

The escape tunnel at a length of 2 Km has been constructed in the Ionian Flysch, inside which silt-stones dominate. In a big part of the tunnel the rock was strongly tectonized due to the Pindos thrusting. The excavation of the tunnel faced serious stability problems. The problems kept on even after the installation of protection measures whereas additional protection measures often had to be taken several days or even months following the excavation.

ENVIRONMENTAL ISOTOPE STUDIES ON KARST GROUNDWATER IN THE HELICON MOUNTAINS (BEOTIA/GREECE)

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The Helicon Mountains in Beotia, stratigraphically and structurally rather well understood, are taken as a perfect example of a Mediterranean karstic massif. A large number of springs, connected with either shallow or deep karst pathways, drain the range. Considerable amounts of groundwater are directly discharged into the Bay of Domvrena. In connection with recent hydrogeologic investigations a geothermic zone has been detected and structurally located the southeast of Levadia.

Stable oxygen isotope compositions of the water as well as carbon isotope compositions of dissolved inorganic carbon (DIC) have been investigated from water samples of springs, wells and open drainage channels from both the mountains and the plains. Main drainage directions of shallow and deep karstic systems could be delineated by ^{18}O distributions in the groundwaters. This result is based on the altitude effect of isotopic differentiation. $\delta^{13}\text{C}_{\text{DIC}}$ ratios refer to a variety of carbon sources, such as atmosphere, soil-biology or weathering.

Characteristic δ value ranges for different waters can be shown by comparison of $\delta^{13}\text{C}_{\text{DIC}}$ and $\delta^{18}\text{O}$ ratios. Little variation of isotope ratios of deep karstic waters depend on sizes of recharge areas and reservoirs. High isotopic $\delta^{13}\text{C}_{\text{DIC}}$ values are relevant to carbon exchanges with atmospheric CO_2 . This is particularly the case in mountainous regions, where only thin soil covers exist and precipitation rapidly supplies the phreatic zone. The restricted sizes and the variations in altitude of the recharge areas of shallow karstic waterbodies are reflected in varying δ values of DIC and ^{18}O .

Recharge areas of the geothermic waters are similar to those of deep karstic waterbodies. Nevertheless they are to be distinguished by isotopical heavy DIC, because endogenic carbon is conveyed from below.

The varying δ values of waters from open systems are caused by equilibration with atmospheric carbon and ^{18}O enrichment due to evaporation.