Problems and Progress in Studies of Diagenesis of Argillaceous Rocks

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The diagenesis of argillaceous rocks includes physical, chemical, and mineralogical changes occurring after the deposition of the sediment. Hedberg's observations, published in 1936, on the gravitational compaction of clays and shales serve well as a framework upon which to organize many of the subsequent researches on diagenesis of those rocks.

The preponderance of illite in marine mudstones (commonly shales) has been interpreted as a result of widespread diagenetic conversion of other clay minerals into illite. More extended researches indicate, however, that primarily formed, expanding montmorillonite is notably more resistant to conversion to illite than is the expanding clay originating as stripped or degraded illite. The conversion of clay minerals to illite or chlorite is probably a two-stage process: (1) cation exchange, controlled by energy relations, and (2) subsequent and more permanent cation fixation. Some glauconite is apparently formed diagenetically, although complete details of the process remain obscure. Clay minerals that are not readily susceptible to diagenetic change are indicators of provenance, whereas those modified by a change in surrounding conditions may indicate the environments of their deposition.

Diagenesis of non-marine mudstones may include fixation of potassium , and alternatively the depotassication of illite; kaolinization of other clays, desilication of clays to form hydrated aluminum oxides, and alternatively their silication; and conversion of montmorillonite to illite and glauconitic mica.

Diagenesis and Paragenesis in Limestones and Dolomites

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The apparent confusion among geologists about the meaning of "diagenesis" probably arises from the fact that there is no universally accepted definition of the word. There seems to be agreement that "diagenesis" begins with, or immediately after, deposition of a sediment, but considerable disagreement arises as to when "diagenesis" ceases.

In this paper, diagenesis refers to the chemical and or physical processes that change the textural and mineralogical characteristics of a sediment. On the basis of a study of some of these characteristics, discernible mostly in thin sections, it is possible to establish reliable sequences of mineral deposition. For this paper, such sequences observed in some limestones and dolomites are shown by paragenetic diagrams, and textural relations on which the paragenetic diagrams are based are shown in photomicrographs.

From an established sequence of mineral deposition in a rock it should be possible to determine an orderly progression of the diagenetic reactions that have taken place. A simple illustration would be a crinoidal limestone in which calcite forms not only distinct overgrowths on the crinoid fragments but also a cement between the enlarged fragments. Basically, the paragenesis would be (1) calcite: crinoid and other fossil fragments, (2) calcite: overgrowths, and (3) calcite: cement. If the deposition of the three calcites is definitely successive (that is, if the deposition of one calcite is completed before the other begins), some geologists might consider that lithification was complete after deposition of calcite (2) and that diagenesis ceased at that time. However, if there is any overlap in time of deposition of the three calcites, especially of (2) and (3), it seems logical to assume that diagenesis and lithification both terminated at the end of deposition of calcite (3).

Diagenesis of Reef Limestones

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The main original reef constituents are a skeletal carbonate framework, syngenetic carbonate detritus, and pore space.

Diagenesis alters these materials by various processes involving addition, removal, and reconstitution of materials.