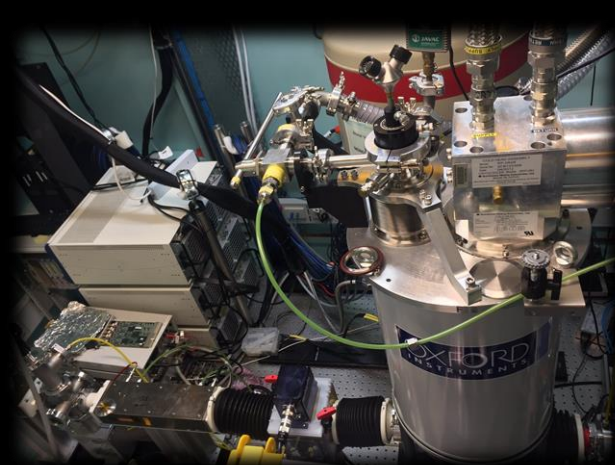
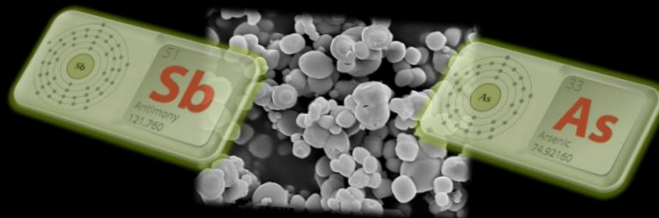
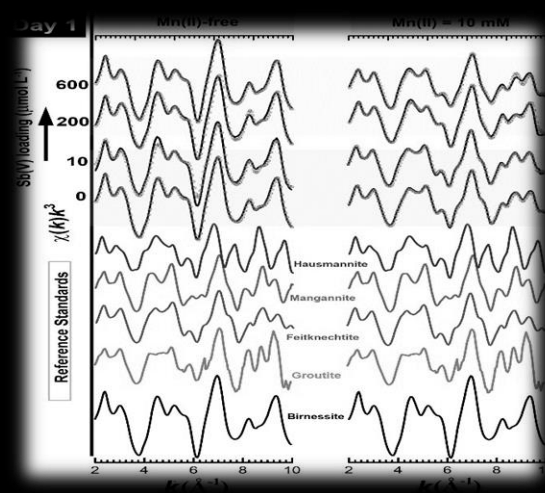




Using **X-ray Absorption Spectroscopy** to Unravel the Mechanisms of **Arsenic** and **Antimony** Uptake by Iron and Manganese Minerals

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Overview

- Background:
As and Sb toxic metalloids ; Fe and Mn minerals
- Antimony and arsenic geochemical behavior during the Fe(II)-induced transformation of **jarosite**
- Reductive transformation of **birnessite** and the mobility of co-associated antimony
- Summary

	13	14	15	16	17
2	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine
3	Al Aluminium	Si Silicon	P Phosphorus	S Sulfur	Cl Chlorine
4	Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	Br Bromine
5	In Indium	Sn Tin	Sb Antimony	Te Tellurium	I Iodine
6	Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine

- As and Sb : Toxic /carcinogenic
- Pollutants of priority interests



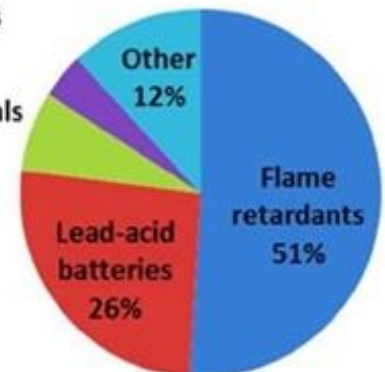
- Inorganic species: **As(V)/As(III)**
Sb(V)/Sb(III)



Consumer products:
Plastics, textiles, rubber,
adhesives, pigments and paper,
pipes...

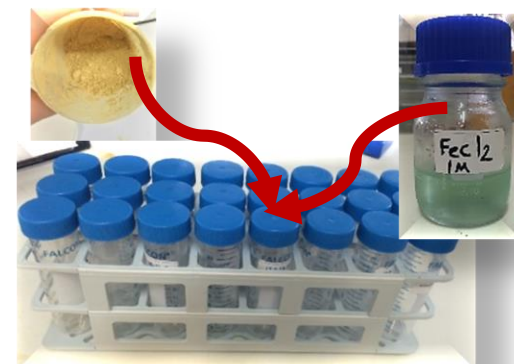


Ceramics
and glass
4%
Chemicals
7%



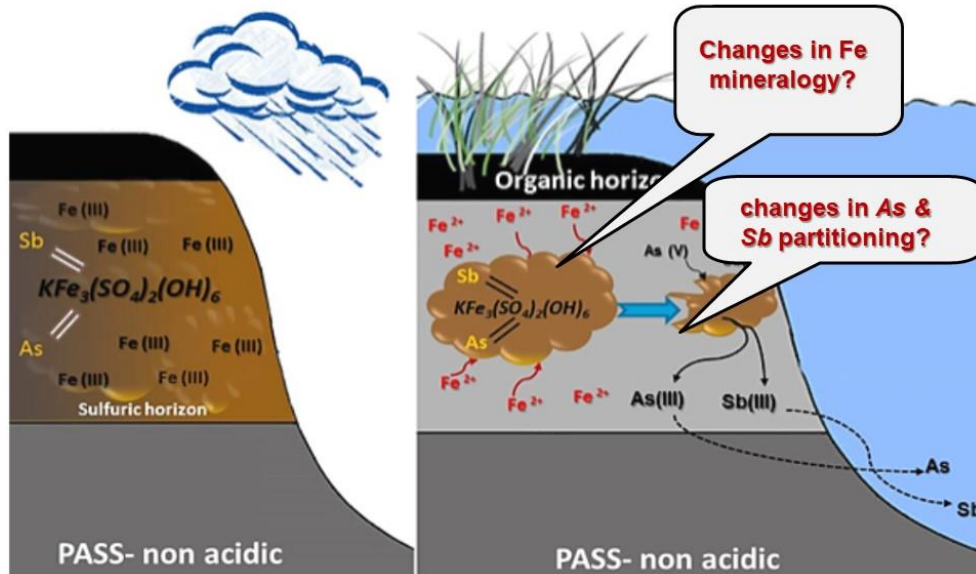
Antimony and arsenic geochemical behaviour during the Fe(II)-induced transformation of jarosite

1. To quantify changes in Jarosite's mineralogy
2. To study the geochemical behaviour of Sb & As.

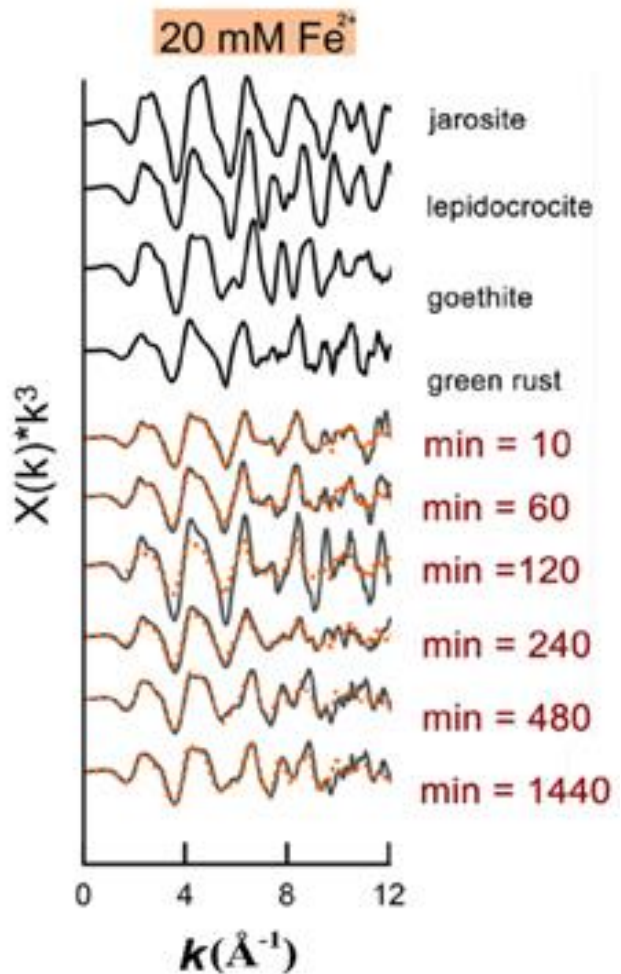


Oxidising acidic conditions

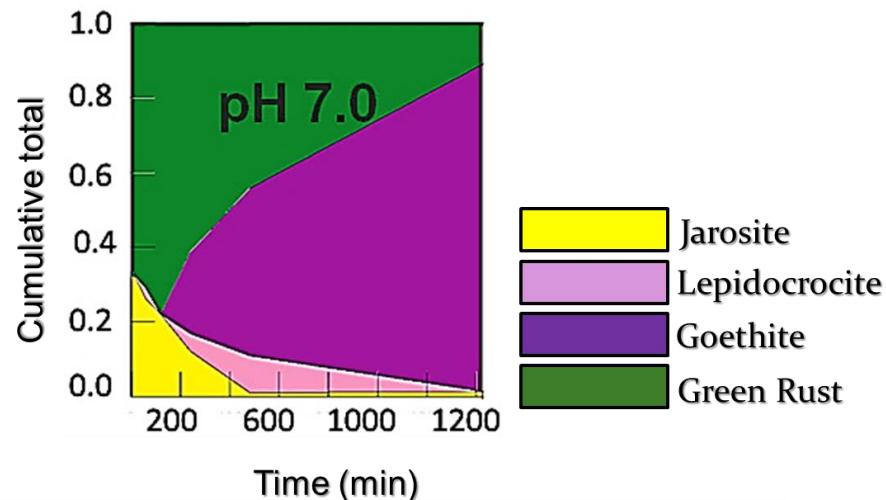
Reducing conditions



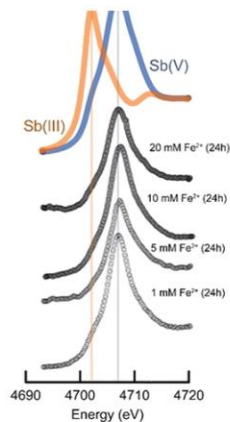
Fe K-edge (EXAFS)



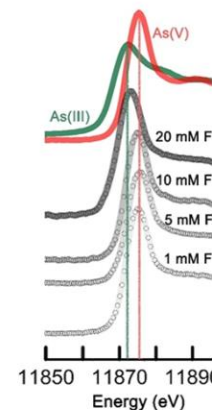
Fe K-edge (LCF)



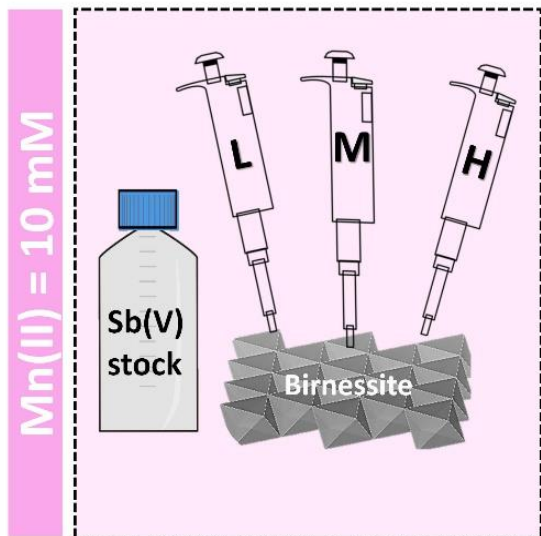
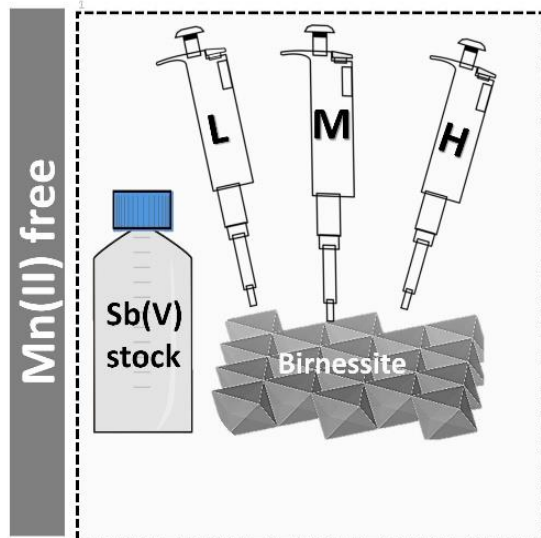
➤ Sb L-edge XANES revealed **no change** in Sb(V) speciation, even at pH 7.0



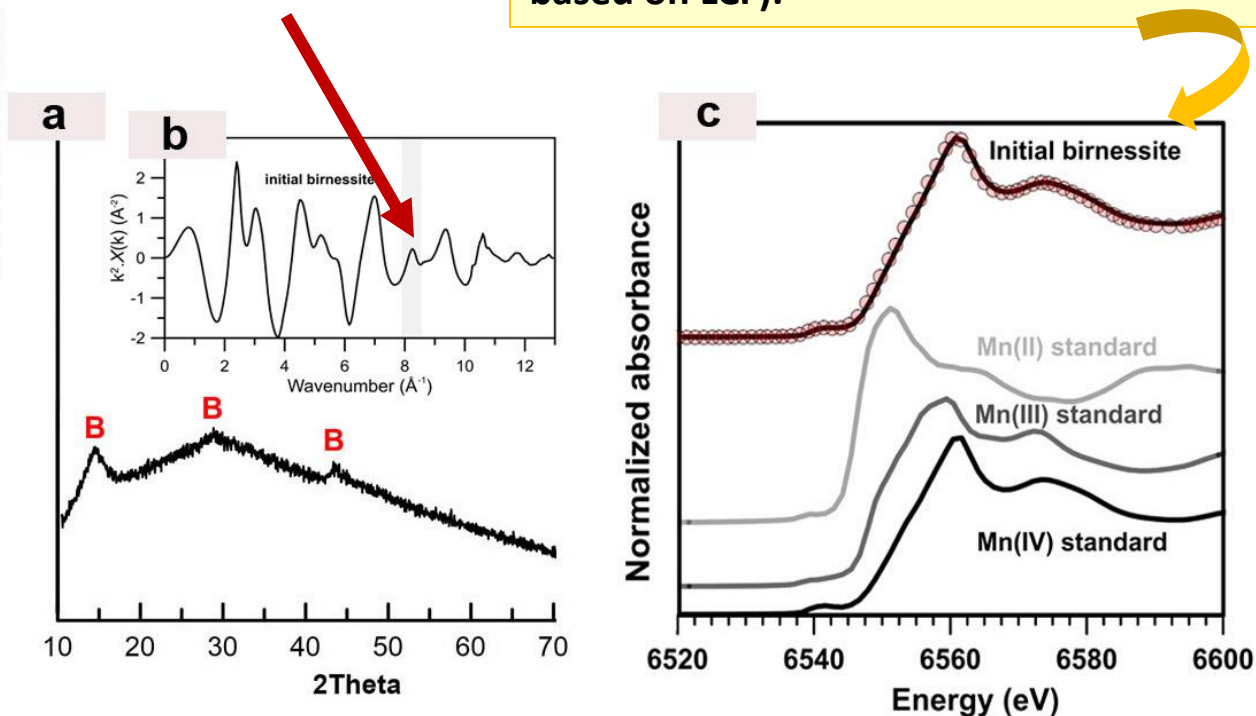
➤ As K-edge XANES indicated e^- transfer to As(V) & an increase in As(III) species.

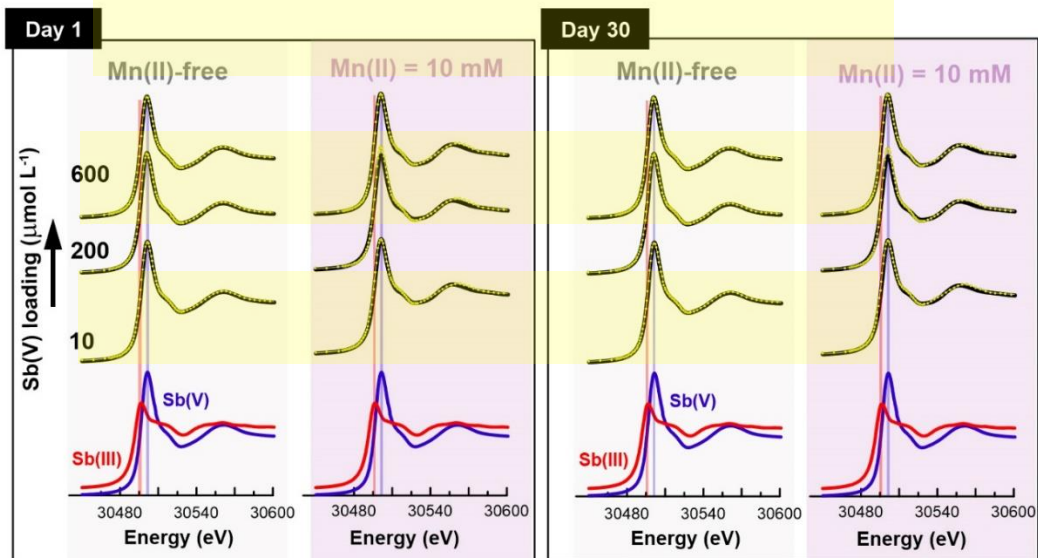
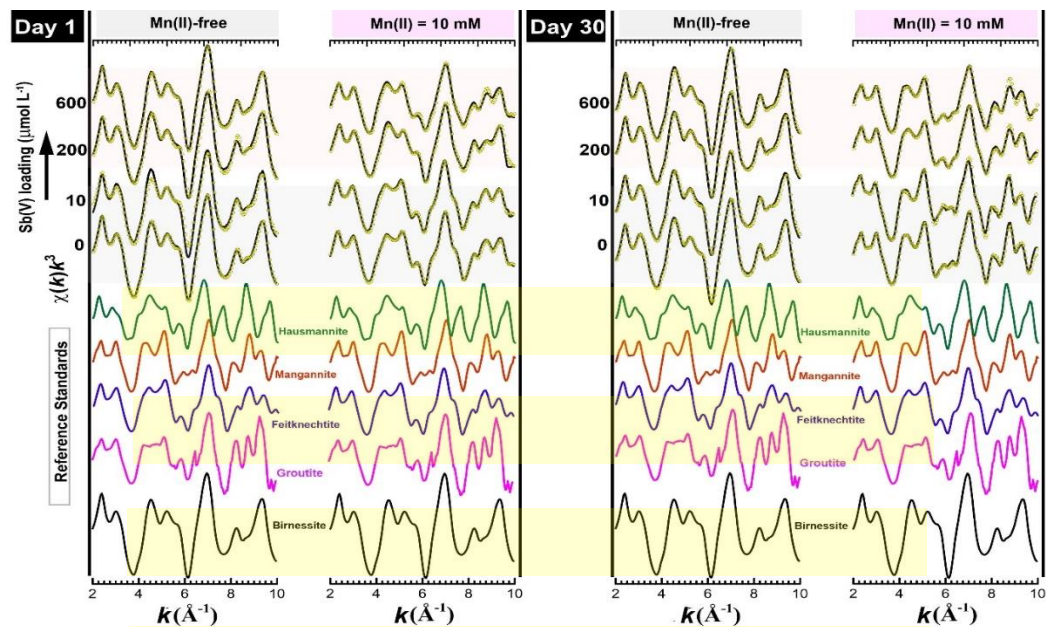
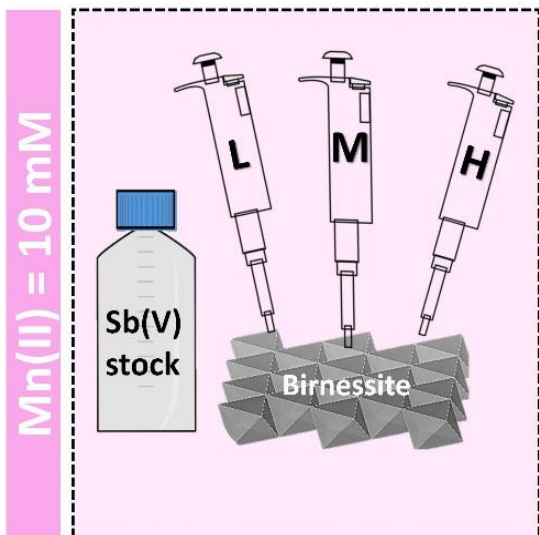
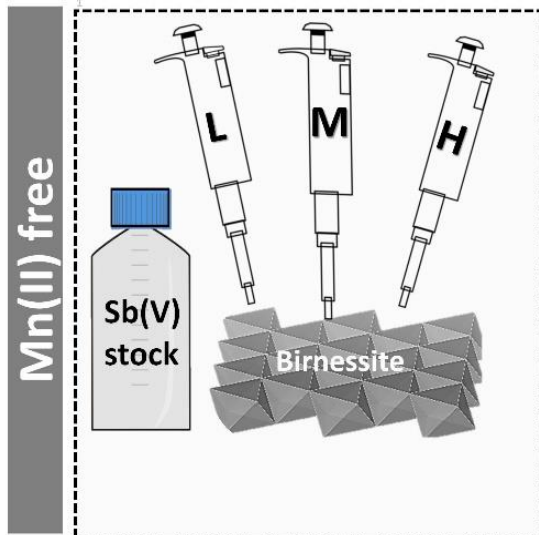


Antimonate controls manganese(II)-induced transformation of birnessite at pH 7

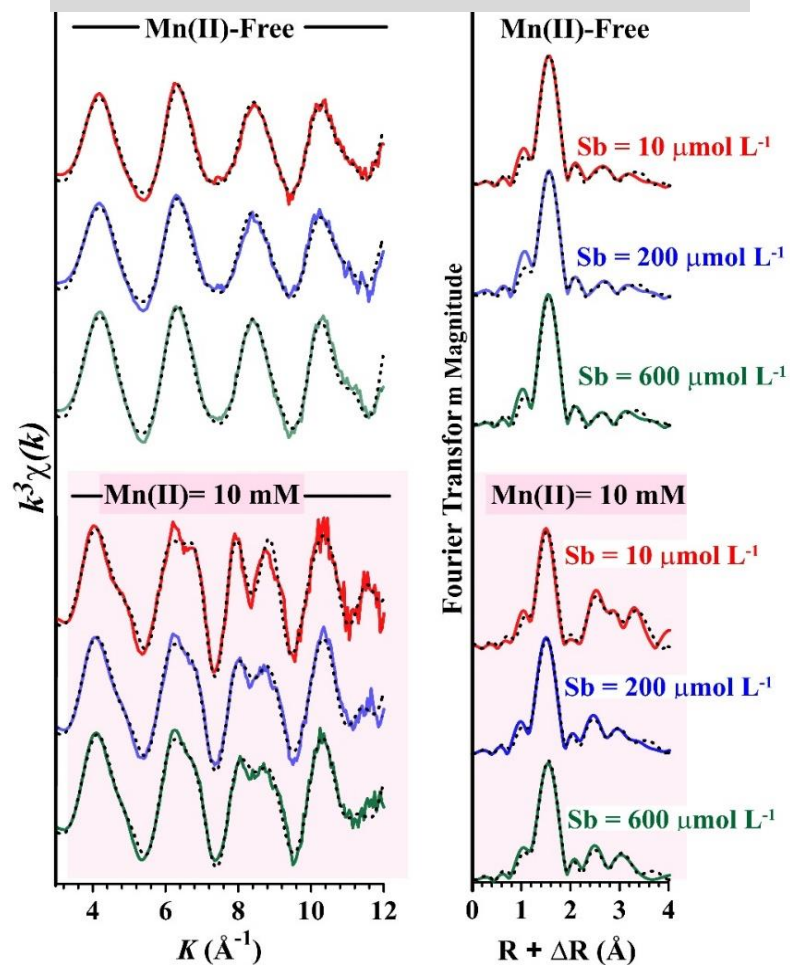


AOS of structural Mn was 3.92 (i.e. the spectrum of 92% Mn(IV) and 8% Mn(III), based on LCF).





Shell fitting of the Sb Kedge EXAFS



sample	shell	CN	R (Å)	ΔE_0 (eV)	σ^2 (Å ²)	R-factor
low Sb, 0 mM Mn(II)	Sb-O	6.0	1.98	8.09	0.002	0.006
	Sb-Mn ₁	1.2	3.03		0.004	
	Sb-Mn ₂	1.8	3.56		0.004	
medium Sb, 0 mM Mn(II)	Sb-O	6.0	1.98	8.20	0.003	0.006
	Sb-Mn ₁	0.8	3.04		0.004	
	Sb-Mn ₂	1.5	3.57		0.004	
high Sb, 0 mM Mn(II)	Sb-O	6.0	1.98	8.16	0.002	0.006
	Sb-Mn ₁	0.4	3.03		0.001	
	Sb-Mn ₂	1.0	3.56		0.001	
low Sb, 10 mM Mn(II)	Sb-O	6.0	1.98	6.05	0.003	0.015
	Sb-Mn ₁	1.7	2.95		0.001	
	Sb-Mn ₂	3.7	3.62		0.001	
	Sb-Mn ₃	4.5	3.76		0.001	
medium Sb, 10 mM Mn(II)	Sb-O	6.0	1.98	6.47	0.003	0.005
	Sb-Mn ₁	1.2	2.94		0.002	
	Sb-Mn ₂	3.4	3.61		0.002	
	Sb-Mn ₃	3.9	3.77		0.002	
high Sb, 10 mM Mn(II)	Sb-O	6.0	1.98	7.01	0.003	0.002
	Sb-Mn ₁	1.2	2.95		0.003	
	Sb-Mn ₂	3.7	3.61		0.003	
	Sb-Mn ₃	3.5	3.77		0.003	

Summary

- **XAS** provides sufficient energy resolution to allow ready identification of the various Fe, Mn, As and Sb oxidation states.
- **XAS** has the ability to perform *quantitative speciation analysis for As, Sb, Fe and Mn* by use of LFC of EXAFS spectra to reference species.
- The *element-specificity of XAS* will let us to measure trace concentrations of As and Sb in our samples.
- **XAS** is capable of resolving *coordination environment of* As, Sb, Fe & Mn in bulk samples, as opposed to surface-based spectroscopic techniques (such as XPS).





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Questions



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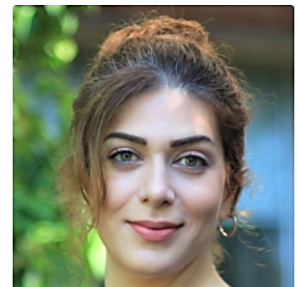
ORCID

Research Gate: https://www.researchgate.net/profile/Niloofar_Karimian

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Education

- PhD Environmental Geochemistry, (2013- 2017) under the supervision of Professor Scott Johnston and Professor Edward Burton, Southern Cross GeoScience, Southern Cross University, Lismore, NSW, Australia. (Project title: *Iron, sulfur and trace metals geochemistry during redox oscillations in freshwater re-flooded acid sulfate soil wetlands.*)
- Master of Science, Soil Science engineering: Soil chemistry and fertility
- Bachelor of Science, Soil Science engineering



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