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# The Birefringent Orientation and Relaxation of Clay Platelets as Affected by Particle Size, Saturating Cation and Clay Type\*

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\* Supported by the Illinois Agricultural Experiment Station, Urbana, IL, U.S.A.

Previous work has shown that some clay particles orient at both low and high voltages due to a permanent dipole and an induced dipole, respectively, whereas other clays under similar short-duration pulses orient only at high voltages. The permanent dipole was attributed to the iron in the octahedral layer of the clay mineral, whereas the induced dipole was probably due to a redistribution of the diffuse double-layer cations. This study shows that smaller clay particles orient more readily at low voltages and have greater rotational diffusion coefficients at high voltages. The higher the rotational diffusion coefficient, the faster the particles move in their surrounding water-cation environment. The effect of the saturating cation on the rotational diffusion coefficients was  $\text{Na} > \text{Li} > \text{K}$  for the permanent dipole and  $\text{K} > \text{Li} > \text{Na} > \text{Ca} > \text{Mg}$  for the induced dipole orientation. Previous results (Schepers and Miller, 1974) are interpreted to mean that a particle in dilute suspension can rotate independently of its environment only when the salt concentration in the surrounding medium approaches zero. At higher salt concentrations, or if the particle environment is perturbed by an electric field, the particle rotates with a water shell. As the concentration of salt or strength of the electric field increases further, either the viscosity of the surrounding solution increases or the size of the rotating shell is greatly increased. Thus, the water around clay particles appears to be structurally different than normal, and this condition is probably caused by the nature of the clay—cation interaction.

*Clays and Clay Minerals*; August 1976 v. 24; no. 4; p. 163-169; DOI: [10.1346/CCMN.1976.0240403](https://doi.org/10.1346/CCMN.1976.0240403)

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