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Study of the origin of soil ^{222}Rn and ^{220}Rn activities in Taylor Valley, Antarctica.

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Warming global climate threatens the stability of the polar regions and may result in cascading broad impacts. Studies conducted on permafrost in the Arctic regions indicate that these areas may store almost twice the carbon currently present in the atmosphere. Therefore, permafrost thawing has the potential to magnify the warming effect by doubling the more direct anthropogenic impact from burning of fossil fuels, agriculture and changes in land use. Permafrost thawing may also intensify the Rn transport due to the increase of fluid saturation and permeability of the soil. A detailed study of ^{222}Rn and ^{220}Rn activity levels in polar soils constitutes a starting point to investigate gas migration processes as a function of the thawing permafrost. Although several studies have been carried out in the Arctic regions, there is little data available from the Southern Hemisphere. The Italian – New Zealand "SENECA" project aims to fill this gap and to provide the first evaluations of gas concentrations and emissions from permafrost and/or thawed shallow strata of the Taylor Valley, Antarctica. Taylor Valley is one of the few Antarctic regions that are not covered by ice and therefore is an ideal target for permafrost investigations. Results from our field observations highlight very low values for ^{222}Rn and higher values for ^{220}Rn, suggesting a shallow source. Usually the measured ^{222}Rn activity values are controlled by the radionuclide content in the soil, the temperature of the soil, the porosity of the soil, and the water content. By means the comparison between the ^{222}Rn values measured in situ and in laboratory analyses on the collected soil samples, the presence of ^{222}Rn amounts higher than those naturally produced by the outcropping sediments is detected. These results demonstrate the presence of preferential gas pathways through the permafrost from a deep source. It is the first time that this type of study has been performed in Antarctica and can make a significant contribution to understanding the melting permafrost processes and its implications for the environment. This dataset also represents an important benchmark for future measurements to track the melt progress of Antarctic permafrost.