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Blue lagoon mud. Chemical composition and grain size distribution

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BLUE LAGOON MUD

Chemical composition and grain size distribution

The chemical composition of Blue Lagoon mud is shown in the table below. Moisture (H_2O) is on average 71,9 % and silica (SiO_2) 26,5 %. Sodium (Na), potassium (K) and calcium (Ca) chlorides (Cl) are less than 1,5 % and other components are in trace amounts. Since this is a natural product some variation in composition can be expected.

Composition of silica mud from the BLUE LAGOON	
Weight %	
H2O	71,9
SiO_2	26,5
Li	0,0004
Na	0,62
K	0,11
Mg	0,004
Ca	0,14
Sr	0,002
Al	0,012
Cr	0,0001
Mn	0,002
Fe	0,01
Cu	0,0001
Zn	0,0011
As	0,00008
Cd	0,00001
Co	<0,000008
Hg	<0,000008
Pb	0,0001
Se	<0,000006
Ni	0,0001
CO3	0,002
B	0,0006
Cl	1,1
SO_4	0,003
Total	100,43

The analyse is based on measurements of the moisture by weighing the substance in natural condition and dried at 100 °C and 200 °C. There was not observed significant differences between weight loss by drying at either temperature. The chloride (Cl), boron (B), sulfate (SO_4) and carbonate (CO_3) were derived from analyses of the Blue Lagoon water, but all other components from analyses of the dried substance. Analytical methods are described in annex 1.

The measured grain size distribution reveals that 30 % are clay size, <0,002 mm, 60 % silt size, 0,002-0,063 mm, and 10 % sand size, > 0,063 mm. The measurements are based on the assumption that the grains are all cubes in shape, which certainly is not the case and makes the results somewhat less accurate. Dissoved solids will be added to the smallest grain fraction, but this gives less than 1 % error in measurement. A diadram showing result of the actual measurement is shown in annex 2.

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Const-ituent	Fract-ion	Method	Brief description	Standard	RSD %	D. L. µg/l
Cd	Fa	AAS GF	Dried 30 s 125°C, ashed 30 s 700°C, atomized 10 s 2000°C. Purge gas Ar. 228.8 nm	Merck. $Cd(NO_3)_2$ 0.5 M HNO_3	3.2-4.6 for 2.5-10 µg/l	0.05
Cu	Fa	AAS GF	Dried 30 s 125°C, ashed 30 s 900°C. atomized 2 s 2000°C. Purge gas Ar. 324.7 nm	Merck. $Cu(NO_3)_2$ 0.5 M HNO_3		0.1
Pb	Fa	AAS GF	Dried 30 s 125°C, ashed 30 s 750°C, atomized 2 s 2000°C. Purge gas Ar. 283.3 nm	Merck $Pb(NO_3)_2$ 0.5 M HNO_3	3.2-5.2 for 25-100 µg/l	0.1
Zn	Fa	AAS GF DA	Dried 30 s 125°C, ashed 30 s 400°C, atomized 2 s 1000°C. Purge gas Ar. 213.9 nm. Aspirated directly into flame	Merck $Zn(NO_3)_2$ 0.5 M HNO_3	34-37 for 280-310 µg/l	0.1 20
Cr	Fa	AAS GF	Dried 30 s 125°C, ashed 30 s 1200°C, atomized 3 s 2300°C. Purge gas Ar. 357.9 nm	Merck $Cr(NO_3)_3$ 0.5 M HNO_3	0.4-1 for 19-77 µg/l	0.1
Co	Fa	AAS GF	Dried 30 s 125°C. ashed 30 s 1000°C, atomized 3 s 2200°C. Purge gas Ar. 240.7 nm.	Merck $Co(NO_3)_2$ 0.5 M HNO_3.		0.2
Ni	Fa	AAS GF	Dried 30 s 125°C. ashed 30 s 1000°C. atomized 3 s 2300°C. Purge gas Ar. 232.0 nm	Merck $Ni(NO_3)_2$ 0.5 M HNO_3		0.5
Al	Fa	AAS GF	Dried 30 s 125°C. ashed 30 s 1500°C. atomized 3 s 2400°C. Purge gas Ar. 309.3 nm	Merck $Al(NO_3)_3$ 0.5 M HNO_3		1
Fe	Fa	AAS GF	Dried 30 s 140°C, ashed 30 s 1200°C, atomized 3 s 2100°C. Purge gas Ar. 248.3 nm	Merck $Fe(NO_3)_3$ 0.5 M HNO_3		0.1
Mn	Fa	AAS GF	Dried 30 s 140°C, ashed 30 s 1000°C. atomized 3 s 2000°C. Purge gas Ar. 279.5nm	Merck $Cr(NO_3)_3$ 0.5 M HNO_3		0.1
As	Fa	AAS HG	Organic matter converted with HNO_3-H_2SO_4-$HClO_4$, As reduced and converted to AsH_3 using $NaBH_4$. The hydride is swept into a heated cell placed int he beam of an As EDL lamp and As determined at 193.7 nm.	Merck H_3AsO_4 0.5 M HNO_3	5.5-9 for 5-20 µg/l	0.1

Const-ituent	Fract-ion	Method	Brief description	Standard	RSD %	D. l. µg/l
Hg	Fu	AAS Fl	For clay digest Hg is reduced and converted to HgH_2 with NaBH4 . The hydride is swept into a cell placed in the beam of an Hg EDL lamp and the atomic absorption determined at 253.7 nm. At collection $KMnO_4/K_2S_2O_8/HNO_3$ is added to water sample, $H_2NOH.HCl$ and then $SnCl_2$ added at the start of determination. The resulting gaseous Hg is amalgamated with gold and then heated to be released into a cell for flameless AAS determination at 253.7 nm	Merck $Hg(NO_3)_2$ 0.5 M HNO_3	4-16 for 2.5-18.1 ng/l	0.001
Se		AAS HG	Se is reduced and converted to SeH_2 using $NaBH_4$. The hydride is swept into a heated cell placed in the beam of a Se EDL lamp and Se determined at 196.0 nm.	Merck SeO_2 0.5 M HNO_3	11-19 for 5-15 µg/l	4
pH	Ru	Electro-metric	A glass electrode in combination with a reference potential is inserted into the sample and pH and temperature values recorded.	Merck-Titrisol. pH 4, 7, 10	±0.1 pH unit	
Cond-uctivity	Ru	Bridge	Specific conductance is measured using a Wheatstone type bridge using temperature compensation to 25°C.	KCl		
Na	Fa	AAS DA	A small amount of Cs solution is added and the sample directly aspirated into an oxidizing air-acetylene flame. Absorption read at 589.6 nm.	Merck-Titrisol. NaCl /H_2O	1.2-1.5 for 8.2-52 mg/l	1
K	Fa	AAS DA	A small amount of Cs solution is added and the sample directly aspirated into an oxidizing air-acetylene flame. Absorption read at 766.5 nm.	Merck-Titrisol. KCl /H_2O	7.9-12.5 for 1.6-6.3 mg/l	1
Li	Fa	AAS DA AES	Sample directly aspirated into an oxidizing air-acetylene flame. Absorption read at 670.8 nm. Clay digests aspirated into air-acetylene flame and emission read at 670.8 nm.	Merck-Titrisol for 0.1 ppm Na, K and Li after dilution to 1 L		0.5
Mg	Fa	AAS DA	A small amount of La solution is added to water sample which isdirectly aspirated into an oxidizing air-acetylene flame. Absorption read at 285.2 nm.	Merck-Titrisol $MgCl_2$/HCl.	2.4-4.8 for 21-82 mg/l	1
Ca	Fa	AAS DA	A small amount of La solution is added and the sample directly aspirated into an oxidizing air-acetylene flame. Absorption read at 422.7 nm.	Merck-Titrisol $CaCl_2$/HCl.	1.7-3.3 for 9-36 mg/l	10

Const-ituent	Fract-ion	Method	Brief description	Standard	RSD %	D.L. µg/l
Sr	Fa	AAS DA GF	A small amount of La solution is added to water sample which is directly aspirated into an oxidizing air-acetylene flame. Absorption read at 460.7 nm. Clay digests dried 30 s 140°C, ashed 30 s 1300°C, atomized 3 s 2600°C. Purge gas Ar. 460.7 nm	Merck $Sr(NO_3)_2$ 0.5 M HNO_3		Da 50 GF 0.1
SiO_2	Rd	Spec-tro-photo-metry	Iodine and thiosulphate added to destroy H_2S, ammonium heptamolybdate and HCl added. Absorption determined at 410 nm.	Natural hot spring water from Spóastaðir whose SiO_2 concentr-ation (~104 ppm) is determined gravi-metrically.	1.8-2.5 for 0.87 - 67.3 mg/l	500
B	Fu	Spec-tro-photo-metry	Sample buffered with $NH_4Ac/Na_2EDTA/HAc$. Azomethine-H/ascorbic acid reagent added. Absorption determined at 420 nm.	Merck-Titrisol. H_3BO_3/H_2O		5
CO_2	Ru	Electro-metric titration	Sample pH adjusted to 8.2 with HCl/NaOH, then titrated to pH 3.8 with 0.1 N HCl using a pH meter.	Merck-Titrisol. 0.1 N HCl	3.6 for 5-1500 ppm	1000
H_2S	Ru	Tit-ration	NaOH added to make sample basic. Titrated with 0.001 M HgAc , dithizone as indicator.		3.9 for 0.03-800 ppm.	20
Cl	Fu	IC	Anions from a small volume of sample are separated by means of a guard column, a separator column and a suppressor column. Cl determined using a conductivity detector.	Merck-Titrisol HCl/H_2O	2.9 for 10 mg/l	25
F	Fu	Select-ive electr-ode	TISAB buffer added, electrode inserted and potential read.	Merck 1000 mg/l NaF/H_2O	3.5 for 0.85 ppm	2
Br	Fu	IC	Anions from a small volume of sample are separated by means of a guard column, a separator column and a suppressor column. Br determined using a conductivity detector.	Merck-Titrisol 1000 mg/l NaBr/H_2O		5
I	Fu	IC	Anions from a small volume of sample are separated by means of a guard column, a separator column and a suppressor column. I determined using an electrochemical detector.	Merck solid KI weighed dissolved in H_2O to make 1000 mg/l		0.2
NO_3	Ru	IC	Anions from a small volume of sample are separated by means of a guard column, a separator column and a suppressor column. NO_3 determined using a conductivity detector.	Merck-Titrisol $NaNO_3$ /H_2O		25

Const-ituent	Fract-ion	Method	Brief description	Standard	RSD %	D. l. µg/l
SO_4	Fu	IC	Anions from a small volume of sample are separated by means of a guard column, a separator column and a suppressor column. SO_4 determined using a conductivity detector.	Merck-Titrisol H_2SO_4/H_2O	1.5 for 98.5 mg/l	20
Total dis-solved solids	Fu	Gravi-metric	Sample evaporated and dried at 180°C and 260°C and residue weighed.		2.6-3.8 for 190-1680 ppm	2500

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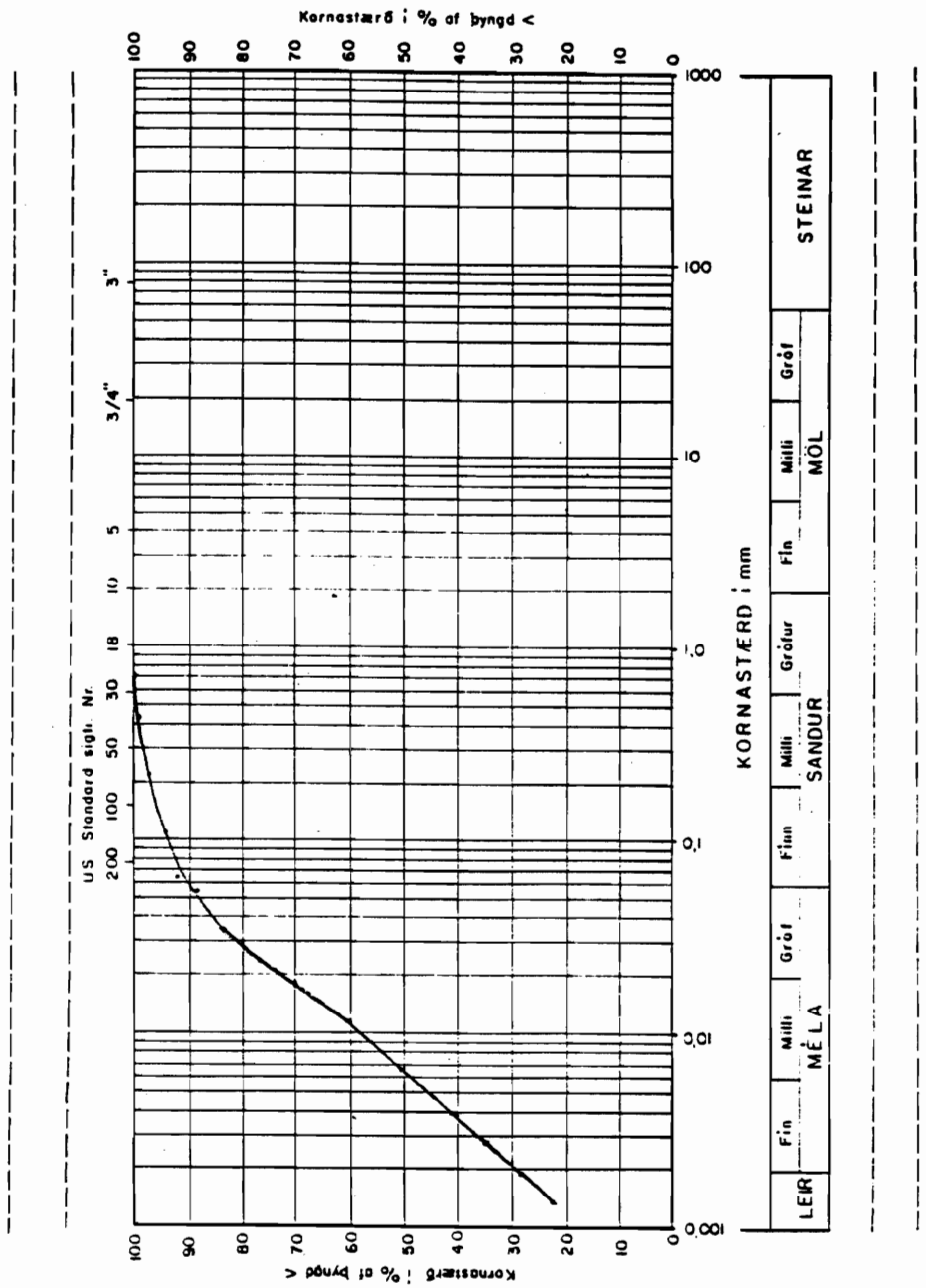

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