A34 Cathodoluminescence (CL) Microscopy and Spectroscopy Application to Soil/Sand

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After attending this presentation, attendees will understand the principles of cathodoluminescence (CL) microscopy and spectroscopy applied to soil/sand, as well as sample preparation, mineral component identification, digital image processing, and elemental analysis.

This presentation will impact the forensic community by illustrating the key steps in practical application of the method and its integration into techniques currently used in forensic soil/sand analysis.

This poster presentation describes and demonstrates the application of cathodoluminescence (CL) microscopy and spectroscopy to the characterization of mineral components of soil/sand. Forensic geologic samples are often comprised of varying concentrations of both light and heavy minerals, as well as foraminifera, diatoms, and other organic particles, making them amenable to identification by a variety of methods. Quartzes, carbonates, and feldspars are the most abundant minerals on Earth and, as such, are usually encountered as constituents of soil/sand samples. Because these minerals are ubiquitous, they may be found in even very small amounts of trace geologic materials such as dirt smears and dust. Application of CL microscopy and spectroscopy is suitable to differentiate among common classes of minerals, such as feldspars, carbonates, zircons, and quartzes, all of which exhibit characteristic CL colors when bombarded with an electron beam. The cathodoluminescence emission is related to the presence of trace element activators, such as Cr^{3+}, Mn^{2+}, Mn^{4+}, Fe^{3+}, and rare earth elements ($REE^{2+/3+}$), such as hafnium, neodymium, dysprosium, and europium, as well as due to lattice defects within the crystal.

Additionally, within the mineral types, cathodoluminescence microscopy and spectroscopy will provide information that can discriminate among different sources of each mineral. The additional discrimination among sources of quartz, for example, would provide a useful tool for the forensic comparison of these geologic materials. Further, CL microscopy and spectroscopy, combined with traditional forensic geologic methods, may offer information for source determination by providing information about the conditions under which the mineral was formed.

Study results presented will include: (1) suitable sample preparation for processing with multiple techniques, (2) the application of CL digital image processing, and (3) particle elemental analysis, using automated SEM-EDS and micro-XRF. The focus of this study is to develop an optimized analytical scheme for processing small sample sizes with these microanalytical methods. Considerations of sample size and sequence of analyses necessary for sample manipulation, integrity and beam damage, as well as automation of processing for high sample throughput, will also be presented.

Cathodoluminescence, Soil, Microscopy

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