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Relationship between modern speleothem formation and surface weather in an Asian tropical cave

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Introduction

For precise climate prediction, it is necessary to reconstruct high time and space resolution paleo-climate (especially past 2000 years) from paleo-climate proxies and assimilate the result to climate model. Tropical Asia, including Indonesia, is well affected by El Nino Southern Oscillation (ENSO). The ENSO does not only directly affect on precipitation in tropical Asia, but also indirectly on middle and high latitude climate through teleconnection [1]. In Indonesia, Watanabe et al. [2] suggested inverse-correlation between δ^{18}O and δ^{13}C in speleothems and instrumental precipitation. However, relationship between modern speleothem formation and surface weather is not revealed clearly.

Therefore, the cave monitoring program, which included cave air temperature, relative humidity, airflow current, air CO_2 concentration monitoring and δ^{18}O and δ^{13}C analysis of dripwater and farmed speleothems, was initiated from 2011 in Petruk Cave (Central Java, Indonesia) in order to study the recording mechanism of precipitation variation into the δ^{18}O and δ^{13}C fluctuation in speleothems.

Result and Discussion

Air CO_2 concentration in Petruk Cave is fluctuated daily and seasonally until over 100 m deep site from the entrance.

It is revealed that cave air CO_2 concentration may be a significant factor that controls stable isotope value in speleothems, because temperature, humidity and drip rate in Petruk cave are nearly stable.

A scenario of precipitation recording is as follows: (1) surface rainfall cools outside air temperature; (2) cave airflow direction is inversed; (3) outside fresh air flows into the cave and air CO_2 concentration is dropped; (4) pCO_2 difference between cave air and dripwater becomes higher and calcite precipitation is promoted; (5) δ^{18}O and δ^{13}C in dripwaters and speleothems are decreased.

In addition to above discussion, we will show you δ^{18}O and δ^{13}C values in dripwaters and farmed speleotems and confirm the scenario by these data.

[1] Hastenrath (1991) Climate dynamics of the tropics. [2] Watanabe et al. (2010) Palaeogeography, Palaeoclimatology, Palaeoecology 293, 90?97.

Keywords: cave monitoring, speleothem, isotope, peleo-climate