Gammon,

Diagenesis and Methane Generation in Upper Cretaceous Gammon Shale, Northern Great Plains, United States

In the northern Great Plains, isotopically light methane is entrapped at shallow depths in marine rocks of Late Cretaceous age. Products of early diagenetic decomposition of organic matter in the Gammon Shale support the view that the gas is biogenic and formed at shallow depths early in the burial history of the sediments. This interpretation implies widespread gas occurrence and is consistent with a larger gas resource figure than alternative interpretations suggest.

The Gammon Shale was deposited offshore during a major regression of the Late Cretaceous epeiric sea. The sediment-water interface was oxygenated, and soft-bodied organisms burrowed the silt-clay sediment. Organic matter was sufficiently abundant for oxygen depletion at shallow depths. Bacterial sulfate reduction occurred quickly and resulted in the formation of framboids and octahedra of pyrite. Abundant concretions and discrete crystals of siderite began forming within tens of meters of the sediment surface. Interstitial waters became saturated with methane, and a free gas phase, held in siltstone layers by capillary forces, inhibited silicate diagenesis. Methane generation probably continued to burial depths of hundreds of meters. At the maximum burial depth (1,200 to 1,500 m), int rstitial waters contained their maximum dissolved methane, and silt layers still contained free gas. Cenozoic uplift and erosion permitted gas exsolution. Exsolved gas combined with free methane already in the reservoirs to form the gas being currently explored and extracted.