REGIONAL HYDRODYNAMICS WITHIN THE EDWARDS LIMESTONE, SOUTH-CENTRAL TEXAS[1]

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ABSTRACT

The "bad-water line" of the Edwards aquifer separates two hydrologic systems — an updip fresh-water zone and a downdip saline-water zone (Fig. 1). The "bad-water line" has been attributed to fault control and to facies changes, but it probably developed as a hydrologic barrier indirectly controlled by periodic structural adjustments of the Balcones/Ouachita hinge zone. The plan view of the "bad-water line" shows the line to converge toward certain major springs along the Balcones Escarpment. These springs are potentiometric base levels that draw on the well-integrated (locally cavernous) porosity system of the fresh-water zone. The "bad-water line," then, is a lateral boundary of underground "watersheds" whose "mouths" are the springs. Within the fresh-water zone, porosity is so uniform and permeability so high that the waters have almost homogeneous properties: TDS content is generally less than 350 mg/L, and temperature ranges from 71°F to 82°F. Downdip from the "bad-water line" the waters are moderately homogeneous; divergent TDS content indicates multiple sources and ineffective mixing probably owing to poorly integrated porosity systems. TDS values near the line are greater than 1,000 mg/L and commonly exceed 3,500 mg/L; water temperatures there are generally greater than 90°F and commonly as much as 110°F.

The divergent histories of the two hydrologic systems are clearly indicated by the temperature/depth relations of the two waters. The rapid recharge and efficient underground flow in the fresh-water zone cause a thermal depression (relative to a "normal" geothermal gradient of up to 1.75°F/100 ft on the basis of BHT/depth relations for nearby deep oil tests). In contrast, the saline-water zone displays thermal anomalies (up to 2.5°F/100 ft) suggesting local upwelling of waters. These upwelling waters contain H_2S and may be genetically related to brines produced from nearby oil fields. Moreover, our chemical analyses show the saline waters to be typically oversaturated with respect to fluorite, and fluorite does precipitate in some area well bores. Other researchers have also documented high lead concentrations in these waters. These findings indicate that a Mississippi Valley-type ore deposit may be forming in parts of the Edwards Limestone.

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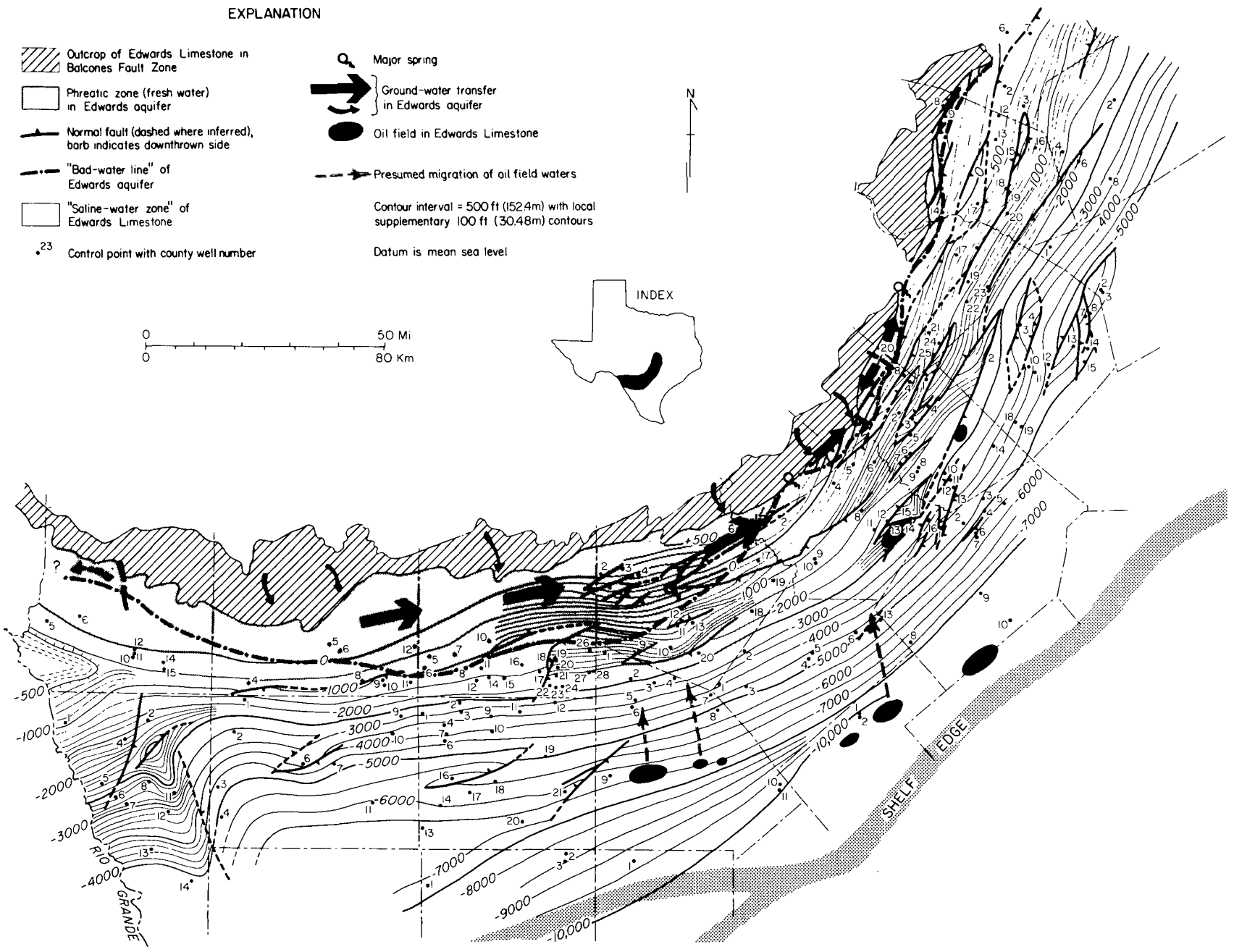

Figure 1. Regional fluid-flow patterns in the Edwards Limestone compared to structural contours on the top of the Edwards.