



Certificate of Analysis

Certified Reference Material

SESA-1

Sea Salt Certified Reference Material for Trace Elements in Seawater

SESA-1 is an artificial sea salt Certified Reference Material (CRM) from the National Research Council Canada (NRC) to be used as a proxy for seawater. A unit of SESA-1 consists of 9 g of salt powder certified for trace elements. Additionally, SESA-1 was spiked with numerous organic contaminants for future method development purposes. Gravimetric formulation information is provided for all spiked analytes. A 4.0 g of SESA-1 should be transferred into a pre-cleaned flask and reconstituted to 100 g using diluted HNO₃ as detailed in the Intended Use section. SESA-1 reconstituted solution has a typical salinity of seawater and can be used for method development and quality control for the analysis of trace elements in seawaters similar to NRC CASS-6 [1] and NASS-7 [2]. The density of SESA-1 reconstituted solution is 1.024 g/mL at 21 °C.

Table 1 shows the certified and reference values established for the SESA-1 reconstituted solution. The expanded uncertainties associated with the certified and reference values were evaluated according to the JCGM Guide [3] and correspond to approx. 95 % confidence ($k = 2$).

**Table 1: Quantity values and expanded uncertainties ($k = 2$)
for reconstituted SESA-1 solution**

Analyte	Mass fraction, µg/kg (in reconstituted SESA-1 solution)	Type of value	International recognition of measurement capability (CMC)
arsenic (b)	0.122 ± 0.034	reference	TEW19
boron (a)	499 ± 12	certified	TEW42
cadmium (b)	0.198 ± 0.030	certified	TEW20
chromium (a, b)	0.97 ± 0.16	certified	--
cobalt (b)	0.081 ± 0.006	certified	TEW22
copper (b)	2.47 ± 0.28	certified	TEW23
iron (b)	28.5 ± 3.2	certified	--
lead (b)	2.81 ± 0.40	certified	TEW25
manganese (b)	278 ± 18	certified	--
molybdenum (a, b)	1.55 ± 0.22	certified	TEW27
nickel (b)	3.90 ± 0.30	certified	TEW28
uranium (a,b)	0.058 ± 0.008	certified	--
vanadium (b)	0.165 ± 0.028	certified	TEW29
zinc (b)	4.53 ± 0.24	certified	--

Table 2: Information values for contaminants spiked to SESA-1

Analyte	Molecular formula	CAS registry number	Mass fraction, µg/kg (in SESA-1 salt powder)
sodium nitrate (c)	NaNO ₃	7631-99-4	90 500
methylmercury chloride (c)	CH ₃ HgCl	115-09-3	0.30
acenaphthene (c)	C ₁₂ H ₁₀	83-32-9	13
acenaphthylene (c)	C ₁₂ H ₈	208-96-8	25
anthracene (c)	C ₁₄ H ₁₀	120-12-7	1.2
benz[a]anthracene (c)	C ₁₈ H ₁₂	56-55-3	1.2
benzo[b]fluoranthene (c)	C ₂₀ H ₁₂	205-99-2	1.2
benzo[k]fluoranthene (c)	C ₂₀ H ₁₂	207-08-9	1.2
benzo[ghi]perylene (c)	C ₂₂ H ₁₂	191-24-2	2.5
benzo[a]pyrene (c)	C ₂₀ H ₁₂	50-32-8	1.2
chrysene (c)	C ₁₈ H ₁₂	218-01-9	1.3
dibenz[a,h]anthracene (c)	C ₂₂ H ₁₄	53-70-3	2.5
fluoranthene (c)	C ₁₆ H ₁₀	206-44-0	1.2
fluorene (c)	C ₁₃ H ₁₀	86-73-7	2.5
indeno[1,2,3-cd]pyrene (c)	C ₂₂ H ₁₂	193-39-5	1.3
1-methylnaphthalene (c)	C ₁₁ H ₁₀	90-12-0	12
2-methylnaphthalene (c)	C ₁₁ H ₁₀	91-57-6	13
naphthalene (c)	C ₁₀ H ₈	91-20-3	12
phenanthrene (c)	C ₁₄ H ₁₀	85-01-8	1.2
pyrene (c)	C ₁₆ H ₁₀	129-00-0	1.1
aldrin (c)	C ₁₂ H ₈ Cl ₆	309-00-2	0.11
α-HCH (c)	C ₆ H ₆ Cl ₆	319-84-6	0.11
β-HCH (c)	C ₆ H ₆ Cl ₆	319-85-7	0.12
γ-HCH, lindane (c)	C ₆ H ₆ Cl ₆	58-89-9	0.12
δ-HCH (c)	C ₆ H ₆ Cl ₆	319-86-8	0.12
p,p'-DDD (c)	C ₁₄ H ₁₀ Cl ₄	72-54-8	0.11
p,p'-DDE (c)	C ₁₄ H ₈ Cl ₄	72-55-9	0.11
p,p'-DDT (c)	C ₁₄ H ₉ Cl ₅	50-29-3	0.12
dieldrin (c)	C ₁₂ H ₈ Cl ₆ O	60-57-1	0.11
α-endosulfan (c)	C ₉ H ₆ Cl ₆ O ₃ S	959-98-8	0.12
β-endosulfan (c)	C ₉ H ₆ Cl ₆ O ₃ S	33213-65-9	0.11
endosulfan sulfate (c)	C ₉ H ₆ Cl ₆ O ₄ S	1031-07-8	0.11
endrin (c)	C ₁₂ H ₈ Cl ₆ O	72-20-8	0.11
endrin aldehyde (c)	C ₁₂ H ₈ Cl ₆ O	7421-93-4	0.12
heptachlor (c)	C ₁₀ H ₅ Cl ₇	76-44-8	0.12
heptachlor epoxide (c)	C ₁₀ H ₅ Cl ₇ O	1024-57-3	0.11
methoxychlor (c)	C ₁₆ H ₁₅ Cl ₃ O ₂	72-43-5	0.12
tributyltin chloride (c)	C ₁₂ H ₂₇ ClSn	1461-22-9	1.3
dibutyltin dichloride (c)	C ₈ H ₁₈ Cl ₂ Sn	683-18-1	0.60
butyltin trichloride (c)	C ₄ H ₉ Cl ₃ Sn	1118-46-3	0.60
bisphenol A (c)	C ₁₅ H ₁₆ O ₂	80-05-7	24
pentachlorophenol (c)	C ₆ HCl ₅ O	87-86-5	12

Coding

The coding refers to the instrumental method of analyte determination.

- a Isotope dilution inductively-coupled plasma mass spectrometry (ID-ICP-MS) [4]
- b Standard addition inductively-coupled plasma mass spectrometry (SA-ICP-MS) [4]
- c Gravimetric preparation

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 non-certified values for which insufficient data are available to provide a comprehensive estimate of uncertainty.

Information values

Information values are those for which insufficient data are available to provide any estimate of uncertainty. Gravimetric formulation data, reported in Table 2, represent the maximum levels for these analytes in the SESA-1 as losses during preparation and storage might have occurred.

Intended use

The SESA-1 reconstituted solution can be used for calibration, method development, validation, and quality control for the analysis of trace elements in seawater, similar to NRC CASS-6 and NASS-7 [1-2]. The reconstitution yields a material commutable to seawater for the analysis of trace elements.

The SESA-1 material should be reconstituted as follows:

1. Accurately weigh 4.0 g of SESA-1 into a pre-cleaned bottle.
2. Dissolve the material in diluted HNO₃ solution (to prepare diluted HNO₃ solution, dilute 0.15 mL high-purity concentrated HNO₃ in 100 mL high-purity (18.2 MΩ cm) de-ionized water).
3. Bring the solution to a final weight of 100 g with the diluted HNO₃ solution.
4. Mix it well and ensure the material is completely dissolved before use. The reconstituted SESA-1 solutions should be stored at room temperature.

For the analysis of spiked organic contaminants, listed in Table 2, similar reconstitution could be carried out without the addition of nitric acid.

Storage

It is recommended that the material is stored at nominal temperature of $-20\text{ }^{\circ}\text{C}$. Each bottle is packaged in a trilaminate foil pouch which provide protection to atmospheric moisture. The CRM should be stored in the original pouch and opened just before use. The bottles should be opened only in a clean area with precautions taken against contamination.

Preparation of material

This reference material was prepared from a commercial artificial sea salt. The artificial sea salt was spiked with several organic contaminants as reported in Table 2. The reference material was further grinded, blended and subsequently bottled into amber glass vials with a minimum of 9.0 g of salt powder in each unit.

Stability

The content of trace elements in this material is deemed stable under typical transportation conditions and long-term storage conditions. Monitoring of stability will continue throughout the lifecycle of the CRM.

Homogeneity

The material was tested for homogeneity at the NRC using ICP-MS. Results from randomly selected bottles were evaluated using Bayesian analysis of variance (ANOVA) [5] to determine both within-unit and between-unit heterogeneity components. These uncertainties were combined to assign an associated uncertainty component.

Uncertainty

Evaluation of the uncertainty associated with certified and reference values was carried out. Uncertainties associated with batch characterization and possible between bottle variations are included in the combined uncertainty estimate [6].

Metrological traceability

Results presented in this certificate are traceable to the International System of Units (SI) through gravimetrically prepared standards of established purity and CRMs produced by National Metrology Institutes. As such, SESA-1 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

Users should ensure that the certificate they have is current. For updates please refer to doi.org/10.4224/crm.2022.sesa-1.

References

1. Brophy C, Nadeau K, Yang L, Grinberg P, Gedara I P, Meija J, Pagliano E, McRae G, Mester Z. (2016) CASS-6 Nearshore Seawater Certified Reference Material for Trace Metals and other Constituents. Ottawa: National Research Council Canada. doi.org/10.4224/crm.2016.cass-6
2. Nadeau K, Brophy C, Yang L, Grinberg P, Gedara I P, Meija J, Pagliano E, McRae G, Mester Z. (2016) NASS-7 Seawater Certified Reference Material for Trace Metals and other Constituents. Ottawa: National Research Council Canada. doi.org/10.4224/crm.2016.nass-7
3. Evaluation of measurement data: Guide to the expression of uncertainty in measurement JCGM100:2008. <https://www.bipm.org/en/publications/guides/gum.html>
4. Yang L, Nadeau K, Meija J, et al (2018) Inter-laboratory study for the certification of trace elements in seawater certified reference materials NASS-7 and CASS-6. *Anal. Bioanal. Chem.* 410: 4469–4479. doi.org/10.1007/s00216-018-1102-y
5. van der Veen AMH (2017) Bayesian analysis of homogeneity studies in the production of reference materials. *Accred Qual Assur.* 22(6): 307-319. doi.org/10.1007/s00769-017-1292-6
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Cited by

A list of scientific publications citing SESA-1 CRM can be found at doi.org/10.4224/crm.2022.sesa-1.

Authorship

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Acknowledgments

Natasha Luckovitch and Ovi Mihai are acknowledged for providing great support throughout the realization of this project.

Citation

Pagliano E, Nadeau K, Grinberg P, Meija J, Mester Z. SESA-1: Sea Salt Certified Reference Material for trace elements in Seawater. Ottawa: National Research Council Canada, 2022. Available from: doi.org/10.4224/crm.2022.sesa-1

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Date of issue: November 2022

Date of expiry: November 2027

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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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