



School of Natural and Computing Science – Institute Annual Report 2020

Centre/Institute Title	TESLA (Trace Element Speciation Laboratory, Aberdeen)
Aims and objectives	Aim: We are studying environmental and biological processes in which toxic and essential metals and metalloids and increasingly non-metals are transformed. We are aiming to do pioneering analytical work to develop elemental speciation and elemental bioimaging methodologies for solving pertinent problems in environmental and biosciences.
Academic Staff Involved	Professor Joerg Feldmann (Director), Dr Eva M. Krupp (Reader, Deputy Director) Dr Andrea Raab (PDRA, Lab & Resource Manager)
Summary of Work (main focus)	<ol style="list-style-type: none"> 1. Identification of inorganic arsenic in rice as a significant source of arsenic exposure. 2. Identification that mercury bioaccumulates in the marine food chain and that pilot whales have develop a unique way of detoxifying the neurotoxin mercury. 3. Mercury forms nanoparticles in oil and gas condensates and this is a reason why it cannot easily be removed from the petrochemical stocks. 4. Marking fluorine determination possible with ICP-MS, especially for the use of non-targeted analysis of PFAS.
Potential Impact Case Studies for REF	Introduction of a maximum permissible concentration of inorganic arsenic in rice and rice-based products and make the analytical methodology fit for the market place (continuation case study)
Annual TESLA seminars	In addition to regular group meetings, the group meets twice a year for 4-5 days in the Highland retreats (Mar Lodge Braemar and Cromarty Arts Trust Centre) for a structured symposium in which every member of the centre gives an oral presentation.
Organising seminars	<ol style="list-style-type: none"> 1. Seminar at Salima (Malawi) July 2019 Promoting use of field deployable method in screening rice containing elevated inorganic arsenic among smallholder farmers in Malawi to promote exportation of low inorganic arsenic rice for baby food production 2. 2nd Scottish/German TESLA Seminar on environmental analytical chemistry at Mar Lodge (Scotland) Dec. 2019

The members of TESLA have published 22 peer reviewed papers and given 19 invited/plenary lectures in 2019. TESLA was involved in projects with a value of £2M, has 22 PhD students and 5 PhD have successfully graduated in 2019.

Prizes/Awards/Showcase:

1. Featured collaboration with Agilent Technology: [Agilent Case Study: University of Aberdeen](#)
2. Top 10% of cited papers in PLoS One: [Host-Imposed Copper Poisoning Impacts Fungal Micronutrient Acquisition during Systemic Candida albicans Infections](#)

Primary Publications in peer-reviewed journals:

1. A. Akhdhar, M. Schneider, A. Orme, L. Schultes, A. Raab, E.M. Krupp, J.P. Benskin, B. Welz, J. Feldmann, The use of high resolution graphite furnace molecular absorption spectrometry (HR - MAS) for total fluorine determination in extractable organofluorines (EOF), **Talanta** (2019) in press.
2. A.T. Mlangeni, M. Perez, A. Raab, E.M. Krupp, G.J. Norton, J. Feldmann, Simultaneous use of zero valent iron and alternate wetting and drying water management stimulate arsenic methylation and limit bioaccumulation of cadmium in rice grain. **Science of the Total Environment** (2019) in press.
3. E. Ender, M.A. Subirana, A. Raab, E.M. Krupp, D. Schaumloeffel, J. Feldmann, Why is NanoSIMS elemental imaging of arsenic in seaweed (*Laminaria digitata*) important for understanding of arsenic biochemistry in addition of speciation information? **Journal of Analytical Atomic Spectrometry** (2019) **34**, 2295-2302
4. L.A. Bullock, J. Parnell, J. Feldmann, J.G. Armstrong, A.S. Henn, M.F. Mesko, et al. Selenium and tellurium concentrations of Carboniferous British Coals, **Geological Journal** (2019) **54**, 1401-1412.
5. J.G.T. Armstrong, J. Parnell, L. Bullock, A. Boyce, M. Perez, J. Feldmann, Mobilisation of arsenic, selenium and uranium from Carboniferous black shales in west Ireland, **Applied Geochemistry** (2019) 104401.
6. K.C. Nwoko, L. Cheyne, D. Dawson, J. Feldmann, A. Raab, E. Krupp, Matrix-dependent size modifications of iron oxide nanoparticles (Ferumoxytol) spiked into rat blood cells and plasma: Characterisation with TEM, AF4-UV-MALS-ICP-MS/MS and spICP-MS, **Journal of Chromatography B** (2019) **1124**, 356-365.
7. X.J. Liang, M.A.M.J. Perez, K.C. Nwoko, P. Egbers, J. Feldmann, L. Csetenyi, G.M. Gadd, Fungal formation of selenium and tellurium nanoparticles, **Applied Microbiology and Biotechnology** (2019) **103**, 7241-7259.
8. X.J. Liang, M.A.M.J. Perez, J. Feldmann, L. Csetenyi, G. Gadd, Formation of selenium- and tellurium-containing nanoparticles during growth of filamentous fungi, **Access Microbiology** (2019), **1**, doi.org/10.1099/acmi.ac2019.po0286.
9. E. Ownsworth, D. Selby, C.J. Ottley, E. Unsworth, A. Raab, J. Feldmann, A.D. Sproson, J. Kuroda, C. Faidutti, P. Bruecker, Tracing the Natural and Anthropogenic Influence on the Chemistry of Estuarine Macroalgae and the Implications for Human Consumption: Insights from the Firth of Forth and Forth Estuary, Scotland. **Science of the Total Environment** (2019) **685**, 259-272.
10. C. Cabello, K.C. Nwoko, J.F. Marco, M. Sanchez-Arenillas, A.M. Mendez-Torres, J. Feldmann, C. Yanez, T.A.D. Smith, Cu@Au self-assembled nanoparticles as SERS-active substrates for (bio)molecular sensing. **Journal of Alloys and Compounds** (2019) **791**, 184-192.
11. S.T. Lancaster, C.C. Brombach, W.T. Corns, J. Feldmann, E.M. Krupp, Determination of methylmercury using liquid chromatography – photochemical vapour generation – atomic fluorescence spectroscopy (LC-PVG-AFS): a simple, green analytical method, **Journal Analytical Atomic Spectrometry** (2019) **34**, 1166-1172.
12. L.S. Kato, E.A. de Nadai Fernandes, A. Raab, M.A. Bacchi, J. Feldmann, Arsenic and cadmium contents in Brazilian rice from different origins can vary more than two orders of magnitude, **Food Chemistry** (2019) **286**, 644-650.
13. M. Blanz, P. Ascough, I. Mainland, P. Martin, D. Burkart, J. Wishart, K.L. Sayle, A. Raab, J. Feldmann, Seaweed fertilization impacts the chemical and isotopic composition of barley: implications for analyses of archaeological skeletal remains, **Journal of Archaeological Science** (2019) **104**, 34-44.



14. N.L.A. Jamari, J.F. Dohmann, A. Raab, E.M. Krupp, J. Feldmann, Novel non-targeted analysis of perfluorinated compounds using fluorine-specific detection regardless of their ionisability (HPLC-ICPMS/MS-ESI-MS). **Analytica Chimica Acta** (2019) **1053**, 22-31.
15. K. Marschner, A.H. Petursdottir, P. Brucker, A. Raab, J. Feldmann, Z. Mester, T. Matousek, S. Musil, Validation and inter-laboratory study of selective hydride generation for fast screening of inorganic arsenic in seafood, **Analytica Chimica Acta** (2019) **1049**, 20-28.
16. A.H. Petursdottir, J. Blagden, K. Gunnarsson, A. Raab, D. Stengel, J. Feldmann, H. Gunnlaugsdottir, Arsenolipids are not uniformly distributed within two brown macroalgal species *Saccharina latissima* and *Alaria esculenta*, **Analytical and Bioanalytical Chemistry** (2019) **411**, 4973-4985.
17. D. Ruhland, K. Nwoko, M. Perez, J. Feldmann, E.M. Krupp, AF4-UV-MALS-ICP-MS/MS, spICPMS and STEM-EDX for the characterization of metal-containing nanoparticles in gas condensates from petroleum hydrocarbon samples, **Analytical Chemistry** (2019) **91**, 1164-1170.
18. A. Retzmann, M. Blanz, A. Zitek, J. Irrgeher, J. Feldmann, M. Teschler-Nicola, T. Prohaska, A combined chemical imaging approach using (MC) LA-ICP-MS and NIR-HSI to evaluate the diagenetic status of bone material for Sr isotope analysis, **Analytical and Bioanalytical Chemistry** (2019) **411**, 565-580.
19. E. Bolea-Fernandez, A. Rua-Ibarz, E.M. Krupp, J. Feldmann, F. Vanhaecke, High precision isotopic analysis sheds new light on mercury metabolism in long-finned pilot whales (*Globicephala melas*), **Scientific Reports** (2019) **9**, 7262.
20. F.S. Rondan, A.S. Henn, P.A. Mello, M. Perez, L.A. Bullock, J. Parnell, J. Feldmann, E.M.M. Flores, M.F. Mesko, Determination of Se and Te in coal at ultra-trace level by ICP-MS after microwave-induced combustion, **Journal of Analytical Atomic Spectrometry** (2019) **34**, 998-1004.

Invited Book Chapters and Reviews:

21. A. Raab, J. Feldmann, Biological sulphur-containing compounds – analytical challenges, **Analytica Chimica Acta** (2019) **1079**, 20-29.
22. J. Feldmann, E.M. Krupp, Analytical methods involve speciation analysis and elemental mapping to describe processes in biogeochemistry: a review, in **Selenium Research for Environment and Human Health: Perspectives, Technologies and Advancements**: Proceedings of the 6th International Conference on Selenium in the Environment and Human Health (ICSEHH 2019), CRC Press (2019) 213-214.

Research metrics for TESLA (Google Scholar):

J. Feldmann (h-index 66, citations >16,000)
E.M. Krupp (h-index 35, citations >3,500)
A. Raab (h-index 43)

Invited/keynote and plenary lectures

1. Invited RSC Lecture, J. Feldmann, Arsenic, the good, the bad and the ugly, **University of Aberdeen**, January 2019.
2. Keynote lecture: J. Feldmann, Elemental speciation versus Nanoparticle characterization in biological and environmental samples, European Winter Conference on Plasma Spectrochemistry, **Pau, France**, Feb. 2019



3. Invited Departmental lecture: J. Feldmann, Natural Nanoparticles in Biota, **matis, Reykjavik, Iceland**, Feb. 2019.
4. Invited Departmental lecture: J. Feldmann, from nanoparticles to molecular speciation, The University of the West Indies, Mona, **Kingston, Jamaica**, April 2019.
5. Plenary lecture: J. Feldmann, from molecular species to nanoparticles: analytical aspects and their application in biogeochemistry, 15th ICOBTE, **Nanjing, China**, May 2019.
6. Invited Departmental Lecture: J. Feldmann, Speciation and nanoparticles are important for the characterization of biological and environmental processes, **Oerebro University, Sweden**, May 2019.
7. Invited lecture: J. Feldmann, Speciation and nanoparticle analysis solve mystery in biogeochemistry, 63rd International Conference on Analytical Sciences and Spectroscopy (ICASS), **Montreal, Canada** June 2019.
8. Keynote lecture: J. Feldmann, Should we bother about speciation analysis in the oil & gas industry? 63rd International Conference on Analytical Sciences and Spectroscopy (ICASS), **Montreal, Canada** June 2019.
9. Invited departmental lecture: J. Feldmann, lecture: Arsenic in rice, Lilongwe University, **Lilongwe, Malawi**, July 2019.
10. Keynote lecture: J. Feldmann, Analytical methods for selenium in biogeochemistry, 6th International Conference on Selenium in the Environment and Human Health, **Xi'An, China**, October 2019.
11. Invited lecture: J. Feldmann, Are nanoparticle and speciation interesting in the oil and gas industry, 15th Rio Symposium for Atomic Spectrometry, **Mendoza, Argentina**, October 2019.
12. Invited lecture: E.M. Krupp, Does the use of HPLC-ICPMS answer all questions how the elements occur in a sample? 15th Rio Symposium for Atomic Spectrometry, **Mendoza, Argentina**, October 2019.
13. Invited lecture: A. Raab, Analysing the "right" side of the periodic table - applications in environmental studies using qICP-MS(/MS), Goldschmidt2019 conference, **Barcelona Spain**, August 2019.
14. Invited lecture: A. Raab, J. Feldmann, E.M. Krupp, D. Ruhland K. Nwoko, A. Thembachako Mlangeni, F. Ezzeldin, Z. Gajdosechova, S. Freitag, K. Uroic, Can elemental speciation solve problems in the industry? CANAS , **Freiberg, Germany**, September 2019.
15. Invited Lecture, A. Raab, What one can do with ICP-MS for Research and Contract Analysis, Agilent Scottish user group meeting, **Edinburgh UK**, March 2019.
16. Invited departmental lecture: M. Blanz, Seaweed as food, fodder and fertiliser, Orkney Archaeology Institute, **Kirkwall, UK**, April 2019.
17. Invited public lecture: M. Blanz, On the difficulties of dating seaweed-eaters, and other archaeological issues, Inverness Science Festival, **Inverness, UK**, May 2019.
18. Invited lecture: M. Blanz, Seaweed as food, fodder and fertiliser in the North Atlantic Islands, Animal husbandry and isotopes workshop of the Passage Tomb People project, **University College Dublin, Dublin, Ireland**, August 2019.
19. Invited lecture: Elizabeth Griffin, The Periodic Table of Alzheimer's: Using Atomic Spectroscopy to study disease models, RSC Atomic Spectroscopy Group's celebration of IYPT, **London, UK**, November 2019.

Students oral and poster presentations at national and international meetings:

Oral presentation: M. Blanz, 5000 years of waiting for the tooth-fairy: Orkney's Neolithic Sheep, UHI postgraduate student's research conference, **Thurso, UK**, November 2019



Oral presentation: Savarin Sinaviwat, Why do pilot whales accumulate arsenic in their tissues? University of Aberdeen, PhD Symposium, **Aberdeen, UK** June 2019.

Oral Presentation: Elizabeth Griffin, Total element determination in the brains of Alzheimer's Disease mouse models by ICPMS, ReMIND conference 2019, **Braunschweig, Germany**, June 2019.

Oral Presentation: Laurie Savage, arsenic speciation in the atmosphere, 5th Northern Postdoctoral Research Meeting (NPRM5) at Lancaster University, **Lancaster, UK**, July 2019.

Oral Presentation: Elizabeth Griffin, Total element determination in the brains of Alzheimer's Disease mouse models by ICPMS, University of Aberdeen PhD symposium, **Aberdeen, UK**, June 2019.

Poster presentation: Shaun Lancaster, Methylmercury determination using photochemical vapour generation with LC-AFS — Potential application for ICP-MS, European Winter Conference on Plasma Spectrometry (EWPCS), **Pau, France**, February 2019.

Poster presentation: Shaun Lancaster, Determination of methylmercury in Scottish birds of prey using LC-PVG-AFS, International Conference on Mercury as a Global Pollutant (ICMGP), **Krakow, Poland**, September 2019.

Poster presentation: Martin Mueller, Solubility of elemental mercury in different solvents and mixtures for the modelling of Hg partitioning throughout oil and gas processing, 14th International Conference on Mercury as a Global Pollutant (ICMGP 2019), **Krakow, Poland**, September 2019.

Poster presentation: Camilla Faidutti, Toenail sampling to assess the exposure to trace elements in epidemiological studies: a difficult task, 15th ICOBTE, **Nanjing, China**, May 2019.

Poster presentation: Abdullah Akhdhar, Effect of Different Modifiers on the Measurement of Organofluorine Compounds Using High-Resolution Graphite Furnace Molecular Absorption Spectrometry, Analytical Research Forum (ARF 2019), **London, UK**, June 2019.

Poster presentation: Elizabeth Griffin, Total element determination in the brains of Alzheimer's Disease mouse models by ICPMS, Alzheimer's Research UK conference, **Harrogate, UK**, March 2019.

Poster presentation: Elizabeth Griffin, Total element determination in the brains of Alzheimer's Disease mouse models by ICPMS, Emerging Analytical Professionals, **Leeds, UK**, May 2019.

Poster presentation: Elizabeth Griffin, Total element determination in the brains of Alzheimer's Disease mouse models by ICPMS, **RSC twitter poster conference**.

Poster presentation: Elizabeth Griffin, Metal content of Alzheimer's Disease mouse models brains: total element determination by ICPMS, International Symposium on Metallomics, **Krakow, Poland**, July 2019.

Poster Presentation: Louise Hair, Method Development for the Analysis of Toxic Elements and Arsenic Metabolites in Nail Samples, 15th ICOBTE, **Nanjing, China**, May 2019

Poster Presentation: Louise Hair, Method Development for the Analysis of Toxic Elements and Arsenic Metabolites in Nail Samples, International Symposium on Metallomics, **Krakow, Poland**, July 2019.

	Name	Degree	Start date	Funder	Title
1	Parinda Manurut	PhD	2015	Royal Thai	Mercury in rice
			Writing up		
2	Lara Schultes	PhD	2014	FORMAS (Swedish RC)	Fluoronomics (with Stockholm University, Sweden)
			Writing up		
3	Angstone Mlangeni	PhD	2015	Commonwealth	Sourcing rice with low inorganic arsenic in Malawi
4	Daniel Ruhland	PhD	2016	Johnson & Matthey	Mercury speciation in gas condensates
5	Dennis Tutogon	PhD	2016	National Tsing Hua University (Taiwan)	Antimony speciation in plants (with University of Liverpool, UK and NTHU, Taiwan)
6	Sa'adatu O. Abatemi-usman	PhD	2016	PTDF (Nigeria)	Exposure to metals in the environment
7	Elizabeth Griffin	PhD	2016	EU funded EMPIR	Absolute quantification of the Tau protein
8	Magdalena Blanz	PhD	2016	UHI funded	Identification of seaweed use in Neolithic times (UHI and Uni Glasgow)
9	Shaun Lancaster	PhD	2017	PS Analytical Ltd	Use of atomic fluorescence for mercury and arsenic speciation in environmental chemistry
10	Martin Mueller	PhD	2017	Equinor/Statoil and Genesis	Sulfur speciation studies and solubility of mercury in condensates
11	Abdullah Akhdhar	PhD	2017	Saudi Arabia Cultural Bureau	Determination of fluorinated particles
12	Tengentile Nxumalo	PhD	2017	Commonwealth	Organofluorines using ICPMS/MS and ESI-MS in the environment
13	Louise Hair	PhD	2018	University of Cambridge DPHPC	Arsenic speciation in toenails in a case study for cardiovascular disease (BRAVE study)

14	Camilla Faidutti	PhD	2018	University of Cambridge DPHPC	Trace element exposure of Bangladeshi's in Dhaka (BRAVE study)
15	Ahmed Alanazi	PhD	2018	Saudi Arabia Cultural Bureau	Nanoparticles in e-cigarettes
16	Ali Alazahrani	PhD	2019	Saudi Arabia Cultural Bureau	Iodine in hair
17	Ibrahim Almosa	PhD	2019	Saudi Arabia Cultural Bureau	Zinc status in humans
18	Amnah AlZbedy	PhD	2019	Saudi Arabia Cultural Bureau	PFAS in pilot whales
19	Kenneth Nwoko	PhD	2016	Elphinstone Scholarship and NDDF	Nanoparticles in non-aqueous media
20	Savarin Sinaviwat	PhD	2016	Royal Thai	Arsenic speciation in biological samples
21	Mauana Schneider	PhD	2016	CNPq	Halogen determination with HR-CS MAS (with UFSC, SC, Brazil)

Graduation of PhDs in 2019
funder
title/destination

1	Lara Schultes	PhD	2014	FORMAS	Fluoronomics (with Stockholm University, Sweden) Now Postdoc at Harvard University (US)
2	Kenneth Nwoko	PhD	2015	Elphinstone Scholarship and NDDF	Nanoparticles in non-aqueous media Now postdoc at TESLA
3	Angstone Mlangeni	PhD	2015	Commonwealth	Sourcing rice with low inorganic arsenic in Malawi Now Lecturer at Agriculture University Lilongwe, Malawi



4	Daniel Ruhland	PhD	2016	Johnson & Matthey	Mercury speciation in gas condensates
5	Nunnapus Laitip	PhD	2015	Royal Thai	Selenium speciation studies in fish and whales Now Researcher at Metrology Institute in Thailand, Bangkok

PDRAs 2019

Name	Dates	Funder	Title
Xueying Wang	08/2018-10/2019	NERC	Tellurium and selenium cycling and supply (TeaSe)
Wladiana Matos	02/2019-01/2020	CAPES	Arsenic speciation in farmed and wild shrimps
Laurie Savage	02/2019-01/2021	GCRF-MRC	CAPABLE Project
Kenneth Nwoko	11/2019-03/2020	NERC	Tellurium and selenium cycling and supply (TeaSe)

Live Grants 2019

Start Date	Funder	Total Value	Title
2018	University of Cambridge DPHPC	£202k	BRAVE – Bangladesh Risk of Acute Vascular Events and environmental exposure
2016 & 2019	Equinor/Statoil and Genesis (phase I and II)	£80k	Mercury solubility in organic solvents
2019	University of Cambridge	£79k	Efficacy of piped drinking water supply intervention on human arsenic levels: a pilot study in Goalmari, Bangladesh (Co-PI JF with PI J Danesh, J Ashoka)
2018	Saudi Arabia Cultural Bureau	£73k	+ PhD stipend for A. Alanazi for NP in e-cigarettes



2018	GCRF-MRC	£230k	CAPABLE (Global Challenges Research Funds through MRC, total £8000k) (Co-PI JF with University of Cambridge (PI) + PhD stipend for T Nxumalo, Fluorinated compounds in the environment
2017	Commonwealth	£50.9k	+ PhD stipend for A. Alzahrani: iodine in hair
2019	Saudi Arabia Cultural Bureau	£79.5k	+ PhD stipend for A. Akhdhar: fluorinated nanoparticles
2017	Saudi Arabia Cultural Bureau	£79.5k	+ PhD stipend for A. Al Zbedy: PFAS in pilot whales
2019	Saudi Arabia Cultural Bureau	£79.5k	+ PhD stipend for I. Almosa: Zinc status in humans
2019	Saudi Arabia Cultural Bureau	£79.5k	Partner laboratory agreement with providing a 7900 ICPMS
2016	Agilent technologies	£150k	Role of metals and metal containing biomolecules in neurodegenerative diseases such as Alzheimer's disease
2016	EU EMPIR	£227k	MILEAGE (Microelements in Life Expectancy and Ageing) total £600k
2016	EU-H2020-MSCA-RISE2016	£30k	Identification and quantification of the molecular form of mercury in gas condensates
2015	Johnson & Matthey	£65k	TeaSe: Tellurium and selenium cycling and supply
2015	NERC	£666k	Organising a workshop in Malawi for arsenic in rice
2018	GCRF-RISE fund	£5.6k	Environmental Fluoronomics – from anthropogenic emissions to accumulation in top predators
2015	FORMAS Swedish RC	£57k	Development of IR and RAMAN imaging for objective scoring of breast cancer tissue sections
2015	Qatar National RC	\$29.7k	Sourcing rice with low inorganic arsenic in Malawi
2015	Commonwealth	£50.9k	+ PhD stipend for Parinda Manorut for mercury speciation rice
2014	Royal Thai Foundation	£57k	+ PhD stipend for Savarin Sinaviwat for Arsenic speciation in biological samples
2015	Royal Thai Foundation	£60k	+stipend for K. Nwoko for Nanoparticles in non-aqueous media
2016	Elphinstone Scholarship and NDDC (Nigeria)	£24k	

**Total Live Grants for
TESLA**

£2388k