TEM-STUDY OF MUSCOVITE-CHLORITE MIXED LAYERS IN A SLATE FROM THE PUNCOVISCANA FORMATION (SALTA PROVINCE, ARGENTINA)

DO CAMPO, M. D.,[1] NIETO, F.[2]

[1] Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Pabellón INGEIS, Buenos Aires, 1428, Argentina
[2] Departamento de Mineralogía y Petrología, Universidad de Granada, Avenuda Fuentenueva s/n, Granada, 18002, Spain
E-mail: nieto@ugr.es

Mica-chlorite mixed layers were identified by X-ray diffraction (XRD), as a major or a subordinate phase, in several slates of the Puncoviscana Formation from Sierra de Mojotoro (Easter Cordillera, NW Argentina). In order to determine the crystal chemical characteristics of these mixed layers and interpret its petrological meaning, the anchizonal slate P90 (Kübler Index = 0.30) was chosen for TEM observations as it displays less evidences of retrograde alteration of clay minerals than other slates of the area (Do Campo, 1999; Do Campo and Nieto, 2003). In this slate dioctahedral mica and chlorite form interleaved phyllosilicate grains up to 110 μm long, preferentially oriented with (001) sub parallel to slate cleavage, which forms an angle of 70° with bedding.

In agreement with XRD results the main phyllosilicates identified by TEM, were dioctahedral mica and 10–14 Å mixed layer, with chlorite in subordinate amounts and scarce smectite. The electron diffraction (SAED) patterns obtained for the 10–14 Å mixed layers present the following reflections in 001 row.

B134: 12.0 Å, 7.4 Å, 5.9 Å, 4.6 Å, 3.7 Å, 3.2 Å, 2.8 Å, 2.6 Å, 2.3 Å, 1.9 Å, 1.8 Å. (CV = 2.6%)

B137: 22.2 Å, 12.0 Å, 7.7 Å, 6.1 Å, 4.7 Å, 3.9 Å, 3.4 Å, 2.9 Å, 2.6 Å, 2.3 Å, 2.2 Å, 2.0 Å (CV = 2.6%).

B140: 12.2 Å, 7.8 Å, 6.2 Å, 4.8 Å, 3.5 Å, 3.0 Å, 2.7 Å, 2.4 Å, 2.0 Å, 1.7 Å (CV = 1.6%).

The coincidence between XRD and SAED data is quite good though the shape and position of the first peak in XRD traces (002 reflection) seems to be affected by the presence of smectite. In both cases reflections at 7.3–7.4 Å that could be attributed to chlorite appear. The coefficients of variation (CV) obtained for these patterns are clearly higher than the value of 0.75% established by AIPEA for rational XRD patterns (Bailey, 1982); therefore they represent random mixed layers. Besides, in $k \neq 3n$ rows the patterns present line and scarce points elongated along **c***, irregularly spaced. In lattice fringe images a sequence of irregular stacking to produce apparent 24 Å (10 + 14) layers could be observed, but frequently it is possible to distinguish the 10 Å layer from the adjacent 14 Å layer. In nearly all packets 14 Å layers prevail, exhibiting 14 Å/10 Å ratios between 1:1 and 3:1. The 10–14 Å pair appears repeated until seven times; this order is broken by stacking faults (10–14–14–10), or for excess 14 Å layers or less frequently 10 Å layers. Several open layers were identified in these packets.

Scarce diffraction patterns characteristic of chlorite, with semi-random or less frequently ordered stacking, were obtained. In lattice fringe images layers at 10 Å in ratios from 1:4 to 1:10, some of them open, interleaved among predominant 14 Å layers were observed in almost all packets. The 10–14 Å pair is not repeated more than three times consecutive and several lateral transformation from 14 Å to 10 Å layers was imaged.

The straight and continuous appearance of lattice fringes in all the mixed layer packets imaged plus the few open layers identified, let us conclude that they correspond principally to mica-chlorite mixed layers. However, scarce smectite layers could be present. The AEM analyses carried out for these packets clearly indicate that they correspond to interstratifications of chlorite-like and muscovite-like layers. The main cation in interlayer site is K, sometimes accompanied by Ca. In some cases the interlayer charge is lower than expected for muscovitic layers, which could be reflecting the existence of illitic substitution in 10 Å layers. Besides, several analyses exhibiting low (Fe + Mg)/Si contents may represent complex muscovite-chlorite-smectite mixed layers.

The structural site in which muscovite-chlorite mixed layers appear together with the observed along layer transformations from 14 Å to 10 Å let us interpret them as the result of a prograde metamorphic replacement of chlorite in porphyroblasts by dioctahedral mica layers, probably in presence of an aqueous fluid.

References

BAILEY, S. W. (1982): American Mineralogist, **67**, 394–398.

DO CAMPO, M. (1999): PhD Thesis (unpublished). Universidad de Buenos Aires, 287 pp.

DO CAMPO, M., NIETO, F. (2003): Clay Minerals, **38**, 459–481.