



SLRS-5**River Water Reference Material for Trace Metals**

The following table lists the elements for which certified values have been established along with their expanded uncertainty ($U_{\text{CRM}} = k u_c$, where u_c is the combined standard uncertainty calculated according to the ISO Guide [1] and $k=2$ is the coverage factor). It is intended that U_{CRM} encompasses every aspect that reasonably contributes to the uncertainty of the certified mass fraction [2]. Certified values are based on the results of determinations by at least two independent methods of analysis. Information values (identified with an “*”) are listed for elements which could not be certified because of insufficient information for accurate assessment of the associated uncertainties. The density of SLRS-5 is 1.0007 g/mL.

Mass Fraction ($\mu\text{g}/\text{kg}$)

Aluminum (c,g,i) [†]	49.5	±	5.0
Antimony* (d)	0.3		
Arsenic (c,h)	0.413	±	0.039
Barium (d,j)	14.0	±	0.5
Beryllium* (c)	0.005		
Cadmium (d,e,n)	0.0060	±	0.0014
Chromium (d,e)	0.208	±	0.023
Cobalt* (c)	0.05		
Copper (d,g,j)	17.4	±	1.3
Iron (d,g,j)	91.2	±	5.8
Lead (d,e,n)	0.081	±	0.006
Manganese (c,g,j)	4.33	±	0.18
Molybdenum* (d)	0.5		
Nickel (d,e)	0.476	±	0.064
Strontium (d,i)	53.6	±	1.3
Uranium* (d)	0.1		
Vanadium (c,n)	0.317	±	0.033
Zinc (d,g,j,n)	0.845	±	0.095

Mass Fraction ($\mu\text{g}/\text{g}$)

Calcium (f,i)	10.5	±	0.4
Magnesium (c,f,i)	2.54	±	0.16
Potassium (f,i)	0.839	±	0.036
Sodium (f,i)	5.38	±	0.10

† - See overleaf for key to coding

Coding

- c - Direct determination by inductively coupled plasma mass spectrometry (ICPMS)
- d - Direct determination by isotope dilution ICPMS
- e - Concentration by evaporation; determination by graphite furnace atomic absorption spectrometry (GFAAS)
- f - Direct determination by flame atomic absorption spectrometry (FAAS)
- g - Direct determination by GFAAS
- h - Hydride generation; determination by GFAAS
- i - Direct determination by inductively coupled plasma emission spectrometry (ICPAES)
- j - Concentration by evaporation; determination by ICPAES
- n - Matrix separation; determination by ICPMS

This reference material is primarily intended for use in the calibration of procedures and the development of methods used for the analysis of river waters for trace metals.

Preparation

Untreated river water was collected at the City of Ottawa's Britannia Water Purification Plant. The water was peristaltically pumped through 0.45 µm porosity acrylic copolymer filters and immediately acidified with ultrapure nitric acid to pH 1.6 during transfer to polypropylene carboys. The water was later refiltered through 0.2 µm porosity acrylic copolymer filters into a polyethylene tank in a clean room at NRCC. It was subsequently blended and bottled in precleaned polyethylene containers. The bottled water was gamma irradiated to a minimum dose of 25 kGy at the Canadian Irradiation Centre, Laval, Québec, to inhibit any bacterial action.

Storage and Stability

It is recommended that the material be stored in a cool, clean location. The bottles should be opened only in a clean area with precautions taken against contamination during sampling. Studies of similar waters indicate that the material is stable with respect to total trace metal concentrations for more than ten years.

Certification

The analytical work was done within the Institute for National Measurement Standards. Randomly selected bottles were chosen for the analytical determinations. Results from different bottles showed no significant differences, nor was there any correlation between values obtained and bottle sequence. Certified values were calculated using a procedure that conforms to the ISO framework of combining measurement uncertainties. Individual method uncertainties were calculated and combined with a type B bias uncertainty to derive the final values [2]. Based on NRC's experience with similar materials, uncertainty components for homogeneity, and long and short

term stability were considered negligible and are thus not included in the uncertainty budget.

As more data become available the established values may be updated and certified numbers assigned to more elements. These updates will be posted on our website (<http://www.nrc-cnrc.gc.ca/eng/services/inms/reference-materials.html>).

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References

[1] Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st ed. ISO, Geneva, Switzerland (1993).

[2] M.S. Levenson et al., An Approach to Combining Results From Multiple Methods Motivated by the ISO GUM J. Res. Natl. Inst. Stand. Technol. 105, 571 (2000)

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Data presented in this certificate are traceable to the SI through gravimetrically prepared standards of established purity and international measurement intercomparisons. As such, they serve as suitable reference materials for laboratory quality assurance programs, as outlined in ISO/IEC 17025. This CRM is registered at the Bureau International des Poids et Mesures (BIPM) in Appendix C of the Comité International des Poids et Mesures database listing Calibration and Measurement Capabilities accepted by signatories to the Mutual Recognition Arrangement of the Metre Convention.

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