Extremophile bacteria could be key to solving nuclear problems

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Radiation-tolerant bacteria could be even more effective at clearing up nuclear waste through natural processes than previously thought.

Last year, a team from the University of Manchester discovered an 'extremophile' microorganism in the Peak District, capable of breaking down organic material that is present in nuclear waste, preventing the organic compounds from leaching out key radioactive elements into the environment.

Other studies from the group have shown that land contaminated with radioactive waste can also be cleaned up by bacteria that convert soluble forms of radionuclides, such as uranium, to insoluble forms that are less hazardous and mobile. However, for this to be useful, a critical question has needed addressing for some time; whether these unusual naturally occurring activities are killed off by radiation associated with the radioactive waste.

Now in a new paper published today in the journal *Applied and Environmental Microbiology* the team explain how they have discovered that radiation could actually allow certain microbes to thrive, rather than killing them, possibly including a species known to transform radioactive material into much more stable forms. Hence, radiation could make them more effective in the cleanup of contaminated land or in contributing to the safety of radioactive waste disposal in the long-term.

Professor Jonathan Lloyd, who has led the research at the University of

Manchester, said, "This could provide a new, and very useful extra layer of protection when we are trying to dispose of nuclear waste. There are advanced plans on how this can be done safely, often involving the use of concrete and steel barriers, but there is recognition that at some point in the distant future these barriers will be breached.

"But by assessing the ability of these useful microbes to survive radiation stress, we can be more confident that the waste will remain locked-up for very long periods of time (many thousands of years), helped by a naturally evolving "biobarrier". Before this research, the assumption was that the radiation would probably kill off the bacteria that we are studying, but it seems that is not the case. It is potentially a very important finding for the nuclear industry, and illustrates how resilient biology can be!"

Getting rid of nuclear waste poses a big problem for the UK, with very large volumes destined for burial deep underground. The largest volume of radioactive waste, termed 'intermediate level' and comprising of 364,000m3 (enough to fill four Albert Halls), will be encased in concrete prior to disposal into underground vaults. When ground waters eventually reach these waste materials, they will react with the cement and become highly alkaline.

More information: "The impact of gamma radiation on sediment microbial processes." *Appl. Environ. Microbiol.* AEM.00590-15; Accepted manuscript posted online 3 April 2015, DOI: 10.1128/AEM.00590-15

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