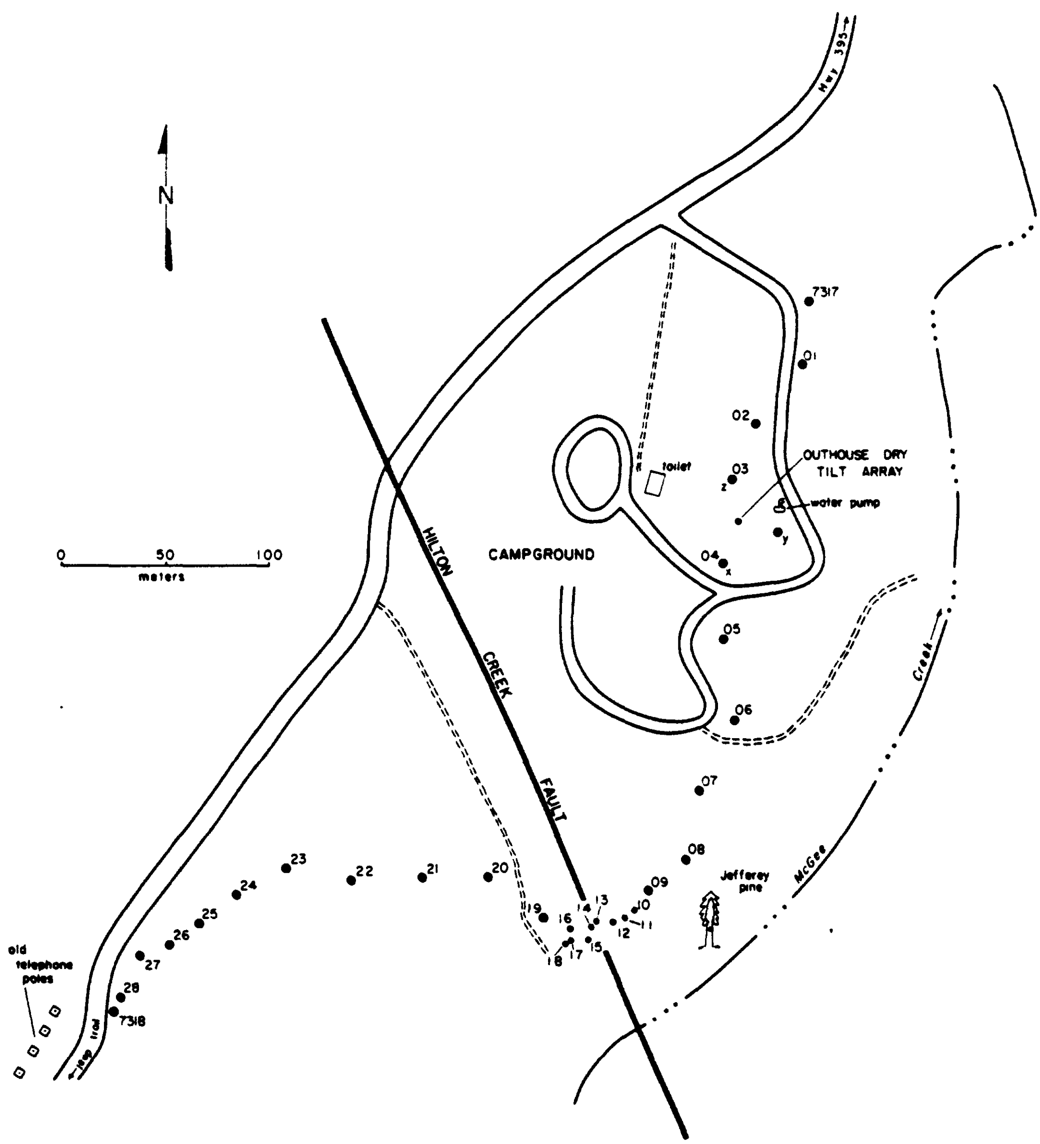


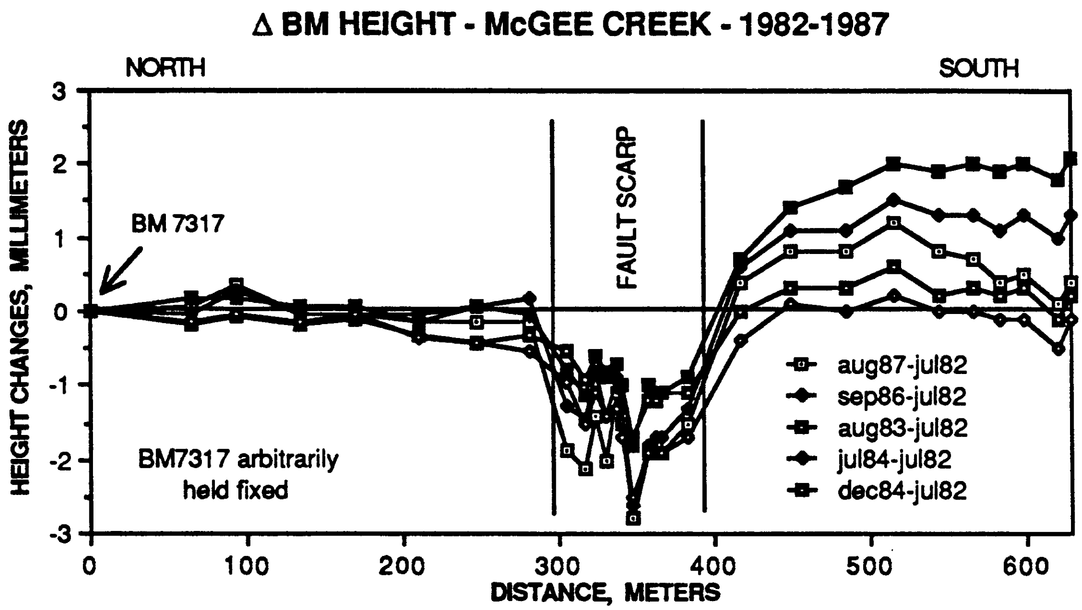
Location of UCSB precise leveling array across the Hilton Creek fault in McGee Creek, Long Valley.

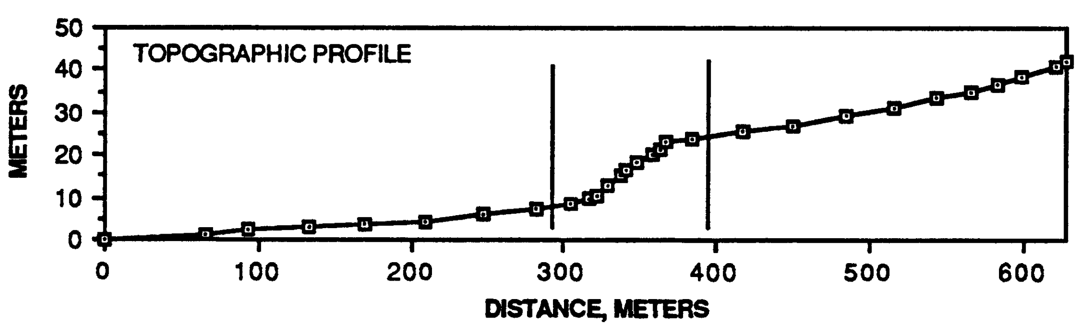
MT. MORRISON QUADRANGLE
CALIFORNIA
15 MINUTE SERIES (TOPOGRAPHIC)



SITE MAP OF McGEE CREEK LEVELING ARRAY




Δ BM HEIGHT - McGEE CREEK - 1982-1987
NORTH
SOUTH
HEIGHT CHANGES, MILLIMETERS
BM 7317
FAULT SCARP
BM7317 arbitrarily
held fixed
aug87-jul82
sep86-jul82
aug83-jul82
jul84-jul82
dec84-jul82
DISTANCE, METERS


TOPOGRAPHIC PROFILE
METERS
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
7317	MC01	49.764
MC01	MC02	71.879
MC02	MC03	93.880
MC03	MC04	67.950
MC04	MC05	77.799
MC05	MC06	67.713
MC06	MC07	163.437
MC07	MC08	125.190
MC08	MC09	107.054
MC09	MC10	128.126
MC10	MC11	106.227
MC11	MC12	242.626
MC12	MC13	250.244
MC13	MC14	119.368
MC14	MC15	173.889
MC15	MC16	179.396
MC16	MC17	108.885
MC17	MC18	156.340
MC18	MC19	96.075
MC19	MC20	151.275
MC20	MC21	169.379
MC21	MC22	199.998
MC22	MC23	189.180
MC23	MC24	239.316
MC24	MC25	165.337
MC25	MC26	183.085
MC26	MC27	180.337
MC27	MC28	204.818
MC28	7318	161.555

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
7317	TP01	56.402
TP01	MC02	65.250
MC02	MC03	93.910
MC03	MC04	67.911
MC04	MC05	77.802
MC05	MC06	67.697
MC06	MC07	163.438
MC07	MC08	125.193
MC08	MC09	106.881
MC09	MC10	128.100
MC10	MC11	106.300
MC11	MC12	242.566
MC12	MC13	250.333
MC13	MC14	119.330
MC14	MC15	173.754
MC15	MC16	179.483
MC16	MC17	108.898
MC17	MC18	156.335
MC18	MC19	96.114
MC19	MC20	151.467
MC20	MC21	169.423
MC21	MC22	199.988
MC22	MC23	189.215
MC23	MC24	239.281
MC24	MC25	165.333
MC25	MC26	183.049
MC26	MC27	180.352
MC27	MC28	204.776
MC28	7318	161.582

MESA VALLEY Leveling Array

Latitude:	34°48'46"	**Length:**	410.0m
Longitude:	118°54'20"	**Number of Bench marks:**	21
Date of Initial Survey:	18 February 1977	**Number of Surveys to 1988:**	21
Trespass Permission:	None needed.		

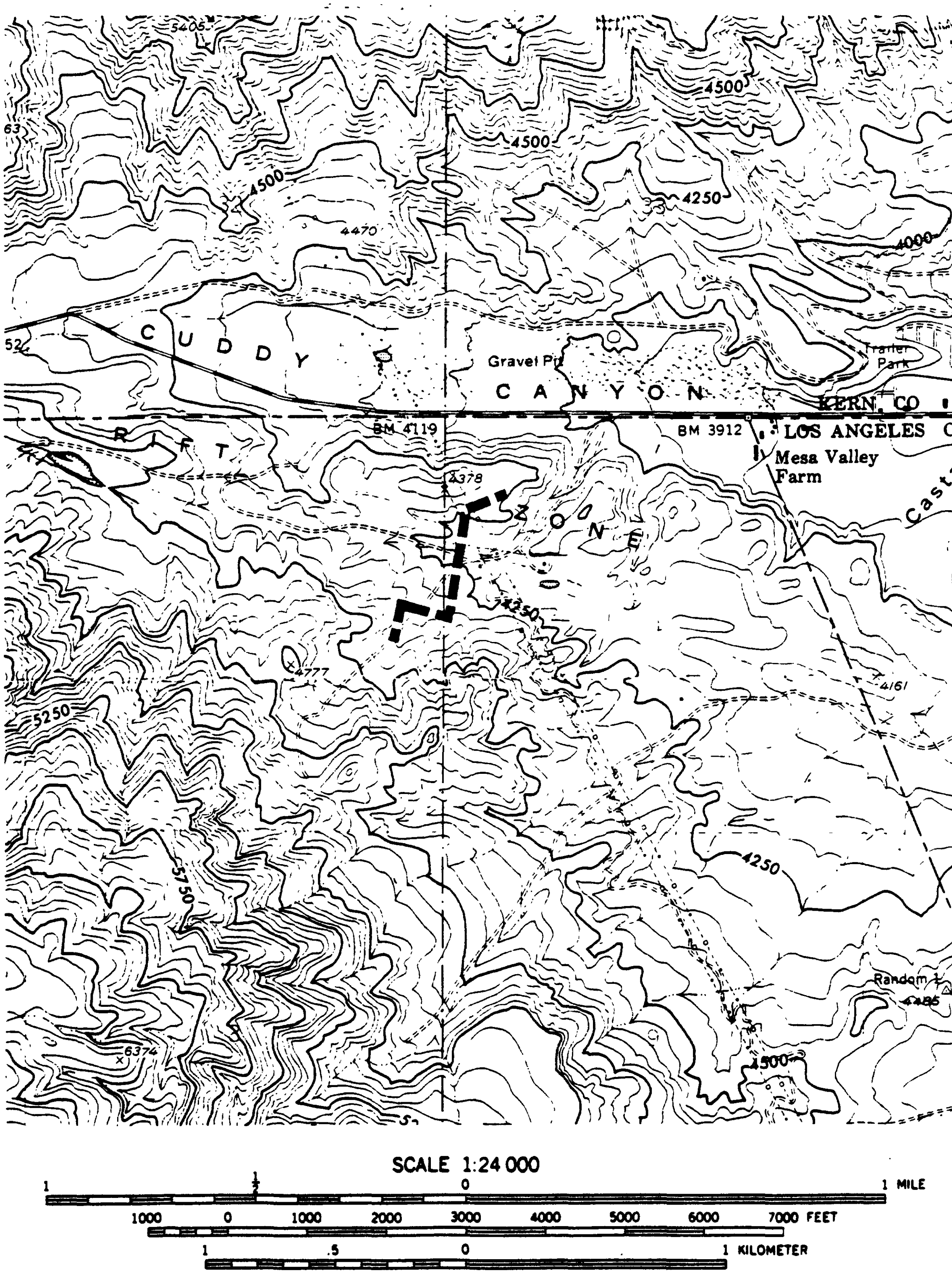
Comments:

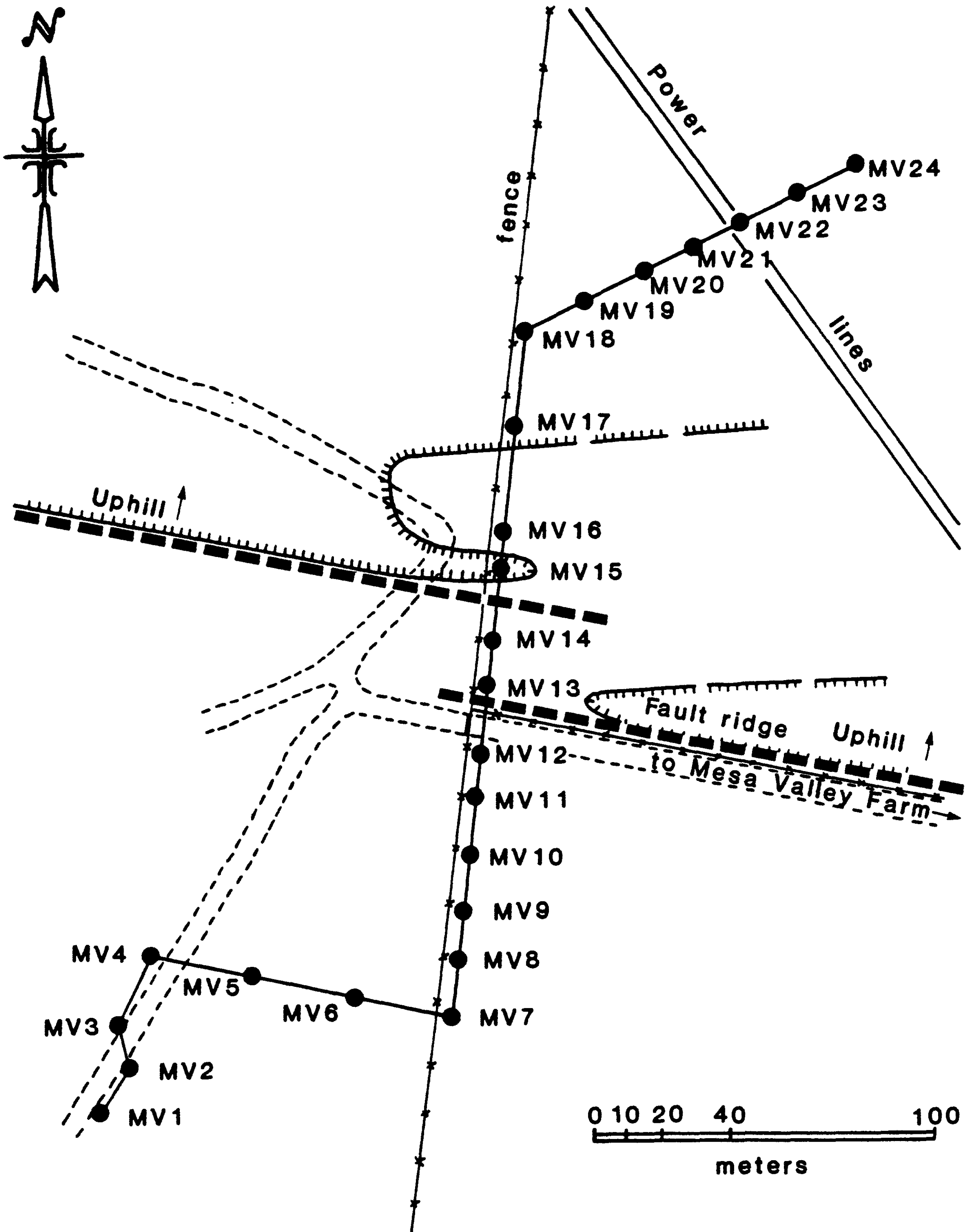
This S-shaped line crosses a wide zone of fault strands in the San Andreas fault zone miles northwest of Gorman. Bench marks MV07 through MV24 are on property belonging to Mesa Valley Farm. Bench marks MV10 through MV18 constitute an alignment array.

Several bench marks have been added at various times to extend the length of the line, the most recent being MV01, 02, and 03.

One of the first surveys of the elongated array is compared with the latest survey in an accompanying figure. Most of the bench marks are quite stable, one to another. Near the fault, two bench marks show up to 8mm relative subsidence. MV13 has shown a tendency to rise and fall throughout the history of the line, yet field inspection reveals no reason to suspect it is loose or periodically disturbed.

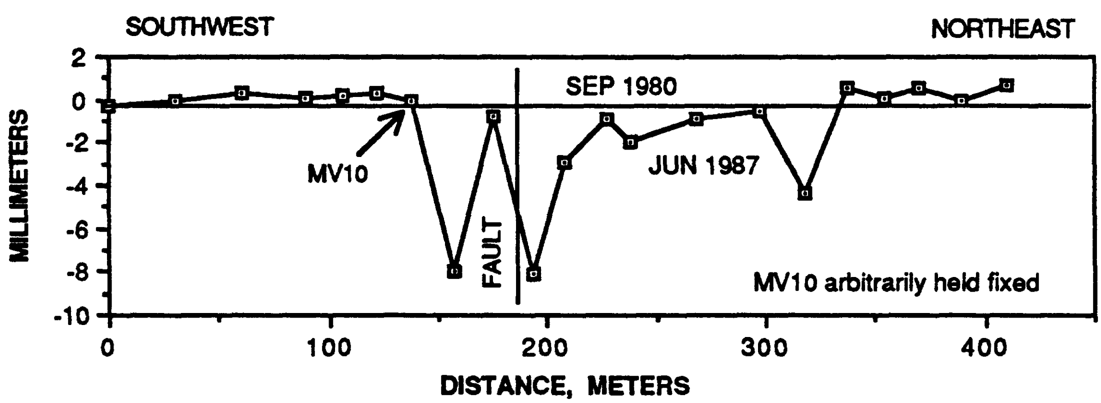
FRAZIER MTN. QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)

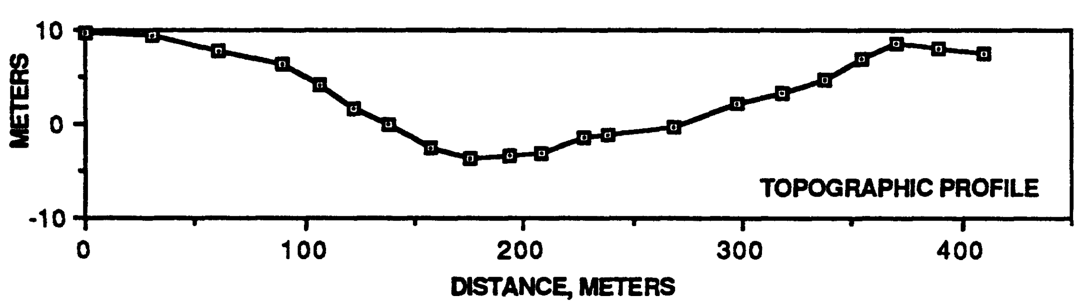




Mesa Valley Farm leveled alignment array across the San Andreas fault near Gorman.

Δ BM HEIGHTS - MESA VALLEY - 1980/1987





******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MV10	MV11	-238.058
MV11	MV12	-115.995
MV12	MV13	13.386
MV13	MV14	42.635
MV14	MV15	149.434
MV15	MV16	47.336
MV16	MV17	85.868
MV17	MV18	243.006

GORMAN, CALIFORNIA MESA VALLEY JUNE 30, 1987

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MV04	MV05	-38.723
MV05	MV06	-149.523
MV06	MV07	-158.808
MV07	MV08	-213.165
MV08	MV09	-237.359
MV09	MV10	-179.886
MV10	MV11	-238.798
MV11	MV12	-115.207
MV12	MV13	13.424
MV13	MV14	42.535
MV14	MV15	149.624
MV15	MV16	47.332
MV16	MV17	85.764
MV17	MV18	243.119
MV18	MV19	117.731
MV19	MV20	129.524
MV20	MV21	210.475
MV21	MV22	182.740
MV22	MV23	-72.139
MV23	MV24	-56.675

MINA Level Line

Latitude:	38°21'58"	**Length:**	565m
Longitude:	117°53'25"	**Number of Bench marks:**	36
Date of Initial Survey:	11 July 1985	**Number of Surveys to 1988:**	2
Trespass Permission:	Contact: Mina Water Department Mina, Nevada		

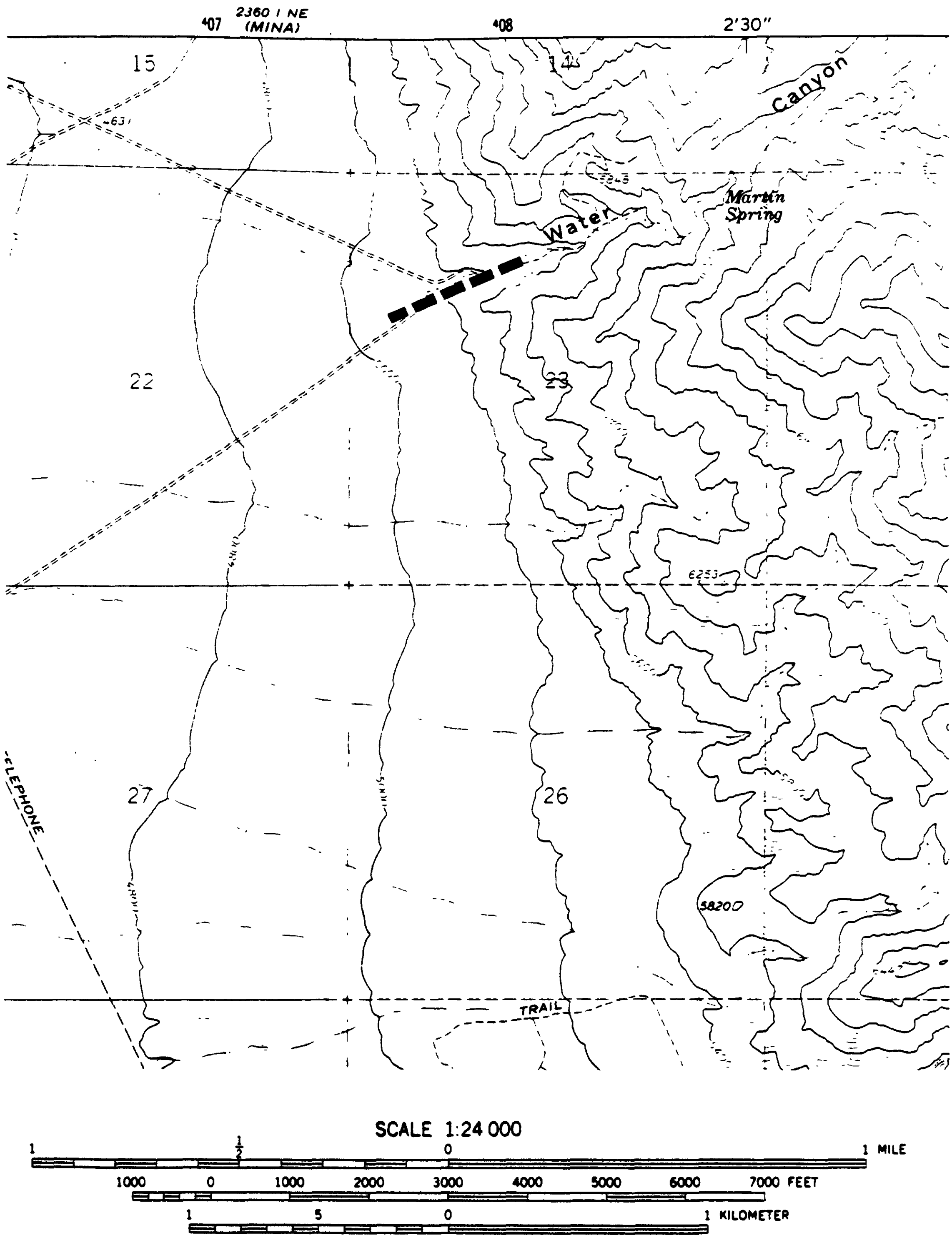
Comments:

This line was established in July 1985 in response to a tip from R.E. Wallace (U.S.G.S.) who heard from Norm Sleep that a water pipe across the fault at the west front of the Pilot Mountains broke at the fault every so often. We have not been able to confirm this story in direct conversation with officials of the Mina Water Department.

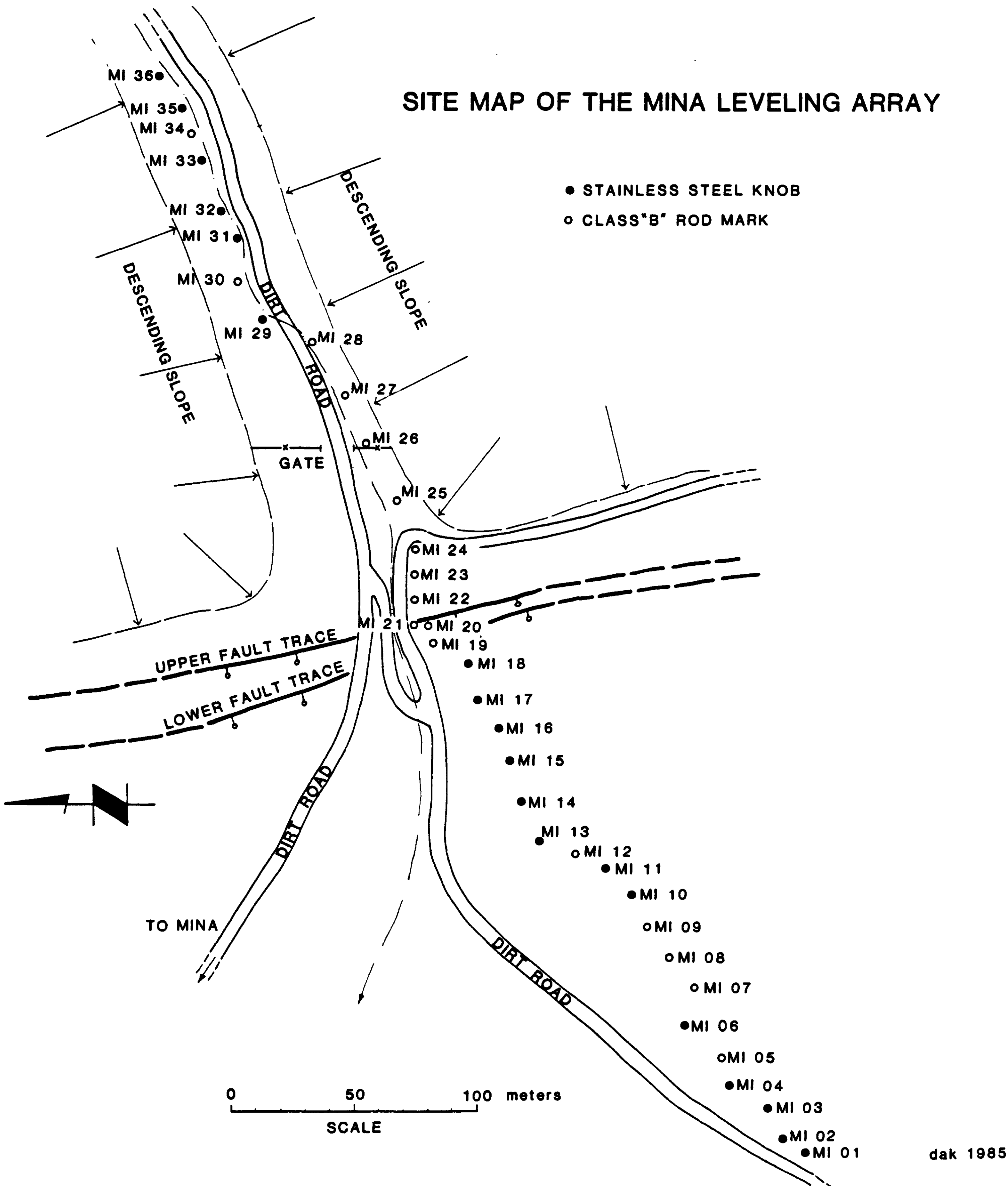
A new water line was placed in the canyon in 1986, obliterating bench marks numbered 30 through 36. This line is three miles ESE of the townsite of Sodaville, Nevada.

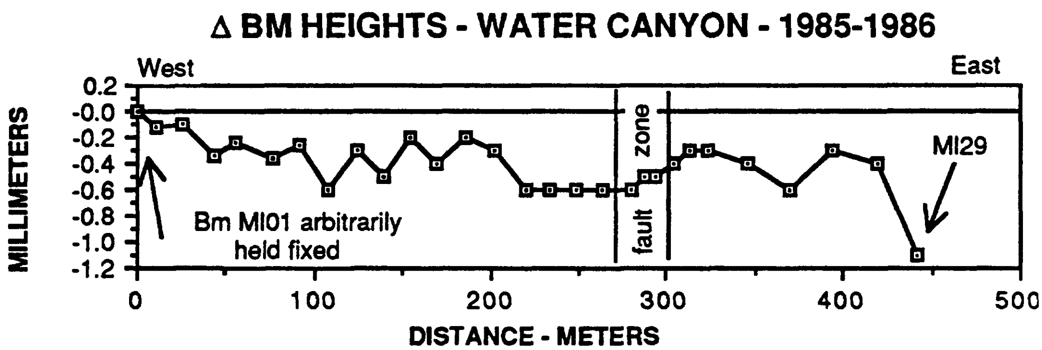
No significant changes were measured among the remaining bench marks in two surveys shown in an accompanying diagram.

SODAVILLE QUADRANGLE
NEVADA-MINERAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

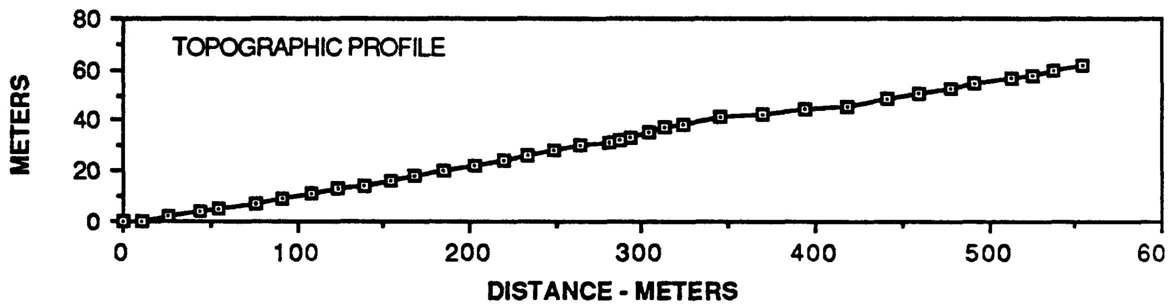


SITE MAP OF THE MINA LEVELING ARRAY





Δ BM HEIGHTS - WATER CANYON - 1985-1986
West
East
MILLIMETERS
0.2
-0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
fault zone
Bm MI01 arbitrarily
held fixed
MI29
0
100
200
300
400
500
DISTANCE - METERS



TOPOGRAPHIC PROFILE
METERS
80
60
40
20
0
0
100
200
300
400
500
600
DISTANCE - METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
MI01	MI02	28.197	
MI02	MI03	179.243	
MI03	MI04	196.202	
MI04	MI05	122.410	
MI05	MI06	210.486	
MI06	MI07	127.875	
MI07	MI08	206.363	
MI08	MI09	206.728	
MI09	MI10	183.653	
MI10	MI11	190.514	
MI11	MI12	196.377	
MI12	MI13	196.934	
MI13	PI76	4.595	single run, 1 shots.
MI13	MI14	204.053	
MI14	MI15	219.613	
MI15	MI16	184.356	
MI16	MI17	154.921	
MI17	MI18	202.757	
MI18	MI19	102.799	
MI19	MI20	141.355	
MI20	MI21	130.166	
MI21	MI22	145.693	
MI22	MI23	169.697	
MI23	MI24	166.061	
MI24	MI25	255.647	
MI25	MI26	147.011	
MI26	MI27	158.970	
MI27	MI28	175.254	
MI28	MI29	237.670	
MI29	MI30	182.803	
MI30	MI31	191.434	
MI31	MI32	225.229	
MI32	MI33	222.187	
MI33	MI34	138.843	
MI34	MI35	171.535	
MI35	MI36	230.442	

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MI01	MI02	28.184
MI02	MI03	179.245
MI03	MI04	196.178
MI04	MI05	122.421
MI05	MI06	210.474
MI06	MI07	127.883
MI07	MI08	206.339
MI08	MI09	206.748
MI09	MI10	183.641
MI10	MI11	190.537
MI11	MI12	196.359
MI12	MI13	196.948
MI13	MI14	204.040
MI14	MI15	219.597
MI15	MI16	184.345
MI16	MI17	154.927
MI17	MI18	202.759
MI18	MI19	102.800
MI19	MI20	141.354
MI20	MI21	130.171
MI21	MI22	145.701
MI22	MI23	169.714
MI23	MI24	166.054
MI24	MI25	255.638
MI25	MI26	146.997
MI26	MI27	158.998
MI27	MI28	175.237
MI28	MI29	237.600

MIRACLE HILL Level Line

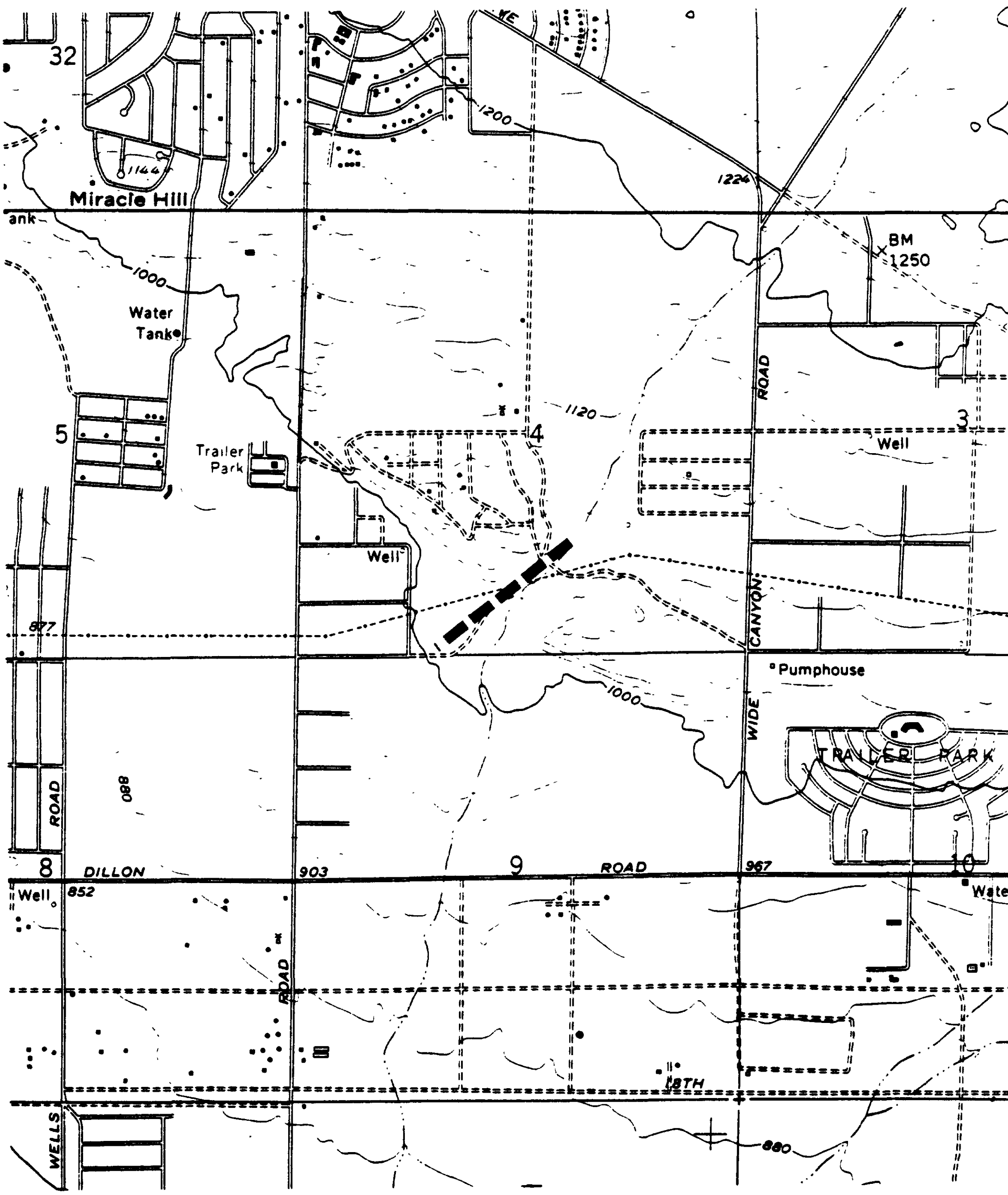
Latitude:	33°56'03"	**Length:**	720.1m
Longitude:	116°28'00"	**Number of Bench marks:**	22
Date of Initial Survey:	7 September 1985	**Number of Surveys to 1988:**	4
Trespass Permission:	None needed.		

Comments:

This line was established across the Mission Creek strand of the San Andreas fault two miles southeast of Desert Hot Springs.

Four levelings covering the period September 1985 to June 1987 are compared in an accompanying figure. The levelings span the timing of the North Palm Springs earthquake of July 1986. Bench marks are quite stable along the entire length of the line. MH07 was apparently dislodged before the most recent survey.

SEVEN PALMS VALLEY QUADRANGLE
CALIFORNIA–RIVERSIDE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 THOUSAND PALMS 15' QUADRANGLE



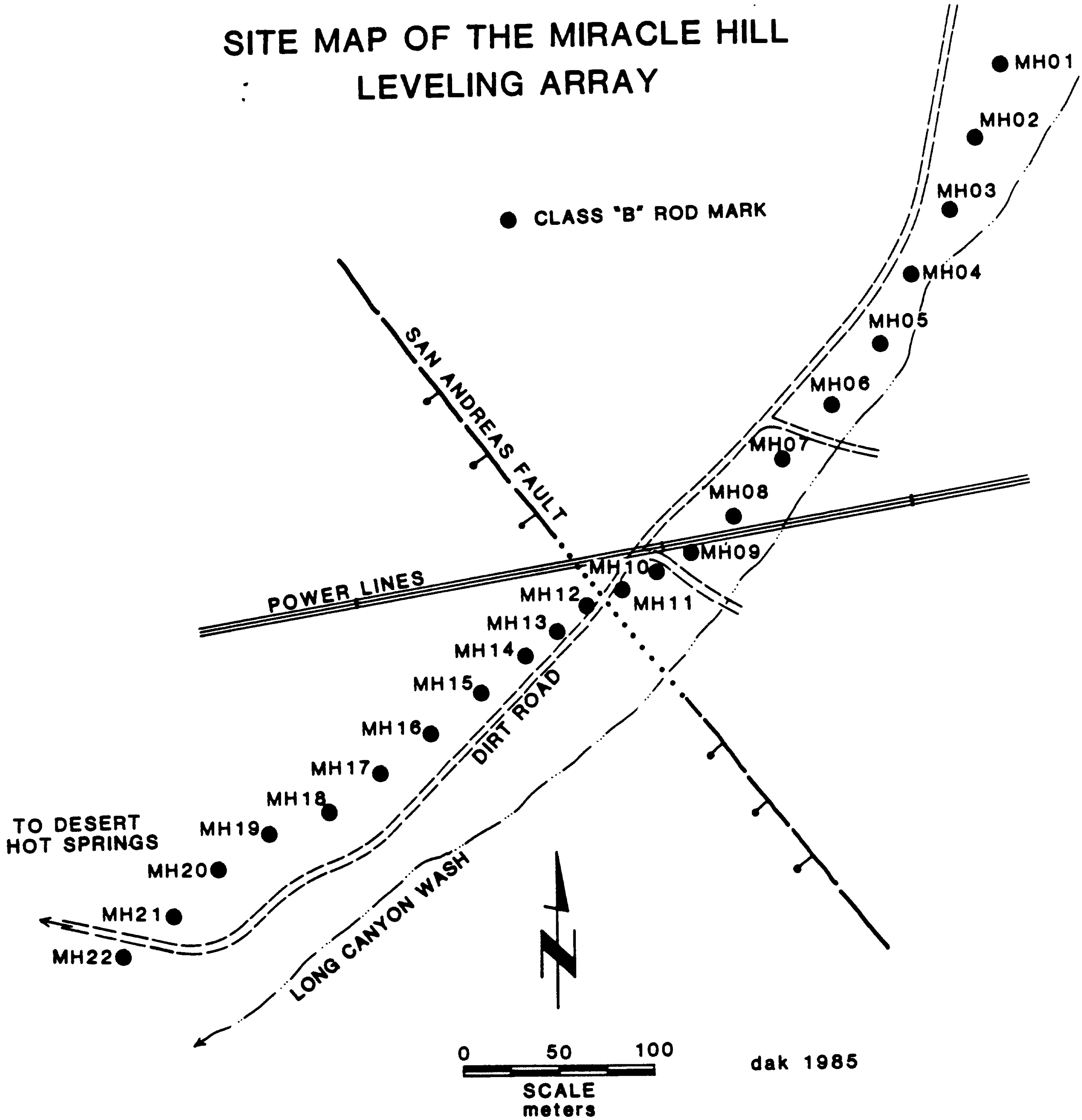
SCALE 1:24 000

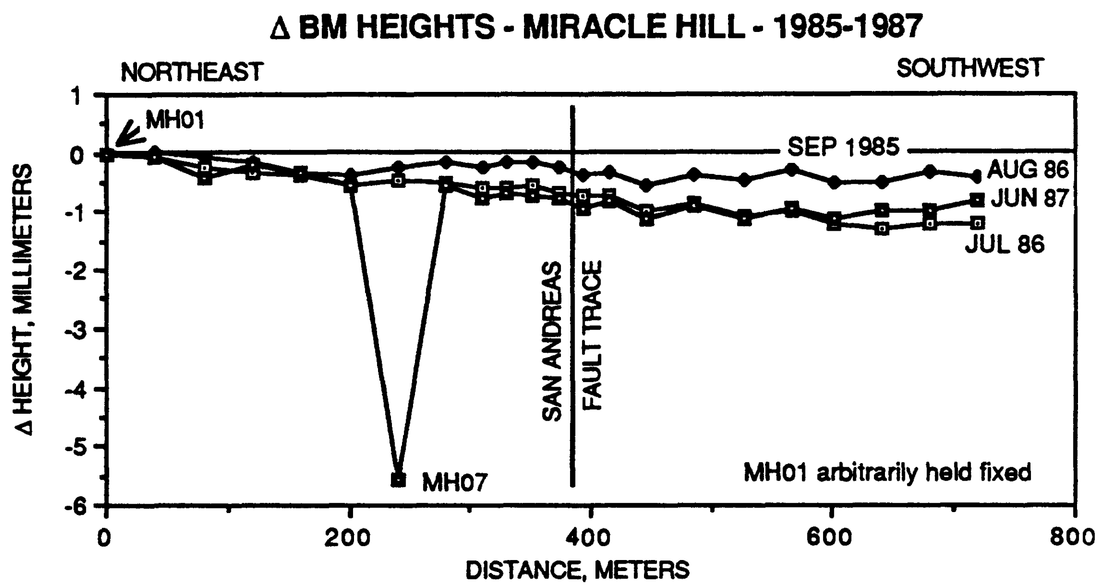
1 ½ 0 1 MILE

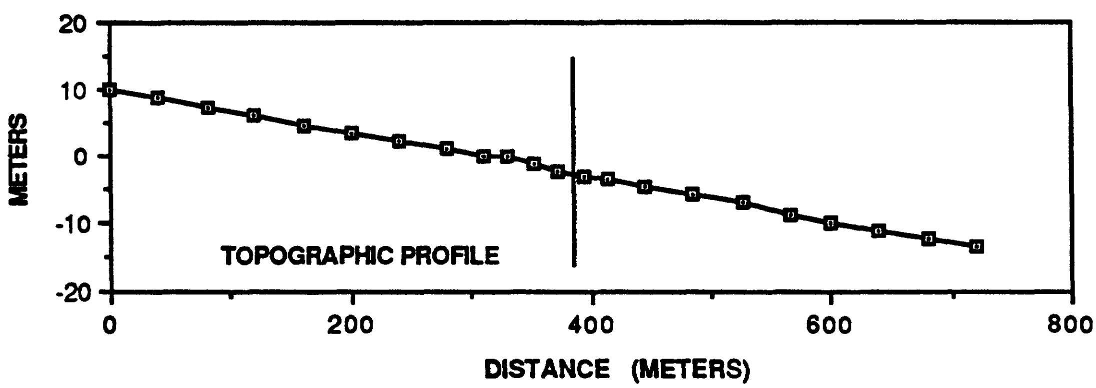
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SITE MAP OF THE MIRACLE HILL
LEVELING ARRAY




Δ BM HEIGHTS - MIRACLE HILL - 1985-1987
NORTHEAST
SOUTHWEST
MH01
SEP 1985
AUG 86
JUN 87
JUL 86
SAN ANDREAS
FAULT TRACE
MH07
MH01 arbitrarily held fixed
Δ HEIGHT, MILLIMETERS
DISTANCE, METERS


TOPOGRAPHIC PROFILE
METERS
DISTANCE (METERS)

DESERT HOT SPRINGS, CALIFORNIA MIRACLE HILL SEPTEMBER 7, 1985

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MH01	MH02	-127.889
MH02	MH03	-124.647
MH03	MH04	-151.220
MH04	MH05	-129.010
MH05	MH06	-126.916
MH06	MH07	-93.159
MH07	MH08	-127.478
MH08	MH09	-112.908
MH09	MH10	-22.300
MH10	MH11	-113.538
MH11	MH12	-106.962
MH12	MH13	-55.824
MH13	MH14	-61.482
MH14	MH15	-90.903
MH15	MH16	-124.706
MH16	MH17	-142.051
MH17	MH18	-159.173
MH18	MH19	-142.230
MH19	MH20	-109.179
MH20	MH21	-108.096
MH21	MH22	-110.585

DESERT HOT SPRINGS, CALIFORNIA MIRACLE HILL JUNE 25, 1987

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MH01	MH02	-127.893
MH02	MH03	-124.665
MH03	MH04	-151.218
MH04	MH05	-129.025
MH05	MH06	-126.936
MH06	MH07	-93.663
MH07	MH08	-126.975
MH08	MH09	-112.927
MH09	MH10	-22.294
MH10	MH11	-113.542
MH11	MH12	-106.963
MH12	MH13	-55.844
MH13	MH14	-61.469
MH14	MH15	-90.934
MH15	MH16	-124.682
MH16	MH17	-142.075
MH17	MH18	-159.154
MH18	MH19	-142.245
MH19	MH20	-109.168
MH20	MH21	-108.101
MH21	MH22	-110.560

MUSTANG GRADE Level Line

Latitude:	36°11'35"	**Length:**	897.4m
Longitude:	120°46'12"	**Number of Bench marks:**	23
Date of Initial Survey:	1 August 1985	**Number of Surveys to 1988:**	3

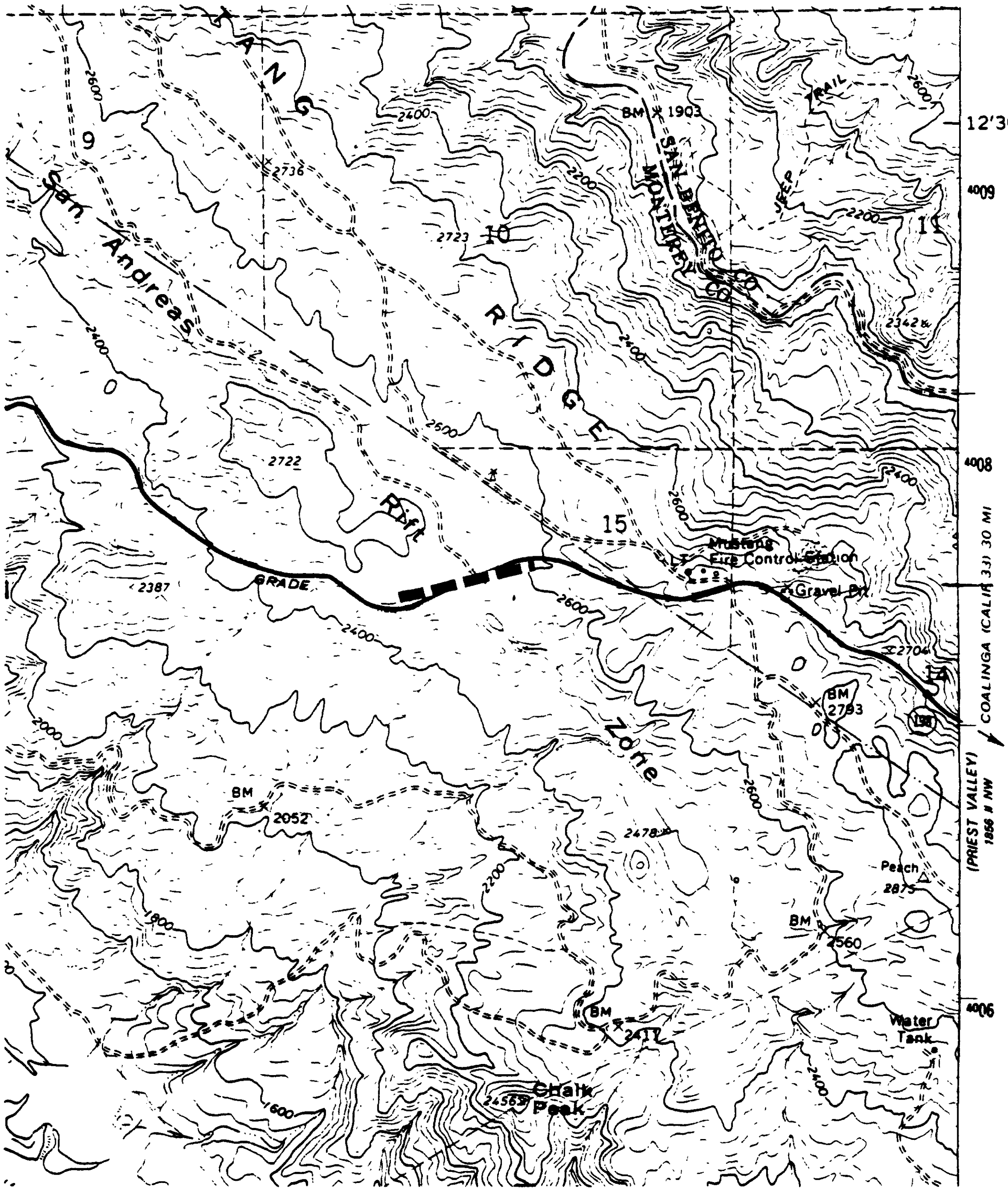
Trespass Permission: None needed, although a permit is required from Caltrans to establish bench marks.

Comments:

This line crosses the San Andreas fault in central California, on State Highway 198, three miles ENE of its intersection with State Highway 25. The highway is heavily travelled, and surveying conditions may be hazardous.

Three August levelings in 1985, 1986 and 1987 are compared in an accompanying figure. The graph shows that several bench marks are not very stable and that the August 1986 survey may be fraught with errors relative to the other two surveys. No compelling differences exist between the data from either side of the fault.

MONARCH PEAK QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 SAN ARDO 15' QUADRANGLE

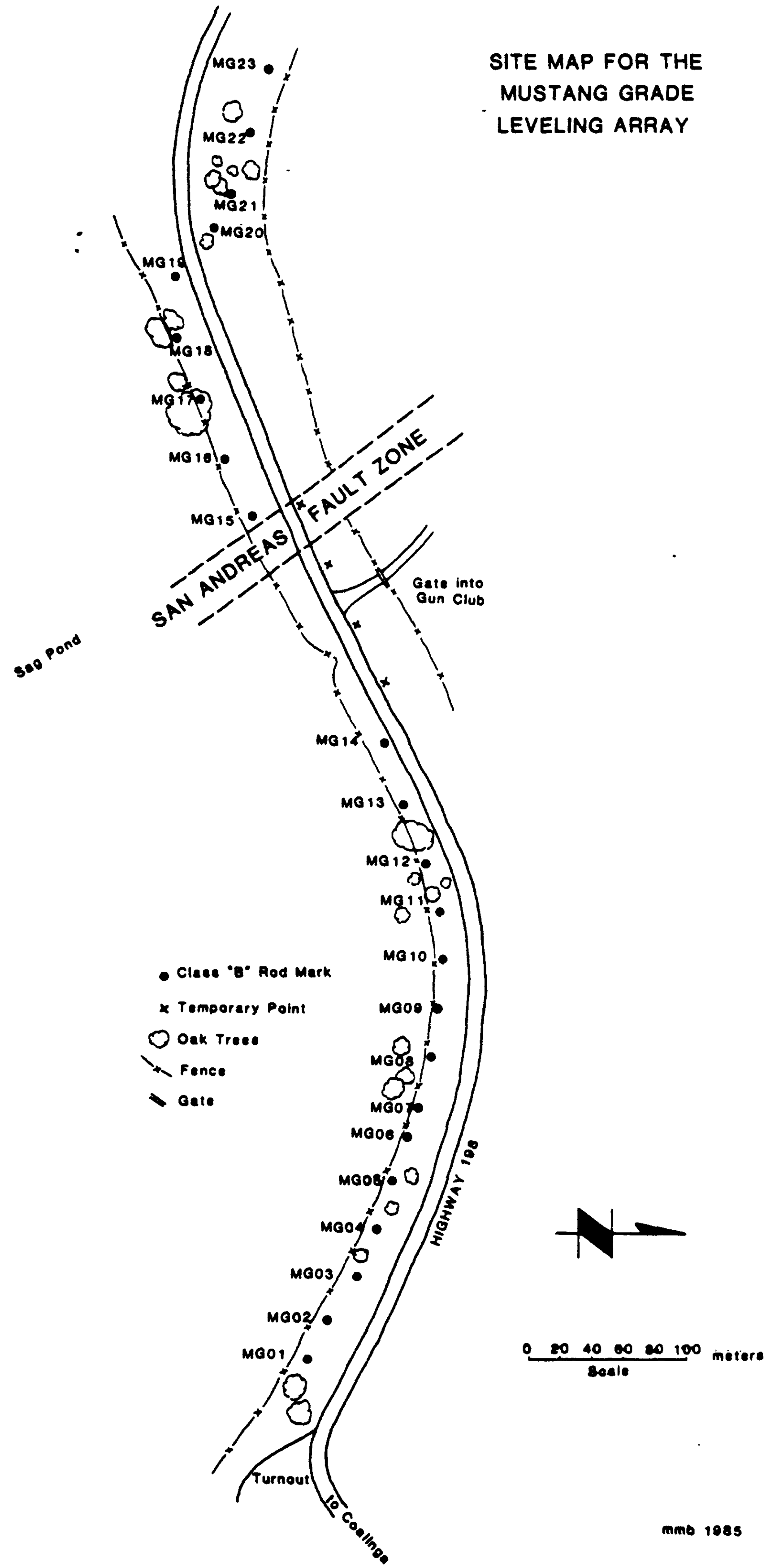


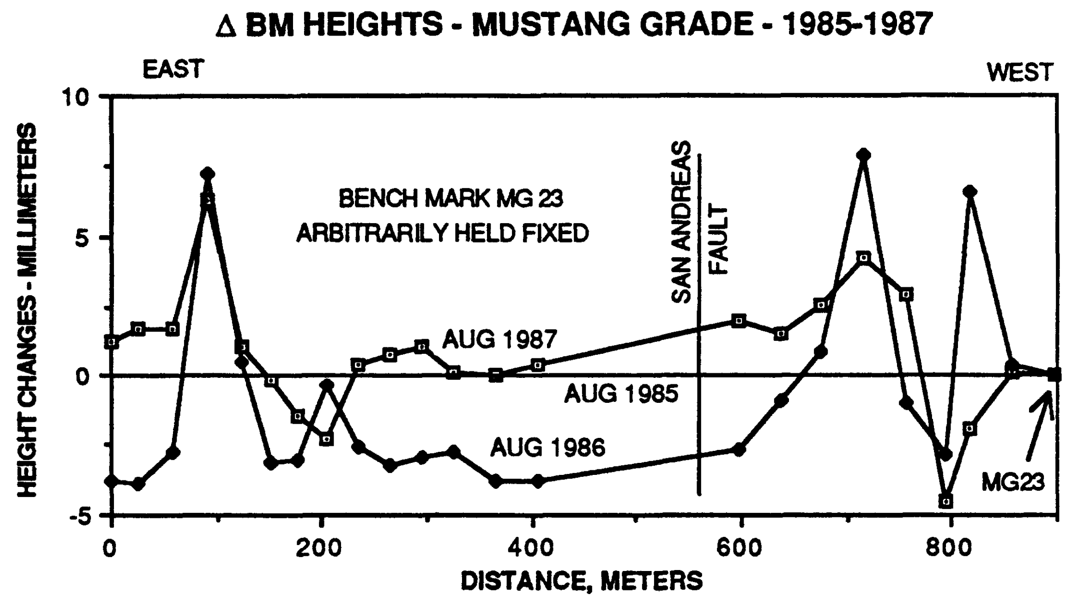
SCALE 1:24 000

1 ½ 0 1 MILE

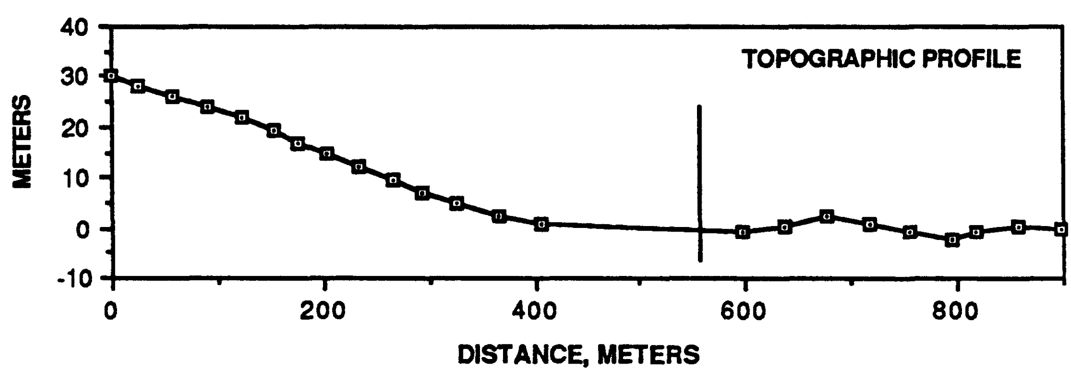
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER


SITE MAP FOR THE
MUSTANG GRADE
LEVELING ARRAY
MG23
MG22
MG21
MG20
MG19
MG18
MG17
MG16
MG15
SAN ANDREAS FAULT ZONE
Gate into
Gun Club
Sag Pond
MG14
MG13
MG12
MG11
MG10
MG09
MG08
MG07
MG06
MG05
MG04
MG03
MG02
MG01
Class "B" Rod Mark
Temporary Point
Oak Trees
Fence
Gate
HIGHWAY 198
0 20 40 60 80 100 meters
Scale
Turnout
to Coalinga
mmb 1985



Δ BM HEIGHTS - MUSTANG GRADE - 1985-1987
EAST
WEST
BENCH MARK MG 23
ARBITRARILY HELD FIXED
SAN ANDREAS FAULT
AUG 1987
AUG 1985
AUG 1986
MG23
HEIGHT CHANGES - MILLIMETERS
DISTANCE, METERS



TOPOGRAPHIC PROFILE
METERS
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MG01	MG02	-198.916
MG02	MG03	-199.009
MG03	MG04	-211.800
MG04	MG05	-224.578
MG05	MG06	-247.440
MG06	MG07	-228.099
MG07	MG08	-229.810
MG08	MG09	-265.672
MG09	MG10	-235.866
MG10	MG11	-243.654
MG11	MG12	-228.566
MG12	MG13	-236.082
MG13	MG14	-163.324
MG14	TP01	4.538
TP01	TP02	-234.709
TP02	TP03	-118.202
TP03	TP04	-48.849
TP04	TP05	-12.352
TP05	MG15	221.298
MG15	MG16	128.581
MG16	MG17	213.499
MG17	MG18	-147.133
MG18	MG19	-182.375
MG19	MG20	-130.186
MG20	MG21	159.169
MG21	MG22	68.875
MG22	MG23	-19.629

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MG01	MG02	-198.863
MG02	MG03	-199.012
MG03	MG04	-211.338
MG04	MG05	-225.097
MG05	MG06	-247.574
MG06	MG07	-228.225
MG07	MG08	-229.896
MG08	MG09	-265.393
MG09	MG10	-235.840
MG10	MG11	-243.618
MG11	MG12	-228.664
MG12	MG13	-236.091
MG13	MG14	-163.287
MG14	TP01	2.300
TP01	TP02	-228.388
TP02	TP03	-125.923
TP03	TP04	-52.591
TP04	TP05	-10.514
TP05	MG15	227.004
MG15	MG16	128.526
MG16	MG17	213.603
MG17	MG18	-146.965
MG18	MG19	-182.500
MG19	MG20	-130.934
MG20	MG21	159.435
MG21	MG22	69.070
MG22	MG23	-19.637

NORTH SHORE Level Line

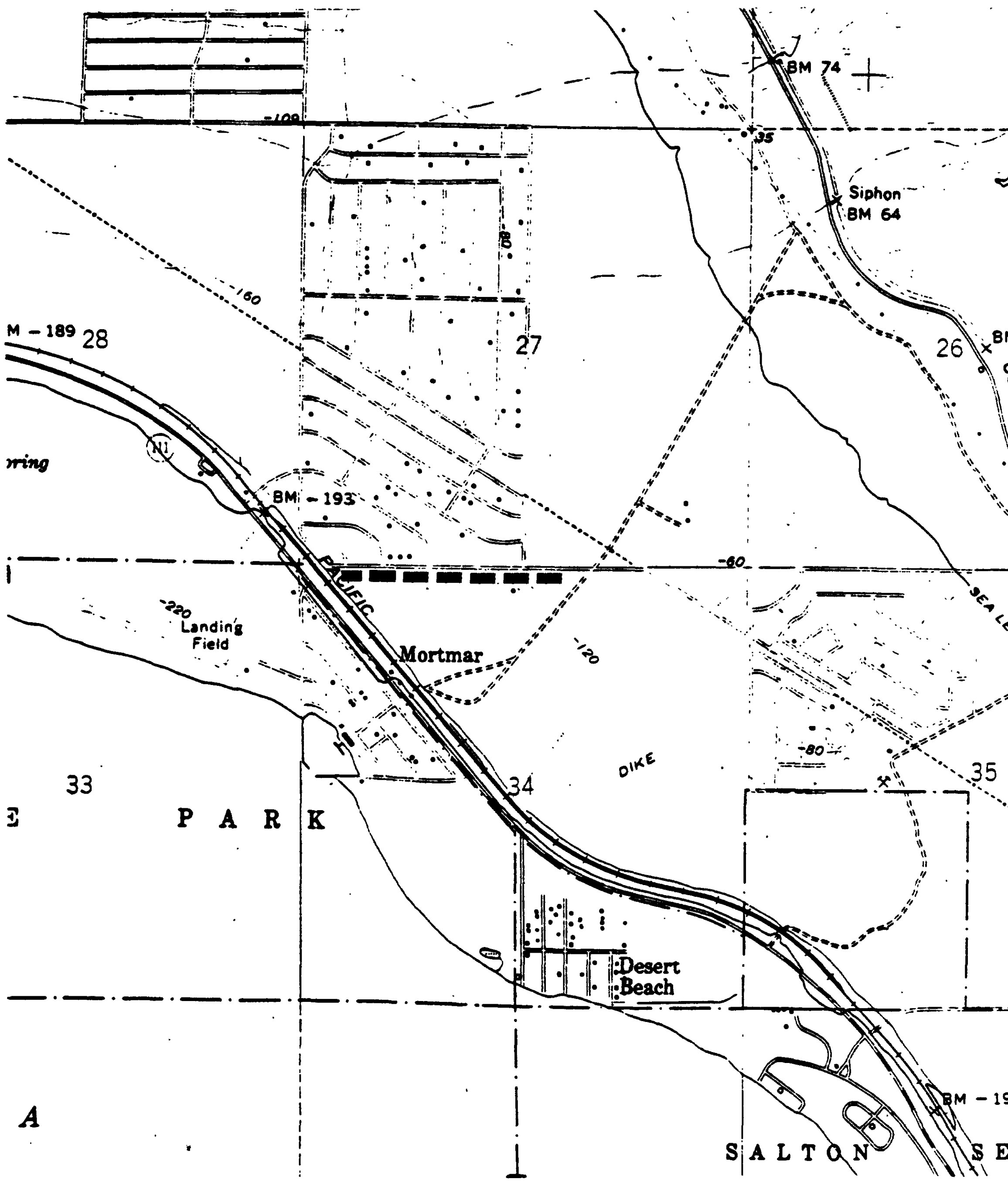
Latitude:	33°35'02"	**Length:**	871.6m
Longitude:	115°55'57"	**Number of Bench marks:**	28
Date of Initial Survey:	7 September 1985	**Number of Surveys to 1988:**	4
Trespass Permission:	None needed.		

Comments:

This line replaces an earlier, shorter line established by Robert Sharp (USGS) across the San Andreas fault at North Shore, one mile north of Desert Beach at the northeast corner of the Salton Sea.

Four levelings between September 1985 and December 1987 are plotted in an accompanying figure. The data show a persistent SW-down tilt across the fault of from one to two microradians per year. A case may also be made for increasing vertical displacement across the fault of about 1.5mm at the last survey.

MORTMAR QUADRANGLE
CALIFORNIA–RIVERSIDE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 COTTONWOOD SPRING 15' QUADRANGLE



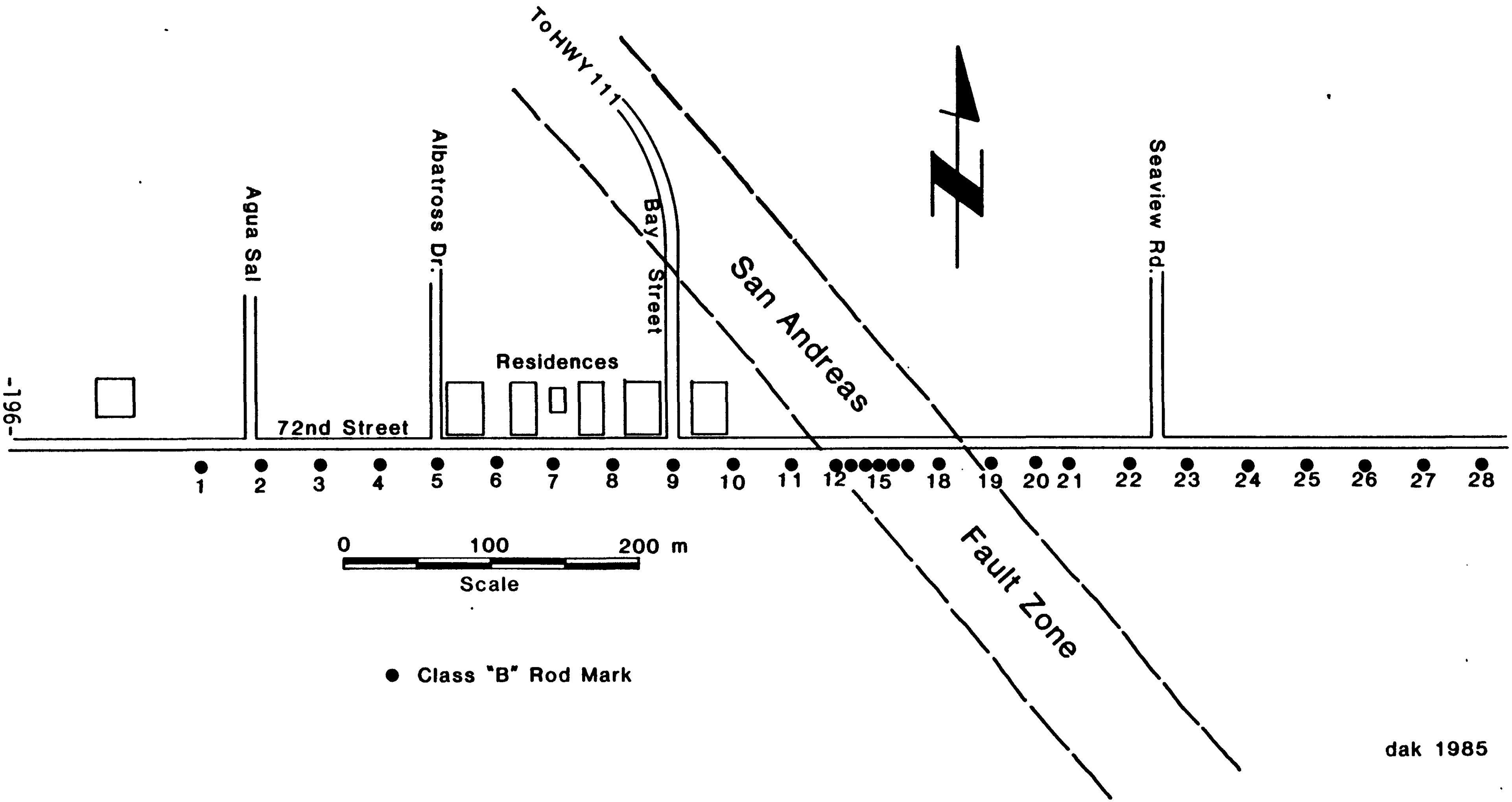
SCALE 1:24 000

1 ½ 0 1 MILE

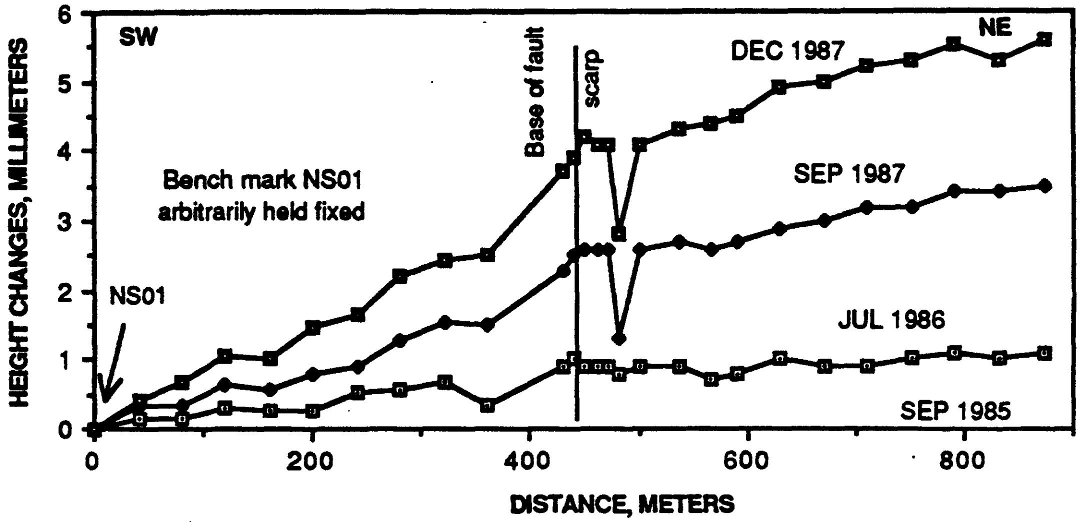
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

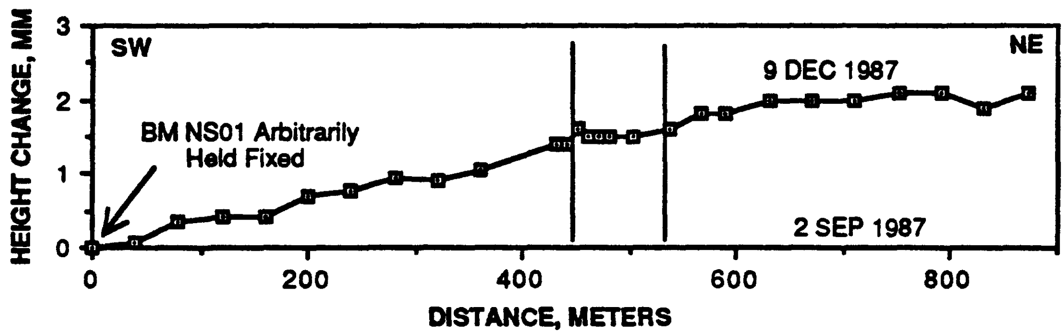
SITE MAP OF THE NORTH SHORE LEVELING ARRAY

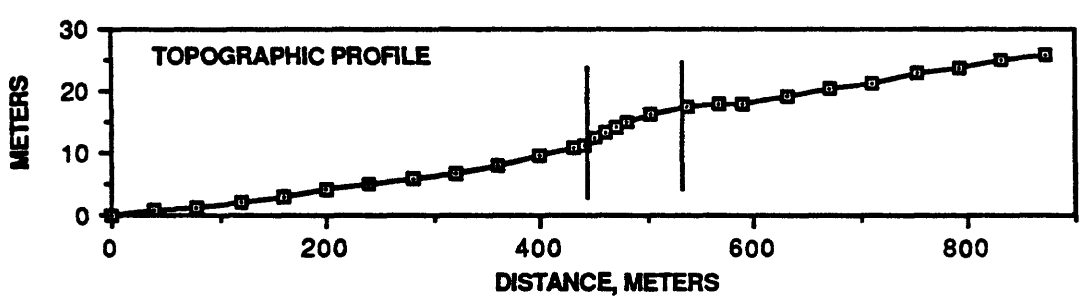


Δ BM Heights - NORTH SHORE - 1985 to 1987



ΔBM HEIGHTS - NORTH SHORE - 2Sep to 9Dec 1987





******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
NS01	NS02	68.654	
NS02	NS03	64.542	
NS03	NS04	60.569	
NS04	NS05	93.154	
NS05	NS06	113.006	
NS06	NS07	93.247	
NS07	NS08	84.392	
NS08	NS09	81.039	
NS09	NS10	135.058	
NS10	NS11	160.103	
NS11	NS12	144.469	
NS12	NS13	40.681	
NS13	NS14	101.488	
NS14	NS15	80.631	
NS15	NS16	80.061	
NS16	NS17	97.986	
NS17	NS18	119.085	
NS18	NS19	139.990	
NS19	NS20	27.243	
NS20	NS21	16.370	
NS21	NS22	104.323	
NS22	RCBM	59.290	single run, 1 shots.
NS22	NS23	116.340	
NS23	NS24	105.265	
NS24	NS25	157.046	
NS25	NS26	103.016	
NS26	NS27	125.989	
NS27	NS28	74.249	

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
NS01	NS02	68.696
NS02	NS03	64.569
NS03	NS04	60.603
NS04	NS05	93.150
NS05	NS06	113.053
NS06	NS07	93.264
NS07	NS08	84.447
NS08	NS09	81.062
NS09	NS10	135.066
NS10	NS11	159.381
NS11	NS12	145.303
NS12	NS13	40.708
NS13	NS14	101.516
NS14	NS15	80.618
NS15	NS16	80.061
NS16	NS17	97.856
NS17	NS18	119.216
NS18	NS19	140.013
NS19	NS20	27.256
NS20	NS21	16.375
NS21	NS22	104.366
NS22	NS23	116.350
NS23	NS24	105.290
NS24	NS25	157.047
NS25	NS26	103.042
NS26	NS27	125.967
NS27	NS28	74.271

PAINTED CANYON Level Line

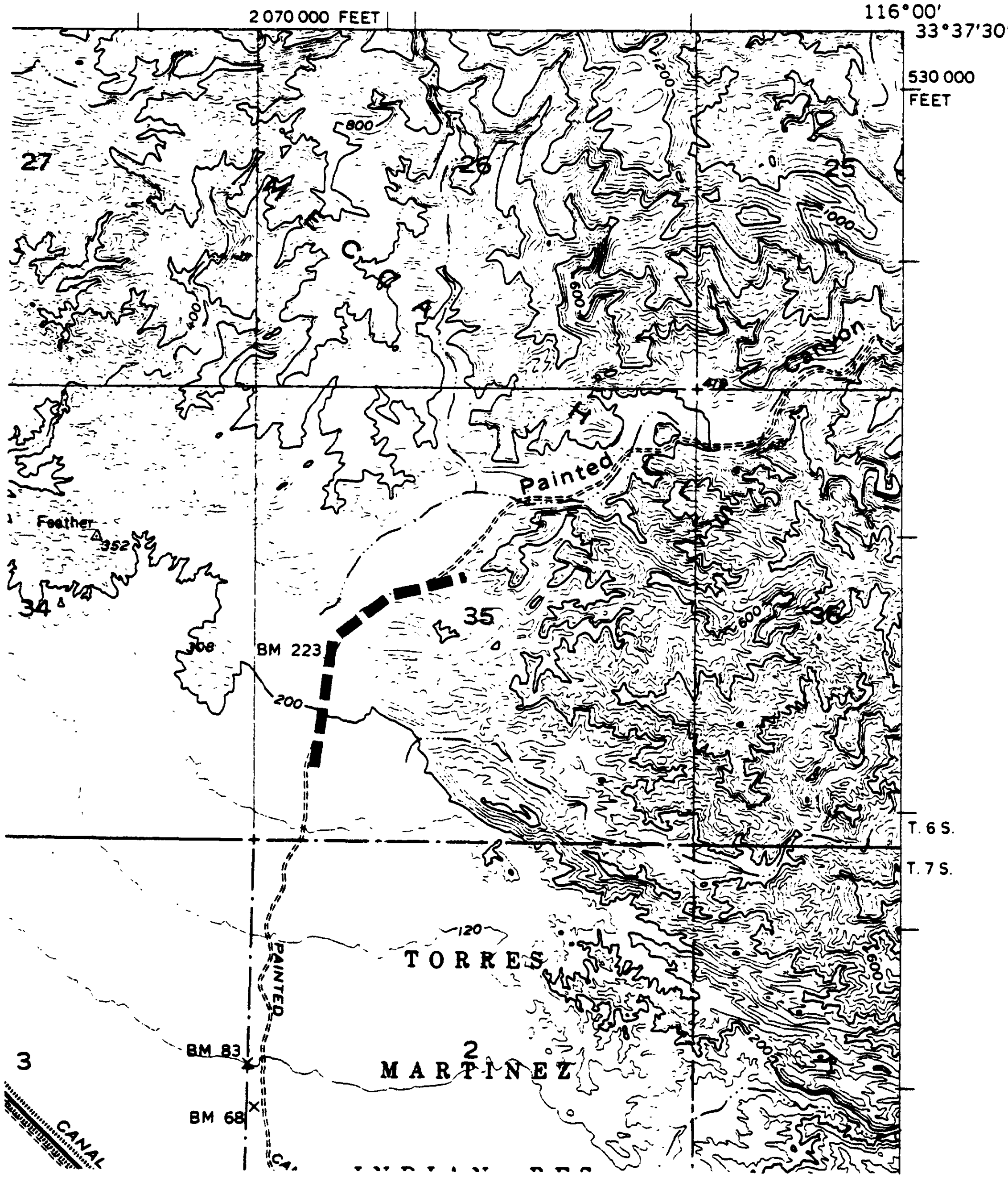
Latitude:	33°36'15"	**Length:**	1606.0m
Longitude:	116°01'20"	**Number of Bench marks:**	53
Date of Initial Survey:	4 September 1983	**Number of Surveys to 1988:**	5
Trespass Permission:	None needed.		

Comments:

This line extends across the San Andreas fault in the mouth of Painted Canyon, Mecca Hills, in the Salton Trough, four miles northeast of Mecca.

Six levelings from September 1983 to December 1987 are compared in an accompanying figure. Bench mark height changes relative to the initial leveling are generally less than 5 mm; however, the central part of the line northeast of the fault has progressively risen. The rising part of the line coincides approximately with the hinge of an anticline that is exposed in the canyon walls. If the rising bench marks and the anticline are related, then the data show that the anticline is rising at a rate of nearly 1mm/yr.

MECCA QUADRANGLE
CALIFORNIA–RIVERSIDE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 COACHELLA 15' QUADRANGLE



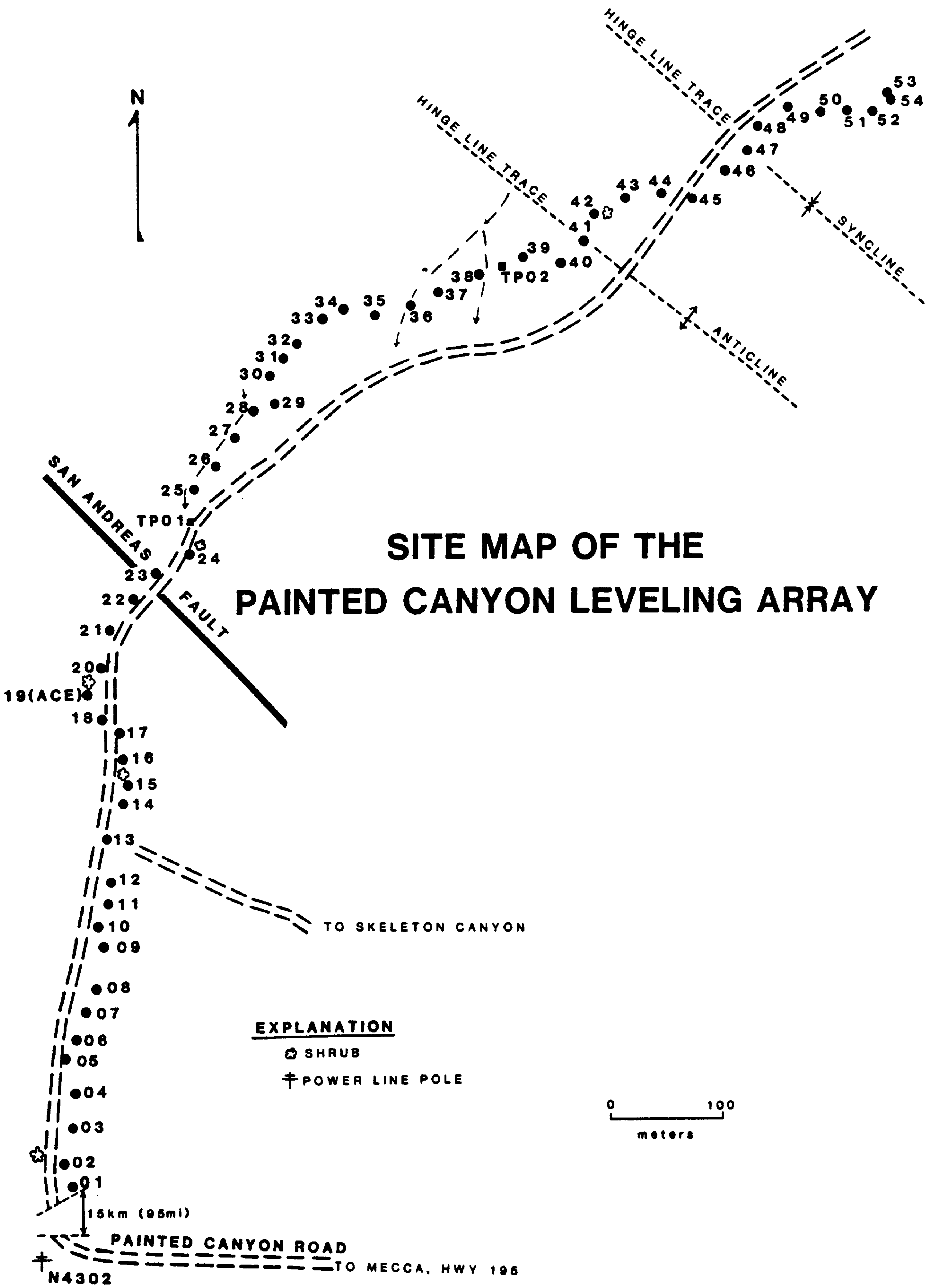
SCALE 1:24 000

1 ½ 0 1 MILE

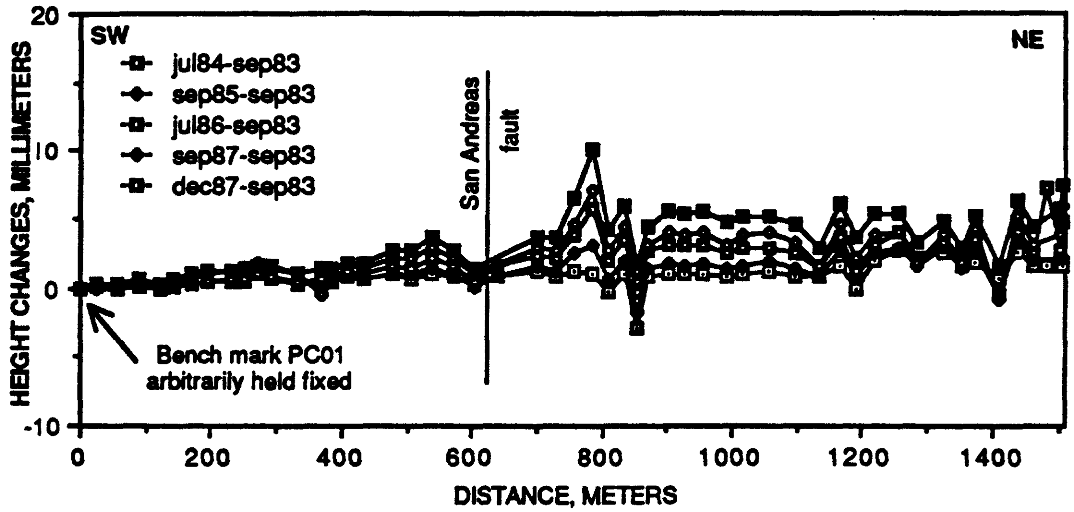
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

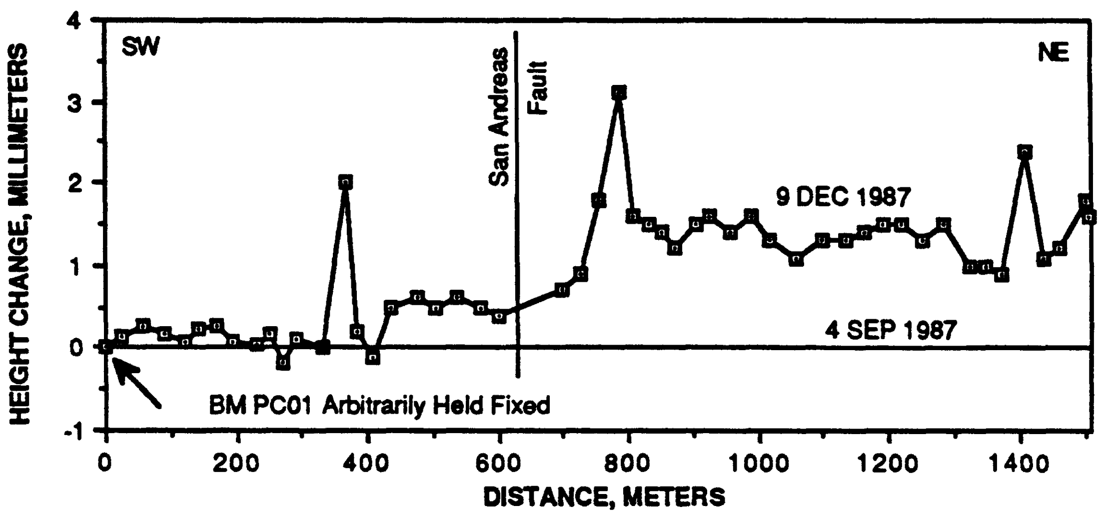
SITE MAP OF THE PAINTED CANYON LEVELING ARRAY

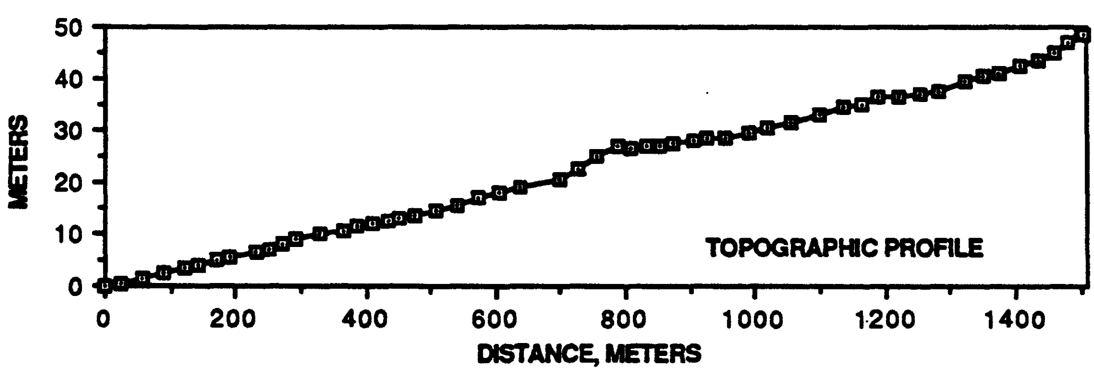


Δ BM Heights - PAINTED CANYON - 1983 to 1987



ΔBM HEIGHTS - PAINTED CANYON - SEP TO DEC 1987





******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MH01	MH02	36.336
MH02	MH03	113.399
MH03	MH04	96.763
MH04	MH05	95.198
MH05	MH06	46.657
MH06	MH07	91.879
MH07	MH08	80.080
MH08	MH09	110.818
MH09	MH10	45.335
MH10	MH11	80.538
MH11	MH12	81.086
MH12	MH13	119.308
MH13	MH14	73.891
MH14	MH15	67.185
MH15	MH16	66.153
MH16	MH17	32.319
MH17	MH18	47.676
MH18	MH19	65.532
MH19	MH20	110.660
MH20	MH21	106.487
MH21	MH22	157.016
MH22	MH23	65.464
MH23	MH24	93.116
MH24	TP01	44.541
TP01	MH25	141.734
MH25	MH26	176.413
MH26	MH27	245.905
MH27	MH28	208.761
MH28	MH29	-47.700
MH29	MH30	24.527
MH30	MH31	47.021
MH31	MH32	38.611
MH32	MH33	57.563
MH33	MH34	54.621
MH34	MH35	-23.783
MH35	MH36	81.653
MH36	MH37	122.882
MH37	MH38	105.458
MH38	TP02	24.240
TP02	MH39	94.535
MH39	MH40	147.500
MH40	MH41	86.189
MH41	MH42	118.143
MH42	MH43	39.084
MH43	MH44	31.844
MH44	MH45	55.271
MH45	MH46	173.161
MH46	MH47	98.810
MH47	MH48	93.678
MH48	MH49	121.930
MH49	MH50	89.791
MH50	MH51	181.933
MH51	MH52	185.680
MH52	MH53	129.984
MH53	MH54	20.015

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
MH01	MH02	36.366
MH02	MH03	113.398
MH03	MH04	96.798
MH04	MH05	95.168
MH05	MH06	46.697
MH06	MH07	91.904
MH07	MH08	80.101
MH08	MH09	110.830
MH09	MH10	45.338
MH10	MH11	80.566
MH11	MH12	81.080
MH12	MH13	119.266
MH13	MH14	73.931
MH14	MH15	67.182
MH15	MH16	66.181
MH16	MH17	32.329
MH17	TP01	64.596
TP01	ACE	48.700
ACE	MH20	110.652
MH20	MH21	106.575
MH21	MH22	156.922
MH22	MH23	65.352
MH23	MH24	89.873
MH24	TP02	64.889
TP02	MH25	124.841
MH25	MH26	176.418
MH26	MH27	246.186
MH27	MH28	209.127
MH28	MH29	-48.288
MH29	MH30	24.685
MH30	MH31	46.621
MH31	MH32	38.864
MH32	MH33	57.668
MH33	MH34	54.612
MH34	MH35	-23.768
MH35	MH36	81.582
MH36	MH37	122.910
MH37	MH38	105.453
MH38	TP03	23.849
TP03	MH39	94.885
MH39	MH40	147.341
MH40	MH41	86.488
MH41	MH42	117.902
MH42	MH43	39.245
MH43	MH44	31.866
MH44	MH45	55.056
MH45	MH46	173.316
MH46	MH47	98.620
MH47	MH48	93.910
MH48	MH49	121.562
MH49	MH50	90.267
MH50	MH51	181.742
MH51	MH52	183.472
MH52	MH53	132.313
MH53	MH54	20.206

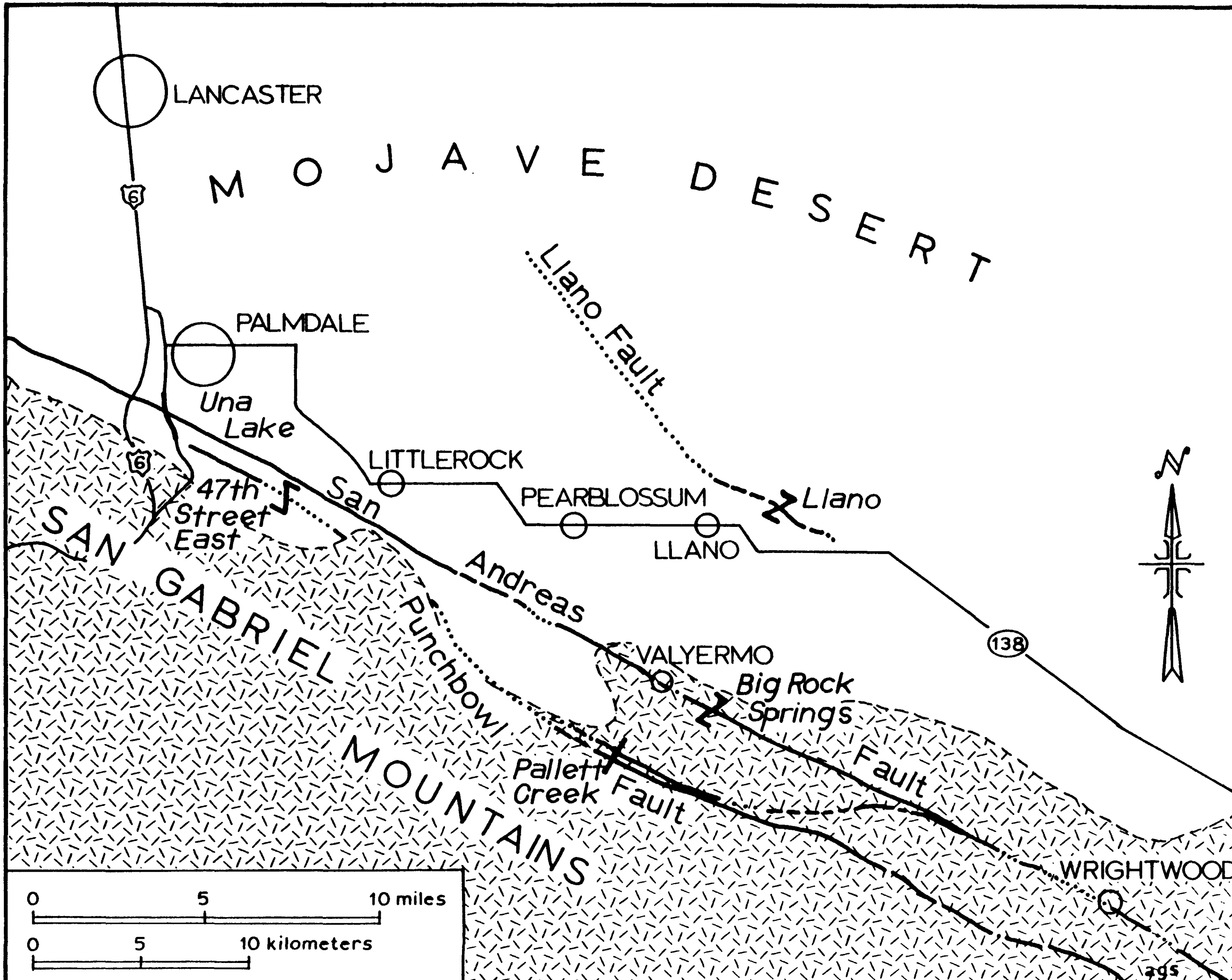
PALLET CREEK Level Line

Latitude:	34°35'10"	**Length:**	1672m
Longitude:	117°54'00"	**Number of Bench marks:**	70
Date of Initial Survey:	22 June 1978	**Number of Surveys to 1988:**	15
Trespass Permission:	The line is on private ranch property: Ranch Manager, Carol Robinson 12880 Juniper Hills Road Pearblossom, CA 93553		

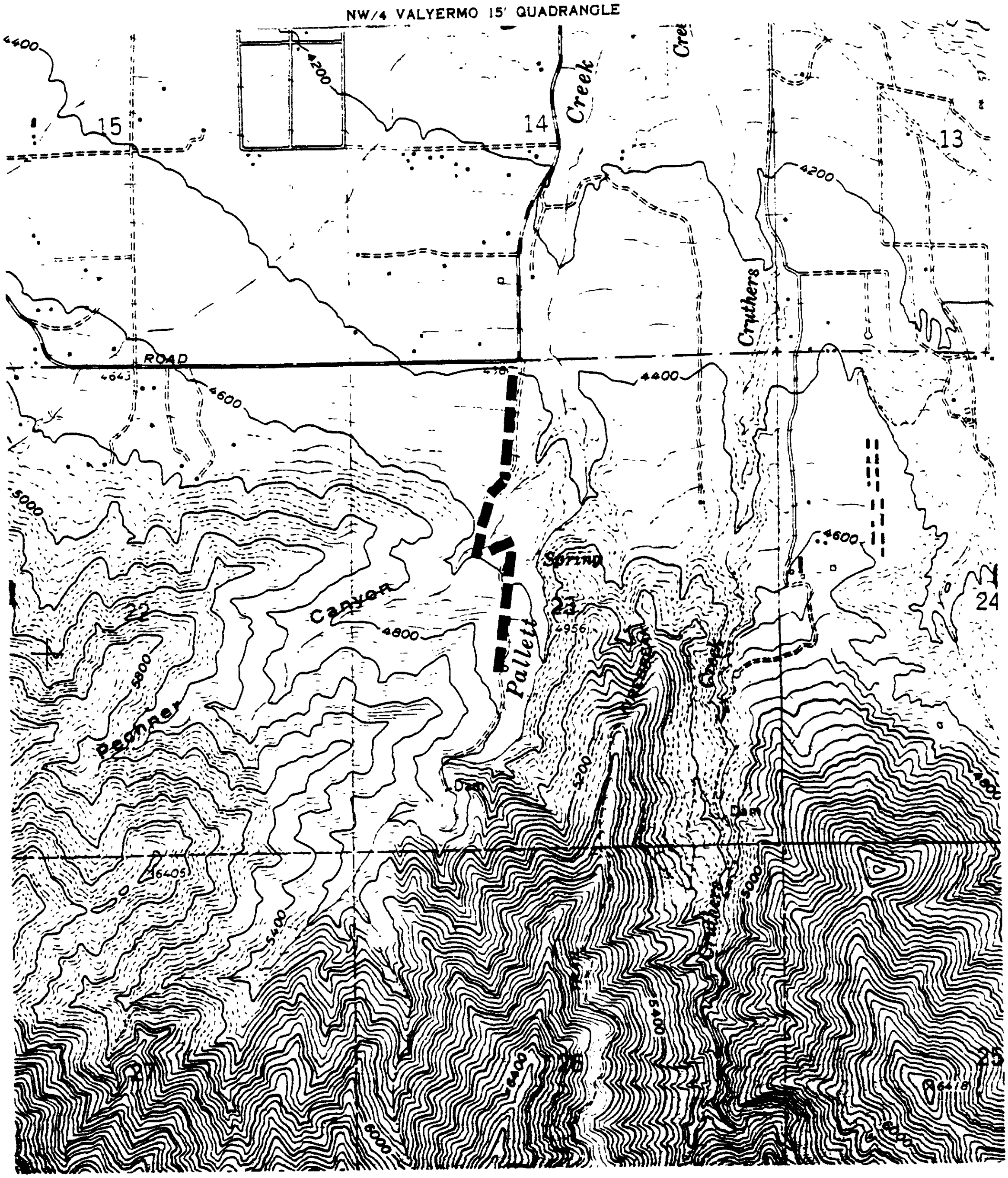
Comments:

This line crosses the Punchbowl fault along the northwest bank of Pallett Creek, six miles south of Pearblossom.

Four levelings in the period 1978 to 1983 are compared in an accompanying figure and show no evidence for vertical displacement across the fault. The apparent tilt is the "Niemeyer effect" of accumulation of minor systematic refraction error rather than being tectonic tilt.


LANCASTER
M O J A V E D E S E R T
6
PALMDALE
Llano Fault
Una Lake
LITTLEROCK
PEARBLOSSUM
Llano
LLANO
47th Street East
San Andreas
SAN GABRIEL MOUNTAINS
Punchbowl
VALYERMO
Big Rock Springs
Fault
Pallett Creek Fault
138
WRIGHTWOOD
N
0
5
10 miles
10 kilometers
ags

JUNIPER HILLS QUADRANGLE
CALIFORNIA–LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 VALYERMO 15' QUADRANGLE

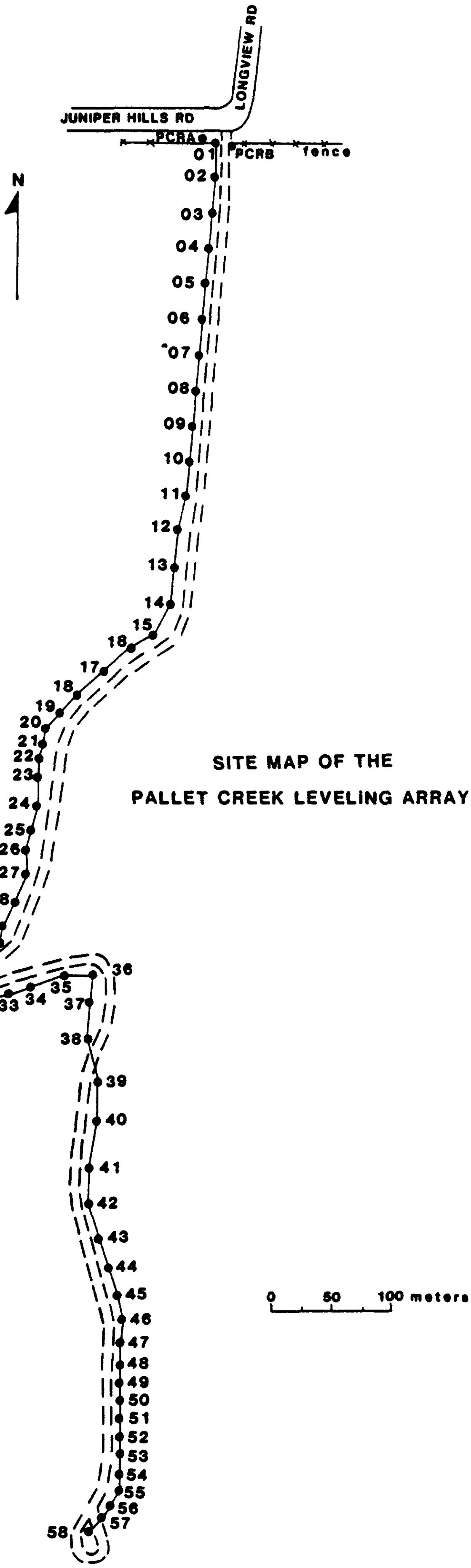


SCALE 1:24 000

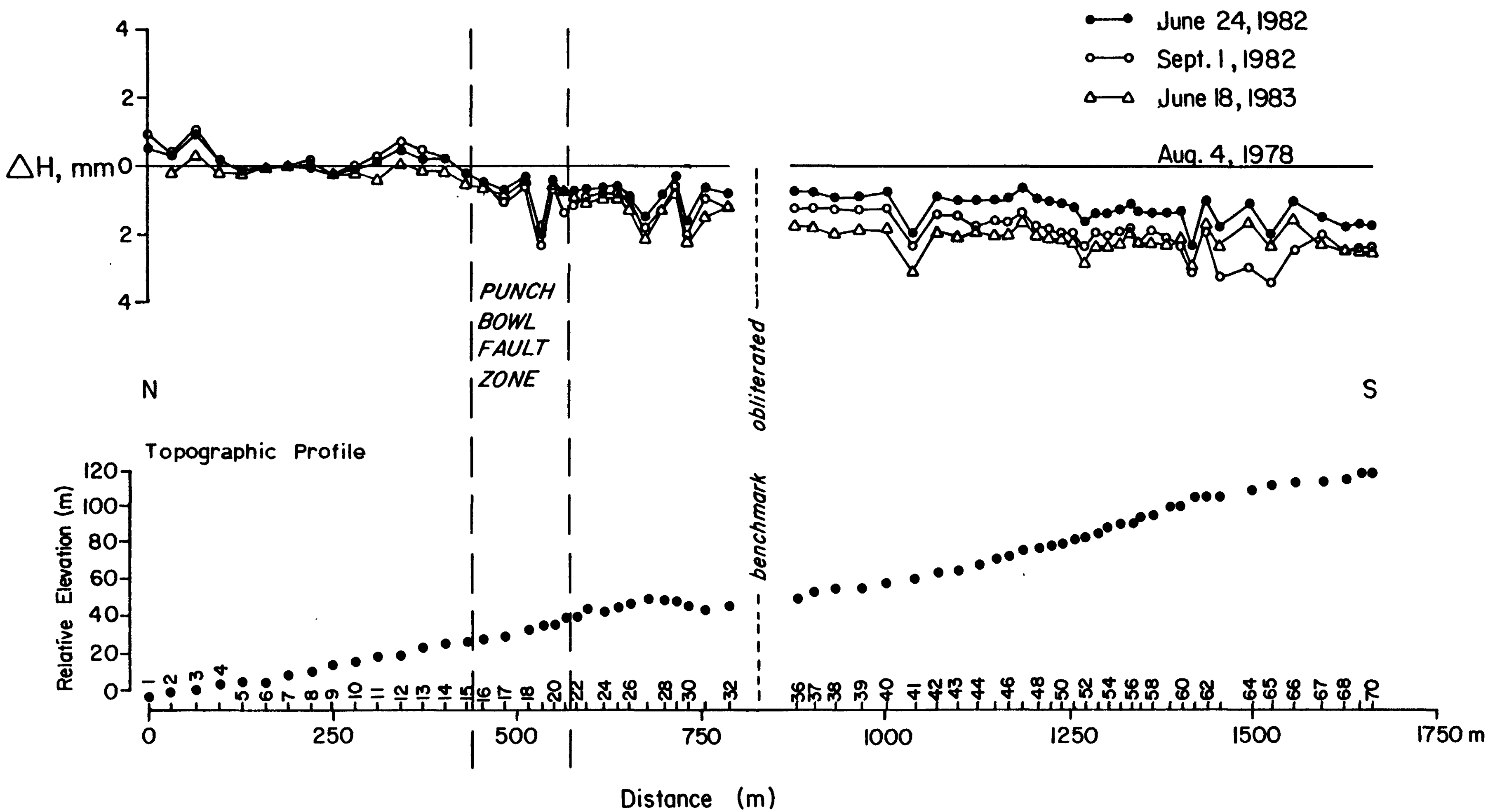
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER



SITE MAP OF THE
PALLET CREEK LEVELING ARRAY


June 24, 1982
Sept. 1, 1982
June 18, 1983
Aug. 4, 1978
ΔH, mm
PUNCH BOWL FAULT ZONE
obliterated benchmark
N
S
Topographic Profile
Relative Elevation (m)
Distance (m)
1750 m

PALMDALE, CALIFORNIA   PALLETT CREEK   JUNE 22, 1978

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
PC01	PC02	236.8658
PC02	PC03	223.6770
PC03	PC04	223.2070
PC04	PC05	211.3175
PC05	PC06	200.0948
PC06	PC07	199.7530
PC07	PC08	209.3930
PC08	PC09	240.0898
PC09	PC10	200.5318
PC10	PC11	194.2452
PC11	PC12	211.4243
PC12	PC13	247.2175
PC13	PC14	224.7030
PC14	PC15	243.6158
PC15	PC16	197.9803
PC16	PC17	226.2353
PC17	PC18	207.1700
PC18	PC19	207.6673
PC19	PC20	228.8848
PC20	PC21	190.3178
PC21	PC22	150.5748
PC22	PC23	160.4560
PC23	PC24	157.2928
PC24	PC25	185.1273
PC25	PC26	185.8133
PC26	PC27	75.7945
PC27	PC28	73.1837
PC28	PC29	-71.4255
PC29	PC30	-178.1253
PC30	PC31	-63.9825
PC31	PC32	77.7175
PC32	PC33	169.6675
PC33	PC34	99.0177
PC34	PC35	102.9230
PC35	PC36	80.4183
PC36	PC37	167.0440
PC37	PC38	197.4123
PC38	PC39	206.0615
PC39	PC40	224.4543
PC40	PC41	248.7310
PC41	PC42	245.5163
PC42	PC43	207.9533
PC43	PC44	202.0455
PC44	PC45	211.7808
PC45	PC46	215.6095
PC46	PC47	213.5835
PC47	PC48	236.3238
PC48	PC49	200.1913
PC49	PC50	205.8475
PC50	PC51	190.1253

(continued)

PALMDALE, CALIFORNIA PALLETT CREEK JUNE 22, 1978

Backsight	Foresight	Height Diff (cm)
PC51	PC52	194.0450
PC52	PC53	192.1478
PC53	PC54	210.5938
PC54	PC55	187.2540
PC55	PC56	223.3475
PC56	PC57	233.7545
PC57	PC58	189.9065
PC58	PC59	177.8063
PC59	PC60	213.5108
PC60	PC61	194.2885
PC61	PC62	199.7578
PC62	PC63	198.8243
PC63	PC64	215.0787
PC64	PC65	180.1880
PC65	PC66	221.1365
PC66	PC67	110.8760
PC67	PC68	146.2045
PC68	PC69	182.8193
PC69	PC70	86.5115

VALYERMO, CALIFORNIA PALLETT CREEK SEPTEMBER 11, 1986

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
PC01	PC02	236.788	
PC02	PCA	-229.287	single run, 1 shots.
PC02	PC03	223.752	
PC03	PC04	223.138	
PC04	PC05	211.248	
PC05	PC06	200.101	
PC06	PC07	199.806	
PC07	PC08	209.370	
PC08	PC09	240.078	
PC09	PC10	200.535	
PC10	PC11	194.239	
PC11	PC12	211.527	
PC12	PC13	247.171	
PC13	PC14	224.678	
PC14	PC15	243.591	
PC15	PC16	197.974	
PC16	PC17	226.142	
PC17	PC18	207.220	
PC18	PC19	207.506	
PC19	PC20	229.034	
PC20	PC21	190.233	
PC21	PC22	150.595	
PC22	PC23	160.496	
PC23	PC24	157.333	
PC24	PC25	185.161	
PC25	PC26	185.794	
PC26	PC27	75.693	
PC27	PC28	73.238	
PC28	PC29	-71.279	
PC29	PC30	-178.420	
PC30	PC31	-63.747	
PC31	PC32	77.660	
PC32	PC33	167.990	
PC33	PC34	99.839	
PC34	PC35	103.803	
PC35	PC36	80.374	
PC36	PC37	167.043	
PC37	PC38	197.448	
PC38	PC39	206.032	
PC39	PC40	224.493	
PC40	PC41	248.472	
PC41	PC42	245.752	
PC42	PC43	207.965	
PC43	PC44	201.994	
PC44	PC45	211.849	
PC45	PC46	215.565	
PC46	PC47	213.688	
PC47	PC48	236.240	
PC48	PC49	200.197	
PC49	PC50	205.841	
PC50	PC51	190.121	

PC51	PC52	193.983
PC52	PC53	192.220
PC53	PC54	210.566
PC54	PC55	187.287
PC55	PC56	223.384
PC56	PC57	233.634
PC57	PC58	190.010
PC58	PC59	177.792
PC59	PC60	213.477
PC60	PC61	194.214
PC61	PC62	199.815
PC62	PC63	198.770
PC63	PC64	214.996
PC64	PC65	180.138
PC65	PC66	221.295
PC66	PC67	110.995
PC67	PC68	146.161
PC68	PC69	182.816
PC69	PC70	86.531

PARKFIELD Level Line

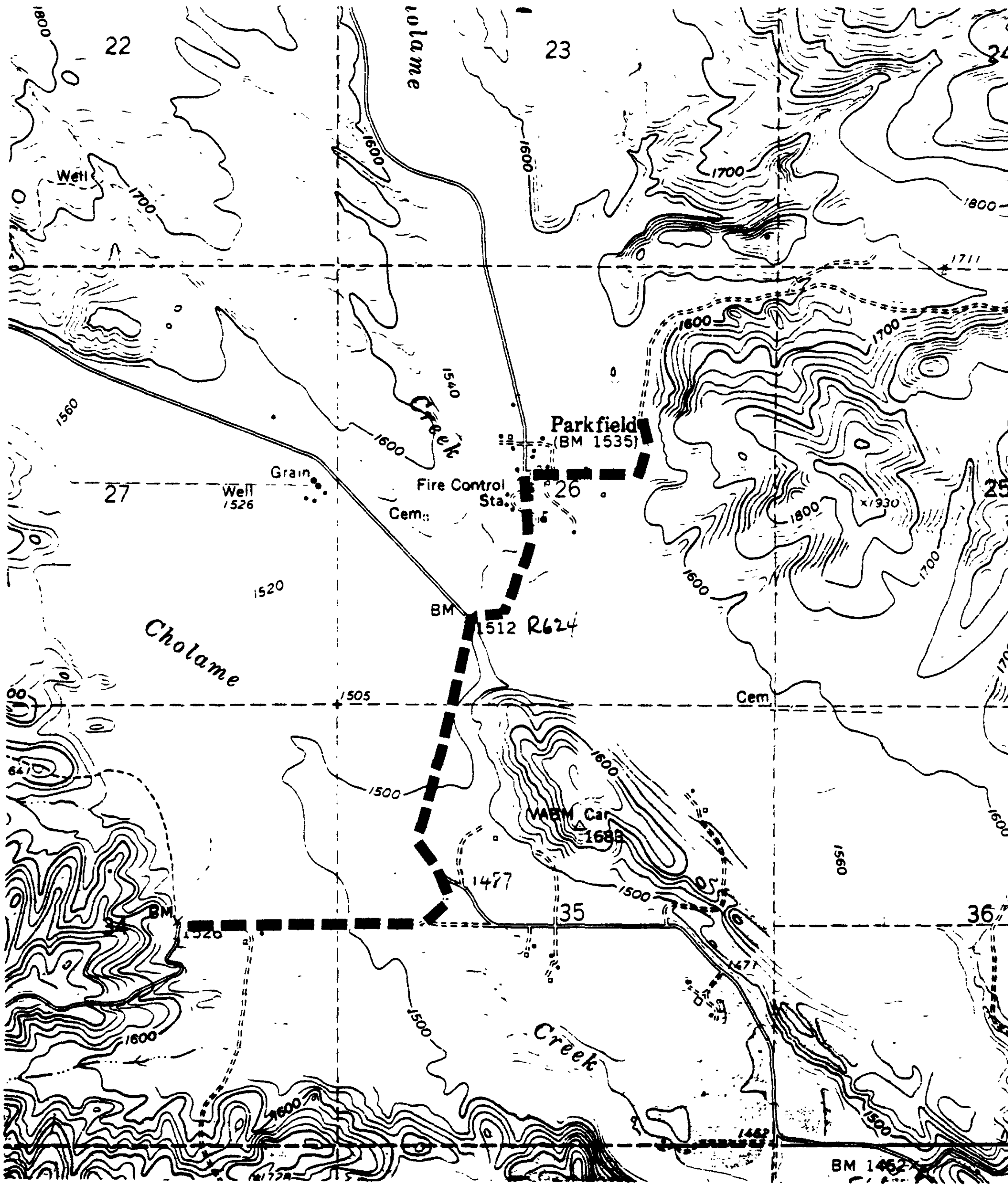
Latitude:	35°53'42"	**Length:**	3000.0m
Longitude:	120°26'02"	**Number of Bench marks:**	27
Date of Initial Survey:	7 April 1984 (UCSB)	**Number of Surveys to 1988:**	6
Trespass Permission:	None needed.		

Comments:

This line was established across the San Andreas fault through the townsite of Parkfield by the U.S. Geological Survey in 1980.

Seven UCSB levelings in the period April 1984 to February 1988 are compared in an accompanying figure. Bench marks northeast of the San Andreas fault show negligible height changes relative to one another. The bench marks step relatively downward across and close to the fault. The bench marks between the 0 and 1500m distance marks rise and fall unsystematically in apparent response to withdrawal of groundwater for irrigation in adjacent fields. Bench mark 1526 has some recent and significant height changes which have no ready explanation at this time.

PARKFIELD QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PARKFIELD 15' QUADRANGLE

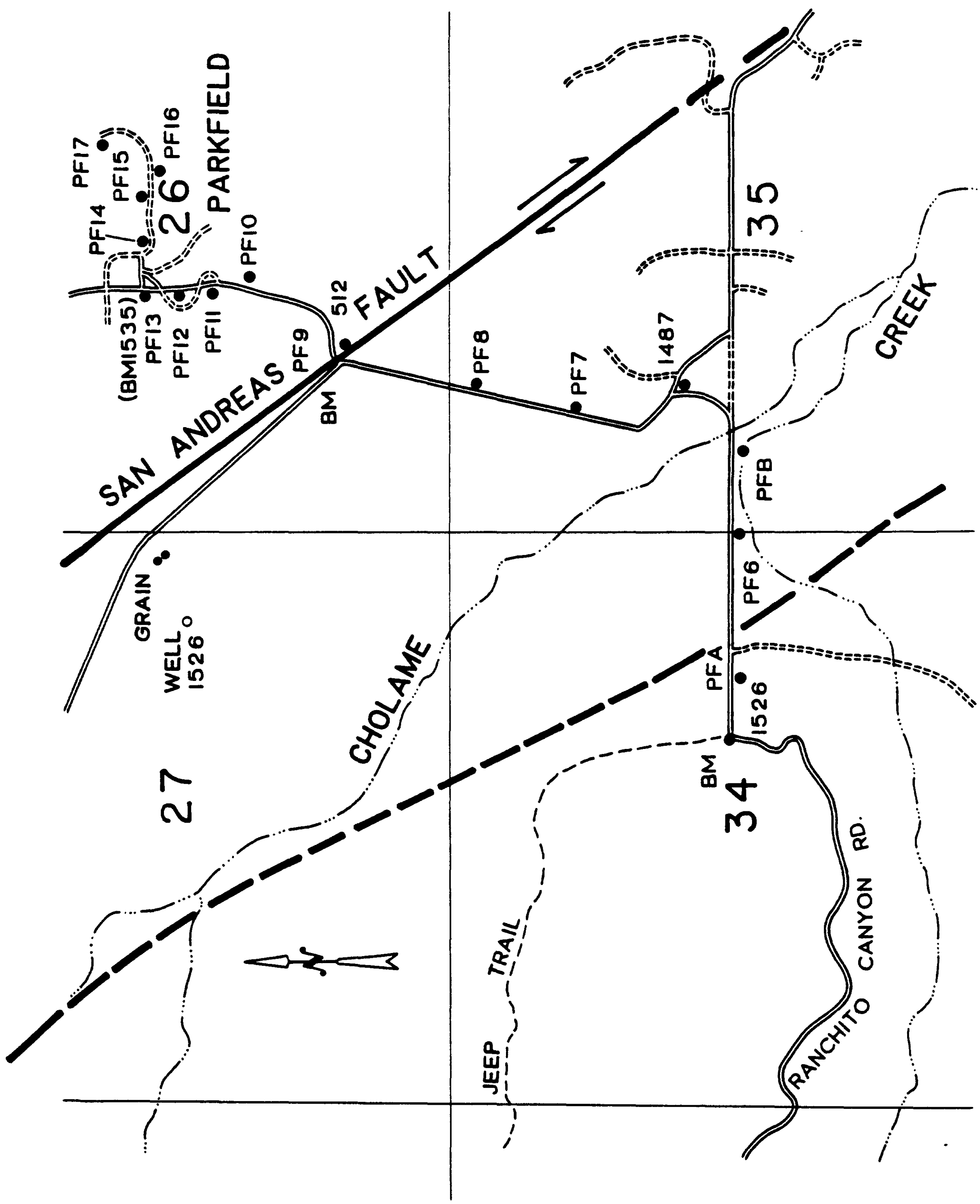


SCALE 1:24 000

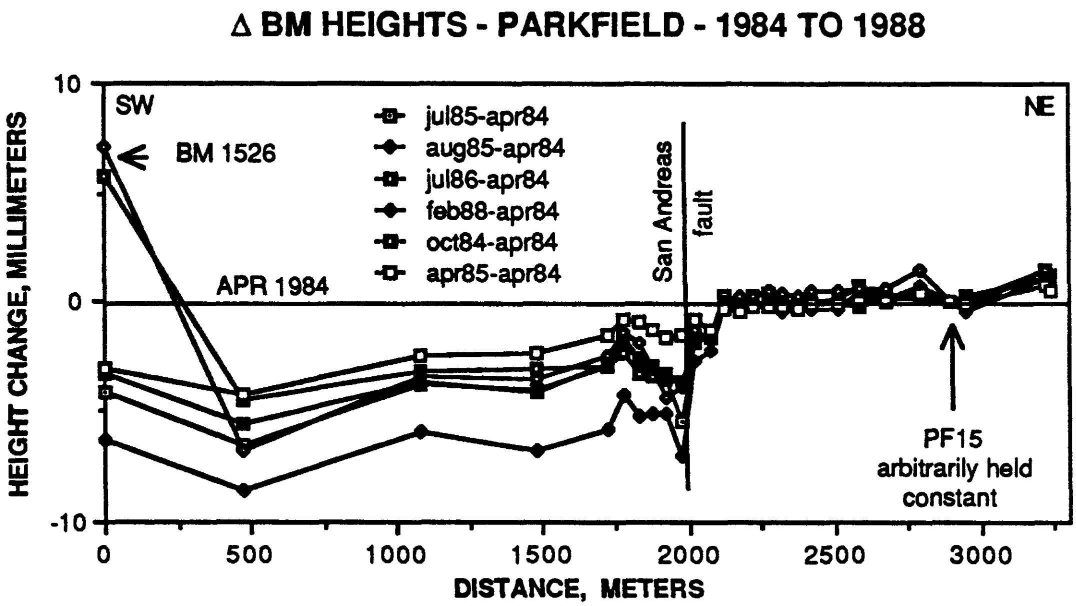
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

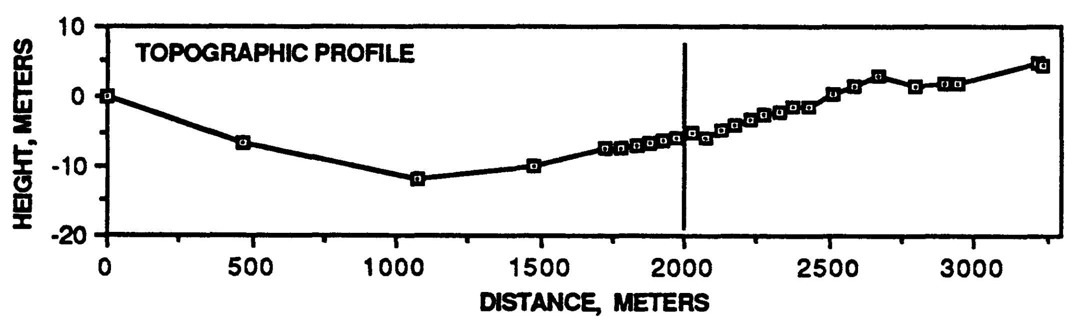
1 .5 0 1 KILOMETER



PARKFIELD
PF17
PF16
PF15
PF14
26
PF10
(BM1535)
PF13
PF12
PF11
512
FAULT
SAN ANDREAS
PF9
BM
PF8
PF7
1487
35
CREEK
PFB
GRAIN
WELL
1526
PF6
PFA
1526
CHOLAME
BM
34
27
RD.
RANCHITO CANYON
TRAIL
JEEP



Δ BM HEIGHTS - PARKFIELD - 1984 TO 1988
HEIGHT CHANGE, MILLIMETERS
SW
NE
BM 1526
jul85-apr84
aug85-apr84
jul86-apr84
feb88-apr84
oct84-apr84
apr85-apr84
APR 1984
San Andreas
fault
PF15
arbitrarily held
constant
10
0
-10
0
500
1000
1500
2000
2500
3000
DISTANCE, METERS



HEIGHT, METERS
TOPOGRAPHIC PROFILE
10
0
-10
-20
0
500
1000
1500
2000
2500
3000
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
1526	TP01	-231.474
TP01	TP02	-76.241
TP02	TP03	-55.814
TP03	TP04	-34.703
TP04	TP05	-56.086
TP05	TP06	-58.170
TP06	TP07	-56.675
TP07	TP08	-30.663
TP08	TP09	-73.032
TP09	TP10	-20.506
TP10	TP11	-15.514
TP11	TP12	2.345
TP12	PF06	45.186
PF06	TP13	-44.125
TP13	TP14	-39.731
TP14	TP15	-95.196
TP15	TP16	-86.491
TP16	TP17	-102.141
TP17	TP18	-79.627
TP18	TP19	-83.872
TP19	TP20	-74.877
TP20	TP21	-31.211
TP21	TP22	2.765
TP22	TP23	-30.421
TP23	TP24	19.114
TP24	TP25	32.450
TP25	TP26	54.161
TP26	TP27	49.295
TP27	BOLT	-9.708
BOLT	TP28	57.363
TP28	TP29	-8.116
TP29	TP30	-3.704
TP30	TP31	11.952
TP31	TP32	16.022
TP32	TP33	30.973
TP33	TP34	46.798
TP34	TP35	27.819
TP35	PF07	13.707
PF07	TP36	30.390
TP36	TP37	27.986
TP37	TP38	25.740
TP38	TP39	29.923
TP39	TP40	32.348
TP40	TP41	29.542
TP41	TP42	18.673
TP42	TP43	17.117
TP43	PF08	19.521
PF08	TP44	14.918
TP44	PF8A	16.836

PF8A	TP45	2.573
TP45	PF8B	23.712
PF8B	PF8C	34.602
PF8C	PF8D	40.054
PF8D	PF8E	44.191
PF8E	PF8F	64.272
PF8F	PF09	-63.649
PF09	TP46	100.911
TP46	PF9A	4.657
PF9A	PF9B	84.163
PF9B	PF9C	52.580
PF9C	PF9D	70.630
PF9D	PF9E	52.871
PF9E	PF9F	55.653
PF9F	PF10	17.780
PF10	TP48	80.704
TP48	TP49	61.050
TP49	PF11	46.512
PF11	TP50	79.587
TP50	TP51	15.693
TP51	PF12	17.516
PF12	TP52	75.915
TP52	PF13	77.228
PF13	TP53	-82.612
TP53	TP54	-53.073
TP54	PF14	-29.661
PF14	TP55	17.505
TP55	TP56	35.608
TP56	PF15	-22.166
PF15	TP57	21.915
TP57	TP58	3.399
TP58	PF16	-25.373
PF16	TP59	26.748
TP59	TP60	91.327
TP60	TP61	46.076
TP61	TP62	55.242
TP62	TP63	36.768
TP63	17EC	47.198
17EC	PF17	-37.680

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
1526	TP01	-181.811
TP01	TP02	-96.374
TP02	TP03	-57.211
TP03	TP04	-45.052
TP04	TP05	-46.104
TP05	PFA	4.695
PFA	TP07	-94.010
TP07	TP08	-51.973
TP08	TP09	-29.146
TP09	TP10	-94.683
TP10	TP11	-16.109
TP11	TP12	-2.583
TP12	PF06	47.986
PF06	TP13	-42.645
TP13	TP14	-37.370
TP14	TP15	-103.869
TP15	TP16	-92.084
TP16	TP17	-99.983
TP17	TP18	-78.072
TP18	PFB	-61.499
PFB	TP20	-93.182
TP20	TP21	-31.785
TP21	TP22	5.479
TP22	TP23	13.623
TP23	TP24	15.989
TP24	TP25	37.842
TP25	TP26	38.431
TP26	TP27	18.434
TP27	BOLT	-8.799
BOLT	TP28	36.344
TP28	TP29	4.046
TP29	TP30	7.638
TP30	TP31	18.395
TP31	TP32	18.623
TP32	TP33	26.458
TP33	TP34	45.373
TP34	TP35	24.777
TP35	PF07	11.181
PF07	TP36	27.163
TP36	TP37	16.914
TP37	TP38	32.370
TP38	TP39	20.470
TP39	TP40	41.135
TP40	TP41	30.199
TP41	TP42	14.989
TP42	TP43	13.395
TP43	PF08	34.610
PF08	TP44	13.342
TP44	PF8A	18.475

PF8A	TP45	-16.626
TP45	PF8B	42.813
PF8B	PF8C	34.593
PF8C	PF8D	40.052
PF8D	PF8E	44.161
PF8E	PF8F	64.488
PF8F	PF09	-63.653
PF09	TP46	103.370
TP46	PF9A	2.335
PF9A	PF9B	84.170
PF9B	PF9C	52.580
PF9C	PF9D	70.628
PF9D	PF9E	52.888
PF9E	PF9F	55.658
PF9F	PF10	17.774
PF10	TP47	70.783
TP47	TP48	72.291
TP48	PF11	45.198
PF11	TP49	81.737
TP49	TP50	18.155
TP50	PF12	12.921
PF12	TP51	55.046
TP51	PF13	98.111
PF13	TP5B	-55.299
TP5B	TP5A	-19.945
TP5A	TP52	-20.579
TP52	TP53	-42.011
TP53	PF14	-27.497
PF14	TP54	21.950
TP54	TP55	28.007
TP55	PF15	-19.057
PF15	TP56	26.430
TP56	TP57	-2.573
TP57	PF16	-23.885
PF16	TP58	28.613
TP58	TP59	109.098
TP59	TP60	31.399
TP60	TP61	50.011
TP61	TP62	40.369
TP62	17ECC	43.943
17ECC	PF17	-37.703

PINYON FLAT Leveling Array

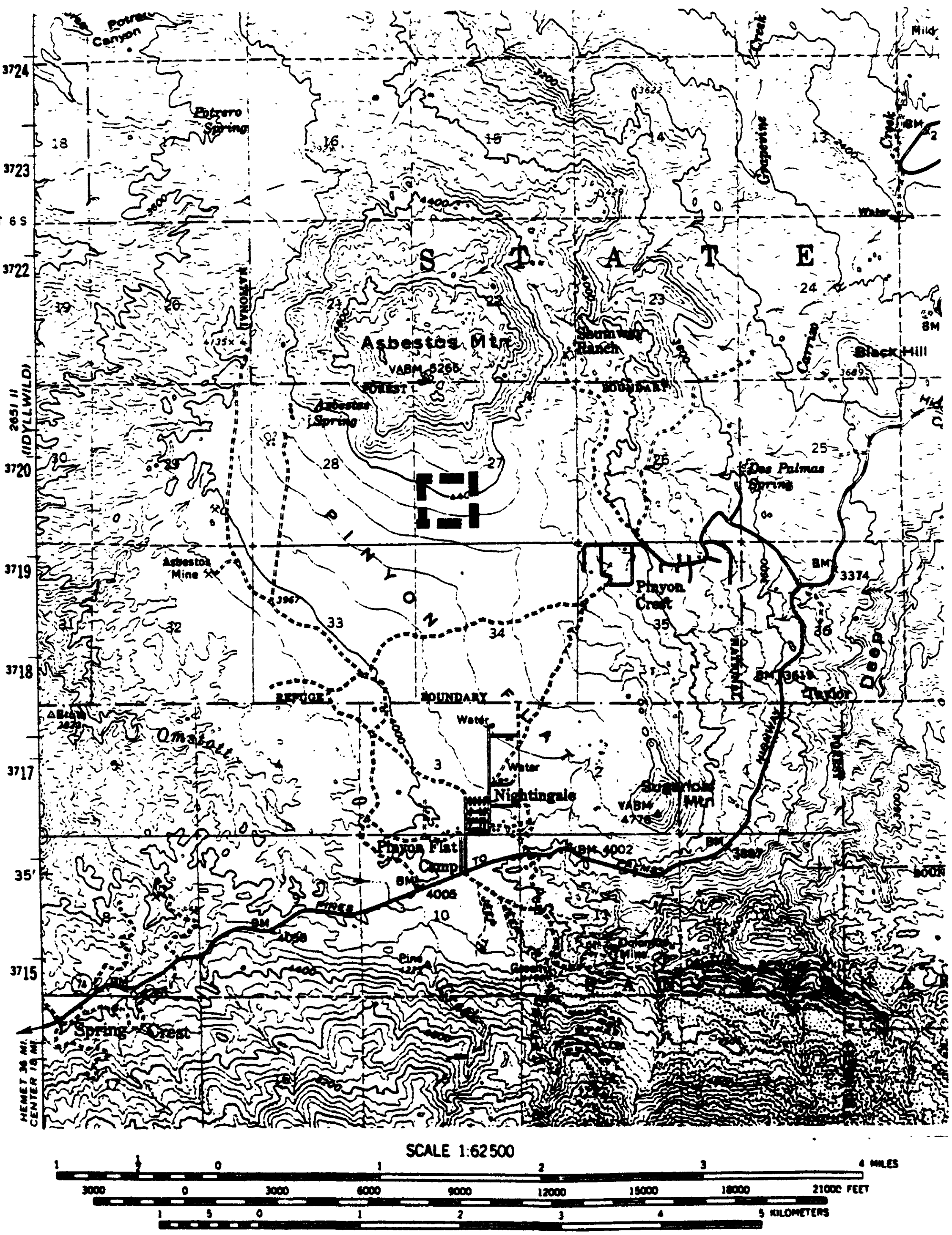
Latitude:	33°35'00"	**Length:**	2584.3m
Longitude:	116°26'00"	**Number of Bench marks:**	74
Date of Initial Survey:	13 October 1979	**Number of Surveys to 1988:**	19
Trespass Permission:	Contact in Advance: Dr. Frank Wyatt Institute of Geophysics and Planetary Physics University of California, San Diego La Jolla, CA 92093		

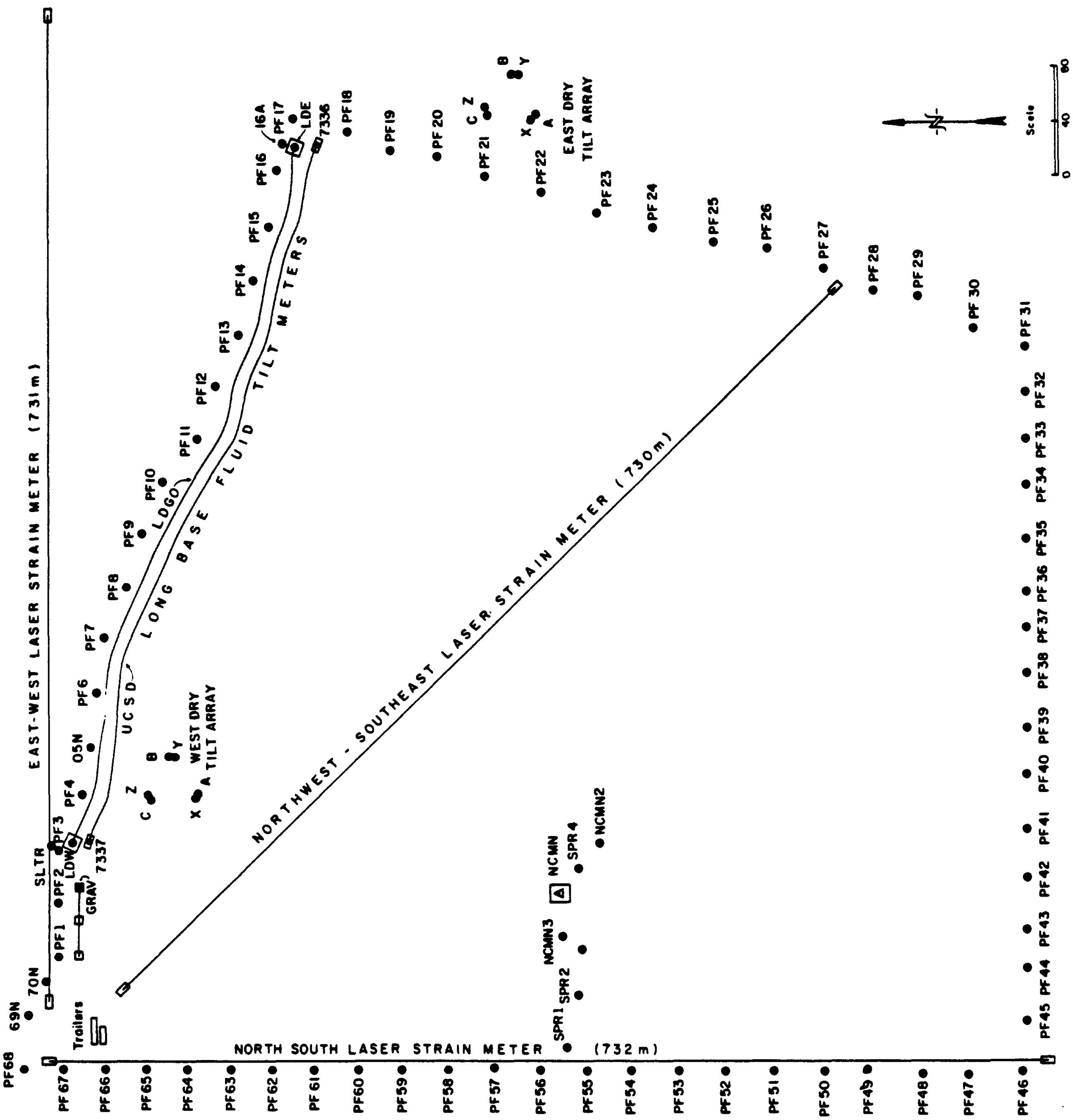
Comments:

This box-shaped array was established at the Pinyon Flat Geophysical Observatory, 9 miles SSW of Palm Desert, to provide precise geodetic control for the various crustal strain experiments being conducted at the Observatory. Several kinds of bench marks have been added at various times to test their stability. A report about the behavior of some of these bench marks was published by Sylvester (1984).

Reference cited: Sylvester, A.G. 1984. Leveling precision and bench mark motions, Pinon Flat Observatory, California. Journal of Geophysical Research 89 (B9), 7949-7956.

PALM DESERT QUADRANGLE
CALIFORNIA–RIVERSIDE CO.
15 MINUTE SERIES (TOPOGRAPHIC)





EAST-WEST LASER STRAIN METER (731 m)
NORTHWEST - SOUTHEAST LASER STRAIN METER (730 m)
NORTH SOUTH LASER STRAIN METER (732 m)
LONG BASE FLUID TILT METERS
UCSD
LOGO
WEST DRY TILT ARRAY
EAST DRY TILT ARRAY
Trailers
SLTR
LDW
LDE
GRAV
7337
7336
16A
05N
69N
70N
NCMN
NCMN2
NCMN3
SPR1
SPR2
SPR4
Scale
Meters
0
40
80

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
PF01	PF02	57.796	
PF02	GRAV	-191.756	
GRAV	NEW1	103.416	
NEW1	LDW	-161.606	
LDW	NEW2	153.057	
NEW2	7337	-166.810	single run, 1 shots.
NEW2	PF04	10.790	
PF04	05N	15.164	
05N	PF06	-15.080	
PF06	PF07	46.268	
PF07	PF08	-31.645	
PF08	PF09	36.231	
PF09	PF10	-3.589	
PF10	PF11	-61.315	
PF11	PF12	11.572	
PF12	PF13	-14.823	
PF13	PF14	51.842	
PF14	PF15	-25.998	
PF15	PF16	15.234	
PF16	P16A	-19.281	
P16A	PF17	-37.573	
PF17	LDE	-131.129	single run, 1 shots.
PF17	PF18	-178.096	
PF18	P18N	10.066	single run, 1 shots.
PF18	PF19	-161.245	
PF19	PF20	-161.171	
PF20	PF21	-165.834	
PF21	PF22	-88.700	
PF22	PF23	-61.768	
PF23	PF24	-19.188	
PF24	PF25	-56.086	
PF25	PF26	-60.051	
PF26	PF27	28.180	
PF27	PF28	-129.662	
PF28	PF29	-61.017	
PF29	PF30	-88.498	
PF30	P30N	24.346	single run, 1 shots.
PF30	PF31	-150.126	
PF31	O31N	29.263	single run, 1 shots.
PF31	PF32	-169.344	
PF32	PF33	-174.419	
PF33	PF34	-174.089	
PF34	PF35	-212.278	
PF35	PF36	-191.408	
PF36	PF37	-163.783	
PF37	PF38	-188.781	

PF38	PF39	-172.395	
PF39	PF40	-174.184	
PF40	PF41	-200.164	
PF41	PF42	-204.032	
PF42	PF43	-156.344	
PF43	PF44	-108.421	
PF44	PF45	-72.747	
PF45	P45N	33.194	single run, 1 shots.
PF45	PF46	-106.760	
PF46	P46N	25.169	single run, 1 shots.
PF46	PF47	93.421	
PF47	PF48	158.775	
PF48	PF49	131.359	
PF49	PF50	151.855	
PF50	PF51	154.338	
PF51	PF52	184.539	
PF52	PF53	159.597	
PF53	PF54	194.876	
PF54	PF55	164.602	
PF55	PF56	202.394	
PF56	PF57	164.973	
PF57	PF58	217.091	
PF58	PF59	194.684	
PF59	PF60	188.032	
PF60	PF61	205.604	
PF61	PF62	185.581	
PF62	PF63	191.115	
PF63	PF64	199.049	
PF64	PF65	200.816	
PF65	PF66	201.440	
PF66	PF67	214.771	
PF67	PF68	224.455	
PF68	69N	29.607	
69N	70N	-33.241	

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
PF01	PF02	57.796	
PF02	GRAV	-191.716	
GRAV	NEW1	103.342	
NEW1	LDW	-161.543	
LDW	SLTR	248.048	single run, 1 shots.
LDW	NEW2	153.082	
NEW2	NGSJ	55.579	single run, 1 shots.
NEW2	PF04	10.789	
PF04	05N	15.164	
05N	PF06	-15.151	
PF06	PF07	46.345	
PF07	PF08	-31.683	
PF08	PF09	36.174	
PF09	PF10	-3.522	
PF10	PF11	-61.328	
PF11	PF12	11.557	
PF12	PF13	-14.824	
PF13	PF14	51.849	
PF14	PF15	-26.020	
PF15	PF16	15.239	
PF16	PF16A	-19.244	
PF16A	PF17	-37.572	
PF17	P16B	44.836	single run, 1 shots.
PF17	PF18	-178.110	
PF18	P18N	-10.101	single run, 1 shots.
PF18	PF19	-161.253	
PF19	P19N	11.706	single run, 1 shots.
PF19	PF20	-161.160	
PF20	PF21	-165.850	
PF21	PF22	-88.662	
PF22	PF23	-61.752	
PF23	PF24	-19.191	
PF24	PF25	-56.074	
PF25	PF26	-60.098	
PF26	PF27	28.250	
PF27	PF28	-129.713	
PF28	PF29	-60.960	
PF29	PF30	-88.464	
PF30	P30N	24.301	single run, 1 shots.
PF30	PF31	-150.234	
PF31	P31N	29.286	single run, 1 shots.
PF31	PF32	-169.317	
PF32	PF33	-174.429	
PF33	PF34	-174.092	
PF34	PF35	-212.243	
PF35	PF36	-191.440	
PF36	PF37	-163.835	
PF37	PF38	-188.800	

PF38	PF39	-172.413	
PF39	PF40	-174.144	
PF40	PF41	-200.138	
PF41	PF42	-204.049	
PF42	PF43	-156.334	
PF43	PF44	-108.449	
PF44	PF45	-72.683	
PF45	P45N	33.183	single run, 1 shots.
PF45	PF46	-106.735	
PF46	PF46N	-25.273	single run, 1 shots.
PF46	PF47	93.405	
PF47	PF48	158.760	
PF48	PF49	131.350	
PF49	PF50	151.797	
PF50	PF51	154.372	
PF51	PF52	184.516	
PF52	PF53	159.543	
PF53	PF54	194.899	
PF54	PF55	164.629	
PF55	PF56	202.438	
PF56	PF57	164.902	
PF57	PF58	217.107	
PF58	PF59	194.670	
PF59	PF60	188.045	
PF60	PF61	205.589	
PF61	PF62	185.592	
PF62	PF63	191.068	
PF63	PF64	199.087	
PF64	PF65	200.793	
PF65	PF66	201.433	
PF66	PF67	214.804	
PF67	PF68	224.470	
PF68	PF69N	29.612	
PF69N	PF70N	-33.245	

PITT RANCH Level Line

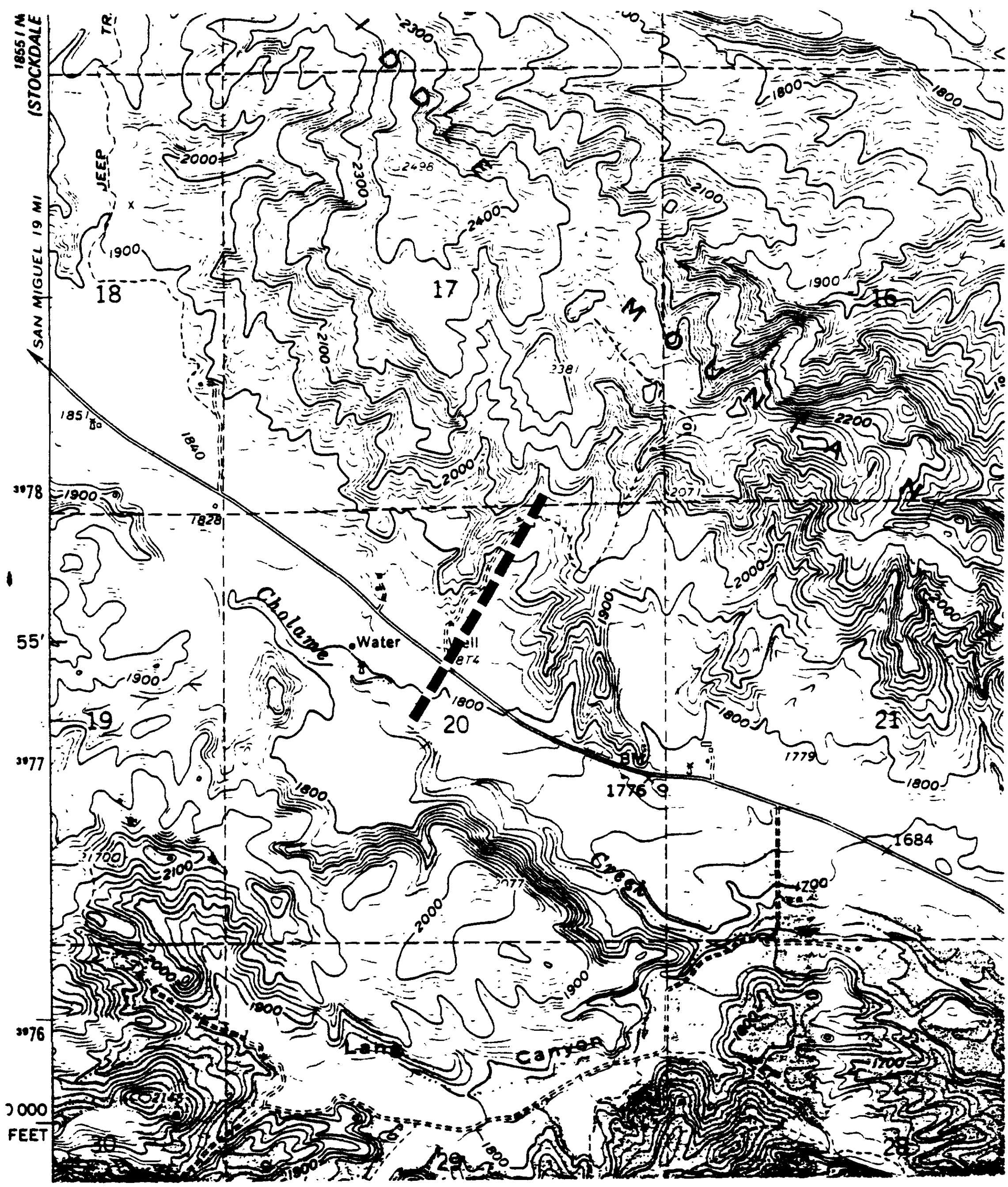
Latitude:	35°55'08"	**Length:**	850.8m
Longitude:	120°28'56"	**Number of Bench marks:**	19
Date of Initial Survey:	6 April 1984	**Number of Surveys to 1988:**	6
Trespass Permission:	None needed, but for courtesy contact Prof. William C. Wirtz, II, Dept. of Biology, Pomona College, Claremont, CA 91711. Office Ph.# (714) 621-8000, Ext. 2950 or 2993. Padlock on gate to ranch.		

Comments:

This line was established by the U.S. Geological Survey as a tilt array on the southwest side of the San Andreas fault, three miles WNW of Parkfield. UCSB set an additional bench mark between each of the USGS bench marks in June 1984.

For much of its length, the line shows remarkable stability since April 1984. But six bench marks at the northeast end of the line have subsided progressively more than 20mm to February 1988. Each of these bench marks lies on the flank of Middle Mountain. The data suggest that the six bench marks lie on the northeast side of a fault that bounds the southwest flank of Middle Mountain, and that Middle Mountain is subsiding relative to Cholame Valley.

PARKFIELD QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW 4 PARKFIELD 15' QUADRANGLE



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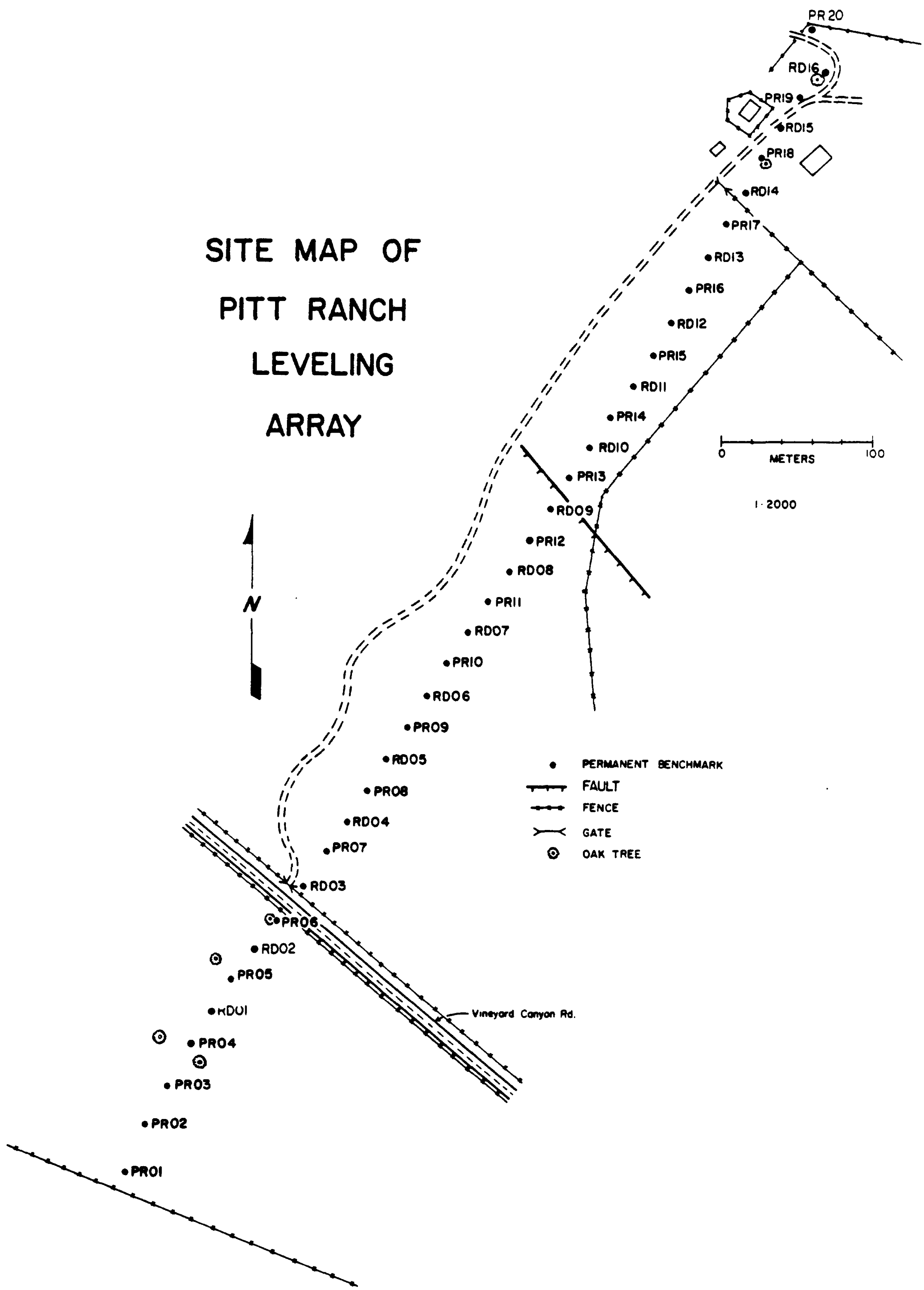
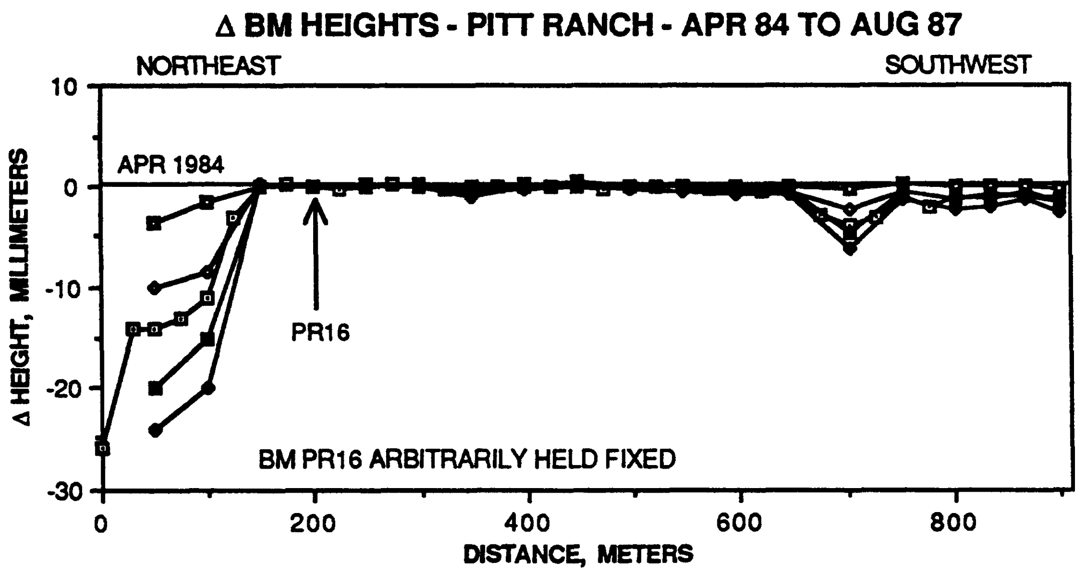
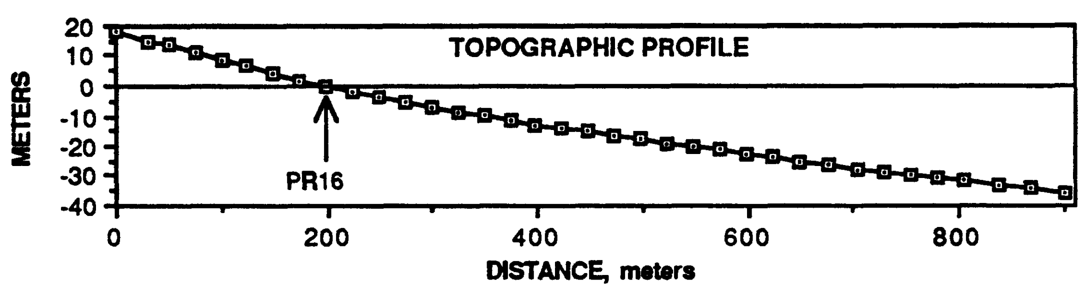
SITE MAP OF PITT RANCH LEVELING ARRAY




Δ BM HEIGHTS - PITT RANCH - APR 84 TO AUG 87
NORTHEAST
SOUTHWEST
APR 1984
PR16
BM PR16 ARBITRARILY HELD FIXED
Δ HEIGHT, MILLIMETERS
DISTANCE, METERS
10
0
-10
-20
-30
0
200
400
600
800


TOPOGRAPHIC PROFILE
PR16
METERS
DISTANCE, meters
20
10
0
-10
-20
-30
-40
0
200
400
600
800

PARKFIELD, CALIFORNIA   PITT RANCH   JUNE 27, 1984

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
PR19	RD15	-264.498
RD15	PR18	-221.792
PR18	RD14	-231.662
RD14	PR17	-255.423
PR17	RD13	-237.571
RD13	PR16	-166.534
PR16	RD12	-207.004
RD12	PR15	-159.422
PR15	RD11	-170.469
RD11	PR14	-163.196
PR14	RD10	-156.112
RD10	PR13	-101.872
PR13	RD09	-168.436
RD09	PR12	-138.563
PR12	RD08	-119.297
RD08	PR11	-114.122
PR11	RD07	-132.589
RD07	PR10	-118.760
PR10	RD06	-130.807
RD06	PR09	-102.296
PR09	RD05	-141.211
RD05	PR08	-110.187
PR08	RD04	-125.523
RD04	PR07	-129.496
PR07	RD03	-124.880
RD03	PR06	-134.979
PR06	TP02	-104.297
PR05	TP01	-196.384
PR04	PR03	-246.241
PR03	PR02	-118.172
PR02	PR01	-118.590

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
PR20	RD16	-267.183
RD16	PR19	-180.520
PR19	RD15	-264.022
RD15	PR18	-222.048
PR18	RD14	-230.556
RD14	PR17	-254.707
PR17	RD13	-237.543
RD13	PR16	-166.576
PR16	RD12	-207.050
RD12	PR15	-159.374
PR15	RD11	-170.454
RD11	PR14	-163.217
PR14	RD10	-156.142
RD10	PR13	-101.949
PR13	RD09	-168.385
RD09	PR12	-138.510
PR12	RD08	-119.314
RD08	PR11	-114.113
PR11	RD07	-132.624
RD07	PR10	-118.726
PR10	RD06	-130.817
RD06	PR09	-102.337
PR09	RD05	-141.229
RD05	PR08	-110.179
PR08	RD04	-125.537
RD04	PR07	-129.498
PR07	RD03	-125.269
RD03	PR06	-135.091
PR06	RDA	-114.051
RDA	PR05	-103.857
PR05	RDB	-87.667
RDB	PR04	-117.891
PR04	PR03	-123.066
PR03	PR02	-118.096
PR02	PR01	-118.681

PORTESUELLO Level Line

Latitude:	34°25'24"	**Length:**	415 m
Longitude:	119°43'37"	**Number of Bench marks:**	16
Date of Initial Survey:	2 February 1972	**Number of Surveys to 1988:**	9
Trespass Permission:	Permit required from Santa Barbara City Department of Public Works		

Comments:

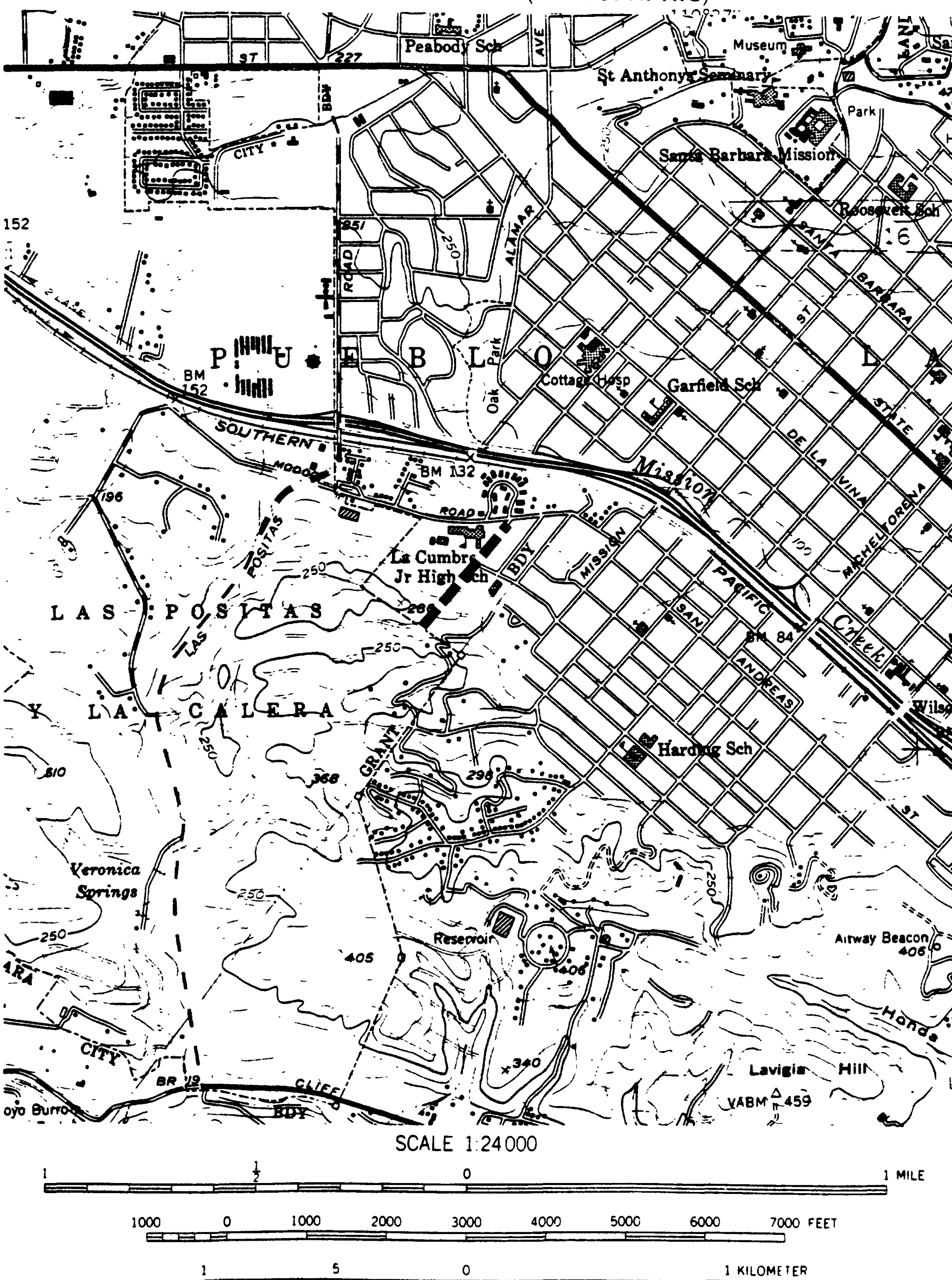
This line crosses the buried trace of the Mesa fault in Santa Barbara. The fault is not known to be active, although unsubstantiated local history places the 1925 Santa Barbara earthquake on the fault.

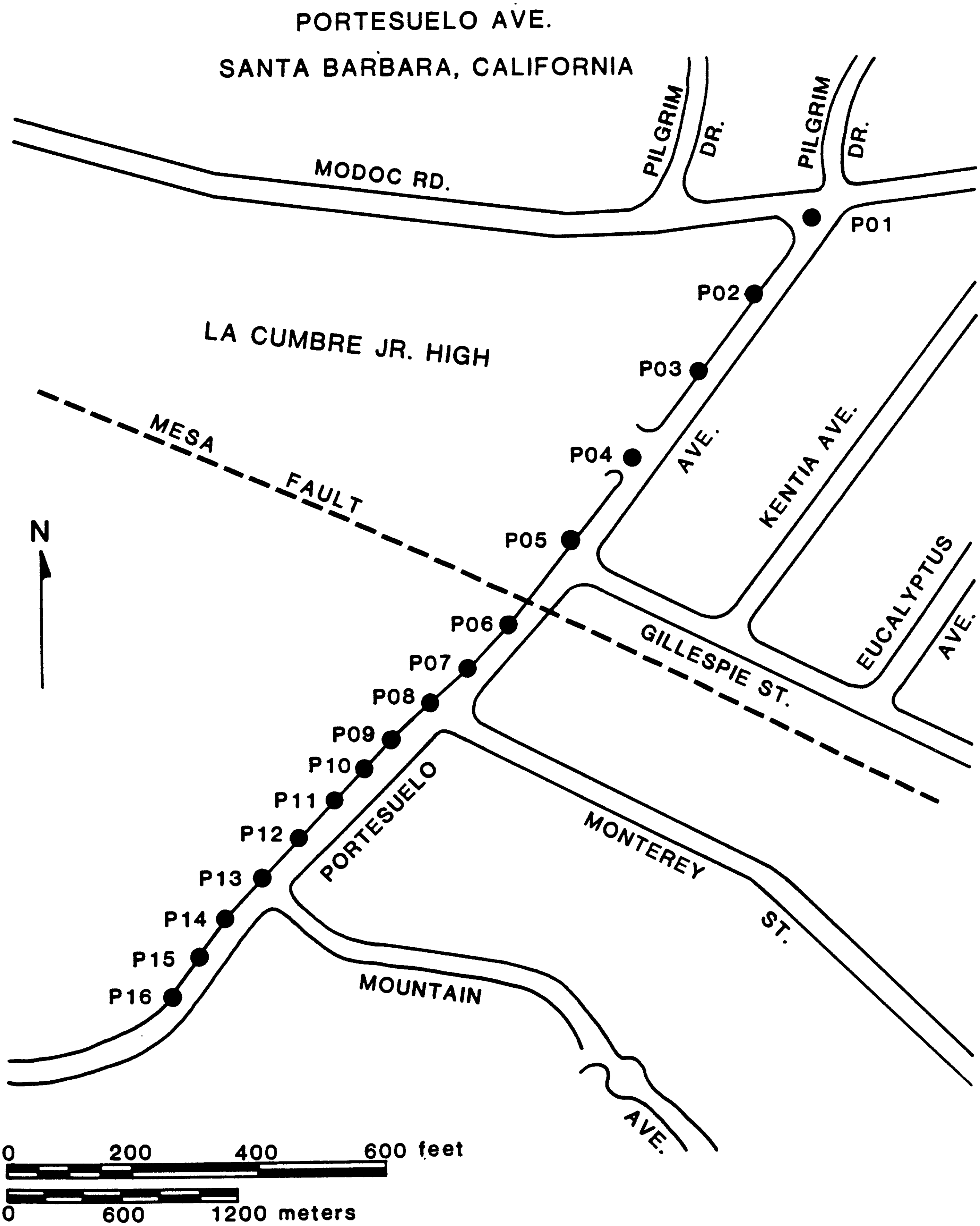
All of the bench marks are located in curbs, and the data show only minor, nonsystematic changes of heights among the bench marks, suggesting relative, nontectonic shifts among the curbs.

SANTA BARBARA QUADRANGLE

CALIFORNIA—SANTA BARBARA CO.

7.5 MINUTE SERIES (TOPOGRAPHIC)




PORTESUELO AVE.
SANTA BARBARA, CALIFORNIA
MODOC RD.
PILGRIM DR.
PILGRIM DR.
P01
P02
P03
P04
P05
P06
P07
P08
P09
P10
P11
P12
P13
P14
P15
P16
LA CUMBRE JR. HIGH
MESA FAULT
N
AVE.
KENTIA AVE.
EUCALYPTUS AVE.
GILLESPIE ST.
PORTESUELO
MONTEREY ST.
MOUNTAIN AVE.
0 200 400 600 feet
0 600 1200 meters

SANTA BARBARA, CALIFORNIA PORTESUELO FEBRUARY 2, 1972

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
P01	P02	-27.7747
P02	P03	-68.5120
P03	P04	-66.6527
P04	P05	-34.0085
P05	P06	26.3555
P06	P07	135.6697
P07	P08	224.1292
P08	P09	260.9672
P09	P10	261.6582
P10	P11	262.1442
P11	P12	260.0480
P12	P13	260.5510
P13	P14	251.1277
P14	P15	263.9765
P15	P16	244.7547

SANTA BARBARA, CALIFORNIA PORTESUELO JUNE 12, 1984

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
P02	P03	-68.0763
P03	P04	-66.6397
P04	P05	-33.3883
P05	P06	26.2265
P06	P07	135.4115
P07	P08	221.4520
P08	P09	263.7797
P09	TP01	253.0617
TP01	TP02	270.9305
TP02	P12	259.6407
P12	TP03	267.0805
TP03	TP04	248.3402
TP04	TP05	266.9340
TP05	7320	234.1950

SB VALLEY COLLEGE Level Line

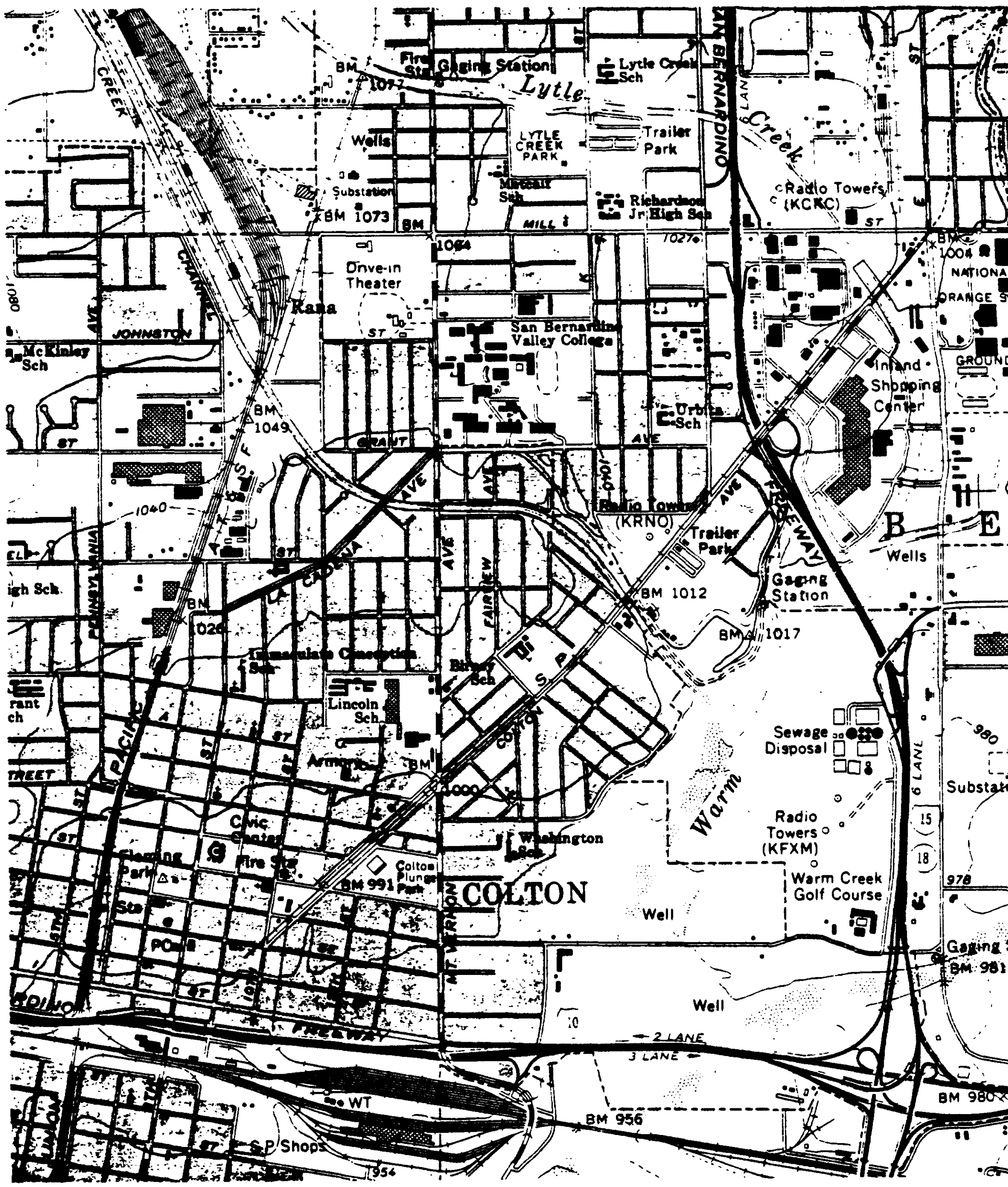
Latitude:	34°05'08"	**Length:**	537.1m
Longitude:	117°18'37"	**Number of Bench marks:**	18
Date of Initial Survey:	19 July 1985	**Number of Surveys to 1988:**	6
Trespass Permission:	Trespass permit required from, San Bernardino Valley College 701 South Vernon Avenue San Bernardino, CA 92410		

Comments:

This line was established across the Claremont strand of the San Jacinto fault on the campus of San Bernardino Valley College.

Six levelings from July 1985 to June 1987 are compared in an accompanying figure. Relative to the west half of the line, the east half has subsided about 5mm in the two years. The data may also be viewed as showing an eastward tilt of approximately 10 microradians in the two years. The San Jacinto fault is a groundwater barrier in this location, and the water table is higher on the north and east side of the fault. One explanation of the data is that the water table has dropped on the northeast side of the fault in response to groundwater withdrawal.

SAN BERNARDINO SOUTH QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 SAN BERNARDINO 15' QUADRANGLE



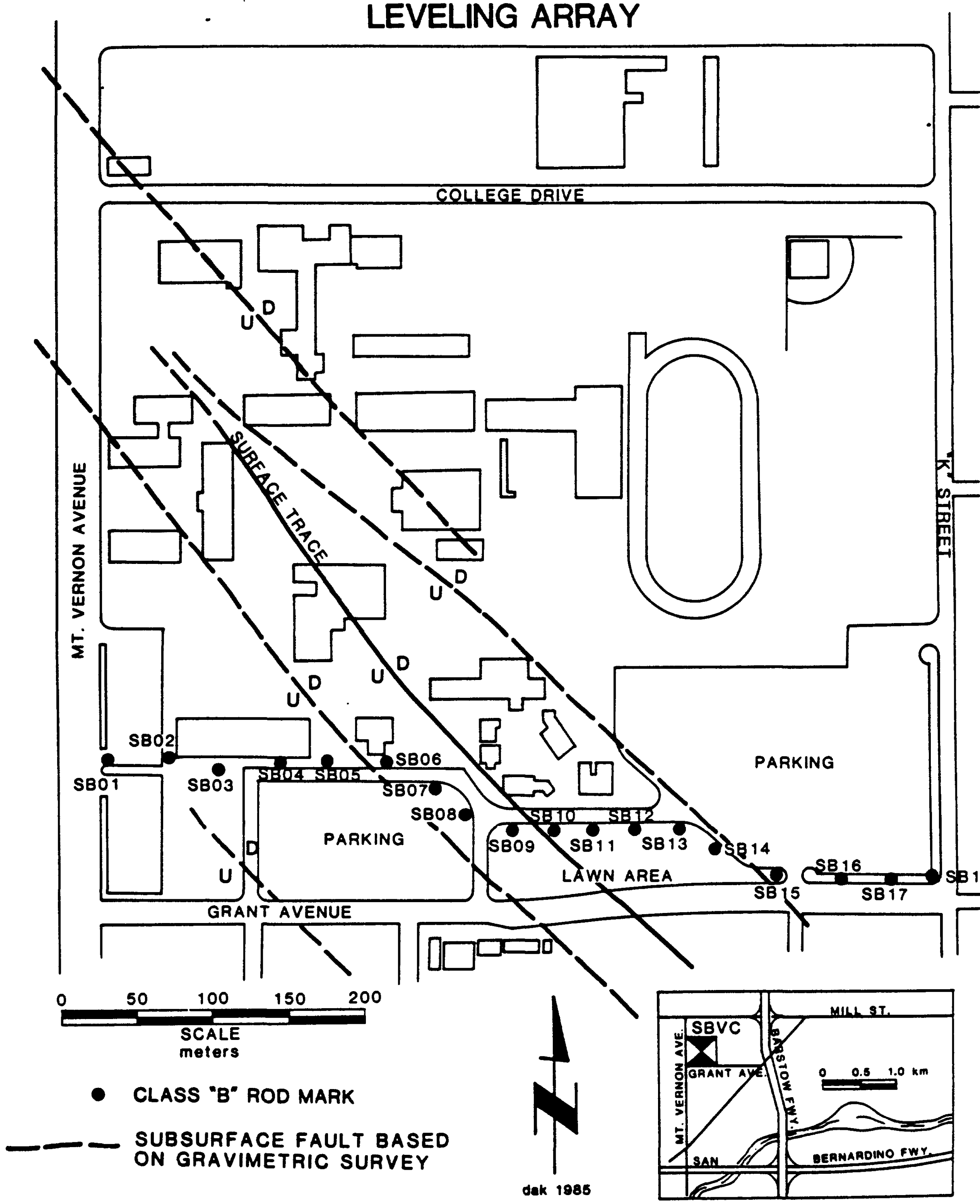
SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

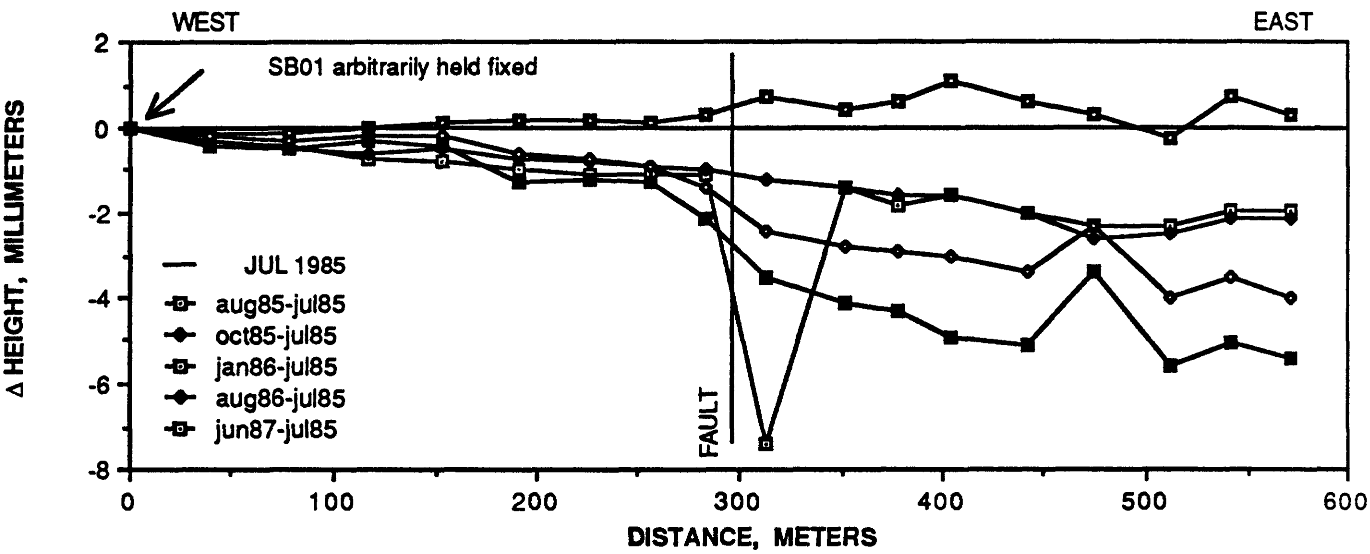
1 .5 0 1 KILOMETER

SITE MAP OF THE SAN BERNARDINO VALLEY COLLEGE LEVELING ARRAY

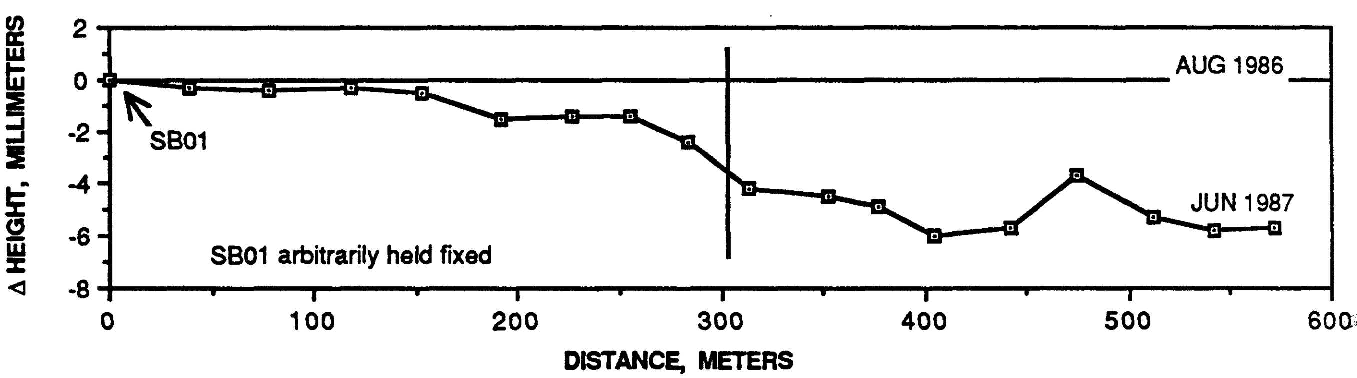


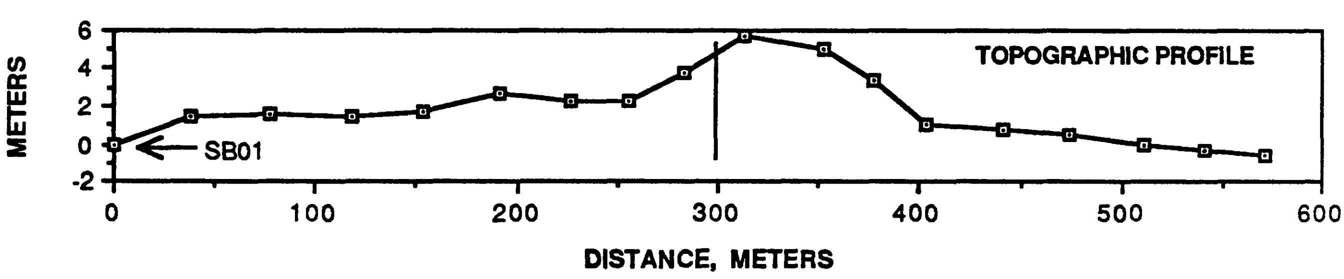
REFERENCE: CLOPINE, 1985

Δ BM HEIGHTS - SBVC - 1985 TO 1987



Δ BM HEIGHTS - SBVC - 1986 TO 1987





SAN BERNARDINO, CALIFORNIA SAN BERNARDINO VALLEY COLLEGE JULY 19, 1985

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
SB01	SB02	137.965
SB02	SB03	22.774
SB03	SB04	-19.796
SB04	SB05	35.449
SB05	SB06	98.225
SB06	SB07	-52.781
SB07	SB08	10.825
SB08	SB09	145.048
SB09	SB10	192.278
SB10	SB11	-59.707
SB11	SB12	-178.457
SB12	SB13	-228.556
SB13	SB14	-33.096
SB14	SB15	-28.281
SB15	SB16	-43.593
SB16	SB17	-31.264
SB17	SB18	-22.378

SAN BERNARDINO, CALIFORNIA SAN BERNARDINO VALLEY COLLEGE JUNE 25, 1987

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
SB01	SB02	137.921
SB02	SB03	22.766
SB03	SB04	-19.780
SB04	SB05	35.443
SB05	SB06	98.140
SB06	SB07	-52.773
SB07	SB08	10.817
SB08	SB09	144.969
SB09	SB10	192.137
SB10	SB11	-59.765
SB11	SB12	-178.482
SB12	SB13	-228.612
SB13	SB14	-33.120
SB14	SB15	-28.108
SB15	SB16	-43.811
SB16	SB17	-31.212
SB17	SB18	-22.417

SAN FERNANDO Leveling Array

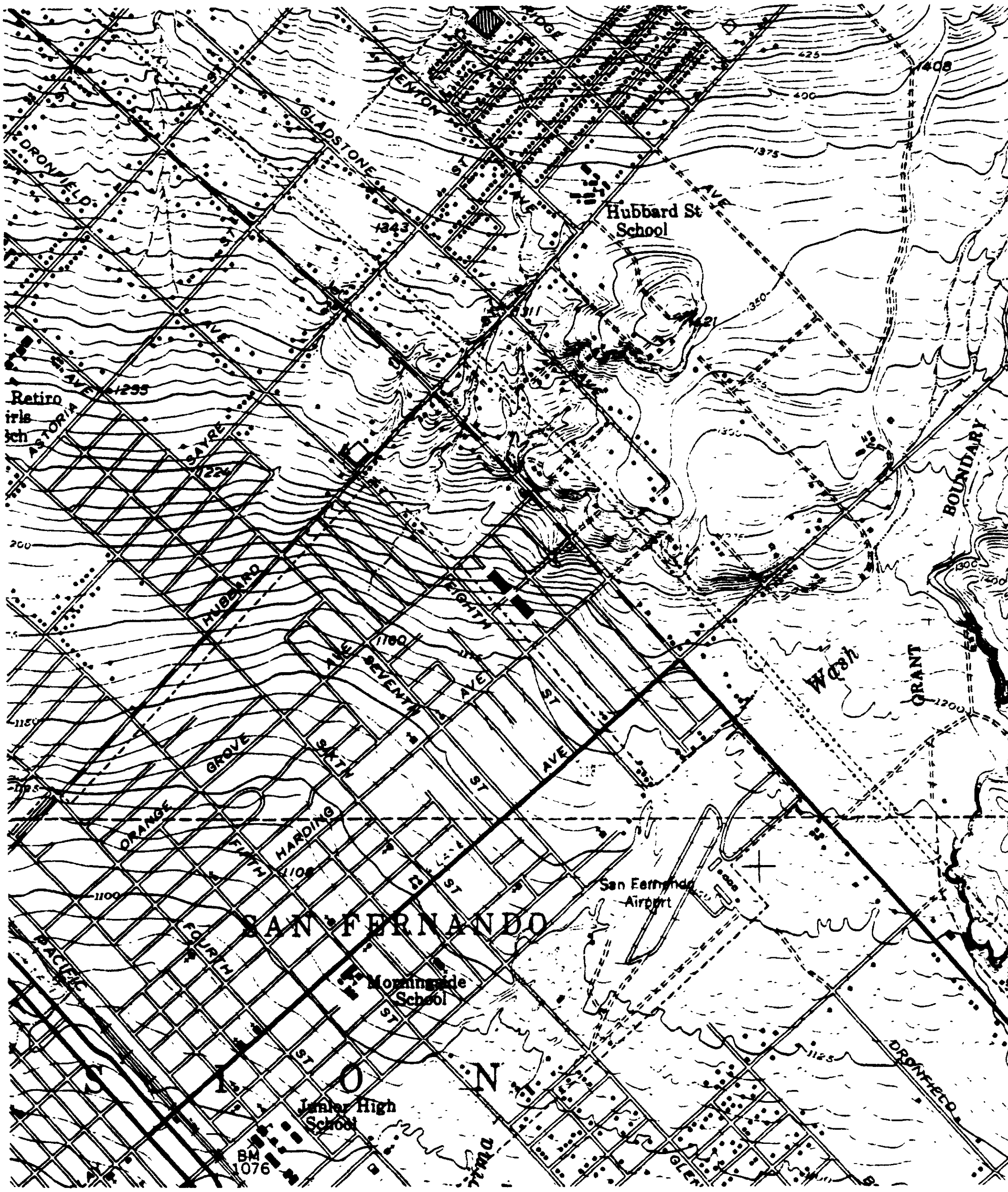
Latitude:	34°18'03"	**Length:**	200 m
Longitude:	118°25'35"	**Number of Bench marks:**	5
Date of Initial Survey:	13 February 1971	**Number of Surveys to 1988:**	11
Trespass Permission:	None required.		

Comments:

This array was established across the surface rupture of the San Fernando fault following the earthquake of 9 February 1971. Data and interpretations pertaining to vertical displacements within a year of the earthquake were published by Sylvester and Pollard (1975). Subsequent resurveys have revealed no significant displacement across the fault.

Reference cited: Sylvester, A.G., and D.D. Pollard, 1975. Afterslip on the Sylmar fault segment, pp. 227-233, *in* Oakeshott, G.B., *editor*, San Fernando, California, earthquake of 9 February 1971. California Division of Mines and Geology Bulletin 196, 463 p.

SAN FERNANDO QUADRANGLE
CALIFORNIA-LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

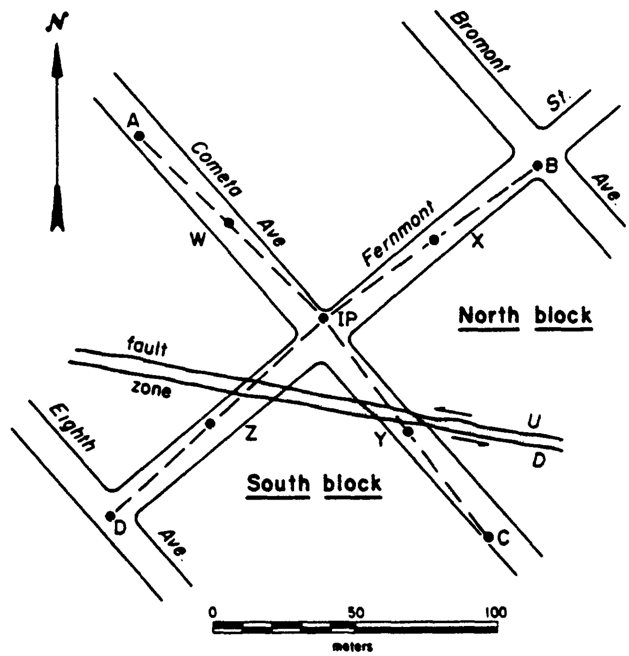


SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER


N
Bromont
St.
Ave.
Cometa
Ave
A
W
B
Fernmont
X
IP
North block
fault
zone
U
D
Eighth
Ave.
Z
Y
South block
D
C
0
50
100
meters

SAN FERNANDO, CALIFORNIA COMETA STREET MAY 13, 1971

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
AAA	AA2	-122.366
AA2	IIP	-129.916
IIP	CC2	-203.344
CC2	CCC	-108.565

SAN FERNANDO, CALIFORNIA COMETA STREET AUGUST 29, 1985

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
AAA	TP01	-104.377
TP01	TP02	-136.135
TP02	TP03	-124.998
TP03	TP04	-136.116
TP04	CCC	-63.067

SAN JUAN BAUTISTA Level Line

Latitude:	36°50'48"	**Length:**	978m
Longitude:	121°32'00"	**Number of Bench marks:**	23
Date of Initial Survey:	20 September 1975	**Number of Surveys to 1988:**	16

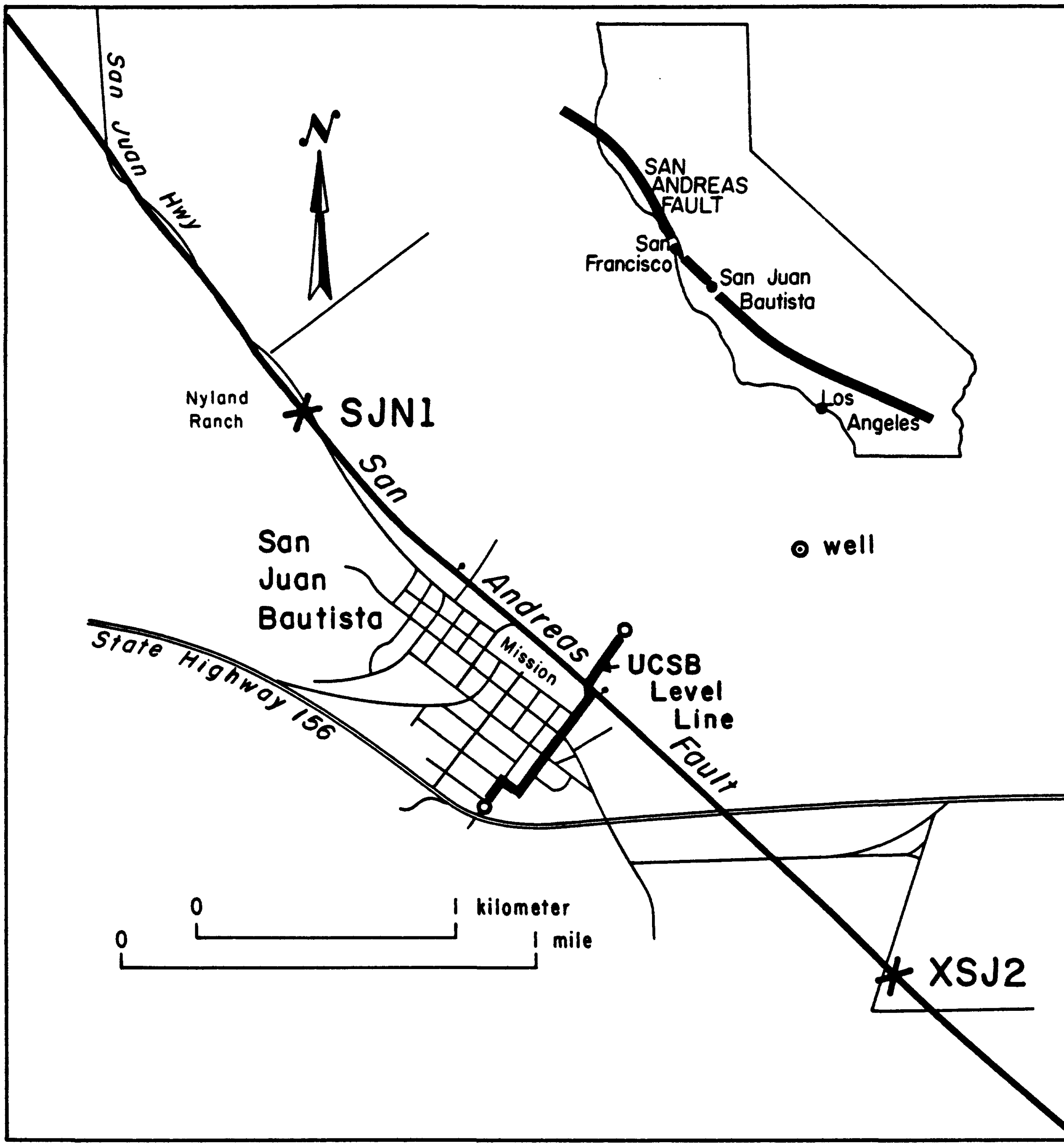
Trespass Permission: Contact ranch owner to survey the northeast end of line.
Bill Fly
9 Wesley Court
Watsonville, CA 95037

Comments:

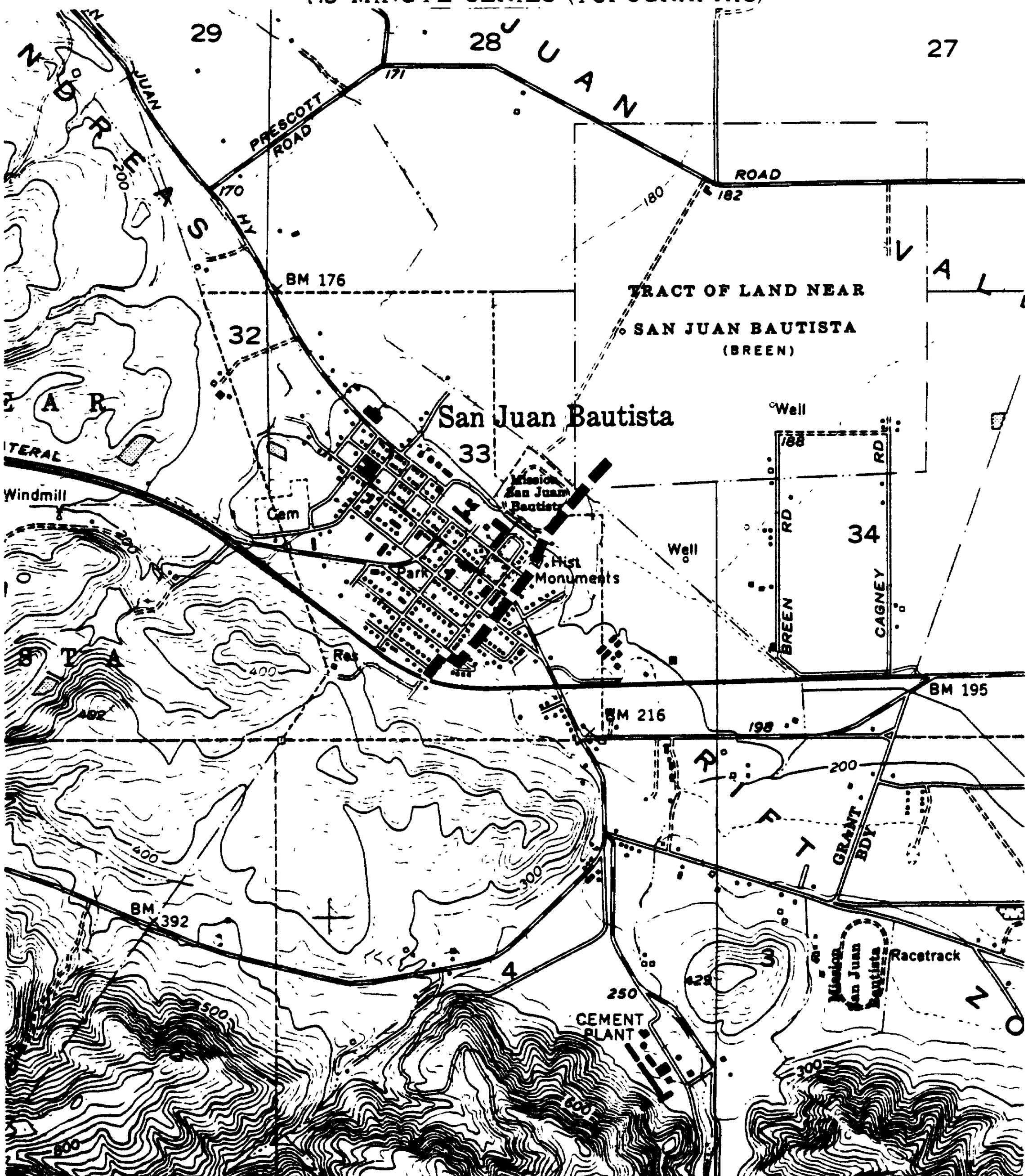
This line was established across the San Andreas fault to determine if the prominent scarp along the fault at the northeast edge of San Juan Bautista is increasing in height at the same time as horizontal creep occurs along the fault. Several bench marks are obliterated because they were placed in concrete curbs that have been replaced with driveways.

Seven levelings from October 1975 to August 1983 are compared in an accompanying figure. Relative to a bench mark in San Juan Bautista Valley, the southwest part of the line has risen nearly 100mm. Alternatively, the valley has subsided a like amount relative to the bench marks in town. The line would have to be lengthened tenfold and cross the full width of San Juan Bautista Valley to resolve the question of valley subsidence vs. tectonic uplift of the fault scarp. The data do show that a sharp boundary does not exist between relative uplift and subsidence at the fault in contrast to the remarkable narrow zone of horizontal movement documented by U.S.G.S. creepmeters northwest and southeast of the town (Sylvester, Brown and Riggs, 1980).

Reference cited: Sylvester, A. G., A. H. Brown, and N. R. Riggs, 1980. Vertical movements and aseismic horizontal creep on the San Andreas fault at San Juan Bautista, California, *in* Streitz, R., and R. Sherburne, *editors*, Studies of the San Andreas Fault Zone in Northern California. California Division of Mines and Geology Special Report 140, 91-97.


San Juan Hwy
N
SAN ANDREAS FAULT
San Francisco
San Juan Bautista
Los Angeles
Nyland Ranch
SJN1
San Andreas Fault
San Juan Bautista
well
State Highway 156
Mission
UCSB Level Line
0
1 kilometer
0
1 mile
XSJ2

SAN JUAN BAUTISTA QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)

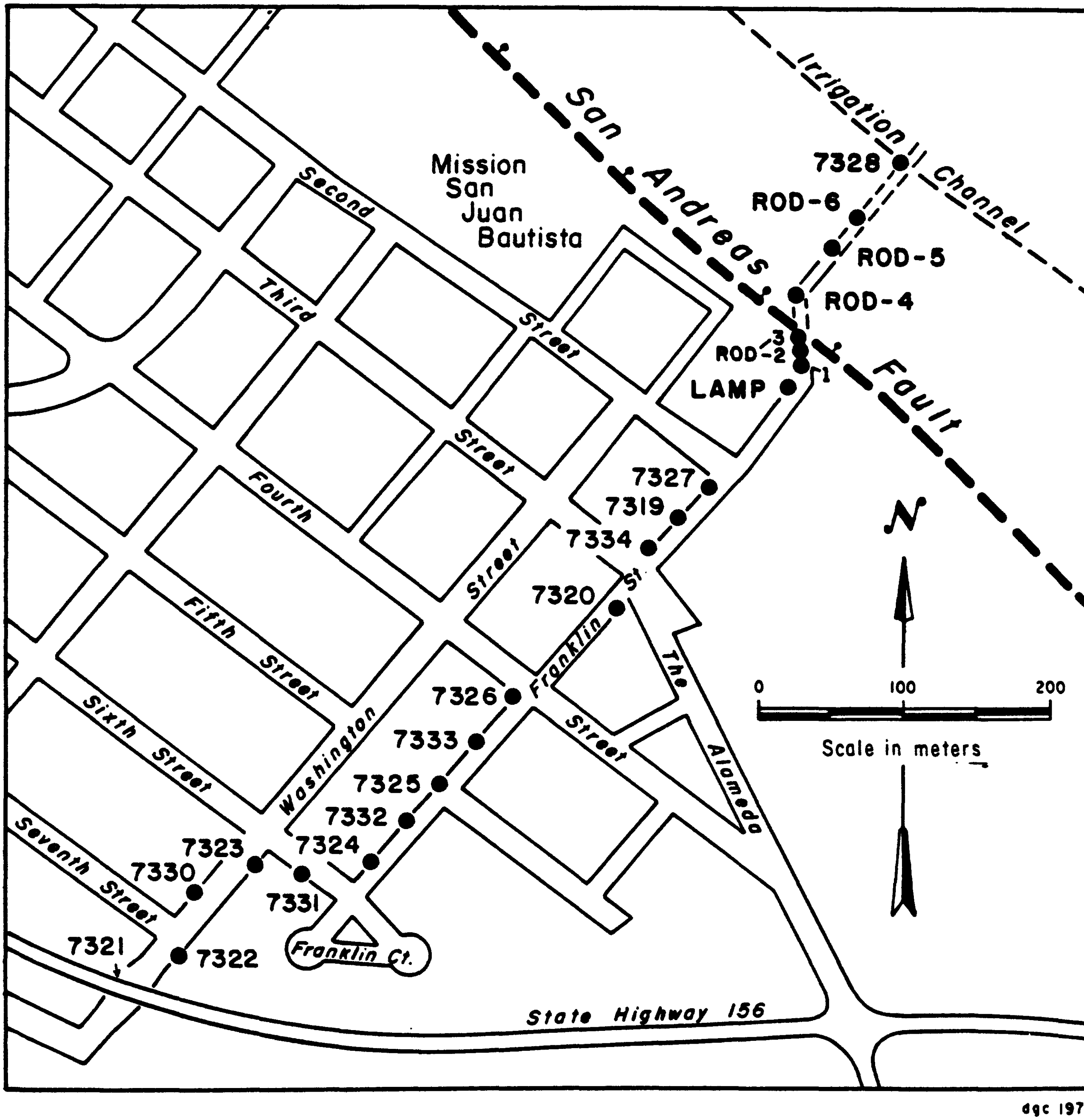


SCALE 1:24 000

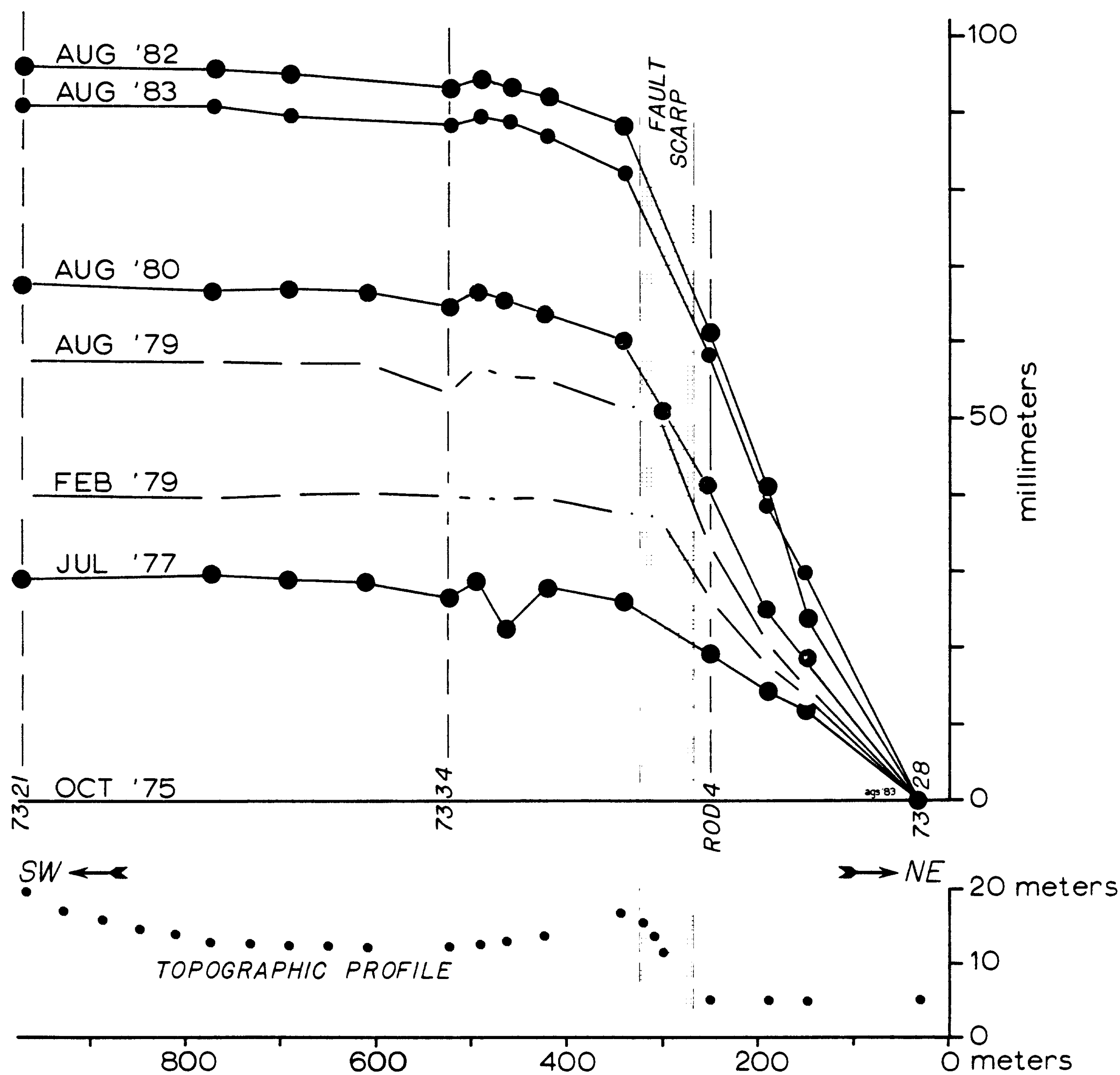
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER


San Andreas Fault
Irrigation Channel
Mission San Juan Bautista
Second Street
Third Street
Fourth Street
Fifth Street
Sixth Street
Seventh Street
Washington Street
Franklin St
The Alameda
Franklin Ct.
State Highway 156
7328
ROD-6
ROD-5
ROD-4
ROD-3
ROD-2
1
LAMP
7327
7319
7334
7320
7326
7333
7325
7332
7324
7323
7330
7331
7321
7322
N
0
100
200
Scale in meters
dgc 1976

△ HEIGHT - SAN JUAN BAUTISTA 1975-1983



SAN JUAN BAUTISTA,CALIFORNIA   SAN JUAN BAUTISTA   OCTOBER 11, 1975

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
7321	7322	-243.1245
7322	7330	-110.9765
7330	7323	-130.2538
7323	7331	-59.0005
7331	7324	-74.4500
7324	7332	-32.0315
7332	7325	-29.2595
7325	7333	-12.0700
7333	7326	-14.5863
7326	TP1	30.9175
TP1	7320	34.4055
7320	7334	34.2163
7334	7319	66.3330
7319	7327	169.6723
7327	TP2	141.8578
TP2	LAMP	4.2567
LAMP	ROD1	-136.2360
ROD1	ROD2	-197.9100
ROD2	ROD3	-204.4250
ROD3	TP3	-208.3115
TP3	TP4	-163.5510
TP4	ROD4	-207.0348
ROD4	TP5	-11.8940
TP5	ROD5	-25.1270
ROD5	ROD6	-19.1805
ROD6	TP8	6.0178
TP8	TP9	-16.6570
TP9	7328	50.2323

SAN JUAN BAUTISTA, CALIFORNIA SAN JUAN BAUTISTA AUGUST 15, 1983

*******Adjusted Height Diferences*******

Backsight	Foresight	Height Diff (cm)
7321	7322	-242.3750
7322	7330	-110.8145
7330	7323	-131.9115
7323	7331	-57.9070
7331	7324	-74.8413
7324	TP01	-35.1570
TP01	7325	-26.1165
7325	7333	-10.3843
7333	TP02	-19.7615
TP02	TP03	25.1753
TP03	7320	43.2480
7320	7334	34.4868
7334	7319	66.1910
7319	7327	169.5538
7327	TP04	141.2068
TP04	LAMP	4.6020
LAMP	TP05	-161.9365
TP05	TP1A	-173.1363
TP1A	TP06	-191.5333
TP06	TP07	-173.8098
TP07	TP08	-174.7245
TP08	ROD4	-244.9220
ROD4	TP09	-11.2928
TP09	ROD5	-27.6825
ROD5	ROD6	-20.1372
ROD6	TP10	11.6568
TP10	TP11	-8.3523
TP11	7328	33.4583

SANTA ANITA CANYON Level Line

Latitude:	34°10'05"	**Length:**	553.2m
Longitude:	118°01'03"	**Number of Bench marks:**	22
Date of Initial Survey:	14 August 1984	**Number of Surveys to 1988:**	5

Trespass Permission:

Contact:
Head, Permit Section
Property Management Division
Los Angeles County Flood Control District
P.O. Box 2418
Terminal Annex
Los Angeles, CA 90051

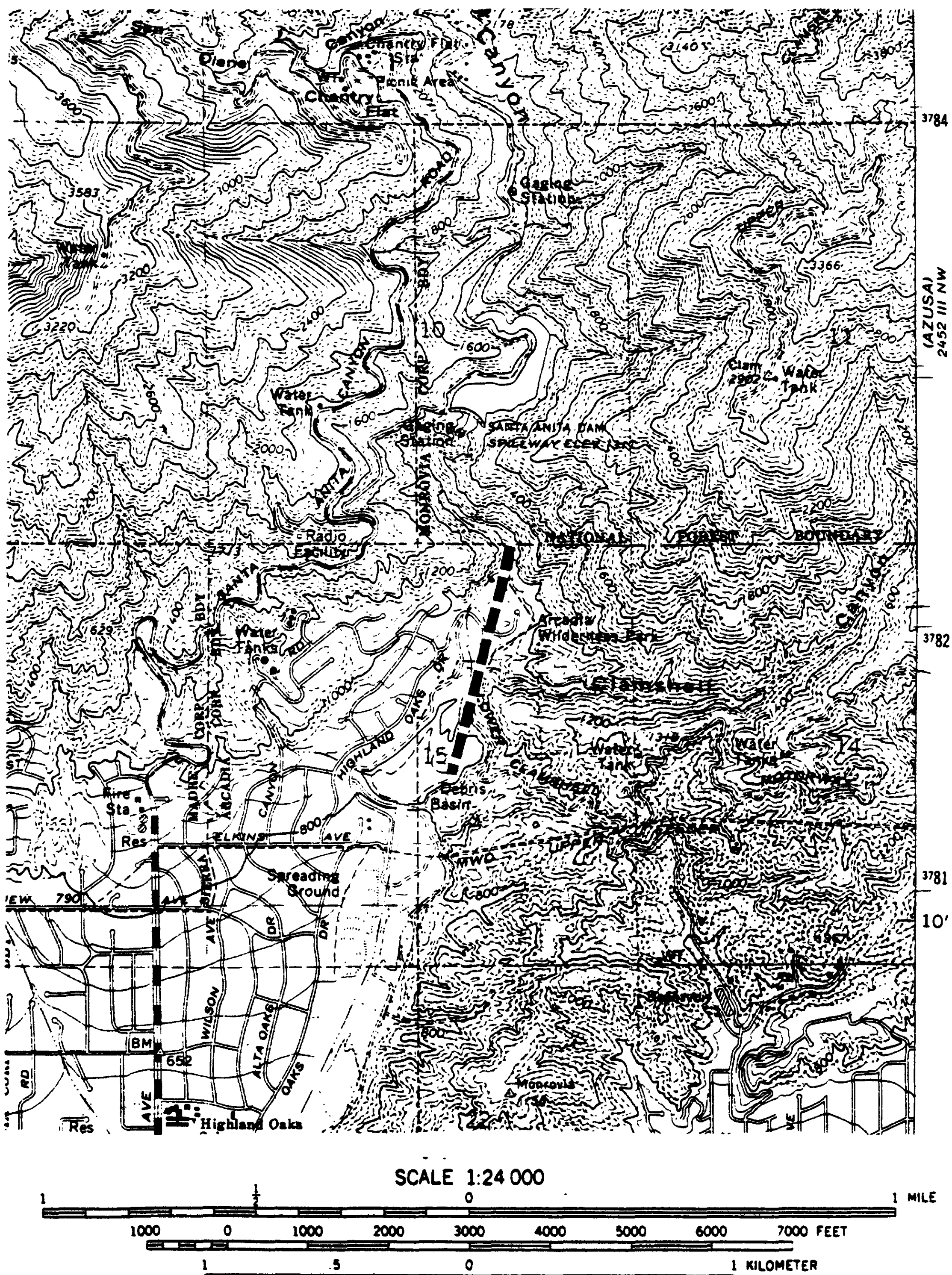
Refer to File No. 223,032, Permit No. 84355-B

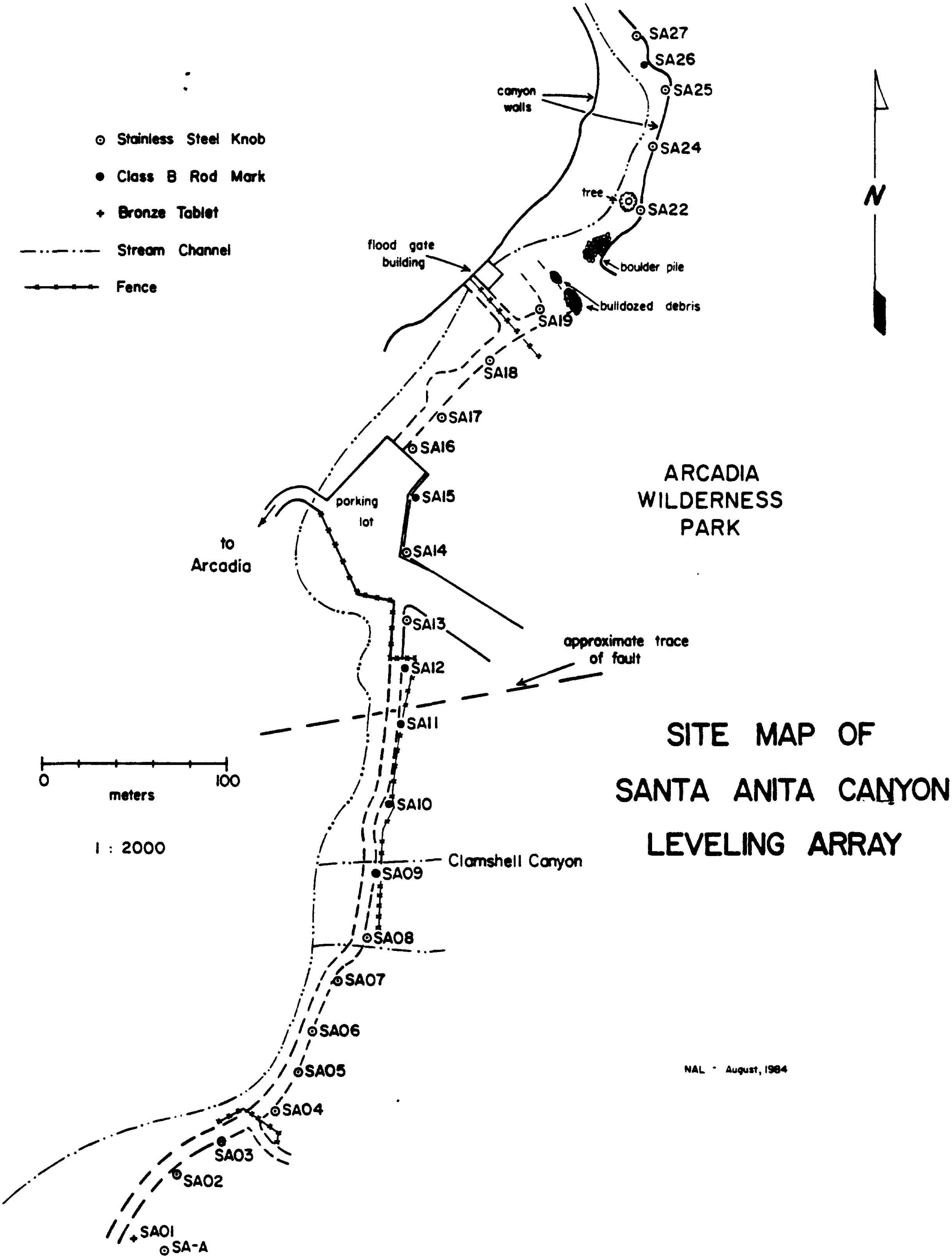
Comments:

This line crosses the Sierra Madre fault in Arcadia Wilderness Park at the southern front of the San Gabriel Mountains, 7 miles northeast of Santa Anita. The line was established to detect vertical creep or displacement. Much of the line is behind fences and locked gates belonging to the Los Angeles County Flood Control District.

Two levelings, from August 1985 to July 1987, are compared in an accompanying figure and show that height changes among the bench marks are negligible in two years.

MT. WILSON QUADRANGLE
CALIFORNIA – LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)





SITE MAP OF
SANTA ANITA CANYON
LEVELING ARRAY
Stainless Steel Knob
Class B Rod Mark
Bronze Tablet
Stream Channel
Fence
N
ARCADIA
WILDERNESS
PARK
canyon walls
tree
flood gate building
boulder pile
bulldozed debris
parking lot
to Arcadia
approximate trace of fault
Clamshell Canyon
0
100
meters
1 : 2000
SA27
SA26
SA25
SA24
SA22
SA19
SA18
SA17
SA16
SA15
SA14
SA13
SA12
SA11
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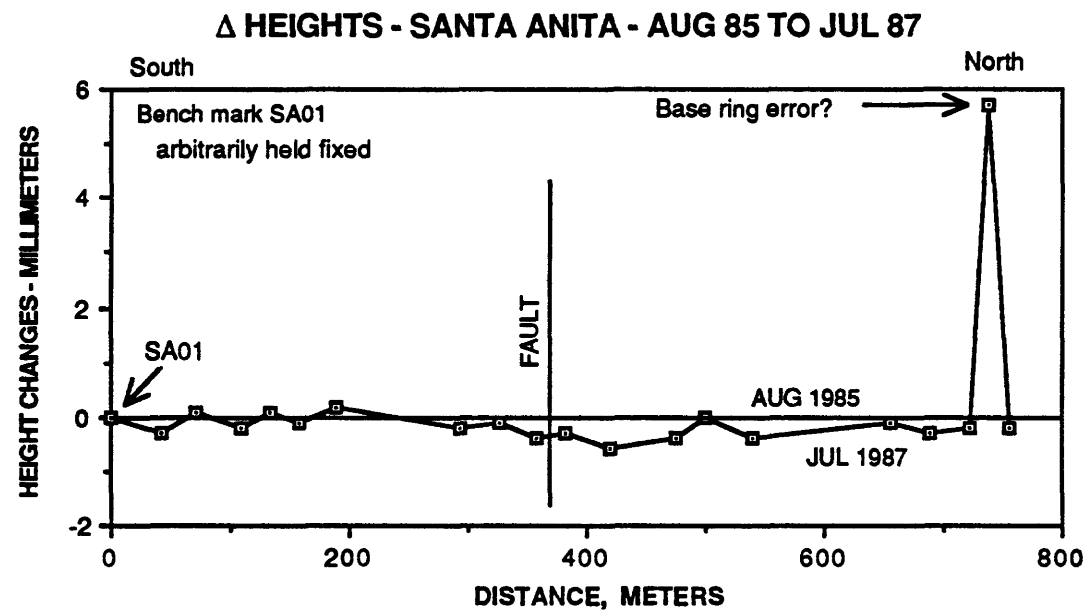
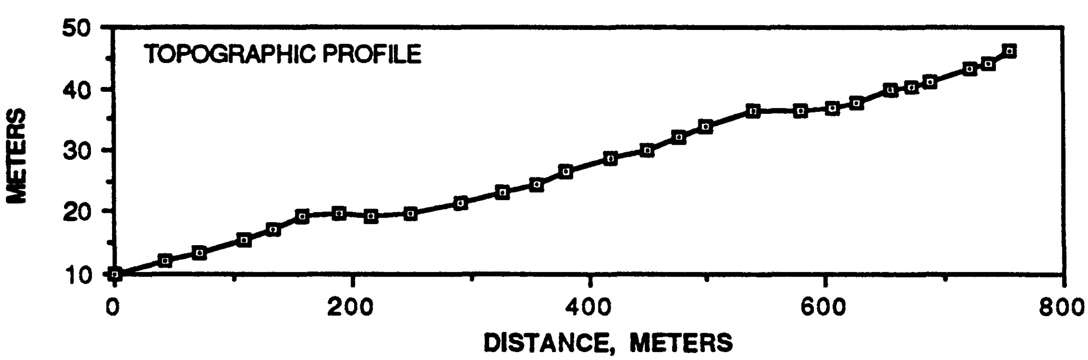
SA09
SA08
SA07
SA06
SA05
SA04
SA03
SA02
SA01
SA-A
NAL · August, 1984


Δ HEIGHTS - SANTA ANITA - AUG 85 TO JUL 87
South
North
Bench mark SA01
arbitrarily held fixed
Base ring error?
FAULT
SA01
AUG 1985
JUL 1987
HEIGHT CHANGES - MILLIMETERS
6
4
2
0
-2
0
200
400
600
800
DISTANCE, METERS


TOPOGRAPHIC PROFILE
METERS
50
40
30
20
10
0
200
400
600
800
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)	
SA01	SA02	199.639	
SA02	SAA	-262.731	single run, 1 shots.
SA02	SA03	146.672	
SA03	SA04	219.407	
SA04	SA05	163.516	
SA05	SA06	189.231	
SA06	SA07	44.259	
SA07	SA08	-14.277	
SA08	SA09	99.963	
SA09	SA10	92.486	
SA10	SA11	166.981	
SA11	SA12	154.291	
SA12	SA13	206.978	
SA13	SA14	222.543	
SA14	SA15	117.814	
SA15	SA16	188.534	
SA16	SA17	183.627	
SA17	SA18	255.667	
SA18	SA19	-3.109	
SA19	TP01	116.249	
TP01	SA22	223.388	
SA22	SA24	141.334	
SA24	SA25	208.193	
SA25	SA26	29.221	
SA26	SA27	267.076	

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
SAA	SA01	63.127
SA01	SA02	199.610
SA02	SA03	146.709
SA03	SA04	219.377
SA04	SA05	163.547
SA05	SA06	189.205
SA06	SA07	44.296
SA07	TP01	-13.434
TP01	SA09	97.516
SA09	SA10	94.051
SA10	SA11	166.990
SA11	SA12	154.264
SA12	SA13	206.984
SA13	SA14	222.517
SA14	TP02	97.595
TP02	SA16	208.768
SA16	SA17	183.664
SA17	SA18	255.627
SA18	TP03	-31.568
TP03	TP04	102.399
TP04	TP05	102.189
TP05	SA22	163.545
SA22	TP06	-21.341
TP06	SA24	162.652
SA24	SA25	208.197
SA25	SA26	29.826
SA26	SA27	266.473

SEWAGE PLANT Level Line (Line 100)

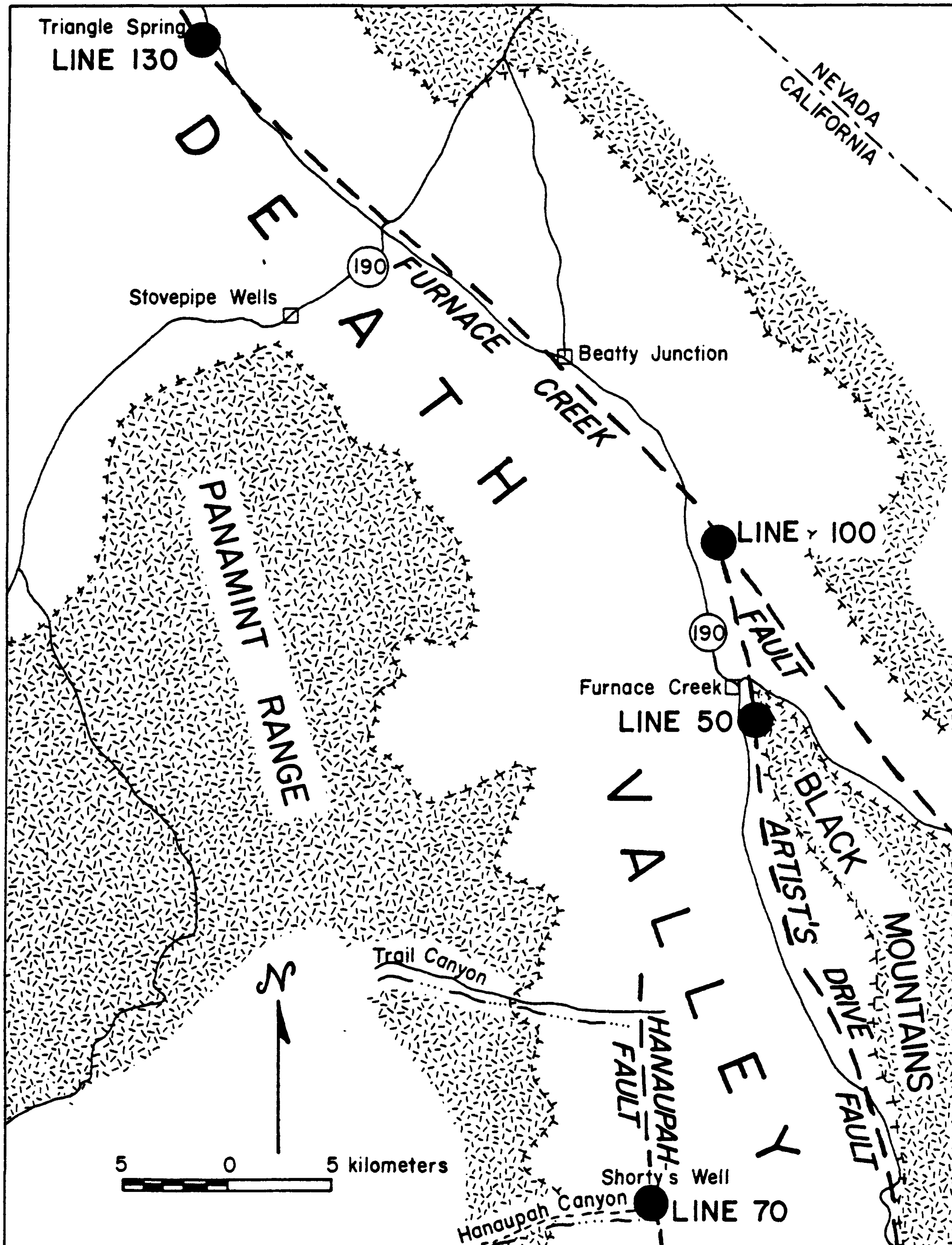
Latitude:	36°30'20"	**Length:**	434m
Longitude:	115°52'25"	**Number of Bench marks:**	14
Date of Initial Survey:	1 October 1971	**Number of Surveys to 1988:**	6
Trespass Permission:	Notify in advance the Chief Ranger National Park Service Death Valley National Monument Death Valley, CA 92328		

Comments:

This line is equally disposed across the geomorphic trace of the Furnace Creek fault on the east side of Death Valley near the old Park Service sewage treatment plant. All bench marks are 1m-long copper-jacketed steel weld rods driven nearly flush to the surface of the desert floor.

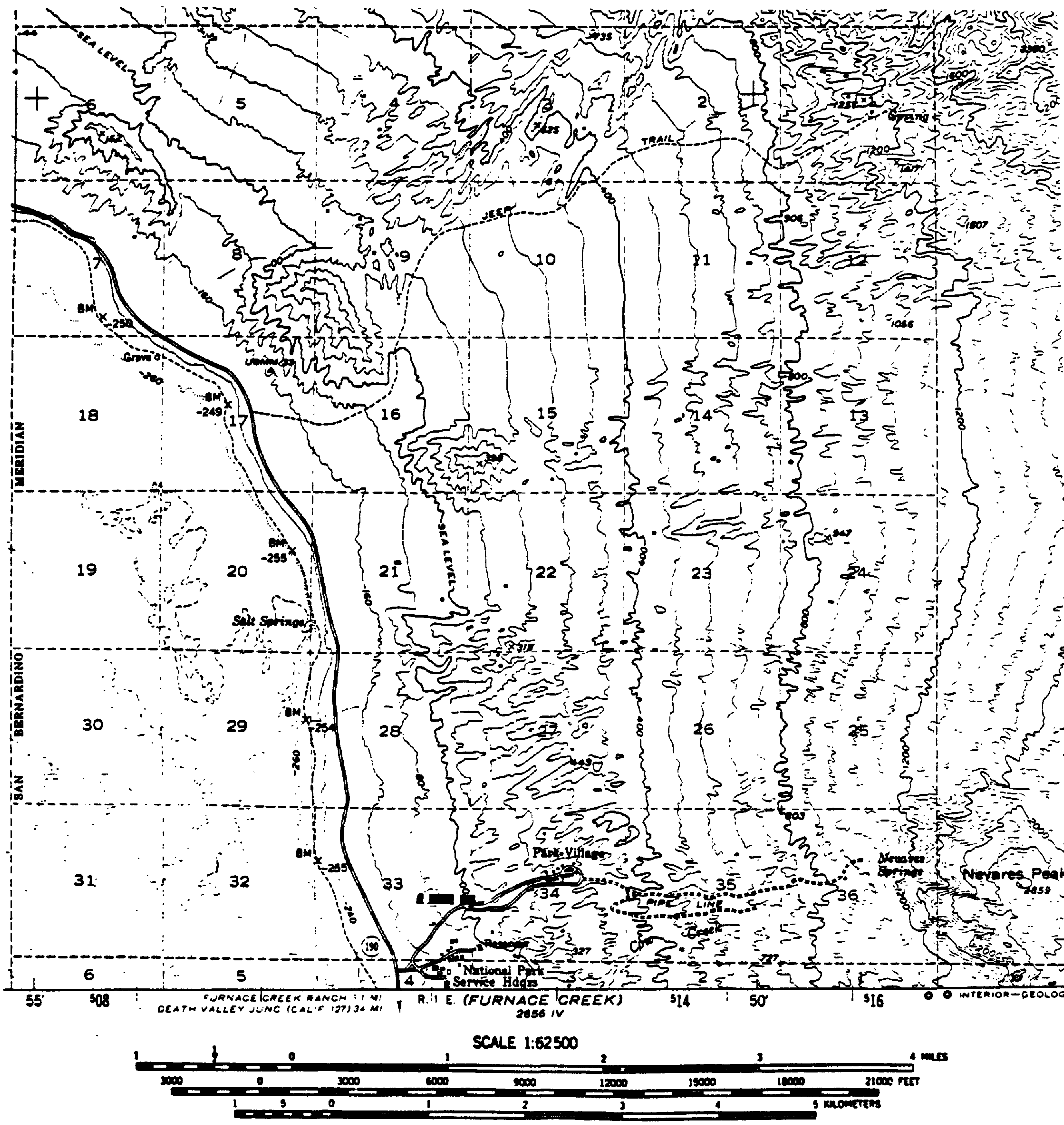
Four levelings from January 1971 to September 1985 show no height changes among the 14 bench marks that can be attributed to vertical displacement across the fault (Sylvester and Bie, 1986).

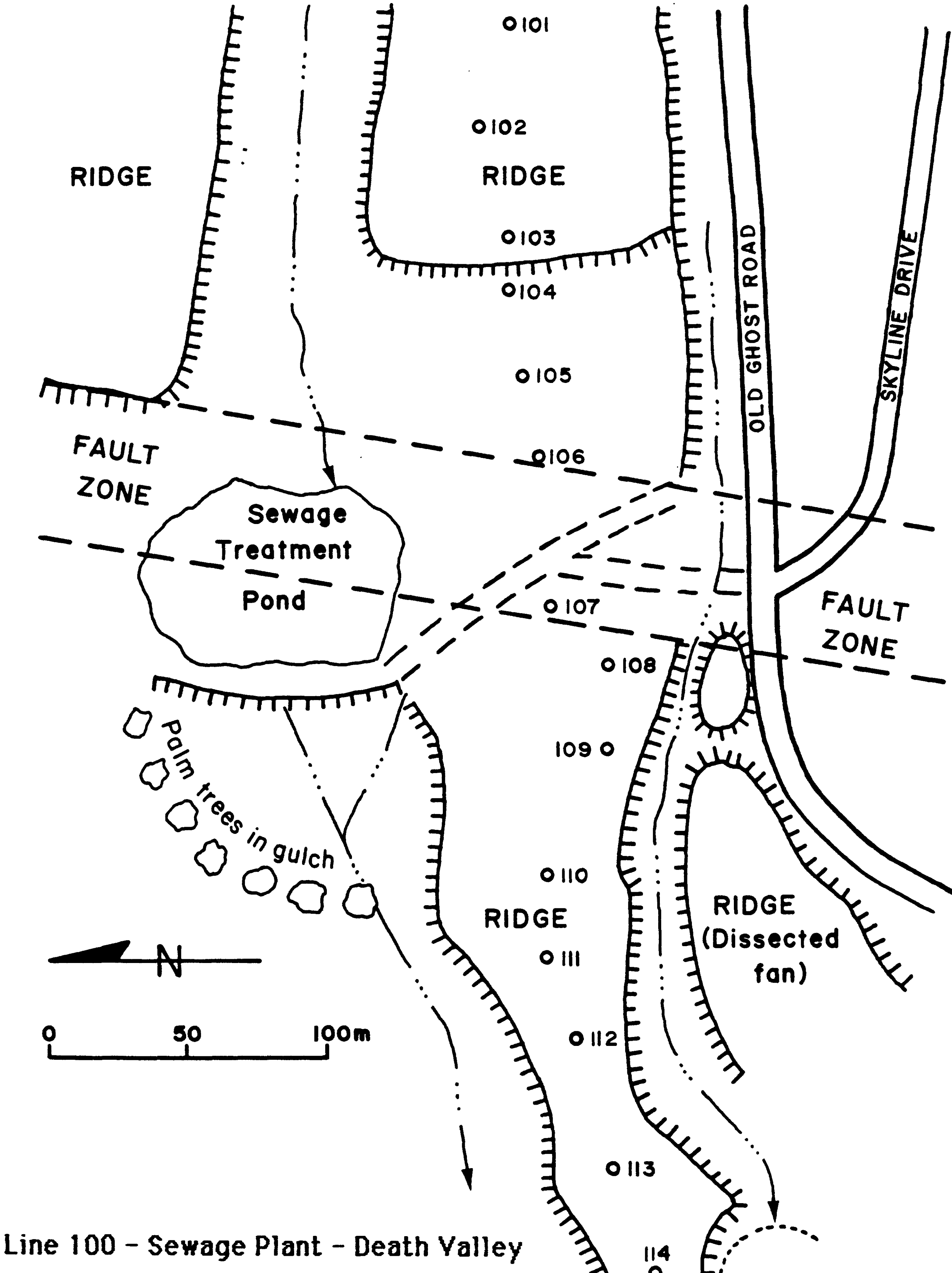
Reference cited: Sylvester, A. G., and S. W. Bie, 1986. Geodetic monitoring of fault movements in Death Valley, 1970-1985, pp. 41-44, *in* Troxel, B. W., *editor*, Quaternary Tectonics of Southern Death Valley. Field Guide, Pacific Cell, Friends of the Pleistocene, 44 p.



Locations of short leveling arrays in Death Valley.

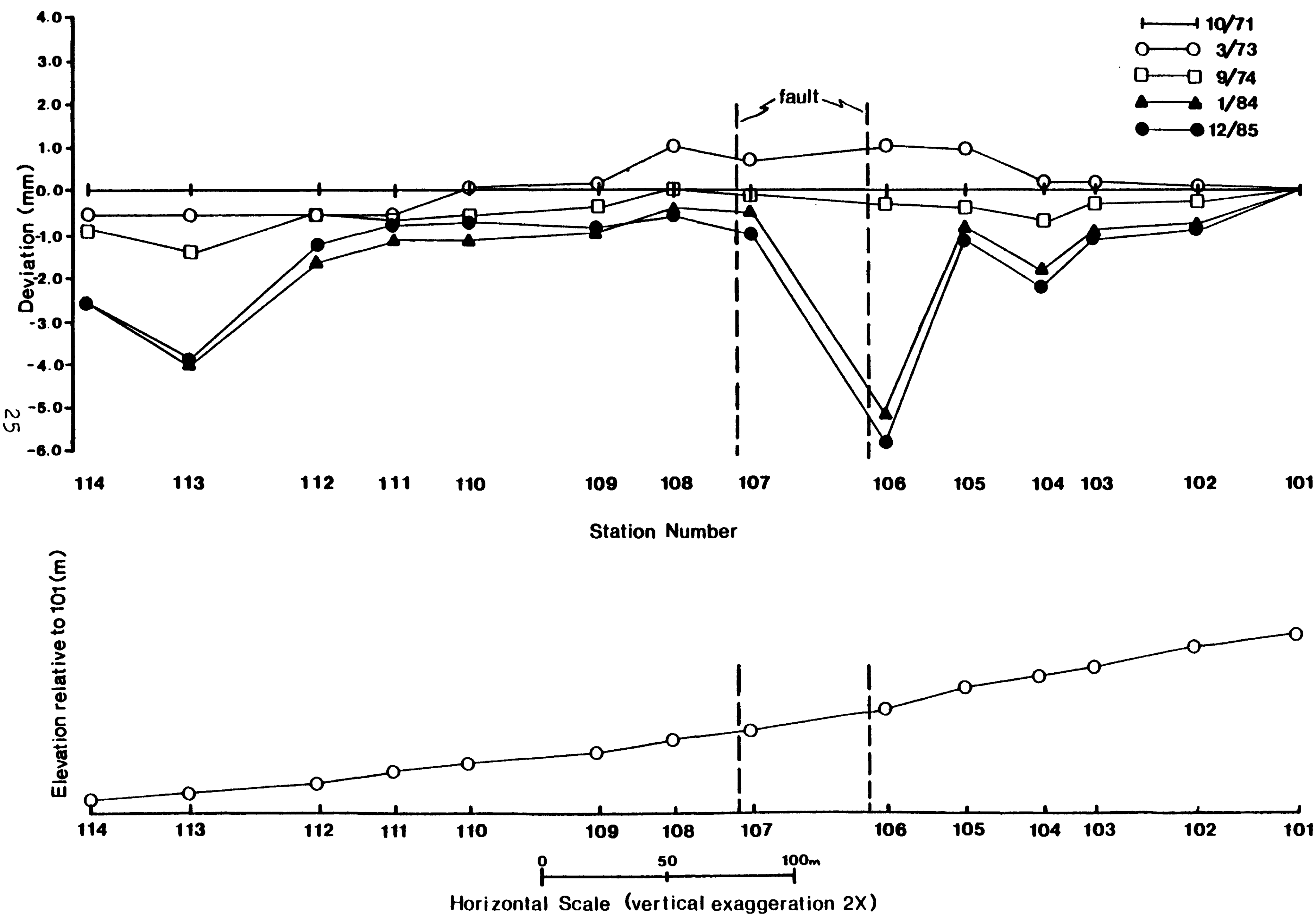
CHLORIDE CLIFF QUADRANGLE
CALIFORNIA-NEVADA
15 MINUTE SERIES (TOPOGRAPHIC)





Line 100 - Sewage Plant - Death Valley

Line 100 - Sewage Plant - Death Valley



Line 100 - Sewage Plant - Death Valley

Relative elevation and elevation deviation from base line data collected Oct., 1971 (in cm). A - base line data, B - adjusted elevation relative to station 101, C - deviation of elevation from base line data, D - datum elevation.

Station and Monument	Type	A	Mar., 1973 B	Mar., 1973 C	Sept., 1974 B	Sept., 1974 C	Jan., 1984 B	Jan., 1984 C	Dec., 1985 B	Dec., 1985 C
101D	A	1000.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00
102	A	775.53	775.54	+0.01	775.52	-0.01	775.46	-0.07	775.45	-0.08
103	A	391.15	391.18	+0.03	391.13	-0.02	391.07	-0.08	391.05	-0.10
104	A	158.98	159.01	+0.03	158.92	-0.06	158.81	-0.17	158.77	-0.21
105	A	- 26.73	- 26.63	+0.10	- 26.76	-0.03	- 26.80	-0.07	- 26.83	-0.10
106	A	- 468.82	- 468.71	+0.11	- 468.86	-0.02	- 469.34	-0.51	- 469.39	-0.57
107	A	- 840.92	- 840.84	+0.08	- 840.92	0.00	- 840.96	-0.04	- 841.01	-0.09
108	A	-1059.36	-1059.25	+0.11	-1059.36	0.00	-1059.33	+0.03	-1059.41	-0.05
109	A	-1302.59	-1302.57	+0.02	-1302.62	-0.03	-1302.68	-0.09	-1302.67	-0.08
110	A	-1448.91	-1448.90	+0.01	-1448.96	-0.05	-1449.02	-0.11	-1448.98	-0.07
111	A	-1638.81	-1638.86	-0.05	-1638.87	-0.06	-1638.92	-0.11	-1638.88	-0.07
112	A	-1871.62	-1871.67	-0.05	-1871.67	-0.05	-1871.78	-0.16	-1871.74	-0.12
113	A	-2058.99	-2059.04	-0.05	-2059.13	-0.14	-2059.39	-0.40	-2059.38	-0.39
114	A	-2283.47	-2283.52	-0.05	-2283.56	-0.09	-2283.73	-0.26	-2283.73	-0.26

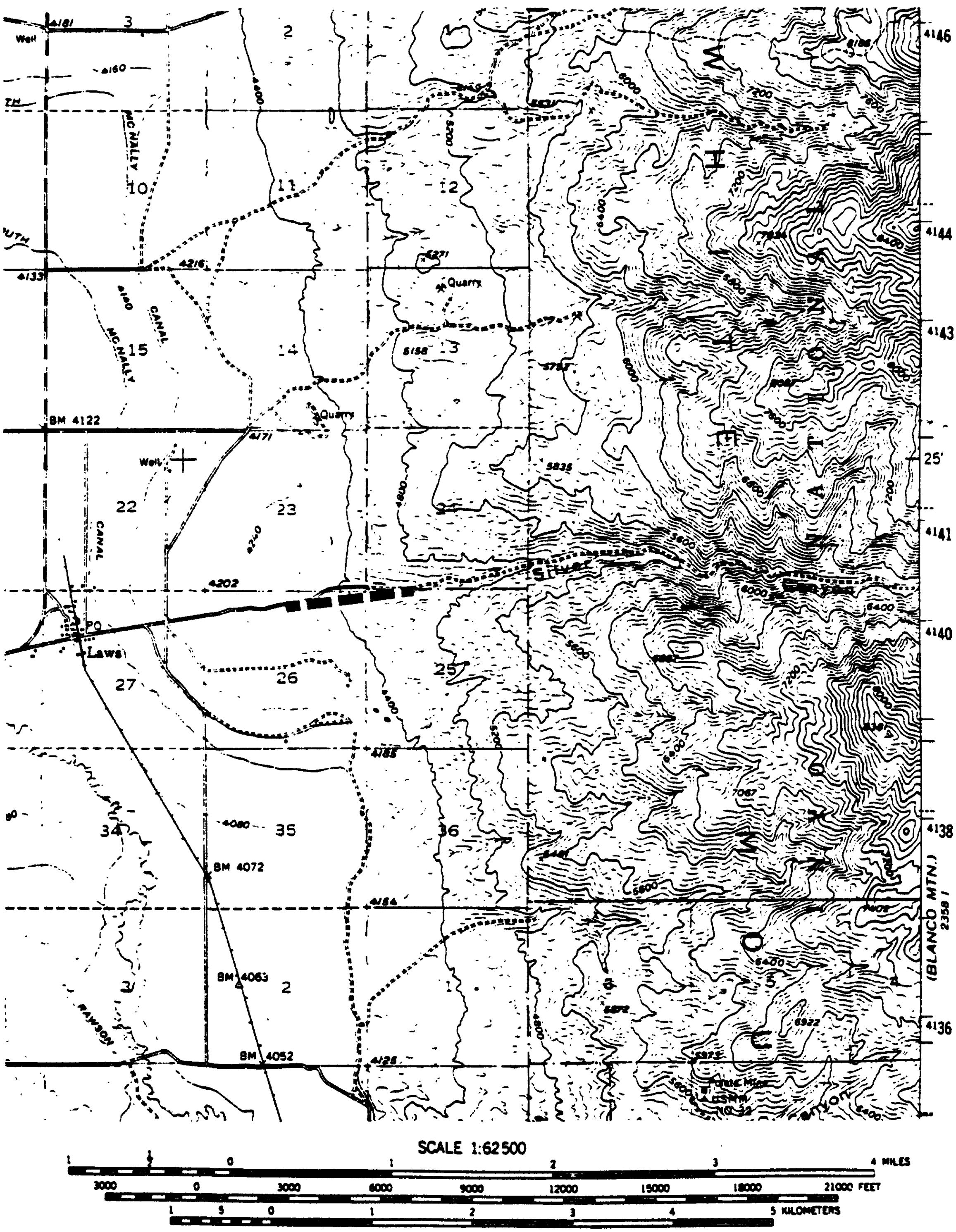
SILVER CANYON Level Line

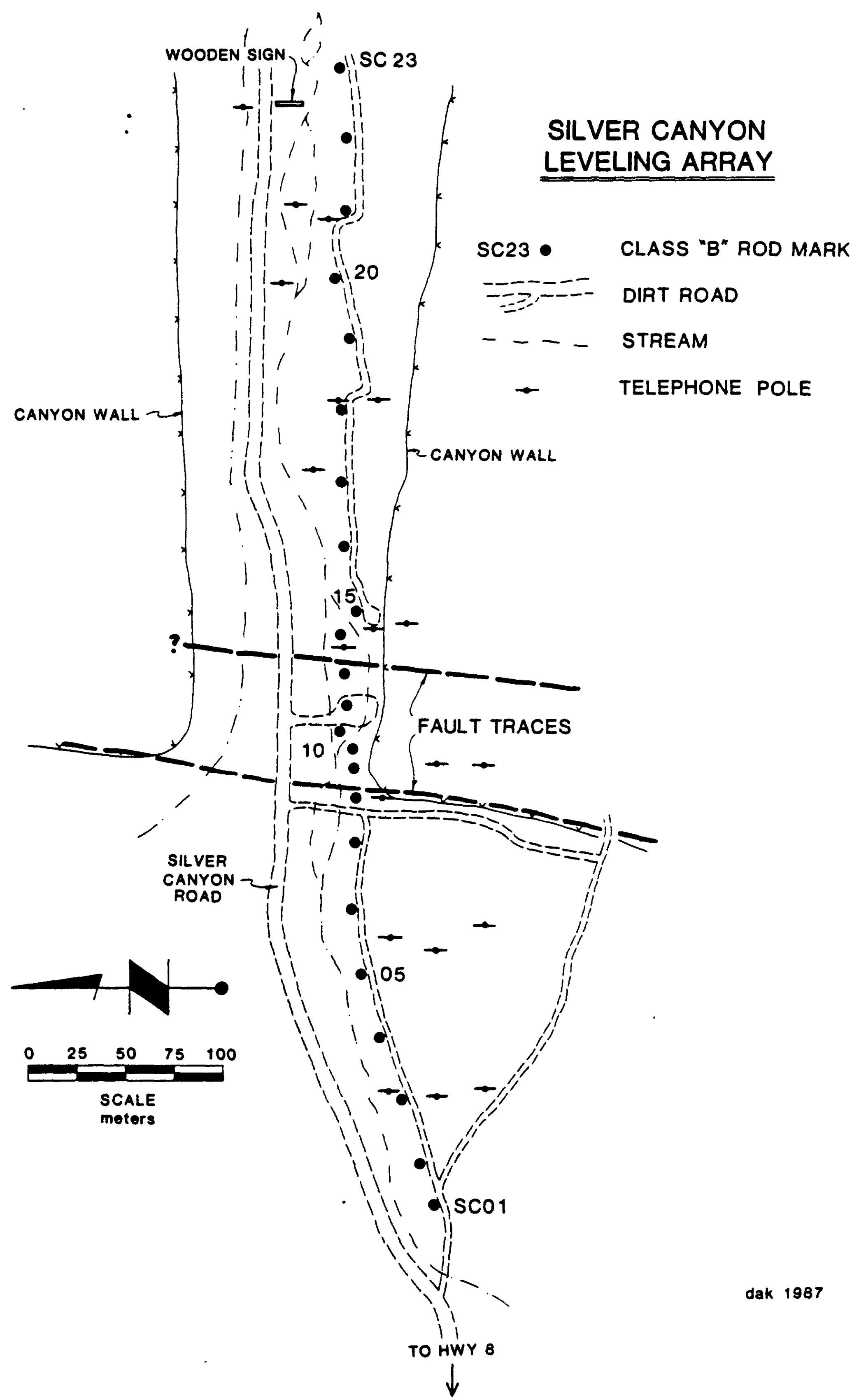
Latitude:	37°24'16"	**Length:**	605.0m
Longitude:	118°18'46"	**Number of Bench marks:**	23
Date of Initial Survey:	7 August 1987	**Number of Surveys to 1988:**	1
Trespass Permission:	None needed.		

Comments:

This line crosses the main traces of the White Mountain fault zone at the west base of the White Mountains one mile east of Laws.

BISHOP QUADRANGLE
CALIFORNIA
15 MINUTE SERIES (TOPOGRAPHIC)




SILVER CANYON
LEVELING ARRAY
SC23
CLASS "B" ROD MARK
DIRT ROAD
STREAM
TELEPHONE POLE
WOODEN SIGN
SC 23
20
CANYON WALL
CANYON WALL
15
?
FAULT TRACES
10
SILVER
CANYON
ROAD
05
0 25 50 75 100
SCALE
meters
SC01
dak 1987
TO HWY 8

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
SC01	SC02	122.546
SC02	SC03	181.082
SC03	SC04	209.528
SC04	SC05	198.335
SC05	SC06	215.905
SC06	SC07	205.899
SC07	SC08	75.525
SC08	SC09	107.813
SC09	SC10	43.891
SC10	SC11	103.900
SC11	SC12	23.184
SC12	SC13	113.205
SC13	SC14	95.422
SC14	SC15	120.019
SC15	SC16	225.105
SC16	SC17	200.440
SC17	SC18	185.676
SC18	SC19	209.063
SC19	SC20	239.565
SC20	SC21	197.302
SC21	SC22	168.165
SC22	SC23	172.363

SNORT Leveling Array

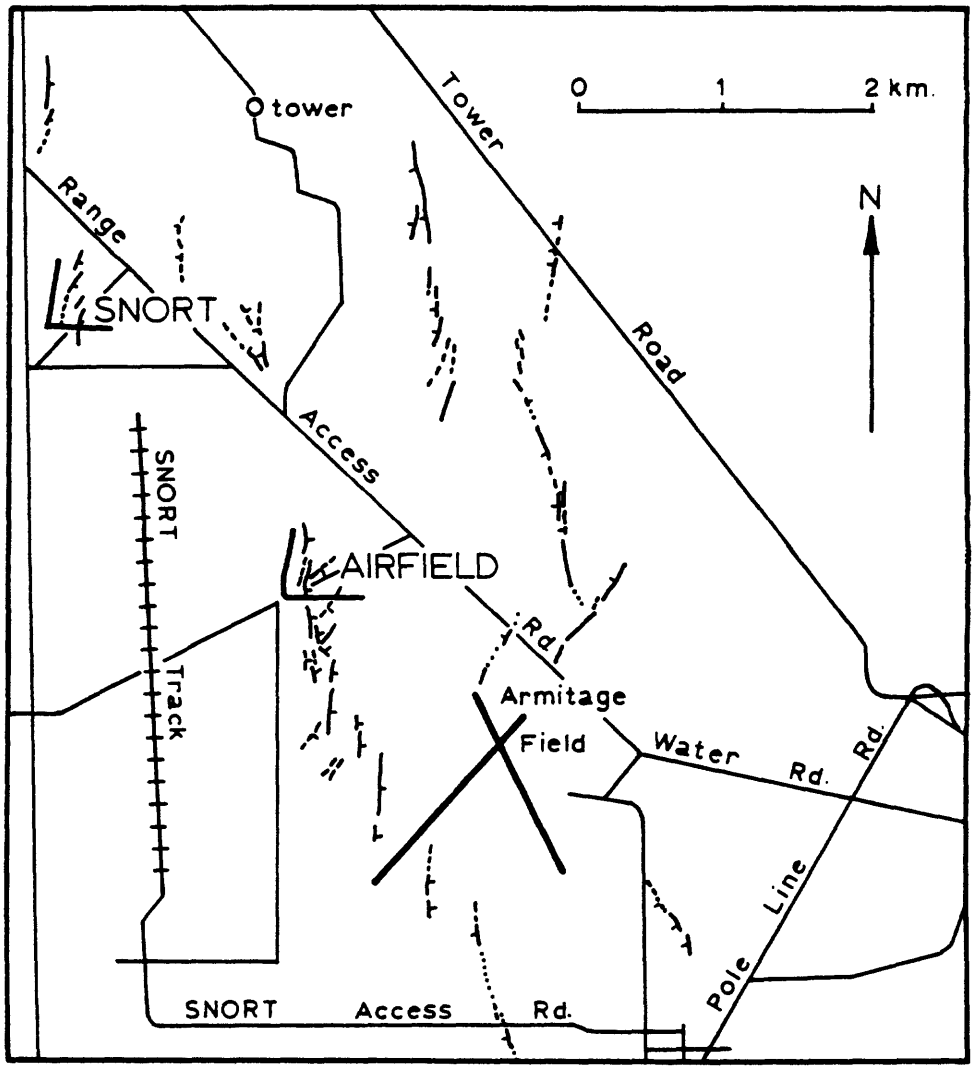
Latitude:	35°44'52"	**Length:**	832.2m
Longitude:	117°45'00"	**Number of Bench marks:**	24
Date of Initial Survey:	11 July 1983	**Number of Surveys to 1988:**	6
Trespass Permission:	Contact in Advance: Dr. Glenn Roquemore or John Zellmer Research Department Naval Weapons Center China Lake, CA 93555		

Comments:

This is one of two L-shaped arrays across one of several normal faults evincing surface rupture following an earthquake swarm in Indian Wells Valley in 1982 (Roquemore and Zellmer, 1983). It is located eight miles NNW of Ridgecrest.

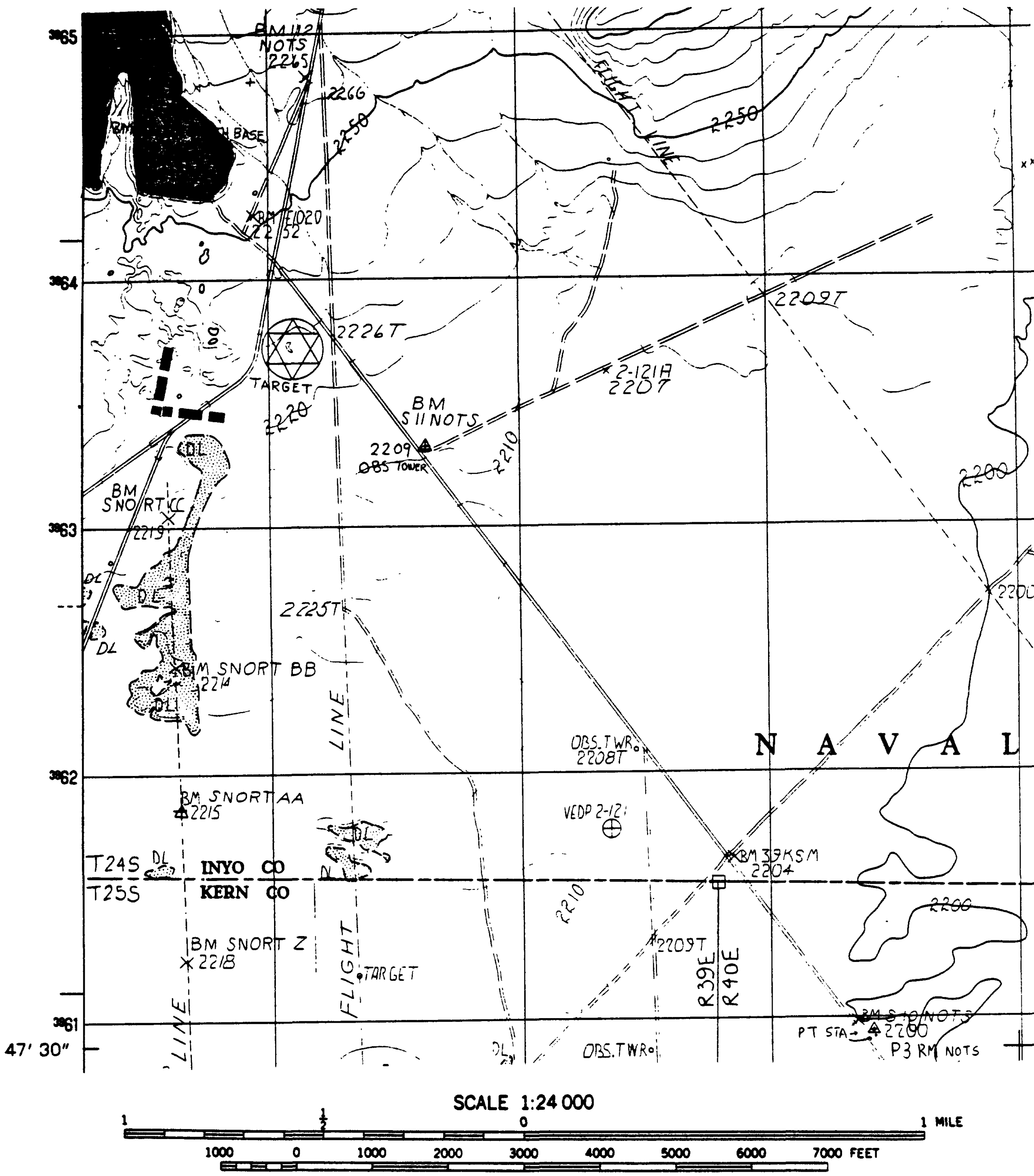
Five surveys from July 1983 to February 1987 are compared in an accompanying figure and show relative height changes of less than 1mm which is nearly equal to the allowable closure error.

Reference cited: Roquemore, G. R., and J. T. Zellmer, 1983. Ground cracking associated with the 1982 magnitude 5.2 Indian Wells Valley earthquake. California Geology 30 (9), 197-200.

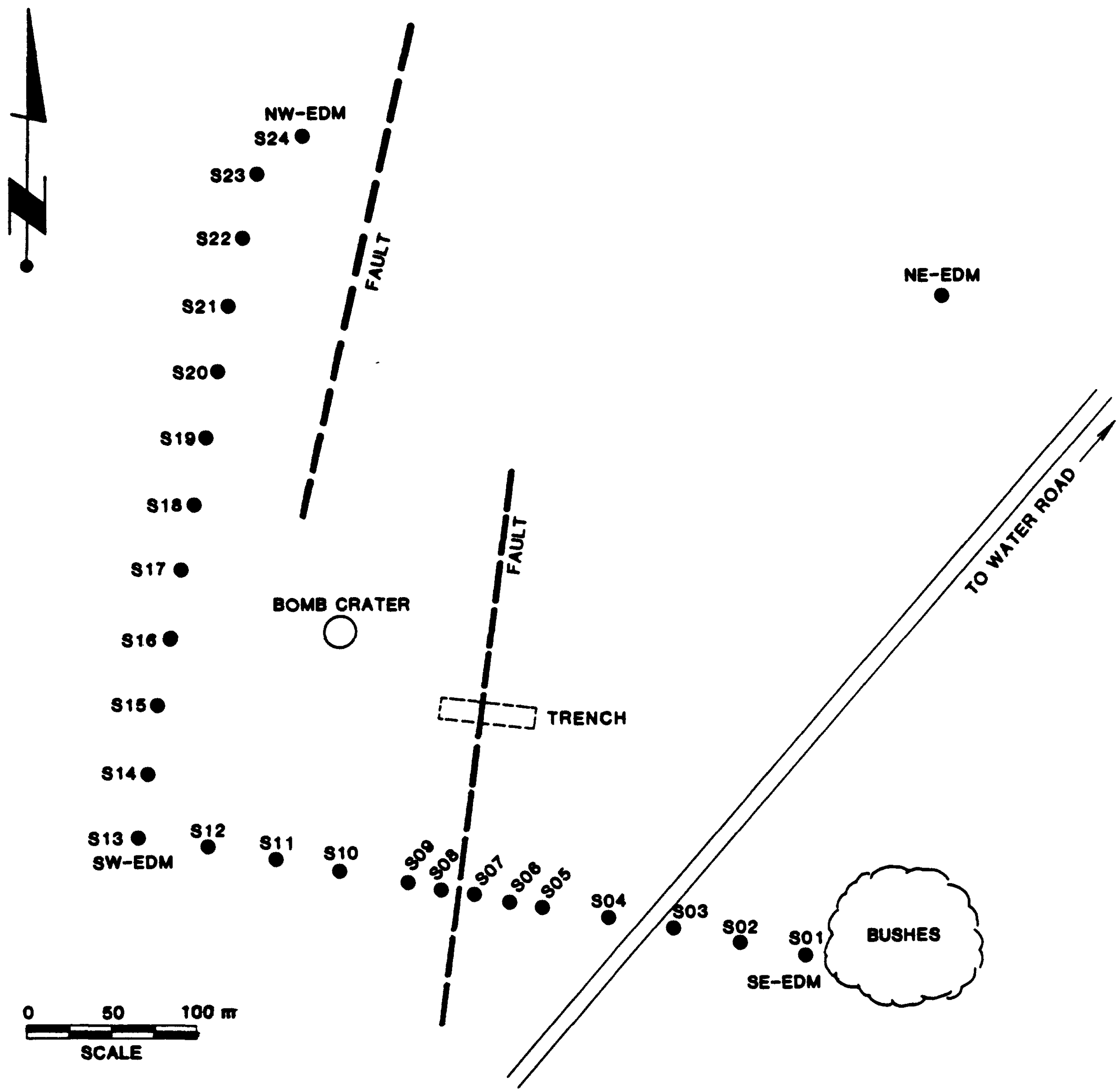


Map showing locations of UCSB precise leveling arrays across faults on China Lake Naval Weapons Center, Indian Wells Valley, Mojave Desert.

WHITE HILLS QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



SITE MAP OF THE SNORT LEVELING ARRAY



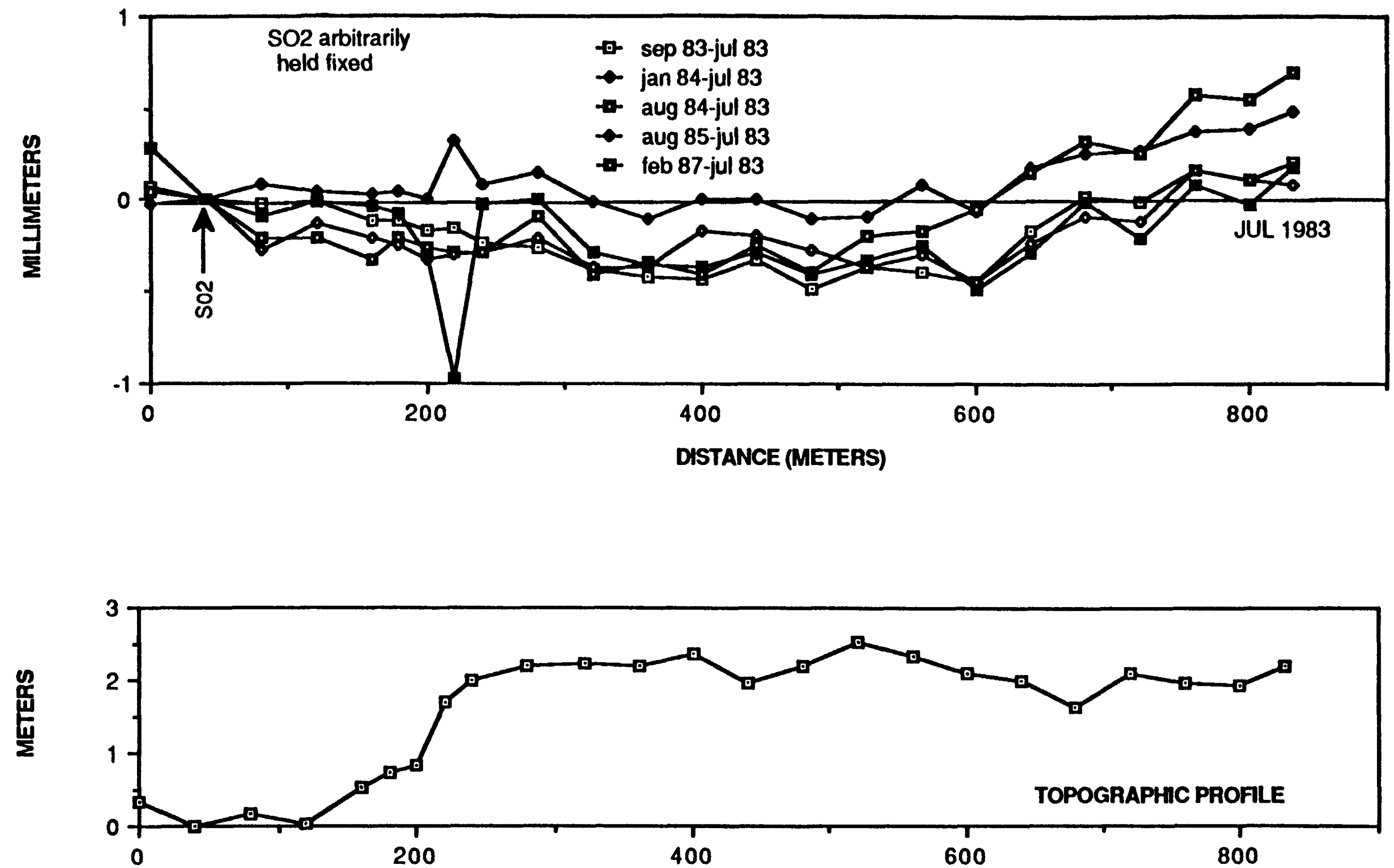


Fig. 4. Height changes of bench marks in the SNORT leveling array for six surveys from July 1983 to February 1987.

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
S01	S02	-33.924
S02	S03	15.734
S03	S04	-13.480
S04	S05	51.931
S05	S06	17.760
S06	S07	11.500
S07	S08	85.270
S08	S09	31.614
S09	S10	19.293
S10	S11	4.297
S11	S12	-3.416
S12	S13	15.855
S13	S14	-40.088
S14	S15	24.860
S15	S16	32.279
S16	S17	-18.945
S17	S18	-25.172
S18	S19	-10.336
S19	S20	-35.284
S20	S21	47.917
S21	S22	-15.722
S22	S23	-1.873
S23	S24	25.971

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
S01	S02	-33.953
S02	S03	15.726
S03	S04	-13.472
S04	S05	51.929
S05	S06	17.756
S06	S07	11.476
S07	S08	85.302
S08	S09	31.609
S09	S10	19.296
S10	S11	4.268
S11	S12	-3.422
S12	S13	15.853
S13	S14	-40.081
S14	S15	24.848
S15	S16	32.288
S16	S17	-18.939
S17	S18	-25.195
S18	S19	-10.315
S19	S20	-35.256
S20	S21	47.897
S21	S22	-15.693
S22	S23	-1.884
S23	S24	25.991

TRIANGLE SPRING Level Line (Line 130)

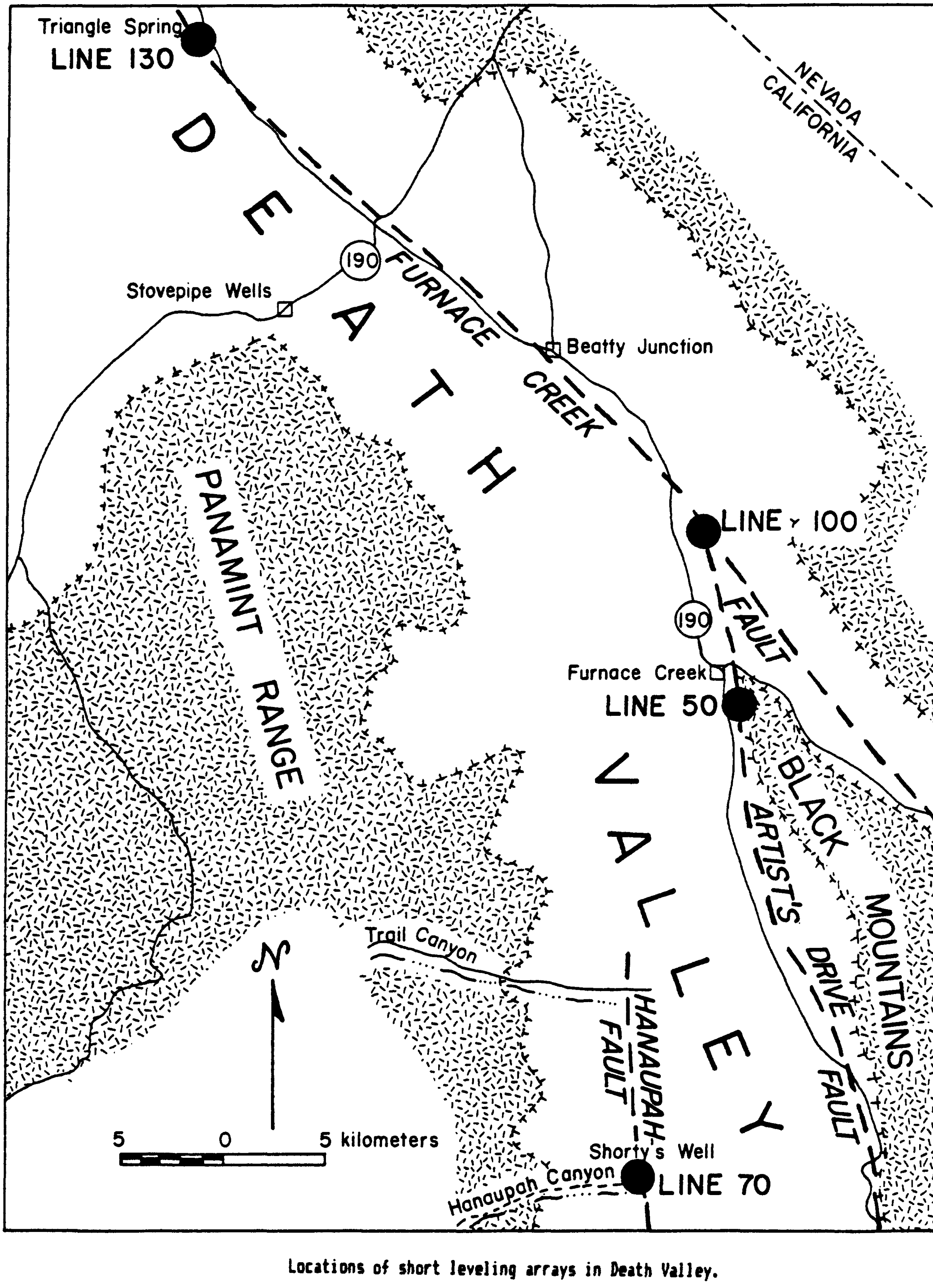
Latitude:	36°42'40"	**Length:**	250m
Longitude:	117°07'20"	**Number of Bench marks:**	10
Date of Initial Survey:	1 October 1970	**Number of Surveys to 1988:**	6
Trespass Permission:	Notify in advance the Chief Ranger National Park Service Death Valley National Monument Death Valley, CA 92328		

Comments:

Vehicles must not be driven off the shoulder of the paved road without the expressed and written permission of the Chief Ranger.

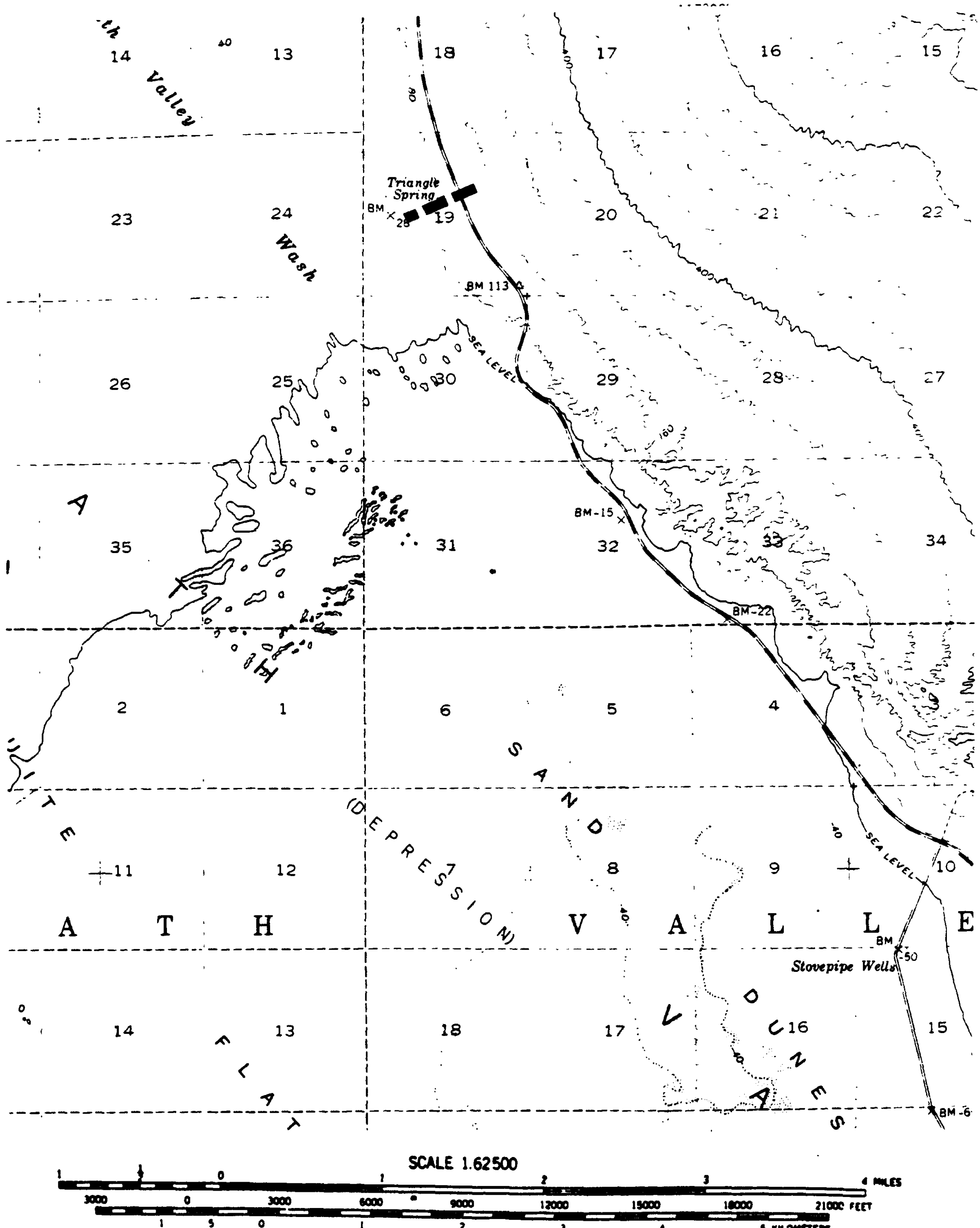
This line constitutes one leg of the four legs of a strain quadrilateral at this site across the Furnace Creek fault on the east side of Death Valley, three miles northwest of Stovepipe Wells. Observed height changes are minimal during the 15 year history of its surveys (Sylvester and Bie, 1986).

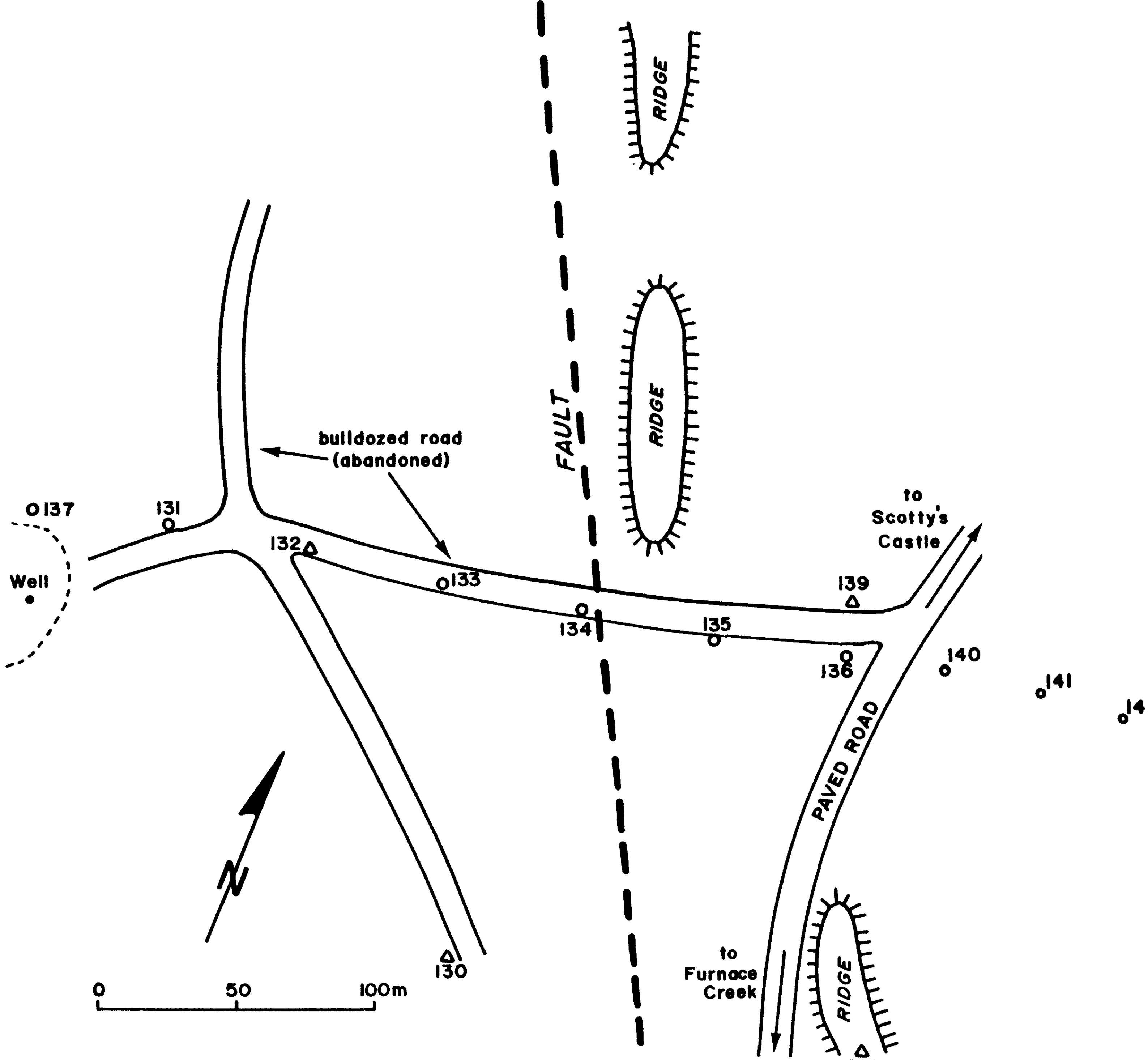
Reference cited: Sylvester, A. G., and S. W. Bie, 1986. Geodetic monitoring of fault movements in Death Valley, 1970-1985, pp. 41-44, *in* Troxel, B. W., *editor*, Quaternary Tectonics of Southern Death Valley. Field Guide, Pacific Cell, Friends of the Pleistocene, 44 p.



Locations of short leveling arrays in Death Valley.

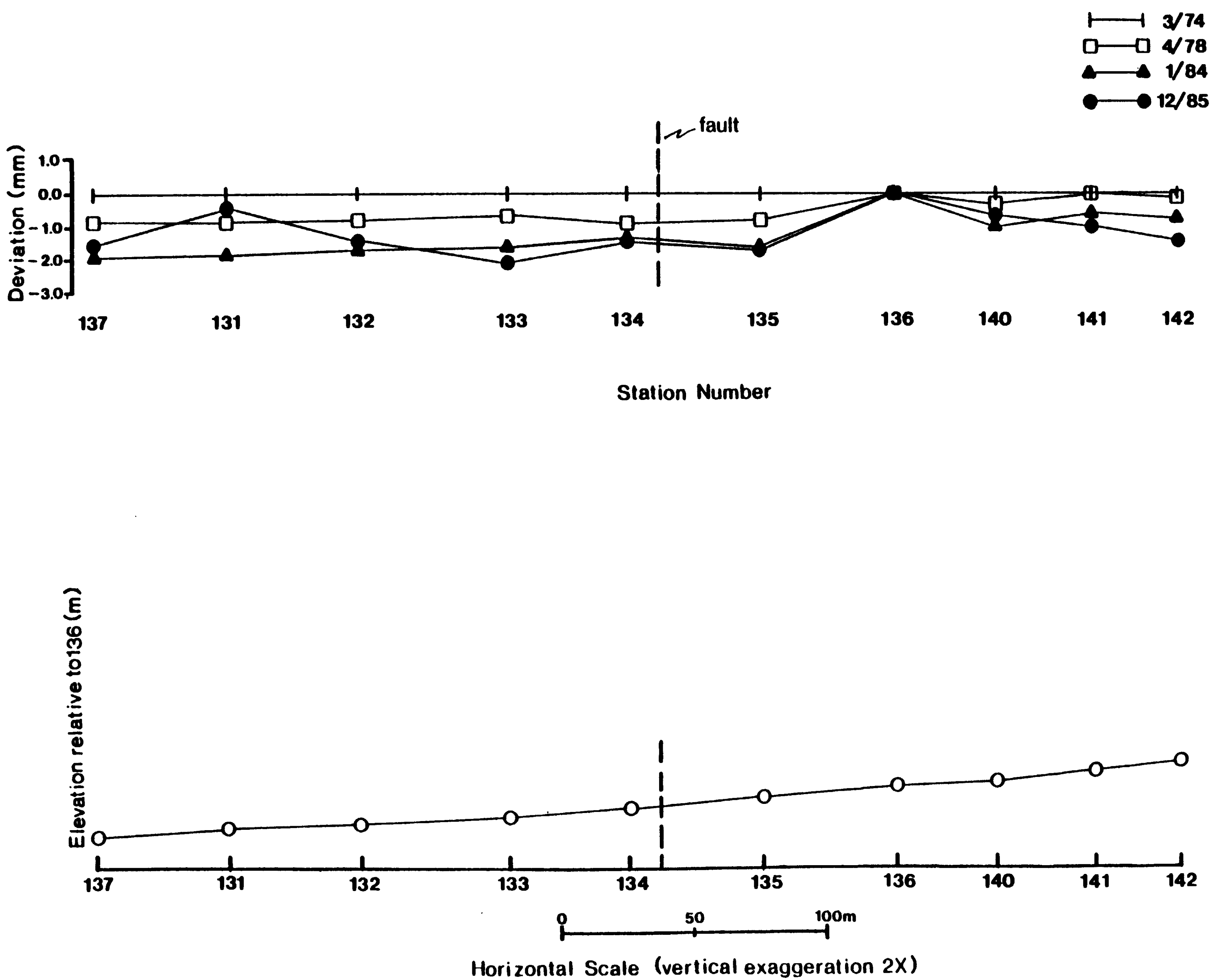
STOVEPIPE WELLS QUADRANGLE
CALIFORNIA-INYO CO.
15 MINUTE SERIES (TOPOGRAPHIC)





Line 130 - Triangle Spring - Death Valley

Line 130 - Triangle Spring - Death Valley



Line 130 - Triangle Spring - Death Valley

Relative elevation and elevation deviation from base line data collected Oct., 1971 (in cm). A - base line data, B - adjusted elevation relative to station 136, C - deviation of elevation from base line data, D - datum elevation.

Station and			Dec., 1970		Aug., 1971		Mar., 1973		Mar., 1974		Apr., 1978	
Monument	Type	A	B	C	B	C	B	C	B	C	B	C
136D	A	1000.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00	1000.00	0.00
135	A	812.30	812.31	+0.01	812.29	-0.01	812.27	-0.03	812.35	+0.05	812.28	-0.02
134	A	615.30	615.29	-0.01	615.28	-0.02	615.23	-0.07	615.33	+0.03	615.24	-0.06
133	A	440.23	440.23	0.00	440.21	-0.02	Destroyed					
132	A	349.05	349.05	0.00	349.01	-0.04	348.95	-0.10	349.08	+0.03	349.00	-0.05
131	A	209.70	209.71	+0.01	209.66	-0.04	209.58	-0.12	209.74	+0.04	209.65	-0.05
137	A	53.93	53.95	+0.02	53.88	-0.05	53.87	-0.06	54.00	+0.07	53.91	-0.02

		Jan., 1984		Dec., 1985	
		B	C	B	C
136D	A	1000.00	0.00	1000.00	0.00
135	A	812.20	-0.10	812.18	-0.12
134	A	615.20	-0.10	615.19	-0.11
133	A				
132	A	348.91	-0.14	348.94	-0.11
131	A	209.56	-0.14	209.70	0.00
137	A	53.81	-0.12	53.84	-0.09

TURKEY FLAT Level Line

Latitude:	35°32'36"	**Length:**	1293.5m
Longitude:	120°24'57"	**Number of Bench marks:**	8
Date of Initial Survey:	22 August 1987	**Number of Surveys to 1988:**	1
Trespass Permission:	None needed.		

Comments:

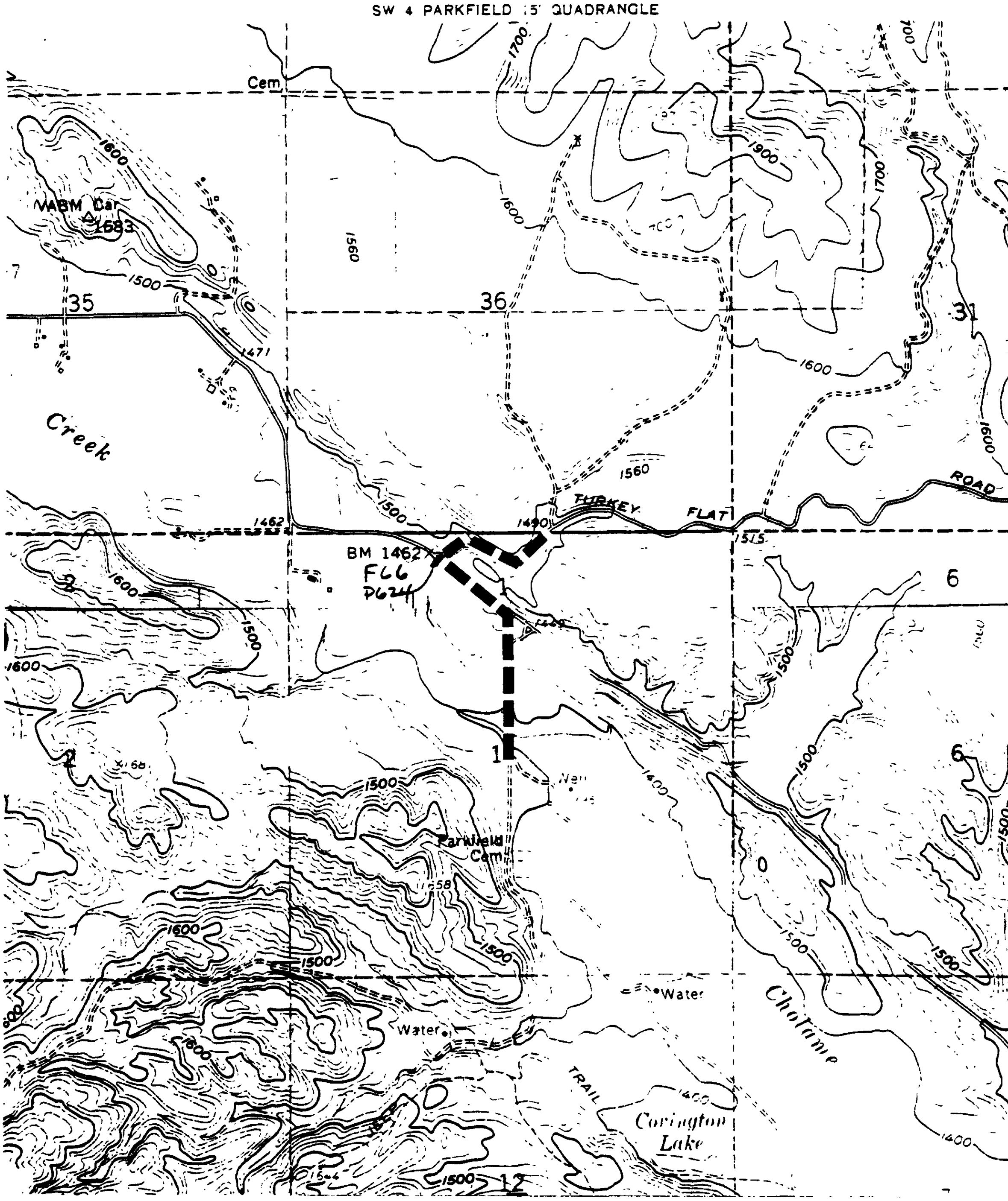
This line was established across the San Andreas fault by the U.S. Geological Survey, 2 miles southeast of Parkfield.

CHOLAME HILLS QUADRANGLE

CALIFORNIA

7.5 MINUTE SERIES (TOPOGRAPHIC)

SW 4 PARKFIELD 15' QUADRANGLE



SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
TODD3	TP01	-171.570
TP01	TP02	-37.666
TP02	TP03	-4.051
TP03	TP04	65.617
TP04	TP05	169.584
TP05	TP06	239.470
TP06	TP07	190.094
TP07	TODD2	220.292
TODD2	TP08	177.096
TP08	TP09	196.595
TP09	TP10	122.014
TP10	TP11	176.826
TP11	TP12	194.563
TP12	TP13	123.001
TP13	TP14	-151.884
TP14	TP15	39.429
TP15	TODD1	60.097
TODD1	TP16	95.048
TP16	TP17	5.152
TP17	TP18	-105.694
TP18	TP19	-45.446
TP19	TP20	42.574
TP20	TP21	-67.657
TP21	TP22	5.966
TP22	TP23	157.823
TP23	TP24	131.085
TP24	TFR1	151.122
TFR1	TP25	-10.516
TP25	TP26	156.727
TP26	TFR2	165.218
TFR2	TP27	31.839
TP27	TFR3	158.189
TFR3	TP28	-71.424
TP28	TP29	17.520
TP29	TP30	-10.322
TP30	TFR4	6.676
TFR4	TP31	-83.186
TP31	TP32	108.704
TP32	TP33	57.532
TP33	TP34	49.431
TP34	TFR5	60.394

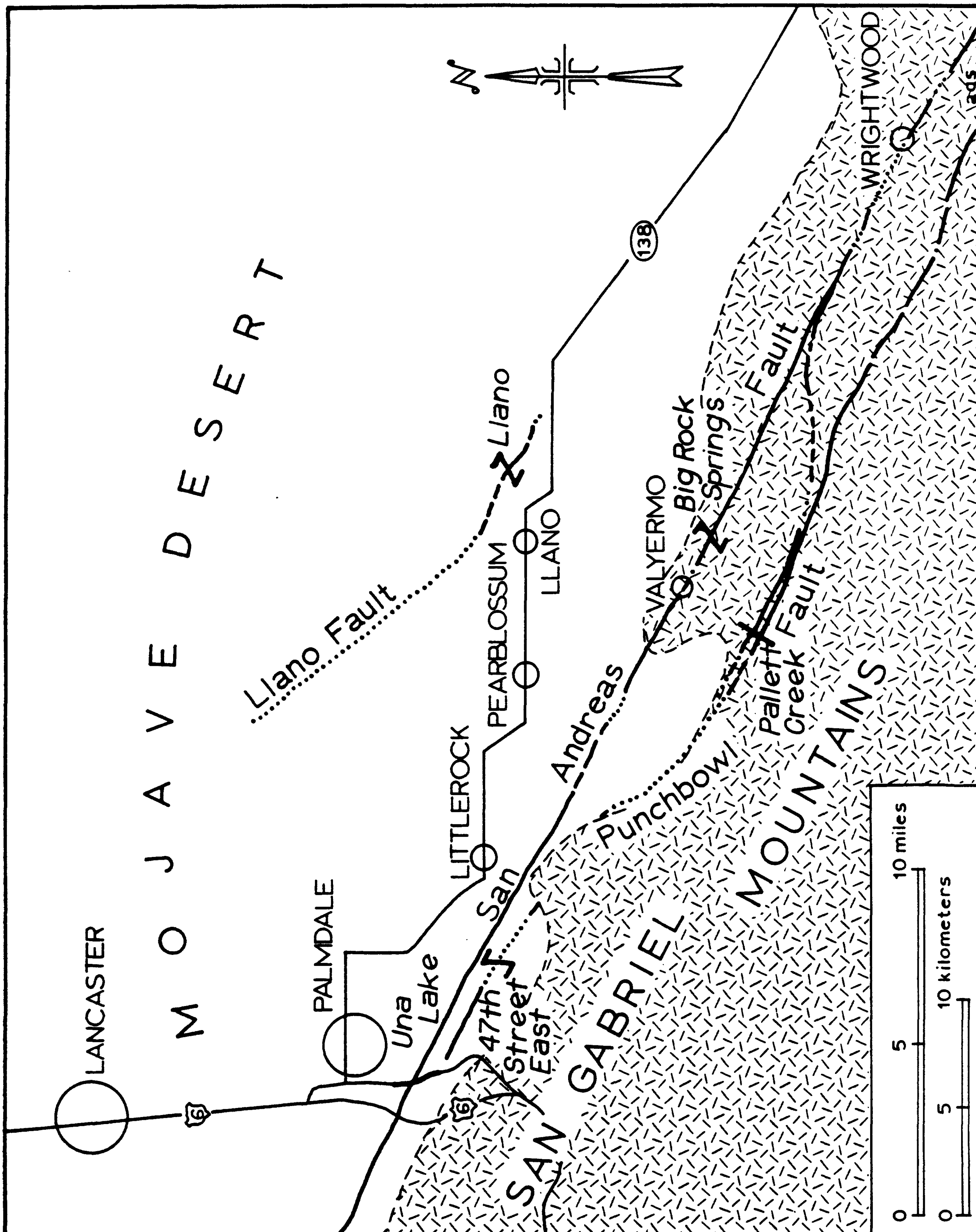
UNA LAKE Level Line

Latitude:	34°33'00"	**Length:**	1554.2m
Longitude:	118°02'47"	**Number of Bench marks:**	27
Date of Initial Survey:	22 August 1979	**Number of Surveys to 1988:**	5
Trespass Permission:	None needed.		

Comments:

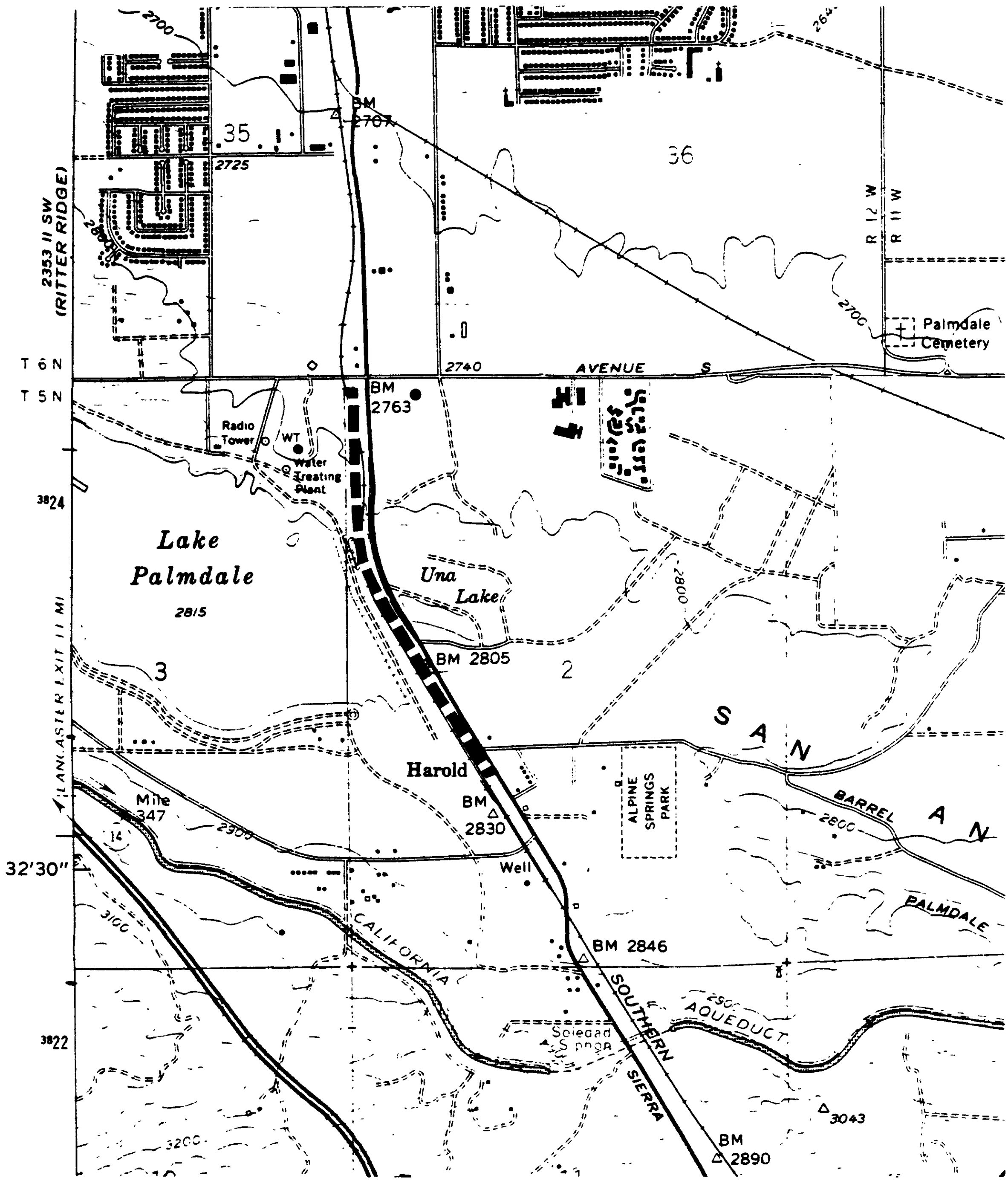
This is one of several fault crossing lines established across the San Andreas fault by the U.S. Coast and Geodetic Survey (NGS) in 1935. The UCSB array covers only part of the entire NGS array which is located along the railroad track, 2 miles south of Palmdale.

Three levelings of the line from July 1981 to August 1984 are compared in an accompanying figure and show that height changes among the bench marks are minimal in that time period.



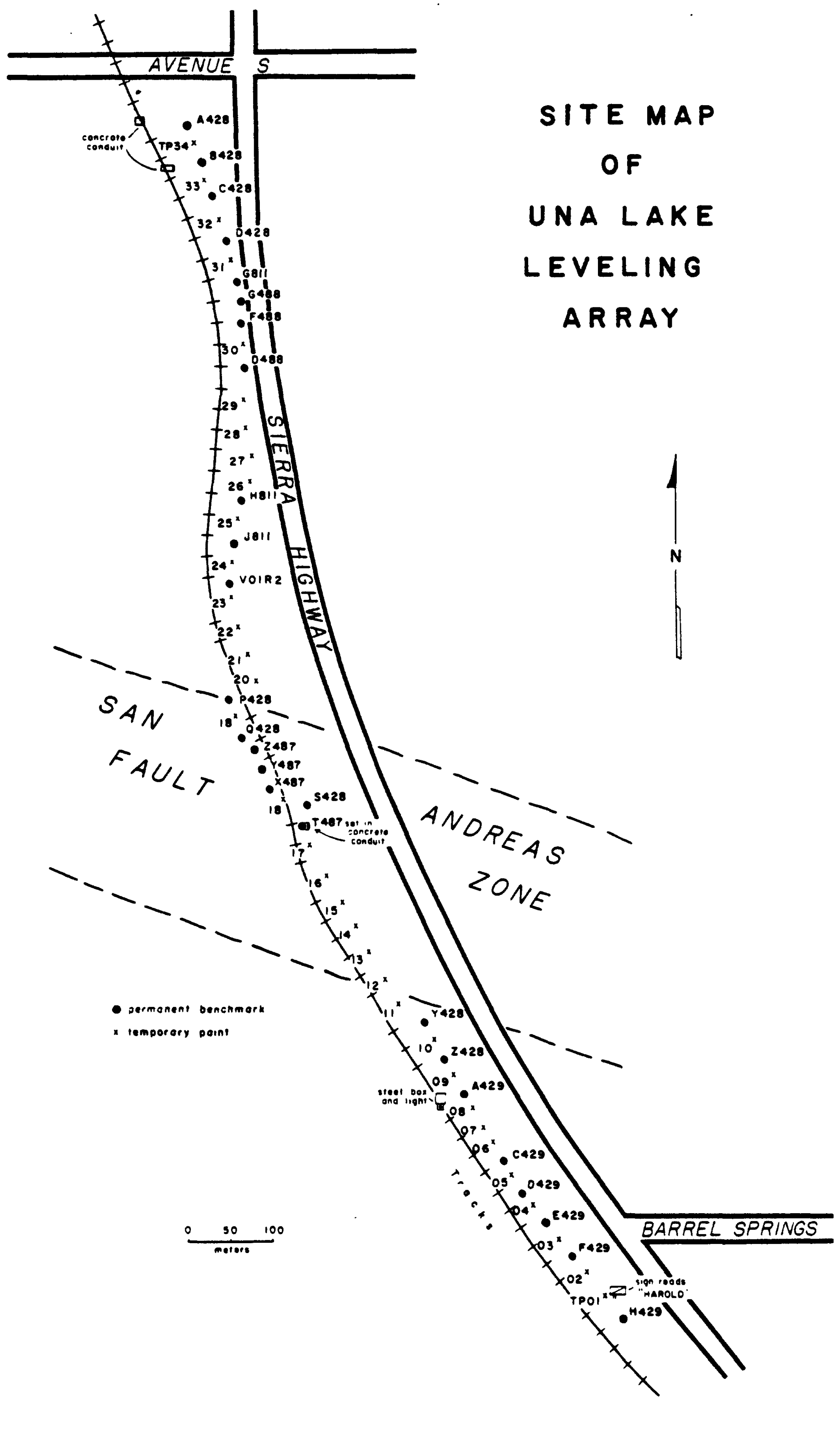
M O J A V E D E S E R T
LANCASTER
PALMDALE
LITTLEROCK
PEARBLOSSUM
LLANO
VALYERMO
WRIGHTWOOD
Llano Fault
Llano
138
6
Una Lake
47th Street East
San Andreas
Punchbowl Fault
Big Rock Springs Fault
Pallett Creek
SAN GABRIEL MOUNTAINS
N
10 miles
10 kilometers
0
5
10

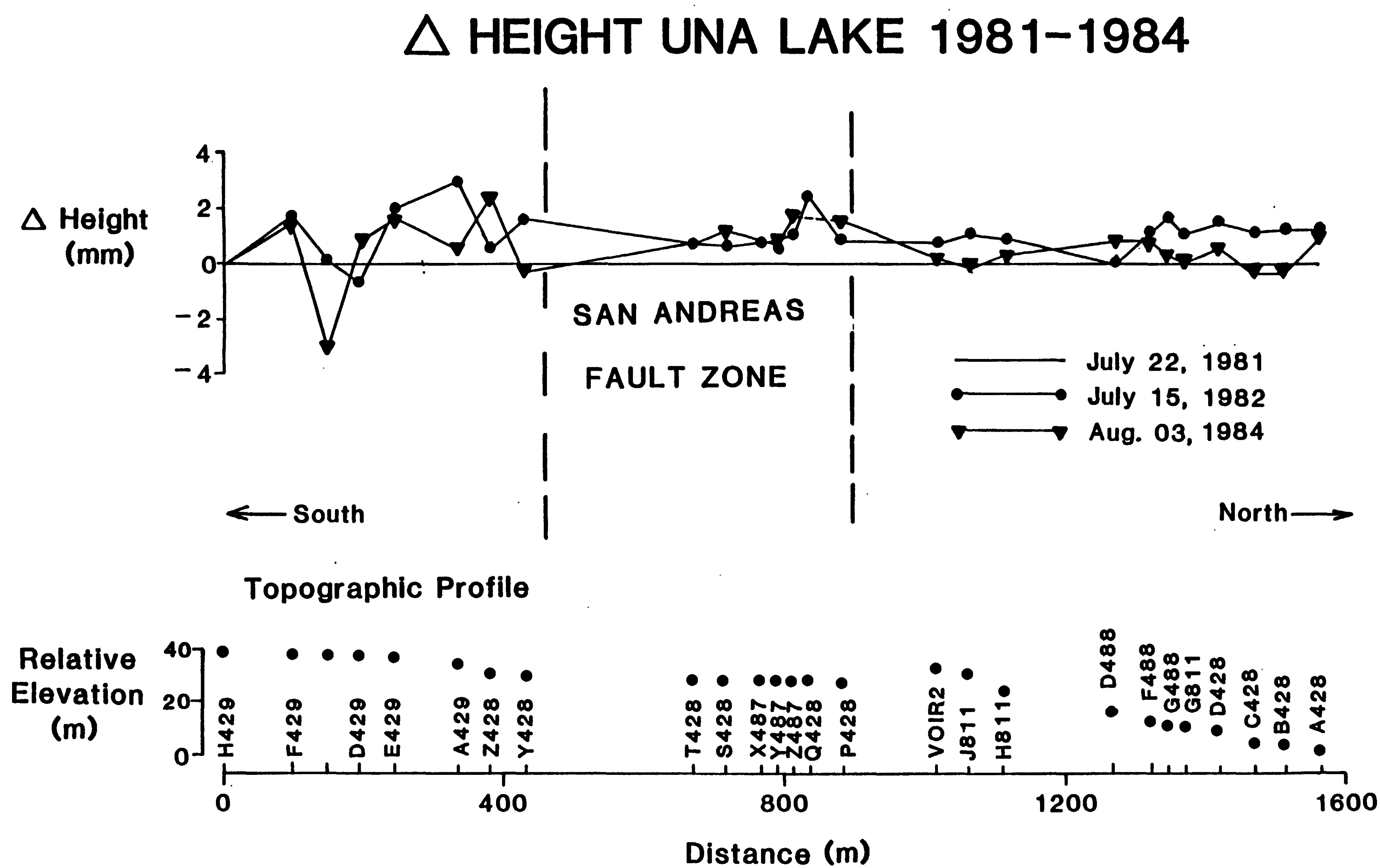
PALMDALE QUADRANGLE
CALIFORNIA—LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 LANCASTER 15' QUADRANGLE



SCALE 1:24 000

1	½	0								1 MILE
1000	0	1000	2000	3000	4000	5000	6000	7000 FEET		
1	.5	0						1 KILOMETER		


SITE MAP
OF
UNA LAKE
LEVELING
ARRAY
AVENUE S
SIERRA HIGHWAY
BARREL SPRINGS
SAN ANDREAS FAULT ZONE
N
concrete conduit
TP34
A428
B428
C428
D428
G811
G488
F488
D488
H811
J811
VOIR2
P428
Q428
Z487
Y487
X487
S428
T487 set in concrete conduit
Y428
Z428
A429
C429
D429
E429
F429
H429
steel box and light
sign reads "HAROLD"
TP01
Tracks
● permanent benchmark
x temporary point
0 50 100
meters



Δ HEIGHT UNA LAKE 1981-1984
Δ Height (mm)
4
2
0
-2
-4
SAN ANDREAS
FAULT ZONE
July 22, 1981
July 15, 1982
Aug. 03, 1984
South
North
Topographic Profile
Relative Elevation (m)
40
20
0
H429
F429
D429
E429
A429
Z428
Y428
T428
S428
X487
Y487
Z487
Q428
P428
VOIR2
J811
H811
D488
F488
G488
G811
D428
C428
B428
A428
0
400
800
1200
1600
Distance (m)

PALMDALE, CALIFORNIA   UNA LAKE   AUGUST 22, 1979

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
H429	TP01	-5.8113
TP01	TP02	5.1240
TP02	F429	-22.1985
F429	TP03	-66.9013
TP03	E429	-1.5932
E429	TP04	-29.0538
TP04	D429	-1.0553
D429	TP05	-67.7960
TP05	C429	-21.6153
C429	TP06	-55.0328
TP06	TP07	-14.8583
TP07	TP08	-35.2985
TP08	A429	-33.4283
A429	TP09	-63.4160
TP09	Z428	-38.1483
Z428	TP10	-71.6188
TP10	Y428	27.8508
Y428	TP11	34.3020
TP11	TP12	-37.5533
TP12	TP13	-35.6585
TP13	TP14	-13.2558
TP14	TP15	-4.6192
TP15	TP16	-11.6635
TP16	T487	-69.3600
T487	TP17	12.4050
TP17	S428	86.8527
S428	TP18	-66.3910
TP18	X487	17.8233
X487	Y487	-5.6290
Y487	Z487	3.7180
Z487	Q428	8.4153
Q428	TP19	-15.8910
TP19	P428	4.8030
P428	TP20	26.5393
TP20	TP21	108.9853
TP21	TP22	57.5693
TP22	TP23	43.9525
TP23	VOIR	83.2775
VOIR	TP24	-39.7905
TP24	J811	-88.7772
J811	TP25	-155.2285
TP25	H811	-175.8193
H811	TP26	-91.3910
TP26	TP27	-127.1293
TP27	TP28	-103.3138
TP28	TP29	-120.7485
TP29	D488	-103.7708
D488	TP30	-31.4660
TP30	F488	-103.7708
F488	G488	-79.1383
G488	G811	-29.6378
G811	TP31	-45.0647
TP31	D428	-4.0443
D428	TP32	-94.9215

(continued)

PALMADALE, CALIFORNIA UNA LAKE AUGUST 22, 1979

Backsight	Foresight	Height Diff (cm)
TP32	C428	-72.6830
C428	TP33	34.5255
TP33	B428	-54.7755
B428	TP34	-87.8210
TP34	A428	-76.2067

PALMDALE, CALIFORNIA   UNA LAKE   AUGUST 3, 1984

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
H429	TP01	4.0095
TP01	TP02	1.7463
TP02	F429	-28.4015
F429	TP03	-68.9105
TP03	E429	-0.4050
E429	TP04	-24.0565
TP04	D429	-5.9050
D429	TP05	-62.1255
TP05	C429	-26.9385
C429	TP06	-53.7583
TP06	TP07	-14.3165
TP07	TP08	-45.9925
TP08	A429	-24.4172
A429	TP09	-65.5480
TP09	Z428	-35.6510
Z429	TP10	-69.7907
TP10	Y428	25.5233
Y428	TP11	-12.3652
TP11	TP12	32.3120
TP12	TP13	-46.1410
TP13	TP14	-11.7217
TP14	TP15	-16.8075
TP15	TP16	-1.2707
TP16	TP17	-17.1447
TP17	T487	-64.5357
T487	TP18	27.2263
TP18	S428	72.3488
S428	TP19	-67.2480
TP19	X487	18.3895
X487	Y487	-5.7150
Y487	Z487	3.8510
Z487	2487	9.3400
2487	P428	-12.0982
P428	TP20	22.8035
TP20	TP21	111.5707
TP21	TP22	53.1895
TP22	TP23	15.7717
TP23	VOIR	116.8437
VOIR	TP24	-42.0918
TP24	J811	-86.7160
J811	TP25	-139.9327
TP25	H811	-190.9525
H811	TP26	-9.5365
TP26	TP27	-173.0132
TP27	TP28	-132.0157
TP28	TP29	-131.5342
TP29	C488	-56.3705
C488	D488	-43.5435
D488	TP30	-38.9915
TP30	F488	-19.9440

(continued)

PALMDALE, CALIFORNIA   UNA LAKE   AUGUST 3, 1984

Backsight	Foresight	Height Diff (cm)
F488	G488	-79.2703
G488	G811	-29.6747
G811	TP31	-48.5183
TP31	D428	-0.5633
D428	TP32	-99.4222
TP32	C428	-68.2625
C428	TP33	37.1608
TP33	B428	-57.3847
B428	TP34	-84.0687
TP34	A428	-79.8200

WALLACE CREEK Leveling Array

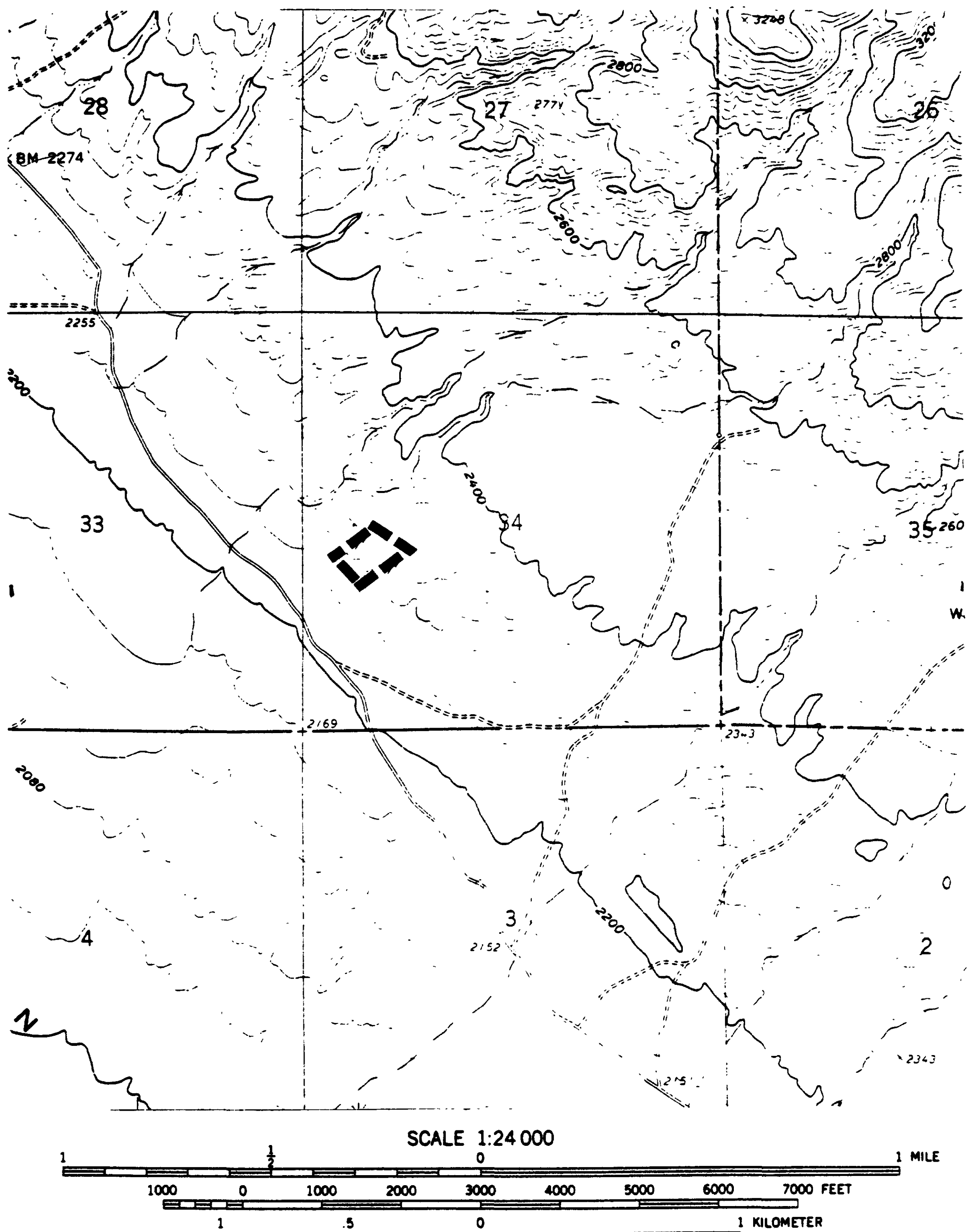
Latitude:	35°16'09"	**Length:**	788.0m
Longitude:	119°26'41"	**Number of Bench marks:**	51
Date of Initial Survey:	20 July 1983	**Number of Surveys to 1988:**	3
Trespass Permission:	None needed.		

Comments:

This is a box-shaped leveling array across the San Andreas fault in the Carrizo Plain about 3 miles south of State Hwy 58 and 10 miles WSW of McKittrick.

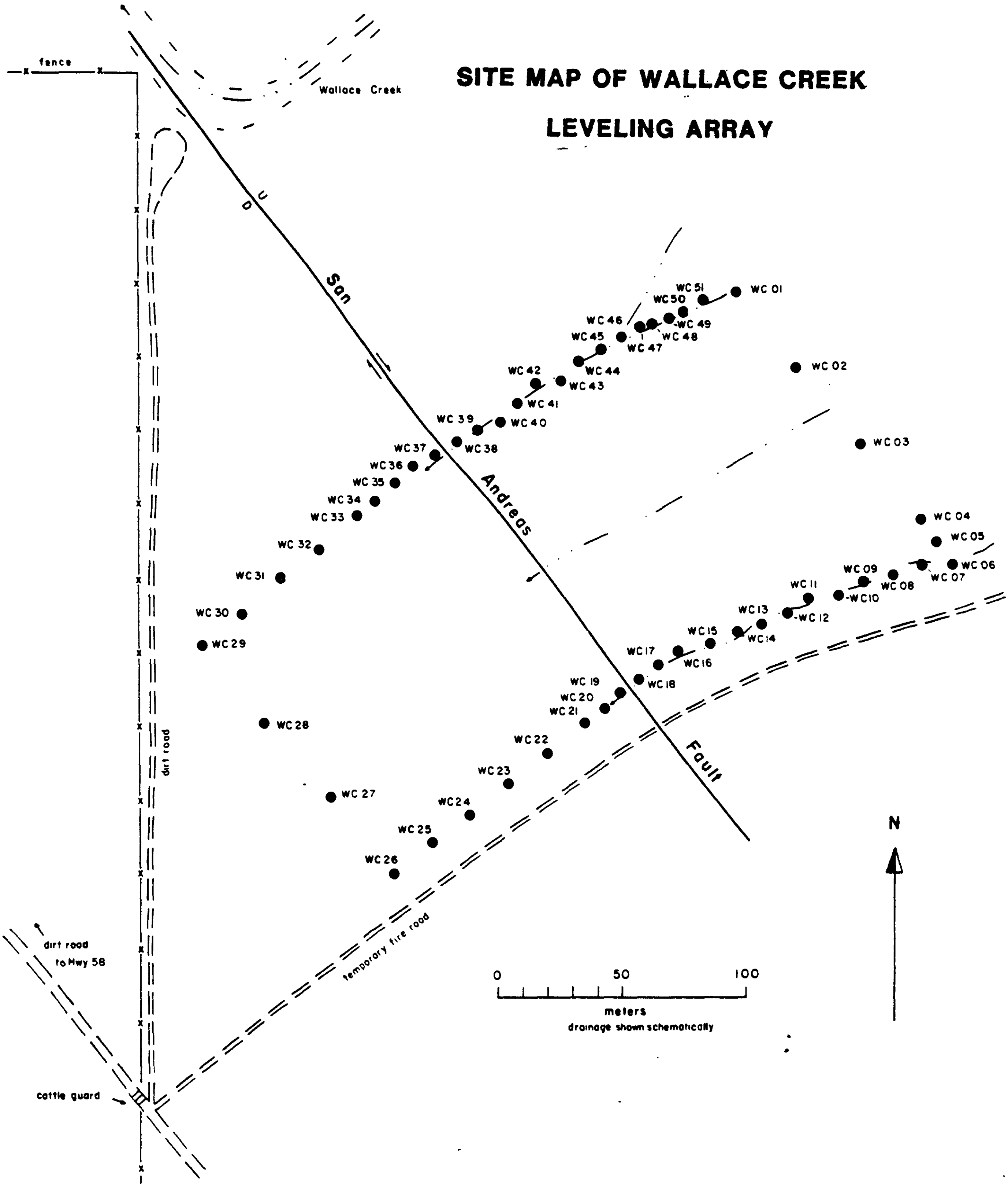
Three levelings from July 1983 to August 1987 are compared in an accompanying figure. Except for two bench marks, the height changes among the bench marks are insignificant and show no evidence for tectonic vertical movement in four years at this site.

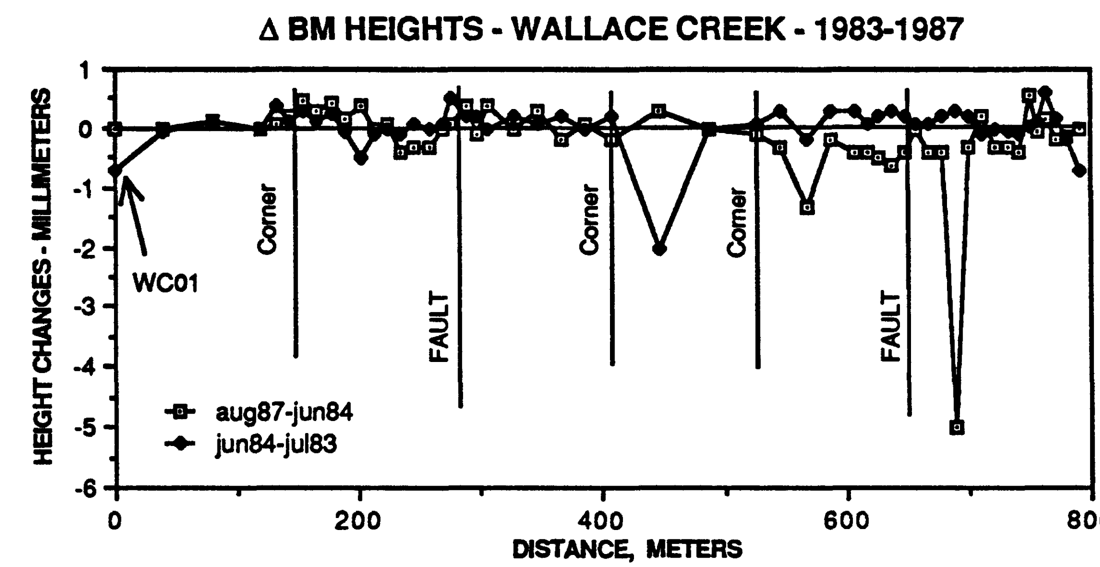
MC KITTRICK SUMMIT QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 SIMMLER 15' QUADRANGLE

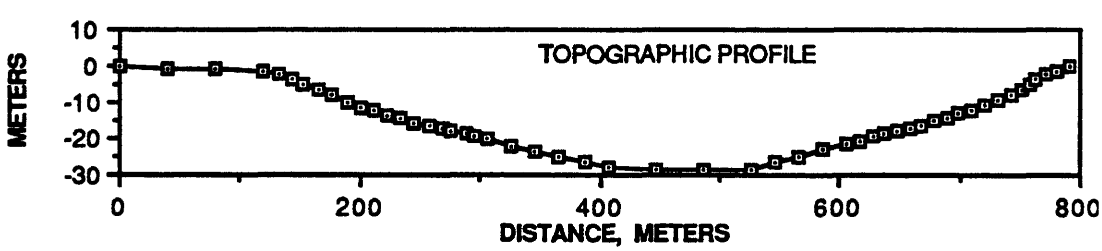


SITE MAP OF WALLACE CREEK

LEVELING ARRAY




Δ BM HEIGHTS - WALLACE CREEK - 1983-1987
HEIGHT CHANGES - MILLIMETERS
WC01
Corner
FAULT
Corner
Corner
FAULT
aug87-jun84
jun84-jul83
DISTANCE, METERS


TOPOGRAPHIC PROFILE
METERS
DISTANCE, METERS

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
WC01	WC02	-50.482
WC02	WC03	-36.796
WC03	WC04	-31.165
WC04	WC05	-75.071
WC05	WC06	-177.383
WC06	WC07	-134.325
WC07	WC08	-172.340
WC08	WC09	-144.379
WC09	WC10	-150.100
WC10	WC11	-138.283
WC11	WC12	-117.148
WC12	WC13	-104.371
WC13	WC14	-106.902
WC14	WC15	-98.071
WC15	WC16	-116.710
WC16	WC17	-96.766
WC17	WC18	-70.530
WC18	WC19	-69.802
WC19	WC20	-54.081
WC20	WC21	-72.578
WC21	WC22	-175.981
WC22	WC23	-157.638
WC23	WC24	-145.058
WC24	WC25	-138.120
WC25	WC26	-141.829
WC26	WC27	-102.624
WC27	WC28	-6.559
WC28	WC29	40.329
WC29	WC30	188.473
WC30	WC31	176.655
WC31	WC32	198.820
WC32	WC33	154.906
WC33	WC34	86.454
WC34	WC35	102.484
WC35	WC36	108.283
WC36	WC37	44.019
WC37	WC38	101.158
WC38	WC39	74.269
WC39	WC40	79.037
WC40	WC41	106.844
WC41	WC42	104.345
WC42	WC43	105.014
WC43	WC44	121.530
WC44	WC45	151.457
WC45	WC46	151.580
WC46	WC47	166.682
WC47	WC48	120.983
WC48	WC49	126.940
WC49	WC50	139.694
WC50	WC51	118.424

SANTA MARGARITA, CALIFORNIA   WALLACE CREEK   AUGUST 21, 1987

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
WC29	WC30	188.477
WC30	WC31	176.506
WC31	WC32	198.983
WC32	WC33	154.879
WC33	WC34	86.439
WC34	WC35	102.476
WC35	WC36	108.287
WC36	WC37	44.023
WC37	WC38	101.198
WC38	WC39	74.224
WC39	WC40	79.050
WC40	WC41	106.397
WC41	WC42	104.810
WC42	WC43	105.029
WC43	WC44	121.484
WC44	WC45	151.456
WC45	WC46	151.569
WC46	WC47	166.787
WC47	WC48	120.933
WC48	WC49	127.012
WC49	WC50	139.615
WC50	WC51	118.395
WC51	WC01	116.267
WC01	WC02	-50.018
WC02	WC03	-36.766
WC03	WC04	-31.191
WC04	WC05	-75.025
WC05	WC06	-177.393
WC06	WC07	-134.279
WC07	WC08	-172.377
WC08	WC09	-144.355
WC09	WC10	-150.157
WC10	WC11	-138.303
WC11	WC12	-117.144
WC12	WC13	-104.349
WC13	WC14	-106.968
WC14	WC15	-98.041
WC15	WC16	-116.722
WC16	WC17	-96.719
WC17	WC18	-70.482
WC18	WC19	-69.797
WC19	WC20	-54.134
WC20	WC21	-72.554
WC21	WC22	-175.995
WC22	WC23	-157.616
WC23	WC24	-145.100
WC24	WC25	-138.112
WC25	WC26	-141.841
WC26	WC27	-102.596
WC27	WC28	-6.583

WHITEWATER CANYON Level Line

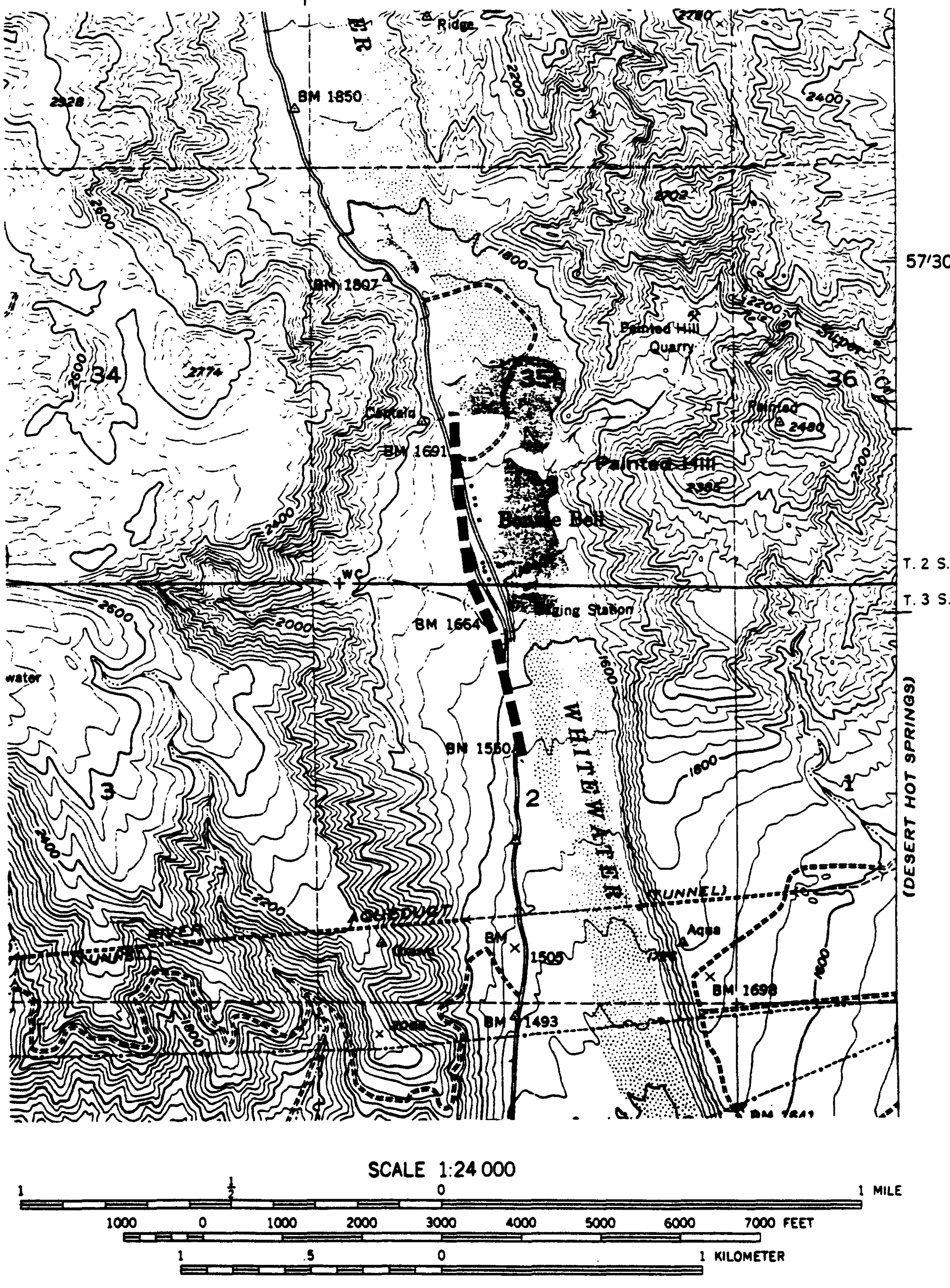
Latitude:	33°56'47"	**Length:**	1381.4m
Longitude:	116°38'01"	**Number of Bench marks:**	44
Date of Initial Survey:	29 August 1986	**Number of Surveys to 1988:**	2
Trespass Permission:	None needed.		

Comments:

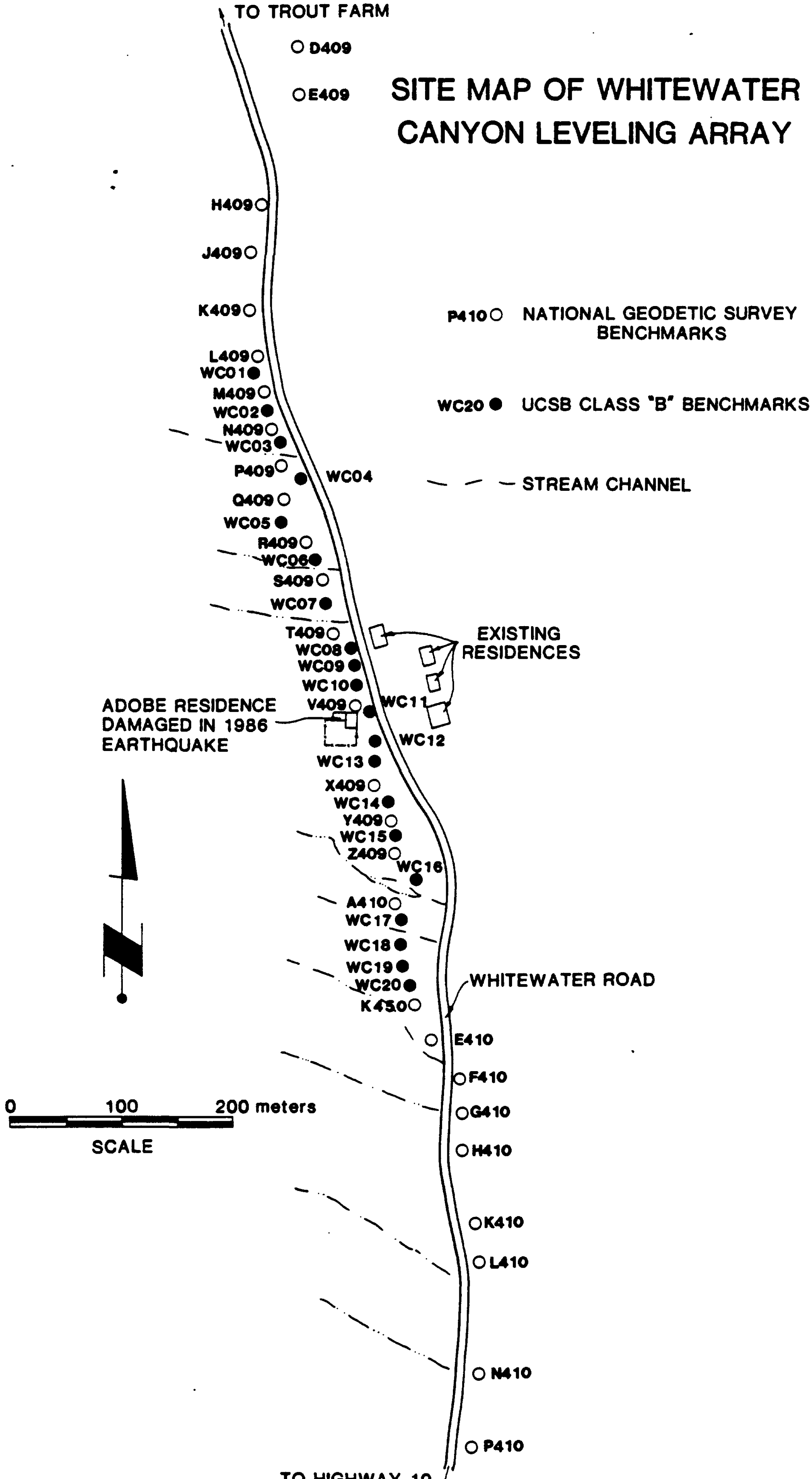
This is one of several fault-crossing leveling arrays established by the U.S. Coast and Geodetic Survey (NGS) in 1935. The line crosses the Banning fault in Whitewater Canyon, one and one-half miles north of Whitewater. The UCSB surveys have observed only part of the string of bench marks in the NGS line since the North Palm Springs earthquake of July 1986.

A UCSB leveling in August 1986, a few weeks after the earthquake, is compared with a second UCSB leveling in June 1987 in an accompanying figure. Relative to an NGS bench mark at the south end of the line, the bench marks show a systematic height decrease northward, as if the entire line has tilted northward about 6 microradians. This is opposite to the topographic rise, suggesting that the tilt is tectonic and not due to refraction error. The tilt is also opposite to the relative sense of vertical displacement across the fault, suggesting that the active fault may be south of the mapped trace of the Banning fault itself.

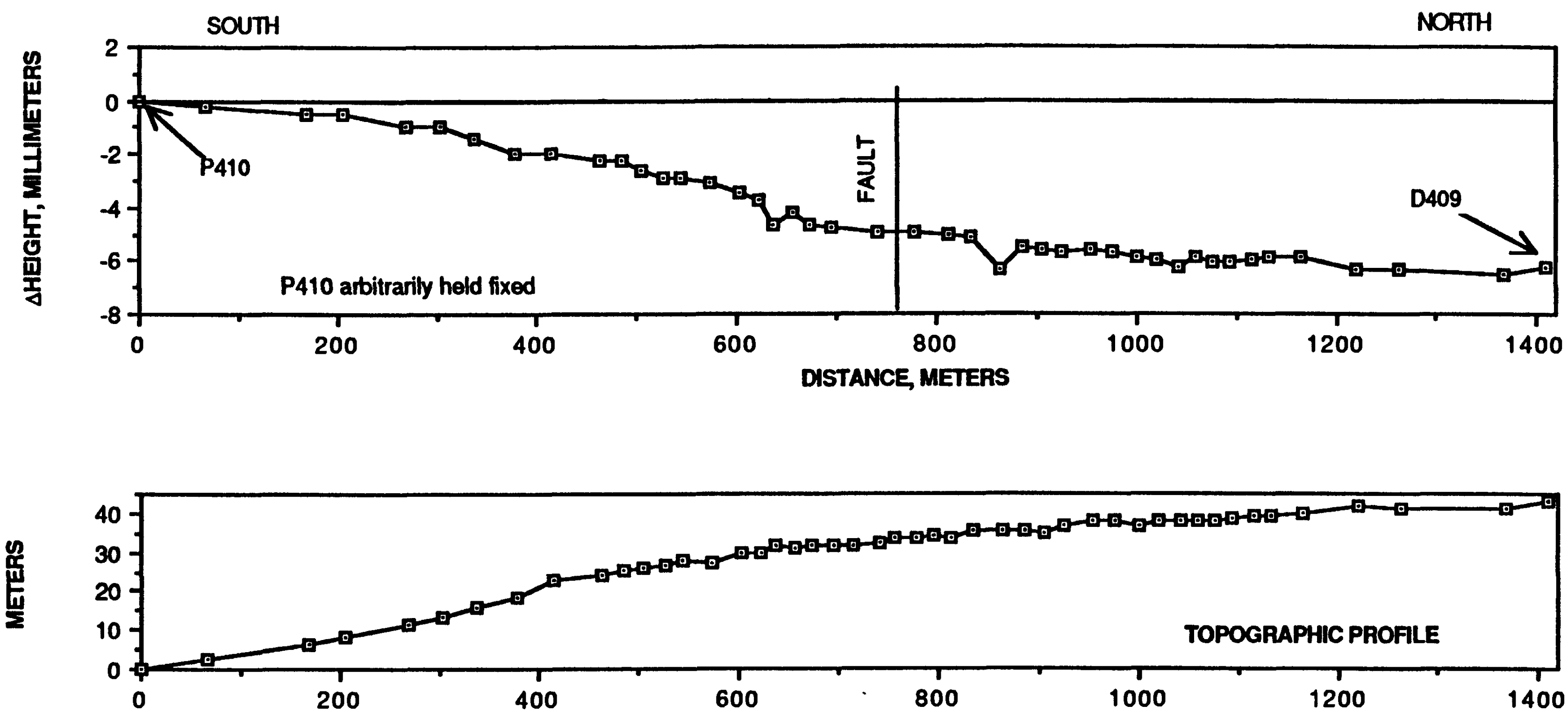
WHITEWATER QUADRANGLE
CALIFORNIA—RIVERSIDE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PALM SPRINGS 15' QUADRANGLE



SITE MAP OF WHITEWATER CANYON LEVELING ARRAY



Δ BM HEIGHT - WHITEWATER - AUG 1986/JUN 1987



******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
P410	TP01	90.462
TP01	N410	157.746
N410	TP02	109.738
TP02	TP03	124.918
TP03	L410	137.874
L410	K410	176.362
K410	TP04	183.198
TP04	H410	164.136
H410	G410	202.588
G410	F410	226.625
F410	E410	254.532
E410	TP05	232.155
TP05	K450	235.101
K450	WC20	121.622
WC20	WC19	127.007
WC19	WC18	46.881
WC18	WC17	43.287
WC17	A410	124.112
A410	WC16	-28.031
WC16	Z409	253.813
Z409	WC15	-3.433
WC15	Y409	112.473
Y409	WC14	-9.425
WC14	X409	66.884
X409	WC13	-4.144
WC13	WC12	7.630
WC12	WC11	66.466
WC11	V409	122.924
V409	WC10	4.104
WC10	WC09	40.980
WC09	WC08	-22.255
WC08	T409	159.714
T409	WC07	-5.963
WC07	S409	37.740
S409	WC06	-98.908
WC06	R409	196.279
R409	WC05	112.626
WC05	Q409	32.271
Q409	WC04	-134.407
WC04	P409	111.210
P409	TP06	-162.658
TP06	WC03	177.069
WC03	N409	-1.015
N409	WC02	9.486
WC02	M409	39.451
M409	WC01	108.800
WC01	L409	-57.913
L409	K409	104.753
K409	TP07	-52.535
TP07	J409	222.967
J409	H409	-71.835
H409	TP08	-125.410
TP08	TP09	51.890
TP09	E409	62.477
E409	D409	192.140

******* Adjusted Height Differences ********

Backsight	Foresight	Height Diff(cm)
P410	TP01	95.957
TP01	N410	152.229
N410	TP02	109.914
TP02	TP03	124.237
TP03	L410	138.348
L410	K410	176.364
K410	TP04	183.393
TP04	H410	163.884
H410	G410	202.593
G410	F410	226.588
F410	E410	254.468
E410	TP05	221.668
TP05	K450	245.584
K450	WC20	121.598
WC20	WC19	127.006
WC19	WC18	46.851
WC18	WC17	43.262
WC17	A410	124.102
A410	WC16	-28.046
WC16	Z409	253.764
Z409	WC15	-3.444
WC15	Y409	112.421
Y409	WC14	-9.422
WC14	X409	66.831
X409	WC13	-4.154
WC13	TP05A	9.073
TP05A	WC11	65.017
WC11	TP05B	90.509
TP05B	WC10	36.508
WC10	TP05C	37.879
TP05C	WC08	-19.149
WC08	T409	159.694
T409	WC07	-5.987
WC07	S409	37.733
S409	WC06	-98.926
WC06	R409	196.275
R409	WC05	112.636
WC05	Q409	32.261
Q409	WC04	-134.432
WC04	P409	111.203
P409	TP06	-162.527
TP06	WC03	176.919
WC03	N409	-0.986
N409	WC02	9.468
WC02	M409	39.448
M409	WC01	108.808
WC01	L409	-57.896
L409	K409	104.744
K409	TP07	-56.974
TP07	J409	227.378
J409	H409	-71.841
H409	TP08	-136.972
TP08	TP09	64.516
TP09	E409	61.391
E409	D409	192.172

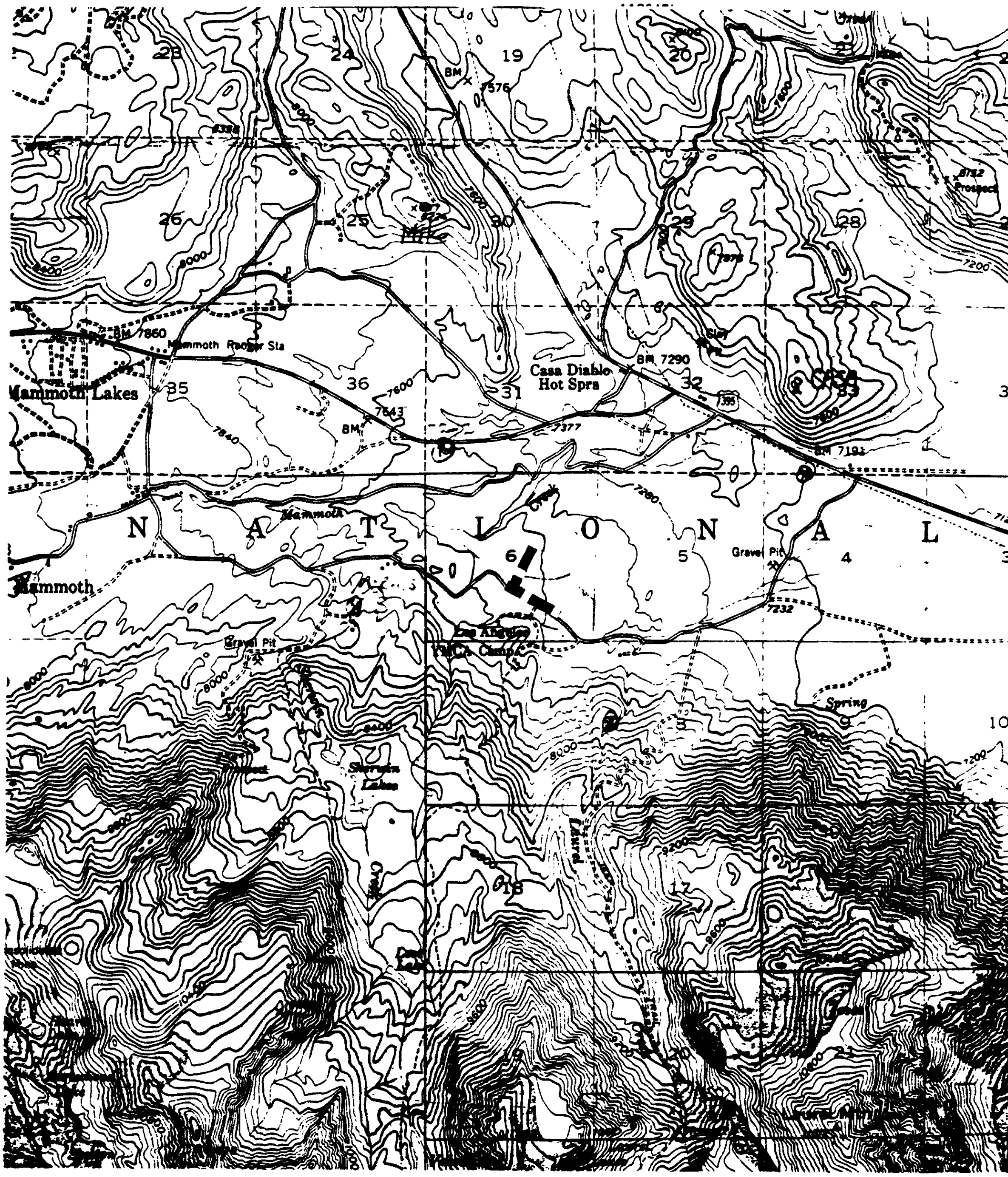
YMCA Leveling Array

Latitude:	37°37'34"	**Length:**	~1019m
Longitude:	118°55'37"	**Number of Bench marks:**	10
Date of Initial Survey:	11 July 1984	**Number of Surveys to 1988:**	1
Trespass Permission:	None needed.		

Comments:

This L-shaped tilt-array was established by John Estrem of the U.S. Geological Survey along Sherwin Road 3 miles southeast of Mammoth Lakes to monitor tilt in Long Valley caldera.

MT. MORRISON QUADRANGLE
CALIFORNIA
15 MINUTE SERIES (TOPOGRAPHIC)

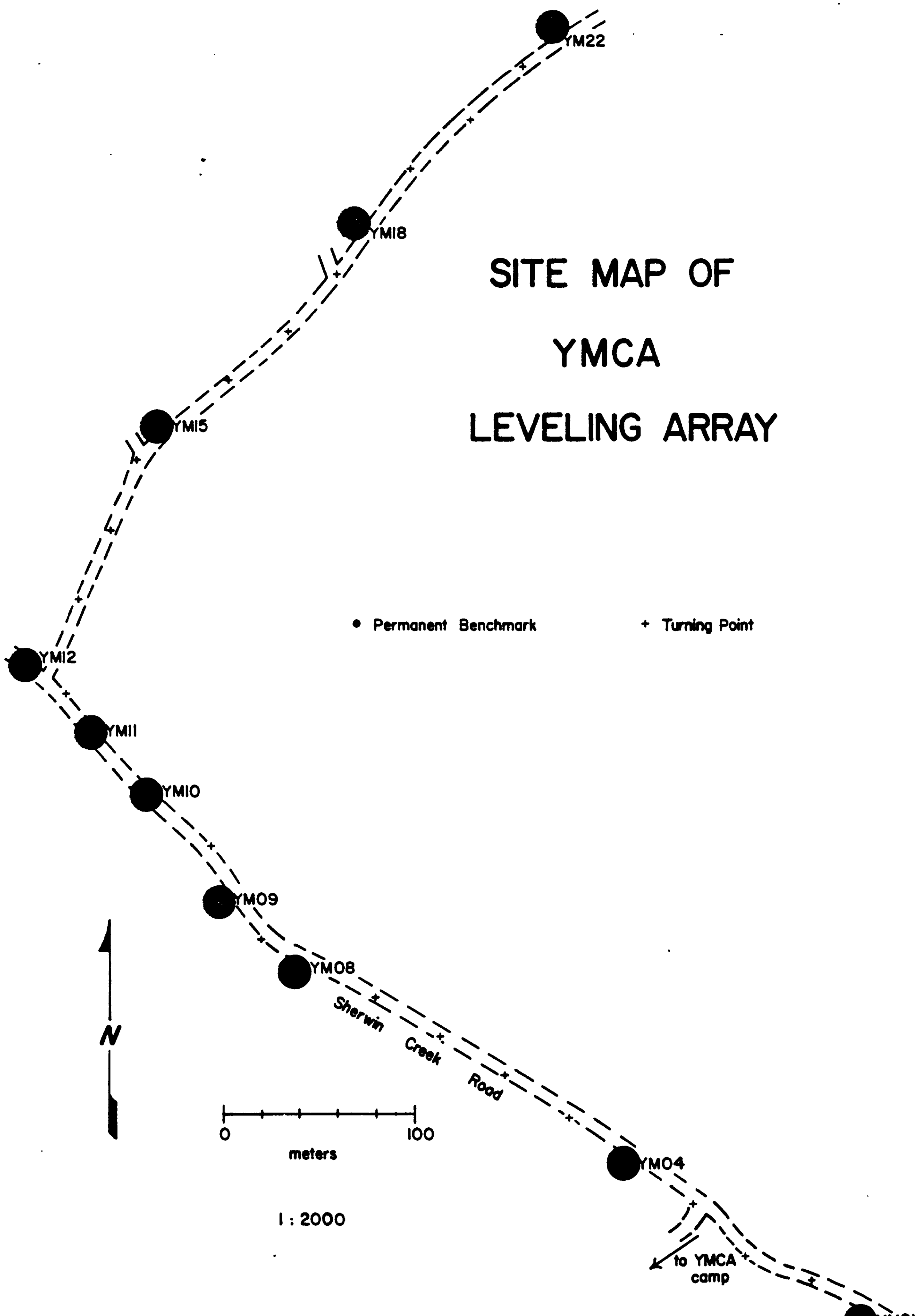


SCALE 1:62500

1 ½ 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS


SITE MAP OF
YMCA
LEVELING ARRAY
• Permanent Benchmark
+ Turning Point
YM22
YM18
YM15
YM12
YM11
YM10
YM09
YM08
YM04
YM01
Sherwin Creek Road
to YMCA camp
N
0
100
meters
1 : 2000

******* Adjusted Height Differences ********

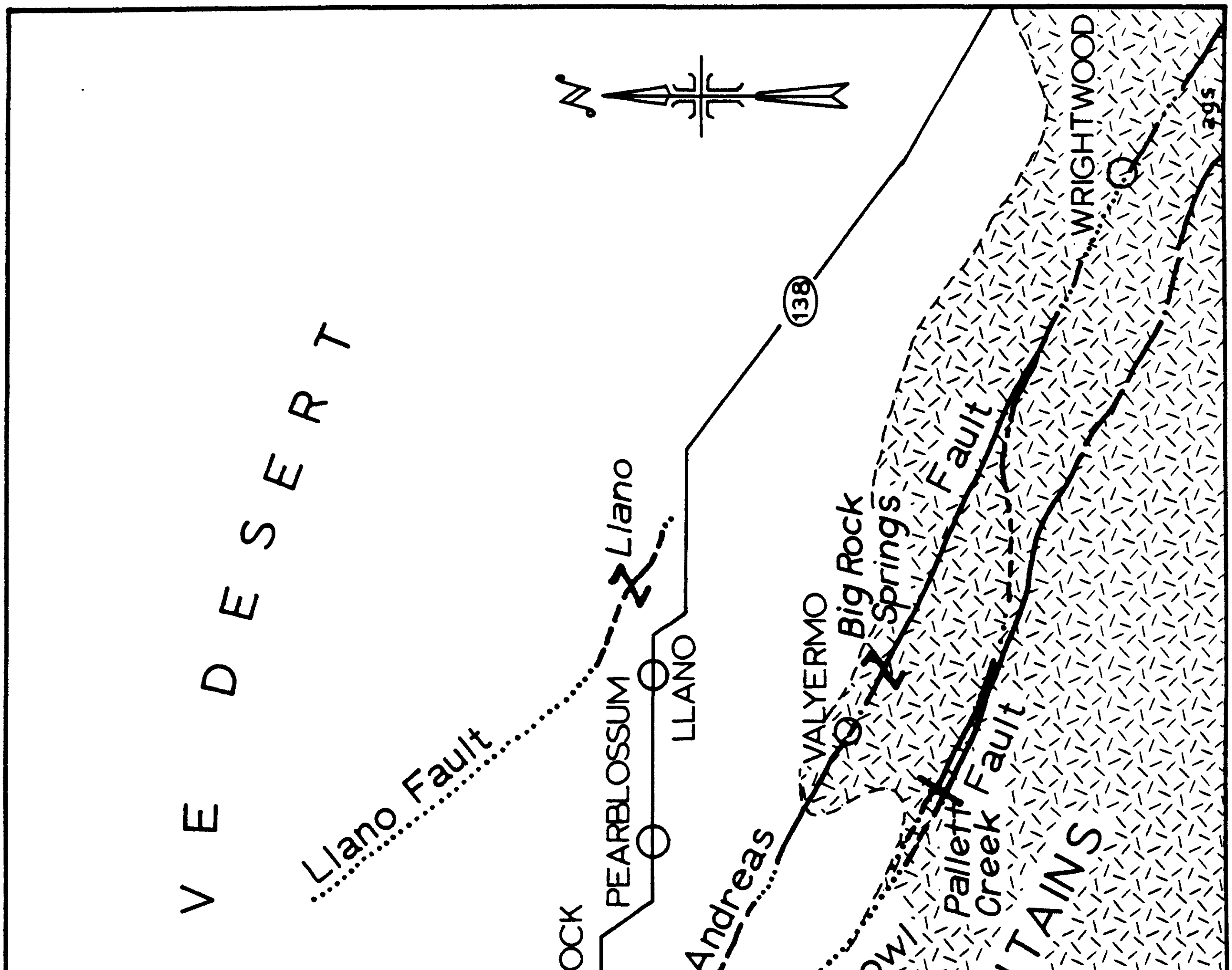
Backsight	Foresight	Height Diff(cm)
YM01	TP01	96.579
TP01	TP02	133.396
TP02	TP03	9.957
TP03	YM04	-3.298
YM04	TP04	54.890
TP04	TP05	83.795
TP05	TP06	108.153
TP06	TP07	80.339
TP07	YM08	62.512
YM08	TP08	-4.694
TP08	YM09	104.369
YM09	TP09	-38.405
TP09	YM10	-10.153
YM10	YM11	46.061
YM11	TP10	-19.707
TP10	YM12	19.731
YM12	TP11	-41.286
TP11	TP12	-18.324
TP12	TP13	-47.883
TP13	YM15	-9.549
YM15	TP14	-110.393
TP14	TP15	-47.977
TP15	TP16	-55.447
TP16	YM18	-13.302
YM18	TP17	-5.746
TP17	TP18	-183.181
TP18	TP19	-0.368
TP19	YM22	-19.040

47TH STREET EAST Leveling Array

Latitude:	34°31'03"	**Length:**	192.0m
Longitude:	118°02'47"	**Number of Bench marks:**	11
Date of Initial Survey:	22 December 1976	**Number of Surveys to 1988:**	13
Trespass Permission:	None needed.		

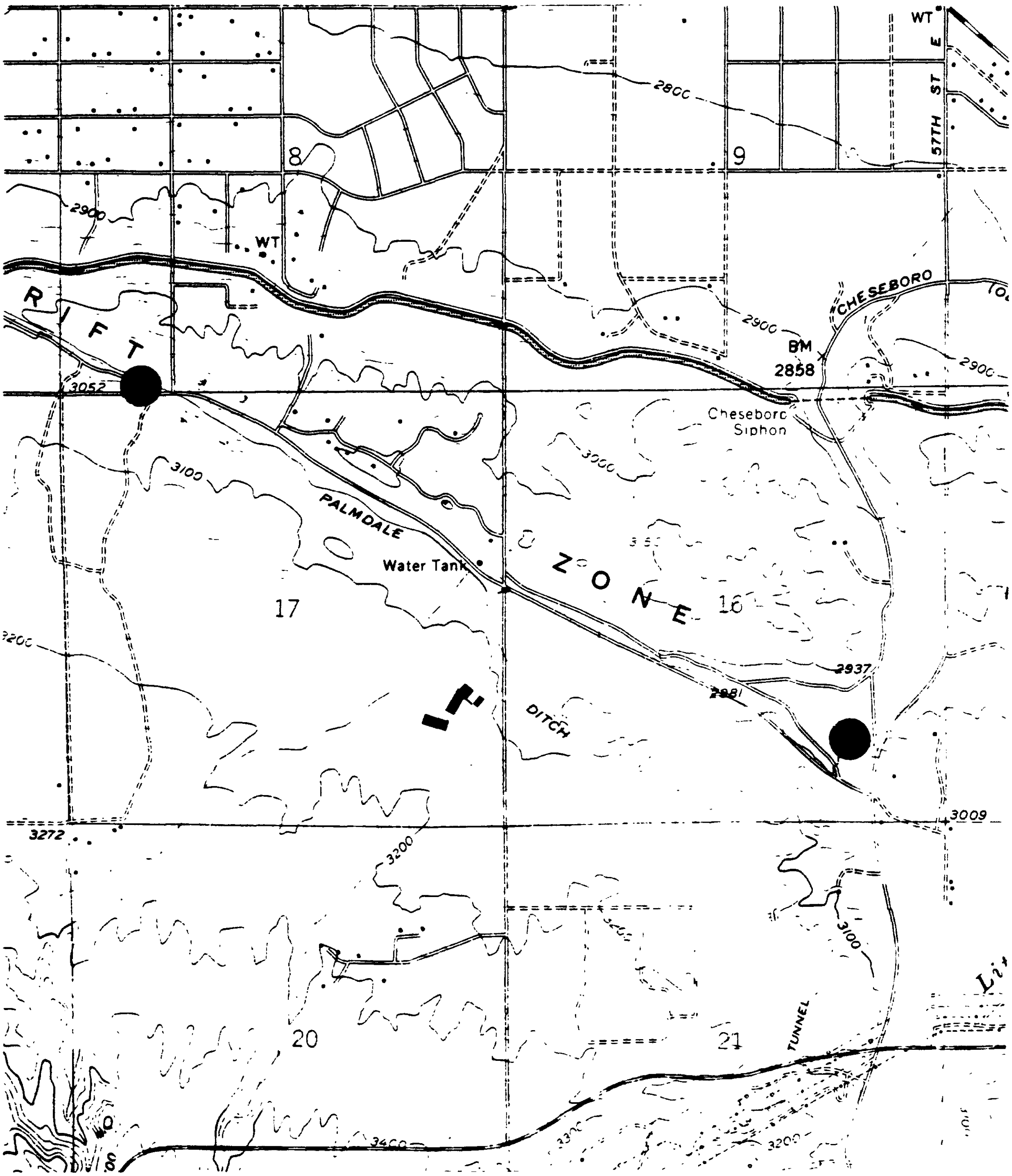
Comments:

Located six miles southeast of Palmdale, this S-shaped line was established across the Nadeau fault in the San Andreas fault zone in response to California Division of Mines and Geology reports of fresh cracks in the pavement of 47th Street East, 50m southeast of the array. Bench marks LR21 through LR28 constitute an alignment array.



MOJAVE DESERT
LANCASTER
PALMDALE
LITTLEROCK
PEARBLOSSUM
LLANO
VALYERMO
WRIGHTWOOD
Llano Fault
Llano
Una Lake
47th Street East
San Andreas
Punchbowl
Pallett Creek
Fault
Big Rock Springs
Fault
SAN GABRIEL MOUNTAINS
138
6
6
395
N
0
5
10 miles
0
5
10 kilometers

PALMDALE QUADRANGLE
CALIFORNIA—LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 LANCASTER 15' QUADRANGLE



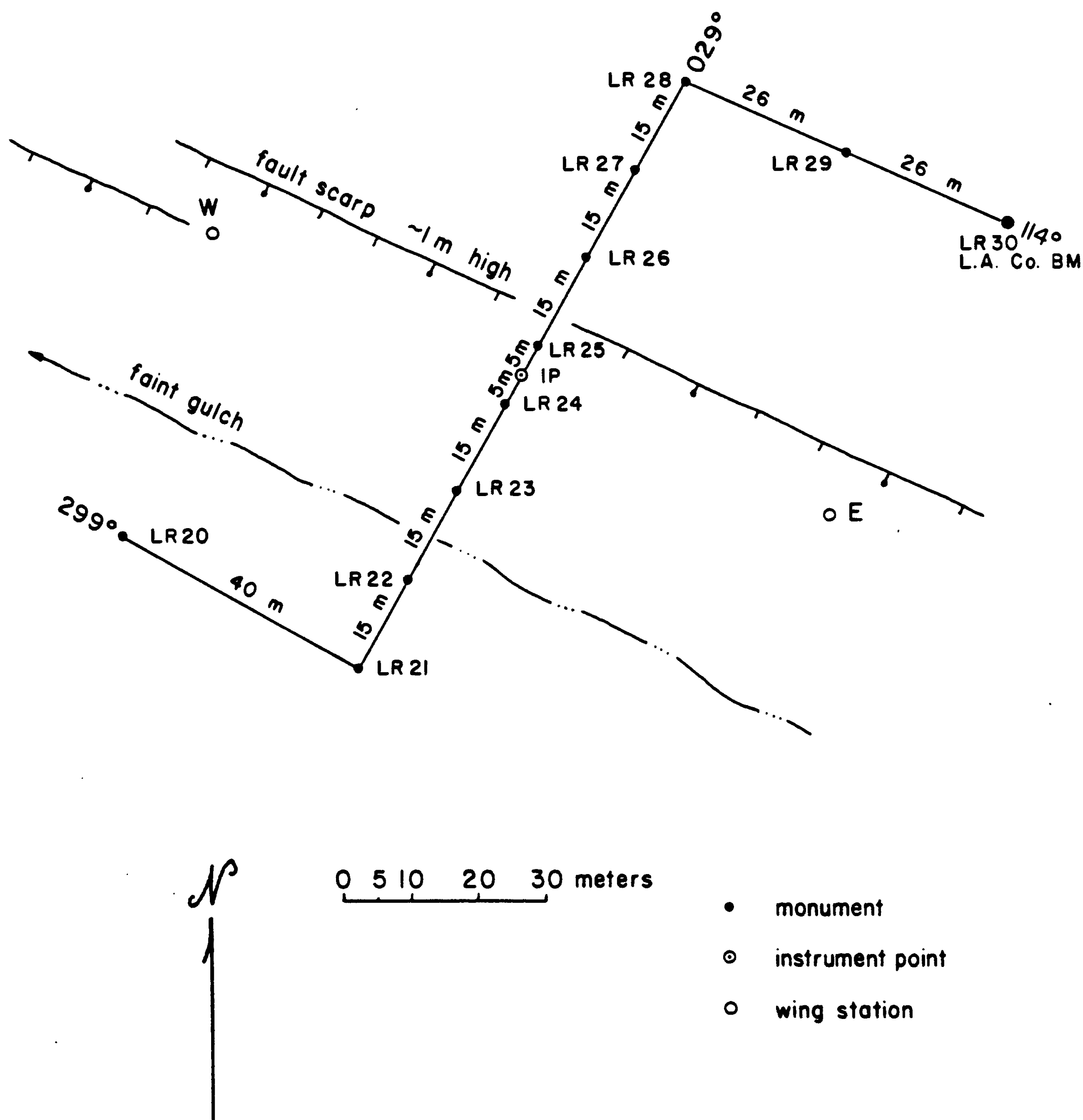
SCALE 1:24 000

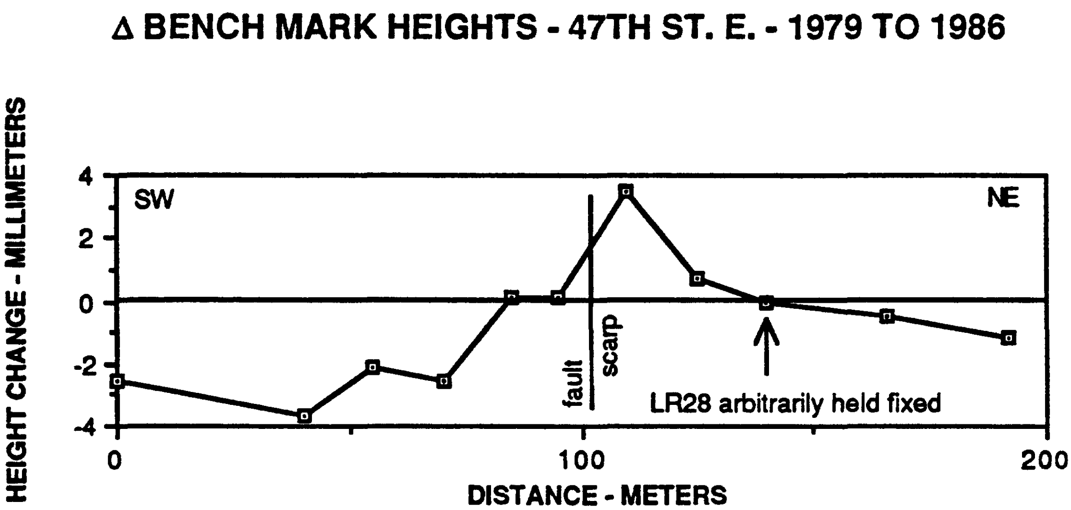
1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

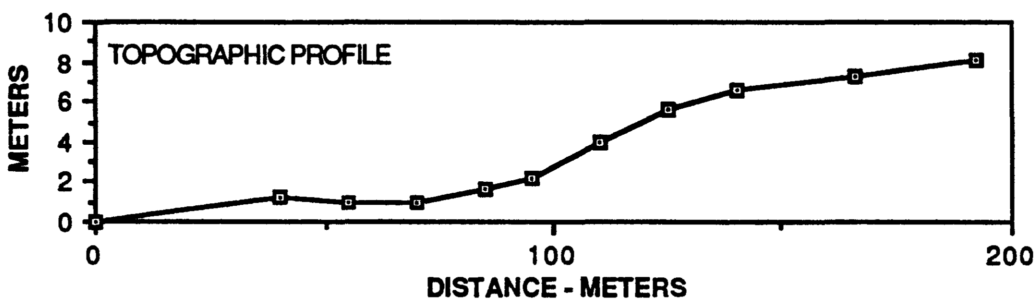
1 .5 0 1 KILOMETER

47TH ST. EAST ALIGNMENT ARRAY





Δ BENCH MARK HEIGHTS - 47TH ST. E. - 1979 TO 1986
HEIGHT CHANGE - MILLIMETERS
SW
NE
fault
scarp
LR28 arbitrarily held fixed
4
2
0
-2
-4
0
100
200
DISTANCE - METERS



TOPOGRAPHIC PROFILE
METERS
10
8
6
4
2
0
0
100
200
DISTANCE - METERS

BARREL SPRINGS, CALIFORNIA 47TH STREET EAST AUGUST 8, 1979

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
LR20	LR21	128.589
LR21	LR22	-34.325
LR22	LR23	4.359
LR23	LR24	64.768
LR24	LR25	61.437
LR25	LR26	178.331
LR26	LR27	151.897
LR27	LR28	103.061
LR28	LR29	64.334
LR29	LR30	82.328

BARREL SPRINGS, CALIFORNIA 47TH STREET EAST SEPTEMBER 12, 1986

*******Adjusted Height Differences*******

Backsight	Foresight	Height Diff (cm)
LR20	LR21	128.475
LR21	LR22	-34.172
LR22	LR23	4.317
LR23	LR24	65.032
LR24	LR25	61.438
LR25	LR26	178.671
LR26	LR27	151.617
LR27	LR28	102.991
LR28	LR29	64.279
LR29	LR30	82.263