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230Th/234U and 40Ar/39Ar dating of Orgnac 3, a Quaternary Prehistoric Site in Ardèche, France

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Multi-radiometric analyses have been conducted at Orgnac 3 in order to refine the Quaternary chronology deposits of the prehistoric site. The site is situated at an altitude of 320 m, on the South-west fringe of a Urgonian karstic plateau (lower cretaceous), in southern Ardèche, central France. This human settlement was first a cave, then it became a rock shelter and at last an open air site (Moncel et al., 2005). The depositional sequence is shown by a cross-section about 7 m thick which extends 4-5 m further lower to rock substratum. The lower levels were deposited in a cave context while the upper levels were accumulated in open air. Seven hominin teeth assigned to Homo heildelbergensis (de Lumley, 1976), about 50,000 stone artefacts and an abundance of mammalian fossils have been discovered. As the Levallois debitage, marking the beginning of Middle Palaeolithic, appears in the middle strata and becomes dominant at the top of the sequence (Moncel et al., 2005), establishing a reliable chronology for this site is particularly important for understanding the human cultural evolution. The aim of this study is to date with greater precision the intercalated speleothem formations by mass spectrometric uranium series method, and the ashes preserved in the uppermost strata with laser fusion multigrain 40Ar/39Ar method.
Four speleothem samples, from levels 7, 6 and 5b, were dated by U-Th using magnetic sector ICP-MS technique. The dates range between 269 $\pm$ 12 ka (ORG-PL1-1) and 305 $\pm$ 14 ka (ORG-PL1-3) for the first speleothem and between 261 $\pm$ 6 ka (ORG-PL2-B2a) and 275 $\pm$ 12 ka (ORG-PL2-B4) for the second, indicating that the two speleothems are largely contemporaneous. Overall, the ages are ranging from 255 ka (MIS 8) to 319 ka (MIS 9).
At the top of the sequence (level 2), volcanic ashes were dated by using the 40Ar/39Ar method. To obtain signal sufficiently strong for a precise measurement, 50-150 sanidine grains were analyzed for each measurement, in hopes that no contaminant mineral was included. 58 samples of sanidine grains, giving a weighted mean age of 304.6 $\pm$ 4.0 ka (2 sigma). This date correspond to the end of MIS9 and the beginning of MIS8 and support the emergence of the Middle Palaeolithic in Europe ca. 300 ka ago. For the first time in a Quaternary prehistoric site, dating using Ar/Ar and U-Th methods with more precision than previous works have been compared to estimate the ages of the infilling.