Geophysical Research Abstracts, Vol. 9, 06727, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06727

High characterization of water-air flow tranport in the vadose zone of geolocial carbonate formation from Radon-222

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Complex process in the unsaturated zone affect the transfers of fluids. Within the context of an integrated study on the process of the meteoric diagenesis in a carbonate formation, we try to determine the time transit of fluids. The aim of this study is to see whether radon 222 is a good natural tracer of fluids vertical diffusivity. Radon is an inert radioactive gas. It has three isotopes ^{222}Rn, ^{220}Rn, ^{219}Rn. ^{222}Rn comes from the decay of ^{238}U. The ^{222}Rn half-life (3.82 days) allows it to be transported far from its origin (Fleischer *et al*., 1981). Temporal variations of radon activity in soil gas depend on several factors such as meteorological variables (temperature, rainfall, atmospheric pressure, etc) and geological variables (concentration of radium in the soil, porosity, grain size, tectonic activity, etc.) (Abbad *et al*., 1993).

The radon was measured on an experimental site : soil (0.40 meter thick) is lying on the Oligocene limestone (30 meters thick). This limestone was exploited in underground quarry with several levels (7 meters and 10 meters deep). Radon product comes from soil clays and limons for the major part and quaternary loess trapped in the limestone karstic framework for an other part. In the unsaturated zone, radon moves vertically in the gaseous phase under piston effect of the liquid phase. It moves as well dissolve in the liquid phase. The underground quarry atmosphere of the two levels shows variations of radon concentration in the time.

Results show correlation between the maxima of effective precipitations and the maxima ones of radon concentration in the underground quarry atmosphere with a seven months dephasing. Dephasing between the maxima of effective precipitations and the maxima of moisture in the porous rock is only five months.

This correlation leads to a diffusion model of radon in the unsaturated zone.