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Speleothems as a sensitive indicators of environmental pollution

Z. Siklosy (1), A. Demeny (1), S. Pilet (2), Sz. Leel-Ossy (3)

(1) Institute for Geochemical Research, Hungarian Academy of Sciences, Budapest, Hungary, siklosy@geochem.hu (2) Institute of Mineralogy and Geochemistry, University of Lausanne, Switzerland, (3) Eotvos University, Budapest, Hungary

Speleothems (cave deposits) are well known paleoclimate archives, but their potential for monitoring environmental pollution has not been fully explored. This study deals with an actively growing stalagmite in which trace element concentration variations suggest anthropogenic contamination rather then effects of natural variabilities. Our objective is to determine the possible effect of the four-decade-lasting uranium ore mining on the environment as exemplified by a cave deposit.

The Trio Cave (46.7°N, 18.9°E) is located in the western part of the Mecsek Mts (S-Hungary) in the base of so-called Szuado Valley, approx. 1.5 km east from the nearest entrance and the air-shaft of the uranium mine (No. IV. mine-pit). The cave is one of the karst systems developed in anisian Lapis Limestone in the area and contains an approx. 200 m passage. There is only one artificially expanded entrance (opened once in 1969 and finally in 1997) which intermittently works as a sinkhole for the Orfü-creek, with a catchment area of 3.5 km2. A stalagmite located about 150 m away from the entrance was drilled and the core investigated for stable isotope and trace element compositions by means of continuous flow mass spectrometry and laser-ablation ICP-MS, respectively (Siklosy et al., 2007). The youngest 1 cm of the drill core was selected for this study that may represent the last cca. 100 years (based on MC-ICP-MS age dating of older parts of the core) that covers the uranium mining period.

The pre-mining period is characterized by systematic co-variations of trace elements

(U, P, Si, Al, Ba, Mg, etc.) that can be related to soil activity and precipitation amount. The youngest 1.3 mm, however, records a sudden change in U content uncorrelated with any other variables. Starting from a background value of 0.2-0.3 ppm, the concentration gradually increases to about 2 ppm (within about 1 mm), remains constant for about 0.5 mm, then declines to about 1.5 ppm at the surface. The significant increase in U concentration suggested a causal relationship with uranium ore mining that started in the 1950's in the area, thus, the mining activity, its environmental impact, and possible uranium sources were investigated for comparison.

Possible source of the uranium can be: 1.) active usage of fertilisers by the agriculture 2.) industrial pollution (e.g. ash from coal-heated power plants) 3.) the uranium ore mining in the vicinity. The valley-type location of the cave and the land use of the surrounding area (mountains and forests) rules out the first possibility. The location and the distance of the only major industrial city and power plant in the southern part of Hungary exclude the infiltration of coal-derived pollutant (e.g. uranium) into the cave system, as these sources are in exactly the opposite direction than the dominating wind direction. Further, coal ash would concentrate a number of metals (Co, V, Zn, etc.) beside U, which elements don't show any increase in the stalagmite. The third source of U is the four-decade-lasting uranium mining. The ore mining in the area studied produced annually about 500 t of uranium as concentrate during its operation and reworked millions of tons of solid material (Bánik et al. 2002). The morphological features exclude the possibility of fluvial U transport to the cave directly from the mining area, however, wind transport of dust released from air shafts and dust deposition have been detected by earlier studies on soil, plants and leaves.

The good fit between U content changes in the studied speleothem and the U ore production and pollution signals obtained during environmental surveys support the assumption of the relationship with mining activity. This study shows that stalagmites can record surficial processes and can help environmental monitoring.

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Siklosy, Z., Demeny, A., Vennemann, T.W., Kramers, J., Lauritzen, S.E., Leel-Ossy, Sz. 2007. Middle bronze age climate change recorded in a Hungarian stalagmite: triggering by volcanic activity? Geophysical Research Abstracts 9 1607-7962/gra/EGU2007-A-00777.

Bánik J., Csicsák, J., Berta, Zs. 2002. Experience on application of continuous drain trench during the remediation of tailings ponds in Hungary.- in Uranium Mining and Hydrogeology III, pp.913-921.