Geophysical Research Abstracts, Vol. 9, 07657, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07657

Modelling increased soil radon emanation caused by instantaneous and gradual permafrost thawing due to global climate warming

P.W.J. Glover and M. Blouin

Département de géologie et de génie géologique, Université Laval, Québec, Canada
(paglover@ggl.ulaval.ca / Fax: +1 418-6567339)

Radon is a naturally occurring radioactive gas which accounts for approximately 9% of lung cancer deaths in Europe and 12% in the USA, and is considered to be the most serious environmental carcinogen by the EPA. Radon leaches into houses from soil derived from rocks containing significant concentrations of U^{238} and its decay products. The diffusive and advective transport of radon through the soil is controlled by the porosity, fluid saturations, diffusion coefficients and relative permeabilities of the soil. All of these parameters are significantly reduced in the permafrost that makes up one fifth of the Earth's terrestrial surface. Following the presentation of results from a pilot study at EGU2006, we are now in a position to report more comprehensive modelling. We have carried out a numerical modelling study involving 2D numerical modelling of radon transport through soil, permafrost and either an unventilated model building with a basement or a ventilated model building built on piles. Modelling has been carried out for instantaneous permafrost melting as well as for gradual melting. We can confirm the results of the pilot study that the presence of the permafrost acts as an effective radon barrier even in the absence of advective transport. For the world average Ra^{226} activity of 40 Bq/kg, the permafrost reduces the domestic radon concentrations by 80 to 90% (5 to 10 Bq/m^3) while leading to an increase in the concentration in the radon behind the barrier by 10 to 15 times (500 to 750 Bq/m^3). However, when we modelled the thawing of the permafrost that is beginning to occur as a result of global climate change the radon in the building increased transiently by up to 100 times (1000 Bq/m^3) over a timescale of 6 months to 5 years before decreasing once again. The inclusion of advection has a time compression effect that has little or no effect on the maximum and final concentrations of radon, or the overall shape of the

curve describing the mean radon in the building as a function of time. The inclusion of gradual melting slightly reduces the maximum value of radon present in the building, but not sufficiently to reduce it to a safe level. The form of the radon concentration-time curve is surprisingly similar to the instantaneous case. It is therefore possible that a significant number of people could be exposed to levels of Radon in excess of the 200 Bq/m^3 threshold that many countries adopt.