

Swelling capacity of mixed talc-like/stevensite layers in white/green clay infillings (“deweylite”/“garnierite”) from serpentine veins of faulted peridotites, New Caledonia

LIONEL FONTENEAU^{1,†}, LAURENT CANER^{2,*}, SABINE PETIT², FARID JUILLOT³, FLORIAN PLOQUIN³, AND EMMANUEL FRITSCH³

¹Corescan Pty Ltd, 1/127 Grandstand Road, 6104 Ascot, Western Australia, Australia

²Université de Poitiers, Institut de Chimie des Milieux et Matériaux de Poitiers, IC2MP UMR 7285 CNRS, 5 rue Albert Turpain, TSA51106, 86073 Poitiers cedex 9, France

³Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), Sorbonne Universités—Université Pierre et Marie Curie UPMC, UMR CNRS 7590, Museum National d’Histoire Naturelle, UMR IRD 206, 101 Promenade Roger Laroque, Anse Vata, 98848, Nouméa, New Caledonia

ABSTRACT

White (Mg-rich) and green (Ni-rich) clay infillings (“deweylite”/“garnierite”) found in serpentine veins of faulted peridotite formations from New Caledonia consist of an intimate mixture of fine-grained and poorly ordered 1:1 and 2:1 layer silicates, commonly referred to as non-expandable serpentine-like (SL) and talc-like (TL) minerals. New data on the swelling and shrinking capacity of these layer silicates were gathered from X-ray diffraction (XRD) after saturation of the clay fractions with different cations (Ca²⁺, Li⁺, K⁺), ethylene glycol (EG) solvation, and heat treatments. Simultaneously, layer charge distribution and vacancy density, respectively, were investigated by FTIR spectroscopy on NH₄-saturated clay fractions and XRD on Li-saturated clay fractions before and after heating (Hofmann Klemen treatment). Five clay infillings, with dominant 2:1 layer silicates and variable Ni contents, were selected for this study, from a large set of veinlets, according to their swelling capacity. The crystal chemistry of these samples was characterized by FTIR spectroscopy and bulk chemical analyses.

The swelling ability of the clay infillings is attributed to the 2:1 layer silicates. It does not seem to be affected by the relative fraction of Mg and Ni in their octahedral sheets. In XRD patterns, the swelling ability is reflected by slight shifts of the basal reflection of the 2:1 layer silicates toward low angles for bulk samples and by splitting of the peak into two contributions for clay fractions saturated with Ca (or Li) and solvated with EG. The split increases with the swelling capacity of the sample. It originates mainly from octahedral-layer charge generated by vacant sites. Such results lead us to consider the 2:1 layer silicates of the infillings as an intimate mixture of non-expandable (TL) and expandable (stevensite) phases. In agreement with previous studies that suggested a contribution of hydrothermal processes in the alteration of serpentine species into 2:1 layer silicates, we propose that the proportion of expandable phases in the clay infillings (or vacancy sites in the octahedral sheets of the 2:1 layer silicates) could be used as an efficient means for assessing the temperature of their formation. Clay infillings mostly made of stevensite would have formed at ambient temperatures, whereas those consisting mainly of non-expandable TL would have formed at higher temperatures.

Keywords: Talc-like, stevensite, nickel, New Caledonia, Ni-ores