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### Interpreting Diagenetic History of Sandstones

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Diagenesis is regarded commonly as effecting only minor changes in a sandstone. However, certain changes in mineralogy and texture can be recognized as responses to physico-chemical conditions similar to those of regional metamorphism, but developed at lower temperatures and pressures. Recognition of mineral associations leads to identification and classification of chemical reactions involved and to reconstruction of the diagenetic environment. The sedimentary history may be reconstructed in reverse order by consideration of three stages: late burial (lithification), early burial, and depositional.

Alterations in cements, mineral replacement relations, and appearance of diagnostic authigenic minerals provide data for interpretation of the reactions leading to the erection of diagenetic isograds, and reconstruction of the condition of late burial. Reactions typical of lithification trend in the direction of reduction in free energy in individual minerals, reduction in water in the crystal lattice, and transformation of clay minerals into more ordered lattices of more definite composition.

With the exception of textural changes brought about by compaction, the environment of early burial is dominated by reactions controlled by Eh and pH. Examples are authigenesis of certain clay minerals, and precipitation of silica, iron oxides, and carbonates in pores or as concretionary growths. Groups of associated minerals representing this stage of development may be plotted in a form comparable with ACF and AKF diagrams. From these can be drawn interpretations of the chemical conditions prevailing.

Paragenetic relations among individual grains permits reconstruction of the composition of the raw detritus. Environments of accumulation represent conditions of important changes in solution, oxidation and reduction. Modification in mineralogy occurs as reactions controlled by Eh, pH, and solubility products occur among the components.

### Some Geochemical Factors in Cementation of Sandstones

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The origin of chemically precipitated cements, such as quartz, carbonates, and sulphates, in originally permeable rocks, is related to (1) the mineralogy of the original sediment, which may include both detritus and chemical precipitates; (2) the solubilities of the minerals in dilute to concentrated aqueous solutions in a range of temperatures and pressures; and (3) the composition of interstitial water solutions during various stages of diagenesis. In turn, the composition of these waters may be related to (1) the composition of the original water of the sedimentation environment (if subaqueous) and (2) routes of migration of groundwaters. Changes in interstitial water composition are associated with the successive stages of diagenesis, which can be characterized in terms of varying degree of depth of burial , with consequent changes of pressure, temperature, and direction of ground-water movement. The actual sequences of cements that have been observed by petrologists can be accounted for by this analysis as well as the referral of particular mineral precipitates to specific diagenetic stages. The reconstruction of the diagenetic stages of a rock's history can be made only if there is a thorough understanding of the geologic history of the particular geologic section and area.