Using geogenic radon potential to assess designation of radon priority areas in Ireland

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Radon is a radioactive gas which emanates from rock, soil and water. Radon concentrations in the atmosphere are generally very low (typically <5 Bq m⁻³), however it can occur at much higher levels in soil (typically 10⁻⁵-10⁻³ kBq m⁻³), or enclosed spaces such as buildings and caves (typically 10⁻⁵-10⁻¹ Bq m⁻³). Exposure to radon and its daughter products is associated with an elevated risk of developing lung cancer. Ireland has a population weighted indoor radon concentration of 98 Bq m⁻³ resulting in an estimated 300 annual lung cancer cases per year, representing approximately 12% of the annual lung cancer cases. A national-scale legislative radon-risk map has a 10 x 10 km spatial resolution and is based exclusively on indoor radon measurements (i.e. it does not contain any geological information). The legislative map satisfies the European Council Directive 2013/59/EURATOM Basic Safety Standard, in that it defines “high radon” areas as those where >10% of homes are estimated to exceed the national reference level of 200 Bq m⁻³. New buildings in such areas are legally required to have a barrier, with low radon permeability installed.

This research focuses on a karstic region of SE Ireland, which features some exceptionally high indoor radon concentrations (65,000 Bq m⁻³), even though it is not classified as a “high radon” area on the national legislative map. Here we demonstrate the use of measuring sub-soil radon concentrations and sub-soil permeability, in order to construct a radon potential (RP) map of the area. Extremely high sub-soil radon concentrations (>1443 kBq m⁻³) and radon potential values (>200) are spatially associated with Namurian shales, interbedded with limestone. Overall, we classify the study area as high radon potential (RP >35) using this technique. We suggest all areas underlain by Namurian shales in Ireland should undergo similar radon potential mapping, and if necessary, should be re-designated as “high radon” areas. If deemed appropriate (i.e. where RP >35), such a designation will help to protect the general public from the harmful effects of indoor radon exposure, and will help to lower the incidence of radon-related lung cancer in these areas.