THE CONDITIONS TO GET COLOUR CATHODOLUMINESCENCE BY ELECTRON MICROPROBE APPLIED TO THE CLASSIFICATION OF PRIMITIVE METEORITES OF TYPE 3

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Introduction: Previous classifications of petrographic type 3 chondrites by cathodoluminescence (CL) used apparatus in which an electron beam source was coupled on an optical microscope (CL-OM). The section-scale colorful images that result is the strength of this technique, but obtaining CL images by electron microprobe (CL-EPMA) has the advantage of enabling SEI and BSE images and compositions by EDS and WDS to be obtained simultaneously. Here we report a comparison of both techniques. The chosen meteorites were Bishunpur (LL 3.1) and Hedjaz (L3.7-6) since these were part of earlier studies.

Experimental: The CL of Bishunpur and Hedjaz meteorite were obtained by CL-OM and CL-EPMA. The optical microscope used was a Zeiss Axio Imager 2 with a CITL MK5-2 electron beam source and Zeiss AXIOCAM HRc digital camera. The probe was operated at 15 KeV and 0.7mA, the same for previous work [1]. Photomosaics were prepared using the Adobe-Bridge CS6 and Adobe-Photoshop CS6 software. The CL-EPMA data were obtained with a Jeol JXA8230 microprobe, and a Jeol XM-Z09013TPCL with an R955P PMT attachment which included RGB color filters. For Hedjaz, a 15 keV, 70nA beam with 1 μm diameter was used. Maxim DL 5 software was used to blend the color images and determined color ratios. The ratio found to achieve an approximate CL-OM colour was L=100%, R =35, G =30 and B = 20. For Bishunpur a beam of 20keV and 7nA was used for the EPMA in order to observe the yellow color mesostasis revealed by CL-OM.

Results and Discussion: First, it was necessary to confirm the equivalence between CL-OM result acqurired on this work and the available in the literature by [1] for the present meteorites. Once them showed the same colour trends, the CL-EPMA analytical condition could be established, based on true colour of the CL-OM result. The CL-OM and CL-EPMA images of both meteorites had essentially the same colour signals with minor differences in intensity. Bishunpur showed a variety of colors, mainly red, blue, green and yellow, as expected for a chemically heterogeneous chondrite of type 3.1, however. In both cases, many chondrules exhibited luminescence of various colour, while others had little or no luminescence. In some cases, chondrules exhibited luminescence in the minerals and mesostasis, and while sometimes only the minerals or only the mesostasis luminesced. For the Hedjaz meteorite, both the matrix and chondrule mesostasis showed blue luminescence, while the grains inside the chondrules did not produce CL. In this respect Hedjaz resembles most more methamorphosed types 3. These CL petrological trends of meteorites exhibited by the both CL techniques is the same as described on [2], which uses the optical microscope method to study the CL signal of unequilibrated ordinary chondrites. The differences of colour response is related to the soft degrees of thermal metamorphism found in these primitive meteorites, which are described by [3].

To more closely match the colours observed on CL-OM images, it was necessary to establish RGB ratios for the blending process. It is a way to offset the sensitivity of the PMT for different wavelengths. The analytical condition have applied to Bishunpur exposed the yellow mesostasis in CL-EPMA. This higher tension is based on the fact that excitation of CL is not very sensitive to the beam, thus sometimes it is advantageous to use at least 20kV [4].

A quantitative comparison between the two techniques was made based on the Chondrules Classification developed by [5]. The amount of chondrules into 8 DeHart`CL Chondrules Groups were almost the same on CL-OM and CL-EPMA results, showing a relatively low standard deviation , ~3 and ~1.7 for Bishunpur and Hedjaz, respectively. This result shows up the two methods have the same CL responses, with previous trends of CL also revealed by CL-EPMA.

Therefore, as the first conclusion, it is important to establish a ratio among RGB image as well as applying a proper analytical condition in order to achieve a better result from the EPMA. Futhermore, the main conclusion is the CL-EPMA might be an alternative technique to classify primitive meteorites in the future, parallel to the existing CL-OM method.

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