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Geochemical and Mineralogical Characteristics Influencing Natural Radioactivity in Triassic Granites from Yongyu-do, South Korea

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Naturally occurring radioactive materials (NORMs) refer to radioactive nuclides such as ^{238}U, ^{232}Th, ^{226}Ra, and ^{222}Rn that exist in geological media [1]. The radiation emitted during their decay can pose health risks with prolonged human exposure [2,3]. Previous research indicates that the Triassic plutonic rocks in Yongyu-do, Incheon, located in the Hongsung-Imjingang Belt of the Korean Peninsula, contain high concentrations of NORMs, with U ranging from 8.1 to 11.1 mg/kg and Th from 66.5 to 74.4 mg/kg [4]. These NORMs are primarily hosted within accessory minerals, which can significantly influence rocks' radioactivity [5]. Here, we explore the mineralogical and geochemical characteristics of the rocks, with a particular focus on accessory minerals, to clarify the potential relationships between natural radioactivity and these factors. A total of 29 granite and altered granite samples were collected from Yongyu-do. The mineralogical composition was identified using XRD and PLM analyses. Gamma-ray spectroscopy was performed to measure the radioactivity of the rocks. ICP analysis was used to determine the whole-rock chemistry, while EPMA was conducted to examine the elemental composition of accessory minerals likely to contain NORMs. The rocks were primarily biotite granite, consisting mainly of quartz, alkali feldspars, and biotite. Their radioactivity ranged from 20.4 to 248.7 Bq/kg for ^{226}Ra and from 47.4 to 341.9 Bq/kg for ^{232}Th. Rocks that had undergone severe hydrothermal alteration exhibited high aluminum saturation indices (ASI) and contained abundant sericite and muscovite. However, their radioactivity did not consistently show a proportional relationship with the ASI. U and Th were mainly concentrated in accessory minerals, such as zircon, uranothorite, and monazite. Our ongoing research aims to characterize the geochemical and mineralogical properties of granites containing NORMs, providing insight into the influence of geological processes, such as magma differentiation and hydrothermal alteration, on the behavior of NORMs in the rocks.

[1] United States Geological Survey (1999); [2] World Health Organization (2023); [3] United States Nuclear Regulatory Commission (2024); [4] Kim (2020), *Economic and Environmental Geology* 57, 563-575; [5] Seow, Mohan Viswanathan & Dodge-Wan (2024), *Environmental Science and Pollution Research* 31, 43292-43308.