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Geochemical Controls On Naturally-Occurring Radionuclides In Private Well Water Of The North Carolina Piedmont

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We present detailed results of natural contaminant occurrence for about 150 wells on the Piedmont of North Carolina, mostly drilled into granite, gneiss, metasedimentary rocks, and metavolcanic rocks. Our results suggest that the overall occurrence of radionuclides in water is highest where rocks containing elevated levels of uranium and thorium, such as granite, are present. However, localized spots exhibit high radionuclides in water in other rock types as well. In the Rolesville Granite, near Raleigh, North Carolina, 72%, 6%, and 9% of water samples exceed existing or proposed EPA drinking water standards for radon, radium, and uranium, respectively. High levels of radon tend to be associated with oxic, slightly acidic waters low in dissolved solids, and elevated radium tends to occur in low-dissolved oxygen waters containing higher dissolved solids. This suggests important links between water chemistry, redox state, and/or weathering, rather than only the radionuclide content of the rock as controls. Although some previous research indicates the importance of reducing conditions on radium mobilization, detailed studies of radium geochemistry in fresh natural waters are uncommon. Our findings indicate that although radium has only one redox state, radium behaves in an indirectly redox-sensitive fashion, probably because its adsorption sites are susceptible to reductive dissolution. As other natural contaminants (e.g. arsenic and uranium) are also redox-sensitive, dissolved oxygen measurements will provide additional valuable information in contaminant occurrence studies. Outside of regulated public water systems, there may be little information about radionuclide occurrence in rural areas, where a high percentage of water supply is from private wells. Because these radionuclides result in increased cancer risk from drinking water, this pattern may be of public health significance for the Piedmont region of the eastern United States.