TNA User Report

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eurochamp2020@lisa.u-pec.fr

Project title	Investigation of Coupled Quinone-Iron Chemistry and Photochemistry within Aqueous Aerosol Droplets
Name of the accessed chamber	LEAK (at TROPOS, Leipzig, Germany)
Number of users in the project	1
Project objectives (max 100 words)	The objective of this project is to study a potentially important and understudied radical cycling mechanism that controls oxidation chemistry within aqueous aerosols. The hypothesis is that quinone chemistry in association with iron is capable of sustaining the oxidizing capacity of aqueous aerosol and driving SOA growth and transformation. Quinones are a class of aromatic compounds that readily transition between benzoquinones, semiquinones, and hydroquinones, and are recognized as drivers of redox chemistry in aquatic and soil organic matter. In the atmosphere, quinones are associated with humic like substances present in biomass burning plumes, and aerosols in rural and urban environments.
Description of work (max 100 words):	We will test our hypothesis by investigating the thermal and photochemistry of a model quinone-Fe system in suspended aqueous aerosols within the LEipziger AerosolKammer (LEAK). Our working hypothesis is that photoreduction of benzoquinones in the presence of iron [or thermal reactions of hydroquinones in the dark] will lead to aerosol growth. We will also examine thermal and photochemistry of aqueous aerosols containing natural organic matter and atmospherically relevant levels of iron. The working hypothesis is that natural organic matter will be more efficient at cycling Fe than isolated model quinones, yielding increased OH and more rapid changes in SOA composition.

Principal Investigator's and group's information	
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User 1 Information[4]	
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[1] Physics; Chemistry; Earth Sciences & Environment; Engineering & Technology; Mathematics; Information & Communication Technologies; Material Sciences; Energy; Social sciences; Humanities.

[2] UNI= University and Other Higher Education Organisation;
RES= Public Research Organisation (including international research organisations and private research organisations controlled by public authority);
SME= Small and Medium Enterprise;
PRV= Other Industrial and/or Profit Private Organisation;
OTH= Other type of organization.

[3] UND= Undergraduate; PGR= Post graduate; PDOC= Post-doctoral researcher; RES= Researcher ENG= Engineer; ACA= Academic; TEC= Technician.

[4] Reproduce the table for each user who accessed the infrastructure

Trans-National Access (TNA) Scientific Report

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Instructions

Please limit the report to max 5 pages, you can include tables and figures. Please make sure to address any comments made by the reviewers at the moment of the project evaluation (if applicable, in this case you were informed beforehand). Please do not alter the layout of the document and keep it in Word version.
The report will be made available on the eurochamp.org website. Should any information be confidential or not be made public, please inform us accordingly (in this case it will only be accessible by the European Commission, the EUROCHAMP-2020 project partners, and the reviewers). Please include:

- Introduction and motivation
- Scientific objectives
- Reason for choosing the simulation chamber/ calibration facility
- Method and experimental set-up
- Data description
- Preliminary results and conclusions
- Outcome and future studies
- References

Name of the PI: Jonathan Raff
Chamber name and location: LEAK, Leipzig, Germany
Campaign name and period: 15/06/2018 to 10/07/2018
Text:

We investigated the thermal and photochemistry of the following model systems: (1) A model quinone-Fe(III) system consisting of anthraquinone-2,6-disulfonate (AQDS) and $Fe_2(SO_4)_3$ and (2) a natural organic matter (Suwannee River fulvic acid)-$Fe_2(SO_4)_3$ solutions. These aqueous phase experiments allowed us to identify the conditions necessary to carry out experiments in aerosols suspended within the LEAK chamber. Solution phase work revealed that hydroxyl radical (OH) production rate is four times higher when quinone-containing organic matter is photolyzed in the presence of iron. There have been delays in the LEAK chamber work because of the move of the LEAK installation and unforeseen breakdowns of measurement equipment such as the AMS and the Api-ToF-CIMS, which were only just now resolved. At the time of writing, experiments #1 and #2 described in Table 1 (below) are under investigation. The other LEAK experiments listed in the table will be aimed at obtaining evidence of enhanced uptake of organics into the aerosol phase. This EUROCHAMP 2020 project will be complete when the experiments listed in Table 1 are complete; a final report will be submitted shortly thereafter.

Table 1: Description of Planned Experiments at the Leipziger Aerosolkammer (LEAK)

Exp #	Aerosol Components and Conditions*	Description	Objective
		Part 1: Quinone and SRFA	
1.	AS + *hv*		control to look at chamber background / wall effects
2.	AS + αP + *hv*	1. add AS; 2. add αP; 3. lights on	control to look at baseline αP uptake onto seed aerosol in absence of quinone or SRFA
3.	AS + Q + *hv*		control to look at background photochemistry of Q alone
4.	AS + Q + αP + *hv*	1. add AS+Q; 2. add αP; 3. lights on	looking at αP uptake in presence of Q
5.	AS + Q + αP + *hv*	" " " "	" " replicate of #4
6.	AS + SRFA + hv		control to look at background photochemistry of SRFA alone
7.	AS + SRFA + αP + *hv*	1. add AS+SRFA; 2. add αP; 3. lights on	looking at αP uptake in presence of SRFA
8.	AS + SRFA + αP + *hv*	" " " "	" " replicate of #7
9.	AS + *hv*		control to look at chamber background / wall effects
		Part 2: Quinone, SRFA, and Iron	
10	AS + Fe(III) + *hv*		control to look at background photochemistry of seed-Fe(III) alone
11.	AS + Fe(III) + αP + *hv*	1. add AS+Fe(III); 2. add αP; 3. monitor for dark rxn; 4. lights on	looking at αP uptake in presence of Fe(III) alone
12.	AS + Fe(III) + Q + *hv*		control to look at background photochemistry of Fe(III) & Q
13.	AS + Fe(III) + Q + αP + *hv*	1. add AS+Q+Fe(III); 2. add αP; 3. monitor for dark rxn; 4. lights on	looking at αP uptake in presence of Fe(III) & Q
14.	AS + Fe(III) + Q + αP + *hv*	" " " "	" " replicate of 13
15.	AS + Fe(III) + SRFA + *hv*		control to look at background photochemistry of Fe(III) & SRFA
16.	AS + Fe(III) + SRFA + αP + *hv*	1. add AS+SRFA+Fe(III); 2. add αP; 3. monitor for dark rxn; 4. lights on	looking at αP uptake in presence of Fe(III) & SRFA
17.	AS + Fe(III) + SRFA + αP + *hv*	" " " "	" " replicate of 16
18.	AS + *hv*		control to look at chamber background / wall effects

**Abbreviations*: AS = seed aerosol = $(NH_4)_2SO_4$ / H_2SO_4, pH 4; αP = α-Pinene (50 ppb); Q = Anthraquinone disulfonate (AQDS);; Fe(III) and Fe(II) added as sulfate salts; SRFA = Suwanee River Fulvic Acid; *hv* = UV-visible irradiation from fifty-six 100W lamps; conditions: 75% RH, ALW pH = 4; 1 atm total pressure of zero air. In all cases, AMS-TOF, PTR-MS-TOF, Api-ToF- CIMS, and SMPS will monitor particle size and composition in the chamber during experiments. In addition, filter samples of aerosols will be collected for high resolution mass spectrometry measurements of particle composition after each experiment.