**Introduction**

Analcime \{Na\(_{x}\)Al\(_{3-x}\)Si\(_{x}\)O\(_{12}\)\} \((3 - x)/2\)H\(_2\)O, where \(x\) varies from \(-0.78\) to \(~1.06\)) is one of the most common rock-forming zeolites. It forms over a considerable range of temperature and pressure conditions, spanning geologic environments from surficial conditions such as soils (e.g., Baldar and Whittig 1968; Bockheim and Ballard 1975; Hay 1978; Renaut 1993) and alkaline lakes (e.g., Hay 1986; de’Gennaro et al. 1990; Sheppard and Hay 2001) through diagenetic and low-grade metamorphic terranes (e.g., Coombs 1954; Wilkinson and Whetten 1964; Utada 1965; Boles 1991) to primary igneous occurrences in lavas and alkaline pegmatites (e.g., Pearce 1970; Woolley and Symes 1976; Luhr and Kyser 1989; Wilkinson and Hensel 1994; Neuhoff et al. 1997; Markl 2001). It is a useful indicator of physical conditions in the crust, often occurring in relatively narrow thermal windows in diagenetic and metamorphic systems (e.g., Iijima 1988; Walker 1960). In addition, the Si/Al ratio of analcime is sensitive to the chemical potential of silica, making it an important indicator of geochemical facies in near-surface environments (Wise 1984; Neuhoff et al. 2004).

The widespread occurrence and importance of analcime as a rock-forming mineral has led to numerous studies of its stability and thermodynamic properties. Recent focus on the stability of analcime during water-rock interaction in diagenetic and hydrothermal systems through solubility measurements and calorimetric studies (e.g., Apps 1970; Johnson et al. 1982; Murphy et al. 1996; Wilkin and Barnes 1998; Redkin and Hemley 2000) permitted Neuhoff et al. (2004) to develop an internally consistent thermodynamic model describing the stability of analcime solid solutions in these environments. In contrast, reconciliation of phase-equilibrium observations at elevated temperatures and pressures involving analcime (e.g., Greenwood 1961; Newton and Kennedy 1968; Manghnani 1970; Kim and Burley 1971; Liou 1971; Thompson 1971) has proven more difficult (cf. Thompson 1973). In large part, this is probably due to the complications arising from solid solution in analcime. In particular, Helgeson et al. (1978) demonstrated that coupled consideration of the consequences of Si/Al substitution and partial dehydration at elevated temperatures and pressures permits reconciliation of the numerous determinations of analcime phase equilibria reported in the literature. Helgeson et al. (1978) based these calculations on limited calorimetric observations of the thermodynamics of dehydration in analcime available at the time (e.g., King 1955; King and Weller 1961; Barany 1962) without the benefit of either calorimetric data or hydration state observations at elevated temperatures.

The present study investigates the thermodynamics of dehydration in analcime through a combination of calorimetric and equilibrium observations at elevated temperatures. Heats of hydration as a function of temperature determined by isothermal adsorption calorimetry were combined with observations of the equilibrium water content of analcime at elevated temperatures.