Improved Graphical Representation of Sedimentary Organic Matter as Paleoenvironmental Parameters

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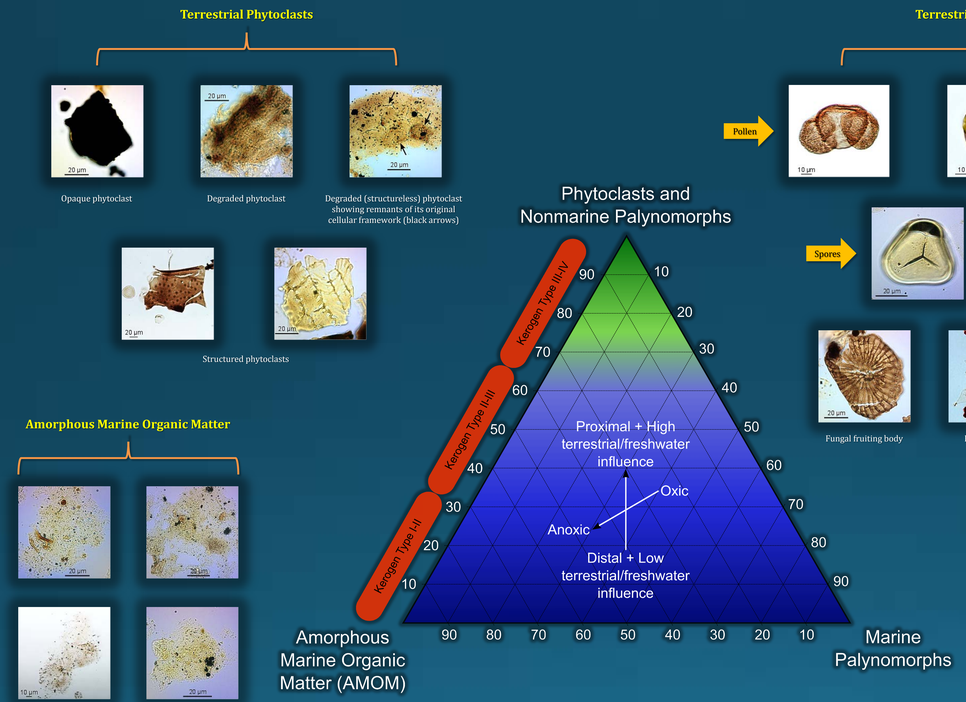
Abstract

A ternary plot is proposed to represent the paleoenvironmental context of palynologically recovered sedimentary particulate organic matter (POM). This plot identifies three major marine paleoenvironmental parameters, namely redox conditions, proximal-distal distribution, and terrestrial influence. It also facilitates hydrocarbon source-rock (kerogen type) interpretation on the basis of the overall POM composition as well as the ratio of marine to non-marine organic components.

In this plot, palynofacies data are categorized into three end-members, each of which has a paleoenvironmental indication. Phytoclasts and non-marine palynomorphs are combined in the top end-member to indicate the degree of terrestrial and freshwater influx. Amorphous marine organic matter (AMOM) is plotted base-left to reflect the oxygenation state, while the base-right end-member represents marine palynomorphs, which together with AMOM mark the approximate basin-ward distance from the shoreline.

Although inspired by the widely used plot of Tyson (1989, 1993, and 1995) and the subsequent modifications by Roncaglia and Kuijpers (2006), the proposed sedimentary POM ternary plot has the advantage of categorizing genetically related palynofacies components based on their paleoenvironmental significance rather than diagenetic structural morphology or palynological classification. This prevents illusive proximal–distal and redox interpretations arising from (1) combining decomposition products from marine and non-marine sources into one (AOM) end-member based solely on the lack of visible definitive internal structure under the light microscope, and (2) grouping Terrestrial and marine palynomorph taxa under one (palynomorphs) end-member. Such problems have been resolved by counting the amorphous non-marine macrophytes as degraded phytoclasts preserving their correct paleoenvironmental implication. In addition, non-marine palynomorphs have been separated from the marine palynomorphs and grouped with terrestrial phytoclasts. One important precaution to consider is that this sedimentary POM ternary plot is not intended to interpret the depositional conditions of submarine fan systems and turbidite sequences where large terrigenous components are known to be transported to the deep sea realm.



Sedimentary Particulate Organic Matter Ternary Plot

Definitions

Palynomorphs encompass both continental and marine-dwelling organic-walled microfossils such as spores, pollen, dinoflagellate cysts, acritarchs, freshwater algae, fungal remains, and foraminiferal test linings.

Phytoclasts are all terrestrial plant fragments, including translucent types with clear internal structures, degraded structureless, and opaques (e.g., cuticles, tracheids, and vessel elements). The ***opaque*** phytoclasts are black kerogen particles derived from the oxidation of translucent phytoclasts, carbonization (coalification) during post-depositional alteration, or as a result of wildfires.

Amorphous marine organic matter (AMOM) includes all semi-transparent, nearly colorless, fuzzy, structureless kerogen particles derived essentially from the bacterial degradation of marine phytoplankton, such as dinoflagellate cysts and acritarchs.

Differential Diagnosis

Structureless particles of terrestrial origin (i.e., from the degradation of terrestrial phytoclasts) are herein named degraded phytoclasts and are not referred to as amorphous organic matter (AOM). Degraded phytoclasts, particularly those of vascular plants, are lignified (contain lignin in their internal cellular structures). Lignin is a complex organic compound that tends to be firm and decay resistant. Therefore, degraded, structureless phytoclasts can be differentiated from AMOM under the light microscope by a thicker and darker appearance. In addition, degraded phytoclasts often show remnants of their original structures, such as cell walls and pitting.

A digital copy of this poster and a clean copy of the ternary plot (for use with your own data) can be obtained from the following link: *http://www.researchgate.net/profile/Mohamed_Zobaa/publications*

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