Ph.D. THESIS DEFENSE ANNOUNCEMENT

CARBONATE DIAGENESIS AND CHEMICAL WEATHERING
IN THE SOUTHEASTERN UNITED STATES:
SOME IMPLICATIONS ON GEOTECHNICAL BEHAVIOR

by
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Abstract

The Savannah River Site (SRS) deposits in the Southeastern US between 30-45 m of depth are calcium carbonate-rich, marine-skeletal, Eocene-aged sediments with varying clastic content and extensive diagenetic alteration, including meter-sized caves that coexist with brittle and hard limestone. An experimental investigation including geotechnical (P- and S-wave velocities, tensile strength, porosity) and geochemical/mineralogical (EDS, XRD, SEM, N\textsubscript{2}-adsorption, stable isotopes, K-Ar age dating, ICP-assisted solubility, groundwater) studies highlighted the contrast between hard and brittle limestones, their relationship with cave formation, and allowed calculation of parameters for geochemical modeling. Results demonstrate that brittle and hard limestones bear distinct geochemical signatures whereby the latter exhibits higher crystallinity, lower clastic load, and freshwater-influenced composition. Results also reveal carbonate diagenesis pathways likely driven by geologic-time seawater/freshwater cycles, microorganism-driven micritization, and freshwater micrite lithification. A second branch of this investigation studied the SRS surface soils which are largely coarse-grained and rich in iron oxides with various degrees of maturity. These soils were simulated in the laboratory using Ottawa sands that were chemically coated with goethite and hematite. Surface (SEM, AFM, N\textsubscript{2}-adsorption) and geotechnical properties (fabric, small-strain stiffness, shear strength) were investigated on the resulting “soil analog”. Results indicate that iron-oxide coated sands carry distinct inherent fabric and enhanced small-strain stiffness and critical state parameters when compared to uncoated sands. Contact mechanics analyses suggest that iron oxide coatings yield an increased number of grain-to-grain contacts, higher surface roughness, and interlocking, which are believed to be responsible for the observed properties.