

JADEITE LUMINESCENCE GEOCHEMISTRY

ERIN DOPFEL, Mount Holyoke College

Jadeite, nominally $\text{NaAlSi}_2\text{O}_6$, has long been observed to emit green, blue, or red luminescence. The chemical origin of these phenomena is currently unknown. The goal of this study is to determine the chemical activators of cathodoluminescence in Na-rich pyroxene using chemical characterization by four analytical techniques. Seventeen samples of jadeite from Guatemala, Burma, California, Russia, and Japan were selected from the collections of the Smithsonian National Museum of Natural History (NMNH). These samples were analyzed using the electron microprobe for major elements, Mössbauer spectroscopy for $\text{Fe}^{3+}/\text{Fe}^{2+}$, ICP-MS for trace and minor elements, and cathodoluminescence (CL) for emission energies. The complete chemical data acquired from these techniques are used to examine the variations in jadeite chemistry as a function of paragenesis, and to link the chemistry of these minerals with their luminescent behavior.

Samples were qualitatively assigned to either dull green CL, bright green CL, blue CL or red CL. Prominent energy peaks were identified at 442 nm, 561-579 nm, and 682 nm. The source of jadeite's "blue band" at 442 nm has previously been hypothesized to be due to the presence of one or more unknown defect centers. However, the CL analyses of tectosilicates have concluded that peaks in the 400 nm-range are correlated with the abundance of Al^{3+} or Eu^{2+} , and results show that the influence of Al^{3+} on the intensity of this peak is especially significant. The "green peaks" observed between 561-579 nm have been assigned by previous studies to represent contributions from Mn^{2+} ions. This Mn^{2+} peak is also observed in pyroxenes and many other silicate minerals, including feldspars. Despite a general consensus that Mn^{2+} is the primary activator in green luminescence, this study suggests that this wide peak is, in fact, a series of smaller peaks stacked side-to-side. Results from ICP-MS analyses show that a handful of REE's, including Dy and Tm, are also correlated with the intensities in the energy range of 570-590 nm. The red peak at 682 nm is well-correlated to the presence of Al^{3+} , Ti^{2+} , Ca^{2+} , and Eu^{3+} , as suggested by previous work. Mössbauer data acquired as part of this study allow us to constrain separately the influence of Fe^{2+} and Fe^{3+} on both the intensities of luminescence and the activation of red emission energies. While this research brings light to the possible luminescence activators in jadeite, it is evident that the uncertainties in these studies require further research in order to bring more insight to the origin of such luminescence phenomena.