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Documentation for Alinement Arrays, Motagua Fault, Guatemala

by

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DOCUMENTATION FOR ALINEMENT ARRAYS,

MOTAGUA FAULT, GUATEMALA

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The following brief report documents the locations and surveying data for four alinement arrays (fig. 1, p. 7-19) across the Motagua fault, Guatemala, which were installed to measure afterslip occurring along the fault. The arrays represent new monuments installed in areas where displacements had been measured as early as four days after the earthquake. The results of those measurements are reported by Bucknam and others (1978). Because of lack of monument stability, the susceptibility to damage of the various monuments used in the earlier work, and the need for more precise measurements because of decreasing rate of slip, the new monuments were installed at the four sites in May 1978.

MONUMENTS

The new monuments are copperclad steel rods, 78 cm long and 1.5 cm in diameter, with a brass cap crimped on the end. They are installed below the ground surface within a plastic sleeve (fig. 2), following a method used in California to ensure permanence and stability of alinement-array monuments (R. O. Burford, oral commun., 1978). The plastic sleeve isolates the survey marker from surface disturbances that affect the zone within about 30 cm of the ground surface. Monument identifying letters and numbers and a centerpunched surveying point are stamped on the brass cap. Because there is no evidence of the monuments at the ground surface their recovery will have to be made by use of the station descriptions and a metal detector.

Monuments were installed along lines on the order of 100 m long, perpendicular to the fault; two monuments were installed on each side of the fault and a reference mark parallel to the fault (fig. 3), to minimize possible effects of ground deformation in the vicinity of the fault. If distortion of the ground occurs as shown in figure 3, alinement of two stations on one side of the fault (C-D) to measure displacement of a station on the opposite side (A) will only indicate part of the true displacement (A-A"). Measurement of the angle EDA' will give the true displacement (A-A') parallel to the fault.

SURVEYING PROCEDURES

Angles between the reference point and the line of monuments crossing the fault were measured using a Hilger and Watts Model ST 200 theodolite, which is set over the base monument using a built-in optical plummet. The sighting targets for the other monuments were steel chaining pins, 5 mm in diameter, set on the centerpunched surveying point on the brass cap. Three sets of direct and reversed sightings were made to each station, setting the micrometer at about 0°, 120°, and 240° to eliminate collimation errors and to reduce micrometer graduation errors.

The theodolite micrometer is graduated to one second. Data obtained from the survey, which includes errors in pointing the instrument accurately at short distances, indicate the standard error for the sets of direct and reversed readings of two seconds, which is equivalent to 1 mm at 100 m. Thus, displacements of about 2 mm or more should be detectable with the equipment and procedures used.

ACKNOWLEDGMENTS

The installation and surveying of the monuments was done in cooperation with the Instituto Geográfico Nacional (IGN), and I gratefully acknowledge the support given by Col. Rene Aguiluz, Director, and by Oscar Salazar. Most of the surveying measurements were made by Ernesto Barrios, IGN.

REFERENCE CITED

Bucknam, R. C., Plafker, George, and Sharp, R. V., 1978, Fault movement (afterslip) following the Guatemala earthquake of February 4, 1976: Geology, v. 6, p. 170-173.

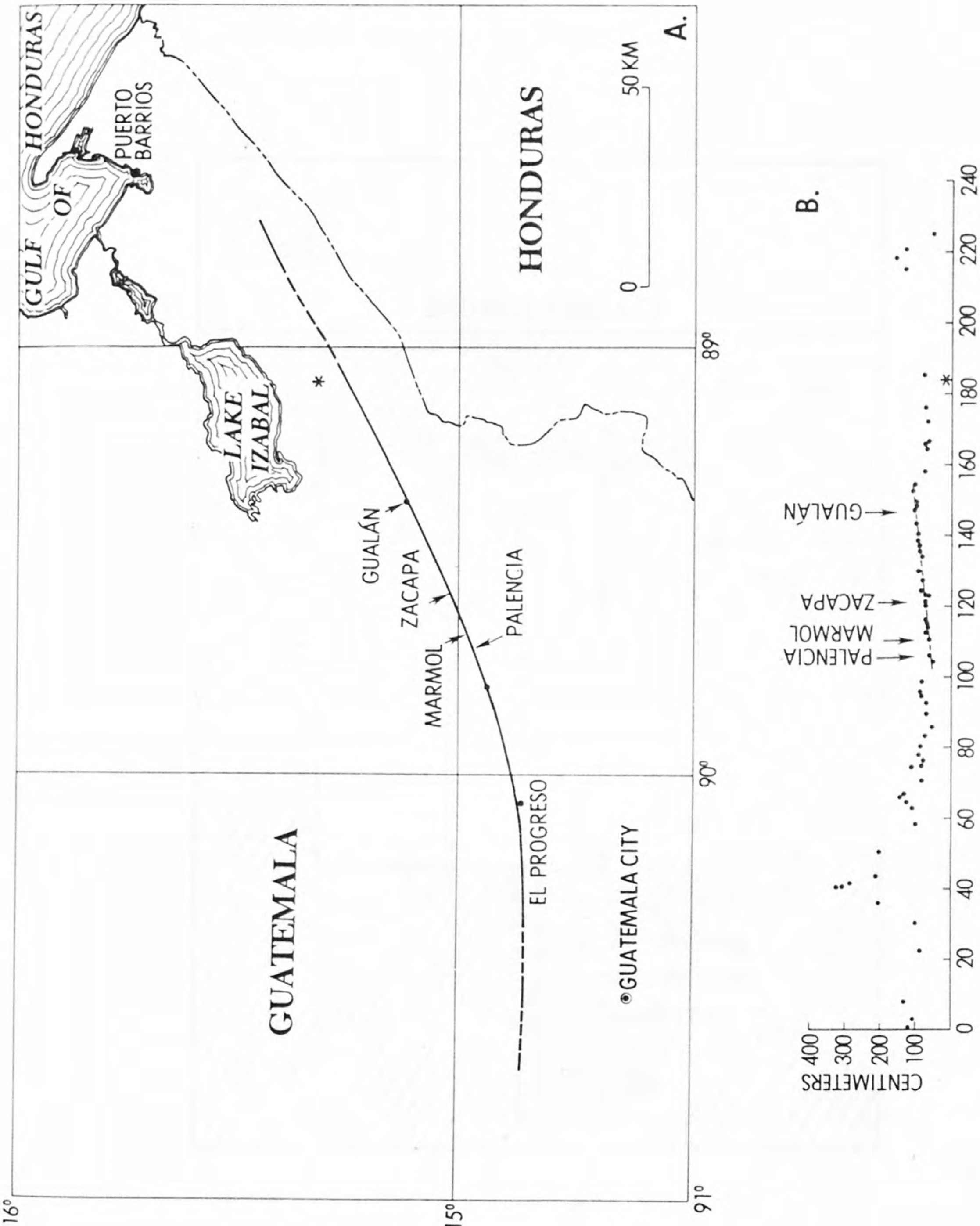

Figure 1.--(A) Locations of alinement arrays (arrows) along the zone of surface breakage (solid line) on the Motagua fault.

(B) Total displacement across the fault as measured in April 1976. February 4, 1976, main shock epicenter shown by asterisk.

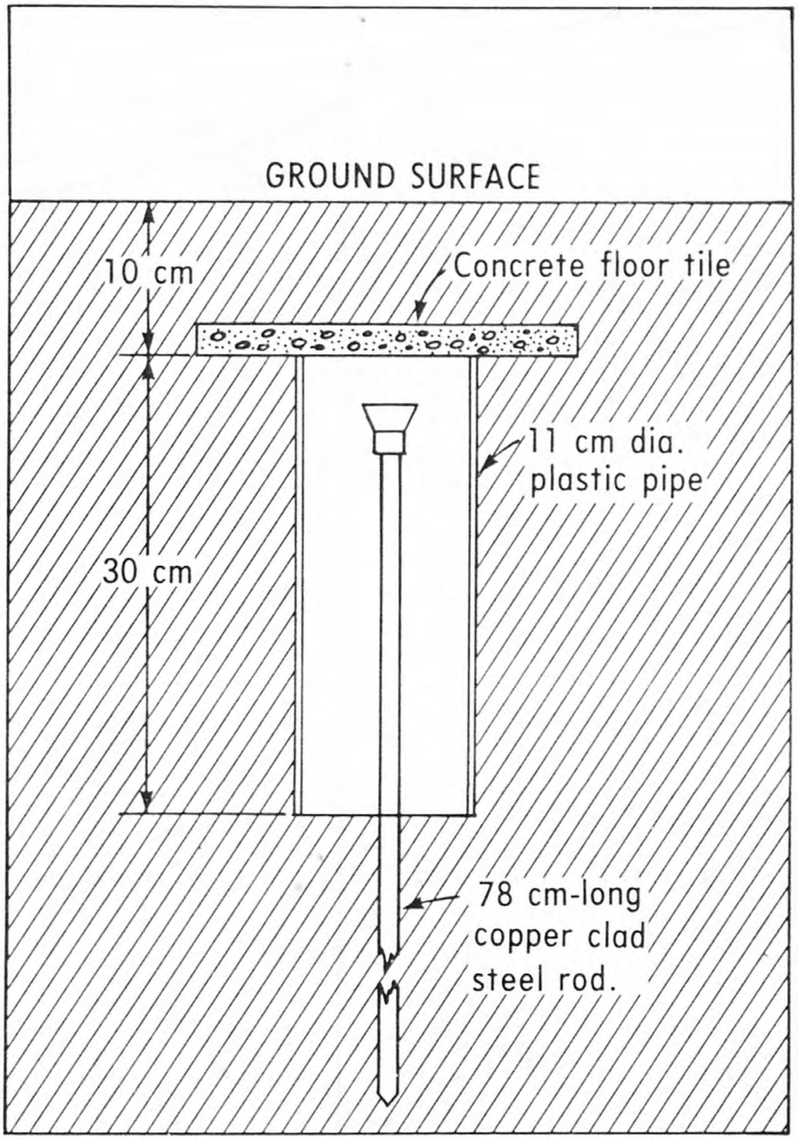

Figure 2.--Cross section showing typical monument installation.

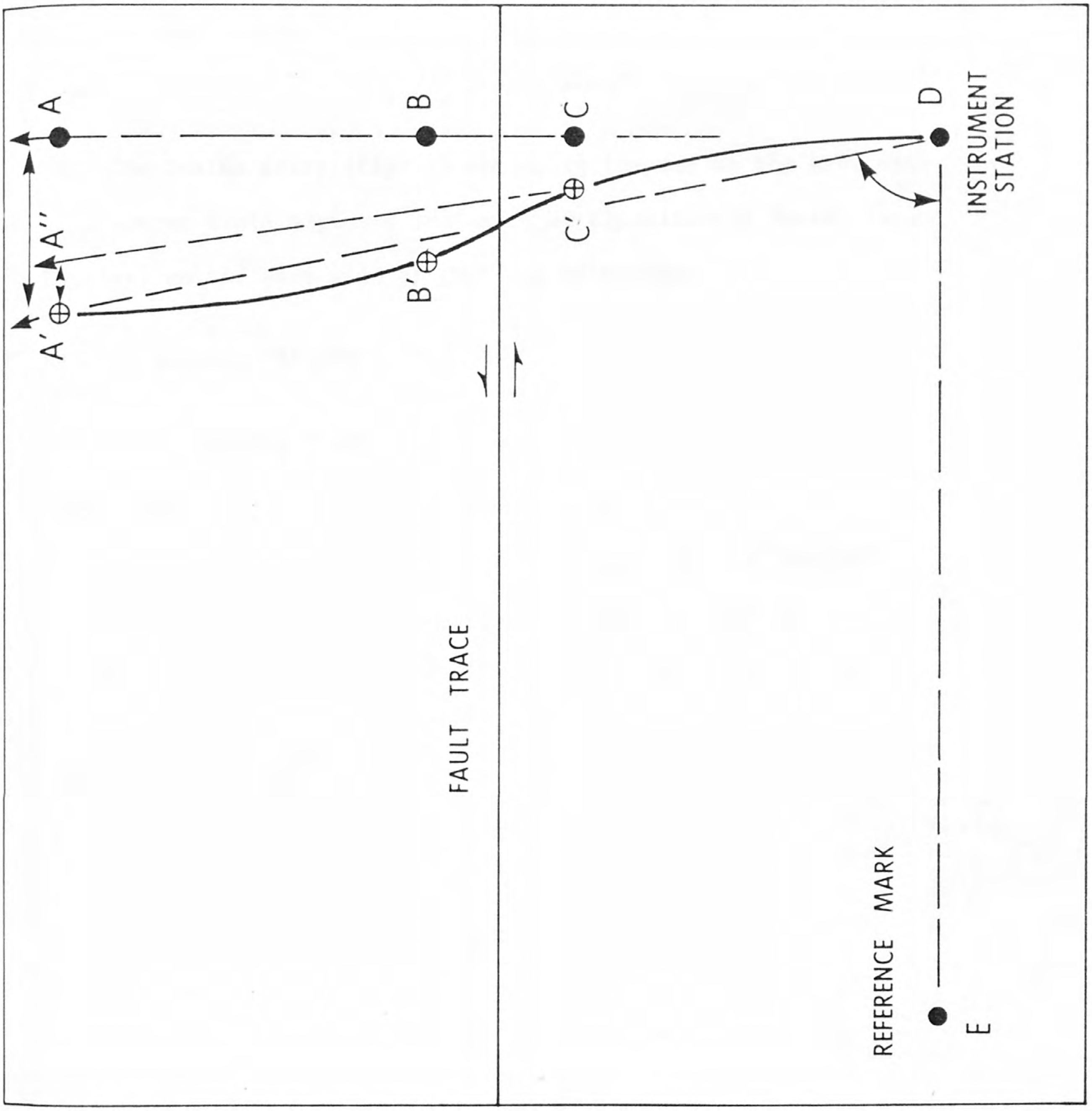

Figure 3.--Schematic map showing arrangement of survey monuments and possible difference between alinement determination of displacement (A-A'') based on line DC, and displacement A-A' based on angle EDA: Difference is the result of distortion of the ground in the vicinity of the fault trace.

GUALÁN ARRAY

The Gualán array (figs. 4 and 5) is located on the east side of a soccer field adjacent to Centro de Capacitacion Social Isaura Esquivel on the east side of the town of Gualán.

Date of Survey: 27 May 1978

Instrument Station = GUA 4

Angle from	To	
GUA 5	GUA 1	84° 16' 02"
GUA 5	GUA 2	84° 14' 13"
GUA 5	GUA 3	82° 56' 04"

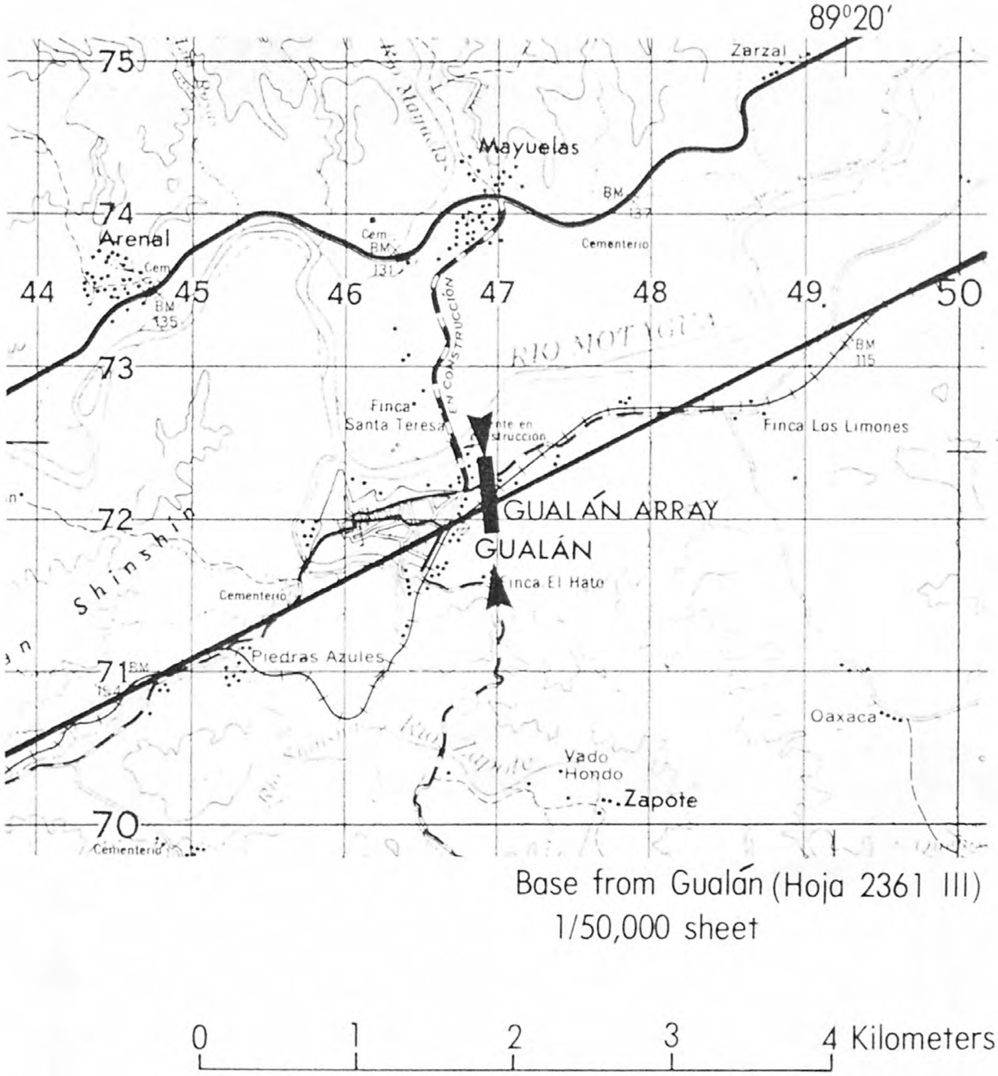

Figure 4.--Location map for the Gualán alinement array. Heavy line shows approximate location of the 4 February 1976 zone of surface faulting.

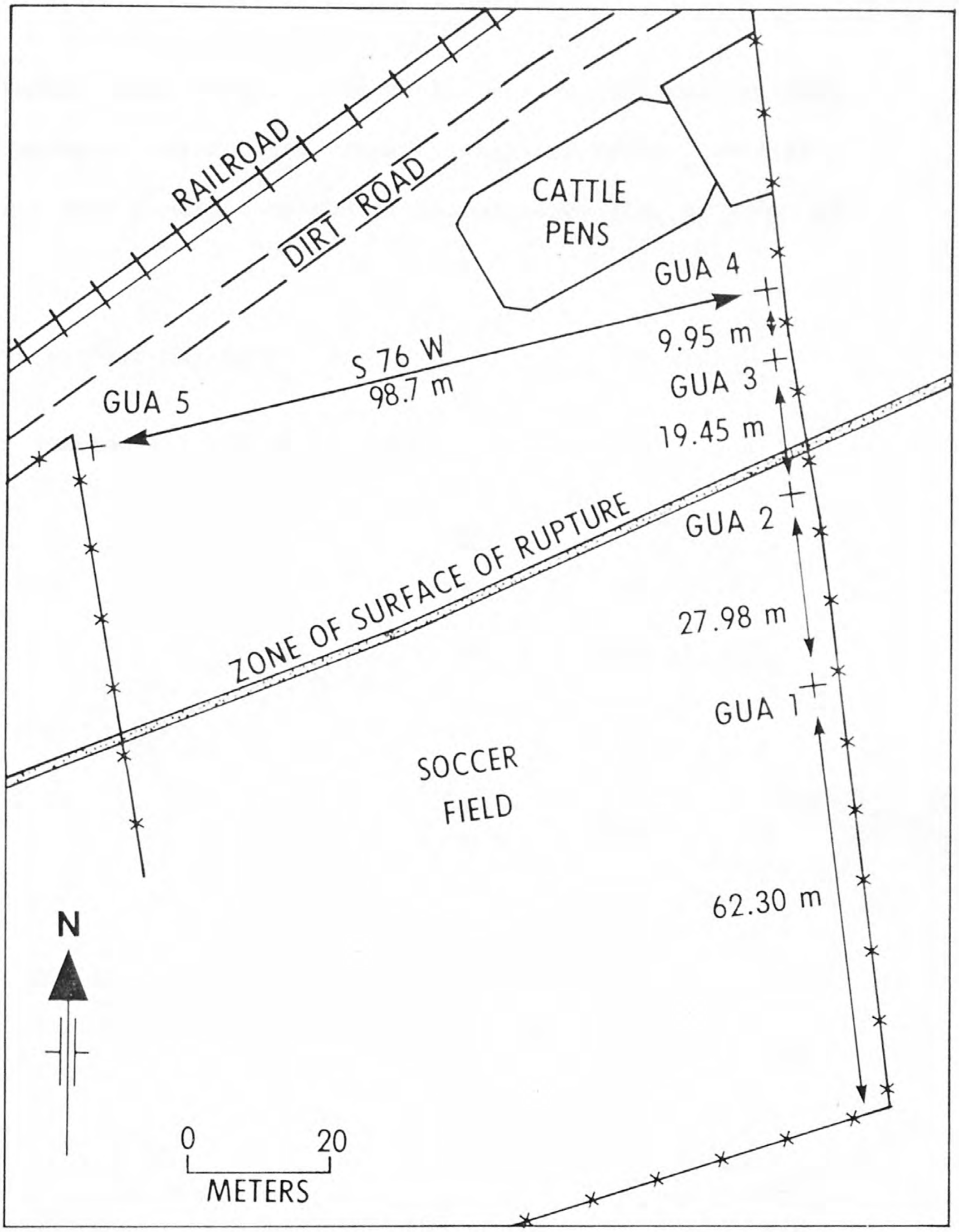

Figure 5.--Survey station locations for the Gualán alinement array.

The Zacapa array (figs. 6 and 7) is located just west of highway CA-10 along a cleared zone beneath telephone wires. Several stations are near concrete monuments installed by IGN, as shown on figure 7.

Date of Survey: 28 May 1978

Instrument Station = ZAC 1

Angle from	To	
ZAC 5	ZAC 4	83° 00' 02"
ZAC 5	ZAC 3	82° 58' 15"
ZAC 5	ZAC 2	83° 00' 27"

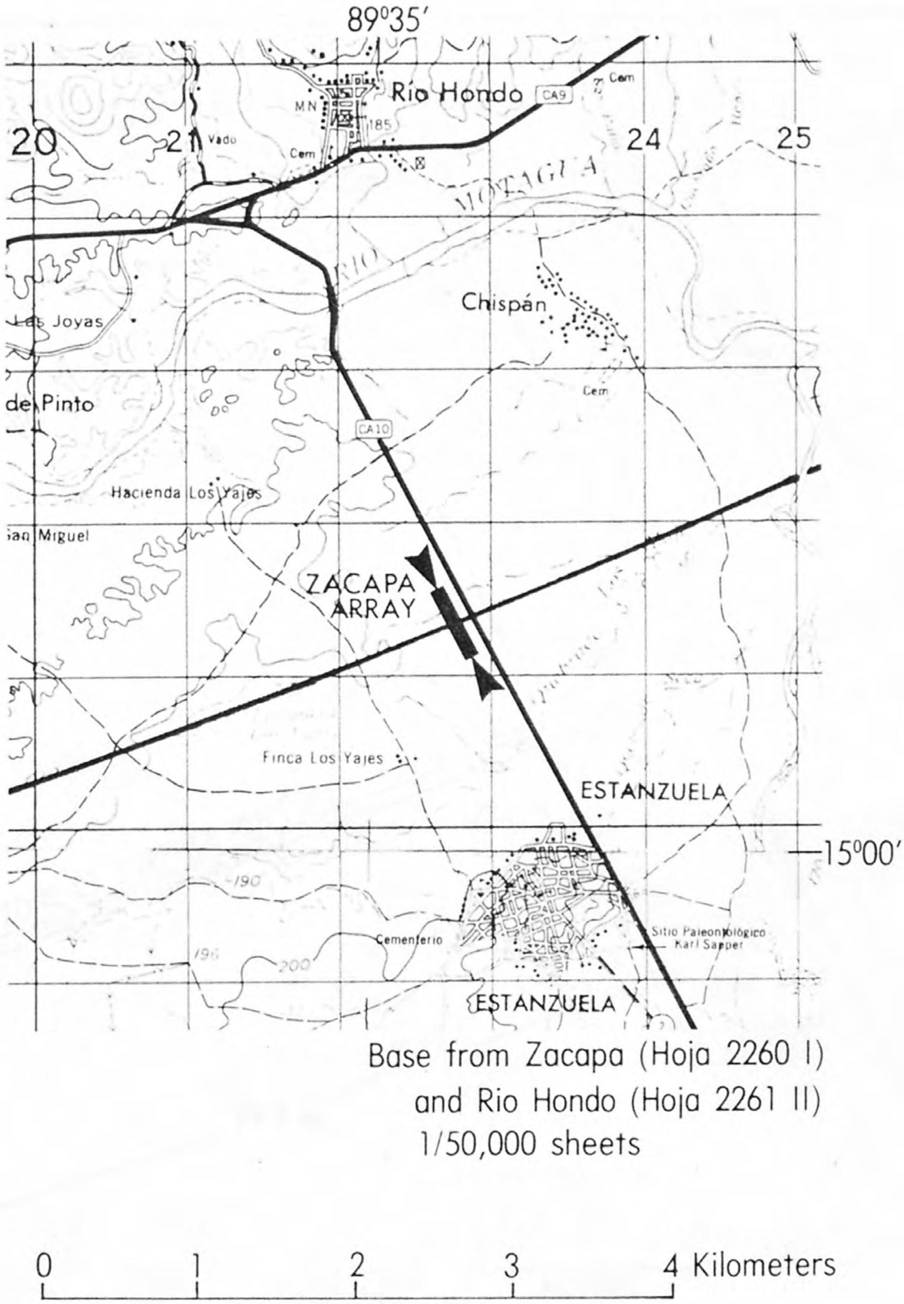

Figure 6.--Location map for the Zacapa alinement array. Heavy line shows approximate location of the 4 February 1976 zone of surface faulting.

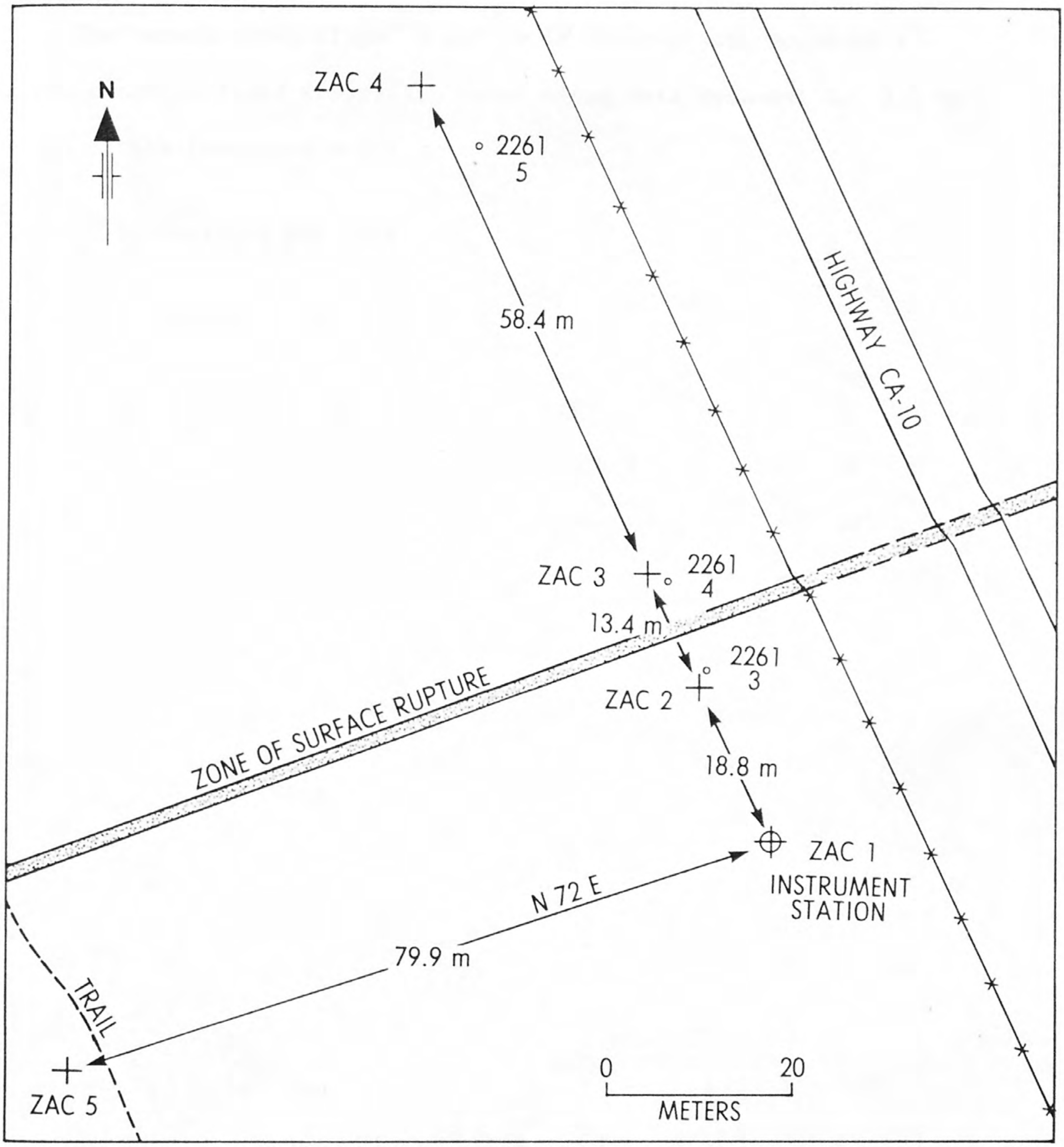

Figure 7.--Survey station locations for the Zacapa alinement array.

MARMOL ARRAY

The Marmol array (figs. 8 and 9) is located just south of a large concrete-lined irrigation canal along Ruta Nacional 20, 3.1 km south of the Longarone Motel.

Date of Survey: 18 May 1978

Instrument Station = MAR 1

Angle from	To	
MAR 2	MAR 3	67° 00' 48"
MAR 2	MAR 4	67° 02' 36"
MAR 2	MAR 5	66° 56' 15"

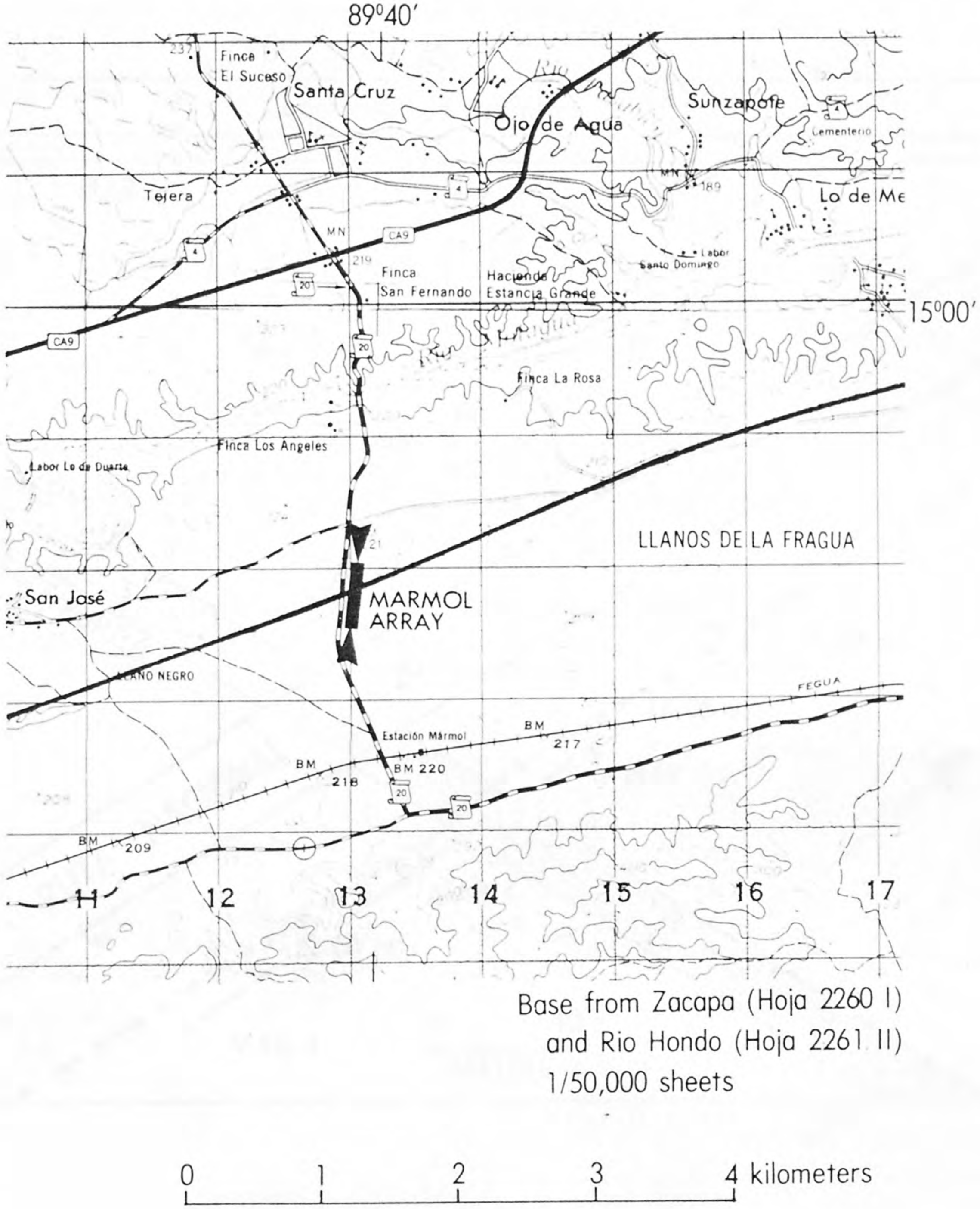

Figure 8.--Location map for the Marmol alinement array. Heavy line shows approximate location of the 4 February 1976 zone of surface faulting.

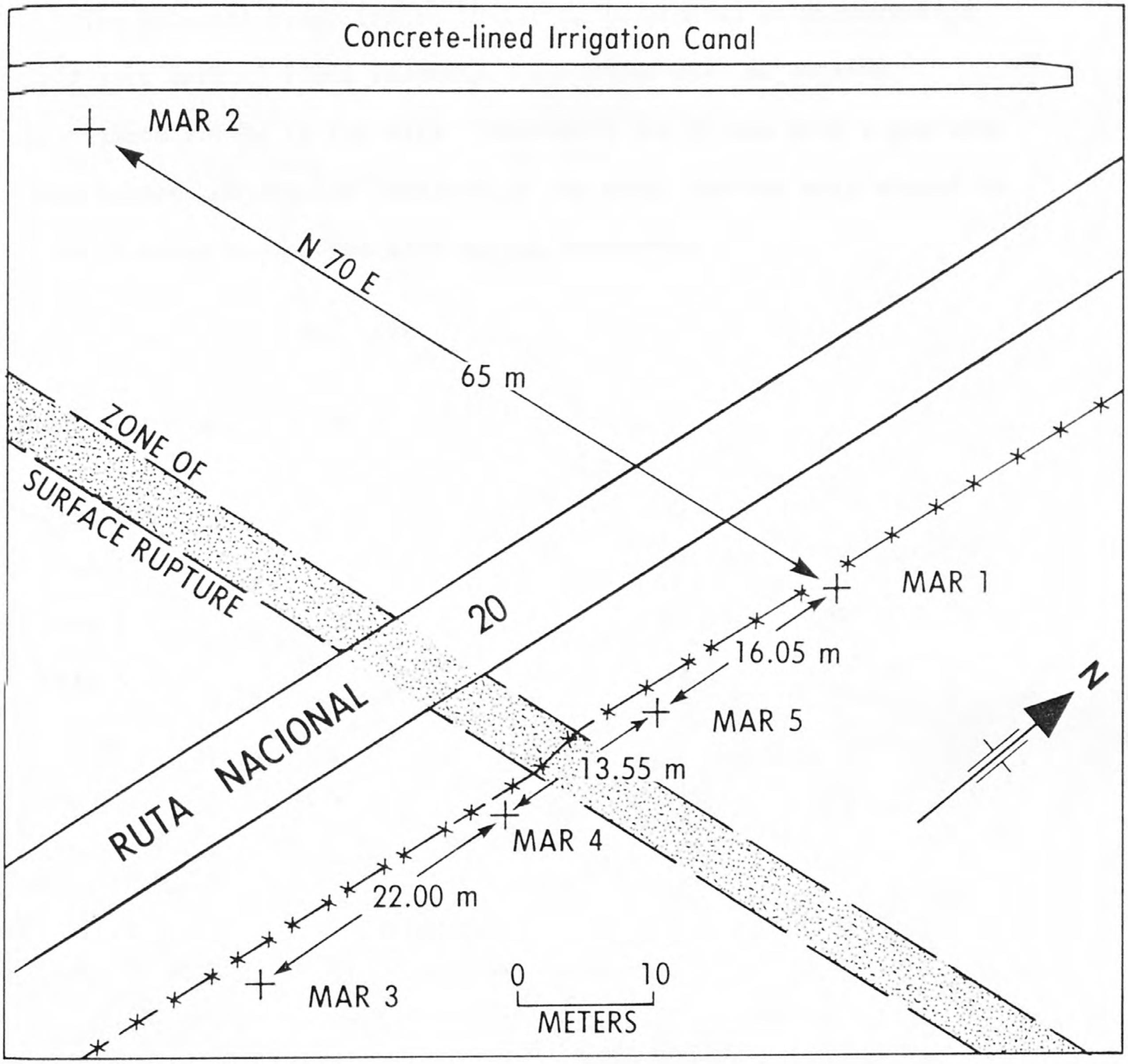

Figure 9.--Survey station locations for the Marmol alinement array.

The Palencia array (figs. 10-12) is located in an uncultivated field just east of Finca Palencia. Equipment must be carried approximately 1 km to the site. Monuments are driven into a gravelly sand; because of the low cohesion of the sand, special care should be given to avoid moving the pins during re-surveys.

Date of Survey: 29 May 1978

Instrument Station = PAL 1

Angle from	To	
PAL 5	PAL 4	102° 06' 09"
PAL 5	PAL 3	102° 03' 37"
PAL 5	PAL 2	102° 08' 39"

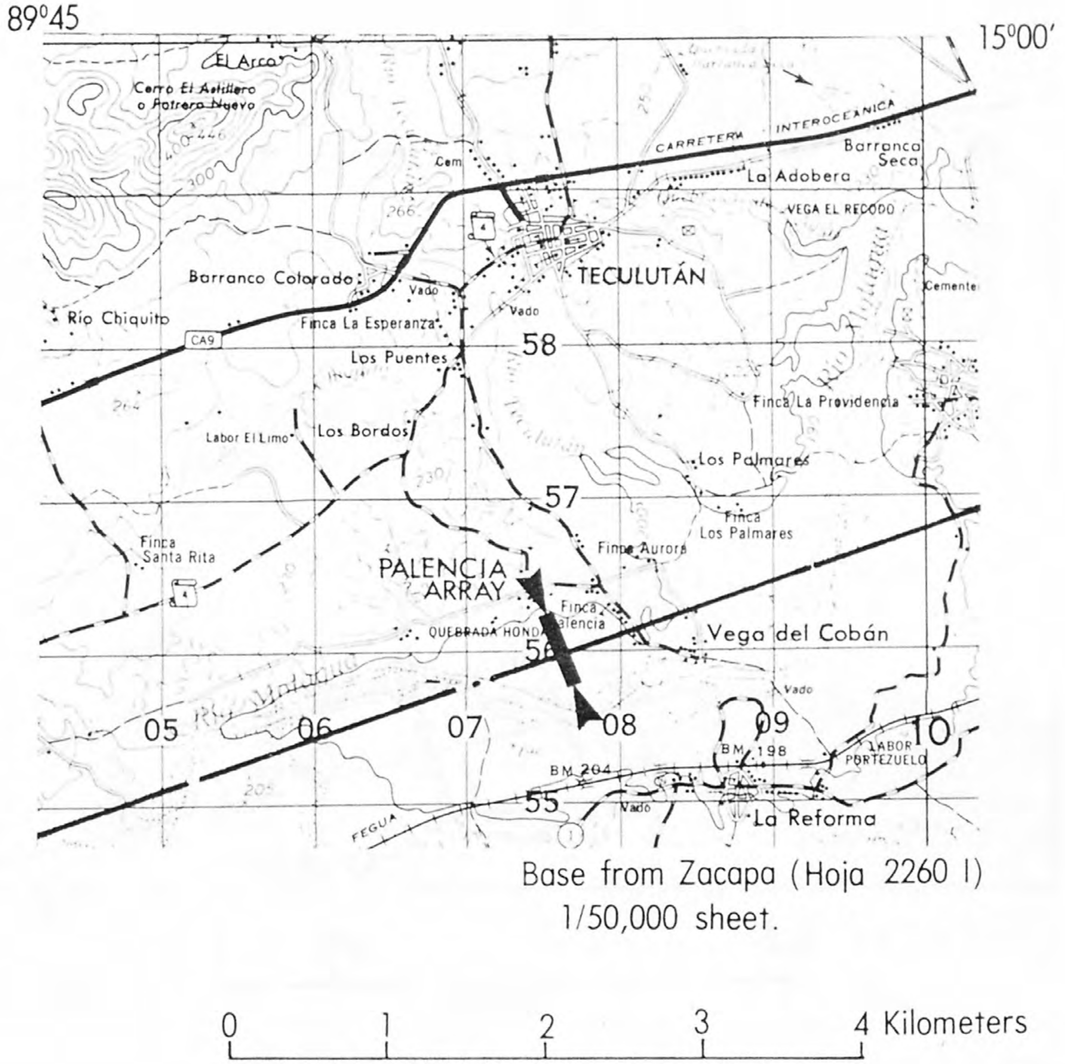

Figure 10.--Location map for the Palencia array. Heavy line shows approximate location of the 4 February 1976 zone of surface faulting.

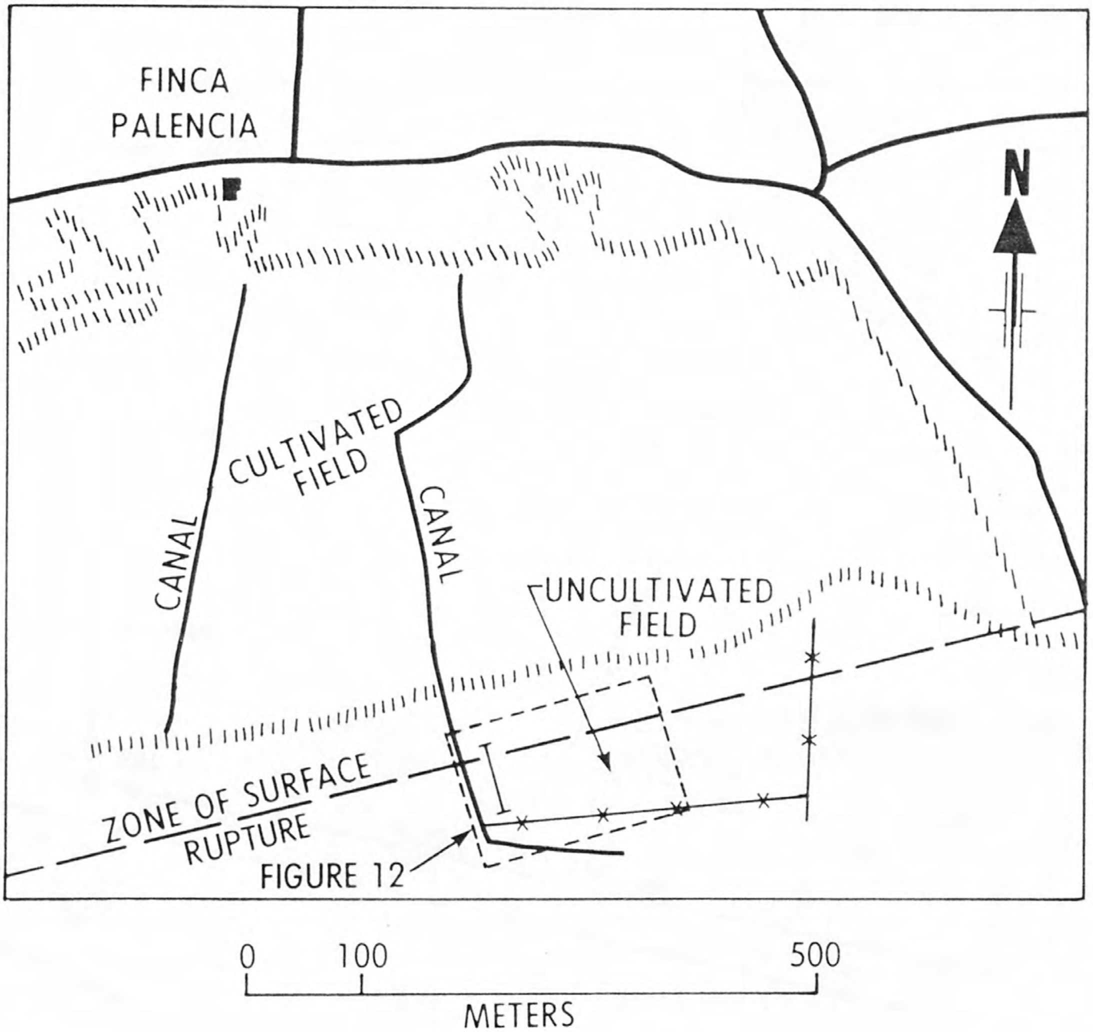

Figure 11.--Map of cultural features in the vicinity of the Palencia array.

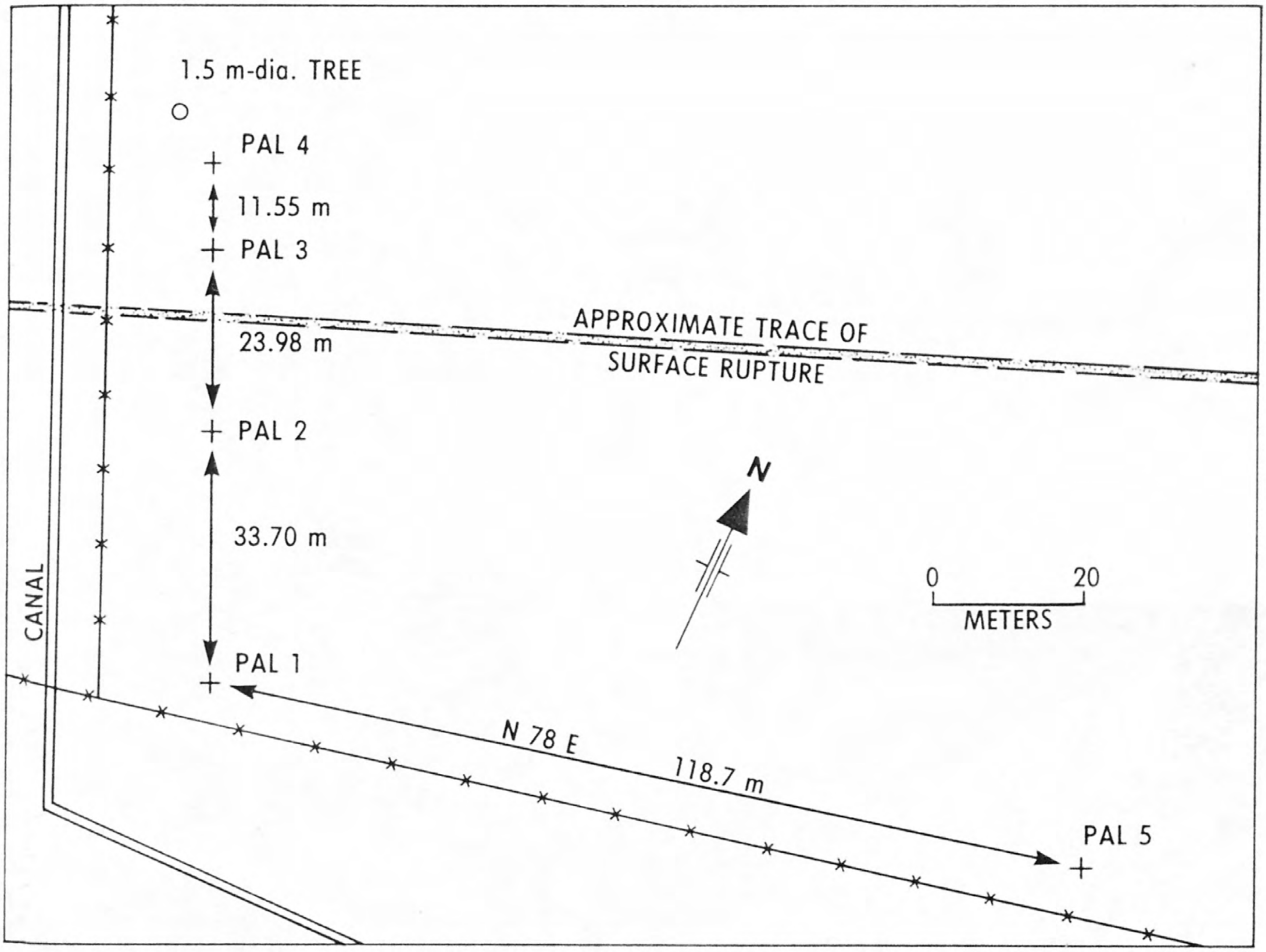

Figure 12.--Survey station locations for the Palencia array.