## A80 Luminescence Studies of Feldspar Minerals and Implications for Forensic Geology

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After attending this presentation, attendees will understand the principles of luminescence spectroscopy applied to forensic mineral analysis and its potential for enhanced discrimination of sediment sources and provenance determination.

This presentation will impact the forensic science community by illustrating the practical application of luminescence spectroscopy to forensic geologic examinations and its integration into techniques currently used in forensic sediment analysis. The additional discrimination among sources of feldspar minerals could provide a useful tool for the forensic comparison of geologic materials. Further, luminescence 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.

Feldspar minerals are the most common constituents of igneous rocks on this planet and, as such, are usually encountered as constituents of sediment samples. Because feldspar minerals are ubiquitous, they may be underutilized in traditional forensic geologic examinations, such as simply providing mere mineral identification rather than yielding a provenance determination or source-level association. Complete mineralogical characterization of each feldspar grain can be used to help distinguish particular soil characteristics, but this process is tedious and expensive to perform and will not necessarily yield the provenance for each sample. One possible method to rapidly analyze large numbers of diverse soil samples involves measuring the luminescence of feldspar minerals among them, which could rapidly yield highly discriminating characteristics of the feldspars.

Alternatively, spectroscopic analysis of the feldspar luminescence that could be performed relatively rapidly could yield specific identifying characteristics of a soil sample that offers additional source discrimination instead of or in addition to commonly used methods. With this approach in mind, the UV-Visible-NIR luminescence of a wide variety of North American feldspar samples was measured and analyzed for distinguishing features that could be used in forensic provenance studies.

In this study, 44 feldspar samples of known provenance were obtained from the geology department of a reputable museum. These included 20 potassium feldspars (microclines, orthoclases, etc.), 8 albite specimens, and 16 plagioclase feldspar samples. These common feldspar mineral separates were examined by two ion beam analysis techniques, as well as by cathodoluminescence (CL) spectroscopy. Particle induced x- ray emission (PIXE) was used for elemental analysis and ion beam induced luminescence (IBIL) was measured spectroscopically and compared to CL. Previously reported luminescent centers ($Mn^{2+}$ and $Fe^{3+}$) were observed and their UV-Visible peak positions vary with stoichiometric changes in the Na-K-Ca composition of the feldspars as expected. Similarly, Si-O and Al-O lattice defect luminescence in the UV-Visible spectra were observed; in addition, a previously unassigned IR luminescence peak was seen in some of the feldspar specimens analyzed. Analysis of the feldspar samples by x-ray diffraction, total- reflection x-ray fluorescence spectrometry, and laser ablation-inductively

coupled plasma-mass spectrometry was performed in an attempt to determine the mechanism for this unassigned IR peak. An observed shift in specific luminescence peak centroids between IBIL and CL measurements is also reported. Experimental methods and preliminary results will be presented.

**Luminescence, Forensic Geology, Feldspar**

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