

Reconstruction of Vistulian palaeoenvironmental conditions based on analysis of speleothems from the Demänová Cave System

Abstract

The reconstruction of paleoenvironmental conditions during the Vistulian period was based on three speleothems formed in the Demänová Cave System in the Low Tatra Mountains (Slovakia). The investigation was based on the speleothem DIC2, the flowstone VD1 and the stalagmite PD4. The speleothems were selected to represent different parts of the cave. The age of the speleothems was determined using U-series dating and the age-depth models were created. They allowed determining the growth rate of the speleothems as well as performing time analysis of microfacies variability and changes of C and O stable isotope ratios.

The studied speleothems crystalized in the following periods: speleothem DIC2 from ca. 104 ka to 72 ka, flowstone VD1 from ca. 68 ka to 32 ka and stalagmite PD4 from ca. 47 ka to 35 ka. Petrographic observations allowed the distinction of the following microfacies: columnar, dendritic, rhythmically laminated and acicular. The crystallization of speleothems during: ca. 104–87 ka, 80–72 ka and 68–32 ka, that is during the MIS 5c, MIS 5a, late MIS 4 and MIS 3, proves that favourable conditions were present in the area of the Low Tatra Mountains, which allowed the dissolution of carbonate bedrock in the epikarst zone, migration of percolating water down the karst massif and precipitation of speleothems in the cave. The variations of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ of the speleothems studied correspond to palaeoenvironmental changes recorded so-far in Europe. They reflect the changes recorded in Greenland ice cores as well. The record of the Greenland interstadials GI 14, GI 12 or GI 11, and GI 9 or GI 8 have been detected in $\delta^{18}\text{O}$ variations of the studied speleothems. The relatively high values of $\delta^{18}\text{O}$ are interpreted as resulted from preferential feeding of the speleothems which grew during the late MIS 4 and MIS 3 by ‘isotopically heavy’ summer water. The high values of $\delta^{13}\text{C}$ prove scarce vegetation and weakly developed soils during the growth of these speleothems.

Key words: karst, $\delta^{18}\text{O}$, $\delta^{13}\text{C}$, palaeoclimate, Pleistocene, Central Carpathians