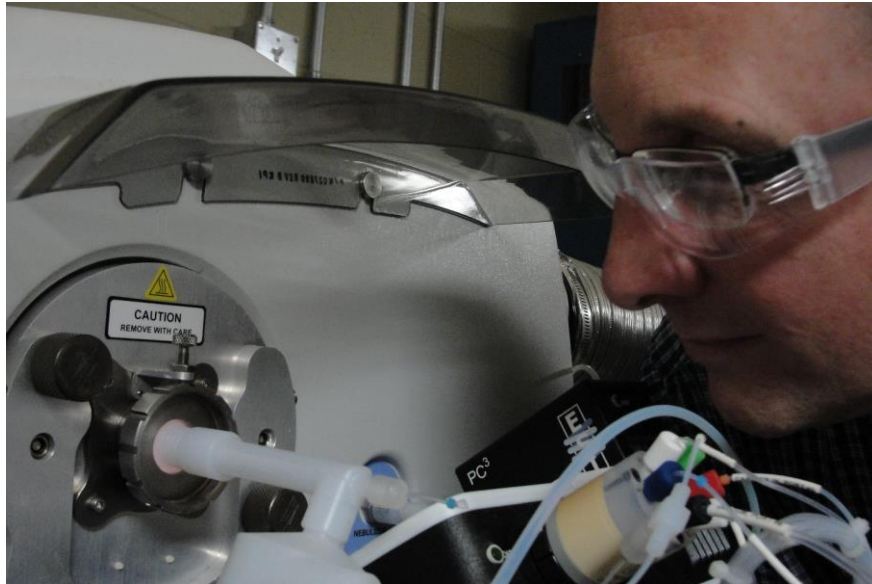


## Dr. Andrew Ross



### Research of Dr. Andrew R.S. Ross, PhD UBC

1998 Ph.D., University of British Columbia, Vancouver, BC

1999-2008 National Research Council, Plant Biotechnology Institute, Saskatoon, SK  
Associate Research Officer

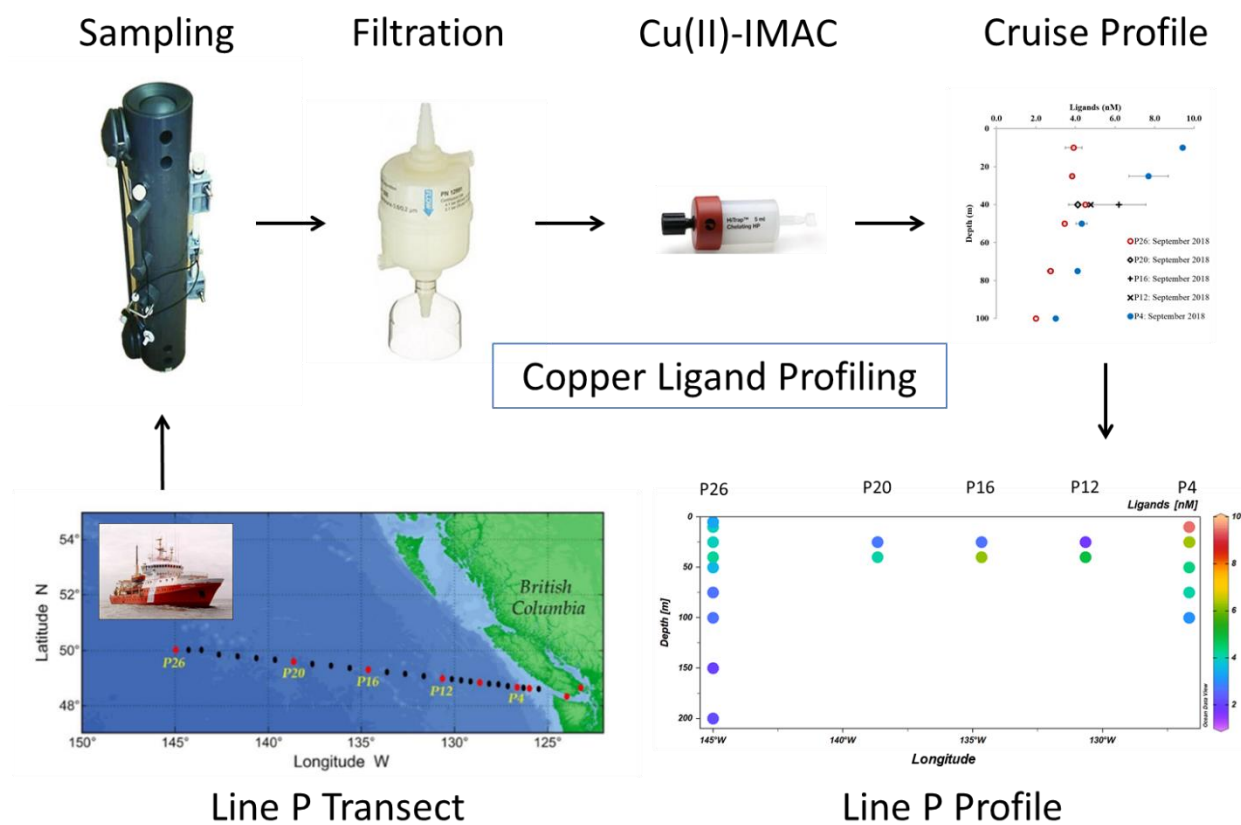
2001-2011 Adjunct Professor, University of Saskatchewan, Saskatoon, SK

2008-present Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC  
Manager, Laboratory of Expertise in Aquatic Chemical Analysis (LEACA)  
Research Scientist and Section Head, Ecology and Biogeochemistry

2011-present Adjunct Assistant Professor, University of Victoria, Victoria, BC  
Adjunct Assistant Professor

Dr. Ross develops and uses analytical methods to study biological and environmental processes that control the distribution and bioavailability of trace elements and the responses of living organisms to stress and disease. His research focuses on studying metal-binding compounds (ligands) in the ocean, identifying modified and stress-related proteins, and developing mass spectrometry (MS) and affinity-based methods to achieve these goals.

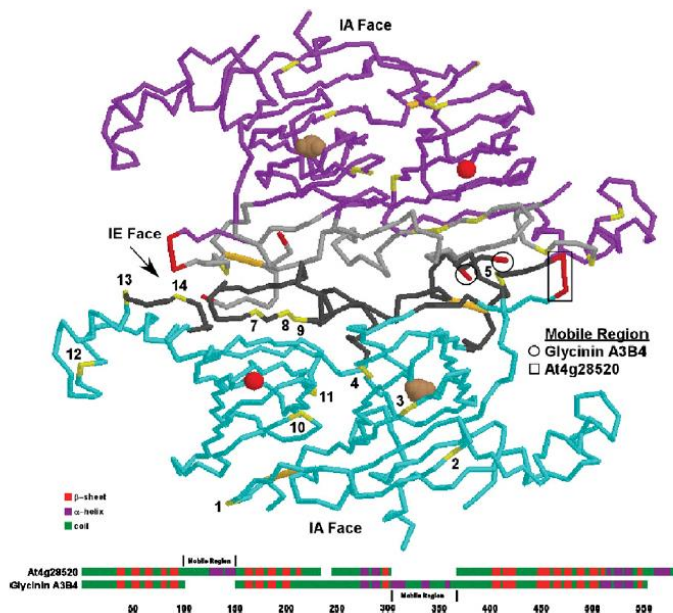
Organic ligands control the bioavailability and distribution of essential trace elements (micronutrients) like iron (Fe) and copper (Cu) in the ocean, yet little is known about the structure and ecological function of these biomolecules. Identification and structural analysis of marine organic ligands would help to explain their involvement in the uptake and utilization of trace elements by the microscopic plants and bacteria (phytoplankton) on which the marine food web is based. This, in turn, would help us to better understanding how phytoplankton growth and micronutrient cycling affect, and are influenced by, processes such as ocean fertilization and climate change.



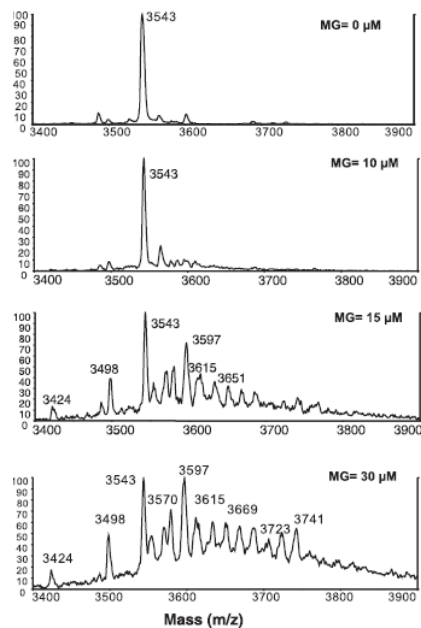
Profiling dissolved copper ligands in the NE Pacific with immobilized metal-ion affinity chromatography (Ref. 26).

Using appropriate analytical techniques like immobilized metal-ion affinity chromatography (IMAC) and electrospray ionization (ESI) mass spectrometry Dr. Ross has shown that organic compounds that bind Cu in coastal seawater include molecules that resemble small proteins (peptides) known to bind metals in plants and

other organisms. He has adapted these techniques to recover and analyze organic ligands from the NE Pacific and Arctic oceans, and to show that their composition and distribution are consistent with terrestrial input and production by marine phytoplankton.



Tertiary structure of a plant seed storage protein showing numbered phosphorylation sites 1-14 identified by mass spectrometry (Ref. 12).



Mass spectra showing glycation of insulin B-chain by methylglyoxal, MG (Ref. 10).

In addition to metal-binding proteins and peptides Dr. Ross has worked extensively on the development and use of methods to identify proteins and protein post-translational modifications (PTMs) involved in stress and disease. Important discoveries include the phosphorylation of cruciferin and other plant proteins involved in germination, growth and stress responses, and glycation of insulin and related signaling proteins implicated in type-2 diabetes.

Dr. Ross is currently developing methods to detect and quantify marine biotoxins in water, sediment and biological samples. Results are being correlated with water properties like temperature, pH, chlorophyll and trace metal concentrations to identify environmental conditions associated with the production of these toxins by harmful algal blooms (HABs). Monitoring ocean conditions, biotoxins and other chemicals of concern will also help to better understand and predict their impacts on marine fisheries and ecosystems in a changing climate.

## Lab Personnel

- Co-op/Summer Student, TBH

## Lab Alumni

### *Research Associate*

- Lianglu Wan, PhD

### *Postdoctoral Fellow*

- Dr. Uma Aryal
- Dr. Richard Nixon

### *Graduate Students*

- Cory Solheim (PhD)
- Richard Nixon (PhD)

### *Undergraduate Co-op/Summer Students*

- Carmen Dereniwsky (2000-2001)
- Sarah Luetngen (2002)
- Wei Shao (2003)
- Jeff Johnson (2004)
- Heather Chivas (2005)
- Angela Chiang (2006)
- Kara Bloomfield (2007)
- Crystal Sommer (2015)
- Jose Campos (2016)
- Jacob Davis (2018)
- Jasper George (2019)
- Mackenzie Mueller (2021)
- Béatrice Ip (2022)

## Selected Publications

1. Ross, A.R.S., Ikonomidou, M.G., Thompson, .J., and Oriens, K.J. 1998. Determination of dissolved metal species by electrospray ionization mass spectrometry. *Analytical Chemistry* **70**: 2225-2235.

2. Ross, A.R.S., Ikonomidou, M.G., and Orians, K.J. 2000. Characterization of dissolved tannins and their metal-ion complexes by electrospray ionization mass spectrometry. *Analytica Chimica Acta* **411**: 91-102.
3. Ross, A.R.S., Ikonomidou, M.G., and Orians, K.J. 2000. Electrospray ionization of alkali and alkaline earth metal species. Electrochemical oxidation and pH effects. *Journal of Mass Spectrometry* **35**: 981-989.
4. Ross, A.R.S., Lee, P.J., Smith, D.L., Langridge, J.I., Whetton, A.D., and Gaskell, S.J. 2002. Identification of proteins from two-dimensional polyacrylamide gels using a novel acid-labile surfactant. *Proteomics* **2**: 928-936.
5. Wanasundara, P.K.J.P.D., Ross, A.R.S., Amarowicz, R., Ambrose, S.J., Pegg, R.B., and Shand, P.J. 2002. Peptides with angiotensin I-converting enzyme (ACE) inhibitory activity from hydrolysed-defibrinated bovine plasma. *Journal of Agricultural and Food Chemistry* **50**: 6981-6988.
6. Ross, A.R.S., Ikonomidou, M.G., and Orians, K.J. 2003. Characterization of copper-complexing ligands in seawater using immobilized copper(II)-ion affinity chromatography and electrospray ionization mass spectrometry. *Marine Chemistry* **83**: 47-58.
7. Napper, S., Kindrachuk, J., Olson, D.J.H., Ambrose, S.J., Dereniowsky, C., and Ross, A.R.S. 2003. Selective extraction and characterization of a histidine-phosphorylated peptide using immobilized copper(II)-ion affinity chromatograph and matrix-assisted laser desorption/ionization-time of flight mass spectrometry. *Analytical Chemistry* **75**: 1741-1747.
8. Ross, A.R.S., Ambrose, S.J., Cutler, A.J., Feurtado, J. A., Kermode, A.R., Nelson, K., Zhou, R., and Abrams, S.R. 2004. Determination of endogenous and supplied deuterated abscisic acid in plant tissues by high performance liquid chromatography-electrospray ionization tandem mass spectrometry with multiple reaction monitoring. *Analytical Biochemistry* **329**: 324-333.
9. Ross, A.R.S., and Luetttgen, S.L. 2005. Speciation of cyclo(Pro-Gly)<sub>3</sub> and its divalent metal-ion complexes by electrospray ionization mass spectrometry. *Journal of the American Society for Mass Spectrometry* **16**: 1536-1544.
10. Jia, X., Olson, D.J.H., Ross, A.R.S., and Wu, L. 2006. Structural and functional changes in human insulin induced by methylglyoxal. *FASEB Journal* **20**: 1555-1557.
11. Hoffmeyer, R.E., Singh, S.P., Doonan, C.J., Ross, A.R.S., Hughes, R.J., Pickering, I.J., and George, G.N. 2006. Molecular form and molecular mimicry in mercury toxicology. *Chemical Research in Toxicology* **19**: 753-759.
12. Wan, L., Ross, A.R.S., Yang, J., Hegedus, D.D., and Kermode, A.R. 2007. Phosphorylation of 12S globulin cruciferin in wild type and abi1-1 mutant *Arabidopsis thaliana* seeds. *Biochemical Journal* **404**: 247-256.

13. Pushie, M.J., Ross, A.R.S., and Vogel, H.J. 2007. Mass spectrometric determination of the coordination geometry of potential copper(II) surrogates for the mammalian prion protein octarepeat region. *Analytical Chemistry* **79**: 5659-5667.
14. Ross, A.R.S. 2007. Identification of histidine phosphorylations in proteins using mass spectrometry and affinity-based Techniques. *Methods in Enzymology: Two Component Signaling Systems*, Simon, M., Crane, B., and Bilwes Crane, A. Eds. **423**: 549-572.
15. Wiramanaden, C.I.E., Cullen, J.T., Ross, A.R.S., and Orians, K.J. 2008. Cyanobacterial copper-binding ligands isolated from a seawater matrix. *Marine Chemistry* **110**: 28-41.
16. Aryal, U.K., Olson, D.J.H., and Ross, A.R.S. 2008. Optimization of immobilized gallium (III) ion affinity chromatography for selective binding and recovery of phosphopeptides from protein digests. *Journal of Biomolecular Techniques* **19**: 296-310.
17. Sheoran, I.S., Ross, A.R.S., Olson, D.J.H., and Sawhney, V.K. 2009. Compatibility of plant protein extraction methods with mass spectrometry for proteome analysis. *Plant Science* **176**: 99-104.
18. Davies, G.F., Ross, A.R.S., Arnason, T.G., Juurlink, B.H.J., and Harkness, T.A.A. 2009. Troglitazone inhibits histone deacetylase activity in breast cancer cells. *Cancer Letters* **288**: 236-250.
19. Aryal, U.K., and Ross, A.R.S. 2010. Enrichment and analysis of phosphopeptides under different experimental conditions using titanium dioxide affinity chromatography and mass spectrometry. *Rapid Communications in Mass Spectrometry* **24**: 219-231.
20. Chang, T., Wang, R., Olson, D.J.H., Mousseau, D.D., Ross, A.R.S., and Wu, L. 2011. Modification of Akt1 by methylglyoxal promotes the proliferation of vascular smooth muscle cells. *FASEB Journal* **25**: 1746-1757.
21. Aryal, U.K., Krochko, J.E., and Ross, A.R.S. 2012. Phosphoproteomic analysis of *Arabidopsis thaliana* mature leaf using optimized polyethylene glycol fractionation, immobilized metal-ion affinity chromatography, two-dimensional gel electrophoresis and mass spectrometry. *Journal of Proteome Research* **11**: 425-437.
22. Aryal, U.K., Ross, A.R.S., Krochko, J.E. 2015. Enrichment and analysis of intact phosphoproteins in *Arabidopsis* seedlings. *PLoS ONE* 10(7): e0130763. doi:10.1371/journal.pone.0130763
23. Ross, A.R.S., Liao, X. 2015. A novel method for the rapid determination of polyethoxylated tallow amine surfactants in water and sediment using large volume injection with high performance liquid chromatography and tandem mass spectrometry. *Analytica Chimica Acta* **889**: 147-155.

24. Nixon, R.L., Ross, A.R.S. 2016. Evaluation of immobilized metal-ion affinity chromatography and electrospray ionization tandem mass spectrometry for recovery and identification of copper(II)-binding ligands in seawater using the model ligand 8-hydroxyquinoline. *Frontiers in Marine Science* **3**: 246. doi: 10.3389/fmars.2016.00246.
25. Nixon, R.L., Jackson, S.L., Cullen, J.T., Ross, A.R.S. 2019. Distribution of copper-complexing ligands in the Canadian Arctic as determined using immobilized copper(II)-ion affinity chromatography. *Marine Chemistry* **215**: doi: 10.1016/j.marchem.2019.103673
26. Nixon, R.L., Peña, M.A., Taves, R., Janssen, D.J., Cullen, J.T., Ross, A.R.S. 2021. Evidence for the production of copper-complexing ligands by marine phytoplankton in the subarctic northeast Pacific. *Marine Chemistry* **237**: 104034. doi: 10.1016/j.marchem.2021.104034