



Groundwater in Fljótisdalsheiði. Chemical composition

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GROUNDWATER IN FLJÓTSDALSHÉIÐI Chemical composition

During the period September 28 to November 2 1990 several samples of cold groundwater and warm geothermal water were sampled from wells and springs on Fljótshéiði.

Samples were taken with a downhole sampler from five wells, two wells were free flowing and samples were pumped from two wells. The coldwater sample at Grenisalda was taken from the "well" that is used at the Grenisalda-camp. In the wells temperature was measured with a downhole thermometer prior to water sampling.

Free-flowing samples were taken from the geothermal springs where possible and temperature measured during sampling. Discharge was measured from two of the warm springs.

During sampling a part of the sample was filtered through a $45\mu\text{m}$ filter and acidified with 6N HCl. Samples for pH and volatiles were collected in airtight gasbulbs.

Dissolved oxygen was measured with Chemét ampules during sampling and samples were stabilized to measure dissolved oxygen with the Winkler method.

Hydrogen sulphide was either measured during sampling or within 2-3 hours.

pH and total carbonate was measured the same day as the sample was taken.

Other chemical constituents were measured at the geochemical laboratory at Orkustofnun. In the appendix is a listing of analytical methods used at Orkustofnun.

Table 1 lists the chemical composition of the cold groundwater, whereas table 2 lists the composition of the geothermal water.

At the present time no effort will be made to explain the variable chemical composition of the groundwater samples, but it is appropriate to point at the following results. The water samples from wells FS-36 and FS-35, especially well FS-36, seems to be very much different from the regional groundwater in the area. It is also appropriate to mention high silica content in water from well FS-37 and high chloride content of water from well FS-31.

Table 1. Chemical composition of cold groundwater (mg/l).

Place Number Depth	FS-30 9066 135m	FS-31 9062 70m	FS-32 9070 135m	FS-33 9067 pumped	FS-34 9068 125m	FS-35 9064 free flow	FS-36 9069 free low	FS-37 9065 pumped	FS-38 9063 135m	Grenisalda 9071 pumped
pH/°C	7.3/16	9.8/13	9.4/14.5	6.8/17	9.1/17	8.3/15.5	7.6/14	10.8/16	9.6/15.5	6.9/14.5
Oxygen - ampules (O ₂)	6	4	0.5	4.5	0.25	0.05	0.1	2	2.5	3.5
Oxygen - Winkler (O ₂)	-	5.1	0.4	5.7	0.5	0.2	0.1	2.7	3.6	-
Hydrogen sulfide (H ₂ S)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Total dissolved salts (TDS)	37	160	84	96	238	313	911	185	90	96
Carbonate (CO ₂ (t))	19.2	31.8	48.7	77.2	151	257	776	20.5	32.8	70.7
Chloride (Cl)	1.23	43.5	2.50	2.56	7.12	3.37	36.1	4.90	3.67	2.22
Sulphate (SO ₄)	0.68	7.6	1.76	0.99	6.11	3.18	23.0	8.33	2.65	1.40
Ammonia (NH ₄)	0.003	0.028	0.008	0.001	0.003	0.001	0.100	0.013	0.005	0.002
Electrical conductivity [*])	49.4	262	149	148	371	529	1502	286	129	140
Silica (SiO ₂)	14.9	19.9	22.5	28.0	27.0	45.3	47.3	52.9	22.8	30.9
Sodium (Na)	2.5	24.3	32.5	7.4	78.5	90.0	158.4	50.5	27.3	5.2
Potassium (K)	0.34	1.68	0.23	0.12	1.19	3.85	16.8	0.91	1.70	0.75
Magnesium (Mg)	1.96	3.63	0.13	7.22	1.66	20.2	103.8	0.05	0.33	6.98
Bromide (Br)	<0.01	0.025	0.01	<0.01	0.02	0.01	0.097	0.015	0.02	<0.01
Nitrate (NO ₃)	<0.01	0.037	<0.01	<0.01	<0.01	<0.01	<0.01	0.12	<0.01	<0.01
Coordinates:										
X (m)	~498.900	365.352,78	370.028,60	371.824,68	376.423,23	377.570,96	379.781,08	368.046,52	362.388,29	~364.650
Y (m)	~371.100	502.832,38	498.273,61	494.728,72	490.161,28	487.313,56	482.413,53	500.309,89	504.036,55	~505.950

* $\mu\text{S/cm}$

Table 2. Chemical composition of geothermal water (mg/l).

Place	Hafursfell	Laugarfell	Kleifar	Axar
Number	0247	0248	0249	0250
Temperature (°C)	44.7	51.1	12.3	17.5
Discharge (l/s)	0.9	-	-	1.5
pH/°C	9.2/16.5	10.0/19	9.5/13	9.4/13
Oxygen - ampules (O ₂)	1.5	2	2.5	1
Hydrogen sulfide (H ₂ S)	<0.03	<0.03	<0.03	<0.03
Total dissolved salts (TDS)	194	176	61	95
Carbonate (CO ₂ (t))	66.4	20.0	38.2	41.3
Chloride (Cl)	11.7	12.4	2.69	3.05
Sulphate (SO ₄)	13.0	15.3	2.46	2.87
Ammonia (NH ₄)	0.001	<0.001	0.004	<0.001
Electrical conductivity*	254	227	139	149
Silica (SiO ₂)	62.2	60.6	28.8	27.3
Potassium (K)	0.77	0.49	0.25	0.17
Calcium (Ca)	2.05	1.88	3.30	2.86
Bromide (Br)	0.04	0.04	0.01	0.01
Nitrate (NO ₃)	0.01	0.01	<0.01	<0.01
Coordinates:				
X (m)	~378.250	~374.250	~369.450	~371.400
Y (m)	~483.500	~489.750	~497.350	~494.350

* $\mu\text{S}/\text{cm}$

Appendix

**ANALYTICAL METHODS USED FOR THE CHEMICAL ANALYSES
OF WATER SAMPLES AT ORKUSTOFNUN**

TABLE 1. Parameters included in a general water analysis

Samples for measurement of pH, total sulfide, and total carbonate are collected in a gas tube and analyzed at room temperature within 24 hours.

Parameter	Method	Detection Limit in mg/kg
pH	is measured by a pH-meter with a glass electrode	
Total sulfide as H ₂ S	is measured by titration with 0.001 M mercuric acetate with dithizone as indicator	0.02
Total carbonate as CO ₂	is measured by titration with 0.1N HCl using a pH-meter.	1.0
Dissolved O ₂	is measured on the site with a Chemét test kit based on reaction with rhodazine D, or with a Winkler titration	0.01
Conductivity	is measured with a conductivity meter.	-
Salinity	is measured with a conductivity meter.	-
Na	is measured by atomic absorption spectrophotometry of a filtered and acidified sample	0.01
K	is measured by atomic absorption spectrophotometry of a filtered and acidified sample	0.02
Ca	is measured by atomic absorption spectrophotometry of a filtered and acidified sample	0.02
Mg	is measured by atomic absorption spectrophotometry of a filtered and acidified sample	0.005
Cl	is measured by ion chromatography of a filtered sample	0.025
SO ₄	is measured by ion chromatography of a filtered sample	0.020
F	is measured by an ion sensitive electrode in a filtered sample	0.020
SiO ₂	is measured spectrophotometrically as yellow or blue silicomolybdate complex in a sample of raw water	1.0
Fe	is complexed with 2,4,6-tripyridyl-1,3,5 triazine and measured spectrophotometrically in a filtered and acidified sample	0.025
Mn	is complexed by a formaldoxime solution and determined spectrophotometrically in a filtered and acidified sample	0.025
B	is complexed with curcumin and measured spectrophotometrically in a filtered sample	0.05
Br	is measured by ion chromatography in a filtered sample	0.05

TABLE 1. cont.

Parameter	Method	Detection Limit in mg/kg
Alkalinity	is determined by potentiometric titration in a raw sample	1.0
Hardness	is determined titrimetrically by EDTA in a raw sample	1.0
Color	is measured spectrophotometrically in a raw sample	-
Taste	is judged by a panel	-
Odor	is judged by a panel	-
Turbidity	is measured by nephelometry in a raw sample	0.5
Temperature	is measured on the site by a digital thermometer	-
Stable isotopes, D and O18,	are measured by mass spectrometry in a filtered and acidified sample	-
Total non-filterable residue	is determined gravimetrically after drying at 180°C	0.1
Total Filterable residue	is determined gravimetrically after drying at 103-105°C	0.1
NO ₃	is measured by ion chromatography of filtered sample	0.01