Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 9	Graz 2004

STABLE ISOTOPIC (C,O) SIGNALS FROM LIHTIFIED TALUS BRECCIAS (NCA, AUSTRIA): IMPLICATIONS ON DIAGENESIS

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Stable isotope analysis of lithified carbonate talus breccias within the Northern Calcareous Alps (Austria) have not been investigated comprehensively although they can be employed for reconstructing sedimentary paleo-environments and give hints to their diagenetic pathway.
δ^{18}O and δ^{13}C values allow an estimation of the isotopic composition, the origin and the temperature of diagenetic fluids involved in meteoric cementation. About 1000 samples from 17 different locations in roughly similar latitude (47°12´- 47°30´) and all out of carbonatic geological settings were analyzed. While sampling it was discerned between meteoric cements, primary or secondary infiltrated matrix and hostrock, mostly Mesozoic marine limestones. The isotopic composition of the hostrock (marine calcites) and the meteoric fluids which depend on climate control the signature of meteoric cement when pore fluids become saturated and supersaturated and precipitation occurs (e.g. BANNER & HANSON, 1990).
The isotopic composition of the fossil talus breccia cements (meteoric cements) shows a pattern of strongly variable δ^{13}C form 3,9 ‰ to -10,4 ‰ and relatively invariant δ^{18}O values between -6,1 ‰ and -11,7 ‰ with a maximum of values around -9,6‰. In view on the wide variation of the δ^{13}C values (14,3 ‰) the coupled variation of the δ^{18}O values seem to be relatively stable which indicates meteoric origin (e.g. ALLEN & MATTHEWS, 1982; LOHMANN 1988).
The δ^{13}C values of the cements show a maximum between -7 to – 10 ‰ which can be considered together with the most negative δ^{13}C values of the cements (-10,4 ‰) the best estimate for the value of pure meteoric calcite. This suggests light δ^{13}C values for soil-CO_2 (-18,0 to -20,0 ‰) (ROMANEK et al., 1992).
The carbon isotope in meteoric cements could originated from different sources such as atmospheric CO_2 (about -8,0 ‰), dissolution of matastable carbonate minerals such as aragonite and CO_2 from soil/calcrete organic matter decay ($\delta^{13}C \geq -20$ ‰). Carbonate precipitated in surface or shallow diagenetic setting with a open-system exchange with atmospheric CO_2, will have an isotopic composition, which reflects the air-CO_2 signature (RAHIMPOUR-BONAB & BONE, 2001). RIGHTMIRE & HANSHAW (1973) mentioned that calcite precipitated in open-system equilibrium with soil-gas CO_2 is limited to a δ^{13}C value of about -15 ‰.
The hostrock signals with mean $\delta^{13}C = 2,6$ ‰ and $\delta^{18}O = -5,2$ ‰ are normally for ancient mostly marine limestones. More interesting is the isotopic pattern of the matrix which shows a wide variety in both isotopic values. δ^{13}C ranges between -6,2 ‰ and 6,6 ‰ with a mean value of 0,6 ‰ and δ^{18}O values from -11,2 ‰ to -2,1 ‰ with averagely $\delta^{18}O = -8,0$ ‰. The δ^{13}C values seem to be more hostrock buffered than the δ^{18}O values do because the decrease from hostrock to cement values is more linear for δ^{18}O. Further investigations for understanding matrix isotopic composition are necessary and will be done in future.
Latitude and temperature are the primary factors controlling the isotopic composition of meteoric cement (HAYS & GROSSMAN, 1991) but also altitude is an influencing factor. The altitude effect causes that the mean δ^{18}O values decrease with increasing altitude. HUMER et al. (1995) gave a gradient of -0,16 ‰ per 100 meter difference in altitude for whole Austria but also mentioned that deviations are possible. MOSER & RAUERT (1980) calculated a range between -0,25 and -0,50 ‰ per 100 meters for the altitude effect. In this

study a gradient for the altitude effect of -0,11 ‰ per 100 meters altitude difference was calculated for the western parts of the Northern Calcareous Alps.

According to the equation given by HAYS & GROSSMAN (1991) it was tried to calculate absolute temperature values. The results are not very convincing because calculated temperatures range between 3°C and 33°C for the maximum $\delta^{18}O$ values (-11,7 ‰). The mean $\delta^{18}O$ value (-9,58 ‰) gave temperatures between 5,1°C and 30,4°C, whereas temperatures above assumed 10°C compared with recent temperature measurements (HUMER et al., 1995) are not suitable for this altitudes and geographic positions. Reasons for miscalculations are manifoldly.

Relative temperature estimations (e.g. DANSGAARD, 1964; ROZANSKI et al., 1992) result in 4°-5°C temperature change within the $\delta^{18}O$ values.

The presented data gives an overview of isotopic values found in different types of talus breccias and possible inferences for diagenesis. Minimum age determinations through U/Th-dating of the meteoric cements are under way and will hopefully allow better interpretation for particular breccias.

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