Abstract for NEGSA 2018

Schneider, Jonathan, Geological Sciences and Environmental Studies, Binghamton University, Binghamton, NY 13902 and JENKINS, David M., Geological Sciences and Environmental Studies, Binghamton University, Binghamton, NY 13902-6000, jschnei5@binghamton.edu

Stability of Sodalite Relative to Nepheline In NaCl-H2O Brines at 0.6 GPa and 750 °C

Nepheline and sodalite bearing rocks occur in various localities around the Northeastern United States and Eastern Canada. Determining the relative stability of nepheline ($NaAlSiO_4$) and sodalite ($Na_8Al_6Si_6O_{24}Cl_2$) can place importance constraints on the minimum concentration of NaCl needed to form sodalite relative to nepheline, such as for the York River nepheline gneisses, Bancroft, Ontario (Anderson & Cermignani 1991 Can Min) and the Beemerville carbonatite-alkalic rock complex in New Jersey (Maxey 1976 GSA Bull). Previous work on the stability relations of nepheline and sodalite have been determined at 0.06 - 0.2 GPa (Wellman 1970 J. Petrol.) in NaCl brines and at 0.7 - 0.9 GPa (Sharp et al. 1989 GCA) in the absence of water. This study investigated the reaction $6NaAlSiO_4 + 2NaCl = Na_8Al_6Si_6O_{24}Cl_2$ at 750 °C and 0.5 - 0.6 GPa in the presence of brine concentrations ranging from 0.02 - 1.0 X_{NaCl} (= mole fraction of NaCl /(NaCl + H_2O)) to provide additional information on the hydrothermal formation of sodalite.

The starting materials were synthetic phases including nepheline, sodalite, and halite made in the system Na_2O-Al_2O_3-SiO_2-NaCl-H_2O. Sodalite was made at 800 °C, 0.2 GPa (water-free) in a cold-seal vessel and nepheline was made at 750 °C, 1.3 GPa (with 2 wt% water) in a piston-cylinder press. The halite was reagent-grade NaCl. Experiments were done in sealed Pt capsules for durations of 70-72 hours in a piston-cylinder press with all NaCl pressure media.

The results indicated that sodalite forms over a wide range of brine concentrations from 1.0 - 0.25 X_{NaCl} (18 *m*), while nepheline forms at brine concentrations below 0.05 X_{NaCl} (2.9 *m*). This corresponds to sodalite formation in a brine with activity of NaCl (a_{NaCl}) of 0.2 or greater, while nepheline forms in brines with a_{NaCl} below 0.02, using the activity expression of Aranovich & Newton (1996 CMP). In this study, sodalite occurs well below halite saturation of 0.62 X_{NaCl} (Driesner & Heinrich 2007 GCA). The nepheline-sodalite system investigated demonstrates sodalite's ability to remain stable at low brine concentrations. This indicates that sodalite is a mineral common in high-grade, low-silica, alkali metasomatic conditions at mid-crustal metamorphic locations and may be a useful paleo-salinity indicator at low salinities.