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Optical properties of natural and cation-exchanged heulandite group zeolites

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ABSTRACT

The principal refractive indices, 2*V*, and optical orientation were measured for a series of monovalent and divalent cation-exchanged heulandite samples (Si/Al = 3.19) from Nasik, India, by use of the spindle stage and double variation method. For monovalent cations, Na^+, K^+, Rb^+, and Cs^+, the mean refractive indices were 1.4881, 1.4841, 1.4874, and 1.5039, respectively; and for divalent cations, Mg^{2+}, Mn^{2+}, Cu^{2+}, Sr^{2+}, and Cd^{2+}, the mean refractive indices were 1.4968, 1.5053, 1.4726, 1.5086, and 1.4860, respectively. Lower mean refractive indices correspond to changes in optical orientation from *b*||**Z** in the natural sample to *b*||**Y** in the K sample to *b*||**X** in the Cu sample. Samples exchanged with divalent cations generally have higher channel water contents than samples exchanged with monovalent cations. Water has a high refractivity and samples with high water contents would be expected to have high mean refractive indices. Monovalent samples with high water contents relative to other monovalent samples have low mean refractive indices. Consequently, the refractive indices of the monovalent samples are governed by a factor other than water content. Despite their higher water contents than the monovalent samples, not all divalent samples have higher mean refractive indices than monovalent samples, apparently because full cation exchange did not occur in these samples. Most of the divalent samples exhibit a positive charge deficit based on calculations made from microprobe analyses and crystal structure refinements. The low pH of the exchange solutions and the low mean refractive indices for most of the divalent samples in this study support the claim that H^+ exchanged into the framework channels for charge balance.