National Research Council Canada | Conseil national de recherches Canada

Certificate of Analysis

Certified Reference Material

SLEW-4

Estuarine Water Certified Reference Material

SLEW-4 is an estuarine water Certified Reference Material (CRM) from the National Research Council Canada (NRC) with information on trace element content. A unit of SLEW-4 consists of approximately 200 mL of estuarine water. This material is intended for use in the method development, validation, and quality control for the analysis of trace and matrix constituents in seawater matrices.

Table 1 shows the certified and reference values established for SLEW-4. The expanded uncertainties associated with the certified and reference values were calculated according to the JCGM Guide [1] and correspond to approx. 95 % confidence (k = 2). The density of SLEW-4 is 1.010 g/mL at 20°C.

Table 1: Quantity values and expanded uncertainties (k = 2) for SLEW-4

Analyte	Mass fraction, µg/kg	Mass concentration, µg/L	Type of value	International recognition of measurement capability (CMC)
arsenic (b)	0.98 ± 0.36	0.99 ± 0.36	reference	TEW03
boron (a)	2135 ± 57	2156 ± 57	certified	--
cadmium (a,b)	0.0216 ± 0.0045	0.0218 ± 0.0046	certified	TEW06
chromium (a)	0.223 ± 0.090	0.225 ± 0.091	reference	TEW07
cobalt (b)	0.307 ± 0.038	0.310 ± 0.038	certified	TEW22
copper (a,b)	0.697 ± 0.047	0.704 ± 0.048	certified	TEW09
iron (a,b)	6.89 ± 0.48	6.96 ± 0.48	certified	TEW10
lead (a,b)	0.009 49 ± 0.001 51	0.009 58 ± 0.001 52	certified	TEW11
manganese (b)	4.10 ± 0.55	4.14 ± 0.55	certified	TEW12
molybdenum (a,b)	4.81 ± 0.34	4.86 ± 0.34	certified	TEW13
nickel (a,b)	0.500 ± 0.047	0.505 ± 0.047	certified	TEW14
uranium (a,b)	1.475 ± 0.103	1.490 ± 0.104	certified	TEW16
vanadium (a)	0.775 ± 0.148	0.782 ± 0.150	certified	TEW17
zinc (a,b)	0.587 ± 0.069	0.593 ± 0.070	certified	TEW18

Coding

The coding refers to the instrumental method of analyte determination.

- **a** Isotope dilution inductively-coupled plasma mass spectrometry (ID-ICP-MS)
- **b** Standard addition inductively-coupled plasma mass spectrometry (SA-ICP-MS)

Canada

Supplementary data

The accompanying datasheets (available from doi.org/10.4224/crm.2021.slew-4) provide measurement results that were used in this certification campaign.

International recognition of measurement capability

The measurement capabilities supporting these results are registered at the Calibration and Measurement Capabilities (CMC) database of the *Bureau international des poids et mesures* (BIPM) indicating recognition of the measurement certificates by National Metrology Institutes (NMIs) participating in the Mutual Recognition Arrangement (MRA) with the corresponding identifiers. List of all registered measurement capabilities in water matrix could be found in the BIPM database at https://www.bipm.org/kcdb/.

Certified values

Certified values are considered to be those for which the NRC has the highest confidence in accuracy and that all known and suspected sources of bias have been taken into account and are reflected in the stated expanded uncertainties. Certified values are the best estimate of the true value and uncertainty.

Reference values

Reference values are those for which insufficient data are available to provide a comprehensive estimate of uncertainty.

Intended use

SLEW-4 is intended for use in the method development, validation, and quality control for the analysis of trace and matrix constituents in seawater matrices.

Storage and sampling

It is recommended that the material is stored at nominal temperature of +4 ^{o}C under typical refrigerator conditions. The material shall not be frozen. Each bottle is packaged in a trilaminate foil pouch. The bottles should be opened only in a clean area with precautions taken against contamination during sampling.

Preparation of material

The estuarine water was collected June 2019 from the St. Lawrence River in the vicinity of L'Isle-aux-Coudres, Québec at a depth of 10 m. The sample was filtered through a 0.2 µm acrylic copolymer filters, acidified to pH 1.6 with ultrapure nitric acid and dispensed into 250 mL polyethylene bottles. The CRM units were gamma irradiated to a minimum dose of 25 kGy to inhibit any bacterial action.

Stability

The predecessor CRMs have been periodically analyzed for more than 10 years and found to be both physically and chemically stable in long-term storage and transportation. Similar behaviour is foreseen for SLEW-4.

Homogeneity

The homogeneity of SLEW-4 was assessed from randomly selected units of CRMs using Bayesian analysis of variance (ANOVA) [2].

Uncertainty

Evaluation of the uncertainty associated with certified and reference values was carried out. Included in the overall combined uncertainty estimate are uncertainties in the batch characterization, uncertainties related to possible between-bottle variation, and uncertainties related to inconsistency between the various measurement methods [3,4]. Further information is presented in the supplementary datasheets doi.org/10.4224/crm.2021.slew-4.

Metrological traceability

Results presented in this certificate are traceable to the International System of Units (SI) through CRMs produced by National Metrology Institutes and gravimetrically prepared standards of established purity. As such, SLEW-4 serves as suitable reference material for laboratory quality assurance programs, as outlined in ISO/IEC 17025.

Quality Management System (ISO 17034, ISO/IEC 17025)

This material was produced in compliance with the NRC Metrology Quality Management System, which conforms to the requirements of ISO 17034 and ISO/IEC 17025. The Metrology Quality Management System supporting NRC Calibration and Measurement Capabilities, as listed in the *Bureau international des poids et mesures* (BIPM) Key Comparison Database (kcdb.bipm.org/), has been reviewed and approved under the authority of the Inter-American Metrology System (SIM) and found to be in compliance with the expectations of the *Comité international des poids et mesures* (CIPM) Mutual Recognition Arrangement. The SIM approval is available upon request.

Updates

For updates please refer to doi.org/10.4224/crm.2021.slew-4.

References

1. Evaluation of measurement data: Guide to the expression of uncertainty in measurement JCGM100:2008. https://www.bipm.org/en/publications/guides/gum.html
2. van der Veen AMH (2017) Bayesian analysis of homogeneity studies in the production of reference materials. *Accred. Qual. Assur.* 22: 307-319. doi.org/10.1007/s00769-017-1292-6.
3. Possolo A, Toman B (2007) Assessment of measurement uncertainty via observation equations. *Metrologia*, 44: 464-475. doi.org/10.1088/0026-1394/44/6/005
4. Thompson M, Ellison SLR (2011) Dark uncertainty. *Accred. Qual. Assur.* 16: 483-487. doi.org/10.1007/s00769-011-0803-0

Cited by

A list of scientific publications citing SLEW-4 CRM can be found at doi.org/10.4224/crm.2021.slew-4.

Authorship

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This Certificate is only valid if the corresponding material was obtained directly from the NRC or an Authorized Reseller.

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