

**Chemical composition of freshwater,
saltwater and seawater in the Reykjanes
area, southwestern Iceland**

Jón Örn Bjarnason

Greinargerð JÖB-95-04

CHEMICAL COMPOSITION OF FRESHWATER, SALTWATER, AND SEAWATER IN THE REYKJANES AREA, SOUTHWESTERN ICELAND

At the request of Hitaveita Suðurnesja (Suðurnes District Heating), four water samples for chemical analysis were collected in the Reykjanes area on July 27, 1995. One of these was a sample of the fresh water from Sýrfell well SY-02, which supplies the Reykjanes sea chemicals plant with potable water. Since there is no sampling point on the wellhead or the pipeline leading to the plant, this sample was collected from a tap in the plant shop. A second sample was obtained from Reykjanes well 5, by way of a pipeline valve located in the centrifuge hall. The fluid from this latter well is essentially seawater, whose composition has been slightly modified by reaction with rock. Finally, two samples of seawater were collected at the beach at different locations: one near Gjögur, at the southern end of Stóra-Sandvík; and the other close to Eyrarbær, near the northern end of Hafnaberg. The sample from Stóra-Sandvík was collected at high tide, but the one from Hafnaberg a little over three hours later.

The sample collection and the analyses were carried out by the staff of the Chemical Laboratory of Orkustofnun (The National Energy Authority of Iceland). This work forms a part of the preliminary investigation of the feasibility of building a magnesium extraction plant in the area.

Table 1 displays the concentrations, in mg per liter, of some of the dissolved constituents of these samples. Here, CO₂ represents total carbonate calculated as carbon dioxide, and H₂S denotes total sulfide calculated as hydrogen sulfide. The figure for dissolved solids represents the total mineralization, as measured by evaporating an aliquot to dryness at 110°C. The exact positions, in geographical coordinates, of the two wells in question and of the two seawater sampling sites are included in the table. These were determined by differentially corrected GPS measurements and should be accurate to within ±5 m or so. They are given in the Hjörsey 1955 datum.

We notice that the concentrations of silica, aluminum, manganese, zinc, and iron are all slightly higher in the fluid from Reykjanes well 5 than in the seawater, and that the pH is slightly lower. This difference can be attributed to rock dissolution and ion exchange between rock and seawater. Furthermore, the silica concentration in the seawater samples here, as in surface and coastal waters in general, is considerably lower than one would expect on chemical grounds alone. This is because plankton, which is retained by the 0.45 μm membrane through which the liquid is filtered during sampling, has depleted the dissolved silica.

Table 1. Chemical composition of freshwater, saltwater, and seawater samples from the Reykjanes area. Concentrations in mg/liter.

Sample no.	95-9088	95-9089	95-9090	95-9091
Date	July 27, 1995	July 27, 1995	July 27, 1995	July 27, 1995
Location	Sýrfellshraun well SY-02	Reykjanes well 5	Stóra-Sandvík at the beach	Eyri, Hafnaberg at the beach
Latitude Longitude	63° 50.205' N 22° 39.328' W	63° 49.130' N 22° 40.606' W	63° 51.363' N 22° 41.947' W	63° 53.611' N 22° 44.188' W
pH/°C	7.84/22.2	7.81/22.7	8.15/23.1	8.13/22.5
Carbonate (CO ₂)	17.0	111.2	99.9	100.3
Sulfide (H ₂ S)	<0.03	<0.03	<0.03	<0.03
Boron (B)	0.02	4.14	4.17	4.19
Conductivity (μS/cm / °C)	461/25	32200/25	32000/25	32100/25
Silica (SiO ₂)	14.4	13.9	0.7	0.7
Dissolved solids (TDS)	240	36700	36700	37600
Fluoride (F)	0.05	0.62	0.81	0.81
Chloride (Cl)	113	18700	18800	18900
Bromide (Br)	0.35	61.4	62	62.2
Sulfate (SO ₄)	15.1	2510	2550	2560
Sodium (Na)	61.2	10490	10560	10580
Potassium (K)	2.2	384	380	379
Magnesium (Mg)	9.0	1190	1240	1240
Calcium (Ca)	7.9	451	377	371
Aluminum (Al)	0.009	0.005	0.001	0.001
Manganese (Mn)	0.0002	0.003	0.001	0.002
Iron (Fe)	0.011	0.008	0.002	0.006
Zinc (Zn)	–	0.092	0.002	0.003
Standard salinity (×10 ³)	–	33.1	33.2	33.4

The standard (Knudsen) salinity, S, in parts per thousand, is defined as:

$$S = 0.03 + 1.805 \cdot C,$$

where C is the chlorinity in mg per kg of seawater. C includes chloride, bromide, and iodide, all reported as chloride. Iodide is negligible in the present context. A density of 1.023 at 25°C was used in the calculation.

Table 2 shows the composition of a sample collected five years earlier, on July 11, 1990 from Reykjanes well 5. This sample is included here for completeness and for comparison.

Table 2. Chemical composition of saltwater from Reykjanes well 5 in 1990.
Concentrations in mg/liter.

Sample no.		90-0150	
Location		Reykjanes well 5	
Date		July 11, 1990	
pH/°C	7.82/24.5	Chloride (Cl)	18700
Carbonate (CO ₂)	111.6	Bromide (Br)	64.4
Sulfide (H ₂ S)	<0.03	Sulfate (SO ₄)	2490
Boron (B)	4.5	Aluminum (Al)	0.02
Silica (SiO ₂)	14.9	Manganese (Mn)	0.036
Dissolved Solids (TDS)	34900	Iron (Fe)	0.021
Sodium (Na)	10350	Copper (Cu)	<0.001
Potassium (K)	428	Zinc (Zn)	0.085
Magnesium (Mg)	1123	Cadmium (Cd)	<0.001
Calcium (Ca)	477	Mercury (Hg)	0.000004
Fluoride (F)	0.47	Lead (Pb)	<0.001

The concentrations of aluminum, manganese, and iron are somewhat higher in the 1990 sample than at present. The most likely reason for this is that the 1990 sample was collected after only six hours of pumping from the well, which had been stagnant for some time. The sample of July 27, 1995 was, however, collected after more than 24 hours of discharge. Experience has shown that saline wells in the Reykjanes peninsula often display somewhat elevated levels of manganese and iron after standing, which drop after a day of flow or so.

Jón Örn Bjarnason