Refining the age model of the Lake Junín (Peru) drill core by correlation to regional cave stalagmites

Lake Junín, located in the uppermost Amazon Basin in central Peru, was drilled as part of the International Continental Drilling Program in 2015. A piston core with a composite length of ~95 m provides a continuous archive of upstream glacial activity spanning ~700,000 years. The age-depth model was established with 80 AMS ^{14}C dates, 12 U-Th dated intervals of authigenic calcite, and 17 geomagnetic relative paleointensity tie points, and yields an age of 677±20 ka at 88 m. Four samples from near the base of the core reveal normal polarity paleomagnetic directions, consistent with an age younger than ~773 ka. The composite section comprises intervals of siliciclastic sediment intercalated with intervals dominated by authigenic calcite. The siliciclastic-rich intervals have a consistent signature, with relatively low concentrations of carbonate and organic carbon, and high values of bulk density, magnetic susceptibility and concentrations of elements derived from glacial erosion of the non-carbonate fraction of the regional bedrock. We find that tropical glaciers tracked changes in global ice volume and followed a clear ~100,000-year periodicity. Two caves, Huagapo and Pacupahuain, are located within 25 km of Lake Junín and provide a basis for testing and refining the age model of the Lake Junín drill core based on the high precision and accuracy of Uranium series dates for speleothems from these caves. The assumption here is that significant changes in regional ice volume will also be recorded in the $\delta^{18}O$ of cave drip water and thus in speleothems. Our initial target interval is the 9-8 marine isotope stage (MIS) boundary (~300 ka), which is recorded in the Junín drill core as an abrupt increase in the influx of glacigenic sediment, and in stalagmite 22-22 from Huagapo Cave as an abrupt 4.5‰ decrease in $\delta^{18}O_{calcite}$. The age of the onset of this transition in the Junín drill core is about 25 kyr older than that in Stal 22-22, and this difference is within the age model error envelope for the Junín drill core. Similar MIS boundaries provide the basis for adjustments in the Junín age model, which will improve the precision of correlation of this continuous record of tropical glaciation with paleoclimate archives in extra tropical regions.