

Report for the Experiment 30-02 775, 12 shift 8-12/2/08

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Effect of sulphur on copper transport in hydrothermal vapour and supercritical fluid

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This experiment served as a proof of concept for EC 324. Please refer to report EC 324 for a detailed review of the results of these experiments. The aim achievements of 30-02 775 were:

- Development of an accurate way to calibrate temperature in the CNRS/FAME autoclave using the equation of state of water and measurement of water density in the autoclave.
- Proof that phase separation can be reliably obtained within the CNRS/FAME autoclave up to magmatic hydrothermal conditions ($T > 500^\circ\text{C}$, $P > 500$ bar), based on measurement of solution densities in the H_2O -NaCl system and comparison with known equations of state.
- Development of procedures for the study of Cu in S-bearing hydrothermal fluids. In particular, this experiment emphasized the importance of solution pH in the formation of Cu nano minerals in suspension. These particles interfere with measurement of solutions. The most difficult way of preparing solutions (i.e., by bubbling $\text{H}_2\text{S}(\text{g})$ in a NaOH solution) turns out to provide the best results – also producing pH's that are closest to those inferred for natural solutions.

All these developments and preliminary data were instrumental in the success of EC-324, and enabled us to surmount the difficulties related to the chemistry of copper in the presence of sulfur.

PUBLICATIONS ISSUING FROM EC324 AND 30-02 775.

1. **Brugger, J., Etschmann, B., Testemale, D., Liu, W., Hazemann, J.-L., Proux, O. and Müller, H.** (to be submitted in 2009) An XAS study of the structure of Cu(I) sulfide complexes in hydrothermal brines and vapours (25°C to 600°C , 600 to 180 bars). *Geochimica et Cosmochimica Acta*.
2. **Schmidt Mumm, A., Brugger, J., Chongbin Zhao and Schacht, U.** (submitted 5/6/2009) Fluids in geological processes – the present state and future outlook. GEXPLO-S-09-00149. *Journal of Geochemical Exploration*.
3. **Brugger, J., Pring, A., Ryan, C., Reith, F., Etschmann, B., Liu, W., O'Neill, B. and Ngothai, Y.** (Accepted 26/3/2009) Probing ore deposits formation: new insights and challenges from synchrotron and neutron studies. *Radiation Physics and Chemistry*. <http://dx.doi.org/10.1016/j.radphyschem.2009.03.071>.
4. **Etschmann, B., Liu, W., Brugger, J., Testemale, D., Hazemann, J.-L., Müller, H. and Proux, O.** (2009) Copper speciation and partitioning between vapor and liquid

phases in hydrothermal sulfuric solution. Goldschmidt conference, June 21 - 26 in Davos, Switzerland. *Geochimica et Cosmochimica Acta*, 73, A341-A341.

5. **Liu, W., Brugger, J., Etschmann, B., Testemale, D., Hazemann, J.-L.** (2009) A synchrotron X-ray absorption spectroscopic study of copper solubility and speciation in supercritical water. GEOFLUID 2009 Conference, April 15-18 2009, Adelaide, South Australia. *J. Geochemical Exploration*.
6. **Brugger, J., Pring, A., Reith, F., Etschmann, B. and Liu, W.** (2009) Towards Molecular-level Understanding of Geochemical Processes in Mineral Exploration. GEOFLUID 2009 Conference, April 15-18 2009, Adelaide, South Australia. *J. Geochemical Exploration*. DOI:10.1016/j.gexplo.2008.11.050.