SIGNIFICANCE OF VEIN-FILLING CALCITES: RICHLAND CREEK FRACTURE ZONE, LOWER AUSTIN CHALK (UPPER CRETACEOUS), NORTH-CENTRAL TEXAS

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ABSTRACT

The ''Richland Creek Fracture Zone'' near Milford (Ellis County), Texas, exposes gently flexured lower Austin Chalk (Coniacian) strata which have been disrupted by numerous, northeast-trending (N35° to 40° E), small-scale faults (displacements less than 3m) and closely spaced en-echelon joints. Slickensides, preserved on outer surfaces of vein-filling calcites, record movement along these faults. Swarms of calcite-filled microfractures are developed locally. Most associated joints are stained with iron oxides but have remained uncemented. This intensely fractured and faulted outcrop represents the termination of small northeastward-trending graben along the northernmost extension of the Balcones fault system (Reaser and Collins, 1988).

Multiple generations of coarsely crystalline, nonferroan calcite cemented Richland Creek faults. Individual calcite crystals range up to several centimeters (maximum length) and are oriented perpendicular to vein walls. The width of these calcite veins ranges from 2 to 45 cm. Calcite crystals from seven veins were sampled systematically and analyzed for this study. Petrographic textures reveal several episodes of cross-cutting veins in the Austin Chalk. En-echelon microfractures are commonly bifurcated and exhibit wispy terminations. The most reasonable origin for these veins is a series of fracturing events caused by increases in pre-fluid pressure.

Calcite cements from Richland Creek faults have mean stable isotopic compositions of $\delta^{18}O$ -8.4‰ (PDB) and $\delta^{13}C$ +1.7‰ (PDB). The oxygen isotopic composition of these vein-filling calcites is significantly depleted relative to that of the adjacent Austin Chalk matrix ($\delta^{18}O$ -3.3‰ PDB) and Cretaceous seawater. Similar isotopic compositions have been reported for vein-filling calcites from other Austin Chalk outcrops (Corbett et al., 1991a) and deep subsurface Austin Chalk cores (Czerniakowski et al., 1984). Such depleted oxygen isotopic values are indicative of warm fluids moving updip along the Balcones fault system. Strontium isotope ratios of Richland Creek vein-filling calcites suggest that the Austin Chalk sourced the calcite (i.e., semi-closed diagenetic system).

Calcite-cemented fractures occur in Austin Chalk outcrops (Reaser and Collins, 1988; Corbett et al., 1991b; Dawson and Reaser, 1991) as well as in subsurface Austin strata (Dawson, 1986; Corbett et al., 1987). The Richland Creek fracture zone is analogous to fractured Austin chalk reservoirs and consequently provides insights concerning the distribution and density of fracturing within the subsurface Austin chalk trend of south-central Texas.

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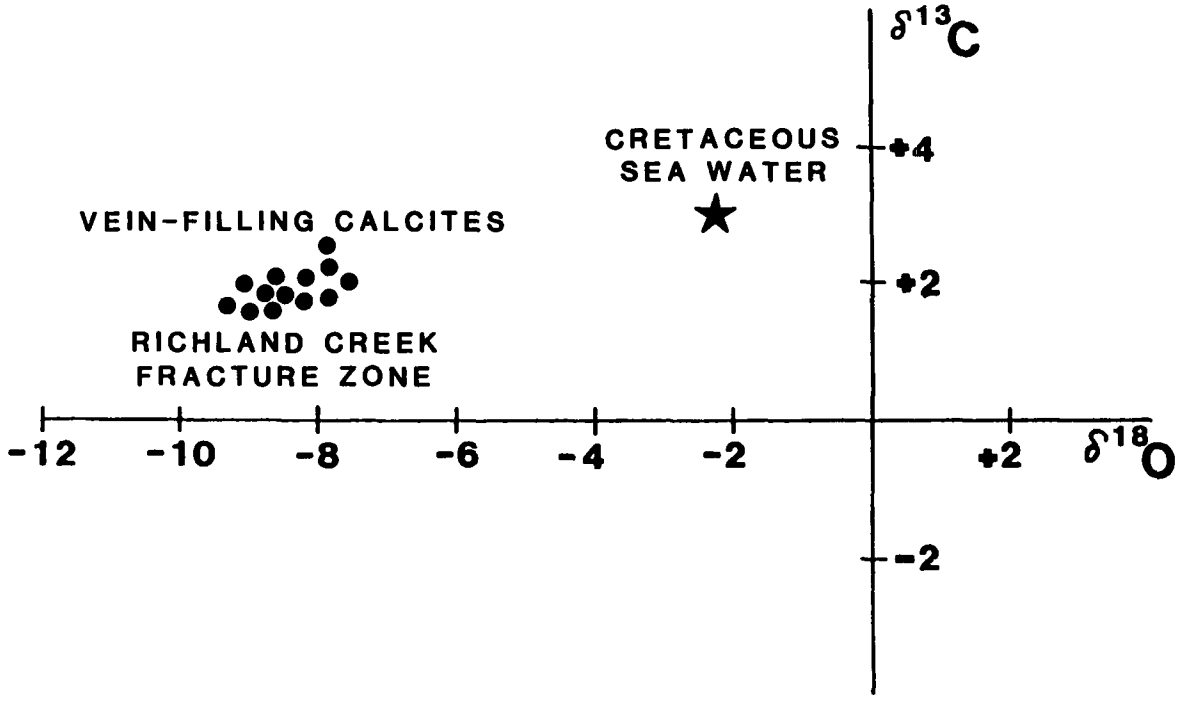

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