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Crystal chemistry of the zeolites erionite and offretite

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Abstract

Many known occurrences of the zeolites erionite and offretite have been characterized by electron probe microanalysis, X-ray powder diffraction, and optical microscopy. For the first time, a substantial amount of experimentally consistent and homogeneous chemical and crystallographic data have been evaluated for these natural zeolites. Systematic analysis of the data, performed by statistical multivariate analysis, leads to the following conclusions: (1) the two zeolites have well-defined compositional fields in the chemical space describing the extraframework cation content, best illustrated in a Mg-Ca(+Na)-K(+Sr+Ba) diagram; (2) no discrimination is possible on the basis of the framework Si/Al ratio because of the extensive compositional overlap between the two species, however the Si-Al content in the framework tetrahedra is the major control on the unit-cell volume dimensions, particularly in erionite; (3) the crystal chemistry of the Mg cations is a major factor in controlling the crystallization of the mineral species; (4) cation compositions at the boundary of the recognized compositional fields might be due to chemical averaging of two-phase intergrowths, although these mixed-phase occurrences are much less common than previously thought; (5) the sign of optical elongation is not a distinctive character of the two phases, it is related to the Si/Al ratio in the framework tetrahedra of each zeolite type and cannot be used for identification purposes; (6) the zeolite mineral species epitaxially overgrown on levyne in all cases is identified as erionite; in a few cases offretite was found to be overgrown on chabazite; (7) erionite samples epitaxially overgrown on levyne are substantially more Al-rich and Mg-poor than the erionite samples associated with other zeolites.