

CO₂ radiocarbon measurements in South-France caves Interest for the carbon origin and for cave air and hydrology dynamics

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CO₂ radiocarbon measurements made in three different caves from South-France since several years reveal significant differences between caves, within each cave and temporal variations that we try to explain with the help of CO₂ isotopes and other environmental factors (i.e. T, pCO₂). In all caves, and for all measurements, the ¹⁴C activity of the cave CO₂ appears to be lower than that of the outside atmosphere (from 2 pMC to 13 pMC). At the same period, a CO₂ ¹⁴C activity difference of more than 11 pMC can be observed between two caves that are relatively close each other (70 km), and under similar climate and vegetation conditions. Inside the same cave, differences of more than 2 pMC can be observed; we have noted that more confined parts of the caves have lower ¹⁴C activity and higher pCO₂ compared to parts that are closer to the surface/entrances. Delta¹³C data tell us that the main source of the cave CO₂ is the soil/OM CO₂, with average values of ~ -23‰ in all three caves (within -20.3 to -24.8‰ limits). There is a strong correlation between d¹³C and pCO₂ : d¹³C increases when pCO₂ decreases, suggesting a mixing of atmospheric and soil/OM sources, especially when the pCO₂ is below 3000 ppmv. In the Villars cave, where we have more frequent measurements, it is observed that the CO₂ maximum occurs in September-October. In the same cave, there is a time offset of ~1.5 month between external mean air temperature and cave pCO₂ maximum, suggesting that there is inertia between the soil/OM CO₂ production and its accumulation in the cave. At the same site, there is a significant opposite correlation between ¹⁴C activity and pCO₂ which, combined with the d¹³C data, suggests that the cave atmosphere CO₂ is contaminated by dead carbon from organic matter degradation which exact source is still unknown (old soil OM, other ?). Apparent present day CO₂ age is 50 years for the Chauvet Cave, 160 years for the Villars Cave and 1000 years for the Cussac Cave. The low CO₂ ¹⁴C activity of this later site is discussed.