Geochemistry of the Albian Kiamichi Formation of East Texas

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Introduction

This study involved the examination of core samples from the Lower Cretaceous aged Kiamichi Formation of the East Texas Basin in order to interpret its organic and elemental geochemistry using various techniques. The Kiamichi Formation may have the potential to be a source rock for hydrocarbons, and may be a plausible target for oil and gas companies. Thus the lithologies of the Kiamichi and its surrounding formations were compared revealing that the Kiamichi depicts black organic rich shales while the Edwards and Goodland are characteristic of blocky limestones and interbedded limestones (Figures 1,2,3). Since this formation has yet to be thoroughly analyzed, techniques such as a CHNS analyzer (Figure 4) and Thermogravimetric analysis were used to determine the amount of organic carbon of the formation. Upon completion of this sample analysis, this geochemical information about the Kiamichi Formation provides beneficial information for further research on the overall Kiamichi Seaway.

Figure 1: CHNS analyzer used to determine the organic Carbon of the samples in the Kiamichi core

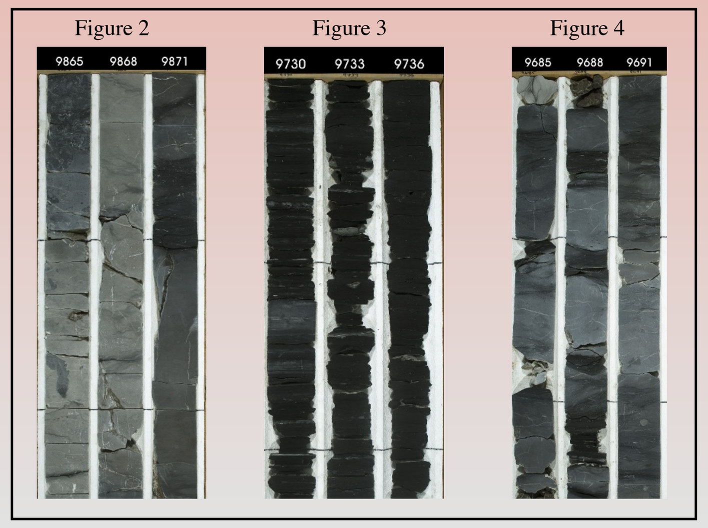


Figure 2: Edwards formation core revealing blocky limestone with grey coloring

Figure 3: Kiamichi formation core depicting black organic rich shales. Contrast in color between the other two surrounding formations.

Figure 4: Goodland formation core showing interbedded limestones and marls.

Background

Figure 5:Stratigraphic column of the East Texas Basin Formations

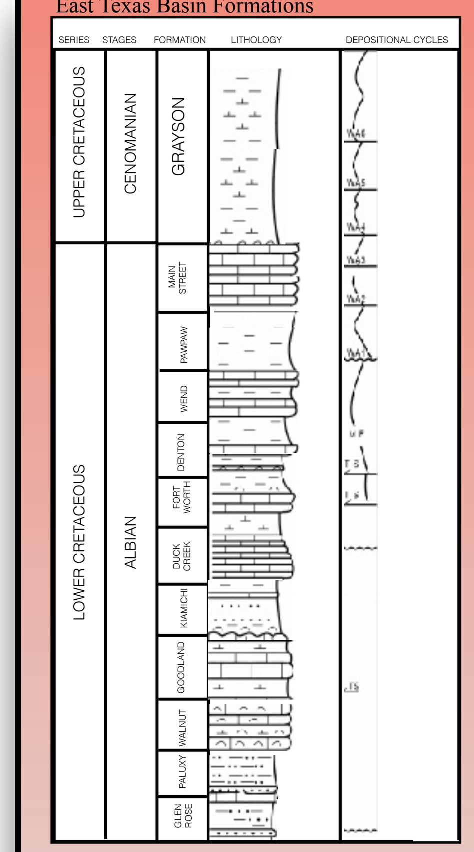
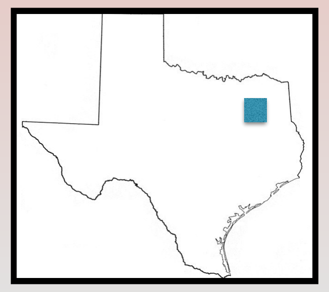


Figure 6: Location of Kiamichi core extraction



- The Kiamichi Formation of the East Texas basin is found specifically in Northeast, Texas and crops out into Southern Oklahoma.
- Composed of organic rich source rocks that have actively generated and expelled hydrocarbons from the late Cretaceous, which have in turn created massive reservoirs.
- In the time of the Lower Cretaceous (112Ma) eustatic sea level rising was capped by regression thus capping massive platform, mounded reef, and shoaling carbonate buildups.
- Multiple flooding events resulted in interbedded organic-rich source rocks and carbonate accumulations which include the Edwards, Georgetown, and the Kiamichi formations.
- Structural events have additionally increased the storage capacity that have made hydrocarbons available for production.
- The Kiamichi enters the oil window in the late Cretaceous however unlike the acknowledged Eagle Ford Formation, it does not stay in the oil window but rather quickly enters the gas window making it less profitable.
- Figure 5 depicts the Kiamichi's location in the stratigraphic column in which geologic age, lithology, and depositional cycle are represented.
- Figure 6 depicts the area of Texas that the Energy Exploration Partners Oil and Gas owned core was extracted from.
- Figure 7 reveals the deposition of the Kiamichi formation during the initial oceanic incursion onto North America during the Cretaceous which is called the Western Interior Seaway

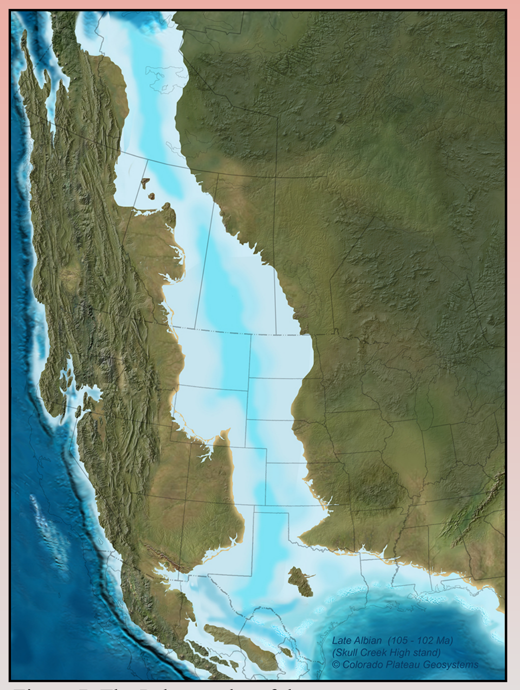


Figure 7: The Paleography of the Western Interior Seaway

Data

Methods

(1) CHNS Analysis

In order to determine the TOC of the core, 2mg samples were taken every two feet along the core. They were taken to the rock deformation lab where they were ground by mortal and pestel instruments in order to assure the material was fine-grained. Then they were weighed, and placed in small capsules to be ready to be inserted into the CHNS Analyzer. They were all placed at once into the CHN analyzer which is a scientific instrument that was used to determine the concentrations of carbon hydrogen and oxygen in eighty samples from the core. The instrument then used combustion in order to oxidize the sample into simple compounds which were detected by infrared spectroscopy or thermal conductivity detection (Figure 8). All samples were compiled to reflect the ratios of hydrogen, sulfur and nitrogen to carbon. The carbon ratios reflected numbers up to ten with tens reflecting the most potential (Figure 9). The carbon rations were also compared to the carbon/ hydrogen ration order to chose reflective samples for the following thermogravimetric analysis(Figure 10).

(2) Thermogravimetric Analysis

Additionally, four samples were taken from the previous eighty and were taken from depths to fully capture the length of the core and reflected sufficient hydrogen to carbon ratios that would have potential. The results from the Thermogravimetric Analyzer are shown in Graph 1 and analyzed in the analysis section below.

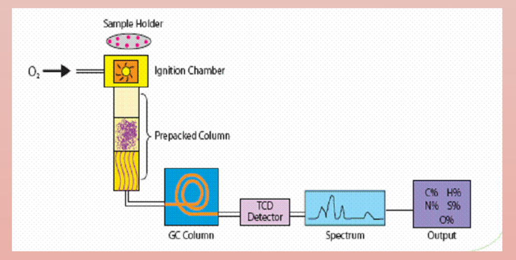


Figure 8: CHNS Analyzer procedure revealing the input of samples, combustion, then the output of element percentages.

Results

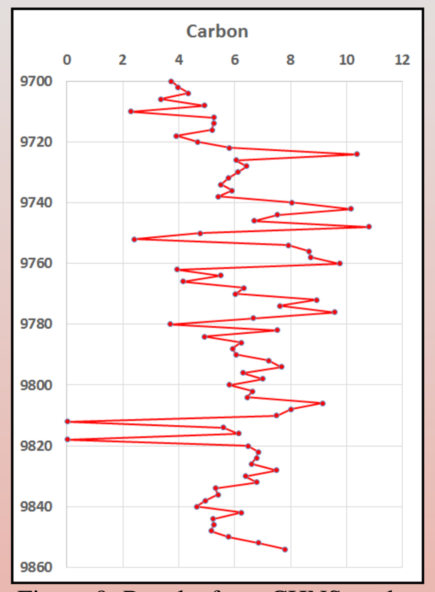


Figure 9: Results from CHNS analyzer: Carbon ratios

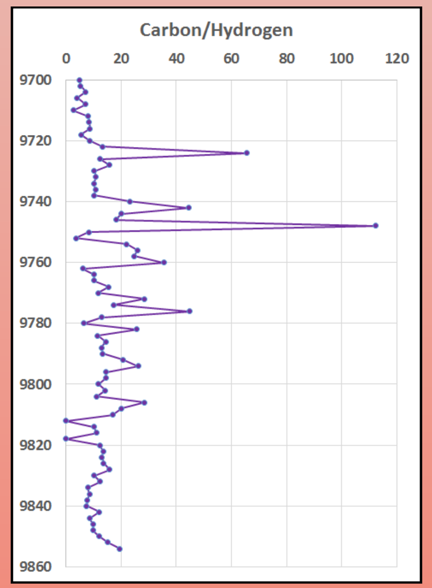
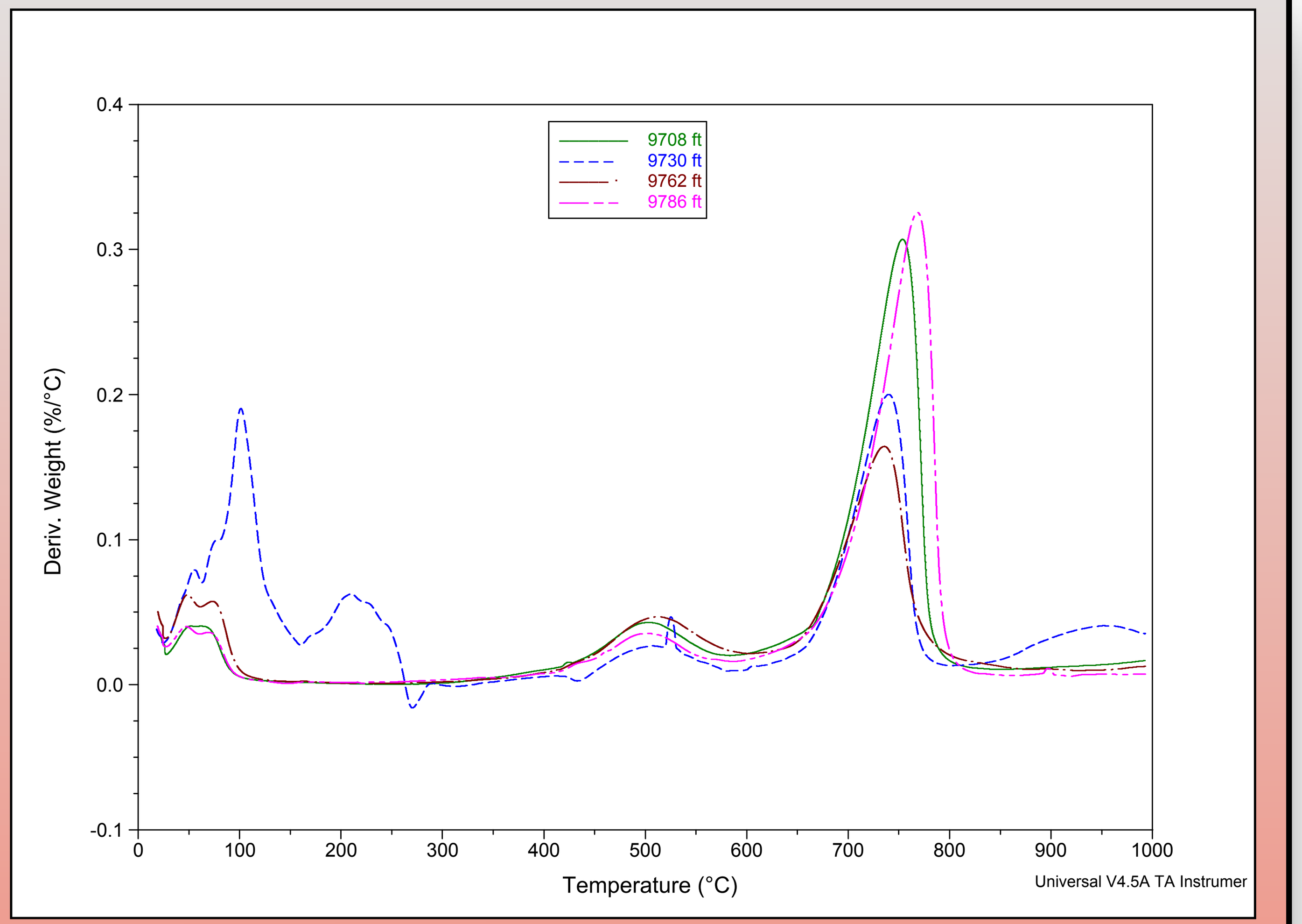


Figure 10: Results from CHNS analyzer: Carbon/Hydrogen Ratios



Graph 1: Results from Thermogravimetric analysis

Analysis

- The results of this study depict the profitability of the Kiamichi core in the range of 9700-9865 where samples were taken from 9708, 9730, 9762, and 9786 depths.
- The bulk of material have volatilities and respond to temperature differently. The ramp on the Thermogravimetric analyzer ranged from temperatures 25-1000 Fahrenheit, based on volatility will see characteristic peaks.
- In Graph 1, the trend shows that organic matter (middle peak) in the latter depths (9786, 9762) show less carbonate compared to organic carbon
- The 9730 depth shows variations of clay material composition due to the high peak in the initial temperatures of the ramp process. This sample needed additional heat applied in order to extract additional bound water out compared to the other samples due to its higher clay composition.
- The three types of waters include free, bound, and mineral. The sample 9730 depicts a bound water material where the water sticks to the material making it difficult for extraction. The other samples water left at around 50 degrees.
- By 400 all water removed and oxidization begins. The second slope depicts the total organic material of the sample in which the samples 9786 and 9762 show constant results while 9730 shows lower results due to its clay consistency.
- The third peak begins at 600 and will stop oxidizing. These steeper slopes depict the carbonate in the rock. The green peak of 9708 reflects high potential carbonate which parallels an active fizz test that was performed. 9786 however did not fizz.
- Further, this third peak shows the clay is degrading possibly due to carbonates or the thermal degradation of the clay itself.
- Overall, the middle peak reflects that the Kiamichi core has the potential for hydrocarbons due to the reflected data of the four samples as well as the potential for further testing to reveal additional evidence reflecting these same results.

Conclusions

- Further research involving various tests are needed to depict the actual profitability of this formation
- Additionally, would need to be done due to the presence of possible carbonates that could be reflected alternatively since they did not fizz.

Acknowledgements

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Energy & Exploration Partners