Evaluation of Maturation and Petroleum Generation in the Eagle Ford Shale, First Shot Field, Texas

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Cuttings and core samples from two wells near the San Marcos Arch in First Shot Field, Texas, were used to evaluate source rock maturation and petroleum generation in the Cenomanian-Turonian Eagle Ford Shale. In First Shot Field, the formation is comprised of open marine, distal turbidite deposits that are dark gray, finely laminated and contain planktonic foraminfera tests, organic matter, clay, and quartz grains. In the Bell Sample #1 well, these deposits have total organic carbon (TOC) contents ranging from 0.50 to 3.51 weight %, Rock-Eval pyrolysis S2 values varying from 1.04 to 13.22 mg HC/g rock, hydrogen index (HI) increasing from a low of 75 to a high of 468 mg HC/g TOC, and Tmax extending from 432 to 445 degrees C. In contrast, in core from the Robinson-Troell #1 well, which is about 12 miles east of the Bell Sample #1 well, TOC contents range from 1.46 to 3.54%, S2 varies from 2.81 to 6.92 mg HC/g rock, HI extends from 187 to 196 mg HC/g TOC, and Tmax falls between 451 and 454. Examination of various maturity parameters including Rock-Eval pyrolysis Tmax, vitrinite reflectance, and biomarkers indicates the Eagle Ford Shale in the Bell Sample #1 well is probably early mature with respect to petroleum generation whereas in the Robinson-Troell #1 well, it is in the late oil window. Variation in some of the Eagle Ford geochemical parameters is interpreted to be the result of maturity differences between the formation in the two wells.

Using the maturity parameters obtained in these two wells for calibration, hydrocarbon generation modeling was performed for both the Bell Sample #1 and Robinson-Troell #1 wells. Although several different types of kinetics were used in the modeling, initial results indicate EASY %Ro kinetics yield the best match to the measured maturity parameters. The EASY %Ro kinetics show the Eagle Ford in the Robinson-Troell #1 well entered the oil window at about 44 Ma, a result in reasonable agreement with the 38 to 30 Ma timing of the principal hydrofracturing event that is responsible for the open, oil-bearing fractures observed in cores from the First Shot Field. In the Bell Sample #1 well, petroleum generation began much later, at about 15 Ma. Based upon the geochemical data and modeling results from this study, it appears the Eagle Ford Shale in the First Shot Field is more likely to be a shale oil play than a shale gas play.