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主　論　文　の　要　旨

論文題目　Development of new dendrochronology in tropics using oxygen isotope ratios and its application to a 400-year hydroclimate reconstruction in northern Southeast Asia

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論　文　内　容　の　要　旨

Monsoon and El Nino southern Oscillation (ENSO) variations, especially associated precipitation changes, have an important effect on agrarian economy of densely populated regions in Southeast Asia and civilizations shift during the past several hundreds of years. However, the instrumental climatic data in this area are spatially and temporally limited. Therefore, tree ring records are necessary to improve our understanding of Asian summer monsoon and ENSO variability.

However, there are two difficulties to hinder the development of tree ring research in tropical area. One is that tropical tree-ring boundaries are often anatomically less distinct, so it is hard to get the basic information (annual growth) for forest and tree ring research. The other is that the correlations between the tree ring width time series of different trees are very low because of ecological disturbance, which result in difficulty in cross-dating using ring width and climate reconstruction based on relationships between ring width-climate parameters.

Therefore, a new proxy which can be used for measuring annual growth for trees without clear ring boundary and can be climate-sensitive is needed. Tree ring cellulose $\delta^{18}O$ seems to be such a good proxy to solve the problems in tree ring research in tropical area based on tree ring cellulose $\delta^{18}O$ fractionation model.

At first, I analyzed intra-annual variations of tree ring cellulose $\delta^{18}O$ for trees without distinct rings (*Styrax* and *Ficus sp*) in northern Laos, and found that there were clear annual cycles of tree ring cellulose $\delta^{18}O$ of *Styrax* and *Ficus sp*, which can be used for measuring annual growth for tropical trees without distinct annual rings.

I measured tree ring cellulose $\delta^{18}O$ of seven cores (*Fokienia hodginsii* with clear ring boundary) with annual-resolution in natural forest in northern Laos during the period of 1588-2002, and found that compared with tree ring width, tree ring cellulose $\delta^{18}O$ shows more consistent variations between different trees, displays higher signal strengths and has significant correlations with climatic parameters (temperature, precipitation and Palmer Drought Severity Index (PDSI)), which indicate that tree ring cellulose $\delta^{18}O$ can provide a useful method to cross-date tree samples, especially for trees in tropical areas that cannot be cross-dated using ring width due to frequent endogenous disturbance or the lack of distinct limiting factors for tree growth.

After solving the cross-dating problem, I reconstructed the monsoon season PDSI based on the linear regression between PDSI and tree ring cellulose $\delta^{18}O$. Reconstructed PDSI shows that the wetter periods were identified as AD 1660-1695, AD 1705-1790, whereas the drier periods mainly occurred during AD 1630–1660, AD 1900-1940 and AD 1954-2002, and a decreasing trend of moisture in monsoon season over the last 200 years. Reduction of monsoon activity can be also found across different tree ring cellulose $\delta^{18}O$ records from the Himalaya, Tibet Plateau and Southeast Asia. Rising sea surface temperatures over the tropical Pacific and Indian Ocean could be responsible for the reduction of Asian summer monsoon.

The correlation analysis between tree-ring cellulose $\delta^{18}O$ and global sea surface temperature (SST) /the Multivariate El Niño-Southern Oscillation (ENSO) Index (MEI) during the investigated period (1872-2002) reveal that ENSO has an important effect on tree-ring cellulose $\delta^{18}O$ in northern Laos. Combining ENSO-sensitive proxy (tree-ring cellulose $\delta^{18}O$ of *Fokienia hodginsii*) in northern Laos and Vietnam, annual MEI and local ENSO even ts history are reconstructed during the period of 1605-2002, which is consistent with global ENSO events.