



	Experiment title: Pumping gold from hydrothermal fluids by sulfoarsenide minerals	Experiment number: 16-01 806
Beamline: BM16	Date of experiment: from: 20/07/2020 to: 26/07/2020	Date of report: 02/09/2021
Shifts: 18	Local contact(s): Jean-Louis Hazemann	<i>Received at ESRF:</i>
Names and affiliations of applicants (* indicates experimentalists): Gleb Pokrovski* (GET, Toulouse); Denis Testemale* (Institut Néel, Grenoble); Jean-Louis Hazemann* (Institut Néel, Grenoble); Maria Kokh (University of Potsdam, Germany); Clement Laskar (GET, Toulouse).		

Report:

The feasibility of this project was tested just after the ESRF upgrade on in-house beam-time during the re-start of the ESRF in summer 2020. The experiment has been turned to be very successful; therefore there was no more necessity for using the officially attributed beam time for round 4/2021.

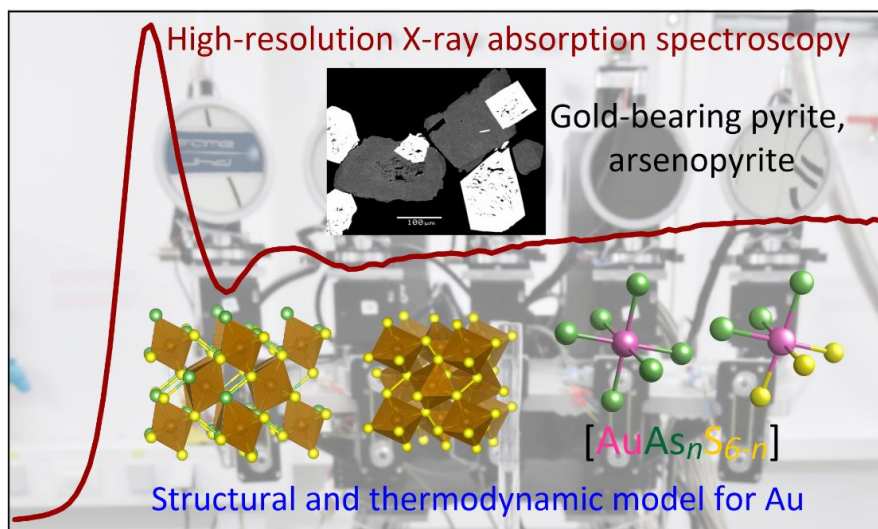
The results of this experiment have recently been published in *Geochemical Perspectives Letters*:

G.S. Pokrovski, C. Escoda, M. Blanchard, D. Testemale, J-L. Hazemann, S. Gouy, M.A. Kokh, M-C. Boiron, F. de Parseval, T. Aigouy, L. Menjot, P. de Parseval, O. Proux, M. Rovezzi, D. Béziat, S. Salvi, K. Kouzmanov, T. Bartsch, R. Pöttgen, and T. Doert (2021):

An arsenic-driven pump for invisible gold in hydrothermal systems.

[Geochemical Perspectives Letters \(2021\) 17, 39-44 | doi: 10.7185/geochemlet.2112.](https://doi.org/10.7185/geochemlet.2112)

Graphical Abstract:



Abstract

Pyrite (FeS_2), arsenopyrite ($FeAsS$) and löllingite ($FeAs_2$) are exceptional gold concentrators on Earth; yet the exact redox and structural state of this “invisible” gold and the forces driving its intake and release by these minerals remain highly controversial. Here we applied high resolution X-ray absorption spectroscopy to Au-bearing pyrite and iron sulfarsenides from hydrothermal deposits and their synthetic analogues. We show that Au preferentially enters octahedral Fe structural sites $[Au(As,S)_6]$ enriched in As, by forming respectively $[AuAs_{1-3}S_{5-3}]$, $[AuAs_3S_3 \cdots AuAs_6]$ and $[AuAs_6]$ atomic units in arsenian pyrite (>0.1 – 1.0 wt% As), arsenopyrite and löllingite, implying a formal oxidation state of Au^{II} in the minerals. In contrast, in As-poor pyrite, Au is dominantly chemisorbed as $[Au^I S_2]$ moieties in much lower concentrations. Combined with experimental data on Au mineral-fluid partitioning, our findings imply a universal control exerted by arsenic on gold incorporation in iron sulfides and sulfarsenides via coupled Au-As redox reactions. These reactions account for the observed variations in invisible gold contents in the minerals from different hydrothermal deposit types and enable quantitative prediction of iron sulfarsenide ability in controlling gold concentration and distribution in hydrothermal systems.