Age of Cave Sediments in Slovenia: Results of Dating

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The territory of Slovenia, with its numerous karst regions from the Alps to the Mediterranean, long history of karst evolution and relatively good knowledge of karst sediments represents an ideal place for dating of cave sediments with different dating methods. We have been applying palaeomagentic and magnetostratigraphy method for more than 10 years. Dating of cave sediments by the application of the palaeomagnetic method is a difficult and sometimes risky task, as the method is comparative in its principles and does not provide numerical ages. Repeated sampling in some profiles have shown that only dense sampling (high-resolution approach with sampling distance of 2 – 4 cm), can ensure reliable results. Correlation of the magnetostratigraphic results we obtained, and the interpretations tentatively placed upon them has shown that in the majority of cases, application of an additional dating method is needed to either reinforce the palaeomagnetic data or to help to match them with the geomagnetic polarity timescale.

The results enable to interpret the time span of karst evolution, age of karst surfaces, speleogenesis and rates of the processes. The majority of karst sediment dating has been carried out in the southwestern Slovenia (Kras) where Eocene flysch is the last marine deposit preserved in the geologic record. The Oligocene to Quaternary period represented mostly terrestrial phase with prevailing surface denudation and erosion processes related to tectonic evolution of the area. Therefore only karst sediments can record karst evolution and its age.

The most important result is the discovery that cave fills have substantially older ages than generally expected earlier (max. 350 ka). Palaeomagnetic data in the combination with other dating methods, especially biostratigraphy, have shifted the possible beginning of speleogenesis and of cave infill processes far below the Tertiary/Quaternary boundary. Results suggest that there were probably some distinct phases of massive deposition in caves. The oldest one took place from about 1.8 to more than 5.4 Ma (phases at 1.8 – 3.6 and 4.1 – 5.4 Ma). The data support and better define the estimated ages of the surface and cave sediments that were based on geomorphic evidences, especially from unroofed caves.

The substantial age of cave fills can be also judged from the fact that some studied sites in the Alpine karst occur at high altitudes with the entrances now on the upper slopes of deeply entrenched valleys. The fills in studied caves are clearly older than 1.77 Ma, maybe even older than 5.0 Ma. The evolution of karst plateaus and massifs is comparable with another part of the Alpine chain – the Northern Calcareous Alps – where caves occur also from 1300 to 1700 m a.s.l. and up, i.e. up to 900 m above recent river-beds. The timing of changes of the original hydrological systems can be also correlated with some caves in Dinaric karst, especially from the Kras.

The evolution of the caves took part within one karstification period, which began with the regression of the Eocene sea and exposing of limestones at the surface within complicated overthrusted structure, which formed principally during Oligocene to early Miocene. Karstification and relief formation was substantially influenced by young tectonic movements, especially those younger than 6 Ma, and series of transgressions and regressions related to evolution of Mediterranean-Paratethys realms (especially in period between cca 17.2 and 5.3 Ma).

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