

## CHEMISTRY-BASED NOMENCLATURES VERSUS DISCRIMINATING ANALYTICAL METHODS (FTIR, XPD) IN THE CELADONITE-GLAUCONITE FAMILY

WEISZBURG, T. G.<sup>1</sup>, POP, D.<sup>2</sup> & TÓTH, E.<sup>1</sup>

<sup>1</sup> Department of Mineralogy, Eötvös Loránd University, Pázmány Péter sétány 1/C, H-1117 Budapest, Hungary.

E-mail: weiszburg@ludens.elte.hu

<sup>2</sup> Mineralogical Museum, Babeş-Bolyai University, Kogălniceanu St. 1, RO-3400 Cluj-Napoca, Romania.

Celadonite and glauconite are <sup>VI</sup>Fe<sup>3+</sup>-rich dioctahedral mica-type layer silicates. In the last 20 years three chemistry-based nomenclature proposals were published for them by the IMA-CNMMN (RIEDER *et al.*, 1998) and the AIPEA (BAILEY, 1980; 1986). In practice, infrared spectroscopy (IR) and X-ray powder diffraction (XPD) were found to be useful distinguishing tools between the two green layer silicates (BUCKLEY *et al.* 1978), and these methods became incorporated into the first AIPEA nomenclature (BAILEY, 1980), too. This work tries to compare the three chemistry-based classification schemes and evaluate their relationship with the two distinguishing analytical methods.

The three classification schemes are partly overlapping, partly divergent. Based on the three possible cation positions in these minerals, a positive charge diagram  $x_T-x_O-x_{IL}$  was designed for the interpretation of the species definitions. In the diagram, the following charge ranges were plotted (using a formula unit based on 11 oxygen atoms): 0–1 for the interlayer charge, 5–6 for the octahedral layer charge and 15–16 for the tetrahedral layer charge, respectively.

In the IMA terminology celadonite is described in terms of four true mica end-members while glauconite represents a series of interlayer-deficient micas. The decisive discrimination between celadonite and glauconite is the interlayer charge, with the dividing value of 0.85 per formula unit. In the AIPEA nomenclature of 1980, discriminative is the tetrahedral layer charge with a value of 15.8 (this corresponds to 0.2 <sup>IV</sup>Al per formula unit). The 1986 recommendation used however, the octahedral layer charge, and the discriminative value was this time 5.3 per formula unit.

Celadonite and glauconite have thus been distinguished by the charge values of all the three possible cation positions.

Concerning IR spectroscopy, both minerals have absorption bands at similar wave numbers, but celadonite has sharp and distinct peaks in the OH-stretching region (3400–3700 cm<sup>-1</sup>) while glauconite is characterized by less pronounced, broader peaks. The sharpness of the absorption bands in the OH-stretching region is dependent on the cation ordering in the octahedral sheet. This is influenced by both the chemistry of the octahedral sheet and the tetrahedral Al substitution. The 1980 AIPEA nomenclature (BAILEY, 1980) defines the border between the two minerals upon the tetrahedral Al substitution, the 1986 AIPEA nomenclature (BAILEY, 1986) mainly upon the charge of the octahedral sheet, thus the AIPEA nomenclatures are somehow coherent with the infrared spectroscopic data of the literature (e.g. BUCKLEY *et al.*, 1978; ODIN, 1988). The IMA nomenclature (RIEDER *et al.*, 1998), on the other side, differentiates between the two minerals upon the interlayer content, suggesting that celadonites and glauconites can have

donites and glauconites can have similar tetrahedral Al substitution, similar <sup>VI</sup>R<sup>2+</sup> / <sup>VI</sup>R<sup>3+</sup> ratio and consequently, similar grade of ordering in the octahedral sheet and similar infrared pattern shapes.

Based on numerous XPD data (BUCKLEY *et al.*, 1978), an almost linear relationship is supposed between the <sup>VI</sup>Fe<sup>3+</sup>-content of the phyllosilicate and the d<sub>060</sub> spacing. It is suggested that the phyllosilicate is celadonite if the d<sub>060</sub> < 1.51 Å and glauconite if d<sub>060</sub> > 1.51 Å. As mentioned earlier, the 1.51 Å d<sub>060</sub> value was adopted as a discriminating value by the AIPEA nomenclature (BAILEY, 1980) though <sup>VI</sup>Fe<sup>3+</sup>-content is not a distinguishing criterion in none of the classification schemes. The IMA nomenclature (RIEDER *et al.*, 1998) does not deal with the applicability of any simple and practical XPD parameter for that discrimination, moreover it is clear that the IL occupancy (i.e. the distinguishing feature between the two minerals) should not be in direct relationship with the d<sub>060</sub> spacing in the mica structure.

It seems that only in the case of the AIPEA nomenclatures (BAILEY, 1980, 1986) can we expect simple IR and XPD criteria for discriminating between celadonite and glauconite. Except for the complete chemical analysis itself there is no other – simple – analytical method that could be used for the application of the IMA nomenclature. Even the formation conditions, used frequently by geologists (glauconite – clearly sedimentary environment, celadonite – always influenced by some kind of hydrothermal activity) may be misleading, as we know “classical” sedimentary glaucony grains of IL charge > 0.85 and celadonite can also be present in seemingly “normal” sediments (WEISZBURG *et al.*, 2003)

This work was supported by the OTKA grant #T25873.

### References

- BAILEY, S. W. (1980). Clays Clay Miner., 28: 73–78.  
BAILEY, S. W. (1986). Suppl. to AIPEA Newsletter 22.  
BUCKLEY, H. A., BEVAN, J. C., BROWN, K. M., JOHNSON, L. R. & FARMER, V. C. (1978). Mineralogical Magazine, 42: 373–382.  
ODIN, G. S. (ed., 1988). Green marine clays. Development in sedimentology, 45. Elsevier, Amsterdam.  
RIEDER, M., CAVAZZINI, G., D'YAKONOV, Y. S., FRANK-KAMENETSKII, V. A., GOTTARDI, G., GUGGENHEIM, S., KOVAL, P. V., MÜLLER, G., NEIVA, A. M. R., RADOSLOVICH, E. W., ROBERT, J., SASSI, F. P., TAKEDA, H., WEISS, Z. & WONES, D. R. (1998). Canadian Mineralogist, 36: 905–912.  
WEISZBURG, T. G., TÓTH, E. & BERAN, A. (2003). Acta Mineralogica-Petrographica, Szeged, 44: (accepted)