American Mineralogist, Volume 86, pages 105–114, 2001

Experimental mixtures of smectite and rectorite: Re-investigation of "fundamental particles" and "interparticle diffraction"

TAKESHI KASAMA,[1] TAKASHI MURAKAMI,[1] NORIHIKO KOHYAMA,[2] AND TAKASHI WATANABE[3]

[1]Department of Earth and Planetary Science, The University of Tokyo, Hongo, Tokyo 113-0033, Japan
[2]National Institute of Industrial Health, Nagao, Kawasaki, Kanagawa 213-0023, Japan
[3]Department of Geoscience, Joetsu University of Education, Joetsu, Niigata 943-0815, Japan

ABSTRACT

To re-investigate "fundamental particles" and "interparticle diffraction" proposed by Nadeau et al. (1984a, 1984b, 1984c), we made physical mixtures of smectite and rectorite and examined them by X-ray diffraction analysis and transmission electron microscopy. Smectite and rectorite consisting of at least 10 and 23 silicate layers in their parent rocks, respectively, reduce their thickness by dispersion in water and a fractionation procedure that releases thin silicate layers from the original crystals. The <0.1 μm fractions of the smectites are composed of mostly two to three silicate layers that are not fundamental particles. The mixtures of smectite and rectorite of 0.5–2 μm fractions are mere physical mixtures and do not show interparticle diffraction. In contrast, the mixtures of smectite and rectorite of <0.1 μm fractions have interstratified structures of a segregation type and show interparticle diffraction. However, interparticle diffraction does not occur for synthetic hectorite with aspect ratios smaller than those of the above smectites of the <0.1 μm fractions. These results strongly suggest that interparticle diffraction occurs, and that interstratified structures are formed by mixing rectorite and smectite physically and preparing the oriented specimens when the particle size in the *a-b* plane and the particle thickness are appropriate. However, such mixtures do not reflect the actual characteristics of natural smectite and illite. A rectorite particle of about 30 nm thickness consists of sub-particles of two or more rectorite units, or four or more 2:1 layers that are nearly perfectly coherent with one another, and the sub-particles are turbostratically stacked. Our results suggest that natural, interstratified illite/smectite are not accumulations of fundamental particles but represent their structural sequences when formed.