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Geogenic radon emissions affected by atmospheric pressure - evidence from a breathing well

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Breathing water wells are usually identified by subsurface gases that are exhaled during periods of decreasing atmospheric pressure (P_{ATM}) and inhalation of air during when P_{ATM} is increasing. An 11-day monitoring program in a breathing water well identified in the Calgary (AB, Canada) region showed consistent variations in radon concentrations ([Rn]) inside the well casing over four P_{ATM} cycles (with observed changes in P_{ATM} between 0.5 and 1.8 kPa in magnitude; Figure 1). Decreasing P_{ATM} caused high [Rn] gases to enter the well from the subsurface, with peak [Rn] > 60,000 Bq/m^3. During periods of increasing P_{ATM}, [Rn] decreased to background levels (< 100 Bq/m^3) as atmospheric air was 'inhaled' into the well.

Gas and isotopic composition of daily grab gas samples collected from the well casing showed two endmember mixing, with a high [Rn] endmember associated with i) elevated [CO_2] and [Ar], ii) decreased [O_2] and [CH_4], iii) decreased ^{13}C-CO_2 values, iv) decreased R/R_A values for He, and v) Ne isotope ratios consistent with a deeper geogenic component. The deeper origin of the high [Rn] endmember gases observed during exhalation combined with the short Rn half-life (3.82 days) suggest rapid transport to the ground surface, perhaps as a buoyant free phase gas.

Rapid buoyant transport of high [Rn] gas from the subsurface could be a previously unidentified source of radon in indoor air in non-tectonic regions.

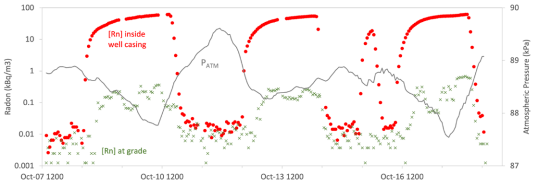

Figure 1: Time series of i) atmopheric pressure (grey line), and radon concentration measured ii) inside the wellhead of the breathing water well (red), and iii) in air sampled at-grade about 2.5m from the wellhead.