European Society for Isotope Research

VI Isotope Workshop

Abstracts

29. June - 4. July 2002
Tallinn, Estonia

Preliminary isotope results on carbonate segregations in red clay on the pediment of the Mátra Hills (NE-Hungary)

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A 10 m thick red clayey soil-sediment complex situated on the pediment of the Mátra Hills (NE-Hungary) includes unusually large amounts of secondary carbonate segregations. The age of carbonate precipitation is presently not known, however, huge amounts of carbonate are uncommon in soils of the Pannonian Basin under Holocene climate. The goal of our investigation is to provide some new data for determination of the origin and possible precipitation mechanism of carbonate.

The studied red clay complex of proposed Late Pliocene to Quaternary age is exposed on the margins of the Mátra Hills (NE-Hungary), in the open pit of the Visonta lignite mine. Shallow lacustrine to terrestrial (alluvial) sediments (including lignite) of Late Pannonian age form the bedrock of the red clay complex, which is covered by Quaternary loess and alluvial sediments. Sedimentary features of the red clay point to a resedimented origin probably from the weathered soil mantle of the nearby Mátra Hills. However, in situ pedogenesis with vertisol characteristics also contributed to the formation of the complex (Horváth et al., 2001). The red clay represents a warm Mediterranean-type climate before the Pleistocene loess deposition under cool and dry climate.

The red clay complex contains carbonate as nodules and concretions of 1 to 20 cm size in sporadic distribution. Preliminary CL investigation of drusy calcite in the concretions shows that it is free of Mn, possibly reflecting precipitation under oxidizing conditions suggesting pedogenic origin. However, a few thin bands of bright luminescence might be interpreted as signs of transient phreatic episodes resulting perhaps from temporary groundwater saturation. In case of pedogenic origin we suppose that transfer and reprecipitation of carbonate occurred under semi-arid climate after leaching probably from the overlying loess.

Stable carbon and oxygen isotope composition of carbonate concretions composed of drusy and fine-grained calcite and internal part of micritic nodules were determined.

Micritic carbonate nodules from a 10 m thick section including underlying Late Pannonian silty clay, clay and overlying loess have $\delta^{13}C^{VPDB}$ values between –11.9 and –8.9‰ with a mean of -9.9‰. $\delta^{18}O^{VPDB}$ values are mainly from –8.9 to

–7.0‰, however, some nodules from the loess (-6.0‰) and the immediately underlying red clay sample (-10.4‰) have different data. The difference between oxygen isotope values from red clay and loess indicates that the formation of the concretions is not simply the result of the redistribution loess-carbonate dissolution and reprecipitation.

Carbon isotope composition of pedogenic carbonate is thought to be controlled by the $\delta^{13}C$ values of soil CO_2 resulting from soil respiration. Consequently, $\delta^{13}C$ values of soil carbonate reflect the types (C_3 and C_4) of vegetation cover (Cerling, 1984). The carbon isotope composition of the carbonate nodules from the red clay complex suggests that the vegetation was C_3-dominated with up to 20% C_4 flora. This type of vegetation refers to a wet climate and contradicts our initial assumption that carbonate precipitation occurred under semi-arid conditions.

The carbonate concretions show internal zonation with micritic and fine-grained carbonate at the margins and drusy calcite grown into the vug. The stable isotope compositions display a systematic change with increasing depletion in both ^{13}C and ^{18}O from the margins towards the interior. Outer micritic and fine-grained carbonate has $\delta^{13}C^{VPDB}$ values between –10.0 and –9.1‰ and $\delta^{18}O^{VPDB}$ values from –6.3 to -5.9‰, while inner drusy calcite crystals have $\delta^{13}C^{VPDB}$ values between –12.3 and –11.5‰ and $\delta^{18}O^{VPDB}$ values from –7.6 to –7.0‰, respectively. This trend indicates that the precipitation of the recognized zones occurred from the margin towards the interior, and was accompanied by enrichment in the heavy isotopes in the first carbonate precipitate. Isotope data indicate that carbonate mass probably did not exchange isotopes with the environment and the development of carbonate concretions occurred in a closed system. This also suggests that the observed CL zonation could have been resulted by diffusion controlled crystal growth rather than by changing redox conditions (Paquette et al., 1993).

References

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