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Cathodoluminescence microscopy and spectroscopy of plagioclases from lunar soil

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ABSTRACT

Cathodoluminescence (CL) microscopy and spectroscopy of single plagioclase grains from lunar soil show that plagioclases from Luna 20 (highland) have more or less homogeneous CL with both blue or green colors, whereas plagioclase grains sampled by Luna 24 (mare) luminesce dominantly green with partially distinct oscillatory zoning. The three main emission bands in the blue (~450 nm), green (~560 nm), and red-IR (~690 nm), mimic the most common emission bands in terrestrial feldspars. Mn^{2+} is the most important activator element in lunar plagioclases. Variations in the amount of structurally incorporated Mn^{2+} cause variations in the intensity of the green emission band at 560 nm, in some cases resulting in zoning of the CL intensity within single crystals. Calculations by a combination of quantitative spectral analysis of CL emission and PIXE measurements yield Mn concentrations of 7–47 ppm. The intense intrinsic emission band at 450 nm (probably an Al-O^--Al center), which was especially prominent in Luna 20 plagioclases, causes their blue CL color. The occurrence of a CL emission band at ~690 nm in plagioclases from Luna 24 samples confirms that Fe^{3+}-activated CL is common in these grains. The results indicate that at least some of the Fe in Luna 24 plagioclases is Fe^{3+}, whereas all Luna 20 plagioclases have Fe^{3+}-near the CL detection limit of about 0.1 ppm.