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# A New Laboratory System for the Study of the Effect of Temperature on Radon Transport processes

G. Haquin (1), H. Zafrir (2), D. Ilzycer (1), Y. Ganot (3), N. Weisbrod (3), Z.B. Alfassi (4), and S.M. Barbosa (5)

(1) Soreq NRC, Israel (gustavo@soreq.gov.il), (2) Geological Survey of Israel, Jerusalem, Israel, (3) Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Israel, (4) Ben-Gurion University of the Negev, Israel, (5) University of Lisbon, IDL, Portugal

The goal of the research is to investigate the mechanisms that control radon temporal changes produced within the geological subsurface media, besides the concentration and pressure gradients within the subsurface lithology that at present are considered the physical driving-forces for radon flow , and specifically to explore the impact of temperature on this mechanism. Lately continuous in-situ field measurements have demonstrated that the ambient temperature at any exposed surface undulates with the daily cycle, with heat waves that last several days and with seasonal (winter and summer) trends producing a changeable temperature gradient at the ground surface, which in turn produces a radon flow within the subsurface media.

Following the above-mentioned results, the aim of the new laboratory system is to validate the assumption that time-dependent heating of rock or soil surface media will create an oscillating radon flow with a similar period along a porous media column placed in a climate controlled laboratory (CCL).

A large cylindrical container (60 cm diameter x 117.5 cm high) was constructed and equipped with horizontally collimated gamma detectors, and vertically inserted temperature and pressure sensors at different internal levels. In the bottom of the container a curvature shape base with a pressure hose allows the development of a 2D pressure gradient along the container. In the center of the container a PVC rod with 10 thermocoupler will record the temperature gradient along the container, in parallel to the monitor of the pressure gradient performed at various heights of the container. The container will be packed with homogeneous crushed rock material (soil, granite or phosphate rocks) and will be encircled with thermal insulation material except for the upper surface. Heat will be applied to the top of the material column to enable continuous stable heat flow producing a steady state of down-migrating radon.

The working hypothesis of this work is the assumption that time-dependent heating of rock or soil surface media creates an oscillating radon flow along a porous media column with a similar period.

The simulation with the natural daily and seasonal variations (summer and winter) will be achieved by heating or cooling the top of the material column to different temperatures: 20 to 45oC for the summer and 7 to 25oC for the winter. The high sensitivity of the gamma detectors in the collimated housing and the implementation of fragmented phosphate rocks with radon concentration 100 times higher than widespread rocks at the column are the key expedients to achieve radon transport parameters, including thermal conductivity, at this "micro scale".

An upward air flow will be induced under mass-flow control through the internal material column in order to balance the radon thermal diffusion flow within it. The conditions at equilibrium could enable us to extract the physical parameters that are responsible for the "thermal advection" of the radon within the porous media.