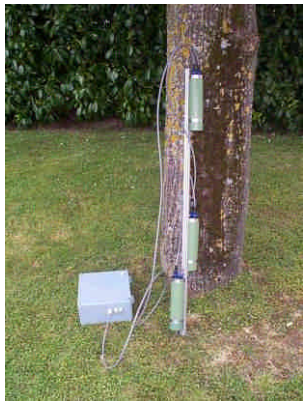
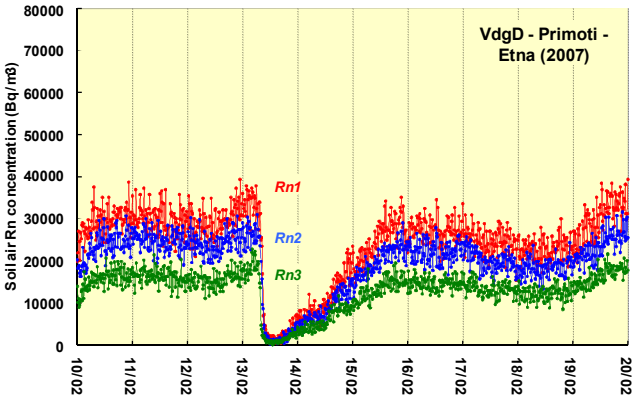
VDG System

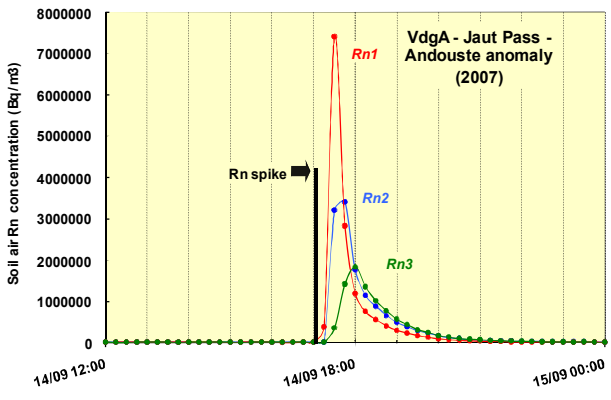
❍ IN SITU MEASUREMENT AND MONITORING OF SOIL GAS FLUX (CO_2, CH_4…)

<u>Applications</u> : ***gas geochemistry research, public and industrial safety, health impacts***



- Continuous in situ monitoring (flux and velocity) of natural or anthropogenic soil degassing;
- Surface monitoring of underground gas storage sites, monitoring of diffuse degassing of former landfill sites;
- Monitoring of natural ground degassing before and after the setting up of industrial plants (Carbon dioxide sequestration, underground fuel gas storage, geothermal or hydrothermal facilities, etc.);
- Characterization and geochemical monitoring of seismically active faults;
- Distal monitoring of volcanic activity.





❑ The **VDG system** uses Radon (^{222}Rn) as a natural tracer of soil gas.

❑ The **VDG system** combines:

- **3 superimposed sensors,** set up inside a buried chamber;
- **A gas injection device** for calibration of the chamber;
- **VDG Supervisor,** control software;
- **VDG Flow,** data processing software.

❑ **VDG**, with its 3 silicon detectors for measuring ^{222}Rn alpha emissions, records the time taken for the gas to rise from one sensor to the next, taking into account the radioactive decay of radon and its diffusion.

❑ **VDG** is contained in a known volume, usually within a PVC pipe. Calibration is carried out by injection of a radon spike, with or without CO_2 or another gas.

❑ The system can be used in all types of soils. For soils poor in uranium, the addition of a sample of uranium ore below the installation improves the instrument sensitivity.

❑ Temperature and pressure are recorded simultaneously allowing the subsurface gas velocity to be modelled.

❑ The **VDG system** is protected by **patent FR/0413988 - WO/2006/070139.**

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VDG System

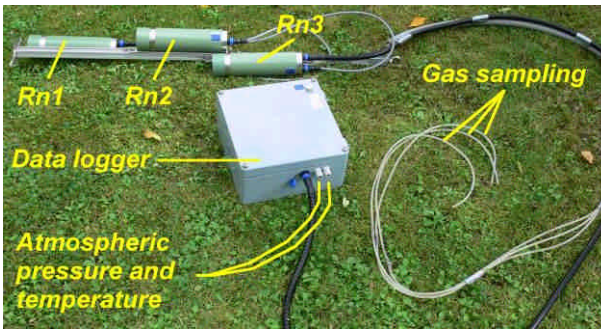
CHARACTERISTICS

1 – VDG sensors

Description :

Three detectors labelled Rn1 to Rn3 from bottom to top are fixed along a vertical axis. Each device measures the radon activity, temperature and pressure of the soil gas at its installed depth.

The 3 devices are connected by a serial bus and communicate with an external data logger.
Power supply and data memory are designed for at least 6 months of autonomous operation.
A gas injection device for a monitored constant flow is incorporated.



Parameters measured:

Measuring sensors: Radon, barometric pressure, temperature, shocks.

Data logger: Atmospheric pressure and temperature, power supply.

Gas enters the detection volume through a cellulose filter that traps all the solid radon daughters. The sensor is an implanted silicon detector with a 100 µm depletion depth and a 400 mm^2 measuring surface. It measures ^{222}Rn, and daughters created in the detection volume, by alpha spectrometry using a 1.5 - 6.0 MeV window.

Calibration of the sensor enables the volume activity of ^{222}Rn to be calculated.

Radon: Sensitivity of 50 $Bq.m^{-3}$/impulse/h (typically)
Dynamics from 0 to 1 $GBq.m^{-3}$

Temperature accuracy:
0.005°C (relative)
0.1°C (absolute)

Atmospheric pressure:
Resolution 0.05 hPa
Range from 500 to 1500 hPa
Accuracy 1 hPa

Shocks: binary detection. The detector is tuned to the same sensitivity as the radon sensor (interferences are generated in the silicon detector in the event of shocks)

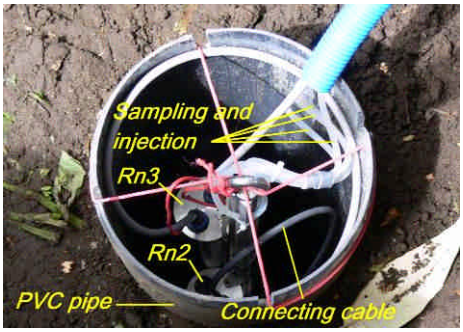
Power supply: Resolution 0.10 V

Measuring cycle:
Adjustable parameter from 1 to 240 min, 1 mn step.

Memory capacity:
4 MByte Flash Memory, can be extended to 16 Mbytes (saves data in case of power failure).
Storage capacity more than 1 year (15 min measuring cycle).

Power supply:
7.5 V to 3.5 V; alkaline or Lithium batteries.

Measuring device casing:
489 mm high * 62 mm diameter / Weight 2 kg
Shielding: 5 µm copper and 3 µm nickel
Protection index: IP 68



Assembly:
Each sensor is fixed to one of the 4 sides of an aluminium section.
The relative positions of the sensors can be adjusted.
Height of the unit: can be extended up to 1500 mm.

Data logger:
250 x 250 x 100 mm high / Weight 5 kg
Shielding: 5 µm copper and 3 µm nickel.
Protection index: IP 68

Parameter setting and data collection:
USB2 and RS232 connectors.
Softwares for PC with Windows 2000, XP, Vista.

Environment:
Operating temperature: -20°C to +70°C
Relative humidity: 100%

The standard VDG system includes:

- 3 VDG measuring devices.
- Data logger.
- Positioning support.
- Calibration device.
- VDG Supervisor software.
- VDG Flow software.
- Connecting cables.
- Batteries for 6 months.
- Accessories for positioning, gas injection, gas sampling at each sensor, closing of the chamber.
- Certificate giving calibration coefficients for the radon detectors.
- User manual.

2 – Device for calibration by gas injection

The calibration device is connected, temporarily or permanently, to the chamber containing the detectors. It allows a ^{222}Rn spike, with or without CO_2, to be injected at the base of the chamber to calibrate the VDG system for its installed geometry. Samplers allow volumes of gas to be taken for each measuring device.
^{222}Rn spike can be obtained from a commercial source or created from uranium-bearing ore.
CO_2 can be obtained commercially.

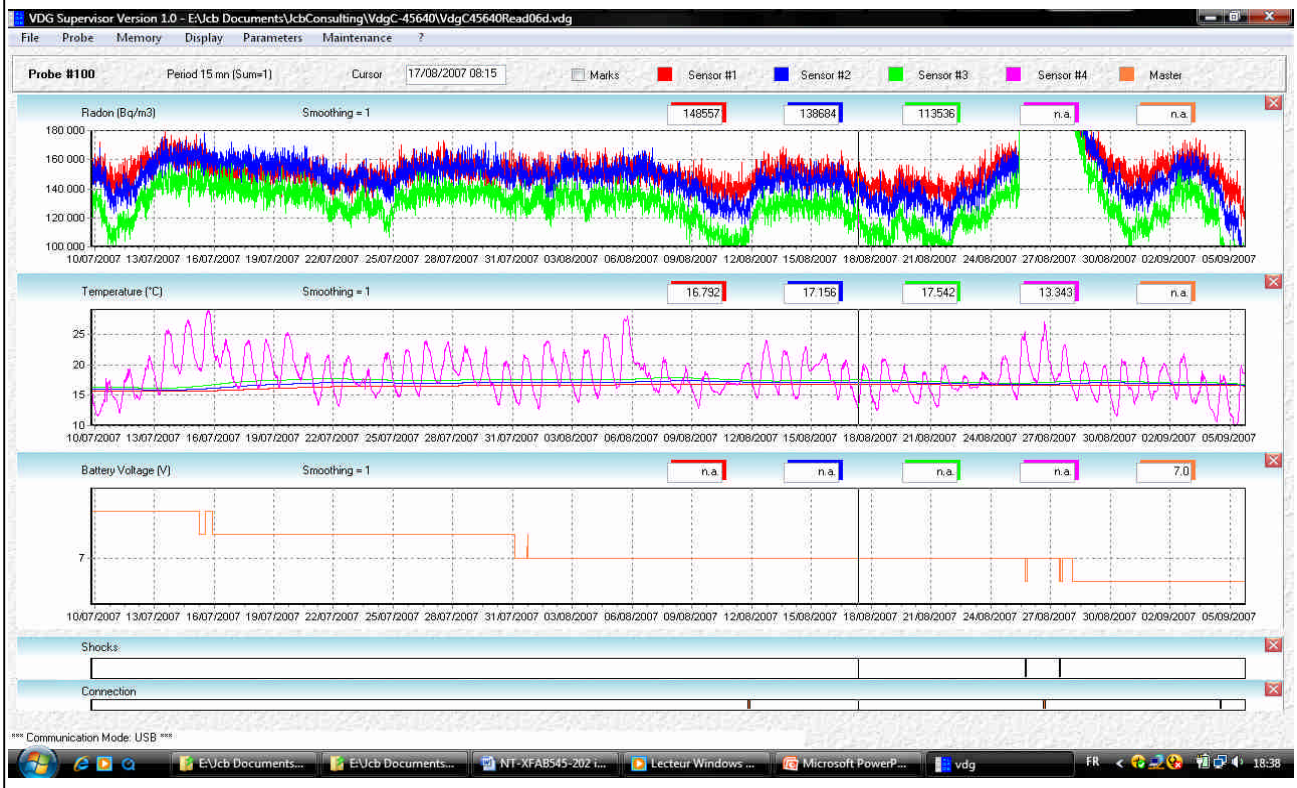
The injection device is made of:

- A micropump (12V battery supply).
- A mass flowmeter for low gas flows.
- Injection and sampling valves.

3 – Supervision sofware: VDG Supervisor

Running:

- Software for PC with Windows 2000, XP, Vista.
- Parameter setting (selection of measuring interval…).
- Initializing sensors.
- Reading data.
- Stopping recording for transport or temporary storage of the equipment.
- Export of data as Excel or text files, printing.



Display:

- 1 to 3 display windows available.
- Display of radon, temperature, pressure, battery voltage records with time.
- Display of 1 to 4 sensors per window (for example: radon for devices 1, 2, 3; pressure for devices 1 to 3 and data logger).
- Display of a window with instrument status (shocks and power failure).
- Change of time scale for all windows simultaneously.
- Change of ordinate scales separately.
- Display of data values by cursor, smoothing of curves by running average (1 to 10 points), summation, zoom.

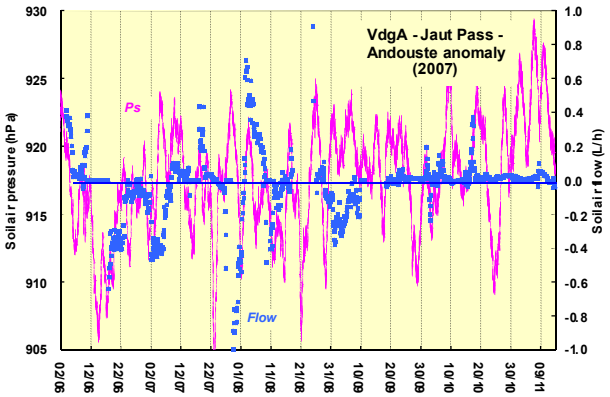
VDG System

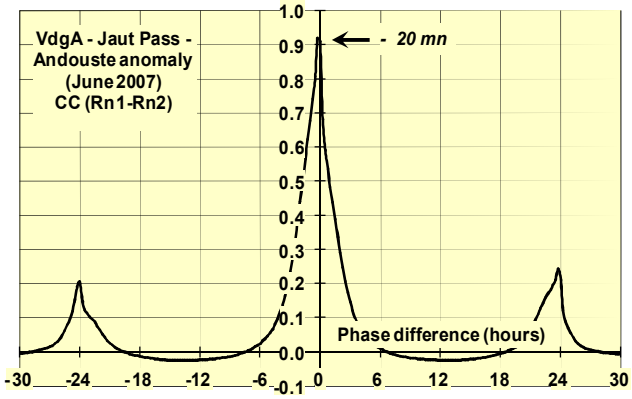
CHARACTERISTICS

4 – FLUX MODELLING SOFTWARE: VDG Flow

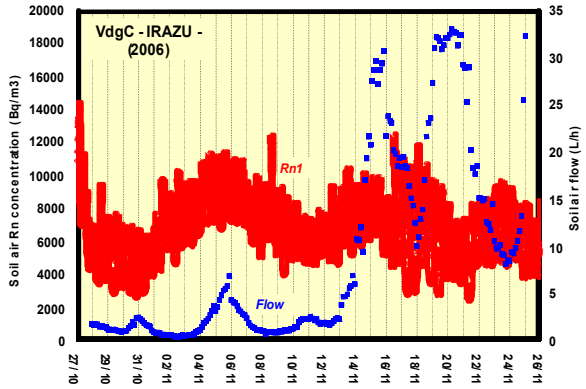
The flux is calculated from the time-lag in radon activity between the Rn1, Rn2 and Rn3 sensors. It is based on analyzing the cross correlation of the temporal responses of the sensors.

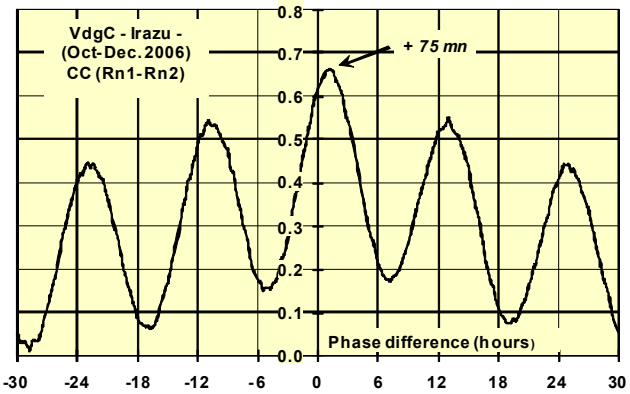
In the absence of advection, the cross correlogram reveals chance correlations between the various signals or those resulting from homogenization processes (especially diffusion); and the symmetry of the cross correlogram shows that these correlations take place both upwards and downwards.





In the presence of an upward advective flow, the cross correlogram shows a larger positive off-set than negative off-set, because correlations resulting from the flow of the gas into the probe are added to the chance. The flux is inversely proportional to the transfer time of the column of gas between the detectors.





5 – Options

Solar power supply:

- Unit composed of a solar panel, a battery and a charge regulator.
- Integrated in a protective casing.

Remote data transmission:

- GSM to PC and 56K modem
- GSM GPRS to PC and internet link
- Radio to PC and radio modem

6 – To order

1 - Instrumentation	
Measuring device VDG	P-545-101
Data logger	P-545-103
2 – Supervision software	
VDG Supervisor	P-545-110
3 – Flux modelling software	
VDG Flow	P-545-113
4 - Accessoires :	
Injection device	P-545-106
5 - Options :	
Solar power supply	P-515-102
GSM transmission	P-542-126

NT-XFAB545-202i ndA-Dec 2007