An investigation into UV fluorescence in feldspar group minerals

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Feldspar group minerals are among the most abundant mineral groups in the Earth's lithosphere. These minerals have been documented, studied and analyzed for a wide range of petrologic purposes, including examining igneous phenocrysts to investigate crystallization conditions and compositions of parent melts. The range of methods used to examine feldspars, both qualitatively and quantitatively, are also wide ranging and include cathodoluminescence, petrographic Michel-Levy compositions, scanning electron microscope (SEM) and X-Ray Diffraction (XRD). Due to the extensive history of study of these minerals, most of their physical properties and paragenesis are well understood. However, their ability to react to long- or short-wave UV light, i.e., fluorescence, has long been documented but had, to date, not been fully quantified. The fluorescence of a selected suite of feldspar group minerals is being examined to investigate the link between fluorescence, crystal chemistry through determination of major and trace elements, and crystal structure. The methods used include petrographic characterization, X-ray diffraction analysis, electron microprobe analysis, UV spectroscopy analysis and crystal-structure modeling. Samples from Canada and the United States will be used in this study focusing on compositions of alkali feldspars including microcline (including amazonite) and orthoclase (including adularia) and plagioclase feldspars (albite, oligoclase, labradorite, bytownite, and anorthite). Using these samples, we will look for intercrystalline impurities known as activator elements, characteristically metal cations (Fe^{2+}, Fe^{3+}, Ti, and Mn) or rare earth elements. Electrons within these elements become excited at an atomic level by photons at UV wavelengths which in turn cause the electron to jump to a higher orbital. The de-excitation of this electron causes a loss in energy. This energy is subsequently released in the form of light, at a different wavelength than that absorbed, which, in the case of UV fluorescence, is visible to the human eye. Preliminary results show different compositions fluorescing at different colors along with strongly variable intensities. One note is the observation that different samples of similar bulk compositions show different wavelengths and intensities. Furthermore, it is been evident that certain parts of the minerals, microcline in particular, fluoresce with different intensities. This indicates that the cause of UV activated fluorescence is most likely to be trace element- activator variations. Detailed microscope and petrographic analysis will be carried out, along with electron microprobe analyses, to determine which elements are responsible for the fluorescing phenomena.

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