Acid geothermal waters and elemental mobility at Krísuvík geothermal area

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Acid surface alteration and mud pools characterize the Krísuvík geothermal area and are also common in most high-temperature geothermal areas. When geothermal waters assent to the surface they may start to boil due to pressure decrease and H_2S and CO_2 and other volatiles become enriched in the steam. Near the surface the steam mixes with oxygen rich cold fresh groundwater. The H_2S from the steam is oxidized by the dissolved oxygen to form elemental sulfur or sulfuric acid (H_2SO_4) which lowers the pH value. These steam heated ground waters are characterized by high concentration of sulfate, low pH value and high concentration of metals that are in high concentration in the surrounding rocks.

In the present study samples where collected of steam heated ground waters in the Krísuvík geothermal area for analysis of major and some trace elemental concentration. The purpose of the work was to study the chemistry of acid sulfate geothermal waters, water-rock interaction and elemental mobility. These waters have not been studied in any extent in Icelandic geothermal areas as the are not feasible for utilization because of its scaling and corrosion potential.

The steam heated geothermal waters at Krísuvík geothermal area are characterized by low pH value or between 2 and 3, high concentrations of sulfate or between 467 and 1363 mg/kg and high concentration of iron and aluminum or between 34 and 100 mg/kg and 25 and 83 mg/kg. Low chlorine concentration indicates insignificant rock leaching.

The relative elemental mobility (RM-i)of 17 elements (Si, Na, K, Ca, Mg, Fe, Al, Sr, P, Ba, Cr, Zn, Sc, Ti, Y, V, Mn) was estimated relative to aluminum. The results indicate that major rock forming elements including K, Na, Al, Mg, Fe, Ca and Si are easily leached from the rocks by the hot acid waters and do not form secondary minerals, i.e. are mobile. However, elements like Ti form pH insoluble oxides which solubility is pH independent are immobile as indicated by low relative mobility. Other elements such as Sc and V also act as immobile. From this it is evident that pH has major impact on mobility of elements in natural waters. Metals such as iron and aluminum are for example considered to be immobile in natural waters of higher pH-value.