Thermal stability and vibrational spectra of the sheet borate tuzlaite, 
\[ \text{NaCa} \{ \text{B}_5\text{O}_8\text{(OH)}_2 \}_3 \cdot 3\text{H}_2\text{O} \]

VLADIMIR BERMANEC,1,* KREŠIMIR FURIĆ,2 MAŠA RAJIĆ,3 AND GORAN KNIEWALD4

INTRODUCTION

Tuzlaite, a hydrated pentaborate from the Tuzla evaporite deposit in Bosnia and Herzegovina, was analyzed for water content and loss upon heating using thermal analysis methods and vibrational spectroscopy. The resulting phases were identified by X-ray diffraction. The heating of tuzlaite results in a gradual loss of water over several dehydration steps. Two coordinated H2O molecules escape at 191 °C. Between 248 and 298 °C two hydroxyl groups are eliminated, with an associated structural transformation. A continuous escape of the third water molecule occurs above 300 °C. A phase relationship model for different hydrated borate minerals implies the possible formation pathway of tuzlaite by sequential polymerization of the borate polyanion.

The aqueous and crystal chemistries of hydrated borate minerals are closely related. Most polyanions that are present in the structures of crystallized hydrated borate minerals also exist in aqueous solution (Ingri 1963; Burns et al. 1995). Primary borate minerals precipitate from solutions saturated with their components, but tuzlaite does not seem to be associated with the primary assemblage. Such a situation is commonly observed in deposits of Neogene age where diagenetic borates appear in mineral assemblages as a result of thermal diagenesis, usually followed by reaction diagenesis (Smith and Medrano 1996). Some transformations of borate minerals, involving a change in the water content of the mineral, are considered to be an effect of reaction diagenesis. They can take place isothermally, and do not require the breaking of O-H or O-B bonds, an initial step in polymerization.

The aim of the present investigation was to clarify the role of water in the crystal structure of tuzlaite and its thermal stability, since water is incorporated in its crystal structure both as interlayer water molecules and as bridging OH groups. A model for the phase relationships of hydrated borate minerals containing mineral in the same deposit. The main argument in favor of diagenetic tuzlaite formation is the lack of other precursor borate minerals (i.e., colemanite, kernite, ulexite) and characteristic textures observed in the host sediment (Bermanec et al. 2001). The sequence of borate minerals is highly dependent on the chemical characteristics of the depositional environment. In addition to the primary gypsum (gypsarenite) and syndepositional anhydrite, the formation of borate minerals is largely controlled by the activities of Na, Ca, B, Cl, and water. Different borate minerals often accumulate at the margins and in central areas of evaporite basins (Warren 1999). In this respect, the chemistry of tuzlaite, associated minerals and saline formation waters in the area of the Tuzla evaporite deposit may reflect the water/evaporite interaction during burial.

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| * E-mail: vberman@public.srce.hr
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