Frio Shale Mineralogy and the Stoichiometry of the Smectite-to-Illite Reaction: The Most Important Reaction in Clastic Sedimentary Diagenesis

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Abstract: Burial diagenesis of shales of the Frio Formation resulted in an increase in the abundance of mixed-layer illite-smectite (I-S), albite and chlorite, and a decrease in the abundance of K-feldspar, illite and kaolinite. Some of the mineralogic trends determined in this study contrast with the results of Hower et al. (1976) and other studies of Frio shales. The differences are due to improvements in laboratory and clay quantification techniques since the time of the earlier research. I-S composition changed from $\sim$20% to $\geqslant$80% illite, and mineralogic and chemical reaction of I-S continued throughout burial. Shale diagenesis was an open-system process that required addition of K_2O and Al_2O_3, and resulted in loss of SiO_2. The amount of SiO_2 made available by shale diagenesis is sufficient to be the source of the quartz-overgrowth cements in the associated Frio sandstones. The relationships between I-S diagenesis and fluid flow from shales into sandstones, generation of abnormal formation-water fluid pressure, onset of sandstone diagenesis and distribution of authigenic phases in sandstones indicate that reaction of the I-S in shales is one of the most important components of the sandstone/shale/formation water diagenetic system.

Key Words: Diagenesis • Illite-Smectite • Mass Balance • Mineralogy • Shale

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