THE LATITUDE EFFECT ON ISOTOPIC COMPOSITION IN PRECIPITATION ACROSS THAILAND

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Abstract
This study investigated the spatial and temporal variation of the isotope precipitation over Thailand in related to climatic and geographic conditions. The 3 years (2013-2015) daily data of stable isotope (δD and δ18O) and climate data were conducted along latitude transect (from 5°37’N to 20°27’N) to determine possible effects of latitude and climatic condition on the δD and the δ18O signature. To this end, the spatial variability is mainly affected by the latitude effect, the isotopic latitude effect in wet season have negative correlation average -0.23 ‰/°N for δD and -1.59 ‰/°N for δ18O. Conversely, the event base latitude effect in dry season have positive correlation average +0.12 ‰/°N for δD and +0.81 ‰/°N for δ18O. These effects are conversely trend depending upon monsoon events and seasonal effect.

I. Introduction
In Thailand, isotope hydrology had been used to assess the hydrogeologic cycle, particularly surface water and ground water interaction. However, the fractionation effect of isotopes in local precipitation separately in dry and wet season have never been analyzed. Hence, this study considered the raw data of the isotopic composition (δD and δ18O) in precipitation at 26 stations collected during 2013-2015 over Thailand (Fig 1), to study possible spatial and temporal correlations between the isotopic composition and latitude effect during wet season (June-October) and dry season (November-May).

II. Climate Condition
The climate of Thailand is affected by the seasonal characteristics of the southwest (June - October) and northeast monsoons (November - April) including the Intertropical Convergence Zone (ITCZ) and tropical cyclones (Fig 2).

III. Data Analysis
Daily precipitation samples were collected (2013-2015) in 26 sites as standard rain gauge at 07:00 local time (if rainfall had occurred). Temperature and relative humidity were also made at same time. All samples were analyzed as soon as possible after collection using Cavity Ring-Down Spectroscopy (Picarro L2130-i Analyzer) at Thailand Institute of Nuclear Technology (TINT). Analytical precision was 0.55‰ for δD and 0.16‰ for δ18O. These data were fitted by using least square regression method to report and discuss the latitude effect on the isotopic composition in precipitation during wet and dry seasons.

Spatial Distribution

Vertical Integrated Moisture Flux

IV. Results
The isotopes in the precipitation generally depletes with increasing latitude in wet season, associated to southwest monsoon which brings air originated from Indian Ocean toward Thailand (Fig 4a). On average, the δ18O latitude effect is -0.23 ‰/°N (R=0.75), and for δD it amounts to -1.59 ‰/°N (R=0.71) exposed negative correlation. Conversely, the isotope value enriches with increasing latitude throughout dry season. This is happened because the effect of northeast monsoon over northern Thailand, which brings cool moisture with enriched isotopes from the South China Sea (Fig 4b). At the same time, the southern Thailand is affected by the ITCZ and easterly winds that contain supersaturated air from the Gulf of Thailand producing heavy rain. Therefore, the heavy isotopes were depleted during November until February in lower latitude area. On average, the latitude effect in dry season is +0.12 ‰/°N for δ18O (R=0.34), and +0.81 ‰/°N for δD (R=0.27) exposed positive correlation (Fig 5).

V. Conclusion
In tropical regions, the latitude effects on an isotopic precipitation can be adequately described in terms of condensation processes and the original moisture sources change seasonally. The slope of latitude effect appears to be related to the amount of precipitation, resulted the latitude effect in wet season is greater than dry season.

The regressions of latitude effect have different trend when related to the amount of precipitation, resulted the latitude effect seasonally. The slope of latitude effect appears to be related to the amount of precipitation, resulted the latitude effect in wet season is greater than dry season.

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References