



	Experiment title: Rhenium solubility in chloride-bearing and oxidizing fluids	Experiment number: A30-2-1167
Beamline: BM30	Date of experiment: from: 25.04.2023 to: 02.05.2023	Date of report: 22.05.2023
Shifts: 21	Local contact(s): Denis Testemale	<i>Received at ESRF:</i>
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Report:

For a more comprehensive understanding of rhenium solubility in oxidizing fluids and conclusions on Re mobility during porphyry copper deposit formation we performed a systematical study on the solubility of rhenium in chloride-bearing and oxidizing fluids at conditions relevant for porphyry copper deposit formation, e.g., 350 °C and 80 MPa. Experiments are conducted in the hydrothermal autoclave available at BM30 and using the multi pixel Ge detector to account for the very low Re concentrations in the aqueous fluids.

Preliminary results:

After setting up the beamline, temperature calibration of the hydrothermal autoclave, and measurements of solid and liquid references, we were able to perform ten dissolution experiments with each experiment running at least 4 hours.

Preliminary results are summarized Figures 1 and 2. Figure 1 shows Re concentrations in the fluid as function of time elapsed at experimental conditions. Corresponding average XANES spectra are presented in Figure 2.

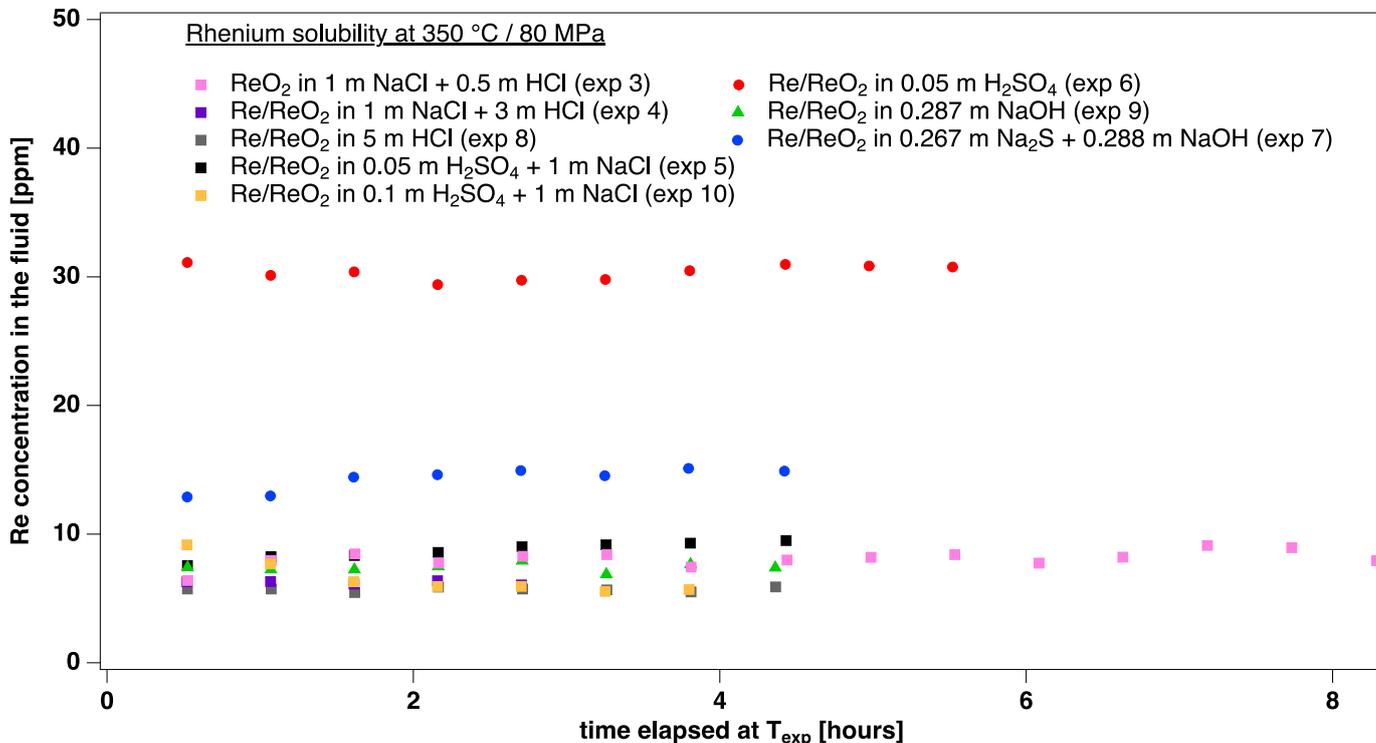


Figure 1: Rhenium concentration vs. time elapsed at 350 °C and 80 MPa. Different colors represent different fluid compositions.

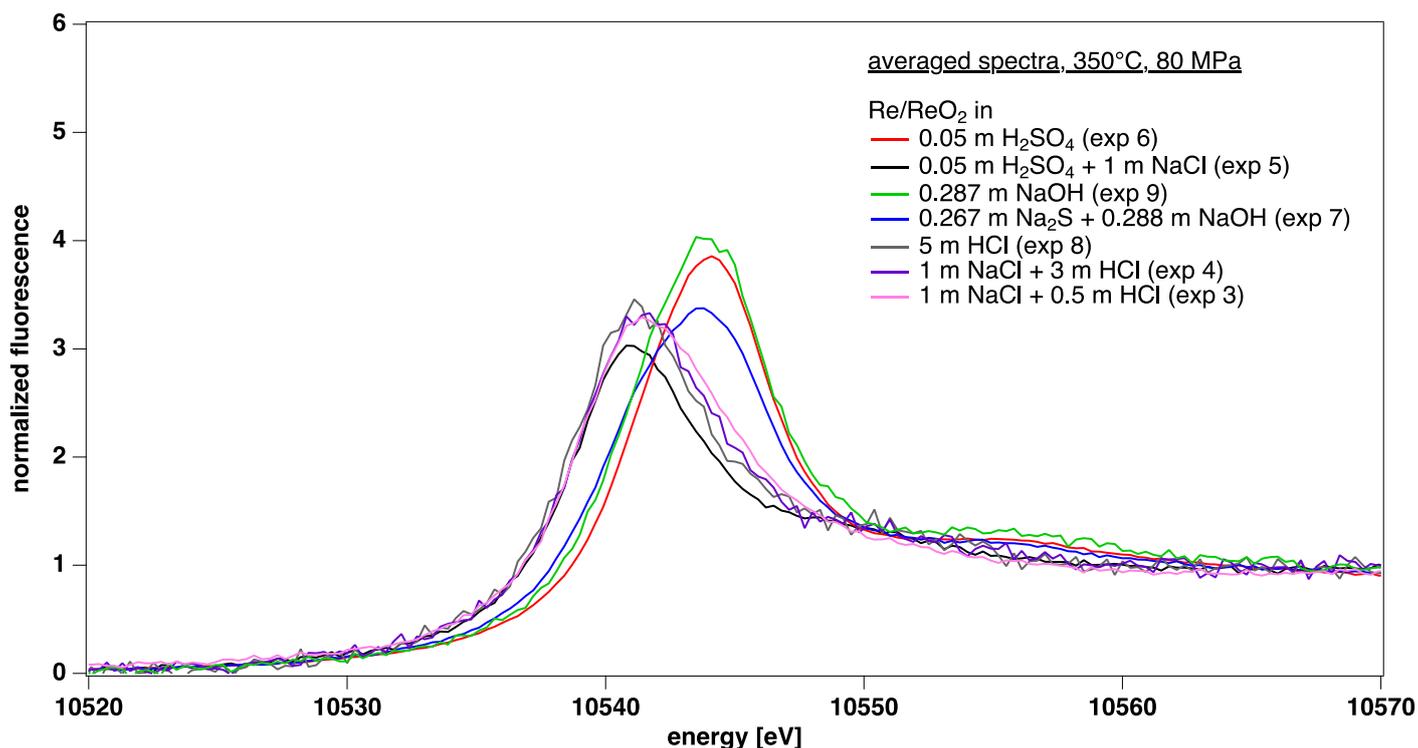


Figure 2: Average XANES spectra obtained at 350 °C and 80 MPa. Same color code as in Figure 1.

The data demonstrate that

- dissolution of Rhenium is a fast process and concentrations are usually ~10 ppm or lower. Only in a 0.05 m H₂SO₄ solution, concentration of Rhenium is enhanced by a factor of three. Thus, the data show that presence of sulphur potentially increases Re concentration in the fluid. However, sodium (and probably chloride) seems to have an opposing effect compared to sulphur as all data obtained in sodium- (and chloride-)bearing fluids are significantly lower even in the presence of sulphur.
- Another very interesting result is the formation of two different kinds of Re complexes which are clearly dependent on the availability of Cl⁻. In chloride-free fluids the white line is shifted to slightly

higher energies (10.544 keV) compared to chloride-bearing fluids (10.541 keV). These observations are in very good agreement with recent speciation measurements at BM16. In chloride-free solutions Re complexes with oxygen ($[\text{ReO}_4]$) while in chloride-bearing fluids Re favors oxo-chloro complexes (e.g., ReO_mCl_n) similar to molybdenum.

In general, beamtime was very successful. Results obtained during the experimental session are striking and allow us to draw conclusion on Re mobility and Re complexation during porphyry copper ore deposit formation. The results will lead to at least one publication in particular combined with previous results on the speciation of Re (ES976) obtained at BM16 at similar PT conditions.

The overall performance of the beamline was great and the support by the local contact and the beamline staff is highly appreciated!