MULTIPHASE FLOW AND REACTIVE TRANSPORT MODEL UNDER VERY DRY CONDITIONS

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Summary. Nearly 50% of irrigated lands in arid and semi-arid regimes have salinization problems. Salinization is generally caused by salts carried to the soil surface by capillary rising water and occurs under very dry conditions, when vapor fluxes become the main water flux mechanism. Despite its global importance, actual salinization mechanisms are only poorly understood. Soil salinization is generally studied by means of water and salt balances without entering on small scale processes. This may suffice for explaining large scale behavior but hardly for designing remediation practices. The objective of this work is to study the solute transport under evaporation conditions. We have performed laboratory experiments and modelled them. We have built open sand columns initially saturated with an epsomite (MgSO4·7H2O) solution. Evaporation was driven by an infrared lamp and proceeded until the overall saturation fell down to 0.32. Results imply that water vapor flows not only upwards above the evaporation front, but also downwards beneath this front, where it condensates. Condensation causes the dilution of the solution. That is, concentrations fall below the initial values. The experiments have been modelled with the program Retraso-CodeBright, which couples non isothermal multiphase flow and reactive transport. To simulate high concentration solutions a Pitzer's module was also added to the code. Reproducing the observations also required modifying the standard retention and relative permeability functions to include oven dry conditions. The model reproduces the observed concentration, water content and temperature profiles along the column and confirms the existence of condensation and decrease of salt concentration below the evaporation front. The model also allows us to distinguish the relevance between suction, osmotic and thermal effects on water fluxes. The mechanism displays positives feedbacks, as condensation will be most intense in areas of highest salinity, thus diluting saline water that may have infiltrated.