

Editorial: How does research in Japan contribute to the global body of paleoscientific knowledge?

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Despite its long tradition, Japanese paleoscience was not well represented in the scientific world until recently. This may be partly due to Japan's geographical location at the eastern rim of the Eurasian continent, far away from the scientific hotspots of Europe and North America. In addition, numerous publications were written in Japanese and have not yet been translated.

To strengthen the contact with the Japanese paleoscience community and to highlight the diversity of Japanese paleoresearch, a PAGES Regional Workshop was held in Nagoya, Japan in 2010, alongside the PAGES Scientific Steering Committee meeting. That workshop resulted in the idea of a dedicated special section of the PAGES newsletter. The following thirteen science highlights showcase to the global community a cross-section of Japanese contributions to paleoscience.

The North Pacific Ocean around Japan was for a long time one of the most under-researched areas in paleoceanography due to the very deep waters and the resulting scarcity of calcareous microfossils in the sediments. However, by taking advantage of recent progress in sediment coring technology (e.g. through the IMAGES program), Japanese scientists now have access to many new sediment cores. For example, *Okazaki et al.* used cores from sea mounts and continental slopes to demonstrate that deep-water ventilation occurred in the North Pacific during the deglacial as it does today in the North Atlantic. Recent studies in the western North Pacific Region (*Harada et al.*, *Nagashima and Tada*, and *Yamamoto*) also show that the western North Pacific and its marginal seas are well suited to reconstruct millennial-scale climate variability.

Climate in East Asia, including Japan, is characterized by the strong

Asian summer and winter monsoon, resulting in a meridional "green" belt extending from the equator to the subarctic uninterrupted by any major mid-latitude desert. The monsoon signal is well preserved in the sediments of Lake Biwa, one of the most studied lakes in Japan (*Takemura*). At the northwestern coast of Japan, the strong seasonality intrinsic to the monsoon has led to the formation of distinct varve layers in the brackish lake sediments of Lake Suigetsu. Detailed counting of varve layers up to 150 ka by *Nakagawa et al.* revealed details of climate variations over the entire last glacial-interglacial cycle. Moreover, with several hundreds of ¹⁴C data of plant fragments in the dated varve layers, Lake Suigetsu is now becoming a new international standard for ¹⁴C calibration.

Asian summer monsoon often favors dense forests where it is difficult to extract significant paleoclimate signals from tree-ring width. Alternatives are presented by *Sano et al.* and *Watanabe et al.* They indicate that oxygen isotope ratios of tree-ring cellulose and oxygen and carbon isotope ratios in stalagmites are good proxies for past hydroclimate in the humid tropical-subtropical regions of Asia. Finally, data from glacial ice cores in high mountains (*Fujita and Sakai*) and from coral cores in subtropical islands (*Suzuki*) help elucidate past changes in Asian monsoon dynamics.

Japan has a very long history and a unique cultural heritage. Japanese paleoscientists have been utilizing many precious cultural artifacts, such as documentary information, to reconstruct past variations in climate and environment. One of the significant features in Japanese culture is that, until the 19th century, most buildings in Japan were made of wood. The construction timber can be recovered from old buildings or excavated at archeological

sites, and utilized for high-resolution climate reconstructions. When coupled with $\Delta^{14}\text{C}$ and $\delta^{18}\text{O}$ analyses, these studies can even help in elucidating impacts of changes in solar activity on Earth's past climate (*Miyahara et al.*).

In Japan, the quantity of historical private and governmental documents and their conservation is remarkable, reflecting the high literacy rates in pre-modern Japan. By assembling numerous weather descriptions in national diary archives, daily meteorological conditions in Japan, including weather charts, have been quantitatively reconstructed for the last 400 years (*Zaiki*). Historical documents not only describe daily weather but often also local environmental conditions such as deforestation and animal extinction, together with the population's (political) reactions to those environmental changes. *Yumoto* has led a unique research project involving historians and archeologists, and reports how the Japanese environment has been managed in the past and what lessons can be learned for the sustainable management of ecosystems.

Compared to Europe and North America, past climatic and environmental changes in the western North Pacific and East Asian regions, and their role in the global system, are still poorly understood. Many interesting challenges remain for Japanese and Asian paleoscientists, together with colleagues from elsewhere, to elucidate the unique climate and environment in this region.

