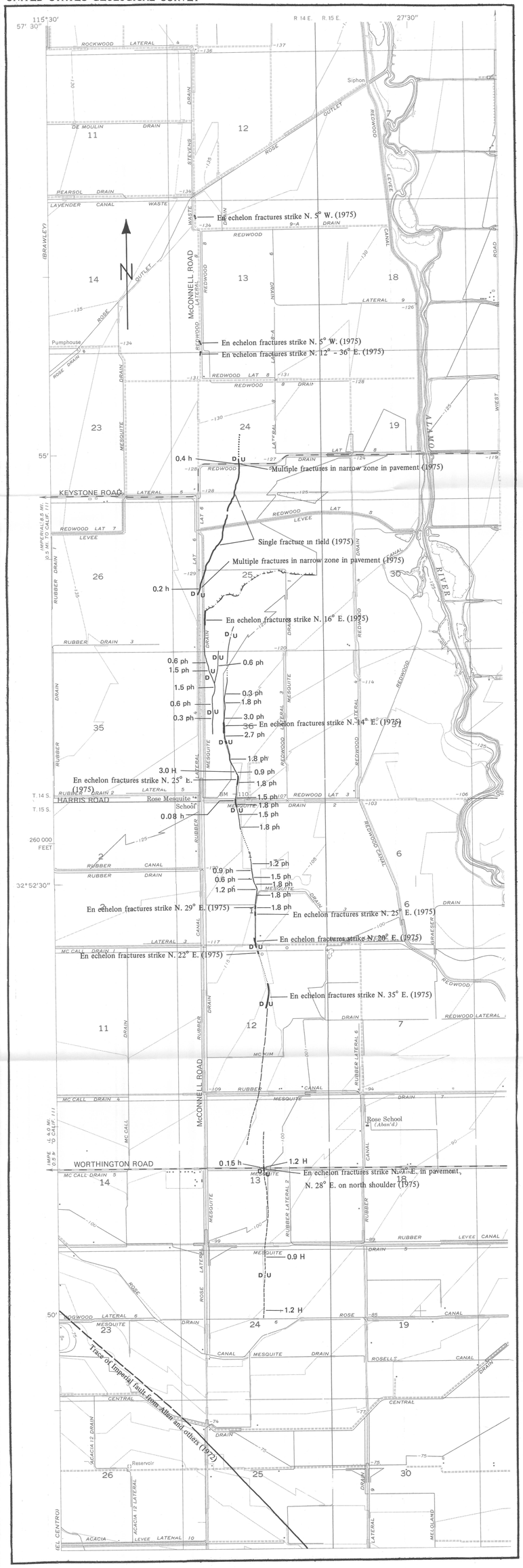
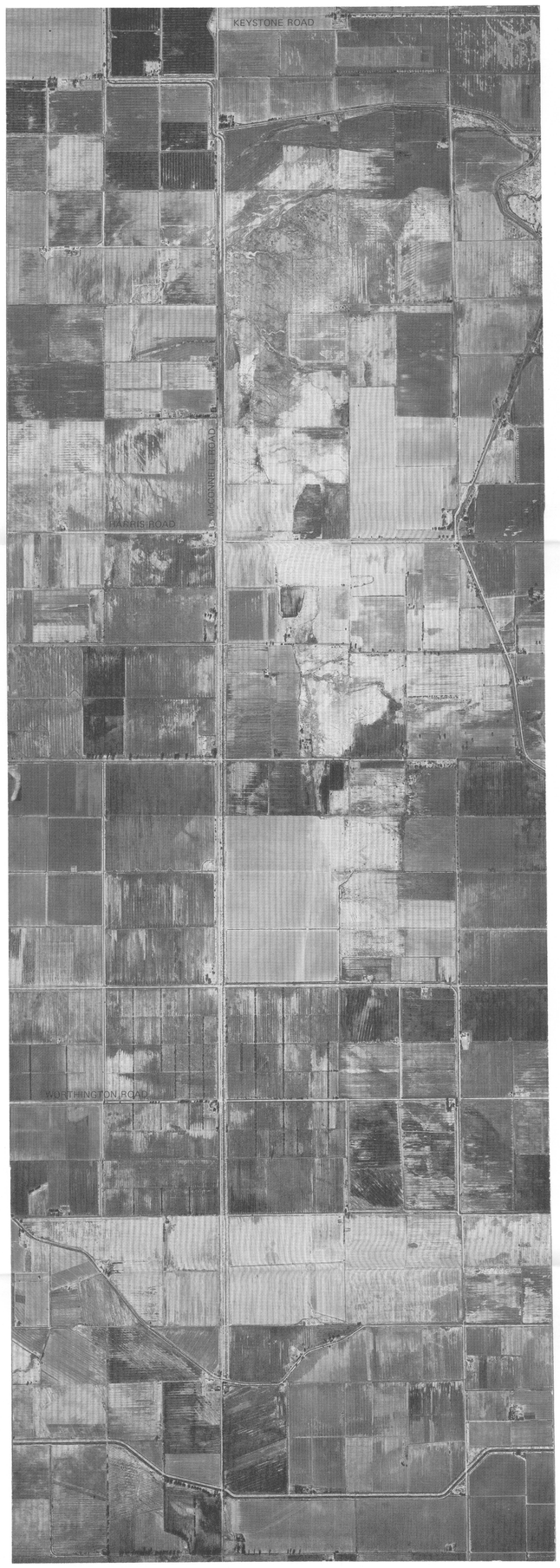
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY





SCALE 1:24 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

QUADRANGLE LOCATION

MAP SHOWING HOLOCENE SURFACE EXPRESSION OF THE BRAWLEY FAULT, IMPERIAL COUNTY, CALIFORNIA

BY

ROBERT V. SHARP

1977

MISCELLANEOUS FIELD STUDIES
MAP MF – 838

SHARP–BRAWLEY FAULT, CALIF.

DISCUSSION

This map shows traces of fault strands along part of the Brawley fault in south-central Imperial Valley (see index map for location with respect to the Imperial fault and surrounding towns). Two kinds of features are displayed on the map--fractures in the ground surface that were observed at the time of the earthquake swarm of January-February 1975 and fault scarps and linears visible on aerial photographs of this region taken in November 1937 by the U.S. Department of Agriculture. A mosaic of these photos along the fault traces is reproduced on this sheet. As a source of data, these photographs are unique; they reveal the natural topographic features of a 3.6-km segment of the fault zone that remained virtually undisturbed in 1937; progressively since then, agricultural activity along the fault has modified or obliterated the fault features. Because only a very minor part of the fault trace now remains approximately in its natural state, few of the features shown on this map are detectable on the ground surface at the present time.

Fractures in the ground surface along the Brawley fault that were mapped in February 1975 (Sharp, 1976) during the later part of an earthquake swarm (see description by Johnson and Hadley, 1976), were located on the topographic base of this map by resection in the field. The fault scarps and photolinears later were transferred to the topographic base with a Kern PG-2 stereoplotter and the same instrument was used to measure height of scarps. Several significant relations are revealed by the superposition of these two sets of data: (1) Within the limits of error (approximately ± 5 m) of the independent methods used to locate the various features, the 1975 surface fractures coincide nearly exactly with the positions of the fault traces as mapped from the 1937 photographs. Correspondence of this type between historic and earlier fault movement has been demonstrated for major segments of several active faults in California. This relation implies that the next movements of the Brawley fault in this area are most likely to reoccur along the fault traces shown on the map. Furthermore, the general locational coincidence of the surface ruptures with the lines of prehistoric movement together with earthquake foci in basement rocks and the en echelon character of the fractures provide compelling evidence that the surface fractures and associated vertical offsets of 1975 reflect tectonic displacement at depth. (2) Two small apparent divergences of the 1975 surface fractures from the earlier trace occur 1.5 and 2.2 km south of Harris Road, but these are limited in extent and fall within an expected "normal" width of disturbance along a fault trace. (3) The surface faulting of 1975 probably developed along at least four separate preexisting strands within the zone of the Brawley fault. A fifth preexisting strand might extend through the fractures in McConnell Road 1.1-2.7 km north of Keystone Road, but the existence of earlier surface faulting at the locations indicated is not substantiated by any known evidence.

Scarp heights indicated for different locations along the fault traces show the amount of cumulative vertical displacement over three subdivisions of Holocene time. The most recent time interval, here termed "historic" (map label, h), corresponds to offsets measured in pavements of Keystone, Harris, Worthington, and McConnell Roads in February 1975. The amount of displacement indicated may not be related entirely to the earthquake swarm itself but may also include pre-1975 displacement by creep after the time of construction of the roads (1960, 1970, 1961, and 1962, respectively). Scarps formed over an interval of time termed "prehistoric" (labeled ph on the map) are marked by relatively steep natural slopes, generally near the west margin of a westward-facing eroded fault scarp of even greater antiquity, designated here as late Holocene in age. Time distinction between prehistoric and late Holocene offsets is made subjectively on the basis of degree of degradation of the respective fault scarps. The cumulative late Holocene offsets designated H on the map correspond to the difference in elevation of the surface of Imperial Valley across the entire width of the degraded slopes of the fault scarps.

REFERENCES

Allen, C. R., Wyss, M., Brune, J. N., Grantz, A., and Wallace, R. E., 1972, Displacements on the Imperial, Superstition Hills, and San Andreas faults triggered by the Borrego Mountain earthquake: U.S. Geol. Survey Prof. Paper 787, p. 87-104.

Johnson, C. E., and Hadley, D. M., 1976, Tectonic implications of the Brawley earthquake swarm, Imperial Valley, California, January 1975: Seismol. Soc. America Bull., v. 66, p. 1133-1144.

Sharp, R. V., 1976, Surface faulting in Imperial Valley during the earthquake swarm of January-February, 1975: Seismol. Soc. America Bull., v. 66, p. 1145-1154.

EXPLANATION

TRACE OF SURFACE FAULTING IN 1975

Heavy solid line represents en echelon fractures or distributed vertical fault movement mapped in February 1975; heavy dotted line, fracturing observed on January 23, 1975, but obliterated prior to accurate mapping (drainage of field now slightly disturbed along location of line); double line, en echelon cracks in pavement without obvious evidence of displacement

FAULT TRACE IDENTIFIED ON 1937 AERIAL PHOTOGRAPHS

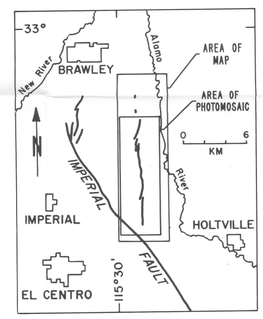
Solid line represents Holocene fault scarps in uncultivated ground; long-dashed line, distinct photolinear in cultivated ground without preserved evidence of displacement of topography; short-dashed line, relatively broad photolinear with indistinct margins in cultivated ground (location shown corresponds to centerline of linear); dotted line, probable fault trace without direct evidence confirming location shown

Numbers with letter suffixes give height of scarps in meters. h, historic vertical displacement estimated from 1975 heights of scarps in pavements (date of pavement construction[1] given in text); ph, approximate vertical displacement since prehistoric time on fault scarps only moderately degraded by erosion (error approximately ± 0.2 m); does not include post-1937 vertical displacement; H, approximate vertical displacement in late Holocene time (see text)

1. Dates of paving of Keystone, McConnell, Harris, and Worthington Roads provided by Imperial County Road Department, 1975.

BOUNDARY OF STREAM CHANNEL

South edge of pre-1937 braided stream channel that terminated northward extent of older fault features. Channel may have been last active during flooding of 1905 to 1907. Post-1937 agricultural activity has destroyed all surficial evidence of this channel



INDEX MAP

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