SPECTRAL EVOLUTION

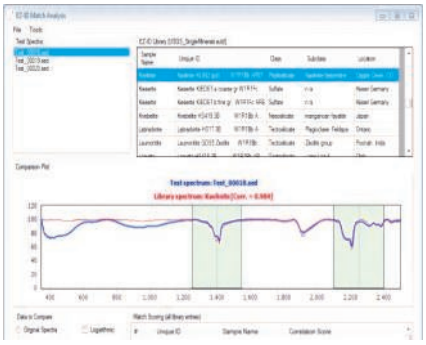
Clay Mineralogy in Soil

Soil is a mixture of solids, liquids, and gases. The solid portion is made up of organic and inorganic material. An ideal soil mixture might be 45% mineral, 5% organic matter, 25% water, and 25% gas (air). Clay minerals are the major inorganic component and are layer silicates formed typically by weathering of other silicate minerals. They contain a large percentage of water within their silicate sheets and can also hold dissolved plant nutrients. Cation exchange capacity (CEC) is a measure of a soil's ability to hold positively charged ions and influences soil structure stability, nutrient availability, soil pH and soil reaction to fertilizers and other ameliorants. In addition various clays have the ability to attract water molecules and swell—which can affect soil drainage capabilities. Some of the most common clay types in soil are kaolinites, smectites, and illites. NIR spectroscopy is a valuable technology for identifying clays in soil in the field and the lab and establishing an accurate picture of soil characteristics.

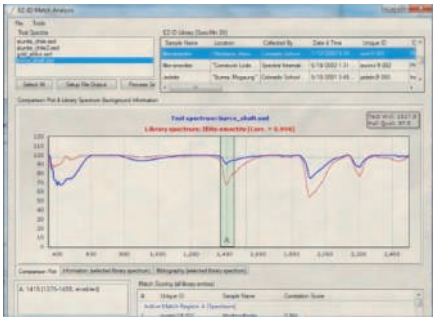
O-H stretch combinations and a metal O-H bend allow clay minerals to show absorptions. In the NIR regions between 2200 and 2500 nm, there are combination vibrations associated with a metal bend and an O-H stretch. For clays like illite, kaolinite and smectite/montmorillonite, absorptions near 2200 nm are due to Al-OH. H_2O, OH and CO_3 combination vibrations and overtones typically show clay mineral absorptions.

Kaolinte shows characteristic absorptions doublets around 1400 and 2200nm. At 1400nm, the absorption is due to overtones. An O-H stretch combination and an Al-OH bend are shown near 2200nm. Smectite, a group that includes montmorillonite, has strong characteristics with absorptions at 1400, 1900 and 2200nm. Smectite has an octahedral layer causing the first overtone of a structural O-H stretching to show at the 1400nm band. Water bound in the lattices of smectite will show absorbance at 1400 and 1900nm due to vibrations. The combination bands that are caused by vibrations of bound water appear at somewhat shorter wavelengths — 1400 and 1900nm. Shoulders of absorbed water will appear around 1468 and 1970nm and will dominate by remoistening. Smectite and illite can sometimes show very similar absorptions if one does not know what to look for. Illite shows absorptions at 1400, 1900 and 2200nm just like smectite. Illite can be distinguished from smectite by having additional absorptions at 2340 and 2445nm.

The PSR+ field portable spectroradiometer from Spectral Evolution has the features required for accurate and fast soil and clay identification and analysis. With its industry leading resolution and sensitivity, it collects clear spectra from clays and soil organic matter that are essential for accurate analysis. The PSR+ is made for field use—take it right into the soil pit and collect data from different soil horizons. Equipped with optional EZ-ID software, it can compare your target spectra against two spectral libraries to match against known samples of different clays from different locations. In addition, the Custom Library Builder module allows you to create your own spectral library from known field samples for a particular application, region, or analysis.



Kaolinite spectra matched by EZ-ID to a known sample of the clay in the SPECMin library



Smectite/montmorillonite sample identified with EZ-ID

Illite sample—sometimes illite and smectite spectra look very similar. Here you clearly see the difference with a doublet absorption feature for illite between 2300-2500nm.

26 Parkridge Road ◊ Suite 104
Haverhill, MA 01835 USA
Tel: 978 687-1833 ◊ Fax: 978 945-0372
Email: sales@spectralevolution.com
www.spectralevolution.com