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Petrologic and stable isotopic studies on the Upper Crataceous travertine cone and red calcites (Vértes-Mts., Hungary) – Evidence for magmatic fluid influence

Zoltán Siklósy[1], Attila Demény[1], Csaba Szabó[2], Kamilla Gálné Sólymos[2], László Korpás[3]

[1]Laboratory for Geochemical Research, Hungarian Academy of Sciences, Budaörsi út. 45, 1112 Budapest, Hungary, e-mail: siklosy@geochem.hu

[2]Eötvös Unievrsity, Dept. Of Petrology and Geochemistry, Pázmány P. 1/c, 1117 Budapest, Hungary

[3]Geological Institute of Hungary, Stefánia 14, 1143 Budapest, Hungary

A carbonate cone and red calcite debris occurrences were found in the Vértes Mts. (Transdanubian Central Range, Hungary). Petrographic and geochemical studies were carried out to determine the formation of the carbonates that can be clearly distinguished from the surrounding Triassic Main Dolomite.

The carbonate cone exhibits a special structure: vertically bedded carbonate characterize the middle part of the cone, whereas at the rims the beddings' dipping is less steep: 10-30°. The carbonate itself has a typical travertine texture: the spring cone consist of alternating massive, layered and porous calcite. The occurrence can be described as a travertine cone.

Thin sections were analyzed using EMPA techniques to determine the composition of the accessory minerals. The carbonate consists dominantly of calcite but minor amounts of xenomorphic zircon, xenotime and monazite were also found. According to the analyses we can conclude they are not derived from the surrounding dolomite.

Trace and rare earth elements (REE) analyses of bulk rock samples were carried out using neutron activation analysis (INAA). The carbonate cone is relatively enriched in LREEs particularly at the hypothetical vent-facies. A positive U anomaly was also observed. We can distinguish our trace element patterns from the Quaternary travertines of the area.

The $\delta^{18}O$ and $\delta^{13}C$ values obtained (24,5‰ and -8,5‰ respectively, average of 50 samples) are in agreement with those of the previously studied red calcite dikes widely occurring in the Transdanubian Central Range, but differs from the surrounding dolomite

and from the younger travertines. A late Cretaceous age was suggested for the red calcite dykes based on the biostratigraphic evidence of the overlying sediments that contain red calcite fragments. The isotopic range of the samples studied indicates that magmatic CO_2 played an important role during the carbonate formation. Magmatic fluids can be associated with upper Cretaceous lamprophyre dykes recognized in the area.

The $\delta^{18}O$ values of travertine cone show a positive shift of about 1.5 ‰ from centre to rim suggesting that approximately 10°C temperature drop occured along the flow direction. Examinating the distribution of the $\delta^{13}C$ values we can distinguish concentric zones within the travertine cone: the $\delta^{13}C$ values increase from the vent facies towards to rim most likely caused by the rapid CO_2 degassing from the water.

On the base of trace element and isotope geochemistry, the formation of carbonate cone is not related to mobilization and precipitation of the surrounding dolomite, but it may rather be related to the upper Cretaceous magmatic activity of the area. Thus, it is one of the very rare pre-Cenozoic travertine occurrences.

References

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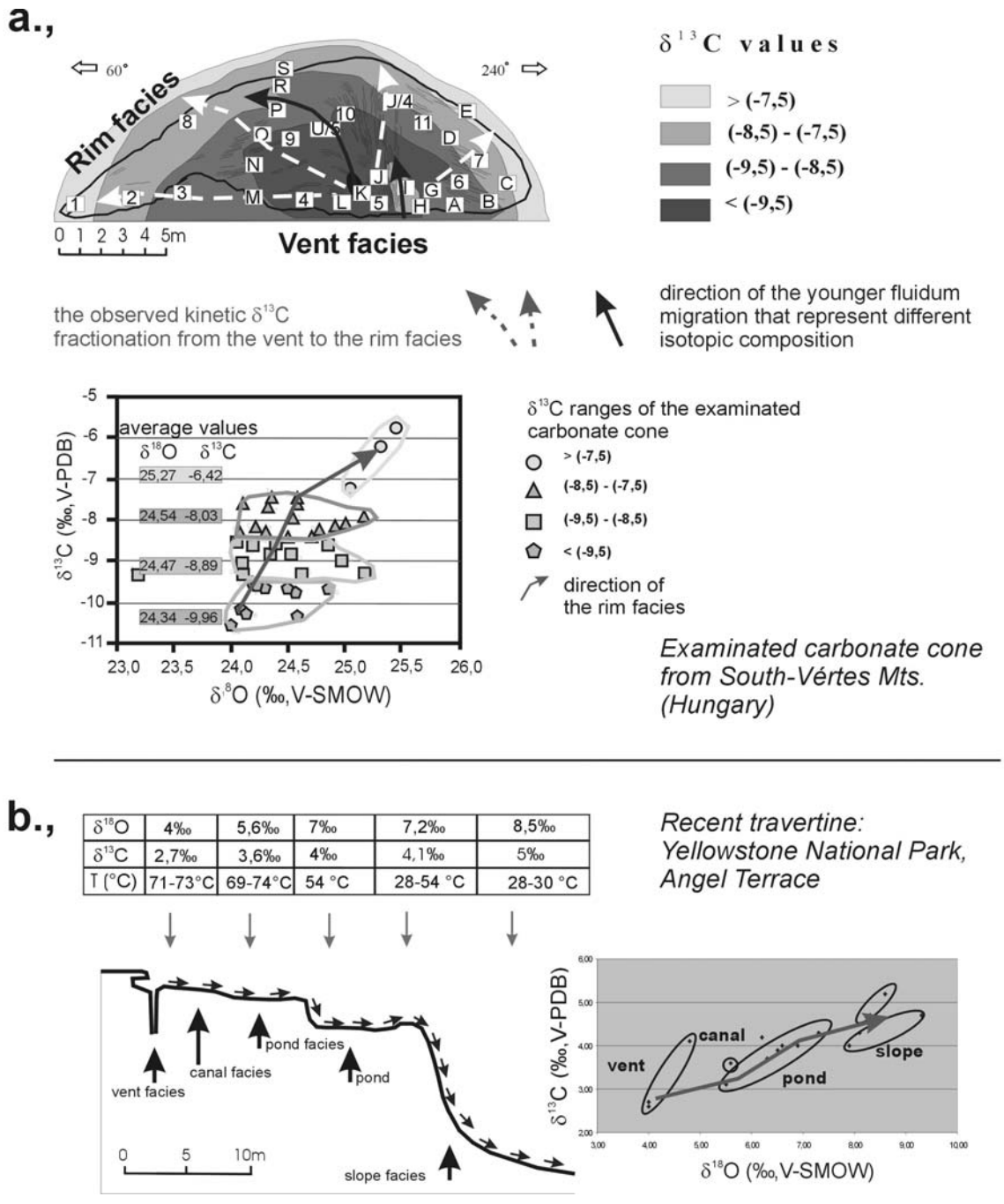

δ18O	4‰	5,6‰	7‰	7,2‰	8,5‰
δ13C	2,7‰	3,6‰	4‰	4,1‰	5‰
T (°C)	71-73°C	69-74°C	54 °C	28-54 °C	28-30 °C

Fig. 1 The measured stable isotopic composition and it's distribution of the examinated travertine cone (**a**.,) compared with a recent travertine occurrences (**b**., Angel Terrace,Yellowstone; Fouke et al. 2000). A remarkably positive shift can be recognised considering the stable carbon and oxygen isotope values from the vent moving to the slope facies at the Angel Terrace travertine (**b**.,). Similar trend is also typical for the examinated travertine cone (**a**.,) however more expressed $\delta^{13}C$ and less notable $\delta^{18}O$ changing can be seen at the South-Vértes (Hungary) occurrences. Arrows shows the direction from the central vent to the rim facies.