

CHARACTERISATION OF CHEMICAL EXCHANGES BETWEEN WASTE WATERS AND MINERAL SIZE FRACTIONS IN SOILS AND SEDIMENTS AROUND A WASTE DISPOSAL SITE¹

M. A. Gonçalves, J. Figueiras, C. Almeida, and A. Mateus

Departamento de Geologia, Faculdade de Ciências da Universidade de Lisboa. Edifício C2, Piso 5, Campo Grande, 1749-016 Lisboa. Portugal. E-mail macg@fc.ul.pt

The current work focus on the chemical characterisation of contaminated waters, soils and sediments around a waste disposal site to elucidate on the chemical exchanges taking place between these systems. The studied site is located in a topographic elevated area having a fractured coarse grained granite as bedrock.

Sampling was performed to characterise ground and surface waters, and soils from areas free of any sort of contamination and areas subject to supposedly different levels of contamination. Soils are poorly developed, having some 20 cm thickness. Small seasonal streams where contaminated waters had circulated, sediments were taken from them when surface runoff had ceased. Sediments were divided according to their size and two portions taken for analysis: particle size fraction < 63 µm, and particle size fraction between 63 and 90 µm. These sediments have quartz, feldspar, biotite, and muscovite as main mineral constituents. In the size fraction below 63 µm, X-ray diffraction peaks of clay minerals appear and, in some circumstances, possibly gibbsite as well.

Using measured field parameters, ground and surface waters fall into different classes with distinct pH values: while the former are more acidic with pH = 4.2-4.6, the latter have pH = 5.2-5.6. In contaminated surface waters the pH may rise to 6.6. Uncontaminated waters are chemically very similar to each other and anomalous amounts of minor elements, especially in waters around the waste disposal site, were easily identified. The contaminated surface waters show more contrasting anomalous contents in major cations and anions. Among the minor elements it is worth noting to refer Zn, Br, I, Al, Cu, As, and Pb. Having sampled and analysed the waste waters collected in pools for treatment, the provenance of these elements has been uniquely determined as having origin in the waste disposal site.

Soils and sediments gave quite different results. We failed to identify any major evidence for soil contamination. Only some elements such as As, Br, and Zn suggest a slight degree of contamination. Sediments have shown a downstream gradient of contamination, especially evident for Cu, Zn, and Pb and less so for Cr and Ni. The coarse fraction has concentrations on these elements similar to the fine fraction. This suggests no partitioning of these contaminants between the different size fractions, but requires further confirmation given the incomplete analysis of the coarse fraction.

Having no major evidence for airborne dispersion of contaminants, surface and ground waters must be the main agent of contaminant transportation. Accordingly, soils in the vicinity of the disposal site show only the slightest levels of contamination, the bulk of contaminated material being creek sediments laid down by runoff waters originating in the waste pile. Comparison of water and sediment analysis indicate that the rate of transport of contaminants from water to sediments greatly varies from element to element. This implies that some elements may be dispersed to long distances, eventually entering into major rivers. In addition, sediment analysis show no meaningful partitioning of contaminants into the finer fractions, thus casting doubts on adsorption on clay minerals as the main fixation mechanism at work.

¹ This is a contribution from Project DIWASTE, funded by FCT-MCT, Portugal