Geophysical Research Abstracts
Vol. 19, EGU2017-9957, 2017
EGU General Assembly 2017

Quantification of the effect of temperature gradients in soils on subsurface radon signal

Gustavo Haquin (1,2), Danielle Ilzycer (1), Tamir Kamai (3), Hovav Zafrir (4), and Noam Weisbrod (1)

(1) Zuckerberg Institute for Water Research, Jacob Blaustein Institutes for Desert Research, Ben Gurion University, Sde Boker, Israel, (2) Radiation Safety Division, Soreq NRC, Yavne, Israel, (3) Institute of Soil, Water and Environmental Sciences, Agricultural Research Organization, Volcani Center, Beit Dagan, Israel, (4) Geological Survey of Israel, Jerusalem, Israel

Temperature gradients that develop in soils due to atmospheric temperature cycles are factors of primary importance in determining the rates and directions of subsurface gas flow. Models including mechanisms of thermal convection and thermal diffusion partially explain the impact of temperature gradients on subsurface radon transport. However, the overall impact of temperature gradients on subsurface radon transport is still not well understood.

A laboratory setup was designed and built to experimentally investigate the influence of temperature gradients on radon transport under well controlled conditions. A 60 cm diameter and 120 cm tall column was thermally insulated except from the atmosphere-soil interface, such that it was constructed to simulate field conditions where temperature gradients in soils are developed following atmospheric temperature cycles. The column was filled with fine grinded phosphate rock which provided the porous media with radon source. Radon in soil-air was continuously monitored using NaI gamma detectors positioned at different heights along the column. Soil temperature, differential pressure, and relative humidity were monitored along the column.

Experiments based on steep and gradual stepwise changes in ambient temperature were conducted. Absolute changes on radon levels in the order of 10-30% were measured at temperature gradients of up to $\pm$20oC/m. Results showed a non-linear correlation between the temperature gradient and the subsurface radon concentration. An asymmetric relationship between the radon concentration and the temperature gradients for $\Delta T>0$ and $\Delta T<0$ was also observed.

Laboratory simulations of the time- and depth-dependent temperature wave functions with frequencies ranged from a daily cycle to few days were performed. In response to the harmonic temperature behaviour radon oscillations at similar frequencies were detected correspondingly.

In this work a quantitative relationship between radon and temperature gradients will be presented for cases beyond the classical conditions for thermal convection and thermal diffusion.