

CERTIFICATE OF ANALYSIS

Request Nº: FT002/07/2022	
Client: MNKITOTA EXPLORAÇÃO MINEIRA	
Address:	Date of receipt of samples: 06/07/2022
Telephone: +244 925 83 04 78	Analysis date: 14/07/2022
Email: miguelsergio24@hotmail.com	

Description and sample condition:	<ul style="list-style-type: none"> Manganese Ore
Number of samples:	<ul style="list-style-type: none"> One (1)
Analysis parameter:	<ul style="list-style-type: none"> Multi-Elements by 4 Acids- ICP-OES (CHP 006) Loss on Ignition(LOI)-CHP 023 at 1005°±5°C
Sample preparation method:	<ul style="list-style-type: none"> 4 acid digestion of 0.125g sample followed by determination of the elements content by ICP-OES LOI: 1g of the sample was ashed in a furnace at 1005°±5°C to constant mass, weight lost is the LOI.
Used equipment:	<ul style="list-style-type: none"> Balance Metler Toledo ML-204, ICP-OES spectrometer, Optima 3000, Perkin Elmer LOI oven, model Heraeus T max. 1200°C
Sampling method:	<ul style="list-style-type: none"> By Geoangol

Verified by: John. O. Bomani

Technical Signatory (TS):



Approved by Kakoma Mboko

Technical Signatory (TS):



Date: 15/07/2022

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ANALYTICAL RESULTS

A. ANALYSIS OF MULTI-ELEMENTS BY 4 ACIDS-ICP-OES, LOI AND MOISTURE (Accredited Method)

Sample ID	SiO ₂ %	UM ±	Al ₂ O ₃ %	UM ±	CaO %	UM ±	Cr ₂ O ₂ %	UM ±
Manganese 1	31,05	0,23	4,29	0,25	1,83	0,06	0,03	0,00

Sample ID	CuO %	UM ±	Fe %	UM ±	Fe ₂ O ₃ %	UM ±	K ₂ O %	UM ±
Manganese 1	0,04	0,00	3,11	0,07	4,44	0,10	1,67	0,05

Sample ID	MgO %	UM ±	Mn %	UM ±	MnO %	UM ±	Na ₂ O %	UM ±
Manganese 1	0,36	0,05	38,02	0,19	49,09	0,25	0,88	0,03

Sample ID	TiO ₂ %	UM ±	S %	UM ±	P %	UM ±	Moisture %	UM ±	LOI %	UM ±
Manganese 1	0,17	0,00	0,50	0,06	0,01	0,00	0,98	0,01	4,88	0,05

B. Certified reference Materials (For information only)

Amostra ID	CV %	Al %	CV %	Ca %	CV %	Cr %	CV %	Cu %	CV %	Fe %
AMIS 0403	0.196	0.216	3.560	3.455	0.021	0.029	0.000	0.010	12.43	13.652
AMIS 0641	5.970	6.106	4.450	4.415	0.016	0.012	0.007	0.003	7.56	5.849
AMIS 0724	3.420	3.562	4.580	5.096	0.051	0.051	0.031	0.028	11.72	9.018
AMIS 0561	3.632	3.189	0.028	0.077	0.023	0.015	0.006	0.003	4.77	4.372

Amostra ID	CV %	K %	CV %	Mg %	CV %	Mn %	CV %	Na %	CV %	Ti %
AMIS 0403	0.019	0.021	0.398	0.326	46.86	47.89	0.134	0.126	0.012	0.009
AMIS 0641	0.115	0.111	1.740	1.363	0.13	0.206	4.610	4.612	0.396	0.407
AMIS 0724	0.575	0.537	2.280	1.796	0.27	0.335	0.223	0.227	N/A	N/A
AMIS 0561	0.550	0.339	0.139	0.132	0.01	0.011	0.119	0.088	0.122	0.185

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**C. ANALYSIS OF DRY MATTER BY OVEN AT 105°C
(Non Accredited method)**

Particle Size Distribution		
Sieve Size	Weight Retained (g)	Cummulative (%)
100,00 mm	0,00	0,00
+6,30 mm	258,13	100,00
-6,30 mm	0,00	0,00
TOTAL	258,13	

UM= UNCERTAINTY OF MEASUREMENT**C.V= CERTIFIED VALUE (OR REFERENCE MATERIAL)**

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OPINIONS AND INTERPRETATIONS

None

DECLARATION OF CONFORMITY AND DECISION RULE

Not requested

DEVIATIONS FROM THE METHODOLOGICAL:

None

QUALITY PROTOCOL

The quality control protocol is summarized in the following:

- Samples arriving at the lab are checked and confirmed according to the list sent by the customer and recorded in the sample listing form received in use in the laboratory, (SPF/FT/LA/01) that is attached to the chain of custody form, (QMF 009).
Any discrepancies between the physical samples and the list received are discussed with the customer, by phone or via e-mail, prior to their registration in the laboratory.
- The samples are dried at moderate temperatures, crushed in jaw crushers and ground in sprayers.
Crushers are cleaned with compressed air, then between one sample and another a white (silica) is used to ensure that there is no cross-contamination between the samples. The white material is analyzed in the chemical laboratory in a sequence of 10 out of 10 samples (QMP 0022) for process control issues and result reported as part of the flow of analyzed samples. Grinding is done in ring and disc sprayers (LM2), in this process similar to crushing, contamination is avoided by cleaning the spray pan with compressed air after each sample processed and with silica material before the following sample, when the material adheres to the walls of the pan.
- The choice of reference material depends on the matrix of the samples, as well as the mean concentration ranges.
- Geoangol-Geologia e Sondagem, S.A (Laboratory) currently participates in international proficiency testing schemes (PT), AMIS PT, GeoPT and China NIL PT; and also uses samples from these PT schemes, and OREAS reference materials; for quality control purposes.

ABOUT PRESENTATION OF RESULTS:

It is common practice in the manipulation of data derived from analytical instrumentation the presentation of the result with a maximum of two or three significant digits. Some data reported here may show more numbers than that. The presentation of more than two digits in no way implies that the third, fourth and subsequent number may be real or significant.

PULP STORAGE

All remaining solid samples (test pulps, bulk pulp and waste) will be stored without cost at Geoangol, S.A. facilities for a period of 60 days after completion of the analyses requested by the client. At the end of this period, all samples will be stored at a rate of \$5 per day for each batch until the written opinion received from the customer about their collection or return.

STORAGE OF SOLUTIONS

Samples received in liquid state, water or solutions will be stored for a period of 60 days after completion of the analyses requested by the customer. At the end of this period, all samples will be discarded unless there is a written opinion on their collection or return.

IMPORTANT NOTE

This report specifically refers to the sample(s) submitted to the Geoangol Laboratory, S.A. provided by the customer for analysis and may not be used for any other sample of a similar nature so Geoangol, S.A. declines all liability for losses or damages resulting from the transaction of the results of this report. This certificate of analysis shall not be reproduced in part or in full without the written approval of the General Directorate of Geoangol, S.A.

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APPENDIX A: ACCREDITED METHODS

Method description	Abbreviations	Method code
Determination of LOI by furnace	LOI: Mass loss on ignition	CHP 001
Determination of Humidity by oven	Moisture: Mass loss by drying	CHP 002
Gold by gravimetric FA or AAS/ICP	FA: Fire Assay	CHP 003
Gold by aqua regia – MIBK and AAS/ICP	MIBK: (Methyl Isobutyl Ketone)	CHP 004
Analysis of multi-elements with digestion in aqua regia and analysis by AAS/ICP-MS, ICP/OES	AAS: Atomic Absorption Spectrometer ICP-OES: Inductively Coupled Plasma Optical Emission Spectrometry/Mass Spectrometry	CHP 005
Analysis of multi-elements with digestion 4-acids and AAS/ICP-MS, ICP/OES	ICP-MS: Inductively Coupled Plasma Mass Spectrometer	CHP 006
Analysis of larger elements XRF in pressed pellet, powder or metal discs	XRF: X-RAY Fluorescence	QUANT-EXPRESS (CHP 007)
Analysis of Gold, Platinum and Palladium with FA and AAS/ICP in aqueous phase	FA: Fire Assay	CHP 008

APPENDIX B: NON-ACCREDITED METHODS

Method description	Abbreviations	Test/method code
Analysis of Gypsum parameters		CHP 009
pH analysis in water and other solutions	pH: Potencial hidrogénio	CHP 010
Analysis of TDS in water by evaporation	TDS: (Total Dissolved Solids	CHP 011
Analysis of electrical conductivity in water (EC)	EC: (Electrical conductivity),	CHP 012
Analysis of TSS in water by filtration	TSS: (Total Suspended Solids),	CHP 013
Multi-element analysis in water by AAS/ICP	Pack of cations	CHP 014
Phosphorous analysis by UV-Vis	UV-Vis: Ultra Violet-visible Spectrometer	CHP 015
Gold Analysis by Density		CHP 016
Analysis of Gold and other precious elements by hand-held X-ray Spectrometer	Precious elements: Au, Pt, Ag, Cu, Pd	CHP 017
Analysis of water-anions package	Anions: Cl, SO ₄ , Br, NO ₂ , NO ₃ , F, HN ₃	CHP 018
Soil-CEC analysis	CEC: Cations Exchange Capacity (by: Acetic Acid or BaCl ₂ leaching, ICP/OES)	CHP 019
Soil analysis -Total Kjeldahl Nitrogen		CHP 020
TOM	TOM: Total Organic Matter (Total estimate of organic matter as LOI up to 550°C)	CHP 021
Salinity package	Soluble CE, pH, Na, Ca, Mg, K, S, Chloride, SO ₄ , Sodium Adsorption Ratio (SAR), Saturation %	CHP 022
Determination of Dry Matter and Water Content on a Mass Basis in Sediment, Sludge, Soil, and Waste – Gravimetric Method		CHP 023
PSD: Particle size distribution	PSD: Particle size distribution (Particle size by different sieve sizes)	SP 07
S.G Soil	Specific gravity of soil samples	SP 04
Bulk Density	Bulk density for soil and rock samples	SP 09
Screen fire assay		SPP008

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