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# Management of TENORM

## Practical Assessment

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(May 13, 2014)

- Overview
- Oil and Gas Operations
  - Regional Considerations
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- Looking Ahead

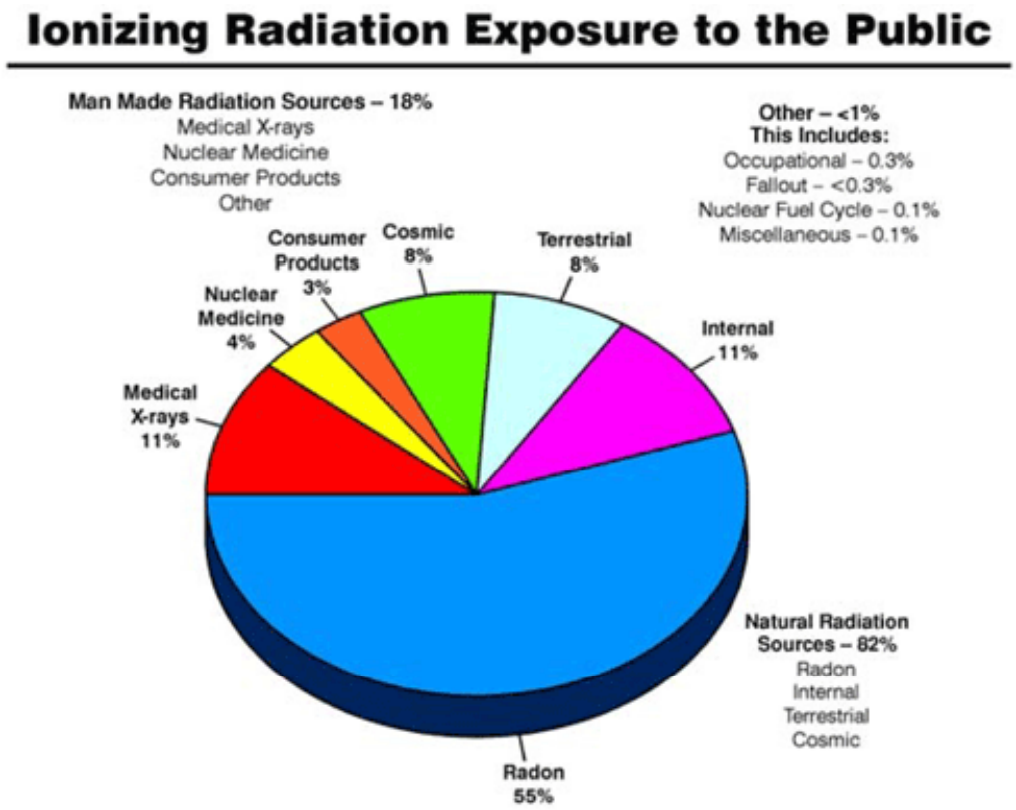
# Overview

- The Earth itself is radioactive, and the ground contains a variety of radioactive isotopes.
- This naturally occurring radioactive material (NORM) is typically composed of one or more of the following elements:
  - Radium and its Decay Products
  - Uranium and its Decay Products (including Radon)
  - Thorium and its Decay Products
  - Lead-210

# Overview

- The metals usually do not exist in their free metallic form but are found in the geology as salts.
- Uranium salts are generally not soluble in water, but radium salts are. The water existing within the rock formations, called produced water, has high concentrations of both salts – hence the term "*brine water*" – and radioactivity.

# Overview



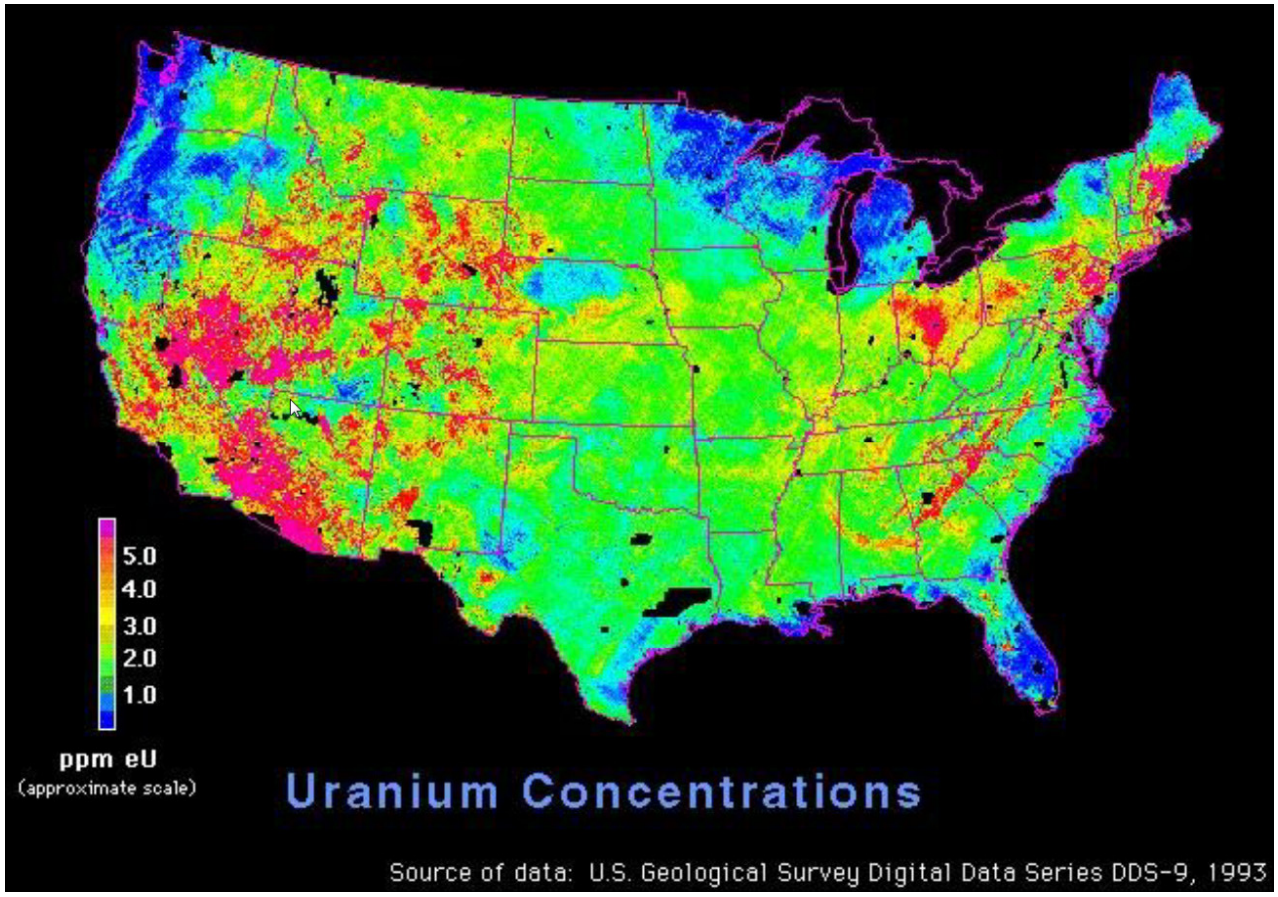

The above chart is taken from the National Council on Radiation Protection and Measurements (NCRP) Report No. 93, "Ionizing Radiation Exposure of the Population of the United States," 1987.

This chart shows that natural sources of radiation account for about 82% of all public exposure while man-made sources account for the remaining 18%.

# Overview

- This natural radiation is not a cause for concern as it contributes to normal background radiation.
- Industrial operations, however, may concentrate NORM and produce technologically enhanced naturally occurring radioactive material (TENORM).
- TENORM may pose a higher risk to humans as a result of the higher concentrations of radioactive materials.

# Oil and Gas Operations



# Oil and Gas Operations

- Natural gas deposits tend to have higher concentrations of radioisotopes.
- The elevated presence of radioactive material assists geologists in their efforts to identify natural gas deposits.
- The presence of NORM also raises operational considerations if the site is selected for active drilling and production.

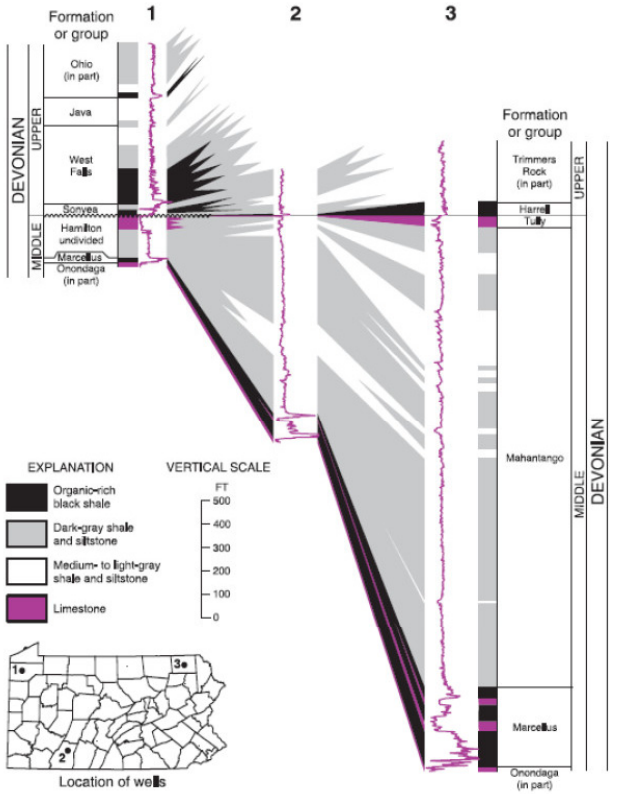



Figure 2. Correlation of Middle and Upper Devonian organic-rich shale facies and interbedded strata in three wells in Pennsylvania, based on gamma-ray log signatures (the jagged purple lines) and descriptions of well cuttings. Note that the black shales correspond in large part to higher-than-normal gamma-ray readings (radioactivity increases to the right in all log signatures).





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# Oil and Gas Operations

When a well is installed, NORM can come to the surface in several ways:

- Drilling Fluid - during the drilling process, the rock cuttings must be removed so drilling can continue. To this end, drilling fluid is used to bring the rock cuttings to the surface. The drilling fluid can be a liquid, a gas, or a combination of the two. Drilling fluid is usually a mud-like substance that contains the rock cuttings, which may have radioactive solids, and formation water, which likely has radioactive salts.

# Oil and Gas Operations

- Hydraulic Fracturing – anywhere from 10 to 40 percent of the water used in hydraulic fracturing comes back up the well carrying formation water and concentrations of salts that dissolve in the fracturing water, which may include NORM.

- Production – produced water, which may contain high concentrations of salts and radioactive material, is brought to the surface along with the extracted gas and oil. It is also possible that radon gas may be extracted along with the natural gas.

# Oil and Gas Operations

When a well is operated, NORM may be concentrated into TENORM in several ways:

- Scale – salts have a specific solubility in water. Once that solubility level is reached, no more of that salt will dissolve in the water. Excess salt – including radioactive salts – will precipitate out on nearby solid surfaces, including the well head and casing. Other areas that can have radioactive scale deposits include the water lines associated with separators, heater treaters, and gas dehydrators.
- Sludge – sludge is composed of dissolved (potentially radioactive) salts that precipitate from produced water as its temperature and pressure change.

# Oil and Gas Operations

- Recycling Water – radioactive salts are not easily filtered out of water. So, each time the water is sent down the well, the concentration of radioactivity in the water increases. In addition, if chemical scale inhibitors are used, the concentration of radioactivity remains in the water.
- Operators use recycled water in many different ways in an effort to be environmentally conscious and efficient, but these practices may have unintended consequences.
  - For example, operators routinely spray recycled water on unpaved roads several times a day as a dust suppressant, which could expose workers and the environment to increased radiation levels. In the winter, recycled water can also be sprayed on roadways to de-ice the roads, having a similar result.

# Oil and Gas Operations

- Filters – often cloth or bag filters are employed in the process of cleaning the water before reuse. The fine sediment that collects in the screen or filter may contain elevated radioactivity.

- Separation Pits – separation pits are used to divide the solids, including drill cuttings, and from the liquids – produced water and drill fluid. As the solids settle out, they may contain increased concentrations of radioactive material. The liquids may also have increased radioactive concentrations.

- Shale Shakers – a similar concept to the separation pits, shale shakers are used to separate solid and liquid wastes. Both the liquid and solids may contain elevated radioactivity.

# Oil and Gas Operations

- Equipment – as a result of work processes that spread radioactivity over the work site, the equipment can become contaminated with radiation. Gas processing equipment with the highest radiation levels includes reflux pumps, propane pumps and tanks, and more.

# international presence

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*In association with Mohammed Buhashem Advocates & Legal Consultants