One of the limitations of the archeological record is that sites with sufficient tools to be useful for geologic stratigraphy and geologic mapping are mostly at the surface, and these provide only a limital date for the underlying deposit. Only rarely are diagnostic artifacts contained within a deposit over sufficient extent or in sufficient numbers to be exposed in a cross-section cut and thus useful in geologic mapping. Nevertheless, the sites, especially the younger ones, are sufficiently numerous to be of great assistance in many areas for distinguishing the different stages of Recent deposits.

REFERENCES

Hunt, C. B., 1953, Pleistocene-Recent boundary in the Rocky Mountain region: U.S. Geol. Survey Bull. 996–A, p. 1–25.

Lyell, Charles, 1873, Geologic evidences of the antiquity of man: 4th ed. London, p. 3–4.

Forbes, Edward, 1846, On the connexion between the distribution of the existing fauna and flora of the British Isles and the geologic changes which have affected their area, especially during the epoch of the northern drift: Geol. Survey of England and Wales, Mem., v. 1, pt. III, p. 402–403.

Krieger, A. D., 1950, A suggested general sequence in North American projectile points: Utah Univ. Anthropological Papers, no. 11, p. 117–124.

82. EVIDENCE OF STRIKE-SLIP MOVEMENT ON NORTHWEST-TRENDING FAULTS IN MOJAVE DESERT, CALIFORNIA

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The western Mojave Desert region is transected by many prominent northwest-trending high-angle faults, as shown on figure 82.1. These are nearly parallel to the San Andreas fault and terminate south of the Garlock fault, and they cut Quaternary sediments and basalt; many have inconsistent or even alternating vertical displacements. Movements on these faults have been interpreted to be mainly dip-slip (Hewett, 1954, p. 17). However, geologic mapping of this region during the past few years reveals that structural and physiographic features adjacent to some of these faults indicate or suggest movements that are predominantly right lateral, as on the San Andreas fault, but on a smaller scale.

In the western part of this region, southwest of Mojave, two northwest-trending faults (fig. 82.1 *A*) show conclusive evidence of right-lateral displacement but no discernible vertical displacement. Vertical east-trending pre-Tertiary rock units transected by these two faults are offset as much as 1,500 feet, and several southward-draining stream-channels that dissect the overlying Quaternary fan gravel are deflected westward as they cross the faults.

Farther east, in the central part of the region, a northwest-trending fault (fig. 82.1 *B*) transecting an extensive exposure of Mesozoic granitic rock south of Boron offsets several hundred feet right laterally a network of vertical dikes of pegmatite and aplite (Dibblee, 1961).

Still farther east, metavolcanic rocks that are exposed on the southwestern side of the Helendale fault (fig. 82.1 *C*), notheast of Victorville, are apparently displaced several miles northwestward. Vertical displacements on this fault are reversed at several places on its course and are small.

On the Lockhart fault (fig. 82.1 *D*) northeast of Boron, vertical displacements are small and alternating. On the northeast block undrained depressions formed in Quaternary alluvium along several north-trending branch faults (Dibblee, 1959) suggest that these branch faults may be in part tension fractures resulting from internal stresses set up by right-lateral drag movement of the block.

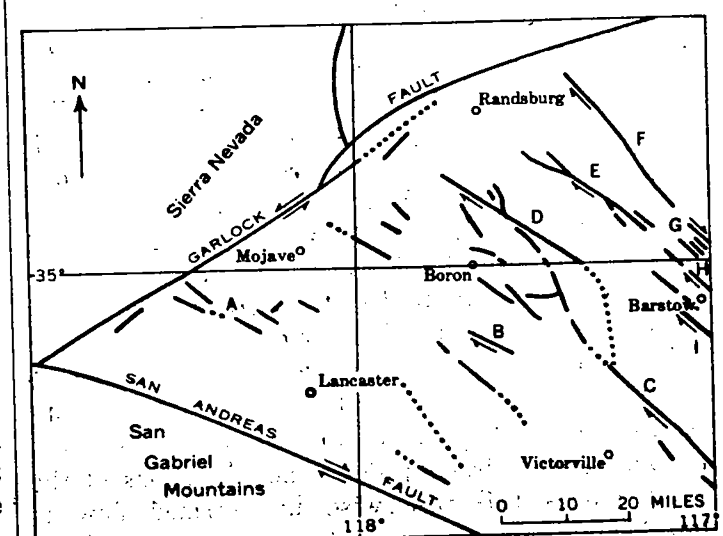

FIGURE 82.1.—Faults in the western Mojave Desert region (between San Andreas and Garlock faults). Position of faults referred to in text is indicated by letters.

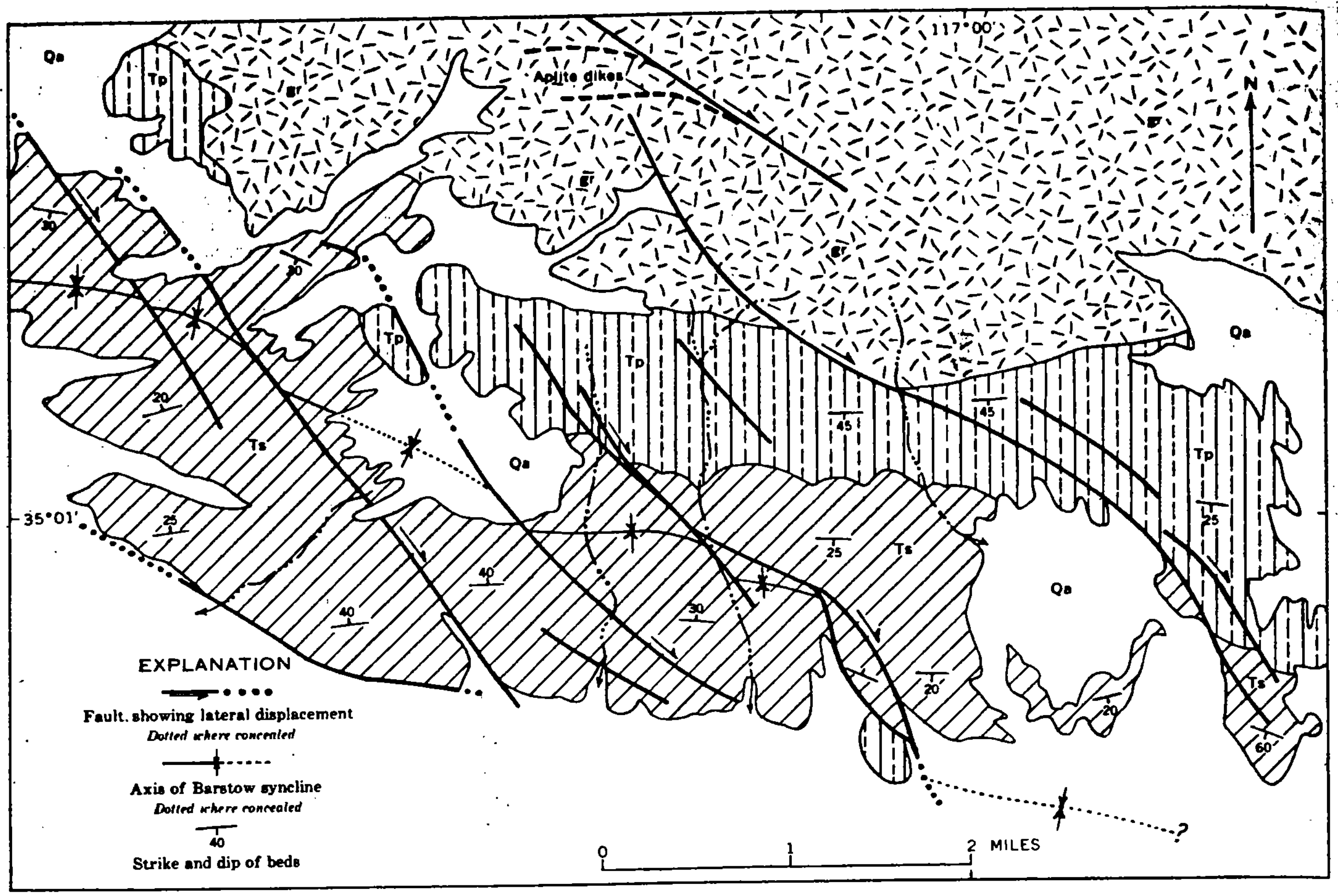

FIGURE 82.2.—Map of the Mud Hills near Barstow. Qa, alluvial sediments, Quaternary; Ts, sedimentary rocks, Miocene; Tp, mainly pyroclastic rocks, Miocene(?); gr, granitic rocks, Mesozoic.

Southeast and east of Randsburg, structural features in the Tertiary and Quaternary sedimentary and volcanic rocks strongly suggest right-lateral drag movement and displacement along the Harper and Blackwater faults (Hewett, 1954, pl. 1). The Harper fault (fig. 82.1 *E*) is a zone of several minor parallel faults along which Tertiary rocks are compressed into folds with axes trending east as compared to the northwesternly trend of the faults, and the axes of several folds are offset right laterally along several of the faults of this zone. The Blackwater fault (fig. 82.1 *F*), a few miles northeast, also offsets contacts of several rock units right laterally. Southeastward, both these faults pass into and apparently die out under a thin but extensive cover of Quarternary basalt; along the extensions of the fault traces this otherwise undeformed flow is buckled into several arches whose axes trend south of east, indicating right-lateral drag movement. Vertical displacements on these faults are small and inconsistent.

In the Mud Hills, 8 to 12 miles north of Barstow and a few miles southeast of the Quaternary basalt flow under which the Blackwater fault disappears, granitic rocks are overlain by some 6,000 feet of stratified rocks of Miocene age that are compressed into a symmetrical syncline with an axis trending nearly east. This axis and some contacts between rock units are offset right laterally by several northwest-trending faults (fig. 82.1 *G*) that diagonally transect the folded sequence as shown on figure 82.2. Nearly horizontal grooves can be seen on several of the fault planes where well exposed. On the southwest block of a fault north of the Mud Hills, aplite dikes are bent parallel to the fault where they approach it (fig. 82.2).

A northeast-dipping fault (fig. 82.1 *H*) near Barstow (Dibblee, 1960) has generally been regarded as a thrust fault (Waterman thrust of Bowen, 1954, p. 104–105, pl. 1) with vertical uplift on the northeastern block. Recent mapping reveals that it displaces a small granitic intrusion right laterally a few hundred feet. The northeast-trending foliation of the gneiss of this area bends northwesterly, parallel to the fault along part of its course.

Another northwest-trending fault (fig. 82.1 *I*) southwest of Barstow (Dibblee, 1960), displaces right laterally the axis of at least one large east-trending fold in Quaternary alluvial sediments and terminates several drag folds east of the fault.

Evidence of right-lateral displacement on several other northwest-trending faults in the western Mojave Desert region is lacking, but their straight traces suggest all are high-angle or vertical faults. None shows evidence of left-lateral movement.

At a few places where some of the northwest-trending faults are exposed, the fault planes are generally vertical or dip steeply. Steep dips are suggested, also, by the generally straight traces of all the faults. They generally transect hilly terrain or alluviated valleys. Gravity data (Mabey, 1960) indicate that, with a few local exceptions, the faults do not bound the deep alluvial basins. Some form only low scarps, and none lies at the foot of high steep mountain fronts. Strike-slip displacements probably exceed vertical displacements along some of the faults; some show little or no geologic or physiographic evidence of vertical displacement, yet make conspicuous lineations on aerial photographs. In marked contrast, most of the great normal faults of the region north of the Garlock fault trend north, sharply bound alluviated valleys and mountain ranges, have imposing fault-line scarps, commonly curve abruptly or jog, and dip toward the sunken valley blocks.

Presumably, the strike-slip movement of the northwest-trending faults are related to movement along the San Andreas fault, but the movements are of much smaller magnitude.

REFERENCES

Bowen, O. E., Jr., 1954, Geology and mineral deposits of the Barstow quadrangle, San Bernardino County, Calif.: California Div. Mines Bull. 164, p. 1–185.

Dibblee, T. W., Jr., 1959, Geologic map of the Boron quadrangle, California: U.S. Geol. Survey Mineral Inv. Field Studies Map MF–204.

——— 1960, Geologic map of the Barstow quadrangle, San Bernardino County, California: U.S. Geol. Survey Mineral Inv. Field Studies Map MF–233.

——— 1961, Geology of the Rogers Lake and Kramer quadrangles, California: U.S. Geol. Survey Bull. 1089–B.

Hewett, D. F., 1954, A fault map of the Mojave Desert region, [Pt.] 2, Chap. 4 of Jahns, R. H., ed., Geology of southern Cailfornia: California Div. Mines Bull. 170, p. 15–18.

Mabey, D. R., 1960, Gravity survey of the western Mojave Desert, California: U.S. Geol. Survey Prof. Paper 316–D, p. 51–72.

83. ZONING OF SALINE MINERALS AT DEEP SPRING LAKE, CALIFORNIA

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The Deep Spring Valley is a relatively small intermontane basin in northern Inyo County, Calif. Drainage is wholly internal and the area possesses many features in common with the larger lacustrine closed basins of the region. At the southern end of the valley is a small playa known as Deep Spring Lake (fig. 83.1). The playa is nearly equidimensional and covers an area of approximately 5 square miles. The northeastern third of this area has a porous multilayered saline crust up to 16 inches thick and is underlain for the most part by fluid organic black mud. This area is outlined by a low levee built up in connection with a commercial attempt to obtain potash salts. The playa south and immediately west of the levee is covered by a thinner saline crust, which overlies dense moist gray-green or brown mud. The western one-third of the area consists of clay, grading to silt and sand toward the playa margins; much of this area is marked by very shallow alluvial channels and is covered by efflorescent salt crust.

The distribution of saline minerals in the Deep Spring Lake deposits is largely dependent on the hydrography of the area. About two-thirds of the area enclosed by the levee contains a perennial body of dense highly colored brine, which is exposed in a