Fixing Cation Interaction with Blister-Like Osmotic Swelling on Vermiculite Cleavages

K. Sridhar and M. L. Jackson*

Department of Soil Science, University of Wisconsin, Madison, Wisconsin 53706, U.S.A.

* Research Assistant and Professor of Soil Science, respectively.

Abstract: The shrinkage of osmotically swollen natural and artificial blisters on vermiculite cleavages by exchange saturation with fixing cations such as Cs^+, Rb^+, NH_4^+, and K_+ was investigated by replica electron microscopy. Incomplete collapse of either the natural or artificially produced blisters occurred with Cs^+, Rb^+, and NH_4^+ saturation, while K^+ saturation completely collapsed the artificially produced blisters but not the natural blisters. The reason for incomplete collapse with Cs^+, Rb^+ and NH_4^+ was the incomplete replacement (trapping in the flakes) of interlayer hydrated cations such as Na^+, shown by electron probe microanalysis. Much less trapping occurred with K^+ saturation. Na^+ entrapment increased with increasing size and decreasing hydration of cations, i.e. $Cs^+ > Rb^+ > NH_4^+ > K^+$.

Semiquantitative determination of Na^+, by electron probe microanalysis, in vermiculite flakes near the edge revealed that 1 N CsCl entrapped as much as 45 · 6 per cent while 1 N KCl entrapped only 7 · 5 per cent. In general, more Na^+ was entrapped by 1 N solutions than by dilute solutions. With 0 · 01 N KCl solution, the Na^+ entrapment was only 4 · 4 per cent. The amount of Na^+ at the center of the macroflakes was less than at the edge, apparently as a result of more CEC at frayed edges and (or) because of incomplete diffusion of Na^+ to the center. Shrinkage of artificial blisters by K^+ could thus be attributed to its more effective removal of the interlayer hydrated cations, whereas the other fixing cations were less effective. Natural blisters on vermiculite from Libby, Montana were not completely collapsed even by K^+, apparently because the layer charge density was too low in the blister areas.

Clays and Clay Minerals; October 1973 v. 21; no. 5; p. 369-377; DOI: 10.1346/CCMN.1973.0210513

Clay Minerals Society (www.clays.org)