Data Repository Item B – Palynological results from Cretaceous mudstones samples from Beaver Lake

Biostratigraphy.com, LLC

7518 Twin Oaks Court, Garland, TX 75044 • USA • (972 496-3642
paz@biostratigraphy.com • www.biostratigraphy.com

Donald Koepp
Bucknell University
Geology & Environmental Geosciences
Lewisburg, PA 17837

Palynology of four outcrop samples near Euchre Mountain, Alaska

Pierre A. Zippi, Ph.D., Biostratigraphy.com, LLC

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Executive summary:
Four outcrop samples were submitted for palynological analysis to determine the age, paleoenvironments and thermal maturity of the sampled strata. Palynomorph recovery was poor to nearly barren and did not allow for precise age or paleoenvironmental assignments. However, a sparse assemblage of spores broadly suggest a Cretaceous age. Sample JT12LA may be restricted to Late Valanginian to Early Cenomanian, and JT17LA-A may be restricted to Late Valanginian to Early Campanian. Spore color suggests a high thermal maturity, equivalent to a %Ro approximately 1.1-1.5%.

Introduction:
Four outcrop samples were submitted for palynological analysis to determine the age, paleoenvironments and thermal maturity of the sampled strata.

Methods and personnel:
Palynology and kerogen
The samples were processed twice as part of an internal quality control. They were processed by an independent lab (Global Geolab, Ltd.) and by Dr. Pierre Zippi, Biostratigraphy.com, LLC. Both results were the same.

The samples were washed to remove surficial contaminants. Carbonate minerals were dissolved using HCl and silicate minerals removed using HF. The organic residue was washed with cold HNO_3 followed by a wash with ammonia or KOH. The residues were sieved through a 7-µm mesh screen to remove small particles that would be unidentifiable in transmitted light microscopy. Organic residues were mounted on a coverslip with polyvinyl alcohol and fixed to a microscope slide with polyester resin. Prepared slides were shipped to Biostratigraphy.com, LLC in Garland, Texas for palynological analysis. Slides were examined with phase contrast and differential interference contrast illumination using oil immersion at a minimum of 500X with a research grade Zeiss Axio Imager microscope. When possible, palynomorph occurrence data is collected until the total count reaches 100 specimens for relative abundance data, after which, the remaining area of the slide was scanned searching for rare taxa that may have stratigraphic significance. Rare taxa are added to the count data. Kerogen residues are typically separated from the palynology residues after demineralization with HCl and HF, but before oxidation. For samples that do not require strong oxidation, the kerogen can be described from the lightly oxidized palynology slides. Dr. Pierre Zippi performed the palynological, kerogen and spore color analyses. Dr Zippi has more than 30 years experience working with palynology and organic residues in oil and gas exploration.

Results:
Palynology:
Palynological recovery was poor to nearly barren. The very few specimens observed were dark and mostly opaque, and only a few could be identified species level.

Kerogen:
The kerogen was primarily dark wood (unstructured blocky, structured tracheids, charcoal), perforate kerogen typical of high thermal maturity and very rare amorphous kerogen. Identification of some kerogen particles was questionable due to high maturation levels. At high levels of thermal maturity, kerogen particles begin to lose characteristic features.

Thermal maturity of organics by spore color:
The thermal maturity of each sample was estimated from spore color. Normally, specific types of spores and pollen are used to achieve a consistent estimate of thermal maturity. At higher levels of thermal maturity all organic particles become black and opaque. Thermal maturity estimates are presented in the discussion section.

Discussion/Interpretation:
Sparse palynomorph recovery, poor preservation and high thermal maturity precluded precise age assignments. However, all samples are likely Cretaceous; JT12LA may be restricted to Late Valanginian to Early Cenomanian, and JT17LA-A may be restricted to Late Valanginian to Early Campanian. If all samples were taken from the same formation at the same location and stratigraphic level, then the Late Valanginian to Early Cenomanian age can be applied to all samples.

Based on the sparse spore flora, lack of marine palynomorphs and the overwhelmingly terrestrial nature of the kerogen, these samples were likely deposited in nonmarine, fluvial/floodplain environments. The presence of very rare amorphous kerogen may indicate lacustrine environments, or possibly proximal deltaic environments.

The modern pollen and spore contaminants are easily distinguished from fossil specimens based on color and preservation.

Details of palynological analysis:

JT12LA
Matonisporites crassiangulatus? triangular with valvae, Hettangian to Early Cenomanian
Distaltriangulisporites perplexus? Late Valanginian to Early Campanian
Classopollis? sp fragmented
Indeteminant spore fragments
Modern contaminants: Alnus, Polypodium, Graminae, Betula
Age: Cretaceous, possibly Late Valanginian to Early Cenomanian
Kerogen: primarily dark wood (coalified, tracheids, charcoal), very rare amorphous unstructured kerogen.
Environment: Nonmarine, possibly proximal deltaic.
Thermal maturity: The few questionable spores seen were very dark brown to opaque. This corresponds to an estimated vitrinite reflectance of %Ro ~ 1.4-1.5%.

JT14LA
Laevigatosporites? sp fragmented
Classopollis? sp fragmented
Indeteminant spore fragments
Modern contaminants: *Picea, Alnus, Polypodium, Graminae*.
Age: Indeterminate, possibly Cretaceous.
Kerogen: primarily dark wood (coalified, tracheids, charcoal), very rare amorphous unstructured kerogen.
Environment: Nonmarine, possibly proximal deltaic..
Thermal maturity: The few questionable spores seen were very dark brown to opaque. This corresponds to an estimated vitrinite reflectance of %Ro ~ 1.4-1.5%.

JT17LA-A
Cicatricosisporites sp fragments (5) long ranging but common in the Cretaceous
Classopollis? sp fragmented
Classopollis? tetrad sp fragmented Sinemurian to Maastrichtian
Deltoidospora minor (2) long ranging but common in the Cretaceous
Distaltriangulisporites perplexus (4) Late Valanginian to Early Campanian
Matonisporites sp triangular with valvae
Indeteminant spore fragments
Modern contaminants: *Picea, Alnus, Polypodium, Graminae*.
Age: Cretaceous, Late Valanginian to Early Campanian
Kerogen: primarily dark wood (coalified, tracheids, charcoal), very rare amorphous unstructured kerogen.
Environment: Nonmarine, possibly proximal deltaic.
Thermal maturity: The few questionable spores seen were brown to very dark brown. This corresponds to an estimated vitrinite reflectance of %Ro ~ 1.1-1.3%.

JT17LA-B
Osmundacidites wellmani long ranging but common in the Cretaceous
Indeteminant spore fragment
JT17LA-B differs from JT17LA-A in having more large blocky coal particles in the kerogen composition and fewer spores.
Age: Cretaceous?
Kerogen: primarily dark wood (coalified, tracheids, charcoal), very rare amorphous unstructured kerogen.
Environment: Nonmarine, possibly proximal deltaic.
Thermal maturity: The few questionable spores seen were brown to very dark brown. This corresponds to an estimated vitrinite reflectance of %Ro ~ 1.1-1.3%.

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