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Ni-phyllosilicates (garnierites) from the Falcondo Ni-laterite deposit (Dominican Republic): Mineralogy, nanotextures, and formation mechanisms by HRTEM and AEM

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Abstract

Ni-bearing magnesium phyllosilicates (garnierites) are significant Ni ores in Ni-laterites worldwide. The present paper reports a detailed TEM investigation of garnierites from the Falcondo Ni-laterite deposit (Dominican Republic). Different types of garnierites have been recognized, usually consisting of mixtures between serpentine and talc-like phases that display a wide range of textures at the nanometer scale. In particular, chrysotile tubes, polygonal serpentine, and lizardite lamellae are intergrown with less crystalline, talc-like lamellae. Samples consisting uniquely of talc-like and of sepiolite-falcondoite were also observed, occurring as distinctive thin lamellae and long ribbon-shaped fibers, respectively. HRTEM imaging indicates that serpentine is replaced by the talc-like phase, whereas TEM-AEM data show preferential concentration of Ni in the talc-like phase. We suggest, therefore, that the crystallization of Ni-bearing phyllosilicates is associated with an increase in the silica activity of the system, promoting the replacement of the Ni-poor serpentine by the Ni-enriched talc-like phase. These results have interesting implications in material science, as garnierites are natural analogs of Ni-bearing phyllosilicate-supported synthetic catalysts. Finally, SAED and HRTEM suggest that the Ni-bearing talc-like phase corresponds to a variety of talc with extra water, showing larger d_{001} than talc (i.e., 9.2–9.7 Å), described as "kerolite"-"pimelite" in clay mineral literature.

Keywords: Ni-laterites, garnierites, chrysotile, polygonal serpentine, lizardite, "kerolite"-"pimelite", sepiolite-falcondoite, HRTEM