Ar-37 emanation factors determined by irradiation experiments on soil samples

R. PURTSCHERT[1], S. MUSY[1], G. DELLEPIANE[2], S. BRACCINI[2]

[1]Climate and Environmental Physics, University of Bern, 3012 Bern, Switzerland (roland.purtschert@climate.unibe.ch, stephanie.musy@climate.unibe.ch)

[2]Albert Einstein Center for Fundamental Physics
Laboratory for High Energy Physics, University of Bern,
(gaia.dellepiane@lhep.unibe.ch, saverio.braccini@lhep.unibe.ch)

Underground production of radionuclides can be a blessing or curse for groundwater dating. Accumulation e.g. of ^{222}Rn or ^{37}Ar are tools to assess infiltration from surface waters to aquifers (*1*). Decay dating by cosmogenic isotopes such ^{39}Ar on the other hand may be affected by underground production and lead to underestimation of residence times. ^{37}Ar is relevant in both applications because its half-live of 35 days is long enough to extend the dating range of ^{222}Rn ($T_{1/2}$: 3.8 d) and short enough to act as a neutron flux monitor for ^{39}Ar dating ($T_{1/2}$: 269 yrs). The release rate from the mineral phase where ^{37}Ar is produced to the water filled pore space has to be known in both cases. Soil and rock samples were irradiated by thermal neutrons at the SWAN cyclotron in Bern (*2*). A gas extraction method has been developed in order to transfer ^{37}Ar that has been produced in the irradiation vessel by the ^{40}Ca(n,α)^{37}Ar reaction to the proportional counter where the activity is measured. The elemental composition of the soil was previously determined by Fusion ICP/MS. The comparison between calculated production rates and released Ar-37 atoms revealed emanation factors in the range 2-10% depending on grain size and mineralogy of the samples.

1. O. S. Schilling *et al.*, Advancing Physically-Based Flow Simulations of Alluvial Systems Through Atmospheric Noble Gases and the Novel 37Ar Tracer Method. *Water Resources Research* **53**, 10465-10490 (2017).

2. M. Auger *et al.*, in *Nukleonika*. (2016), vol. 61, pp. 11.