Increased Organic Content in the Presence of Floccules: A Case Study of the Sharon Springs Member of the Pierre Shale, Canon City Basin, South-Central Colorado

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ABSTRACT

Primary production within the Cañon City Basin, south-central Colorado, targets the fractured Upper Cretaceous Pierre Shale, which is sourced by the underlying Sharon Springs. The Sharon Springs Member of the Pierre Shale contains some of the most organic-rich sediments deposited in the Western Interior Cretaceous Seaway. Typically, organic carbon ranges from 2 to 11 weight percent while maturity of the source rock varies from immature to over-mature across the basin. Previous researchers variously ascribe the origin of the organic matter to fecal pellets, phytoclasts and amorphous material. Rock-eval pyrolysis indicates that the kerogen present is of Type II marine origin, however this does not explain the disproportionately high percentage of organic matter. Facies analysis of the Bull 42-4 core, containing the Sharon Springs within the Cañon City Embayment, reveal the presence of sediment gravity flow deposits in the lowest facies of the Sharon Springs. When examined in petrographic thin-section, opaque spheroids represent the previously described fecal pellets or phytoclasts. FESEM analysis of these spheroids show an amalgamation of fine clay particles with an absence of casing surrounding the spheroids, indicating that they are not fecal pellets. Analysis of a bentonite bed, which has characteristics of a sediment gravity flow deposit, also contain diagenetically altered clay-aggregate spheroids. In stratigraphically higher facies, which show laminated fabric, the clay aggregates are elongated along the lamination, indicating a calmer environment of deposition with subsequent compaction. Detailed XRF analysis of the core indicates that deposition occurred within dysoxic, anoxic or euxinic conditions. Settling of clay particles is often aided by flocculation. In the presence of organic matter, the organic material will adsorb to the surface of the clay particles during flocculation. In flume studies performed by Shieber (2011), clay floccules formed in a current were shown to roll and compact into spheroids, similar to those seen in the sediment gravity flow deposits. However, those formed in quiet water settled as uncompacted aggregates. As seen in the Bull core, uncompacted aggregates align with foliation during burial. Bulk XRD analysis illustrates that the entirety of the Sharon Springs, despite variations in facies and depositional environment, is a silica-rich argillaceous mudstone. Detrital matter in the form of quartz and plagioclase were brought into the system along with clay and likely some or all of the organic matter. Enhanced organic concentrations result from adsorption of organic matter to clay floccules with subsequent deposition in dysoxic to euxinic conditions.