

C-O-Sr isotopic record of monsoon climate during 10-20 ka in a stalagmite from central-west China

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A stalagmite (SJ3) from central-west China (Songjia cave, Sichuan province) was TIMS U-series dated to have developed from 38 to 10 ka ago with a growth hiatus between 35-20 ka. An axial slab of the top section (20-10 ka with average growth rate ~8.8 mm/ka) was sliced in 0.1-mm increments (~5-mg-size sub-samples) along its growth band contours, and one in five sub-samples was selected for C-O isotopic analysis. The SJ3 $\delta^{18}\text{O}$ record displays a pattern similar to those of the Tangshan/Hulu (SE China) and Dongge (SW China) speleothem records [1-3]. The results suggest continent-wide synchronicity in Asian summer monsoon rainfall variation and atmospheric teleconnections played an important role in the rapid propagation of deglacial climatic signals on a hemispheric scale. $\delta^{13}\text{C}$ variation in SJ3 also mimics that of the Tangshan record in SE China, which was interpreted to reflect a vegetation response to monsoon rainfall [2].

Sub-samples at larger intervals were also measured for trace element concentrations and Sr isotopic compositions. Sr and $^{87}\text{Sr}/^{86}\text{Sr}$ in SJ3 both display a strong correlation with $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ in SJ3, and dust flux and median grain size (quartz median diameter) changes in Luochuan loess for the same period [4-5]. We suggest that the Sr and $^{87}\text{Sr}/^{86}\text{Sr}$ in SJ3 were mainly controlled by the dust flux, which reflects winter monsoon intensity, whereas $\delta^{18}\text{O}$ variation records changes in summer monsoon rainfall. The data define a linear negative relationship between $1/\text{Sr}$ and $^{87}\text{Sr}/^{86}\text{Sr}$, reflecting two-component mixing, one being groundwater derived from the bedrock of Late Permian limestone (with lower Sr and $^{87}\text{Sr}/^{86}\text{Sr}$), and the other being exogenic (with higher Sr and $^{87}\text{Sr}/^{86}\text{Sr}$). Extrapolating to $1/\text{Sr} = 0$, we obtain a value of 0.7109 for $^{87}\text{Sr}/^{86}\text{Sr}$ in the exogenic component, which is consistent with the value expected for the carbonate fraction in Chinese loess. Our results suggest that Sr and $^{87}\text{Sr}/^{86}\text{Sr}$ in SJ3 is an ideal indicator of dust flux and wind velocity during the East Asian winter monsoon.

References

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