Stable isotope ratios of coexisting veins and host rocks constrain the buriel history of the Austin Chalk

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Twenty nine calcite-filled veins and coexisting whole rocks from the three stratigraphic members of the Upper Cretaceous Austin Chalk in Dallas and Ellis Counties were collected and analyzed for their stable isotope ratios in order to constrain the conditions of vein formation associated with normal faulting. The purpose of this project was to investigate the non-equilibrium relationship between the oxygen isotope composition of calcite veins and the Austin Chalk that had been observed by previous workers [1, 2].Carbon and oxygen isotope ratios were determined for chalk and calcite-filled vein samples for a total of 123 analyses. For the bulk chalk, the carbon isotope ratios and oxygen isotope ratios are relatively uniform over the period of deposition during a Cretaceous high stand of sea level. The carbon isotope ratios of the veins and host rocks cluster around the zero fractionation line on a vein vs. host rock $\delta^{13}C$ indicating minimal contribution of carbon from microbial reactions involving organic matter. The $\delta^{18}O$ values of the veins are bimodal and depleted in ^{18}O with respect to the host rocks. The Δ values between host rocks and veins are $\approx$-2 and -5 for the high and low ^{18}O veins, respectively. Stratigraphically [3], from bottom to top are the Atco, Bruceville and Hutchins Members, with mean whole-rock $\delta^{18}O$ values of -3.8, -4.4, and -3.7, respectively. The high ^{18}O veins by stratigraphic groups, -5.9, -6.3, -6.6 per mil, are all depleted with respect to the host rocks. The low ^{18}O veins have been observed in the lower two members and have mean values of -8.1 and -8.5 per mil. The standard deviations on the mean values for veins and host rocks over the entire formation are at $\pm$0.5 per mil Structurally the analyzed calcite veins are striated, multiple generation, sparry calcite fracture fill that form on fault planes with throws of less than a few meters. The spacing of veins and the amount of calcite precipitated indicates that intraformational fluid provides the necessary fluid flux to form the secondary calcite. Using the contrast in $\delta^{18}O$ values between vein and host rock and testing for sensitivity to the initial depositional conditions, inferred burial depths of 0.5 to 1 km at the time of vein formation for the high and low ^{18}O veins.

[1] Dawson *et al* (1994) *Trans. Gulf Coast Geol. Soc.* ***42***, 787-788 Lee *et al* (1997) *J. Geophys. Res.* ***102***, 22,611-22,628 [3] Gale *et al* (2008) *Cretaceous Res.* ***29*****,** 131-167