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Crustal deformation and gas emission from the Krýsuvík high temperature geothermal system, Iceland

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The Krýsuvík volcanic system is located at the oblique spreading Reykjanes Peninsula, Iceland. Since early 2009 the region has been undergoing episodes of localized ground uplift and subsidence. From March 2011 to the end of 2012 the region inflated by over 7 cm, triggering upper crustal earthquakes at the plate boundary. From 2012 to present the region has been subsiding at a relatively steady rate, reaching the pre inflation state by the end of 2015. GPS measurements indicate that the deflation source is located at 3 km depth coinciding with a previously mapped low resistivity zone from MT measurements suggesting the presence of water, magma or conductive minerals.
In April 2013, near-real time monitoring of gas emissions started in Krýsuvík using a MultiGAS sensor system to collect data gas composition. Gas emissions are correlated with crustal deformation and seismicity within the Krýsuvík geothermal system. The dataset comprises near-continuous gas composition time series (MultiGAS); quantification of diffuse CO_2 gas flux; direct samples of dry gas; seismic records; and GPS dataset.
The gas emissions from the Krýsuvík system are H_2O dominated with CO_2 as the most abundant dry gas species, followed by lesser amounts of H2S. The subsurface equilibrium temperature is calculated as 278°C. This is consistent with previous observations made through sporadical sampling campaigns (e.g. Arnórsson, 1987). In addition, the semi-continuous MultiGAS dataset reveals higher variations of gas composition than previously reported by spot sampling.
The diffuse CO_2 soil flux is found to be variable between the three degassing areas in Krýsuvík ranging from 10.9-70.9 T/day with the highest flux in Hveradalir where the MultiGAS station is located. The total flux was calculated as 101.4 T/day.
Correlation of the MultiGAS data with the geophysical data shows that peaks of H_2O-rich emissions follow events of crustal movements. Coinciding with the H_2O-rich peaks, SO_2 is detected in minor amounts ($\sim$0.6 ppmv), allowing for calculations of H_2O/SO_2, CO_2/SO_2 and H2S/SO_2 ratios. This is the first time SO_2 has been detected in the Krýsuvík area.
The high variations in H_2O/CO_2 and H_2O/H2S are considered to be related to the intensity of degassing activity in the fumarole. The activity of the fumarole appears to be lower during intervals of low or no recorded seismic events. H_2O/CO_2 and H_2O/H2S ratios are believed to be lower due to condensation processes affecting the H_2O concentration before the steam reaches the inlet tube.

-Arnórsson, S., 1987. Gas chemistry of the Krísuvík geothermal field, Iceland, with special reference to eveluation of steam condensation in upflow zones. Jökull 37, 30-47.