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Study of radiocarbon dynamics of Baradla Cave, Hungary

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Carbon isotope composition of speleothems and their parent drip water reflects the isotope composition of the atmospheric CO_2, the soil and the host rock and can sometimes be influenced even by the cave atmosphere. Owing to the fact that 14C in the bedrock has long decayed, the bedrock derived carbon content of the seepage water can be considered as inactive or ”dead carbon”. The initial dead carbon proportion (dcp) of a stalagmite or tufa layer, caused by the incorporation of the inactive carbon, can be calculated with the help of the C-14 level differences between the contemporary atmosphere and the formed stone carbonate. The revolutionary technological advances of 14C (AMS) have brought the possibility of analysing 14C dynamics of karst systems due to the small amount of demanded material.
The Baradla-Domica Cave is the largest cave of Gömör-Torna Karst, a karst area situated in the northeast of Hungary, and located on the Slovakian-Hungarian borderland. The approximately 26 km long cave is a typical example of multi-level speleogenesis.
As a case study we have investigated several recent (age < 50 years) and older (age about 10-11 kyrs) stalagmites and recent drip water, some freshwater tufa samples and the recent cave air carbon-dioxide of the Baradla-cave to study the carbon dynamics and dead carbon level there.
According four modern stalagmites (formed 1991-2004) the current dcp is very small in Baradla Cave (3-7%). Stalagmites deposited in Holocene (U/Th dated) were also characterized by very small dead carbon contents (1-11% dcp). Outside the cave a dpc about 20-25% was found in a freshwater tufa sample. This relatively low dead carbon content might be either explained by the thinness of the limestone bedrock above (56-80 m) or the relatively fast infiltration conditions, or their combined effect.
Cave air is enriched in CO_2 (2-5 times higher than in natural air, not homogenous) but the source of this surplus CO_2 is not the limestone according its relatively high 14C and 13C level. According to our calculations the carbon isotope composition of the excess cave CO_2 gas is $\sim$87 pMC and$\sim$-24 ‰ (PDB) concerning 14C and δ13C, respectively and therefore also suggesting an intensive decomposition of organic matter coming in the soil.