Calculations were made by two methods:

1. Average pedotemperatures were calculated on the basis of CO_2 partial pressure, obtained from the alkalinity of individual springs and taking into account the correlation between the measured partial pressure of soil CO_2 and soil temperature for approximate vegetation structure of the recharge areas.
2. Average temperatures were calculated from the DIC isotope composition, where the correlation between the measured carbon isotope composition of soil CO_2 and soil temperature for approximate vegetation structure of the recharge areas.

The estimated pedotemperatures are shown on Fig. 5.46. The effect of isotope exchange with atmospheric CO_2 was observed in the springs: Bela, Belščica and Prelesje, therefore their mean soil temperatures could only be estimated on a basis of CO_2 partial pressures.

5.3. SHORT-TERM INVESTIGATIONS DURING A HEAVY SNOWMELT EVENT (V. ARMBRUSTER, C. LEIBUNDGUT)

5.3.1. Introduction

A hydrograph separation of Hubelj and Vipava springs into event and pre-event water was done with the stable isotope ^{18}O for a heavy snowmelt event in April 1996. The lighter meltwater made a hydrograph separation possible.

5.3.2. Methods

A two component mixing model was used for the hydrograph separation. In order to determine a representative isotope content of the snowmelt event water, a network of 10 snow lysimeters was put up in the catchment areas of Hubelj and Vipava springs in different altitudes. On the basis of the dependence of snowmelt water heights and isotope contents on altitude a weighting calculation was done and representative isotope contents for the two catchments were obtained.

5.3.3. Results and Interpretation

The field observation period lasted from March the 27th until April the 12th1996. At the beginning of the period the karst plateaux were partly snow-covered. During a heavy precipitation event on April the 1st and 2nd (Fig. 5.47

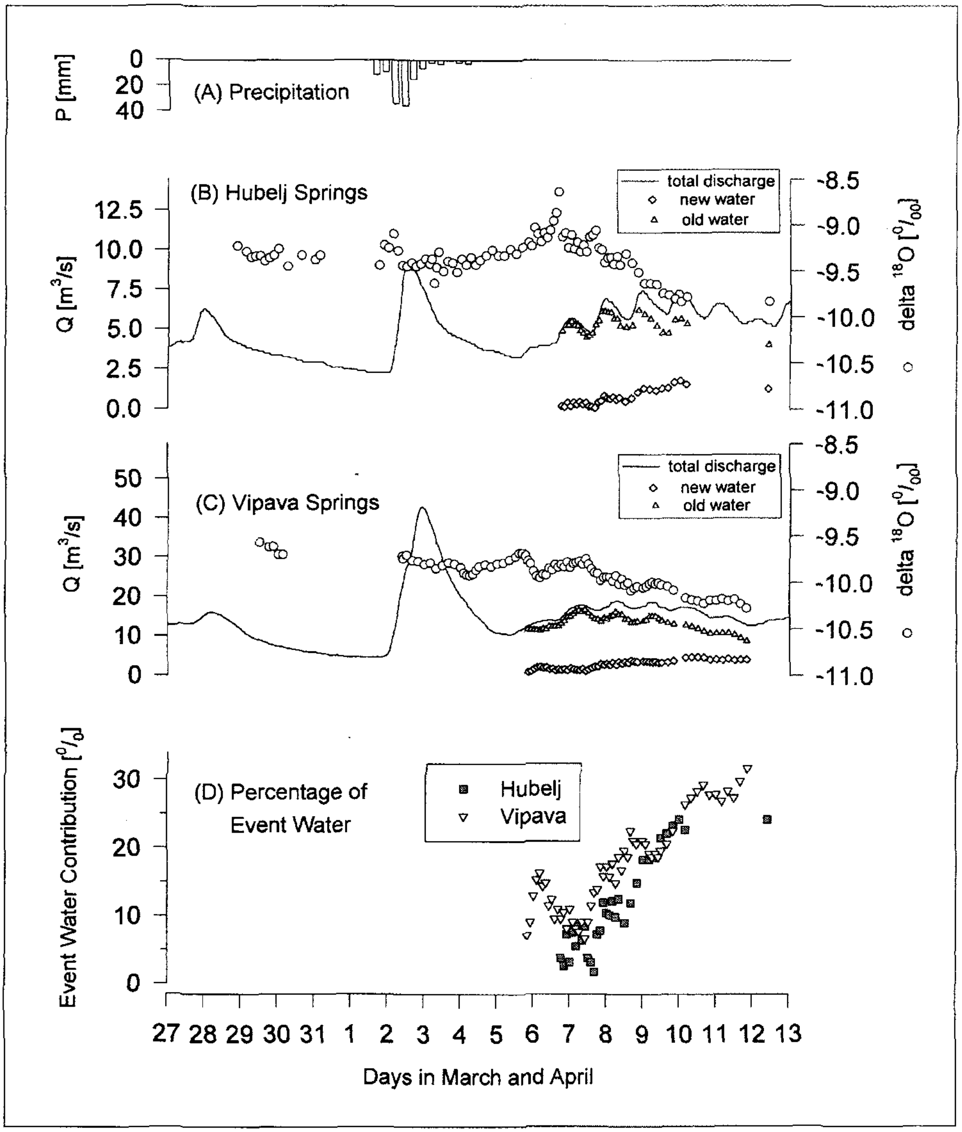

Fig. 5.47: Data of a single snowmelt event in the period from March the 27th till April the 12th 1996: (A) Precipitation heights of 6 hours intervals of precipitation station Podkraj. (B) $\delta^{18}O$ values and total discharge of Hubelj for the observed period; discharge of new and old water of Hubelj for the snowmelt event, starting the 5th of April. (C) Smoothened $\delta^{18}O$ values and total discharge of Vipava for the observed period; discharge of new and old water of Vipava for the snowmelt event. (D) Percentages of event water contributions (new water) of Hubelj and Vipava for the snowmelt event.

(A)), where initial rain turned into snow later, the karst plateaux were completely covered with snow. This precipitation caused the peak discharges of the observed period. Isotope contents of the rain did not differ sufficiently to make a hydrograph separation possible. The deposited snowpack started to melt intensively from the 5th of April onwards, when the weather became very warm and sunny. Mean snowmelt rates amounted to 27 mm/day for the Hubelj and 20 mm/day for the Vipava catchment until the 12th of April. The snowmelt event is represented by daily discharge fluctuations of Hubelj and Vipava springs (Fig. 5.47 (B)/(C)). The snowmelt event water isotope contents are -11.75 ‰ for the Hubelj and -11.69 ‰ for the Vipava catchment for the whole melting period.

Fig. 5.47 (B) shows the discharge and the isotope content of Hubelj springs during the observed period. The isotope content does not show a clear reaction to the precipitation event. After the precipitation event, the isotope content is continuously increasing, until the snowmelt event starts. A possible interpretation might be, that as well heavier older water as lighter event water were activated by the precipitation event and that the contribution of event water decreased faster than that of the older water. When lighter snowmelt event water starts to arrive at the 6th of April, isotope contents decrease. The mean of the isotope contents before the precipitation event amounts to -9.3 ‰ and is used as pre-event water isotope content. The results of the hydrograph separation can be seen in Fig. 5.47 (B) and (D). The event water contribution slowly rises and reaches maximum values of 24 %.

Fig. 5.47 (C) shows the discharge and the smoothened isotope content of Vipava springs. The fluctuating original isotope values were smoothened with the running mean of five values, in order to better visualise the reaction of the Vipava springs. The mean of the isotope contents before the precipitation event amounts to -9.61 ‰ and is used as pre-event water value. The results of the separation can be seen in Fig. 5.47 (C) and (D). The event water contribution slowly rises and reaches maximum values of 31 %.

The snowmelt event was probably still influenced by the preceding precipitation event. Thus, the application of a two component mixing model is a simplification. The snowmelt water was sampled during two periods, and the samples showed, that meltwater became heavier during the ablation. This could not be accounted for in the separation, because a further time.

Discretization of sampling was not practicable. Isotope contents of meltwater varied considerably with the altitude and showed the difficulties of determining a representative isotope content of snowmelt event water in catchments with big altitude differences.

5.3.4. Conclusions

During a heavy snowmelt runoff event the event water contribution to spring discharge of Hubelj and Vipava springs is slowly rising. The contribution is still rising, when discharge is already decreasing. The maximum determined event water contribution 6 days after the snowmelt start is 24 % and 31 % for Hubelj and Vipava springs respectively (actual maxima might be higher, as sampling stopped too early). Only a small part (< 8 %) of the snowmelt water input to the aquifers leaves the karst systems with a short time lag. The hydrograph separation has been done under very specific hydrological conditions and the results can only be rough estimations, as many simplifications are implied.