

The Truth About Granite & Radon/Radiation

Over the past few years, there has been some consumer confusion and concern about rumoured radiation levels occurring in natural granites used for residential countertops, floor tiles, etc. The origins of this concern are advertisements published by manufacturers of competing materials. Levels of radiation from granitic products, while technically measurable, are in fact, just small fractional values of established thresholds for environmental safety. The reader is encouraged to study the information contained within this pamphlet to further understand how these levels are quantified and to appreciate the relative insignificance of any radiation attributable to natural stone surfaces.

Section 1: Granites, Radioactivity and Natural Stone

Radiation is all around us - in the air we breathe, in the water we drink, in the soil and rock we stand on, and in the sun's rays we like to bask in! Added to this is the radiation we get from man-made sources, such as X-rays, medical treatments, building materials and cigarette smoke. This leaflet gives you information on radiation and how it relates to the use of granite in the home, particularly tiles and granite countertops. If you have any questions that are not answered here, please call the Marble Institute of America at (440) 250-9222, or send an email to miainfo@marble-institute.com, or visit www.marble-institute.com.

Is Radiation/Radon in Granite Dangerous? No

There are two ways in which countertops, tiles, and other finishes made of granite might emit any level of radiation. The first is by release of tiny amounts of the radioactive gas *radon* which can be breathed in; the second is by direct radiation from the surface itself to the homeowner. In both cases, the radiation emitted is from the same process: natural radioactive decay of one element into another. These two mechanisms are dealt with separately in this MIA Technical Bulletin but the end result is the same: ***compared to other radiation sources in the home and outside, the risk to the home-owner from radioactivity emitted from a granite counter-top or tiles is practically non-existent.*** The description below and the Q & A discussion in section 2 show that the amount of radon gas emitted by a granite countertop is less than ***one millionth*** of that already present in household air from other sources.

Radioactivity in Granite

All rocks have a small amount of radioactivity in them due to the presence of minerals containing the radioactive elements uranium (U), thorium (Th) and potassium-40 (⁴⁰K). Because granite typically contains more of these elements than most other rocks, it will be more radioactive than a slate or marble, for instance. All of the minerals in granite contain some radioelements: the white or pink feldspars contain ⁴⁰K, the black biotites and hornblendes contain ⁴⁰K, U and Th, and the small inclusions of minerals such as zircon, apatite, sphene, etc. contain the most U and Th.

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The following table shows the range of radioelement concentrations, radiation types and levels for typical granites.

Radioelement	Concentration ²	Radiation type ³	Radiation level (Bq/kg of rock)
U	1-10 ppm	α , β , γ	12.5 – 125
Th	5-30 ppm	α , β , γ	20-120
⁴⁰ K ¹	4 % as K ₂ O	β , γ	100

1. ⁴⁰K is 0.0119% of total K 2. ppm is parts per million 3. For a description of types of nuclear radiation, see Q & A

Section 2: Frequently Asked Questions

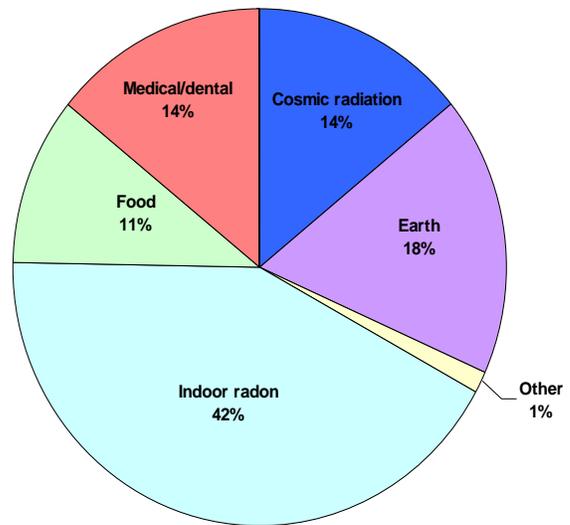
Q: What is radiation?

A: Radiation is energy that is transported as waves or particles. This includes visible light, infrared, ultraviolet, and microwaves. X-rays and gamma radiation are examples of high energy forms of radiation that cause atoms they strike to ionize and potentially cause cell damage in living tissues. Nuclear radiation, more generally called 'radioactivity', falls into the latter category and consists mainly of alpha (α), beta (β) and gamma (γ) radiation, all of which can be damaging to tissue. Each radiation type has a different ability to penetrate: α particles are stopped by a sheet of paper or the top layer of your skin, β particles are stopped by a sheet of plywood and γ radiation is stopped by three feet of concrete. Cosmic radiation is even more energetic and penetrating, and comes from the sun and outside the solar system.

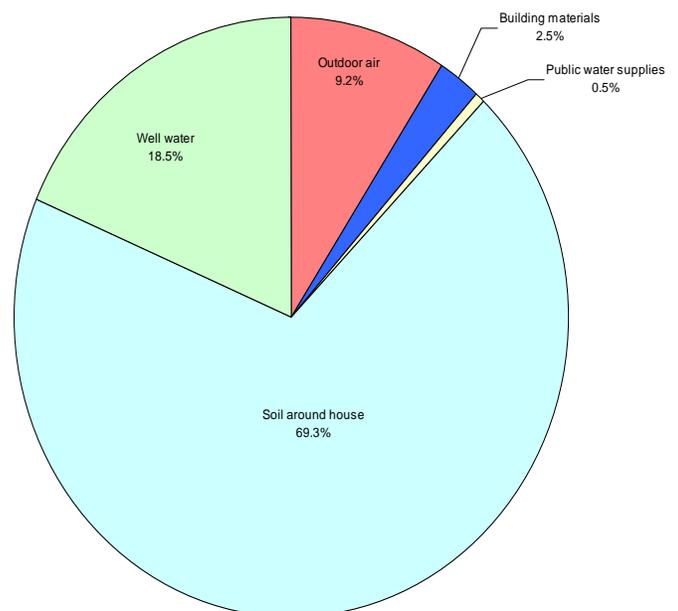
Q: What are the sources of nuclear radiation?

A: There are natural and man-made forms of radiation. Natural radiation includes cosmic radiation and emissions from radioactive elements in the earth, radon gas in your home, some foods and well-water. Man-made radiation comes from dental X-rays, medical diagnostics and treatment, the remains of nuclear bomb testing, emissions from nuclear reactors, radioactive elements in drywall and concrete, and cigarette smoke. The pie chart opposite shows the approximate contribution of each of these to your annual radiation dose. By far the biggest are the natural sources

Typical annual radiation doses from natural and man-made sources



Typical contributions to radon content of indoor air (pCi/L)



such as cosmic rays and radon gas but, if you smoke, ingestion of radioactive polonium will add to the well-known biological effects of cigarette smoke.

Q: How much radon is given off by a granite countertop, and how does this compare with other household materials?

A: The average contributions of radon from various sources to indoor air are shown in the pie chart above¹. For this chart, the total radon is just over 2 pCi/L. Calculations² show that, for an average countertop, containing an average uranium concentration of 4 ppm, the concentration of radon that is given off by the countertop into household air is 0.00000074 pCi/L, an amount that is 270,000 times less than the level of radon in outside air! The granite countertop typically emits a radiation level of 5-10 μ R/hr. So the maximum contact radiation level that you would receive over one year *if you were to sit on countertop all the time* would be about one quarter of the annual radiation dose from all sources. If you were just a few inches away from the granite (e.g. when doing the dishes), then the dose would be too low to measure.

Q: What about food that is prepared directly on the granite surface? Is there a chance that it could absorb radioactive energy, which would later be ingested by those eating the food?

A: The only way that radioactive elements such as uranium can get into the food is if they became dissolved in water and absorbed by the food. However, granite is one of the most insoluble materials known to mankind and the amount that could be dissolved is minute in comparison to the radioactive elements that are already in the food (in meat or from uptake by soil or air-borne particles during growth). Radioactive energy (α , β and γ rays) given off at the granite surface will enter food that is directly in contact with the surface but, like all energetic rays, it changes into heat and/or non-radioactive particles. For instance, microwaves and γ rays turn into heat, α and β particles become helium atoms and electrons, respectively. These processes happen quickly and so the radiation does not remain in the food.

Section 3: Cited References

1. Eisenbud, M. 1987. Environmental Radioactivity. 3rd ed., Academic Press
2. Langmuir, D. 1995. 'Granite & Radon - The Truth'. Publication by the Marble Institute of America (a response to a pseudo-scientific article by unnamed author(s) in the journal Solid Surface, 1995).

Other Sources of Information

- Radiation and You. Produced by the Harwell Laboratory, UKAEA, England (undated).
- Nuclear Facts. Produced by the Canadian Nuclear Association, Ottawa, Ontario, Canada, see the website www.cna.ca
- Radioactivity in Geology: Principles and Applications. 1986. By E.M. Durrance, Senior Lecturer in Geology, University of Exeter, UK. Ellis Horwood Ltd., John Wiley & Sons, NY.
- The web site www.epa.gov gives numerous links to sites containing information on radioactivity.
- Compiled by Dr. Mel Gascoyne, GGP Inc., Pinawa, Manitoba, Canada (Dr. Gascoyne is a geologist and water chemist and has worked in the nuclear industry for over 25 years).

Section 4: Other Technical Bulletins

The following technical bulletins are available online at www.marble-institute.com:

- Countertop Sanitation Study Ranks Granite #1 in Cleanability (June 2004 reprint of 1999 study)
- Countertop Sanitation Study Compares Natural with Engineered Stone (February 2006)
- Granite & Radon — The Truth (September 1995)
- Marble Soundness Classification (January 2005)
- OSHA Bulletin: Hazards Associated with Transporting Granite and Marble Slabs (September 2005)
- Preparing a Generic Material Safety Data Sheet (MSDS) (August 2005)
- Rodding Granite Countertops (April 2004)
- R-Value for Natural Stone (August 2004)
- Sealing Natural Stone (May 2004)
- Wood Packaging Materials (August 2005)

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This bulletin is intended as an educational tool for natural stone professionals and other stakeholders (e.g. architects, interior designers, etc). A consumer oriented version of this bulletin is available from the Marble Institute.