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Modelling reactive transport in a phosphogypsum dump, Venezia, Italia

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We develop a reactive-transport porous media flow model for a phosphogypsum dump located on the intertidal deposits of the Venetian Lagoon: 1. we construct a complex conceptual and geologic model from field data using the GMS™ graphical user interface; 2. the geological model is mapped onto a rectangular MODFLOW grid; 3. using the TMT2 FORTRAN90 code we translate this grid into the MESH, INCON and GENER input files for the TOUGH2 series of codes; 4. we run TOUGH-REACT to model flow and reactive transport in the dump and the sediments below it. The model includes 3 different dump materials (phosphogypsum, bituminous and hazardous wastes) with the pores saturated by specific fluids. The sediments below the dump are formed by an intertidal sequence of calcareous sands and silts, in addition to clays and organic deposits, all of which are initially saturated with lagoon salty waters. The recharge rain-water dilutes the dump fluids. In turn, the percolates from the dump react with the underlying sediments and the sea water that saturates them. Simulation results have been compared with chemical sampled analyses. In fact, in spite of the simplicity of our model we are able to show how the pH becomes neutral at a short distance below the dump, a fact observed during aquifer monitoring. The spatial and temporal evolution of dissolution and precipitation reactions occur in our model much alike reality. Mobility of some elements, such as divalent iron, are reduced by specific and concurrent conditions of pH from near-neutrality to moderately high values and positive redox potential; opposite conditions favour mobility of potentially toxic metals such as Cr, As Cd and Pb. Vertical movement are predominant. Trend should be therefore heavily influenced by pH and Eh values. If conditions are favourable to mobility, concentration of these substances in the bottom strata could be high.
However, simulation suggest that the sediments tend to reduce the transport potential of contaminants.