LAND-SURFACE DEFORMATION AND WATER-LEVEL FLUCTUATIONS NEAR THE PICACHO EARTH FISSURE, SOUTH-CENTRAL ARIZONA, 1980-84

By M.C. Carpenter

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CONVERSION FACTORS

For readers who prefer to use inch-pound units, the following conversion factors may be used:

Multiply SI unit	By	To obtain inch-pound unit
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilogram (kg)	2.205	pound mass (lbm)
newton (N)	0.2248	pound force (lbf)
degree Celsius (°C)	°F=9/5 (°C+32)	degree Fahrenheit (°F)
kilopascal (kPa)	0.1450	pound per square inch (lb/in^2)

Sea level: In this report, altitude refers to sea level, which refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

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ABSTRACT

The Picacho earth fissure trends north and south in alluvial sediments west of the Picacho Mountains in south-central Arizona. In 1980, the U.S. Geological Survey installed a buried invar-wire horizontal extensometer and established a survey line across the Picacho earth fissure to monitor land-surface deformation near the fissure. An additional survey line was established across a nearby set of earth fissures to monitor land-surface deformation in an area expected to be crossed by the Central Arizona Project aqueduct. This report documents, in tables and graphs, the deformation and water-level fluctuations that occurred during 1980-84. Deformation data include continuously recorded horizontal strain across the fissure and horizontal-distance and leveling surveys at a network of 30 bench marks. The surveys were repeated seven times in the 4-year period. Water-level fluctuations were monitored continuously in a piezometer in a nearby test hole. From May 1980 to May 1984, the downthrown west side of the fissure subsided 167 millimeters and moved 18 millimeters to the west. During the same time, the relatively upthrown east side subsided 147 millimeters and moved 14 millimeters westward. The difference between the maximum opening and the maximum closing measured by the horizontal extensometer from November 1980 to December 1984 was 4.620 millimeters, and water level fluctuated 9.05 meters. Maximum opening of the fissure of 3.740 millimeters occurred during March to October 1981; water-level decline during that period was 7.59 meters.

INTRODUCTION

The Picacho earth fissure trends north and south and transects alluvial sediments west of the Picacho Mountains in south-central Arizona (fig. 1). The fissure is 15 km long and exhibits as much as 0.6 m of normal dip-slip movement at the land surface with the west side of the fissure downthrown. Parts of the fissure were known to exist as early as 1927 (J.R. Marie, hydrologist, U.S. Geological Survey, oral commun., 1986; A.E. Douglas, professor, University of Arizona, written commun., 1927). Other sections are identifiable on aerial photographs taken during flights in 1936 (U.S. Soil Conservation Service, unpublished data, 1936). The history of subsidence and fissuring in the basin has been documented by several studies including those by Schumann and Poland (1969), Robinson

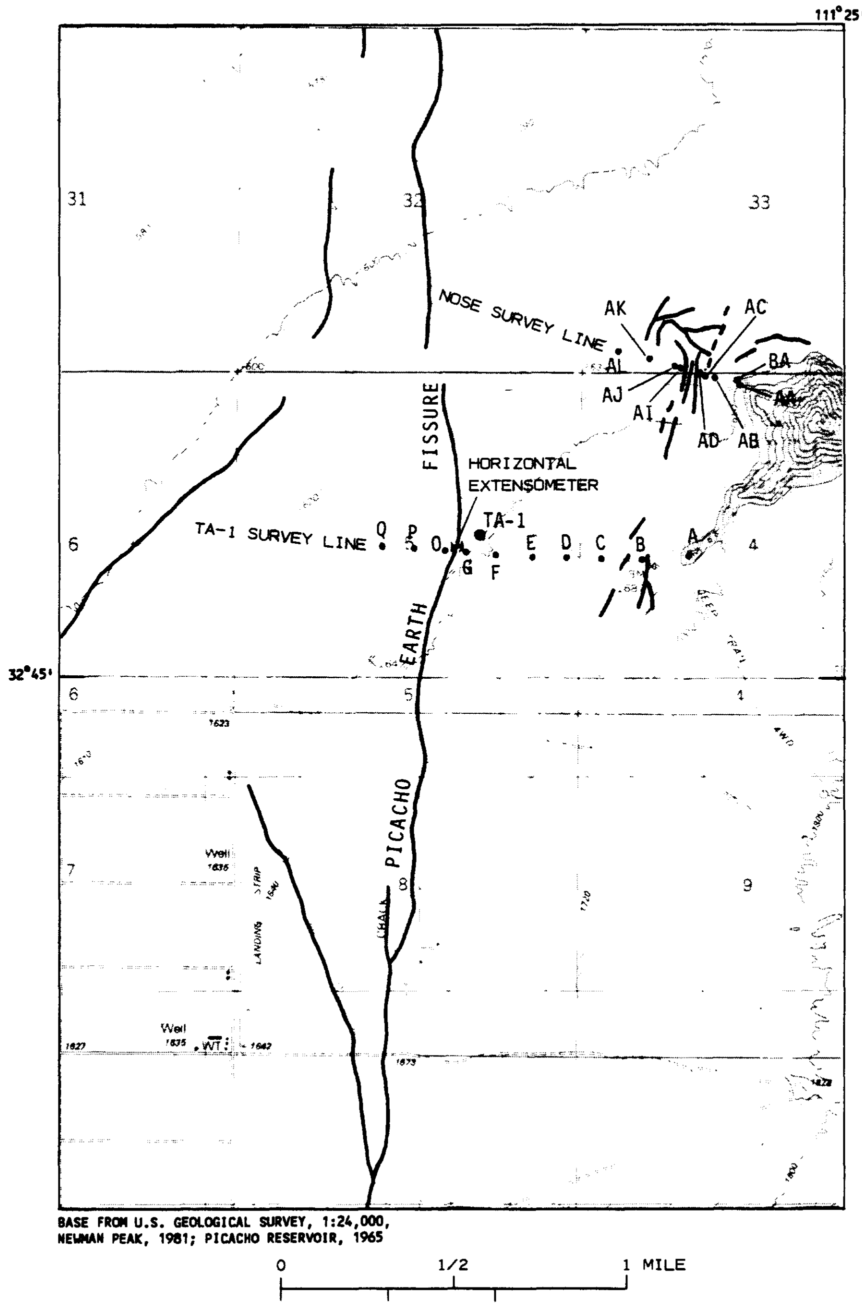
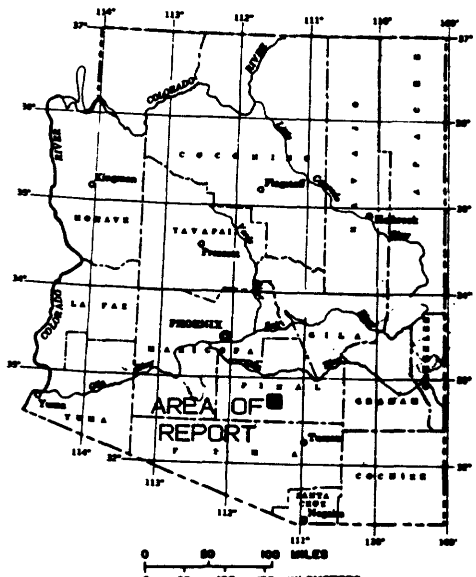


Figure 1.--Study area and locations of selected survey stations and test hole TA-1.



INDEX MAP SHOWING AREA
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EXPLANATION

F — SELECTED SURVEY STATIONS

TA-1 — TEST HOLE

HORIZONTAL EXTENSOMETER

EARTH FISSURE—Mapped by M.C. Carpenter and J.K. Boling, July 1979

Figure 1.

and Peterson (1962), Winikka (1964), Schumann (1974), and Laney and others (1978). Movement across the fissure between 1964 and 1977 was documented by Holzer and others (1979).

In the summer and fall of 1980, the U.S. Geological Survey installed a buried horizontal extensometer across the fissure near test hole TA-1 and set two lines of surveying stations (fig. 1) to investigate movement near the fissure and to test the correlation of fissure movement with water-level fluctuations in piezometer 1 at test hole TA-1. The purposes of this report are to present the data from repeated surveys and continuously recorded horizontal-strain and water-level measurements and to briefly document the methods of data collection and processing. Other water-level data from test hole TA-1 were presented by Wrege and others (1985).

Acknowledgments

J.K. Boling provided extensive field assistance, and B.L. Massey provided rigorous instruction in techniques of precise surveying. F.S. Riley gave valuable comments and criticisms. C.A. Carpenter and E.R. Carpenter provided additional field assistance. Test hole TA-1 was drilled in 1979 by the U.S. Bureau of Reclamation.

METHODS OF DATA COLLECTION

Surveying

Two survey lines, designated TA-1 and Nose (fig. 1), were established in spring 1980 for measurement of horizontal and vertical deformation in subsiding alluvial sediments near the Picacho Mountains (tables 1 and 2). TA-1 survey line consists of 17 stations and extends from station A, north 88° west, normal to and beyond the Picacho earth fissure, to station Q. Fissures cross the TA-1 survey line east of station B, between stations B and C, between stations J and K, and between stations K and L. Nose survey line consists of 13 stations and extends from station AA, north 74° west, approximately normal to and beyond three earth fissures, to station AL. Stations A and AA are on outcrops of granite gneiss and are assumed to be stable. Nose survey line does not cross the Picacho earth fissure. Fissures cross the Nose survey line between stations AD and AE, AF and AG, and AH and AI.

Station A is a 50-millimeter-diameter brass cap labeled "USGS A," which was center punched and cemented into a hole drilled into bedrock outcrop. The station is in a small saddle near the west slope on the end of the southwest-trending protrusion of bedrock in the NW¼, NE¼, SW¼, sec. 4, T. 8 S., R. 9 E., Newman Peak quadrangle (fig. 1). The west, south, and southeast slopes of the outcrop are covered with petroglyphs. The station is about 14.6 m higher than the alluvial surface.

Table 1.--Horizontal distances from station A and altitudes of stations along TA-1 survey line

[Values, in meters. Values with underlined digits are interpolated. Underlined digits are not significant]

Station	1980 May 31	1980 December 16	1981 March 15	1981 November 17	1982 March 17	1983 June 6	1984 May 15
				Horizontal Distances			
A	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B	216.178	216.173	216.176	216.173	216.173	216.177	216.179
C	412.554	412.555	412.562	412.567	412.570	412.584	412.583
D	569.514	569.516	569.521	569.525	569.529	569.539	569.539
E	729.325	729.329	729.329	729.335	729.341	729.344	729.349
F	909.038	909.036	909.039	909.038	909.042	909.051	909.049
G	1 008.273	1 008.269	1 008.275	1 008.277	1 008.276	1 008.284	1 008.284
H	1 027.015	1 027.012	1 027.017	1 027.020	1 027.019	1 027.028	1 027.028
I	1 045.769	1 045.765	1 045.772	1 045.774	1 045.774	1 045.783	1 045.783
J	1 054.156	1 054.149	1 054.155	1 054.158	1 054.157	1 054.165	1 054.167
K	1 060.059	1 060.054	1 060.061	1 060.067	1 060.066	1 060.075	1 060.077
L	1 065.770	1 065.765	1 065.771	1 065.775	1 065.774	1 065.780	1 065.780
M	1 075.059	1 075.053	1 075.060	1 075.065	1 075.065	1 075.075	1 075.077
N	1 096.566	1 096.559	1 096.568	1 096.572	1 096.571	1 096.582	1 096.587
O	1 111.922	1 111.916	1 111.922	1 111.923	1 111.925	1 111.934	1 111.935
P	1 272.271	1 272.272	1 272.275	1 272.284	1 272.283	1 272.292	1 272.295
Q	1 422.361	1 422.357	1 422.365	1 422.374	1 422.368	1 422.379	1 422.376
				Altitude of Stations			
A	527.4176	527.4176	527.4176	527.4176	527.4176	527.4176	527.4176
B	512.7901	512.7897	512.7896	512.7891	512.7889	512.7881	512.7875
C	509.8407	509.8304	509.8257	509.8129	509.8067	509.7835	509.7656
D	507.1149	507.0992	507.0922	507.0727	507.0632	507.0280	507.0009
E	504.8230	504.8036	504.7950	504.7709	504.7593	504.7159	504.6824
F	502.3826	502.3622	502.3531	502.3278	502.3155	502.2698	502.2346
G	501.9720	501.9517	501.9426	501.9179	501.9059	501.8597	501.8244
H	501.9312	501.9110	501.9018	501.8766	501.8649	501.8185	501.7834
I	501.8046	501.7849	501.7759	501.7506	501.7391	501.6927	501.6576
J	501.6292	501.6086	501.5997	501.5749	501.5635	501.5172	501.4821
K	501.6081	501.5866	501.5779	501.5522	501.5411	501.4950	501.4600
L	501.1246	501.0942	501.0838	501.0506	501.0386	500.9889	500.9536
M	501.0396	501.0105	501.0011	500.9680	500.9564	500.9075	500.8722
N	500.5917	500.5630	500.5559	500.5215	500.5110	500.4641	500.4294
O	500.7641	500.7346	500.7252	500.6923	500.6810	500.6319	500.5966
P	498.1885	498.1576	498.1486	498.1138	498.1037	498.0538	498.0186
Q	496.9990	496.9595	496.9508	496.9112	496.9025	496.8508	496.8157

Table 2.--Horizontal distances from station AA and altitudes of stations along Nose survey line

[Values, in meters]

Station	1980 May 31	1980 December 16	1981 March 15	1981 November 17	1982 March 17	1983 June 6	1984 May 15
				Horizontal Distances			
AA	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BA	10.	10.	10.	10.	10.	10.	10.
AB	110.530	110.531	110.531	110.530	110.530	110.536	110.528
AC	157.722	157.700	157.699	157.699	157.698	157.704	157.696
AD	176.649	176.627	176.627	176.626	176.625	176.633	176.626
AE	194.967	194.946	194.945	194.945	194.944	194.952	194.945
AF	211.584	211.563	211.562	211.562	211.561	211.570	211.564
AG	231.123	231.102	231.101	231.100	231.099	231.111	231.106
AH	245.076	245.055	245.054	245.054	245.053	245.064	245.060
AI	263.368	263.352	263.350	263.353	263.352	263.372	263.372
AJ	282.124	282.108	282.107	282.110	282.109	282.127	282.141
AK	431.058	431.064	431.065	431.067	431.069	431.089	431.084
AL	582.294	582.300	582.303	582.303	582.305	582.320	582.316
				Altitudes of Stations			
AA	505.9680	505.9680	505.9680	505.9680	505.9680	505.9680	505.9680
BA	--------	--------	--------	499.1516	499.1517	499.1519	499.1519
AB	498.6557	498.6568	498.6576	498.6556	498.6561	498.6574	498.6579
AC	499.1842	499.1854	499.1851	499.1842	499.1841	499.1846	499.1849
AD	499.1481	499.1483	499.1492	499.1467	499.1472	499.1482	499.1481
AE	498.9245	498.9251	498.9249	498.9232	498.9231	498.9237	498.9233
AF	498.8333	498.8332	498.8330	498.8306	498.8317	498.8316	498.8318
AG	498.7895	498.7884	498.7881	498.7846	498.7849	498.7835	498.7815
AH	498.6457	498.6440	498.6442	498.6406	498.6405	498.6390	498.6368
AI	498.3211	498.3142	498.3111	498.3020	498.3000	498.2873	498.2789
AJ	498.2553	498.2488	498.2462	498.2364	498.2344	498.2212	498.2129
AK	496.9218	496.9080	496.9053	496.8882	496.8845	496.8642	496.8491
AL	496.0811	496.0608	496.0550	496.0317	496.0246	495.9951	495.9735

Stations B through F and P and Q are iron rods, each of which is 1.5 m long and 20 mm in diameter. The rods were driven vertically into the ground through the bottoms of holes 400 mm deep and 200 mm in diameter. The rods were greased where exposed in the holes, and the holes were filled with concrete to the land surface. The rods were greased to allow vertical decoupling between the concrete and the rods to prevent the stations from jacking as a result of expansion and contraction caused by changes in moisture content of the soil surrounding the concrete. The ends of the rods, which were exposed 5 mm or less above land surface, were center punched and punched with letters to designate the stations.

Stations G through O are 3-meter by 20-millimeter iron rods driven 1.05 m into the bottoms of 1.5-meter by 300-millimeter holes, allowing the rods to protrude 450 mm above the land surface. Iron pipes 1.5 m in length by 100 mm in diameter were concreted in the holes around the rods. The pipes projected 410 mm above the land surface, and the rods projected an additional 40 mm above the pipes. The insides of the pipes were filled with concrete so that the rods were centered in the pipes. The rods were greased where they contacted concrete. Ball bearings 25.38 mm in diameter were welded to 9.5-millimeter-diameter threaded rods, which were screwed into threads previously drilled and tapped into the ends of the iron rods. The threaded rods were secured with lock nuts and thread-locking compound.

Station AA of the Nose survey line was a 50-millimeter-diameter brass cap labeled "USGS AA" set on a bedrock bench on a northwest-trending promontory in the NE¼, NE¼, NW¼, sec. 4, T. 8 S., R. 9 E, Newman Peak quadrangle (fig. 1). The station was 6.8 m higher than the alluvial surface. Stations AB, AK, and AL were set like stations B through F of the TA-1 survey line, and stations AC through AJ were set like stations G through O. Station BA was a 25-millimeter-long steel carriage bolt with 8-millimeter threads driven into a 7-millimeter-diameter hole drilled into bedrock at the contact between bedrock and the alluvial surface. Station BA was set in November 1981. Stations AA through AJ were destroyed by construction of the Central Arizona Project aqueduct in the summer of 1986.

Slope distances from station A to each of stations B, C, D, E, F, G, O, P, and Q and from station AA to each of stations AB, AC, AJ, AK, and AL were measured using a Hewlett-Packard HP3808A Electronic Distance Meter (EDM)[1], Hewlett-Packard retroprisms, and tripods with plumb rods that display instrument or target height. The EDM was calibrated in October 1980 and July 1984, and deviation from calibration over that period was less than 5×10^{-5} percent. The EDM is specified for an accuracy of 2×10^{-4} percent and is capable of an accuracy of 1×10^{-4} percent if temperature and pressure corrections are made for differences between the refractive index of air along the line of sight at the time of measurement and the index for which it is set. For short measurements of as little as 1.5 km along the two survey lines, end-point temperature and pressure measurements were made at the heights of the instrument and the retroprism. Temperature measurements were made using shaded, calibrated

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[1]Use of trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

thermometers or thermistors. Pressure measurements were made using Wallace and Tiernan aneroid barometers that were calibrated against a U.S. Weather Service mercury barometer. The mean and the standard deviations were determined from ten replications of each distance measurement. Temperature and pressure corrections were applied to the mean value of the replications to give a measured slope distance. The measured slope distance was then trigonometrically reduced to horizontal distance using the target height, instrument height, and the altitudes of the stations as determined from leveling surveys.

Slope distances between nearest pairs of stations from G through O and AC through AJ were periodically measured using a tape extensometer. This instrument incorporates two built-in dial gages and a surveying tape, which has registration-pin holes punched at 50.8-millimeter intervals. One dial gage measures tape tension by the deflection of a proving ring. The second dial gage measures the distance from the punched hole in which the registration pin was locked. The instrument is mounted on a ball-bearing station with the surveying tape stretched to and mounted on another ball-bearing station. Because of random errors of ±0.07 mm in the locations of the registration-pin holes and nonstandard conditions of tape stretch and sag, the absolute accuracy of these distance measurements may be as much as ±1.0 mm for some measurements. Because tape tension is constant at 146 newtons (N) for all measurements, tape sag, as a function of length and tape tension, is constant for repeated measurements between pairs of stations. Thus, a constant error in the absolute distance between a pair of stations is eliminated as an error in the difference of distances between the pair for periodic measurements. The tape extensometer measures changes in distance over intervals of as much as 30 m with a repeatability of ±0.13 mm or $\pm 4\times10^{-4}$ percent. The temperature of the tape during a measurement was monitored at a point near the center of the tape using a calibrated surface-measuring thermistor. Five replications, each with its own temperature correction, were made for each pair of stations. Data were keyed into a hand-held data logger that stored the data for transfer to a computer. The data logger also used the previous distance and the current distance between stations to calculate and display in the field the displacement and strain since the last set of measurements. The tape extensometer was calibrated before and after each set of field measurements on a frame that had been measured with a caliper with an accuracy of 0.03 mm. Calibration of the caliper was traceable to the U.S. Bureau of Standards. Slope distances between tape-extensometer station pairs were trigonometrically reduced to horizontal distances using leveling data.

The tape-extensometer data were proportionally adjusted to agree with the EDM data. EDM measurements are more accurate over long distances; tape extensometer measurements are more accurate over short distances. The only tape extensometer stations measured by the EDM were the end points of the tape-extensometer lines (points G and O and points AC and AJ) (tables 1-2). Before adjustment, discrepancies between horizontal components of EDM distances from G to O and from AC to AJ and concatenated absolute tape extensometer distances from G to O and from AC to AJ were no more than 1.5×10^{-3} percent.

The two survey lines were leveled using a Zeiss Ni-1 level. Some Ni-1 levels have shown errors caused by magnetic effects (Holdahl and others, 1986). These errors are considered to be insignificant for TA-1 and Nose survey lines because the lines are approximately east-west, or orthogonal to the Earth's magnetic field, and there were no nearby power lines at the times of the surveys. In addition, the same level was used for all surveys, and the changes in altitude of a station are of interest in this study not the absolute altitude. The datum for establishing stations A and AA is the bench mark near station B at an altitude of 514.19 m. The leveling was double run and adhered to 1st Order, Class 1 standards (Federal Geodetic Control Committee, 1974) with the exception that only one rod was used. Maximum sight length was 30 m, so refraction errors were considered to be insignificant (Holdahl, 1981). Balance of sightings was assured by chaining and staking instrument locations for subsequent runs. The allowable closures for 1st Order, Class 1 standards are 3.6 mm for TA-1 survey line and 2.1 mm for Nose survey line. Corresponding nominal accuracies are 1.8 mm and 1.1 mm and apply to each line as a whole. Relative altitudes among closely spaced points should be more accurate than the nominal accuracy. For this reason, values of altitudes of stations in tables 1 and 2 are given to 0.1 mm.

All horizontal distances by EDM and tape extensometer were measured for both Nose and TA-1 survey lines for all seven observation times. All stations on Nose survey line and stations F through Q on TA-1 survey line were leveled for all observation times. Stations A through E were leveled as of May 31, 1980, and May 15, 1984, only. Absolute altitudes of stations B through Q (table 1) for periods between December 16, 1980, to June 6, 1983, were interpolated on the basis of proportional elapsed time between May 31, 1980, and May 15, 1984. Agreement between rates of subsidence for stations AK and C, which are about the same distance from the mountain front, is 3.2 percent and for stations AL and D, also about the same distance from the mountain front, is 5.7 percent (figs. 2-4), so the interpolation scheme seems reasonable. Altitudes of stations B through F for intermediate time periods, however, are not significant beyond 0.01 m. Relative altitudes from F to Q are consistent on the basis of the leveling done from F to Q for all observation times.

Horizontal Extensometer

In the fall of 1980, a buried horizontal invar-wire extensometer (Schulz and Burford, 1977; Duffield and Burford, 1973) was installed spanning a 30-meter interval across the Picacho earth fissure along a line parallel to and 3 m north of the TA-1 survey line (fig. 1). The invar wire was strung through a 200-millimeter-diameter horizontal polyvinyl chloride pipe and buried at an average depth of 2 m. The extensometer piers and recording instrumentation were housed in two 1.2-meter-diameter Fiberglas vaults that extend from 0.2 m to 2.4 m below the land surface. The vaults, which consist of upper and lower sections, were sealed against moisture and air leakage around the piers, pipe, and covers. The upper section of each vault was filled with polystyrene peanuts in plastic bags for thermal insulation. Piers of 2-meter-long by 100-millimeter-diameter iron pipe were set in concrete below the bottoms

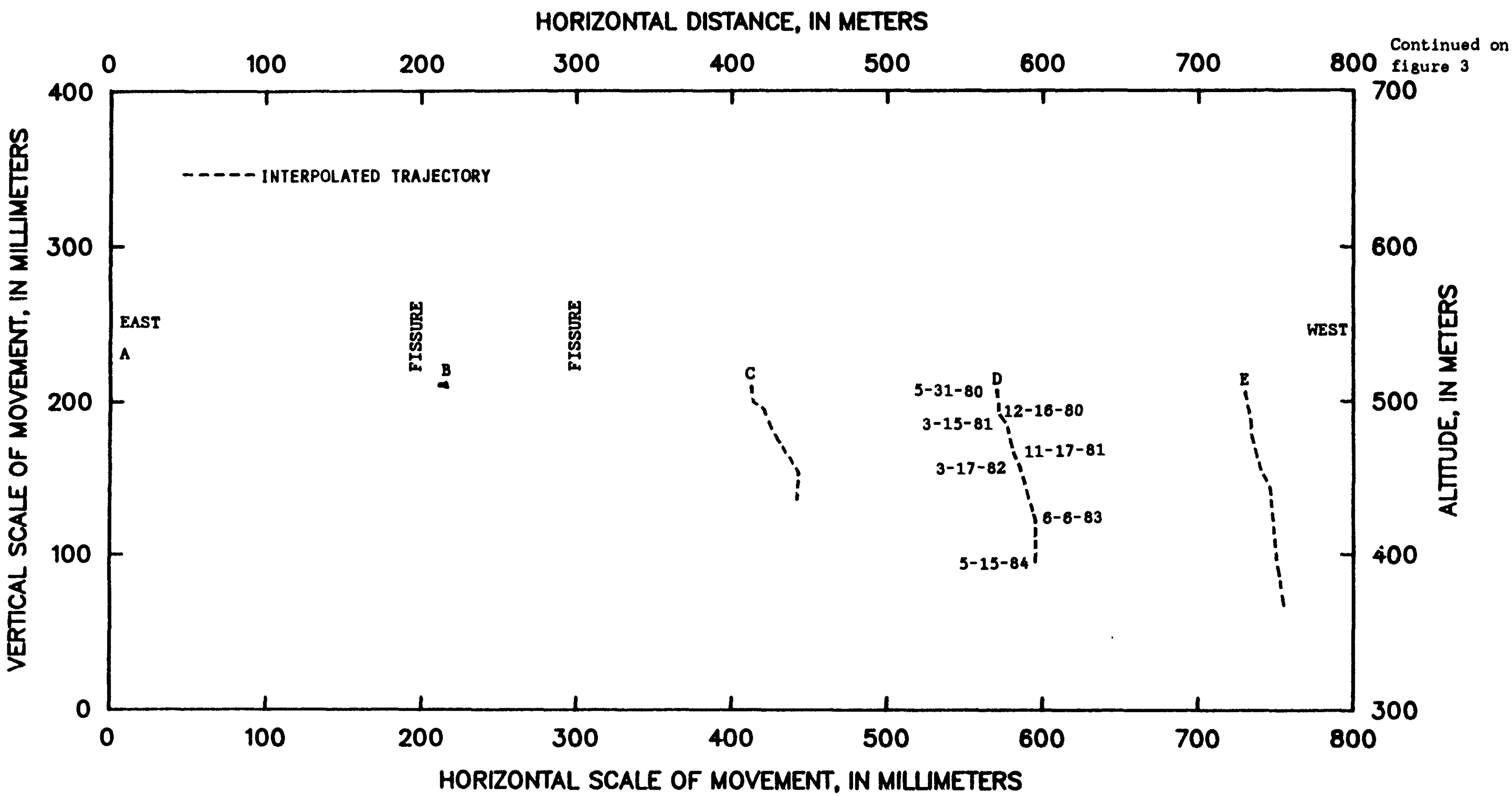

Figure 2.--Station trajectories along TA-1 survey line, stations B-E, 1980-84.

Continued from figure 2

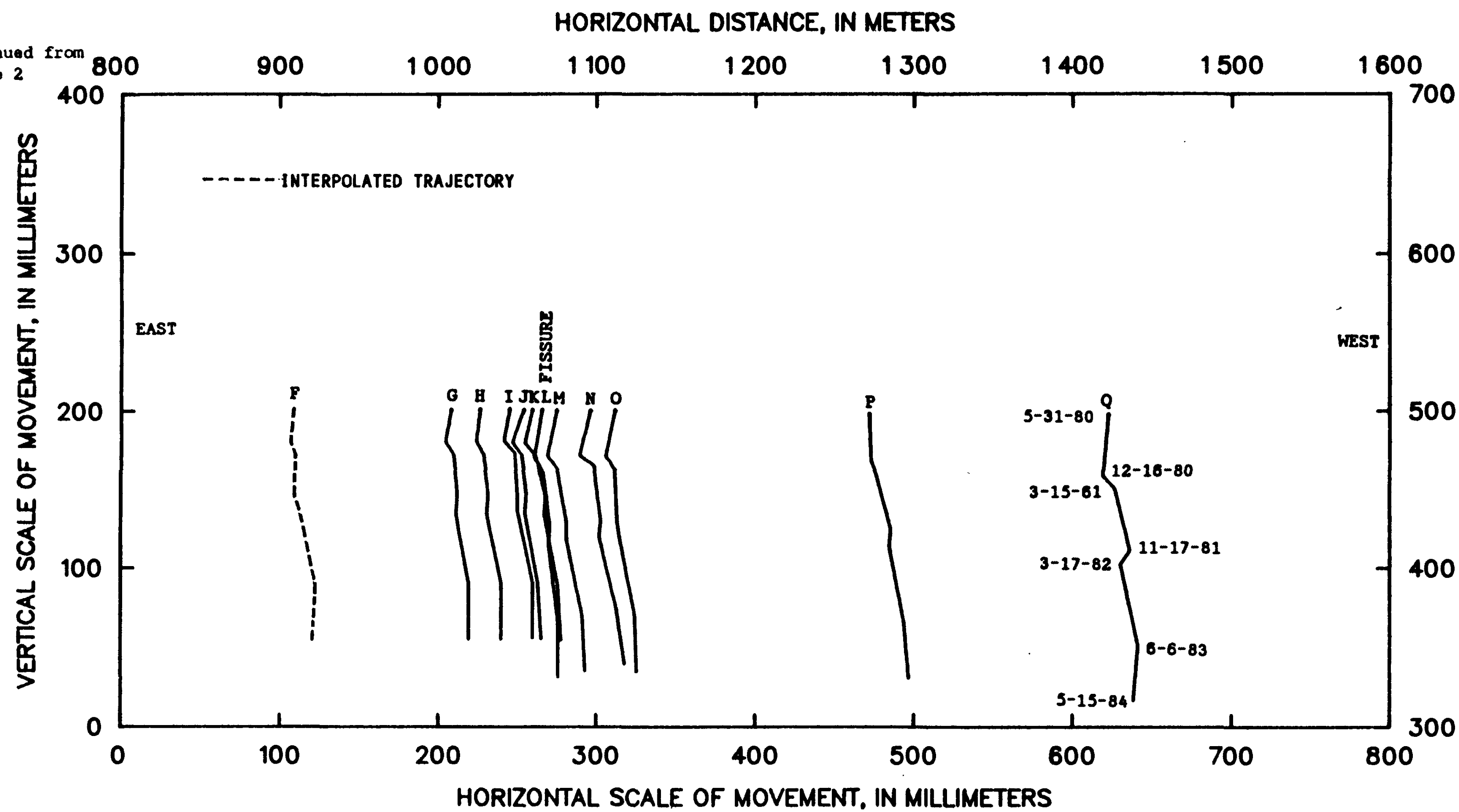

Figure 3.--Station trajectories along TA-1 survey line, stations F-Q, 1980-84.

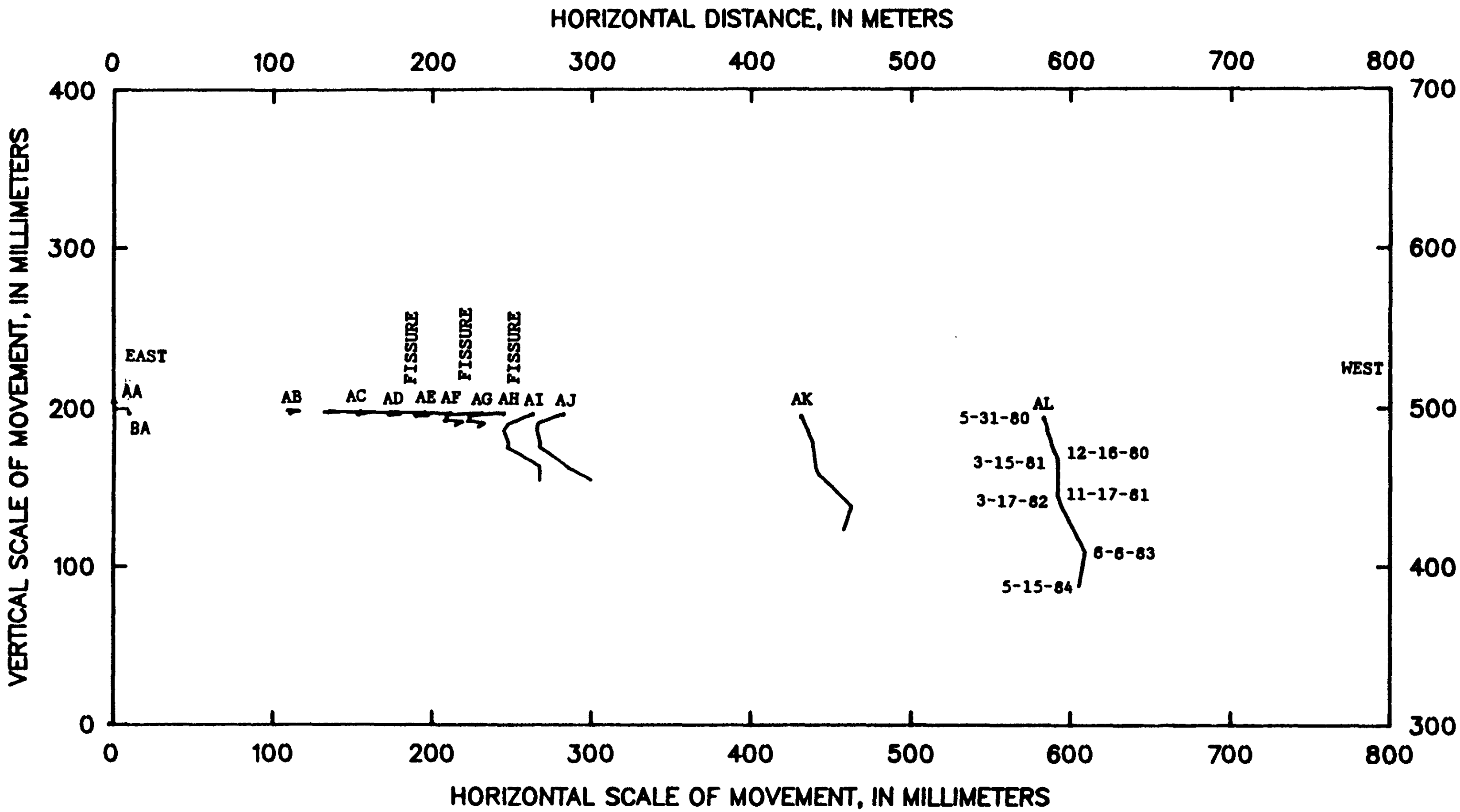

Figure 4.--Station trajectories along Nose survey line, 1980-84.

of the lower sections of the vaults so that the tops of the piers project about 450 mm above the vault floors. The invar wire was attached to the anchor pier 3 m north of station M (table 1), suspended in catenary inside the pipe, and extended to the instrument pier 3 m north of station I (table 1). Above the instrument pier, the wire passes over a low-friction pulley sector mounted on the pier and supports a freely suspended 2-kilogram counterweight. The core of a linear-variable-differential-transformer-displacement transducer was strung on the invar wire above the counterweight. Thus, changes in horizontal distance between the piers are converted to vertical movement of the core inside the transducer. A micrometer head with a resolution of 0.001 mm attached to the instrument pier can be adjusted to contact a reference surface fixed to the invar wire for calibration of the transducer as well as for maintaining continuity of measurement during resets of the invar wire. When the extensometer was installed, the center-to-center distance between the anchor and instrument piers was taped as 29.61 m.

A battery-powered data logger and audio-cassette recorder were used to record the horizontal displacement, water level in piezometer 1 at well TA-1, barometric pressure, power-supply voltage, and temperatures measured by three thermistors in the vaults and the pipe. Resolution of the displacement transducer using the data logger was 0.001 mm. Resolution of the thermistors was 0.07°C. The water-level sensor in piezometer 1 was a continuous-purge bubbler system, which consisted of a 6-millimeter copper-tube air line and a transducer with a gage-pressure range of 0 to 170 kPa and a resolution of 6 mm of water-level fluctuation. The barometric transducer had a range of 0 to 100 kPa absolute pressure and a resolution of 4 mm of water-level fluctuation.

Most of the gaps in the data (fig. 5, tables 3-4) were due to failures of the data logger, probably because of effects of nearby lightning strikes on long signal leads to thermistors and pressure transducers. Lightning protection was used on all leads into the data logger and probably saved the data logger from serious damage. The data logger, however, had to be replaced several times and repaired by the manufacturer. Other gaps were caused by pressure-transducer failures, thermistor failures, and premature battery-voltage dropoff.

WATER-LEVEL AND DEFORMATION DATA

The water-level and deformation data are summarized in tables 1-3 and figures 2-5. The tabulated values of altitude of water surface and horizontal movement are noon values, which were extracted from an array of data that was sampled ten times per day for more than 4 years and totaled more than 100,000 values. The original array contains sample time and date, horizontal movement, water level, barometric pressure, power-supply voltage, instrument-vault temperature, pipe temperature, and anchor-vault temperature. Corrections to the horizontal-movement record include many resets of the invar wire and a temperature correction that used three temperature records and was based on a thermal calibration done on September 10, 1981. Corrections to the water-level record include many resets of air-line length and periodic well taping. Test hole TA-1 subsided from an altitude of 502.13 m in May 1980 to 501.98 m in May 1984.

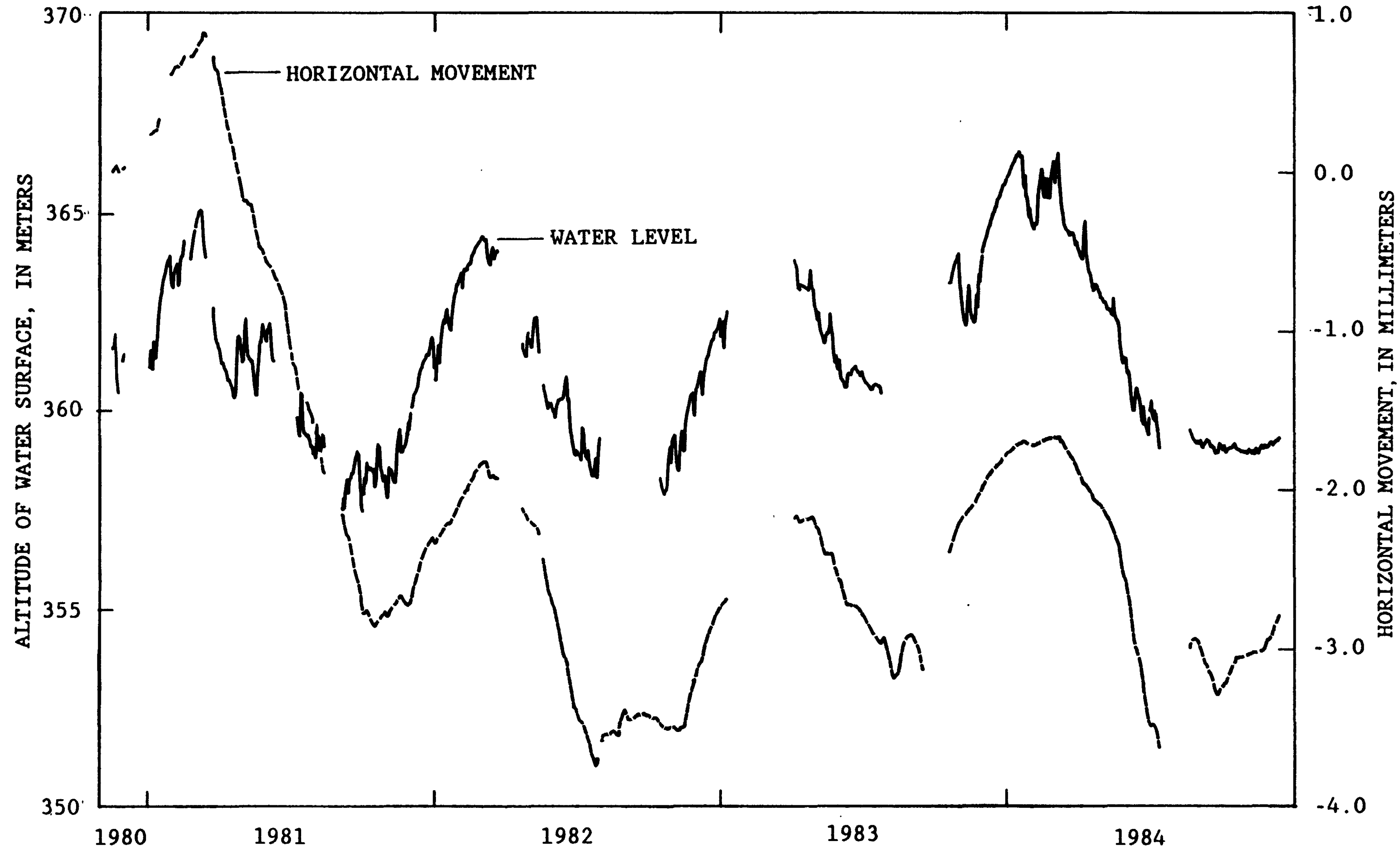

Figure 5.--Water level in piezometer 1 at test hole TA-1 and horizontal movement across nearby earth fissure, 1980-84.

Table 3.--Altitude of water surface in piezometer 1, test hole TA-1, 1980-84

[Altitude, in meters, refers to distance above the NGVD of 1929. Location is in SE¼, SW¼, NE¼, sec.5, T. 8 S., R. 9 E., Salt and Gila River Baseline and Meridian]

	1980		1981											
Day	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	------	361.36	361.09	363.06	364.62	361.51	361.25	362.02	------	358.78	------	357.89	357.97	360.06
2	------	360.85	361.50	363.39	364.74	361.44	361.72	361.97	------	359.02	------	358.30	358.56	360.10
3	------	360.75	361.18	363.53	364.85	361.29	362.16	362.10	------	359.62	357.54	358.16	358.47	360.16
4	------	361.26	361.05	363.58	364.88	361.16	362.28	362.16	------	359.31	357.50	358.25	358.50	360.22
5	------	361.52	361.02	363.63	365.00	361.15	361.84	362.02	------	359.33	357.79	358.68	358.50	360.38
6	------	361.69	361.55	363.69	365.02	361.17	361.56	361.59	------	359.03	357.54	358.56	358.41	360.40
7	------	361.87	361.73	363.62	365.04	361.07	361.34	361.39	------	358.96	357.92	358.55	358.28	360.44
8	------	362.00	361.49	363.12	365.03	361.01	361.32	361.24	359.79	359.05	358.09	358.52	358.21	360.48
9	------	362.12	361.36	363.22	365.00	360.98	361.25	361.22	359.65	359.18	358.25	358.50	358.17	360.53
10	------	362.26	361.30	363.62	364.76	360.95	361.26	------	359.47	359.38	357.93	358.55	358.18	360.59
11	------	362.42	361.58	363.81	364.38	360.85	361.21	------	359.34	359.33	357.91	358.50	358.40	360.77
12	------	------	361.84	363.87	364.14	360.73	360.24	------	359.63	359.08	358.21	358.49	358.99	360.90
13	------	------	362.27	363.88	364.00	360.75	361.08	------	360.27	------	358.27	358.44	359.21	360.98
14	361.51	------	362.50	364.03	363.85	360.73	360.88	------	360.39	------	358.30	358.51	359.32	361.05
15	361.58	------	362.69	364.20	------	360.67	360.66	------	359.98	------	358.41	358.08	359.43	361.06
16	361.57	------	362.84	364.26	------	360.62	360.52	------	359.55	------	358.39	358.14	359.49	361.16
17	361.57	------	362.95	------	------	360.56	360.37	------	359.41	------	358.44	358.28	358.94	361.23
18	361.75	------	363.05	------	------	360.48	360.35	------	359.41	------	358.60	358.84	358.97	361.24
19	361.90	------	363.18	------	------	360.34	360.95	------	359.36	------	358.69	359.13	358.94	361.29
20	361.42	------	363.30	------	------	360.29	361.20	------	359.33	------	358.83	358.82	359.03	361.30
21	360.78	------	363.36	------	------	360.36	361.45	------	359.32	------	358.83	359.08	359.06	361.41
22	360.64	------	363.44	------	------	360.48	361.58	------	359.37	------	358.96	358.72	359.10	361.36
23	360.41	361.03	363.55	363.81	362.53	361.21	361.73	------	359.25	------	358.90	358.49	359.15	361.37
24	------	361.49	363.66	364.01	362.35	361.84	361.69	------	359.21	------	358.88	358.45	359.26	361.37
25	------	361.91	363.77	364.12	362.22	361.85	361.96	------	359.08	------	358.39	358.27	359.39	361.54
26	------	362.09	363.81	364.27	362.06	361.77	362.15	------	359.10	------	358.08	358.22	359.40	361.65
27	------	361.66	363.76	364.43	361.88	361.78	362.07	------	359.04	------	357.80	358.27	359.68	361.77
28	361.22	361.43	363.88	364.52	361.76	361.54	361.89	------	358.95	------	357.63	358.36	359.49	361.83
29	361.32	361.28	363.42	------	361.68	361.38	361.90	------	358.89	------	357.51	358.05	359.73	361.77
30	361.41	361.21	363.18	------	361.66	361.19	361.77	------	359.05	------	357.45	357.87	359.89	361.59
31	------	361.15	363.10	------	361.55	------	361.72	------	358.87	------	------	357.79	------	361.06

Table 3.--Altitude of water surface in piezometer 1, test hole TA-1, 1980-84--Continued

	1982											
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	360.76	363.31	364.30	------	361.76	359.94	358.93	------	------	------	359.31	360.55
2	360.77	363.36	364.36	------	361.74	359.95	358.88	------	------	------	359.36	360.65
3	361.15	363.45	364.39	------	361.67	359.80	358.85	------	------	------	359.33	360.73
4	361.27	363.43	364.36	------	361.57	359.96	358.82	------	------	------	358.89	360.86
5	361.62	363.07	364.30	------	361.58	360.10	358.83	------	------	------	358.68	360.96
6	361.29	363.34	364.26	------	361.91	360.15	358.73	------	------	------	358.55	360.97
7	361.18	363.37	364.27	------	362.15	360.23	359.11	------	------	------	358.47	360.55
8	361.61	363.54	364.31	------	362.31	360.21	359.54	------	------	------	358.47	360.37
9	361.85	363.49	363.98	------	362.29	360.26	359.49	------	------	------	358.89	360.65
10	362.05	363.52	363.82	------	362.27	360.26	359.11	------	------	------	359.20	360.91
11	362.18	363.53	363.75	------	362.31	360.26	358.92	------	------	------	359.36	361.02
12	362.26	363.60	363.68	------	361.95	360.28	358.81	------	------	------	359.45	361.16
13	362.17	363.64	363.65	------	361.65	360.30	358.79	------	------	------	359.12	361.28
14	362.35	363.68	363.89	------	361.43	360.41	358.75	------	------	358.28	358.96	361.32
15	362.48	363.67	364.04	------	360.60	358.97	358.14	------	------	358.14	359.00	361.37
16	362.53	363.68	364.11	------	360.72	358.73	358.05	------	------	358.05	359.48	361.45
17	362.33	363.78	364.04	------	360.81	358.57	357.99	------	------	357.99	359.72	361.55
18	362.20	363.90	363.80	------	360.67	358.48	357.92	------	------	357.92	359.86	361.62
19	362.10	363.96	363.88	------	360.60	360.21	358.39	------	------	357.87	359.96	361.69
20	362.02	363.96	363.97	------	360.48	360.27	358.33	------	------	357.95	360.05	361.76
21	362.00	364.02	363.98	------	360.41	360.26	358.35	------	------	357.97	360.14	361.75
22	362.30	364.09	363.99	361.66	360.34	359.80	358.33	------	------	357.99	360.28	361.80
23	362.49	364.12	364.02	361.55	360.22	359.51	358.58	------	------	358.12	360.35	361.93
24	362.68	364.15	------	361.51	360.10	359.33	358.77	------	------	358.55	360.40	361.95
25	362.81	364.18	------	361.44	360.01	359.18	358.44	------	------	358.84	360.37	361.97
26	362.91	364.20	------	361.38	360.15	359.09	358.28	------	------	359.03	360.42	362.02
27	362.97	364.25	------	361.33	360.11	358.97	358.73	------	------	359.08	359.97	362.06
28	363.08	364.27	------	361.34	360.09	358.86	359.09	------	------	358.67	359.86	362.11
29	363.15	------	------	361.79	360.15	358.84	359.28	------	------	358.98	360.29	362.19
30	363.15	------	------	361.95	360.06	358.96	359.22	------	------	359.22	360.52	362.27
31	363.24	------	------	------	360.00	------	------	------	------	359.27	------	361.83

Table 3.--Altitude of water surface in piezometer 1, test hole TA-1, 1980-84--Continued

	1983											
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	361.99	------	------	------	362.52	361.26	360.80	------	------	------	363.40	363.99
2	362.16	------	------	------	362.43	360.90	360.74	------	------	------	363.08	364.12
3	362.21	------	------	------	362.27	360.79	360.69	------	------	------	362.81	364.15
4	361.77	------	------	------	362.40	360.75	360.66	------	------	------	362.63	364.26
5	361.56	------	------	363.77	362.44	360.71	360.66	------	------	------	362.45	364.30
6	362.00	------	------	363.67	362.15	360.69	360.63	------	------	------	362.34	364.36
7	362.22	------	------	363.62	362.00	360.64	360.60	------	------	------	362.25	364.45
8	362.34	------	------	363.55	361.94	360.55	360.57	------	------	------	362.18	364.55
9	362.45	------	------	363.18	361.88	360.58	360.54	------	------	------	362.13	364.63
10	------	------	------	363.02	361.83	360.79	360.51	------	------	------	362.22	364.65
11	------	------	------	363.00	361.74	360.88	360.50	------	------	------	362.72	364.71
12	------	------	------	363.15	361.68	360.91	360.53	------	------	------	362.97	364.80
13	------	------	------	363.15	361.72	360.88	360.59	------	------	------	363.11	364.84
14	------	------	------	363.13	361.88	360.87	360.61	------	------	------	362.68	364.92
15	------	------	------	363.12	361.90	360.88	360.63	------	------	------	362.46	364.99
16	------	------	------	363.08	361.97	360.95	360.65	------	------	------	362.35	365.01
17	------	------	------	363.08	361.92	361.02	360.63	------	------	------	362.28	365.10
18	------	------	------	363.09	362.04	361.04	360.61	------	------	------	362.28	365.13
19	------	------	------	363.05	362.15	361.04	360.60	------	------	363.19	362.21	365.20
20	------	------	------	363.05	362.39	361.08	360.58	------	------	363.18	362.21	365.30
21	------	------	------	363.03	362.15	361.09	360.60	------	------	363.21	362.32	365.32
22	------	------	------	362.99	361.99	361.02	360.55	------	------	363.33	362.88	365.36
23	------	------	------	363.08	361.91	360.97	360.41	------	------	363.41	362.67	365.41
24	------	------	------	363.15	361.58	360.94	------	------	------	363.53	362.59	365.48
25	------	------	------	363.50	361.35	360.95	------	------	------	363.60	363.16	365.55
26	------	------	------	363.19	361.20	360.91	------	------	------	363.68	363.40	365.60
27	------	------	------	363.06	361.18	360.86	------	------	------	363.74	363.23	365.67
28	------	------	------	363.01	361.37	360.85	------	------	------	363.78	363.54	365.69
29	------	------	------	362.74	361.09	360.95	------	------	------	363.83	363.73	365.68
30	------	------	------	362.58	361.02	360.86	------	------	------	363.90	363.85	365.74
31	------	------	------	------	361.22	------	------	------	------	363.95	------	365.81

Table 3.--Altitude of water surface in piezometer 1, test hole TA-1, 1980-84--Continued

	1984											
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	365.87	364.74	366.18	364.05	362.79	360.96	359.97	------	359.15	359.06	358.96	359.15
2	365.93	364.66	365.73	363.97	362.74	360.91	360.06	------	359.17	358.99	358.94	359.20
3	365.95	364.60	366.09	363.91	362.70	360.98	360.21	------	359.22	359.01	358.91	359.20
4	366.01	364.57	366.21	363.85	362.73	360.87	359.91	------	359.24	359.11	358.97	359.13
5	366.08	364.62	366.34	363.82	362.72	360.67	359.80	------	359.15	358.97	359.02	359.11
6	366.11	364.71	366.46	363.81	362.64	360.39	359.75	------	359.08	358.94	358.98	359.18
7	366.18	364.70	366.08	364.27	362.56	360.23	359.98	------	359.06	358.98	358.97	359.18
8	366.21	364.69	365.68	364.62	362.52	360.10	359.71	------	359.15	359.02	358.95	359.22
9	366.25	364.77	365.48	364.77	362.53	359.98	359.89	------	359.14	359.04	358.92	359.23
10	366.27	365.36	365.22	364.27	362.51	359.98	359.63	------	359.18	359.04	358.97	359.23
11	366.36	365.60	365.06	364.06	362.47	360.23	359.53	------	359.22	359.05	358.93	359.24
12	366.36	365.77	364.99	363.91	362.45	360.40	359.21	------	359.25	359.06	358.90	359.27
13	366.42	365.92	364.82	363.73	362.40	360.54	359.04	------	359.21	359.06	358.97	359.30
14	366.43	366.08	364.67	363.57	362.38	360.51	------	------	359.22	359.07	359.04	------
15	366.43	366.03	364.62	363.46	362.81	360.40	------	------	359.22	359.11	358.99	------
16	366.50	365.59	364.56	363.45	362.53	360.34	------	------	359.13	359.09	358.96	------
17	366.42	365.41	364.54	363.37	362.40	360.26	------	------	359.08	359.15	358.92	------
18	366.36	365.37	364.53	363.25	362.32	360.12	------	------	359.11	359.11	358.99	------
19	366.41	365.84	364.49	363.13	362.27	359.92	------	------	359.07	359.04	359.04	------
20	366.39	365.45	364.45	363.01	362.23	359.72	------	------	359.04	359.02	359.08	------
21	365.91	365.36	364.41	363.05	362.19	359.77	------	359.48	359.05	359.01	359.11	------
22	365.68	365.83	364.48	363.07	362.11	359.63	------	359.49	358.95	358.99	359.04	------
23	365.61	365.48	364.46	363.16	361.74	360.08	------	359.42	358.92	358.99	359.03	------
24	365.90	365.35	364.46	363.13	361.55	359.77	------	359.35	358.93	358.97	359.08	------
25	365.39	365.40	364.47	363.11	361.41	359.68	------	359.30	358.93	358.96	359.11	------
26	365.37	365.83	364.40	363.05	361.24	359.61	------	359.26	358.94	358.96	359.07	------
27	365.27	366.04	364.29	362.97	361.19	359.55	------	359.23	359.05	358.95	359.06	------
28	364.95	366.13	364.16	362.94	361.31	359.49	------	359.20	359.15	358.95	359.09	------
29	364.87	366.27	364.20	362.83	361.30	359.38	------	359.17	359.13	358.94	359.08	------
30	365.08	------	364.24	362.81	361.27	359.78	------	359.15	359.09	358.96	359.11	------
31	364.84	------	364.09	------	361.30	------	------	359.21	------	358.94	------	------

Table 4.--Horizontal movement across Picacho earth fissure near test hole TA-1, 1980-84

[Values, in millimeters. Location is in SE¼, SW¼, NE¼, sec.5, T. 8 S., R. 9 E., Salt and Gila River Baseline and Meridian. Increasing values represent fissure closing and decreasing values represent fissure opening]

	1980		1981											
Day	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	------	0.032	0.233	0.642	0.764	0.564	-0.176	-0.570	-1.149	-1.631	------	-2.777	-2.791	-2.670
2	------	0.037	0.236	0.656	0.774	0.543	-0.180	-0.585	-1.184	-1.647	------	-2.778	-2.782	-2.650
3	------	0.042	0.241	0.662	0.788	0.528	-0.181	-0.590	-1.208	-1.659	-2.162	-2.772	-2.764	-2.634
4	------	0.045	0.244	0.663	0.800	0.499	-0.178	-0.593	-1.219	-1.673	-2.168	-2.762	-2.756	-2.619
5	------	0.052	0.247	0.666	0.816	0.471	-0.177	-0.599	-1.223	-1.709	-2.191	-2.757	-2.748	-2.604
6	------	0.060	0.254	0.668	0.819	0.436	-0.187	-0.606	-1.232	-1.741	-2.215	-2.764	-2.741	-2.587
7	------	0.072	0.261	0.664	0.827	0.404	-0.204	-0.614	-1.262	-1.773	-2.240	-2.774	-2.734	-2.572
8	------	0.082	0.259	0.662	0.837	0.372	-0.204	-0.628	-1.296	-1.803	-2.263	-2.789	-2.728	-2.557
9	------	0.099	0.264	0.668	0.840	0.345	-0.207	-0.640	-1.329	-1.832	-2.285	-2.804	-2.723	-2.541
10	------	0.116	0.266	0.673	0.878	0.320	-0.204	-0.654	-1.365	-1.867	-2.294	-2.816	-2.717	-2.526
11	------	0.133	0.264	0.687	0.880	0.293	-0.208	-0.667	-1.395	-1.893	-2.299	-2.829	-2.710	-2.510
12	------	------	0.282	0.697	0.875	0.275	-0.237	-0.677	-1.415	-1.897	-2.305	-2.837	-2.700	-2.492
13	------	------	0.312	0.707	0.873	0.254	-0.260	-0.684	-1.415	------	-2.331	-2.847	-2.689	-2.471
14	0.000	------	0.336	0.718	0.862	0.232	-0.282	-0.693	-1.409	------	-2.358	-2.847	-2.681	-2.451
15	0.006	------	------	0.730	------	0.207	-0.314	-0.707	-1.408	------	-2.383	-2.860	-2.672	-2.432
16	0.008	------	------	0.730	------	0.186	-0.344	-0.722	-1.424	------	-2.410	-2.852	-2.666	-2.422
17	0.016	------	------	------	------	0.165	-0.373	-0.735	-1.439	------	-2.439	-2.845	-2.671	-2.408
18	0.026	------	------	------	------	0.142	-0.393	-0.752	-1.443	------	-2.469	-2.835	-2.673	-2.390
19	0.034	------	------	------	------	0.119	-0.415	-0.766	-1.448	------	-2.495	-2.829	-2.682	-2.382
20	0.037	------	------	------	------	0.080	-0.443	-0.784	-1.455	------	-2.517	-2.820	-2.691	-2.373
21	0.022	------	------	------	------	0.070	-0.473	-0.800	-1.462	------	-2.539	-2.812	-2.700	-2.360
22	0.015	------	------	------	------	0.048	-0.469	-0.817	-1.471	------	-2.553	-2.807	-2.707	-2.357
23	0.000	0.194	------	0.731	0.725	0.019	-0.469	-0.836	-1.502	------	-2.575	-2.800	-2.715	-2.348
24	------	0.200	------	0.736	0.703	-0.004	-0.484	-0.872	-1.504	------	-2.599	-2.792	-2.721	-2.339
25	------	0.209	------	0.729	0.680	-0.027	-0.488	-0.936	-1.518	------	-2.624	-2.790	-2.724	-2.331
26	------	0.209	------	0.740	0.656	-0.053	-0.488	-0.960	-1.529	------	-2.647	-2.784	-2.725	-2.323
27	------	0.222	------	0.752	0.645	-0.072	-0.503	-1.000	-1.546	------	-2.671	-2.777	-2.717	-2.315
28	0.016	0.225	------	0.758	0.643	-0.096	-0.518	-1.045	-1.560	------	-2.698	-2.769	-2.719	-2.307
29	0.022	0.227	0.612	------	0.638	-0.124	-0.530	-1.080	-1.581	------	-2.726	-2.780	-2.714	-2.303
30	0.029	0.229	0.625	------	0.629	-0.157	-0.552	-1.115	-1.598	------	-2.755	-2.791	-2.691	-2.316
31	------	0.230	0.634	------	0.595	------	-0.570	------	-1.615	------	------	-2.799	------	-2.328

Table 4.--Horizontal movement across Picacho earth fissure near test hole TA-1, 1980-84--Continued

	1982											
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	-2.335	-2.080	-1.839	------	-2.198	-2.733	-3.386	------	-3.389	-3.426	-3.496	-3.175
2	-2.335	-2.068	-1.832	------	-2.203	-2.744	-3.396	-3.586	-3.389	-3.428	-3.498	-3.158
3	-2.328	-2.054	-1.831	------	-2.206	-2.765	-3.409	-3.555	-3.403	-3.432	-3.500	-3.134
4	-2.308	-2.049	-1.827	------	-2.213	-2.788	-3.423	-3.542	-3.420	-3.437	-3.498	-3.116
5	-2.303	-2.045	-1.830	------	-2.218	-2.812	-3.438	-3.548	-3.434	-3.442	-3.503	-3.105
6	-2.298	-2.038	-1.828	------	-2.222	-2.836	-3.453	-3.544	-3.447	-3.441	-3.507	-3.093
7	-2.292	-2.029	-1.827	------	-2.226	-2.856	-3.459	-3.540	-3.449	-3.441	-3.513	-3.082
8	-2.280	-2.025	-1.829	------	-2.228	-2.879	-3.463	-3.540	-3.448	-3.443	-3.519	-3.081
9	-2.270	-2.013	-1.853	------	-2.231	-2.906	-3.466	-3.541	-3.448	-3.441	-3.518	-3.065
10	-2.265	-2.007	-1.875	------	-2.234	-2.933	-3.473	-3.544	-3.448	-3.438	-3.512	-3.046
11	-2.254	-2.000	-1.900	------	-2.239	-2.962	-3.486	-3.546	-3.444	-3.441	-3.513	-3.010
12	-2.250	-1.988	-1.922	------	-2.251	-2.988	-3.499	-3.542	-3.439	-3.443	-3.499	-2.986
13	-2.243	-1.975	-1.928	------	-2.263	-3.014	-3.513	-3.536	-3.437	-3.447	-3.498	-2.965
14	-2.227	-1.966	-1.921	------	-2.280	-3.039	-3.529	-3.529	-3.434	-3.460	-3.498	-2.951
15	-2.223	-1.959	-1.918	------	------	-3.049	-3.545	-3.525	-3.430	-3.468	-3.494	-2.932
16	-2.217	-1.951	-1.912	------	------	-3.056	-3.562	-3.524	-3.426	-3.476	-3.495	-2.913
17	-2.210	-1.936	-1.911	------	------	-3.064	-3.579	-3.521	-3.424	-3.484	-3.490	-2.901
18	-2.210	-1.934	-1.927	------	------	-3.083	-3.594	-3.523	-3.415	-3.491	-3.470	-2.890
19	-2.217	-1.918	-1.930	------	-2.444	-3.090	-3.611	-3.527	-3.416	-3.495	-3.441	-2.875
20	-2.212	-1.906	-1.925	------	-2.470	-3.118	-3.645	-3.535	-3.418	-3.499	-3.414	-2.861
21	-2.207	-1.893	-1.929	------	-2.500	-3.148	-3.670	-3.542	-3.419	-3.502	-3.384	-2.855
22	-2.191	-1.886	-1.929	-2.123	-2.533	-3.173	-3.677	-3.545	-3.423	-3.502	-3.349	-2.844
23	-2.179	-1.881	-1.932	-2.130	-2.565	-3.198	-3.690	-3.549	-3.413	-3.505	-3.327	-2.823
24	-2.169	-1.877	------	-2.138	-2.599	-3.226	-3.707	-3.546	-3.412	-3.505	-3.304	-2.807
25	-2.159	-1.867	------	-2.144	-2.631	-3.254	-3.723	-3.494	-3.412	-3.508	-3.282	-2.793
26	-2.150	-1.855	------	-2.152	-2.646	-3.278	-3.740	-3.474	-3.411	-3.507	-3.267	-2.784
27	-2.142	-1.849	------	-2.159	-2.662	-3.308	-3.730	-3.456	-3.419	-3.506	-3.249	-2.775
28	-2.125	-1.843	------	-2.167	-2.674	-3.339	-3.720	-3.442	-3.419	-3.501	-3.231	-2.768
29	-2.117	------	------	-2.181	-2.688	-3.362	-3.694	-3.427	-3.417	-3.498	-3.216	-2.756
30	-2.105	------	------	-2.191	-2.708	-3.374	------	-3.412	-3.424	-3.497	-3.197	-2.749
31	-2.089	------	------	------	-2.721	------	------	-3.399	------	-3.498	------	-2.744

Table 4.--Horizontal movement across Picacho earth fissure near test hole TA-1, 1980-84--Continued

	1983											
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	-2.732	------	------	------	-2.216	-2.578	-2.797	-3.014	-2.920	------	-2.202	-1.982
2	-2.724	------	------	------	-2.234	-2.570	-2.803	-3.035	-2.926	------	-2.194	-1.973
3	-2.718	------	------	------	-2.242	-2.594	-2.815	-3.056	-2.934	------	-2.185	-1.964
4	-2.713	------	------	------	-2.248	-2.615	-2.825	-3.080	-2.946	------	-2.180	-1.955
5	-2.709	------	------	-2.179	-2.256	-2.635	-2.833	-3.106	-2.956	------	-2.173	-1.945
6	-2.706	------	------	-2.168	-2.275	-2.652	-2.843	-3.132	-2.967	------	-2.167	-1.933
7	-2.700	------	------	-2.167	-2.294	-2.668	-2.853	-3.157	-2.976	------	-2.160	-1.923
8	-2.693	------	------	-2.167	-2.314	-2.690	-2.858	-3.179	-2.989	------	-2.160	-1.911
9	-2.687	------	------	-2.183	-2.335	-2.722	-2.868	-3.188	-3.000	------	-2.155	-1.906
10	------	------	------	-2.195	-2.355	-2.727	-2.877	-3.183	-3.011	------	-2.148	-1.904
11	------	------	------	-2.207	-2.376	-2.724	-2.887	-3.174	-3.038	------	-2.140	-1.893
12	------	------	------	-2.203	-2.394	-2.726	-2.899	-3.166	-3.068	------	-2.134	-1.893
13	------	------	------	-2.201	-2.408	-2.724	-2.906	-3.161	-3.097	------	-2.127	-1.883
14	------	------	------	-2.195	-2.408	-2.725	-2.914	-3.159	-3.120	------	-2.123	-1.877
15	------	------	------	-2.193	-2.405	-2.728	-2.921	-3.143	-3.135	------	-2.115	-1.871
16	------	------	------	-2.191	-2.404	-2.732	-2.927	-3.112	------	------	-2.109	-1.867
17	------	------	------	-2.187	-2.405	-2.733	-2.934	-3.078	------	------	-2.102	-1.859
18	------	------	------	-2.187	-2.405	-2.733	-2.941	-3.040	------	------	-2.097	-1.856
19	------	------	------	-2.185	-2.408	-2.733	-2.949	-3.013	-------	-2.391	-2.092	-1.847
20	------	------	------	-2.188	-2.407	-2.733	-2.957	-2.990	------	-2.378	-2.080	-1.844
21	------	------	------	-2.185	-2.406	-2.737	-2.965	-2.973	------	-2.359	-2.076	-1.840
22	------	------	------	-2.185	-2.406	-2.738	-2.970	-2.957	------	-2.342	-2.063	-1.835
23	------	------	------	-2.182	-2.407	-2.742	-2.967	-2.947	------	-2.324	-2.051	-1.829
24	------	------	------	-2.179	-2.426	-2.745	-2.960	-2.938	------	-2.310	-2.040	-1.824
25	------	------	------	-2.178	-2.450	-2.751	-2.950	-2.930	------	-2.294	-2.033	-1.818
26	------	------	------	-2.178	-2.480	-2.760	-2.941	-2.925	------	-2.275	-2.026	-1.806
27	------	------	------	-2.169	-2.501	-2.767	-2.934	-2.923	------	-2.261	-2.014	-1.800
28	------	------	------	-2.175	-2.507	-2.773	-2.934	-2.919	------	-2.249	-2.006	-1.799
29	------	------	------	-2.186	-2.529	-2.779	-2.953	-2.916	------	-2.235	-1.997	-1.789
30	------	------	------	-2.201	-2.550	-2.788	-2.975	-2.915	------	-2.223	-1.987	-1.781
31	------	------	------	------	-2.554	------	-2.994	-2.916	------	-2.212	------	-1.777

Table 4.--Horizontal movement across Picacho earth fissure near test hole TA-1, 1980-84--Continued

Day	1984											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	-1.772	-1.719	-1.676	-1.894	-2.115	-2.623	-3.486	------	-2.952	-3.241	-3.041	-2.938
2	-1.767	-1.723	-1.676	-1.906	-2.123	-2.654	-3.491	------	-2.964	-3.237	-3.039	-2.929
3	-1.767	-1.722	-1.677	-1.916	-2.133	-2.672	-3.485	------	-2.979	-3.236	-3.038	-2.916
4	-1.763	-1.723	-1.678	-1.928	-2.141	-2.696	-3.478	------	-2.997	-3.219	-3.036	-2.912
5	-1.762	-1.723	-1.678	-1.942	-2.148	-2.732	-3.479	------	-3.009	-3.217	-3.034	-2.888
6	-1.753	-1.721	-1.672	-1.955	-2.160	-2.772	-3.485	------	-3.025	-3.218	-3.031	-2.884
7	-1.749	-1.718	-1.671	-1.964	-2.167	-2.818	-3.493	------	-3.045	-3.207	-3.027	-2.851
8	-1.743	-1.717	-1.672	-1.962	-2.175	-2.864	-3.503	------	-3.060	-3.189	-3.027	-2.851
9	-1.737	-1.712	-1.698	-1.969	-2.182	-2.910	-3.513	------	-3.075	-3.182	-3.026	-2.845
10	-1.735	-1.712	-1.688	-1.969	-2.191	-2.949	-3.529	------	-3.092	-3.164	-3.024	-2.829
11	-1.727	-1.708	-1.695	-1.975	-2.202	-2.970	-3.559	------	-3.097	-3.151	-3.023	-2.819
12	-1.718	-1.705	-1.703	-1.983	-2.214	-2.986	-3.593	------	-3.102	-3.143	-3.022	-2.805
13	-1.718	-1.699	-1.714	-1.988	-2.227	-3.010	-3.626	------	-3.115	-3.127	-3.023	-2.793
14	-1.720	-1.697	-1.723	-1.995	-2.240	-3.023	------	------	-3.130	-3.114	-3.022	------
15	-1.714	-1.695	-1.735	-2.003	-2.251	-3.037	------	------	-3.147	-3.105	-3.022	------
16	-1.709	-1.689	-1.745	-2.011	-2.267	-3.053	------	------	-3.151	-3.096	-3.022	------
17	-1.711	-1.694	-1.752	-2.017	-2.279	-3.073	------	------	-3.160	-3.090	-3.018	------
18	-1.708	-1.688	-1.762	-2.026	-2.296	-3.095	------	------	-3.172	-3.085	-3.017	------
19	-1.703	-1.687	-1.769	-2.037	-2.310	-3.126	------	------	-3.183	-3.052	-3.016	------
20	-1.701	-1.684	-1.778	-2.058	-2.322	-3.162	------	------	-3.203	-3.057	-3.014	------
21	-1.696	-1.679	-1.787	-2.064	-2.335	-3.187	------	-2.992	-3.227	-3.056	-3.014	------
22	-1.701	-1.680	-1.798	-2.068	-2.349	-3.222	------	-2.973	-3.254	-3.056	-3.011	------
23	-1.700	-1.681	-1.803	-2.072	-2.381	-3.250	------	-2.961	-3.271	-3.055	-3.009	------
24	-1.701	-1.677	-1.808	-2.078	-2.417	-3.285	------	-2.951	-3.279	-3.052	-3.004	------
25	-1.711	-1.679	-1.818	-2.083	-2.458	-3.314	------	-2.943	-3.287	-3.053	-2.994	------
26	-1.712	-1.679	-1.823	-2.088	-2.492	-3.344	------	-2.938	-3.295	-3.051	-2.979	------
27	-1.716	-1.677	-1.842	-2.090	-2.519	-3.378	------	-2.938	-3.283	-3.051	-2.964	------
28	-1.715	-1.674	-1.848	-2.092	-2.536	-3.412	------	-2.938	-3.273	-3.050	-2.944	------
29	-1.718	-1.676	-1.857	-2.095	-2.551	-3.441	------	-2.939	-3.261	-3.047	-2.945	------
30	-1.721	------	-1.874	-2.101	-2.568	-3.467	------	-2.942	-3.249	-3.043	-2.942	------
31	-1.720	------	-1.881	------	-2.585	------	------	-2.946	------	-3.042	------	------

This subsidence was applied as a correction to the water-level data by linear interpolation over the period of record. A second, more compact array contains coded day and time, temperature-corrected horizontal movement, corrected altitude of water surface, barometric pressure, and instrument-vault temperature. The data in tables 3 and 4 are extracted from the 14,064-row by 5-column array.

The values in table 4 are the changes in distance between the two piers of the horizontal extensometer since November 14, 1980. To determine movement from date A to date B, subtract the value for date A from the value for date B. A positive result represents fissure closing, and a negative result represents fissure opening.

Deformation along the two survey lines is shown in figures 2 through 4. The location of the origin of the graph of each station is its topographic location along the survey line. Each trajectory then represents the movement of that station in the vertical plane containing the survey line. Because the scale of movement is magnified 1,000 times, it appears that closely spaced stations have collided but, in fact, they have moved only slightly in relation to each other.

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