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Relationship between modern speleothem formation and surface weather in Southeast Asian equatorial cave

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To predict future climate change and prepare it is large scientific and social problem. For precise climate prediction, it is necessary to reconstruct high time and space resolution paleo-climate (especially past 2000 years) by paleo-climate proxies and reflect the result to climate model. Equatorial Southeast Asia, where include Indonesia, is well affected by El Nino Southern Oscillation (ENSO). ENSO do not only directly affect to precipitation in tropical Southeast Asia, but also significantly affect to middle and high latitude climate through heat transport (Hastenrath, 1991). However, continuous paleo-climate data in that area is few (IPCC, 2007), thus paleo-climate reconstruction is particular necessary.

Speleothems are useful as a pleo-climate proxy because they are grown continuously in cave (Fairchild et al., 2006). Watanabe et al. (2010) revealed that oxygen and carbon isotopic ratios in the stalagmite calcite are useful as an effective proxy of ancient precipitation, because annual precipitation amounts have negative correlation with delta ^{18}O and delta ^{13}C values in stalagmite sample. However, relationship between modern speleothem formation and surface weather (e. g. recording mechanism of precipitation in stalagmites, how large or in which season precipitation is recorded in) is not revealed clearly. Thus, cave monitoring studies (cave and surface climate, dripwater chemistry, modern speleothem growth experiment) are starting actively (e. g. Boch et al., 2011; Tremaine et al., 2011). But, few are studied in equatorial region.

Baldini et al. (2008) revealed that seasonal airflow direction change, which was driven by seasonal air temperature difference fluctuation between cave and surface, fluctuated cave air CO_2 concentration, and that might influence delta ^{13}C in stalagmite. Tremaine et al. (2011) revealed that seasonal cave air CO_2 concentration variation fluctuated CO_2 degassing rate from dripwater, and then produced seasonal variation of speleothem precipitation rate. However, these were studied in temperate region. In equatorial region, it is predicted that intra-daily variation of cave air CO_2 concentration is main cause which fluctuate growth rate and stable isotope composition, because it is considered that cave airflow direction is dominated by intra-daily surface air temperature fluctuation rather than seasonal.

Thus, in this study, cave monitoring, which included surface meteorological observation (air temperature, precipitation and delta ^{18}O), cave meteorological observation (air temperature, airflow direction and speed and CO_2 concentration), chemical analysis of dripwaters (pH, Ca^{2+} concentration, HCO_3^- concentration, partial pressure of CO_2 ,calcite saturation index, delta ^{13}C, and delta ^{18}O) and speleothem growth experiment (growth rate, delta ^{13}C, and delta ^{18}O), is started from October 2011 in Petruk Cave, Central Java, Indonesia. High time resolution monitoring (2 hour interval) is conducted in addition to 1 to 3 month interval monitoring which is generally conducted in temperate caves. Aim of this study is to reveal relationship between speleothem formation (growth rate and stable isotopic composition) and surface weather in equatorial cave through obtain time series monitoring data and compare them mutually.

Keywords: cave, stalagmite, carbon dioxide concentration, dripwater, equatorial region, Indonesia