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Sodium Enriched Luminescent Chondrule Mesostasis Rims in the Unequilibrated Ordinary Chondrites. J. M. DeHart,[1] D. W. G. Sears[1] and G. E. Lofgren.[2] [1]Cosmochemistry Group, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701 USA. [2]SN2 Johnson Space Center, Houston, TX 77058 USA.

During the course of our survey of phosphors in the unequilibrated ordinary chondrites (UOC) using cathodoluminescence (CL) petrographic techniques, six chondrules were noted to have their outermost regions of mesostasis luminesce blue while the mesostases in the more interior portions of the chondrule were either nonluminescent (two in Semarkona and one in Krymka) or had red CL emission (the three chondrules noted in ALHA77214). This difference is associated with large differences in sodium content of the mesostases in the chondrules from all three meteorites. The blue luminescent mesostases are from 0.98 to 6.55 weight percent higher in sodium content than the mesostases with different luminescent responses in each chondrule. Previous studies indicate these large differences in sodium content are probably not the result of chondrule forming processes (1).

All six chondrules are porphyritic olivine (PO) chondrules and three of the six have rims of sulfide material. In five of the six chondrules, Al_2O_3 is also slightly higher in the luminescent regions. The largest differences in sodium content are in the chondrule mesostases in Semarkona.

We offer the following interpretation of these compositional and luminescent features. These enrichments in sodium occurred either when these chondrules were exposed to Na-rich gases during their residence in the solar nebula before they acquired their sulfide rims (in the case of the rimmed chondrules), or during their accretionary history prior to being incorporated into their present material. Gases rich in volatile metals are believed to have existed on meteoritic parent bodies as a result of metamorphic heating of the interior materials (2, 3). In addition, it is possible that these gases were not only hot enough to contain and implant the sodium, but also to nucleate the phosphor responsible for the luminescent properties, which is probably a Na-rich feldspar. It is also reasonable to suppose that the production of the phosphor was a two step process, with the annealing event that produced the phosphor having occurred as a separate process. These elevated temperatures did not nucleate the phosphor in more interior mesostasis regions because the lower sodium content of these areas would require higher and/or longer exposure to elevated temperatures to produce the phosphor. The greater difference in sodium content in the chondrule mesostases in Semarkona is probably due to the aqueous fluids this meteoritic material has been exposed to. This indicates these fluids could alter the glasses of the interior mesostases but not affect the crystalline material responsible for the blue luminescence, providing another geochemical indicator as to the nature of the fluids that have altered this meteorite.

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