

SPECTRA CATHODOLUMINESCENCE AND CRYSTAL LATTICE: CERITE VERSUS WHITLOCKITE

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Introduction: We record more than 10 whitlockite cathodoluminescence (CL) spectra from 10 different chondrites exhibiting very similar and characteristic spectral CL patterns. Following to Gotze (2009) the CL spectra of whitlockite (merrillite) are dominated by strong emission peaks of several rare earth elements (e.g., **Figure 1**).

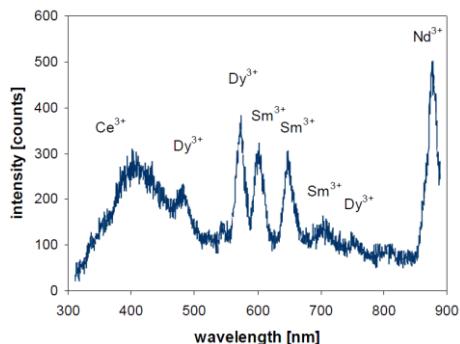


Figure 1.- Spectra CL plot of Götz (2009) of a Lunar whitlockite and REE associated to the main emission peaks.

In addition, we also found this characteristic whitlockitic CL pattern in a natural cerite specimen of a terrestrial slate collected in Castañar de Ibor (Cáceres, Spain) (**Figure 2**).

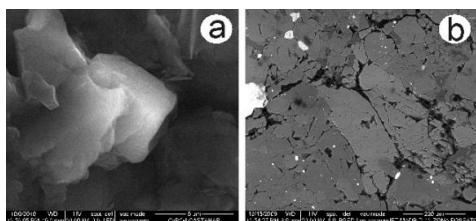
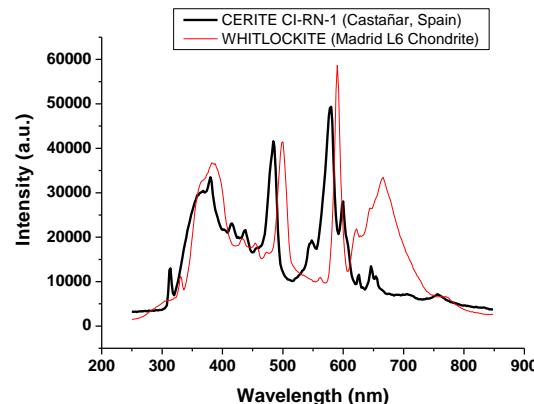


Figure 2.- ESEM images. (a) Cerite crystal sized 5 μ m in Paleozoic slate matrix (Castañar de Ibor, Cáceres, Spain) (b) Couple of whitlockite crystals in the L6 Chondrite Madrid.

In accordance with Noore & Shen (1983) Cerite $\text{Ce}^{3+} (\text{SiO}_4)_6 (\text{SiO}_3) (\text{OH})_4$ is nearly isostructural to whitlockite $\text{Ca}_9 \text{Mg}_{0.7} \text{Fe}^{2+}_{0.5} (\text{PO}_4)_6 (\text{PO}_3\text{OH})$ having the same crystallographic space group R3C. Matching the X-ray Diffraction (XRD) patterns of the structural data of this Cerite specimen with the whitlockite specimen of the Tip Top Pegmatite, Custer County, South Dakota studied by of Hughes J.M. et al. (2008) we detect very close X-ray diffraction patterns with an angular difference of just only of five 2θ angle. The EDS chemical analysis of the meteoritical whitlockite is: Na_2O % 0.76, MgO % 2.11, Al_2O_3 % 0.41, SiO_2 % 3.49, P_2O_5 % 40.01, SO_2 % 0.52, K_2O % 0.14, CaO % 44.58, Fe_2O_3 % 3.10 while the EDS analysis of the terrestrial cerite

is: MgO % 2.09, Al_2O_3 % 5.70; SiO_2 % 16.89; P_2O_5 % 26.56; K_2O % 0.75; CaO % 1.44; Fe_2O_3 % 2.00; Y_2O_3 % 1.87; La_2O_3 % 9.02; Ce_2O_3 % 19.06; Pr_2O_3 % 1.09; Nd_2O_3 % 7.25; Sm_2O_3 % 0.86; Gd_2O_3 % 0.97; ThO_2 % 4.45 in which a minor slate contamination can not be disregarded, i.e, elements Al, Si, K, Fe from the intrinsic EDS spot analysis measurement of a little grain sized 5 μm inlaid in the slate matrix.



More surprisingly was to match very similar spectral CL curves recorded by ESEM/CL of a terrestrial silicate of REE (cerite) with the calcium phosphate whitlockite of the L6 Chondrite Madrid (Spain) (**Figure 2**). The strong similarity among both crystal lattices and both spectra CL suggest that the structural features provide a fruitful researching path to understand the whitlockite spectra cathodoluminescence.

References:

Moore, P.B. & Shen J. (1983) Cerite, $\text{RE}_9 (\text{Fe}^{3+}, \text{Mg}) (\text{SiO}_4)_6 (\text{SiO}_3 \text{OH}) (\text{OH})_3$: its crystal structure and relation to whitlockite. *Am. Miner.* 68, 996-1003.

Hughes, J.M., Jolliff, B.L., Rakovan, J. (2008) The crystal chemistry of whitlockite and merrillite and the dehydrogenation of whitlockite to merrillite. *Am. Mineralogist* 93, 1300—1305

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