

Abstract

Hydrothermal syntheses of serpentine-type and talc-type trioctahedral hydrous layer lattice minerals have been carried out covering the entire Mg-Ni compositional range. Electronprobe microanalyses and x-ray diffraction data conform to the serpentine and talc-type chemistry and structure of these phases. Infrared absorption spectra in the frequency range 4000 - 600 cm^{-1} further characterize and confirm the OH stretching vibrations, OH liberation and the general lattice vibration modes of the synthetic phases. Optical absorption spectra between 2500 nm and 300 nm supplement the infrared absorption data and establish the d - d transition bands caused by octahedrally coordinated Ni^{2+} in the synthetic layer silicates. Rietveld analysis of the step-scanned x-ray diffraction intensity data of one 7Å - type sample has been carried out on the basis of the cell parameters and unit cell atomic coordinates of the natural lizardite structure. The Rietveld analysis has generated a fairly good replica of the observed intensity profile, with minor differences which may be explained as mainly due to poor crystallinity and structural defects of the synthetic phase. An equilibrium thermodynamic modeling of the Ni-enrichment in serpentine has been carried out on the basis of the available and retrieved thermochemical data and an MRK-type nonideal mixing model of H_2O and CO_2 . The calculated equilibrium curves indicate that the serpentine of natural ultramafic parageneses, within a cooling range from about 900° C / 3.5 Kbar to about 350° C / 1Kbar, may undergo a continuous Ni-enrichment through a CO_2 - assisted phase of hydrothermal alteration. The modeled hydrothermal Ni-enrichment of serpentine may well be of magnitude comparable to that of the natural Ni-enriched weathering profiles over ultramafic rocks and may be further intensified in a subsequent phase of low temperature, high pH hydrolysis, generating the actual weathering profile.