

## Frontier's References and Past Experience

### A. Trace Metal Analysis of Shrimp Tissues for Tufts University

Since in 1998, Frontier Geosciences has been analyzing shrimp tissue samples for Tufts University. Trace metals (Al, K, V, Cr, Mn, Ba, Pb, Ni, Cu, Ag, Cd, and Sb) were analyzed by inductively coupled plasma – mass spectrometry (ICP-MS) using EPA method 1638 modified. Iron was determined by colorimetry (SM 3500-Fe), selenium was determined by hydride generation – atomic fluorescence spectrometry (HG-AFS), and mercury was determined by cold vapor – atomic fluorescence spectrometry (CV-AFS) using EPA method 1631. Approximate contract value to date = \$60,000.

Contact: Acacia Alcivar-Warren  
Tufts University  
200 Westboro Rd.  
North Grafton, MA 01536  
(508) 839-5302

### B. Trace Metals in Marine Sediments and Tissues for the University of Alaska

Since 1998, Frontier Geosciences has been analyzing fish tissue and marine sediment samples for the University of Alaska. Samples have been analyzed for V, Cr, Ni, Cu, Zn, As, Cd, Pb, Ba, Hg, and Se. The methods used for the tissues were a concentrated nitric acid digestion followed by analysis by ICP-MS, HG-AFS for Se and As, and CV-AFS for Hg. The methods used for the sediments were the HF/HNO<sub>3</sub> microwave bomb digestion followed by ICP-MS, HG-AFS for Se, and CV-AFS for Hg. Cr and Ba were determined by ICP-MS after a LiBO<sub>2</sub> fusion preparation. Approximate contract value to date = \$33,000.

Contact: Dr. Sathy Naidu  
Institute of Marine Science  
University of Alaska  
Fairbanks, AK 99775-1080  
(907) 474-7032

### C. Trace Metals in Marine Sediments and Tissues for CH2M-HILL

For the past 2 years, Frontier Geosciences has been analyzed marine sediment and fish tissue samples from Puerto Rico for CH2M-HILL. Samples are analyzed for Be, B, Cr, Mn, Ni, Cu, Zn, As, Se, Ag, Cd, Sb, Ba, Hg, Tl, and Pb. The methods used for tissues were concentrated nitric acid digestion followed by analysis by ICP-MS, HG-AFS for Se and As, and CV-AFS for Hg. The methods used for the sediments were the HF/HNO<sub>3</sub> microwave bomb digestion followed by ICP-MS, HG-AFS for Se, and CV-AFS for Hg. Approximate contract value to date = \$120,000.

Contact: Ellen Patterson  
CH2M-HILL  
800 Fairway Drive, Suite 350  
Deerfield Beach, FL 33441  
(954) 426-4008 ext. 233

D. Trace Metals in Tissue Samples for Raptor Resources

From 1999 through present Frontier Geosciences has been analyzing blood and tissue samples for Raptor Resources. Trace metals (Cr, Ni, and As) were analyzed by ICP-MS using EPA method 1638 modified, selenium by HG-AFS, mercury and methyl mercury were determined by cold vapor – atomic fluorescence spectrometry (CV-AFS) using EPA method 1631 and 1630, respectively. Approximate contract value to date = \$37,000.

Contact: Bob Anderson  
Raptor Resources  
2580 310<sup>th</sup> St.  
Ridgeway, IA 522165-8528  
(319) 382-6300

E. Trace Metals in Freshwater for the California Department of Water Resources (CDWR)

Frontier provides analytical services to the CDWR for the analysis of freshwater samples for Hg by Modified EPA Method 1631 (CVAFS) and Al, Cd, Cr, Cu, Pb, Mn, Ni, Se, and Zn by Modified EPA Draft Method 1638 (ICP-MS). Frontier also supplies pre-cleaned bottles.

Contact: Jerry Boles  
CDWR  
2440 North Maine Street  
Red Bluff, CA 96080  
(530) 529-7326  
[bolesj@water.ca.gov](mailto:bolesj@water.ca.gov)

F. Trace Metals in Freshwater and Effluent for the Sacramento Regional Wastewater Treatment Plant (WWTP)

Scope: Frontier provides analytical services to the Sacramento Regional WWTP for the analysis of freshwater samples and effluent for Hg by Modified EPA Method 1631 (CVAFS) and As, Cd, Cr, Cu, Pb, Ni, Ag, and Zn by Modified EPA Draft Method 1638 (ICP-MS). Frontier also supplies pre-cleaned bottles

Contact: Neal Stallions  
8521 Laguna Station Road  
Elk Grove, CA 95758  
(916) 875-6656  
[stallionsn@pwa.co.sacramento.ca.us](mailto:stallionsn@pwa.co.sacramento.ca.us)

#### G. Mercury Speciation in Water-Onondaga Lake Supplemental Lake Water Investigation

During the period from September to December 1999, Frontier Geosciences, Inc. conducted the analysis of total mercury and methyl mercury in water samples collected by Exponent Environmental Group for the Onondaga Lake Supplemental Lake Water Investigation. In addition to analytical services, Frontier also provided the sampling team with ultra-clean sampling equipment.

Contact: Dr. Betsy Henry  
Exponent Environmental Group, Inc.  
1086 Morningside Ave  
Schenectady, NY 12309  
Phone: (518) 370-5132

#### H. Mercury Speciation in Waters, Sediments, Plants, Biota-South Florida Water Management District

During the period from 1997 to 2000, Frontier Geosciences, Inc. conducted analysis of total and methyl mercury on a wide variety of matrices (water, sediments/soils, biota, and plants) in support of the Everglades Nutrient Removal project (ENR). In this project, a constructed wetland around the Florida agricultural area is used to remove phosphorus prior to runoff into the Everglades. This construction is being monitored to see if it alters the mercury cycle for the everglades in either a positive or negative manner (Total project value:~\$1,000,000). In addition to work for this project, Frontier has also performed analysis of samples from other projects on an as needed basis. Frontier continues to perform analytical services for the district under a new contract which runs until the middle of 2002.

Contact: Linda Crean  
South Florida Water Management District  
1468-A Skees Road  
West Palm Beach, FL 33411  
Phone: (561) 681-2500 ext. 4560

#### I. Total and Methyl Mercury in Invertebrates and Plants for URS (Vancouver, BC)

Frontier Geosciences has analyzed total and methyl mercury in invertebrate (both aquatic and terrestrial) samples collected by the Vancouver, BC (Canada) office of URS (formerly Norcol Dames and Moore). The invertebrate samples were collected in conjunction with other samples (including waters, sediments, plants and small mammals) at a contaminated site in the Canadian province of British Columbia.

Approximate contract value to date = \$100,000 (note: this includes analysis of waters and sediments as well as tissues)

Contact: Michael McLeay  
URS/NDM  
P.O. Box 11507  
650 West Vancouver Street, Suite 1900  
Vancouver, BC V6B 4N7  
Canada  
(604) 681-1672

J. Total and Methyl Mercury in Benthic Invertebrates for Exponent, Inc-Pompton Lakes

During the autumn of 1998, Frontier Geosciences performed the analysis of total and methyl mercury on benthic invertebrate samples collected for the Pompton Lakes site investigation. The site was contaminated by previous industrial activity (a fireworks plant located near the lakes). Samples for total mercury were prepared by hot acid (70% $\text{HNO}_3$ /30%  $\text{H}_2\text{SO}_4$ ) digestion. Analysis was conducted by  $\text{SnCl}_2$  reduction, dual gold amalgamation, and cold vapor atomic fluorescence (CVAFS) detection. Methyl mercury was determined by KOH/methanol digest followed by aqueous ethylation, purging and trap, isothermal GC separation, and cold vapor atomic fluorescence spectrometry (CVAFS). In addition to invertebrates, other tissues matrices (algae, zooplankton, and algal mats) were analyzed.

Approximate contract value = \$25,000

Contact: Jane Sexton  
Exponent Environmental Group, Inc.  
15375 S.E. 30<sup>th</sup> Place  
Bellevue, WA 98007  
(425) 643-9803

K. Total and Methyl Mercury in Plant Tissues for South Florida Water Management District

Since 1997, Frontier Geosciences has performed analytical services for the South Florida Water Management District on a number of projects conducted in and around the Everglades National Park. In addition to waters, sediments and fish tissues, total and methyl mercury analyses were conducted on plant tissues. Samples for methyl mercury were prepared by distillation followed by analysis using aqueous ethylation, purging and trap, isothermal GC separation, and cold vapor atomic fluorescence spectrometry (CVAFS). Samples for total mercury were prepared by hot acid (70% $\text{HNO}_3$ /30%  $\text{H}_2\text{SO}_4$ ) digestion. Analysis was conducted by  $\text{SnCl}_2$  reduction, dual gold amalgamation, and cold vapor atomic fluorescence (CVAFS) detection.

Approximate contract value to date =>\$6,000,000

Contact: Linda Crean  
South Florida Water Management District  
8894 Belvedere Road  
West Palm Beach, FL 33461  
(561) 753-2400 ext 4745

L. Trace Metals and Mercury in Bird Feathers for Dr. George Divoky at the University of Alaska, Fairbanks

For the past four years Frontier has been performing trace metals analysis in bird feathers for Dr. George Divoky. Recently, Dr. Divoky was featured on the late night talk show David Letterman for his research regarding his 22-year long study of a bird population in the remote area of Barrow, Alaska. Dr. Divoky has directly correlated his research of the birds with the evidence of global warming.

Contact: Dr. George Divoky  
University of Alaska – Fairbanks  
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