

TEXT

Introduction

The Capitan aquifer of Permian (Guadalupean) age is an important source of the ground water used for municipal, industrial, and agricultural purposes at and in the vicinity of Carlsbad, N. Mex. In addition, water pumped from this aquifer in southern Lea County, New Mexico, and Winkler and Ward Counties, Texas, is injected into other subsurface reservoirs by oil companies to increase the recovery of petroleum from partly depleted oil fields (Hiss, 1971; White, 1971). A knowledge of the structural position of the Capitan aquifer in southeastern New Mexico and western Texas will be useful in programs designed either to explore for and develop additional ground-water supplies or to manage this important resource.

The Capitan aquifer

The Capitan aquifer is a lithosome that includes the Capitan and Goat Seep Limestones and most of all the Carlsbad facies of the Artesia Group as recognized by Meissner (1972) and herein used for the near shelf-margin carbonate facies of the Artesia Group (Hiss, 1975a). Some of the shelf-margin carbonate banks or reefs in the upper part of the San Andres Limestone are included within the Capitan aquifer where they cannot be readily distinguished from the Goat Seep Limestone and Carlsbad facies (Hiss, 1975a; 1975b). The Capitan aquifer closely agrees with the Capitan and Goat Seep Limestones and porous and permeable shelf-margin limestone and dolomite members in the San Andres Limestone (Silver and Todd, 1969, Figs. 12 and 13).

Geographic extent

The locations of nearly 400 wells that have been drilled through the Capitan aquifer within the project area, together with the corresponding structural altitude of the Capitan aquifer penetrated in each well, are plotted on this map. The Capitan aquifer is a continuous unit along the north and east margins of the Delaware basin. Large displacements of the Capitan aquifer by faulting appear to be limited to the mountainous areas along the western and southern parts of the Delaware basin, because faults have not been observed in the subsurface along the western edge of the Central Basin platform and the southern edge of the Northwestern shelf. The irregular top and bottom surfaces and the lobate fore and back-reef edges are depositional forms (map and geologic sections A-A' and B-B'). The age parent major lateral displacement of the Capitan aquifer in the vicinity of T. 23 S., R. 22 E., approximately 15 miles (24 km) southeast of Carlsbad, is not a post-Capitan age fault. This shift in position is probably due to growth of the Capitan reef along a pre-Guadalupean age fault-controlled alignment of the Delaware basin (Hiss, 1963, p. 1715; 1970).

The fore-reef edge of the Capitan aquifer appears to be relatively steep throughout the area. If exposed, this abrupt slope would undoubtedly resemble the reef escarpment southwest of Carlsbad in the Guadalupe Mountains (Green and others, 1964; Newell and others, 1953). Well control is adequate for definition of the fore-reef slope of the Capitan aquifer at several locations in the subsurface. Approximately 1,200 feet (366 m) of vertical relief along the fore-reef edge of the Capitan aquifer was detected in two oil tests drilled within a few hundred feet of one another in secs. 5 and 9, T. 22 S., R. 33 E., Lea County, New Mexico (McIntyre, 1972, plate 1). Similar evidence of the relative steepness of the fore-reef side of the Capitan aquifer is available where deep-well drilling is concentrated in the newly discovered gas fields in the vicinity of Pecos, Mink, and Fort Stockton in Winkler, Ward, and Pecos Counties, Texas, respectively.

The back-reef edge of the Capitan aquifer is much more irregular than the fore-reef edge and is gradational in nature. In some areas, especially along the western edge of the northern part of the Central Basin platform, it is difficult to distinguish the Capitan aquifer from the upper part of the San Andres Limestone. In this area the Capitan aquifer has been extended to include the stratigraphic reef facies of the San Andres Limestone because of the proximity, and similar lithology and hydraulic behavior of the two units (geologic sections A-A' and B-B').

Structural position

The structural position of the Capitan aquifer is shown in longitudinal and transverse geologic sections and in a structural map with contours of the top of the Capitan aquifer. The Capitan aquifer is one continuous unit along the north and east margins of the Delaware basin. Large displacements of the Capitan aquifer by faulting appear to be limited to the mountainous areas along the western and southern parts of the Delaware basin, because faults have not been observed in the subsurface along the western edge of the Central Basin platform and the southern edge of the Northwestern shelf. The irregular top and bottom surfaces and the lobate fore and back-reef edges are depositional forms (map and geologic sections A-A' and B-B'). The age parent major lateral displacement of the Capitan aquifer in the vicinity of T. 23 S., R. 22 E., approximately 15 miles (24 km) southeast of Carlsbad, is not a post-Capitan age fault. This shift in position is probably due to growth of the Capitan reef along a pre-Guadalupean age fault-controlled alignment of the Delaware basin (Hiss, 1963, p. 1715; 1970).

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The contours showing the structural position of the top of the Capitan aquifer may falsely suggest a series of closed structural highs alternating with plunging synclines. However, when the configurations of the contours of the structural position and the thickness of the Capitan aquifer (Hiss, 1975b) are compared, there is a striking coincidence of features. Apparently, most of the features appearing as structural lows are depressions in the surface of the Capitan aquifer and are due to nondeposition and/or erosion in surge channels and submarine canyons of Guadalupean age rather than to warping of the Capitan aquifer (Hiss 1974; 1975a; 1975c).

Most of the features resembling structural highs are not due to structural uplift but are probably carbonate-rock mounds. The Hendrick, Monument, and other fields along the western margin of the Central Basin platform produce from closed highs depicted on structural maps with contours of the top of the Yates Formation (Jekely, Bednarczyk, and Smith, 1930; Stipp and Haigler, 1956; Garza and Wesselman, 1962, Fig. 2; Hiss, 1975a, Figs. 15 and 19). The carbonate-rock mounds described by Stipp and Haigler (1956), and Morris (1972) that form the traps for the small fields east of Carlsbad are probably not primarily due to structural deformation. Apparently, very few closed structures in the Capitan have been found along the northern margin of the Delaware basin.

The Capitan aquifer plunges to the northeast away from the Guadalupe Mountains and passes beneath the surface about 10 miles (16 kilometers) southwest of Carlsbad. The crest of the Capitan aquifer is at an altitude of approximately 3,000 feet (915 metres) at Carlsbad. At this point the Capitan aquifer turns eastward and continues to plunge in the subsurface, until altitudes of 500 to 750 feet (150 to 230 metres) below sea level are reached along the Central Basin platform west of El Paso, N. Mex. The crest of the Capitan aquifer generally remains at altitudes between 500 and 750 feet (150 and 230 metres) below sea level along the western margin of the Central Basin platform from the vicinity of El Paso, N. Mex., southward to near Belding, southwest of Fort Stockton, Texas. The Capitan aquifer rises steeply southward from Belding to exposures in the Glass Mountains, where altitudes exceed 4,000 feet (1,220 metres) above sea level.

Depths to the top of the Capitan aquifer from the land surface in New Mexico vary from not more than a few hundred feet in the Pecos River valley at Carlsbad to more than 4,300 feet (1,310 metres) in the western part of southern Lea County. Depths to the Capitan aquifer in Ward, Winkler, and northern Pecos Counties, Texas, range from less than 2,500 to more than 3,300 feet (760 to 1,005 metres, respectively).

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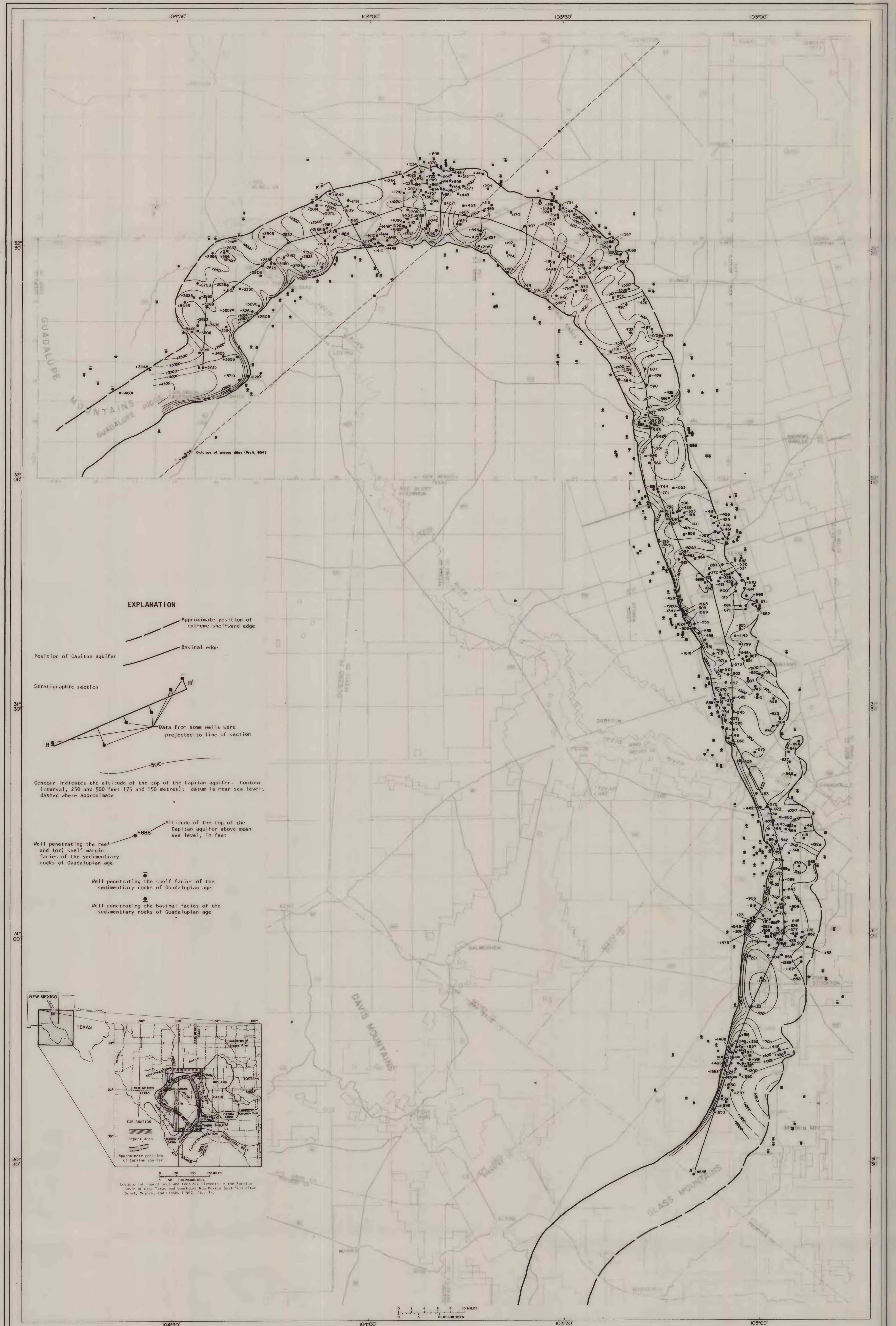
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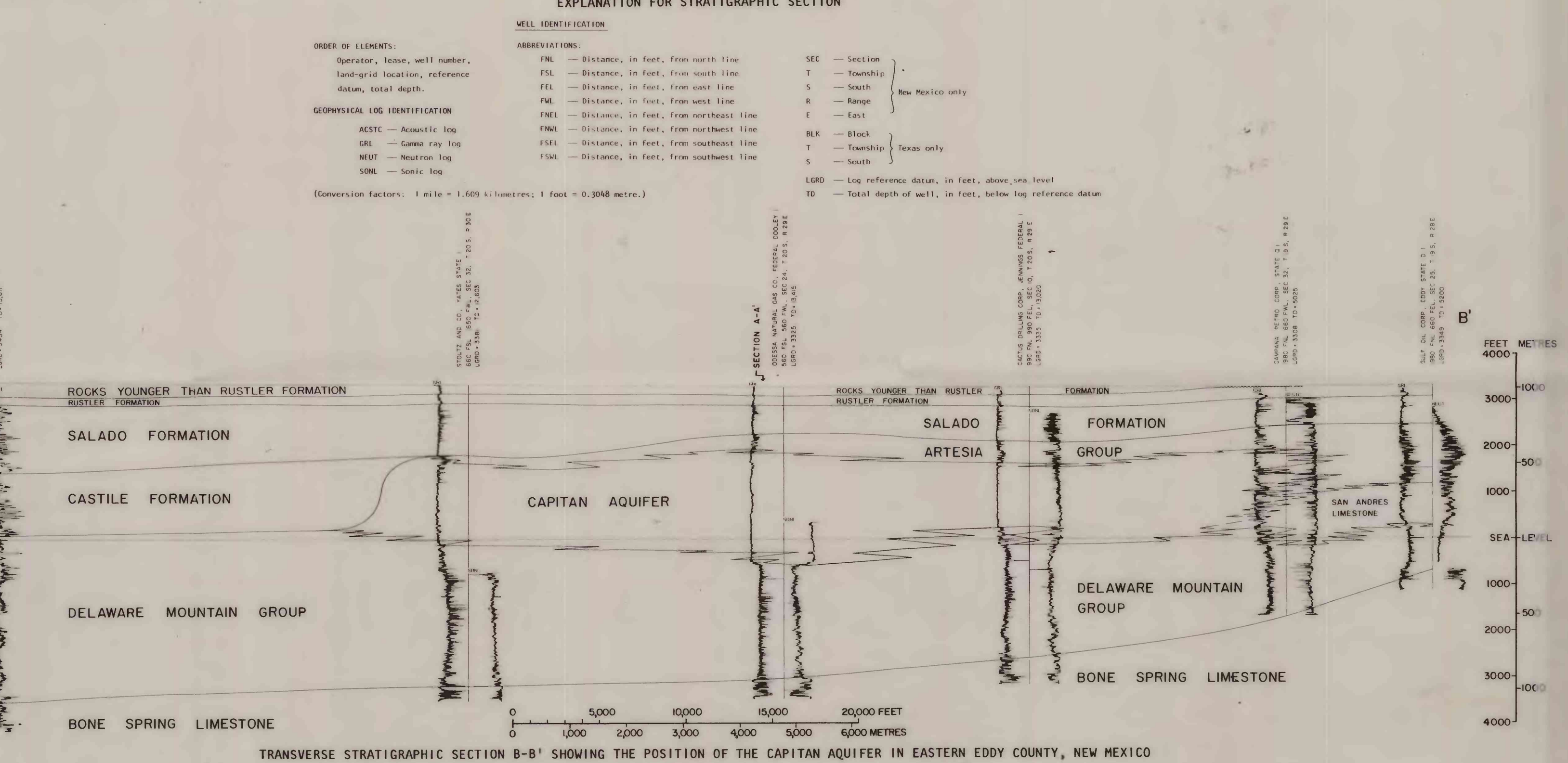
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New Mexico base from U.S. Geological Survey, Branch of Oil and Gas Operations, Bureau of Oil (scale = 2 miles [1961]). Texas base from Meissner, Map Co. 80-2 (1969), 80-3 (1960), 80-4 (1961), 80-11 (1964), 80-12 (1960), 80-13 (1961), 80-17 (1965), and 80-18 (1953). Top = 2,000 feet. Used with permission of Richard Map Co.

Outline of the outcrop of the Capitan aquifer in New Mexico adapted from Hayes and Koogler, 1958; Hayes, 1967 and 1964; and Morris, 1962. Outline of the outcrop of the Capitan aquifer in Texas adapted from King, 1930.



TRANSVERSE STRATIGRAPHIC SECTION B-B' SHOWING THE POSITION OF THE CAPITAN AQUIFER IN EASTERN EDDY COUNTY, NEW MEXICO

STRUCTURE OF THE PERMIAN GUADALUPIAN CAPITAN AQUIFER, SOUTHEAST NEW MEXICO AND WEST TEXAS

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