



Using Radon and Radium isotopes to trace submarine groundwater discharge in Yilan Plain, Taiwan

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The Yilan Plain which located in the northeast Taiwan was selected for submarine groundwater discharge (SGD) study. The geomorphic and climatic conditions induce lush rain drenched mountains and create abundant groundwater resource in the Yilan Plain. The annual precipitation in 2014 is 2025 mm with most of the precipitation concentrated on autumn (from September to November).

In this study, radon and radium isotopes are used as tracers for SGD survey.

The ^{224}Ra ($t_{1/2} = 3.6$ days) was measured by a delayed coincidence counter (RaDeCC). The ^{222}Rn ($t_{1/2} = 3.8$ days) was measured by RAD-7 equipped with RAD H₂O and RAD AQUA system.

The river-water samples were collected from the main stream of Lanyang River and its tributaries from upstream to river mouth. The spring-water samples were collected at 8 sites in April, July and October 2014. Ten surface seawater samples along the coastline of the Yilan Plain were collected in August 2014.

Our results show the activities of ^{222}Rn and ^{224}Ra in springs ranging from 3400 to 30850 Bq/m³ and 0.02 to 0.29 Bq/m³, and there are no significant differences between wet and dry seasons. Unexpectedly, the springs are characterized with high ^{222}Rn and low ^{224}Ra activities. For river samples, the activities of ^{224}Ra in downstream and river mouth (0.18 to 1.48 Bq/m³) are higher than upstream (0 to 0.3 Bq/m³). The average activity of ^{224}Ra in downstream samples which collected in April (0.98 Bq/m³) has the highest value than other seasons (0.41-0.51 Bq/m³). In coastal seawater, the activities of ^{222}Rn and ^{224}Ra ranged from 0 to 366 Bq/m³ and 0.10 to 1.14 Bq/m³ in August 2014.

In summary, this study points out in some coastal regions of the Yilan Plain, where without riverine input, have high ^{222}Rn and ^{224}Ra activities in seawater. We suggest the SGD plays an important role on land-sea exchange along the coastline of the Yilan Plain. Compare with the spring water samples, the ^{224}Ra activities in coastal seawater are 3-4 times higher than springs. It reveals that the SGD of the Yilan Plain may derive from deep aquifers.