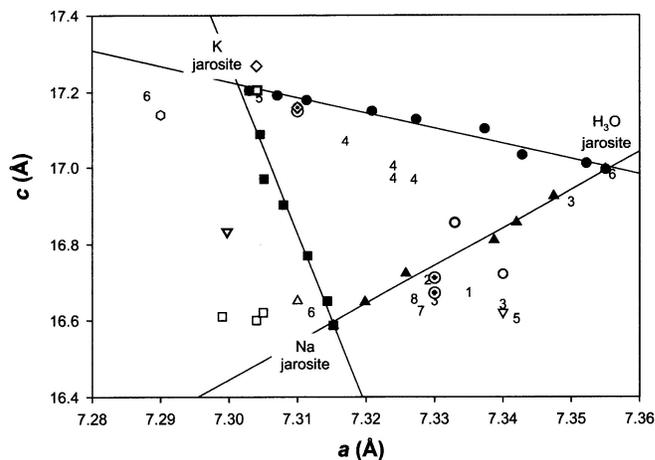


**CRYSTAL CHEMISTRY OF NATROJAROSITE, JAROSITE AND HYDRONIUM JAROSITE SOLID SOLUTION SERIES. IMPLICATIONS FOR CHEMIN DATA ANALYSIS.** Laurel C. Basciano and Ronald C. Peterson, Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, Ontario, Canada, K7L3N6  
([Peterson@geol.queensu.ca](mailto:Peterson@geol.queensu.ca)).

**Introduction:** Members of the natrojarosite  $\text{NaFe}_3(\text{SO}_4)_2(\text{OH})_6$ , hydronium jarosite  $\text{H}_3\text{OFe}_3(\text{SO}_4)_2(\text{OH})_6$  and jarosite  $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$  solid solution series were synthesized and investigated by Rietveld analysis of X-ray powder diffraction data. Well defined trends can be seen in the unit cell parameters across the solid solution series in the synthetic samples. Samples in the jarosite – hydronium jarosite and natrojarosite – hydronium jarosite series in this study were directly synthesized under hydrothermal conditions at  $140^\circ\text{C}$  using starting materials of  $\text{Fe}_2(\text{SO}_4)_3 \cdot 5\text{H}_2\text{O} + \text{K}_2\text{SO}_4 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ . End-member potassium jarosite and members of the jarosite – natrojarosite series were synthesized from a stoichiometric mixture of  $\text{FeCl}_3 + \text{KCl} + \text{LiCl} + \text{Fe}(\text{SO}_4)_3 \cdot 5\text{H}_2\text{O} + \text{H}_2\text{O}$ . End-member natrojarosite was synthesized using a two-step method, where the initial sample was heated in a  $1.0\text{M}\text{H}_2\text{SO}_4 - 0.5\text{Na}_2\text{SO}_4$  solution at  $200^\circ\text{C}$  for 3 days, yielding a sample with 100% Na occupancy. Many of the samples were initially zoned and required grinding and re-heating in the reactant solution for homogenization. Substitution of  $\text{H}_3\text{O}$ , K and Na into the structure changes the unit cell parameters in a linear fashion,  $c$  changes significantly and  $a$  to a lesser degree (Fig. 1). The unit cell parameters presented here are significantly different than previous studies on synthetic samples, as samples in the current study have full iron occupancy and the Na – K jarosite series has no  $\text{H}_3\text{O}$  substitution in the A site. Comparison of these results with previous studies of synthetic jarosite group solid solution indicates that these samples consisted of samples that were non-stoichiometric with respect to iron. One iron deficient sample was synthesized to determine the effect of non-stoichiometry. Iron deficiency leads to a significant decrease in unit-cell volume (large in  $c$ , minor in  $a$ ), which is caused by bond length Fe-O3, which is markedly shorter than stoichiometric samples with similar potassium occupancy. The synthetic samples are compared to natural samples from mine waste deposits in Rio Tinto, Huelva, Spain, Ely Mine, Vermont and a mineral collecting locality near Sharbot Lake, Ontario as well as natural and synthetic samples documented in the literature. Based on unit cell parameters many of the natural samples appear to have full iron occupancy and correlate well with the synthetic samples from this study. The infrared spectra of the jarosite samples were analyzed and there is a gradual change in the spectral features across the solid solution series between end-members (Fig. 2). The cell dimension variation will aid in the interpretation of the possible chemical compositions of any jarosite group minerals identified by CHEMIN X-ray diffraction data.

data.



**Synthetic Samples**

- Basciano and Peterson (2007), K -  $\text{H}_3\text{O}$  jarosite
- Na - K jarosite, current study
- ▲ Na -  $\text{H}_3\text{O}$  jarosite, current study
- 1 Drouet and Navrotsky (2003), Na jarosite
- 2 Dutrizac and Kaiman (1976), Na -  $\text{H}_3\text{O}$  jarosite
- 3 Kubisz (1970), Na -  $\text{H}_3\text{O}$  jarosite
- 4 Drouet and Navrotsky (2003), Na - K jarosite
- 5 Grohol et al. (2003)
- 6 Brophy and Sheridan (1965)
- 7 Menchetti and Sabelli (1976)
- 8 Drouet et al. 2004

**Natural Samples**

- ▼ Ely Mine - current study
- Sharbot Lake - current study
- 7-10 1-5 Rio Tinto - current study
- Mitchell and Giannini (1958)
- ⊙ Kubisz (1962)
- △ Raade (1974)
- Dutrizac and Kaiman (1975)
- ◇ Kato and Miura (1977)
- Abbaticchio et al. (1977)
- ▽ Perez del Villar et al. (1979)
- ◇ Brown 1970

Figure 1. Variation in the cell dimensions of jarosite group minerals.

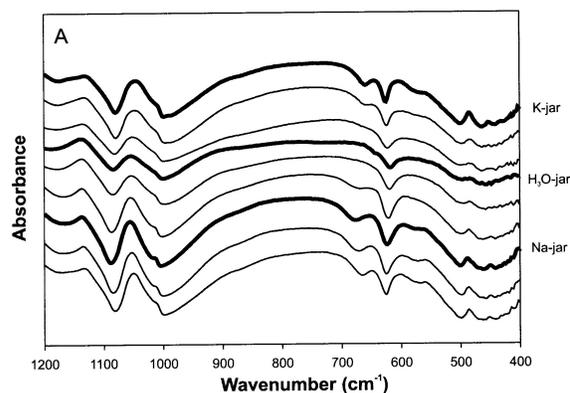


Figure 2. Infra-red spectra of jarosite group minerals