High-Resolution Transmission Electron Microscopy Study of Mn-Oxyhydroxide Transformations and Accompanying Phases in a Lateritic Profile of Moanda, Gabon

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Abstract: Unheated natural mixtures of manganite and secondary pyrolusite, from the same lateritic manganiferous sequence, were studied in different orientations by high-resolution transmission electron microscopy (HRTEM), electron diffraction, and energy-dispersive X-ray analysis (EDX) to determine the fine structure of these phases, their possible crystallographic relations, and the genetic processes that led to the formation of the pyrolusite. Typical palisadic texture was observed for both minerals. Characteristic cracks parallel to (010) of the pyrolusite structure and in particular (210) microfissures in manganite were noted as signs of structural accommodation accompanying the transformation phenomenon between these two minerals. A previously unreported manganese oxide of the spinel-type (γ-Mn_2O_3 or Mn_3O_4) was also identified in the original mixture. This oxide gave pure microdomains as intergrowths with pyrolusite adjacent to manganite. This is the first report of a natural occurrence of γ,-Mn_2O_3. The manganite-pyrolusite transformation process and an unsuspected γ-Mn_2O_3 (Mn_3O_4)-pyrolusite transition were directly illustrated in detail for the first time. Interfaces between the concerned phases were not sharp or smooth, but exhibited strong strain contrasts and interferential periodicities. Lattice images and microdiffraction patterns proved that both transformations were oriented, suggestive of topotactic relations. In addition, the principal minerals in the matrix (illite, kaolinite, and goethite) were examined for a better understanding of their role in Mn-oxyhydroxides transformations.

Key Words: Energy-dispersive X-ray analysis • Hausmannite • High-resolution transmission electron microscopy • Laterite • Manganese • Manganite • Pyrolusite • Topotactic transformation

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