Crystal-chemical variations in K-dioctahedral micas 1M: distinguishing features and identification criteria from XRD and FTIR data

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Isomorphous cation substitutions in the tetrahedral and octahedral sheets typical for micas in general are especially diverse in low-temperature potassium dioctahedral micas. K-dioctahedral 1*M* micas, which are abundant in various geological environments, form two intersecting isomorphous series: Fe-poor varieties range in composition from (Mg, Fe)-poor illite to aluminoceladonite through Mg-rich illite, and Fe-bearing varieties, from illite to celadonite through Fe-illite, Al-glauconite and glauconite. The high degree of crystal-chemical heterogeneity, as well as the ambiguity in conventional nomenclature, complicate the identification of these mica varieties.

To reveal the structural and crystal-chemical variability in K-dioctahedral 1*M* micas and to define the composition ranges and identification criteria for the mica varieties in the two series, a collection of samples of various compositions was studied by X-ray diffraction (XRD) and Fourier-transform infrared (FTIR) spectroscopy. The results and implications for Fe-poor mica varieties are treated in detail in [1] and will be covered in brief, the main attention being focused on Fe-rich micas.

Analysis of the relationships between unit-cell parameters and cation composition showed that the Fe-rich mica series includes four groups, Fe-bearing illites, Al-glauconites, glauconites, and celadonites, each characterized by a specific combination of unit-cell parameter variation ranges. The illite group contains two distinct subgroups, Fe-bearing Mg-rich illites and Fe-illites, which differ not only in cation composition variation ranges, but also in FTIR characteristics. The results obtained suggest a revision in the conventional mica classification, so that illites should be characterized by the ratio of octahedral Al to the total amount of trivalent octahedral cations, $K_{Al} \geq 0.65$. In addition, a revised nomenclature should take into account the subdivision of the illite group into illites proper and Fe-illites, as well as the existence of mica samples of Al-glauconite composition.

The boundary between Fe-illites and Al-glauconites corresponds to K_{Al} between 0.60 and 0.65 and occurs at $b \sim 9.05$ Å. The partially overlapping variation ranges of cation composition and cell parameters may complicate distinction between Al-glauconites and glauconites, which can still be unambiguously differentiated using FTIR data. The dramatically different XRD and FTIR characteristics confirm that glauconite and celadonite should be treated as separate mineral species. The distinctive features of celadonite are relatively low values of $c\sin\beta$ and reduced $|c\cos\beta/a|$ in combination with b parameters that are lower than those for glauconites and similar to those for Fe-illites, as well as the sharp absorption bands at specific positions in the Si-O and OH stretching regions of FTIR spectra.

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References:

[1] Zviagina B.B., Drits V.A., Środoń J., McCarty D.K. & Dorzhieva O.V. (2015) The illite–aluminoceladonite series: distinguishing features and identification criteria from X-ray diffraction and infrared spectroscopy data**.** *Clays and Clay Minerals*, **63**, 378-394