A high-resolution age model from annual bandings in a stalagmite collected in Java, Indonesia

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Speleothems are studied throughout the world in order to reconstruct palaeoclimate change because of their feature for age model. However, very few research using speleothem has done in the Asian equatorial regions where important climate phenomenon occur, such as El Niño Southern Oscillation (ENSO).

'The Cave Project' in KAGI21 has performed geological surveys in limestone caves in Java, Indonesia and collected many speleothems. We aim at reconstructing short-term variations of past climate. A high-resolution age model and more precise understanding of the growth mechanism of speleothems are critical for this purpose. So the aims of this study are the following things:

1. Revealing that the growth bandings of Indonesian stalagmites are annual so as to make a high-resolution age model.
2. Bringing out constituent of their bandings in order to understand growth mechanism of speleothems.

This study collected two stalagmites (CIAW15a, PEN05a) from Ciawitali Cave, West Java and Penganten Cave, Central Java, respectively, which were observed and analyzed with optical microscope, fluorescent microscope, scanning electron microscope (SEM) and Raman spectroscopy. We counted their bandings with optical microscope.

One band is composed of a pair of transparent and opaque layers. The latter showed blue fluorescence under the fluorescent microscope and many tiny holes under optical microscope and SEM. Raman spectroscopy of thin section and residue after dissolved with hydrochloric acid made clear that the transparent layers of both stalagmites were composed of calcite and the opaque layer of PEN05a was mainly composed of calcite with small amount of detrital crystals of pyroxene and feldspar and unidentified organic matters.

We counted 502 bandings which had clear boundary and 870 bandings which had unclear boundary in 12 cm from the top of PEN05a, and 744 clear bandings and 494 unclear ones in 5.4 cm from the top of CIAW15a. Two U-Th ages were measured in CIAW15a, which were 764-874 and 948-1088 years in 28-40 mm and 44-54 mm, respectively. The average numbers of layer counting in the same areas were 796 and 1125. These results indicate that the growth bandings of CIAW15a may be annual.

Annual growth bandings in the Indonesian stalagmite revealed by this study will provide a high-resolution age model for past climate reconstruction. Moreover, it is indicated that annual bandings were formed reflecting seasonal variation such as dry/wet seasons. So they can be useful for climate proxy, which needs more crystallographical information how bandings are formed.