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An Overview of Palynofacies/Kerogen Analysis and it's Assistance in Paleoenvironmental and Geochemical Interpretations

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Summary

Palynofacies describes the total acid-resistant organic matter content of sedimentary rocks within a specific sedimentary environment (Combaz, 1964). Palynofacies analysis involves the identification of palynomorphs, plant debris and amorphous particles, their absolute and relative proportions, size spectra and preservation states (Tyson, 1995). When integrated with sedimentological and stratigraphic data, palynofacies adds a unique aspect to paleoenvironmental interpretations. When integrated with geochemical information, it helps develop a greater understanding of a source rock, it's quality, and the expected (or observed) hydrocarbon phase (gas versus oil). Palynofacies and it's identified components are not to be confused with kerogen which is a geochemical term referring to organic matter that is non-soluble in an organic solvent. Palynofacies refers to ALL organic components in a given sedimentary rock sample, whereas kerogen limits the organic matter to that which is non-soluble. Unfortunately, these two terms have been greatly confused and co-mingled over the years creating debate between palynologists, organic petrographers and geochemists.

Theory / Method / Workflow

The visual identification and characterization used in palynofacies analysis is through transmitted light microscopy with the organic matter strewn on a thin section. The organic matter is liberated from the rock matrix through acid digestion: no other chemical processes are performed. In most instances a semi-quantitative assessment of the palynofacies components is performed, and the terms abundant, frequent, common and rare are adequate in describing the palynofacies assemblage. For additional paleoenvironmental detail, 300 counts may be performed of the organic matter components present.

In a broad sense, palynofacies components are separated into marine and non-marine constituents which will give a sense of hydrocarbon phase: for the most part, non-marine organic matter will result in gas, whereas marine organic matter will result in oil. The exception is non-marine lacustrine paleoenvironments where lacustrine algae will mature and subsequently produce oil (Figure 1). Important terrestrial components include pollen and spores which can further be separated from the palynofacies assemblage to produce a palynology slide, and can then be analyzed for chronostratigraphic interpretations. In the palynofacies assemblage, the color of pollen/spore can be utilized to determine maturation: the lighter the color of the pollen/spore, the less maturation. The darker the pollen/spore the higher the maturity which can be confirmed through vitrinite reflectance (%Ro) and geochemical analyses (e.g. RockEval/Tmax).

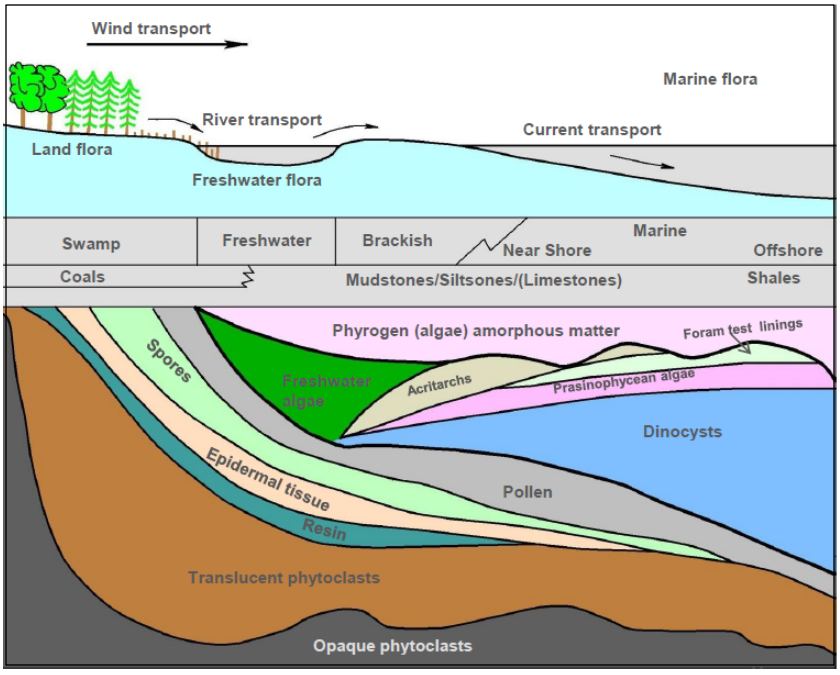

Figure 1. A schematic diagram illustrating the transition of non-marine to marine environments, and the relative abundance of associated various palynofacies components. Note that non-marine constituents can be transported into the marine realm, and the ratio of non-marine to marine constituents can be used as an indicator of proximity to paleoshoreline.

Results, Observations, Conclusions

Case studies demonstrating the significance of palynofacies analyses will be discussed. For example, palynofacies analyses assisted in understanding why wells completed in the Niobrara Formation in a Wyoming field were producing different hydrocarbon phase from the same formation. Differences in the abundances of marine versus non-marine palynofacies components helped define parts of the field which were gas-prone, whereas other areas with abundant marine organic matter were oil-prone.

Novel/Additive Information

Palynofacies data are significant in understanding the full nature of the organic matter present in the sedimentary rock, and more importantly the source rock. Routine geochemical analyses provide basic hydrocarbon phase information, whereas palynofacies describes the true and complete nature of the organic matter constituents.

References

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