Ideality of Clay Membranes in Osmotic Processes: A Review

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Abstract: Clays can act as osmotic membranes and thus give rise to osmotically induced hydrostatic pressures. The magnitude of generated osmotic pressures in geologic systems is governed by the theoretical osmotic pressure calculated solely from solution properties and by value of the membrane's three phenomenological coefficients: the hydraulic permeability coefficient, L_p; the reflection coefficient, σ; and the solute permeability coefficient, ω. Generally, low values of L_p correspond to highly compacted membranes in which σ is near unity and ω approaches zero. Such membrane systems should give rise to initially high osmotic fluxes and gradual dissipation of their osmotic potentials.

The high fluid pressures in the Dunbarton Triassic basin, South Carolina, are a good example of osmotically induced potentials. A unique osmotic cell is created by the juxtaposition of fresh water in the overlying Cretaceous sediments against the saline pore water housed within the membrane-functioning sediments of the Triassic basin. Because wells penetrating the saline core of the basin show anomalously high heads relative to wells penetrating the basin margins, the longevity of this osmotic cell is probably dictated by the rate at which salt diffuses out into the overlying fresh water aquifer.

Key Words: Clay osmosis • Hydraulic permeability • Hydraulic pressure • Membrane • Osmotic pressure • Solute permeability

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