

Chemical and structural basics

- Atomic structure
- Chemical bonds and atomic packing
- Crystallography: Symmetry and crystal systems

Aluminum oxides

- Crystal chemistry and crystallography
- Determination and formation

Iron oxides

- Crystal chemistry and crystallography
- Determination
- Redox reactions in soil environments
- Transformations in soils
- Constant-potential / variable-charge surfaces
- Literature analysis – Fe oxides and soil wetness

Manganese oxides

- Crystal chemistry and crystallography
- Determination and formation
- Specific sorption of trace metals

Silica minerals

- Crystal chemistry and crystallography
- Determination and formation
- Duripans and fragipans

Layer silicate overview

Kaolin minerals

- Crystal chemistry and crystallography
- Determination, formation, and distribution

Micas

- Crystal chemistry and crystallography
- Determination and distribution
- Weathering / neoformation
- Literature analysis -- Biotite weathering

Vermiculites

- Crystal chemistry and crystallography
- Cation fixation and release
- Literature analysis -- Cs fixation by clays

Smectites

- Crystal chemistry and crystallography
- Determination; alkyl ammonium techniques
- Formation and distribution
- Cation exchange equilibria of smectites
- Literature analysis -- Cd sorption on smectites
- Ultrastructure of smectites

Chlorites: Crystal chemistry and crystallography

Structural variations

- Interlayered and pillared clays
- Interstratified clay minerals
- Poorly crystalline materials: Allophane and imogolite
- Framework silicates: Zeolites

Clay - organic matter interactions

- Humic substances
- Pesticides

Clay mineral colloids

- Dispersion and coagulation phenomena

Thermodynamic stability of clay minerals

LABORATORY OUTLINE

Laboratory safety

Preparing soil clays for analysis

- Carbonate and organic matter removal
- Fractionation of sand, silt, and clay
- Fractionation of fine clay
- Cation saturation and freeze drying

Fundamental theory and analysis

- X-ray diffraction
- Thermal analysis
- Infrared spectroscopy

Fe oxides in clay fractions: CBD extractions

Cation exchange capacity of soil clays

EGME surface area determinations

XRD -- Sample preparation and analyses

Thermal analyses

IR analyses

Total chemical analyses

Demonstration of transmission electron microscopy