UNIVERSITÄT
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ESSEN

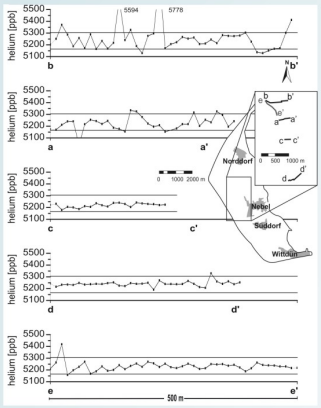
Comparison between different gas bearing structures; indicators, methods and first results.

Transects

At each sampling station soil gas was taken from a depth of one metre by using a metal tube.

Helium: The samples (20 ml) have have been analyses with a portable mass spectrometer (modified helium-leak detector, ASM 142 / alcatel) .
The measuring principle bases on detecting the counts of helium atoms passed the mass spectrometer by the counter flow principle. Due to the constant gasflux the soil air helium concentration is determined in relation to the atmospheric helium concentration.

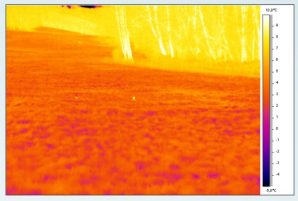
Radon: The radon samples (100 ml soil gas) have to be transferred into scintillation cell (Lucas cell), where á-decays nduce a scintillation. This scintillation can be detected by a scintillation counter and amplified by a photomultiplier (Lucas detector Luk 4a).
Carbon dioxide: The concentration of carbon dioxide of the soil gas [%v (percent per volume)] has been measured with a multi-gas monitor Draeger X-am 7000 after taking the helium and radon sample. The background of carbon dioxide depends on soil type and the activity of soil biota. But carbon dioxide values above 20 % are generated by ascending geogenic gases.
To determine gas-bearing Zones by helium anomalies an upper and lower boundary has to be defined on the basis of the soil gas concentrations of the transect samples. The upper boundary 75thpercentile + 1,5 IQR and the lower boundary by the 25th percentile - 1,5 IQR. This method is used contrary to the root mean square deviation, because of its resistance against outliers.

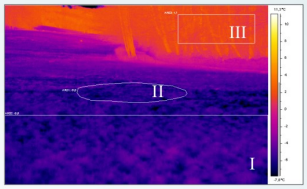


Soil gas transects of the North Sea Island Amrum:
One can see that the distribution of the helium concentrations in the middle and southern part of the investigation area is smoother than in the northern part. We presume that the positive anomalies in the northern part of the investigation area are caused by salt tectonic

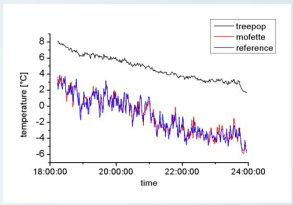
Thermografie

Infrared Thermography was used to detect a thermal influence of the gas flux on the surrounding soil at mofettes. Because of the cooling during night the Method was usually applied in the early morning. In this period the temperature gradient from gas flux to soil should be the highest.
Infrared Thermography is an imaging method to detect variations of temperature in a defined area.
The used Camera (FLIR 620) operates at an electromagnetic spectrum from 7.5 to 13 μm.
The calculated maximum of the radiation emitted by soil and gas flux was about 10 μm.
The influence of the gas flux on the temperature of the surrounding soil could not be clearly detected. As reasons, the low thermal energy transported by the gas flux, the influences of soil humidity, wind and cloudiness could be identified. In addition to these factors, the differing cover of vegetation and the specific emissivity complicated the interpretation of the measuring results.

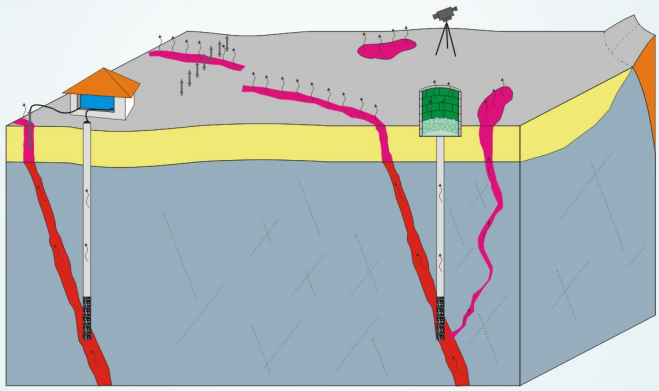




Laacher See:
pictures of the mofette at Laacher See. Allocation of areas of measurement, 03March 19th 2009.
I: Preference area, image section II: mofette, image section III: tree population at the lakefront

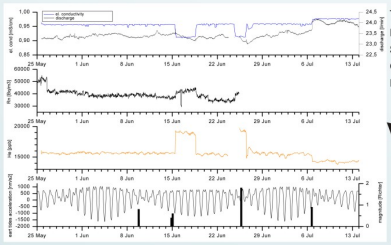


Laacher See
Temperature profile of areas of measurement at Laacher See, March 19th 2009



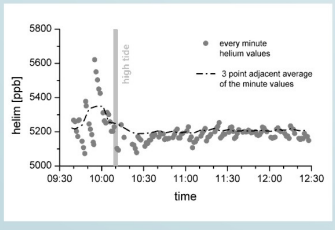
Monitoring

East Eifel:
For a better understanding of degassing processes observations of geochemical variations has been carried out in the East Eifel volcanic field known for the seismic unrest due to ongoing tectonic/magmatic activity.
A multi-parameter monitoring station was installed at the gas artesian mineral spring Elisabethbrunnen near Mendig. The monitoring stations core device was a mass spectrometer (Balzers HLT 100) sensitive for helium. Helium in the free gas phase of the mineral water and alternating in atmospheric air as a helium standart (5220 ppb) were measured continuously. Besides this high temporal resolution (2 min) time series of helium concentration, the radon content and the gas flux of the free gas phase were recorded. Furthermore the water parameters electric conductivity, temperature and discharge as well as climatic parameters have been logged.



East Eifel:
Elisabethbrunnen
Monitoring periode from May 25th to July 13th 2008.
Small scale fluctuations in discharge are related to the meteorological variable air pressure by affecting the gas lift mechanism in the well. Observed diurnal variations in helium show a weak correlation to this trend. Distinctive changes in the time series (He, Rn and electric conductivity) appear in context of weak local earthquakes.

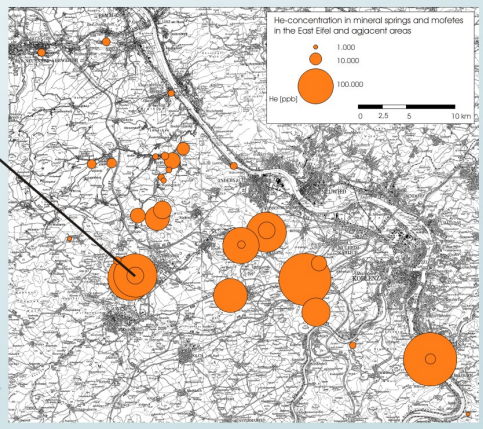
Amrum:
At Amrum different helium monitoring capaigns has been carried out fom 2006 to 2009 with the ASM 142 mass spectrometer.
A short term monitoring (up to 24 h) is realised with individual samples at fixed sample locations. The time span between the sample collections varies between 10 minutes and 15 minutes. The sample procedure is the same as described in section Transects.During continous monitoring arround high tide and over one week the soil gas is pumped (pumping rate of 0.01-0.015 l min-1) via a fixed steel tube which was driven one meter into the ground to the mass spectrometer. To get absolut helium concentrations soil gas and atmospheric air have to be measured alternately.



Amrum:
A rise of the helium concentration in the soil air starts 20 minutes before high tide and reaches a constant lower level ten minutes afterwards high tide

Wells and mofettes

Samples of the free gas phase of several mineral springs and mofettes in the East Eifel region and the Middle Rhine valley have been analysed regarding He, Rn and CO2.
The spatial distribution of helium show strong differences in the helium concentration ranging from 490 ppb to 178085 ppb reflect different upstream histories at the individual sampling locations. A general trend to high values in the southern part of the investigation area can be observed. Apart from this trend strong small scale variability occurs in neighboured springs.



The spatial distribution of helium concentrations at the East Eifel region and the Middle Rhine valley

Jörg Reuther, Peter Janßen, Holger Luick und Ulrich Schreiber

Universitätsstr. 5 45141Essen
+49 (0)201/183 31 09
Joerg.Reuther@uni-due.de; Peter.Janssen@uni-due.de; Holger.Luick@uni-due.de; Ulrich.Schreiber@uni-due.de