

# Geology and radon protection

## Using maps to target the potential hazard

by Don Appleton

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**G**eology is the most important factor that controls the source and distribution of radon. This radioactive gas is believed to be the cause of more than 2000 lung cancer deaths each year in the UK. Radon is produced by the radioactive decay of radium and uranium, which are found in all rocks and soils. In the UK, relatively high levels of radon emissions are associated with some granites, ironstones, phosphatic rocks, and shales rich in organic materials. The amount of radon released from rocks and soils is mainly controlled by the types of minerals in which uranium and radium occur. Once radon gas is released, its migration to the

surface is controlled by the transmission characteristics of the bedrock and soil; the nature of the carrier fluids, including carbon dioxide gas and groundwater; meteorological factors such as barometric pressure, wind, relative humidity and rainfall; and soil permeability, drainage and moisture content.

Radon is quickly diluted in the atmosphere so that concentrations in the open air are normally very low and probably do not present a hazard. However, radon that enters poorly ventilated buildings, caves, mines and tunnels can reach high concentrations. Radon concentrations in buildings are also influenced by the construction method and the degree of ventilation. But a person's exposure to radon will depend on how particular buildings and spaces are used. Radon in soil under homes is the main source of radon in indoor air, and this presents a greater risk of lung cancer than radon in drinking water.

### Radon potential maps

The radon potential of the ground may be assessed from a geologically based interpretation of indoor radon measurements in conjunction with permeability, uranium, soil gas radon, and ground and airborne gamma spectrometric data, such as the BGS High Resolution Airborne Resource and Environmental Survey (HiRES) gamma-ray data (see page 8).

Geological radon potential maps based on indoor radon measurements grouped by geological unit indicate the probability that new or existing houses will exceed a radon reference level, which in the UK is termed the Action Level (200 becquerels per cubic metre). Geological radon potential maps have been produced at 1:625 000 and 1:250 000 scales for



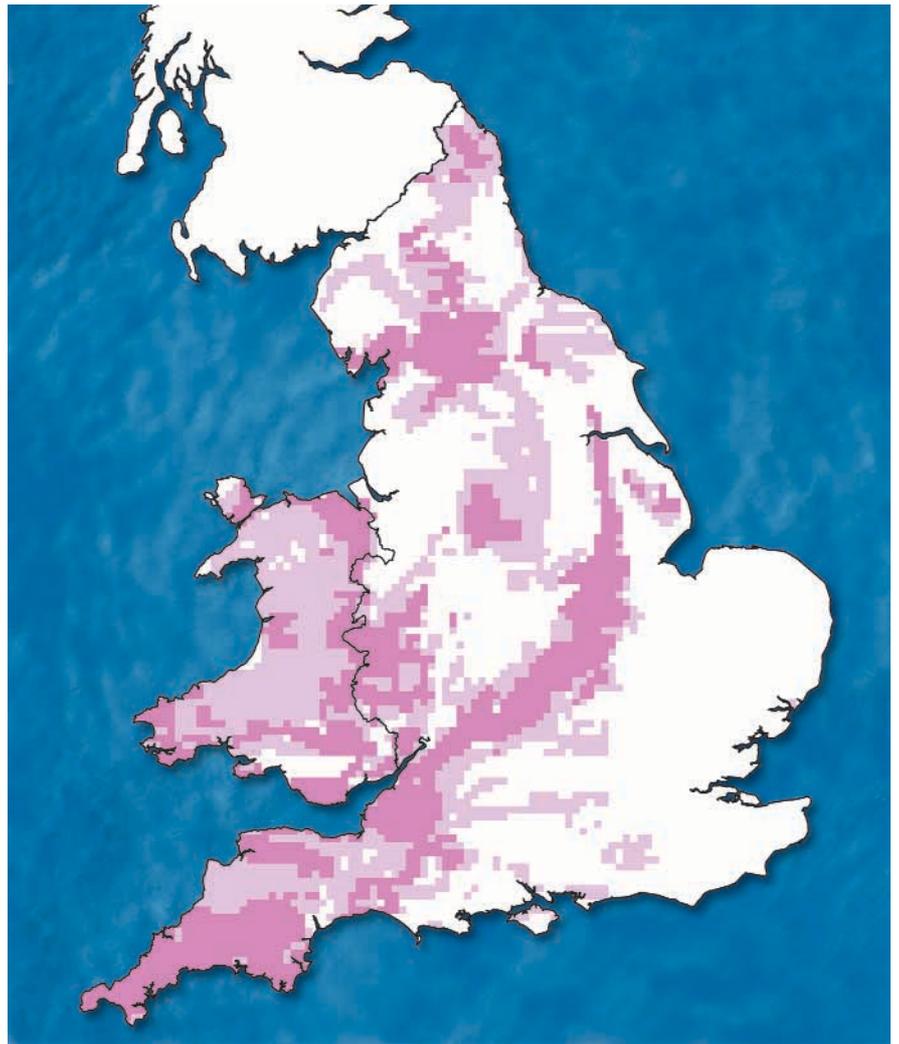
1:50 000 scale geological radon potential map. Basic and full radon protective measures are indicated for new dwellings located in areas coloured pale and dark purple, respectively. Topography © Crown copyright. All rights reserved.

England and Wales and at the 1:50 000 scale for the most radon-prone areas of England. Each geological unit within a map sheet or smaller area, such as a five-kilometre or one-kilometre grid square, has a characteristic geological radon potential (*see bottom left*).

Radon potential maps have important applications, particularly in the control of radon through environmental health and building control legislation. They are used to assess whether radon protective measures may be required in new buildings and for the cost-effective targeting of radon monitoring in existing dwellings and workplaces. They can also be used to provide an assessment of radon risk in existing buildings for homebuyers and sellers. It is important, however, to realise that radon levels often vary widely between adjacent buildings due both to local variations in the radon potential of the underlying ground and to differences in construction style and use. Whereas a radon potential map can indicate the relative radon risk for a building in a particular locality, it cannot predict the radon risk for an individual building. This can only be established by having the building tested for radon.

### Radon protection in new buildings

Radon protective measures need to be installed in new dwellings (and extensions to existing ones) in areas where it is estimated that the radon concentration exceeds the Action Level in 3 % or more of homes. In England and Wales, these areas are estimated by a dual data system based on a combination of National Radiological Protection Board (NRPB) grid square and BGS geological radon potential maps. The dual data system forms the basis for the Building Research Establishment (BRE) guidance on radon protective measures in new dwellings (BR211-1999). A geological assessment may need to be carried out where the development site is located within a shaded square on the BGS map in Annex B of BR211 (1999) (*see above right*). Digital geological radon potential map data are used by the BGS to provide reports that fulfil the requirements of the Stage 2 Geological Assessment outlined in the BR211 (1999). The reports are essential for builders and developers (to ensure compliance with Building Regulations) and invaluable for planners, architects and surveyors, who need to know what



*Areas in England and Wales where a geological assessment may need to be carried out to determine whether radon protective measures are required in new dwellings (Revised and recoloured version of Map 2, Annex B, BR211, 1999). Basic radon protection may be required if the development site is in a pale shaded square; full or basic radon protection may be required if site is in a dark shaded square). Topography © Crown copyright. All rights reserved.*

level of protection is needed in new buildings. Access to the report service is now available online at [www.bgs.ac.uk/georeports/](http://www.bgs.ac.uk/georeports/)

The BGS and the NRPB are collaborating on the production of more detailed radon potential information, based on a combination of 1:50 000 scale geological and one-kilometre grid square mapping techniques. The new radon maps will eventually replace the current maps, published by NRPB; they will be used to provide advice to builders and developers as well as to householders and their legal advisers when a radon enquiry is made in England and Wales as part of property searches (CON29 (2002): Standard Enquiries of Local Authority). ■

*For further information, contact:*

**Don Appleton**  
Tel: +44(0)115 936 3207  
e-mail: [jda@bgs.ac.uk](mailto:jda@bgs.ac.uk)