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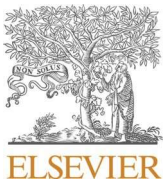

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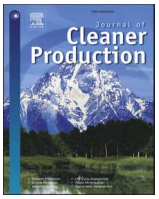

Investigation of radiogeology and environmental geochemistry of quarry ponds in post-tin mining areas of Phuket Island, southern Thailand

Wipada Ngansom [a,*], Dumrongsak Rodphothong [a], Thawatchai Itthipoonthanakorn [b], Saroh Niyomdecha [b], Helmut Dürrast [c], Weerawat Intaratat [d], Patchareeya Chanruang [e], Chakrit Saengkorakot [e], Monthon Yongprawat [e,**]

[a] Department of Physics, Faculty of Science, Ramkhamhaeng University, Bangkok, 10240, Thailand
[b] Regulatory Technical Support Divisions, Office of Atoms for Peace, Bangkok, 10900, Thailand
[c] Geophysics Research Center, Faculty of Science, Prince of Songkla University, Hat Yai, 90110 Thailand
[d] Program of Physics, Faculty of Science and Technology, Phuket Rajabhat University, Phuket, 83000, Thailand
[e] Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology, Nakhon Nayok, 26120, Thailand

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ABSTRACT

Increasing demand for water supply on Phuket Island for both the local consumption and hotel industry has led to overexploitation of ground- and surface water bodies; hence, it is unremittingly important to monitor the local hydrologic regime. Radiogeological and hydrogeochemical environments are investigated by representative water and surface sediment samples collected from the different quarry ponds located in post-tin mining areas on Phuket Island. The study assessed water quality, analyze the relationship between bedrock weathering and water quality, and identify radiogeological factors and natural radon concentrations, with insights into the local geology of the study areas. The representative quarry ponds of Phuket Island consist of a granite quarry pond (PKW1), a Quaternary sediment quarry pond (PKW2), a granitic-metamorphic quarry pond (PKW3), and the perturbation pond (PKW4), with the formation of a variety of geologic features. All collected water samples show total cation concentrations with $Ca^{2+} > Na^{+} > K^{+} > Mg^{2+}$ and total anion concentrations with $HCO_3^- > Cl^- > NO_3^- > SO_4^{2-}$. However, Gibbs diagrams suggest that rock–water interactions and precipitation are major factors in geochemical processes controlling the water quality. Radon enrichments in the water samples are involved in the local geological structures and hydrogeological environments, as follows: PKW1 > PKW3 > PKW2 > PKW4. No significant correlation between the radon activity concentrations and major/minor ions is shown. Surface sediment samples are reported, and the activity concentrations of radium-228 and thorium-228 (radioactive decay series of thorium-232) are relatively higher than those of radium-226 (radioactive decay series of uranium-238). Therefore, the activity concentrations of natural radionuclides in the surface sediments could be directly influenced by physical weathering, particularly the depositional environments of granitic bedrock around the quarry ponds. Long-term monitoring is necessary to consider the behavior of quarry ponds, which is related to tourism planning and the overall development of Phuket Island.

1. Introduction

Phuket Island, located in Southern Thailand, is one of the world's most popular tourist destinations and with 543 km^2 the largest island in Thailand (Fig. 1; World Tourism Organization, 2021; Wood, 2022), and having a local population of around 418,000 people (reported by Phuket Provincial Administrative Organization, 2022). The economic growth rate of the Phuket Island tourism industry, its key economic factor, has followed Thailand's GDP (World Tourism Organization, 2021), and is expected to bounce back after a decline during the Covid-19 years. In 2022 Phuket welcomed 9 million Thai and foreign visitors, whereas for 2023 around 12 million visitors are expected (reported by Tourism Authority of Thailand, Phuket office, 2022). The number of inbound tourists increases usually during the tourist season from November until

* Corresponding author.
** Corresponding author.
E-mail addresses: wipada.n@rumail.ru.ac.th (W. Ngansom), monthon@tint.or.th (M. Yongprawat).

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