Geophysical Research Abstracts, Vol. 9, 03140, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03140

A 12,800 year palaeomonsoon record from a stalagmite in Flores, Indonesia

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The Australian-Indonesian monsoon is among the largest monsoon systems on Earth. Similar to its northern hemisphere counterparts (e.g., Asian monsoons), the affected region experiences a marked seasonal cycle in winds and precipitation. At lower levels, the mean winds shift from easterly in the austral winter (with low precipitation, the 'dry season') to westerly in summer (with enhanced precipitation, the 'wet season'). The Indonesian archipelago is home to millions of people who rely on the monsoon for their livelihood. Climate is the limiting factor controlling food production and it is therefore of vital importance that we gain a clearer understanding of the parameters which control variations in monsoon intensity. This will better enable scientists to predict future changes in the Australian-Indonesian monsoon under enhanced greenhouse gas conditions.

Precise uranium series dating of an actively growing $\sim$1.2 metre long stalagmite (LR-06-b) from Liang Luar (Flores, eastern Indonesia) reveals a basal age of $\sim$12,846 $\pm$ 103 years. The speleothem was active at the time of collection, which indicates that the sample may have grown continuously for the entire Holocene. In previous studies, stable isotope ratios (δ^{18}O and δ^{13}C) and trace element concentrations in speleothems have revealed past environmental change (e.g., Burns et al., 2001; Wang et al., 2001, 2005; Fleitmann et al., 2004; Drysdale et al., 2004; Yuan et al., 2004). In monsoon-affected regions, the δ^{18}O signal recorded in stalagmites seems to be dominated by the amount of precipitation (so-called 'amount effect'), whereby lower (higher) δ^{18}O values indicate enhanced (diminished) precipitation. Preliminary low-resolution δ^{18}O values of LR-06-b reveal a marked increase in monsoon rainfall from the beginning of the record to $\sim$9000 years B.P. From this point to the present, values have remained reasonably constant with the exception of some abrupt changes. The low frequency variations in δ^{13}C have similarities with the changes in δ^{18}O over the period of record. This suggests that changes in the monsoon may have had some influence on the overlying vegetation during the Holocene, although this needs support from trace element analyses, which are currently in progress.

Given the paucity of accurately dated palaeoclimate time series from the Australasian region, there is an urgent need for high-resolution records covering periods of known environmental change, such as from the last glacial-interglacial transition to the present. Results from our study will contribute to a better understanding of tropical palaeoclimates, and help scientists to gain a clearer understanding of the mechanisms driving the changes in the Australian-Indonesian monsoon system during the Holocene.