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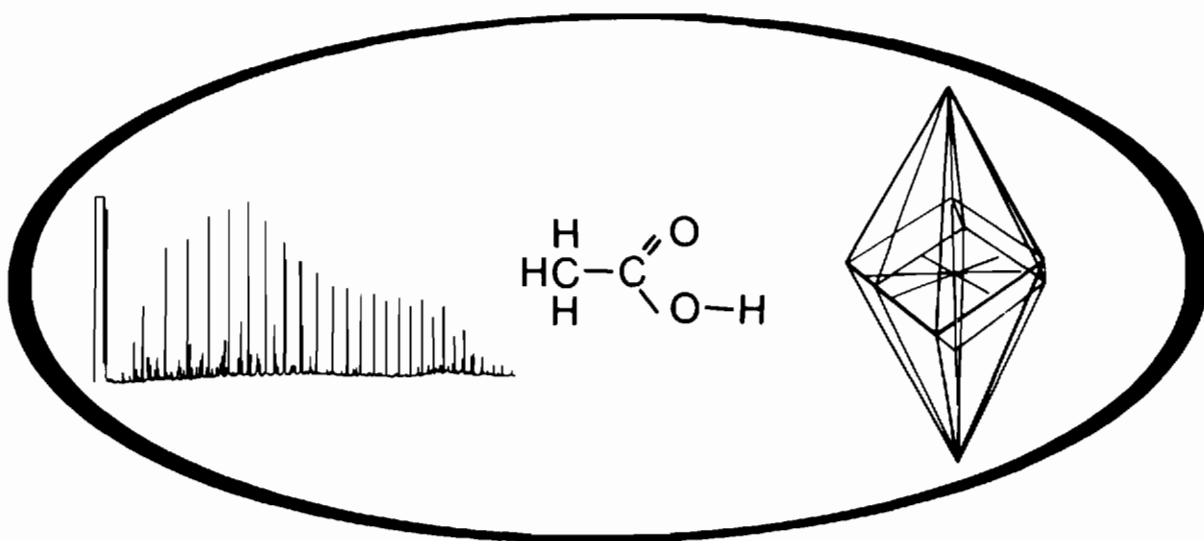
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ROLES OF ORGANIC MATTER IN SEDIMENT DIAGENESIS

*Based on a Symposium
Sponsored by the Society of
Economic Paleontologists and Mineralogists*



*Edited by
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Preface to
Society of Economic Paleontologists and Mineralogists Special Publication
Roles of Organic Matter in Sediment Diagenesis

Donald L. Gautier

This volume is a direct result of a symposium entitled "Relationship of Organic Matter and Mineral Diagenesis" convened as part of the 1984 mid-year meeting of the Society of Economic Paleontologists and Mineralogists (SEPM) in San Jose, California. That symposium, in turn, was the result of a SEPM Research Conference held in October 1983 at Lost Valley Ranch, Colorado. The publication contains, with a few additions, papers presented at the symposium. The goal of the volume "Roles of Organic Matter in Sediment Diagenesis" is to bring to the attention of the sedimentological community the importance of interaction of organic compounds with the inorganic sedimentary system and the degree to which organic compounds drive diagenetic systems.

This volume comprises 16 reports illustrative of the scope and direction of current research in sedimentological and geochemical studies of organic/inorganic interaction. In the first paper, Walter demonstrates that calcite precipitation is inhibited by sulfate, but that aragonite precipitation is inhibited by orthophosphate. Orthophosphate also inhibited dissolution of calcite, Mg calcite, and aragonite, whereas sulfate had little effect on dissolution rate.

John Kocurko, in the second paper, shows that oxidation of organic compounds is the controlling mechanism in the dissolution and precipitation of early diagenetic cements in recent sediments of south Louisiana.

Charles Curtis and Max Coleman carry the interpretation of early diagenetic cements to the ancient sedimentary record of the Carboniferous Coal Measures by means of isotopic and elemental geochemical data.

Laura Crossey and her coauthors discuss use of pyrolytic techniques in the evaluation of the quality, type, and maturity of organic matter in various organic-rich rocks.

In their analysis of diagenesis in Neogene Tertiary rocks of Japan, Taguchi and his coauthors present one of the most comprehensive studies of organic and inorganic diagenesis available. They conclude that transformations of organic compounds do not always drive mineral reactions, but that the thermocatalytic effects of clay minerals may bring about significant changes in lipids, nitrogen fixation, and carbon isotopic trends.

The relationships among transformations of clay minerals, organic compounds, and the thermal evolution of sedimentary basins are discussed by Naeser and by Pollastro and Barker in their studies of the Green River Basin of Wyoming. Naeser, using fission-track dating in formerly annealed apatite grains, provides evidence for the significant recent cooling of the basin. Pollastro and Barker use a combination of clay mineralogy, vitrinite reflectance analysis, and fluid-inclusion homogenization temperatures to arrive at a similar conclusion that the Green River Basin

was 30–50° C hotter during the Neogene than at present. The cooling is explained by uplift and erosion of approximately 1,700 m of sedimentary section.

The Green River Basin is also the subject of Edman and Surdam, who conclude that porosity enhancement in the Upper Cretaceous Ericson Sandstone was controlled by position of the sandstone relative to a paleo-oil water contact. The enhanced porosity is inferred to result from organic acid generation and associated aluminum complexing. Other papers also focus on acids derived from organic matter. Kharaka, LeRoy, Carothers, and Goerlitz illustrate the degree to which aqueous organic species, particularly short-chain aliphatic acid anions, control pH and Eh of subsurface waters in sedimentary basins. Indu Meshri compares the stoichiometric and thermodynamic reactivities of carbonic acid and organic acids. Her work shows that organic acids have a hydrogen donor capacity that is 6 to 350 times greater than carbonic acid. Lundegard and Land provide evidence that, from a mass balance standpoint, decarboxylation of organic matter is insufficient to account for all the secondary porosity in sandstones of the Texas Gulf Coast. They suggest that porosity may be greatly enhanced locally by organic acids and carbon dioxide and that hydrous pyrolysis reactions between organic carbon and kerogen may provide a significant source of acids for dissolution reactions in the subsurface.

Crossey, Surdam, and Lahann argue that reduction of mineral oxidants and consequent oxidation of organic matter may be a viable mechanism for releasing additional carboxylic acids from kerogen, thereby increasing porosity by the dissolution of carbonate cements and aluminosilicates.

Knut Bjørlykke provides evidence that meteoric waters, not organic-derived species, are responsible for the development of secondary porosity in the sandstones of the Brent Group (Jurassic, North Sea). In this case, the secondary porosity is not volumetrically important.

Jim Wood's paper presents a theoretical framework for the development of secondary porosity due to decarboxylation of organic matter. Calculated thermal mass transfer coefficients for calcite and quartz show that low temperatures and high P_{CO_2} are most effective in mobilizing calcite, but that high temperatures are more effective in the mobilization of quartz. Another paper by Wood and Hewett shows that, from a theoretical perspective, forced-fluid flow may be significant in controlling the distribution of authigenic mineral phases.

For the last paper, Charles Barker and Robert Halley present a case study of the application of fluid-inclusion analysis, vitrinite reflectance measurement, and stable isotopic studies to the interpretation of the thermal and diagenetic evolution of the Bone Spring Limestone. Barker and

Halley show that the history of cementation, fluid migration, and petroleum migration are clearly recorded during diagenesis.

Thanks are due to all the authors for their patience and diligence and to the Society of Economic Paleontologists and Mineralogists Publications Committee and Council for authorization. I am grateful to Special Publications Editor Barbara Lidz and to the SEPM Research Committee, who

recognized the significance of the interactions of organic and inorganic constituents of sedimentary basins.

The U.S. Geological Survey was most generous in permitting me the time and technical support to put the symposium and volume together. Finally, my profound thanks to M. P. Krupa for her technical assistance, organizational skill, and forbearance.

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