last October

7.3 quake in Algeria reviewed

After a devastating earthquake struck northern Algeria last October, killing more than 5,000 people and leaving 200,000 homeless, Algeria's Ministry of Education & Scientific Research invited a team from the U.S. Geological Survey to study the quake's surface effects. Here is a report based on field investigations Nov. 5-15.

An earthquake of surface-wave magnitude 7.3 struck at 13:30 CCT on Oct. 10, near El Asnam. Its epicenter was at 36.17°N, 1.36°E, and its depth of focus was about 6 km, as calculated by the National Earthquake Information Service, in Denver. The epicenter was about 170 km west of Algiers and about 45 km south of the Mediterranea

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ent fractures associated with the El Asnam earthquake last October were caused by primary faulting along a northeast-trending thrust and complex secondary faulting within the hanging-wall block northwest of the thrust. The arcuate fracture pattern near Beni Rached nearly duplicates the pattern documented by a French team led by Jean-Pierre Rothé, during its investigation of an earthquake in the same region in 1954. (Based on a map by G.C.P. King & others, Cambridge University.)

and not so continuous as indicated by the general representation on the map. The main surface break strikes about N42°E and dips between 8° and 25° to the northwest at most sites. However, dips as high as 60° were estimated or measured at a few sites, and those values are more consistent with a dip of 55° to 60°, given by the fault-plane solution for the main shock, according to S.T. Harding. In that respect, the 1980 El Asnam earthquake was similar to the earthquake of Feb. 9, 1971, in the San Fernando Valley of California.

The central and northeast sections of the main break were along the base of the steep southeast slope of a ridge about 200 m high, northwest of Oued Fodda. The maximum vertical component of displacement, measured across scarp produced by thrust movement on an 8-km central section of the main break, was 2.6 m near Oued Fodda, so that, given an assumed dip of about 30°, a maximum dip slip of more than 5 m would be
represented (3.4-m dip slip assuming 50° dip). However, the scarp heights at most sites along the 8-km central section of maximum displacement adjacent to Oued Fodda were about 1.0 to 1.4 m, and a more representative estimate of dip slip at the surface thus would range from 2 to 3 m. The surface expression of thrusting died out a few kilometers northeast of a change in strike to N68°E along the main break. That bend in the fault trace coincided with a similar change in the trend of the base of the slope marking the northwest side of Oued Chéïiff valley.

An irregular zone of secondary normal faulting and extensional features such as grabens developed roughly parallel to the central and northeast sections of the main thrust break within 1 to 2 km to the northwest, and extended for about 15 km along the same trend, beyond the northeast end of the surface expression of thrust faulting. Scars along the normal faults above the shallow part of the thrust were generally more conspicuous, if not larger, than those along the trace of the main break.

A complex zone of predominantly normal faulting occurred in the vicinity of the village of Beni Rached, within the hanging-wall block of the thrust, about 6 to 7 km northwest of the main thrust break. Most of the surface fractures in that area were probably produced by secondary faulting, although a few are related to landslides. Scarp heights produced as a result of slip on normal faults just west of Beni Rached typically were slightly less than 1 m (vertical offset) but ranged up to 1.26 m. The accurate pattern of surface breaks near Beni Rached, associated with the 1980 earthquake sequence, nearly duplicates the fracture pattern mapped by Jean-Pierre Rothé and his colleagues ('Le tremblement de terre d’Orléansville et la seismicité de l’Algérie', La Nature n. 3237, p. 1–9, January 1955).
Normal-fault scarps appear on the southeast slope of the northeast-trending ridge northwest of Oued Fodda (3b). Other scarps developed along parts of the subdivided thrust break (middle foreground). (Photo by Robert O. Burford.)

A fault-plane solution for the main shock in 1954 indicated thrusting on a northwest-dipping surface having a northeast strike, according to Dan McKenzie ('Active tectonics of the Mediterranean region,' *Geophysical Journal of the Royal Astronomical Society*, v. 30, p. 109–185). Similar fault-plane solutions are derived from seismic data for the recent main shock and principal aftershock (strike N42°E, dip to NW at 55° to 60°, as reported by S.T. Harding). Those solutions reinforce the suggestion, based on the observed regeneration of the pattern of surface fractures near Beni Rached, that the 1954 and 1980 earthquake sequences may have originated on the same structure or structures, even though no field evidence was reported in 1954 for surface breakage along the trace of the thrust fault.

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Near Beni Rached (5), the normal-fault scarp is 1.26 m high. (Photo by Robert O. Burford.)