EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** **Biomineralisation and speciation of gold in individual cells of the metallophilic bacterium *Cupriavidus metallidurans* incubated with three gold(I)-complexes. Part II: SXRF**	**Experiment number**: SC - 3094
Beamline: ID22	**Date of experiment**: from: 14 Feb 11 to: 18 Feb 11	**Date of report**: 02 March 11
Shifts: 9	**Local contact(s)**: Gema + Jamie	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Frank Reith, Adelaide University, Joel Brugger, Adelaide University, Barbara Etschmann, Adelaide University

Gema, Jamie

Report: Aim

Understanding gold (Au) biomineralisation in metallophillic bacteria such as *C. metallidurans* will allow us to use these organisms for the production of gold nano-particles, as bioprocessing tools and as whole cell biosensors in gold exploration. While Au(III)-complexes are easy to work with (esp. with respect µXRF- and µXANES method development in 3 previous experiments) and occur in highly oxidising chloride rich environments, our recent research suggests that Au(I)-complexes such as Au(I)-thiosulfate and Au(I)-cyanide are the most likely to occur complexes in surface soil environments; in addition cyanidation of Au is the most common process used in Au ore processing. In recent experiments we have shown that Au(I)-complexes are readily accumulated by *C. metallidurans* cells and the apparent formation of nano-particulate Au was observed in Au(I)-thiosulfate amended cells but not in cells amended with Au(I)-cyanide, yet the mechanisms are not understood. Thus before we use this organism for any type of biotechnological application such as biosorption for ore processing or nano-particle formation, we need to understand the Au accumulation process including the formation of the Au(I)-complexes .
Preliminary data on Pt uptake in cells were also measured.

Experimental

SXRF maps were collected at 17 keV at the ID22-NI beam line.

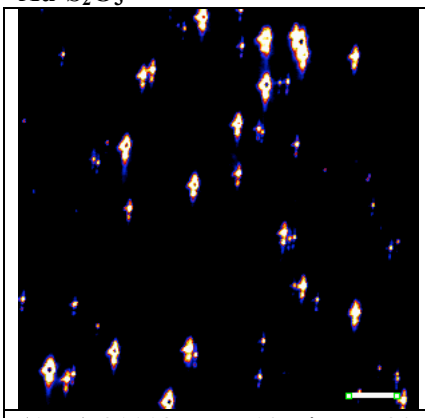
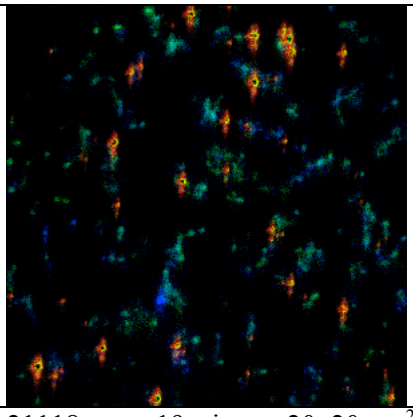
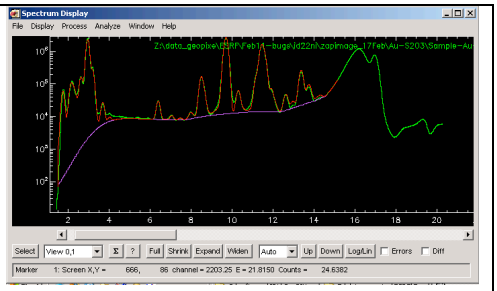
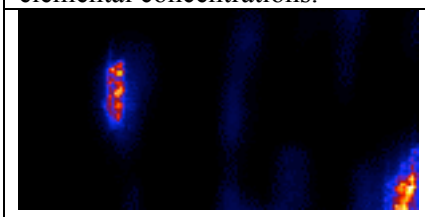
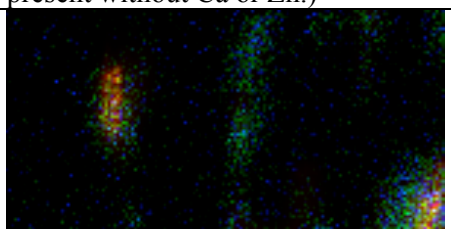
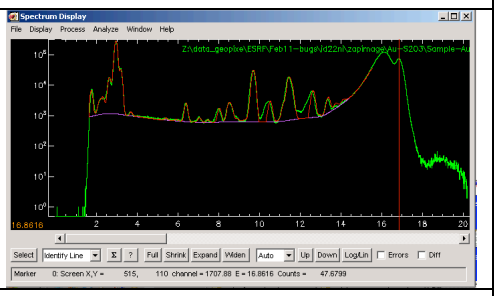
Sample	medium	Live/dead	concentration	time
Au-CN (13116)	PME	Live	500 uM	24 hours
Au-CN (23111)	Tris MM	Live	500 uM	1 min
Au-CN (23115)	Tris MM	Live	500 uM	6 hours
Au-CN (23116)	Tris MM	Live	500 uM	24 hours
Au-CN (23118)	Tris MM	Live	500 uM	6 days
Au-Thiomalate (22111)	Tris MM	Live	500 uM	1 min
Au-Thiomalate (22115)	Tris MM	Live	500 uM	6 hours
Au-Thiomalate (22116)	Tris MM	Live	500 uM	24 hours
Au-Thiomalate (22118)	Tris MM	Live	500 uM	6 days
Au-Thiomalate (22119)	Tris MM	Live	500 uM	18 days
Au-S_2O_3 (21111)	Tris MM	Live	500 uM	1 min
Au-S_2O_3 (21115)	Tris MM	Live	500 uM	6 hours
Au-S_2O_3 (21116)	Tris MM	Live	500 uM	24 hours
Au-S_2O_3 (11116)	PME	Live	500 uM	24 hours
Au-S_2O_3 (21118) x2?	Tris MM	Live	500 uM	6 days
Pt-cisplatin (25126)	Tris MM	Live	50 uM	24 hours
Pt-cisplatin (25128)	Tris MM	Live	50 uM	6 days
Pt-Cl (24121)	Tris MM	Live	50 uM	1 min
Pt-Cl (24125)	Tris MM	Live	50 uM	6 hours
Pt-Cl (24128)	Tris MM	Live	50 uM	6 days
Pt-Cl (24126)	Tris MM	Live	50 uM	24 hours

Some prelimenary observations

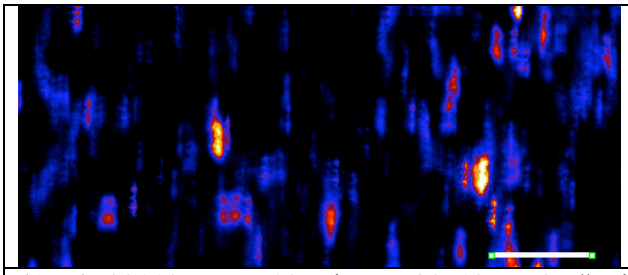
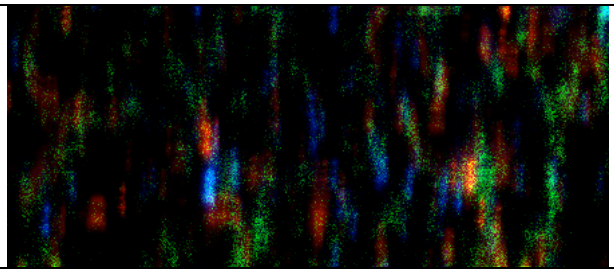
Data collection was a fairly standard and smooth procedure with just a couple of strange occurances:

1. there was a drift of beam size during the experiment (129x100 um^2 to 152x122 um^2)
2. appearance of some unusal Raman-like peaks in *some* SXRF spectra

Au-S_2O_3

		
(AuL) 21118, scan 19, size = 20x20 um^2, # pixels = 300x300, scale bar = 2.4 um. Dark hole in the center of bright spots is due to dead-time: the data collected was optimised for low elemental concentrations.	21118, scan 19, size = 20x20 um^2, # pixels = 300x300 RGB: Au(L) (red), Zn (green), Ca (blue) Evidence of particulate Au (ie Au present without Ca or Zn.)	21118, scan 19: no obvious spurious peaks. Overall counts seem much higher than spectrum for 21116 scan 15.
		
(AuL) 21116, scan 15, size = 10x5 um^2, # pixels = 150x75	21116, scan 15, size = 10x5 um^2, # pixels = 150x75 RGB: Au(L) (red), Zn (green), Ca (blue)	21116, scan 15: there are some unusual peaks, with unusal shapes, which are most likely due to Raman scattering. But why does this only occur for some samples …??? (Need to check if these spurious peaks are more obvious with lower Au concentrations.) Raman contribution to peaks not fitted.

Au-thiomalate

	
(AuL) 22119, scan 10, size = 30x13 um2, # pixels = 450x195, scale bar = 5 um	22119 scan 10, size = 30x13 um2, # pixels = 450x195 RGB: Au(L) (red), Zn (green), Ca (blue) Evidence of particulate Au (ie Au present without Ca or Zn.)