Certificate of Analysis

ISO 17034

ISO

9001:2015

ISO

17034:2016

ISO/IEC

17025:2017

Certified Reference Material (CRM)

Product ID: MBH-NSC-21-P **Product Name:** Norite from Stillwater Complex, MT, CRM

Description: MBH-NSC-21-P is a norite collected from the Archean-age Stillwater Igneous Complex. The Stillwater intrusion hosts PGE-rich layers, and is the only active Ptmine in the US. Norite layers are rich in Ca-plagioclase and orthopyroxene and thus has unusually high CaO and Al2O3 from igneous rocks, and is enriched in Ni and Cr as well. This ISO 17034 accredited CRM is supplied as a homogenous powder with particle size 95% < 200 mesh (74 um).

Intended Use: This material is intended for use as an elemental CRM for the calibration of instruments as well as the validation of analytical methods. Appropriate use of this material will fulfill the CRM and traceability requirements for use in ISO 17025 accredited laboratories.

Certified Values: Consensus values considered to be of highest quality and fit-for-purpose.

Major Elements (wt%)													
Element	Certified Value	Uncertainty		Oxide	Certified Value	Uncertainty	n*						
Al	13.4	0.1		Al ₂ O ₃	25.4	0.1	29						
Ca	10.0	0.1		CaO	14.0	0.2	36						
Fe	2.34	0.03		Fe ₂ O ₃ T**	3.34	0.05	35						
K	0.041	0.002		K ₂ O	0.049	0.003	25						
Mg	4.08	0.02		MgO	6.77	0.04	29						
Mn	0.046	0.001		MnO	0.059	0.001	34						
Na	0.91	0.01		Na ₂ O	1.23	0.02	32						
Si	22.5	0.1		SiO ₂	48.1	0.2	23						
Ti	0.038	0.001		TiO ₂	0.064	0.001	34						

Number of observations

** Total iron expressed as ferric iron Fe₂O₃

Minor and Trace Elements (mg/kg)													
Element	Certified Value	Uncertainty	n		Element	Certified Value	Uncertainty	n					
Ba	16.3	0.5	24		Li	1.4	0.2	12					
Со	21.8	0.5	32		Ni	158	4	26					
Cr	586	10	24		Rb	0.86	0.06	17					
Cu	11.4	0.7	22		Sc	11.0	0.4	32					
Dy	0.22	0.01	21		Sm	0.13	0.02	21					
Er	0.18	0.01	19		Sr	97	1	27					
Eu	0.134	0.009	21		V	44	1	28					
Ga	12.1	0.2	28		Y	1.37	0.08	26					
Gd	0.19	0.01	15		Zn	17.9	0.8	22					
La	0.52	0.05	19		Zr	2.8	0.3	20					

Indicative Values: Values listed when insufficient data was available to provide suitable statistical agreement, typically due to lab or method limitations.

	Indicative Values (mg/kg)																			
Ce	1		Hf	0.1		Но	0.05		Lu	0.03		Nb	0.2		Nd	0.5	Ρ	30	Pb	0.3
Pr	0.1		Tb	0.03		Th	0.09		Tm	0.03		U	0.04		Yb	0.2				

Loss on Ignition (LOI) 110 °C to 1000 °C: 0.78 wt%

Uncertainty and Homogeneity: The uncertainty associated with the certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2. The uncertainty includes the combined effects of method imprecision, material inhomogeneity, and any bias between methods. This material was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples were selected by a stratified random sampling scheme and analyzed to confirm its homogeneity, in accordance with internal procedures for the assessment of homogeneity and stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.



ARMI MBH

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Certification and Traceability: This CRM is processed under the scope of accreditation to ISO 17034 by LGC Standards - Manchester, NH. The certified values of this CRM are determined from the final weighted average results of a comprehensive interlaboratory study. It is an implicit requirement for ISO 17025 accreditation that analytical work be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally or internationally recognized reference materials. Traceability of the certified value includes, but is not limited to, the following: the mole via primary analytical methods, substances of known stoichiometry, ISO 17034 commercial solutions, appropriate NIST SRMs, and as part of the analytical calibration or process control of the laboratory.

Certification Laboratories: Analytical work performed to assess this material was carried out by laboratories with proven competence, typically indicated by ISO 17025 accreditation. The laboratories involved in the certification of this material used a combination of techniques, including but not limited to: ICP-OES, ICP-MS, IR-Combustion, WD-XRF, and neutron activation.

Acts Labs - Ontario, CA Aqat Labs - Ontario, CA ALS - Reno, NV

American Assay Laboratories - Sparks, NV

- Bureau Veritas Sparks, NV
- University of Missouri Research Reactor Columbia, MO

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- LGC Standards Manchester, NH
- Washington State University Pullman, WA

- SGS Vancouver, CA
 - SRC Geoanalytical Laboratories Saskatchewan, CA •

Quality Certifications: This CRM was prepared under a quality management system that is accredited to the following:

- ISO 17034:2016 Accredited: Reference Materials Producer, A2LA Certificate No. 2848.02 General Requirements for the Competence of Reference Material • Producers
- ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35 •
- ISO/IEC 17025:2017 Accredited: Chemical Testing, A2LA Certificate No. 2848.01 – General Requirements for the Competence of Testing and Calibration Laboratories
- ISO 9001:2015 Certified: Quality Management Systems, Registrar: TUV NORD Certificate Registration No. 56 100 19560101 •

Instructions for Use: The powder should be thoroughly mixed and dried at 110°C for 2 hours before analysis. The recommended minimum sample size is 200 mg. This material should be stored tightly capped in a cool dry location when not in use. Minimize exposure to moisture or high humidity.

Period of Validity: The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Health and Safety Information: Refer to the Safety Data Sheet (SDS), which can be obtained at Igcstandards.com

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Chuck Goudreau, Certifying Officer

23 January 2023 **Certification Date** Revision No: 000 Revision Date: 23 January 2023



ISO 17034 Accredited: Reference Materials Producer, Certificate # 2848.02 ISO/IEC 17025 Accredited: Chemical Testing, Certificate # 2848.01