

## Spatial distribution of explosive compounds in the vadose zone of a contaminated site, Portugal

<sup>a</sup>Gonçalves C, <sup>b</sup>Amaral H I F, <sup>b</sup>Fernandes J, <sup>b</sup>Batista M J, <sup>c</sup>Gama C, <sup>c</sup>André S, <sup>d</sup>Abreu M

A site contaminated by the explosives Trinitrotoluene (TNT) and Dinitrotoluene (DNT) is being studied to determine their attenuation in the subsurface under natural conditions. The site is located in the left margin of the River Tejo Basin in Seixal, Portugal, and sits on Plio-quadernary sands mainly. During ~50 years the manufacture of explosives has led to the contamination of the soil and water at the site and downstream. The waste-waters associated with the explosives production were accumulated in permeable lagoons, from where water would infiltrate and pollute the vadose and saturated parts of the aquifer. So far, only the groundwater contamination has been characterized, whereas the concentration of those poly-nitroaromatic compounds (p-NACs) in the vadose zone has not yet been quantified. We present first results of the spatial distribution of the p-NACs in the vadose zone of one of such waste-water lagoons.

Two boreholes were drilled 30 m apart to a depth of 9 m, down to the water table of the contaminated aquifer. Sediment samples were taken every 1 m or

less, for different organic compounds [p-NACs and volatile organic compounds], pH and electrical conductivity, microbiology, grain size and chemical analysis. In both boreholes, the main contaminant TNT was the organic compound to be found in higher concentrations [approximately 1 g/kg], whereas DNT and the metabolite nitrotoluene (NT) were found in much lower concentrations of ~0.1 g/kg and 0.01 g/kg, respectively. The depths of the peaks corresponding to higher and lower p-NACs concentration did not coincide between both boreholes, most probably due to the different clay content. It is known that clay can act as a barrier to the dispersion of organic compounds due to its sorbing capacity or simply by reducing permeability.

No correlation existed between the p-NACs concentration and the low pH (4-6), and the high electrical conductivity (23-63 mS/cm), even though those values indicate contamination and/or high content in organic matter. No other (volatile) organic compounds were detected in any of the samples, thus TNT, DNT and NT seem to be the main organic con-

taminants in the study area.

The presence of NT indicates the occurrence of TNT degradation, since NT is not produced or used as a primary compound, i.e. explosive. Thus, natural conditions did exist to allow the natural transformation of TNT, and maybe DNT. However, that mass reduction of the contaminants was not efficient as observed by the much higher concentrations of the primary contaminant TNT.

Whether natural transformation still occurs, and at which depths is favoured, will be elucidated with the microbiological data. Moreover, the potential for the p-NACs in the soil to act presently as an active source of groundwater contamination will be assessed.

<sup>a</sup> University of Algarve, Faculty of Sciences and Technology, Portugal

<sup>b</sup> LNEG, National Laboratory of Energy and Geology, Portugal (Helena.Amaral@lneg.pt)

<sup>c</sup> APA, Environmental Portuguese Agency, Portugal

<sup>d</sup> ISA, Agronomy Institute, Portugal