Calculation of the mixing ratio of wastewater effluents leakage to a pristine water source: The Israeli Experince

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A methodology to estimate of the average percentage of wastewater effluents in an otherwise pristine water site was developed and applied in several vulnerable sites in Israel using mono or multiple effluent indicators. The model takes into account the levels and the uncertainty margins in the evaluation of each of the indicators in the site, in the potential effluent sources and in the uncontaminated surrounding.

Several detailed demonstrative studies exemplify the use of this model by the Israel Water Authority. In these studies we used chloride, acesulfame and carbamazepine as wastewater effluent indicators.

a The Northern Galilee springs: This research concentrated on six nearby perched springs draining upper cretaceous carbonate aquifers with Karst morphology which are influenced to an unknown extent by agricultural communities that still use septic tanks. In this site fecal contamination was found in the past, but since then the two major sources of pollution in the area were collected and diverted to a mechanical biological wastewater treatment systems.

b The Shafdan soil-aquifer treatment site. Leakage from the soil – aquifer treatment system of the Dan municipality (treating some 130 Mm^3 per annum) to the coastal plain aquifer was quantified.

c The contamination of the perched Judea Mountains springs which serve for irrigation and recreation by septic wastes was explored.

In all cases we found good correspondence between the dilution predictions by the two organic tracers, whereas the chloride predictions differed somewhat and exhibited higher level of uncertainty.

Chemical influence on recoil damage annealing and impact on (U-Th)/He age in apatite

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Apatite (U-Th)/He (AHe) age is a function of the production/ejection and diffusion of He particles in a grain of determined size and for a particular time-temperature path. Recent studies have demonstrated that He diffusion is sensitive to the amount of α-recoil damage [1-2]. As a result, new models accounting for α-recoil damage creation and annealing were created to characterize the diffusion behaviour of He in apatite, which are currently utilized in forward and inverse tools for reconstruction of T-t paths [3]. However, although these models are based on the annealing scheme used for apatite fission tracks (AFT), the effect of grain chemistry on annealing rates, shown to be critical for AFT, has not been investigated in the context of He diffusion. For this purpose, we studied the grain chemistry measured by microprobe (EMPA), laser and solution ICPMS on independent AFT dated and He degassed grains. We investigated the behaviour of sedimentary samples from Hercynian origin that shows a wide range in AFT single grain ages due to variable apatite composition (measured by Dpar, EMPA or ICPMS). Our aim was to test if apatite chemistry has an influence on the annealing rate of α-recoil damage. Dispersion of the single grain ages is large for both AFT and AHe datasets although AHe ages are systematically younger (AFT: ~14-208 Ma; N=117; AHe: ~4-76 Ma and one grain at 120 Ma; N=36). Using the thermal history reconstruction from the AFT data, we show that the poor correlation observed between AHe age and eU content can be simply explained by adjusting the annealing law parameter. For slowly exhumed samples we demonstrate that apatite grain chemistry can more easily explain some of the AHe grain age variation. This study reveals that grain chemistry can significantly influence He diffusion, and we conclude that to fully access the thermal history information in AHe ages, the potential for variation in damage annealing kinetics needs to be considered.

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DOI:10.1180/minmag.2013.077.5.7