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Stable isotope geochemistry of calcrete nodules and septarian concretions in a Quaternary 'red clay' paleovertisol from Hungary†

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Calcrete nodules and concretions in unusually large amounts are embedded in the Quaternary clay-rich (Vertisol-type) 'red clay'soil-sedimentary complex at the pediment of the Mátra Mountains (Hungary). Stable isotope signatures were studied in nodules and septarian concretions, uncommon due to their several millimeter sized calcite crystals filling voids and fractures, to reveal their origin. The isotope composition of calcrete covers a wide range: $\delta^{18}O = -5.9$ to -10.4‰and $\delta^{13}C = -8.9$ to -12.3‰ (*vs.* V-PDB). Isotope compositions support pedogenic (*sensu stricto*) and/or shallow groundwater origin for the calcrete nodules and concretions, the role of 'evolved' (isotopically modified) groundwaters in the formation of secondary carbonate was possibly subordinate. Late-stage, large, Mn-rich euhedral calcite crystals in concretions have the lowest δ13C values, which are interpreted as a result of larger contribution of isotopically light organic carbon due to decomposition of organic matter under reducing conditions. Precipitation of late calcite crystals in concretions occurred in early diagenetic environment after shallow burial of the 'red clay' paleovertisol.

Keywords: Calcrete; Carbon-13; Concretion; Oxygen-18; Quaternary; Red clay; Signatures; Vertisol

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