Ion transfers, iron reduction and mineralogical implications in irrigated fields : new results for soil and water quality management under irrigation.

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Irrigation is very often related to environmental problems. Due to the high evaporative demand, salt accumulation is induced by irrigation in arid or semi arid regions. The resulting salinisation of soils and water tables is one of the most important factor limiting irrigated crops in dry lands. Under temperate climate, irrigation is mainly concerned with pollutant transfers such as nitrates or heavy metals.

Therefore, modeling solute and water transfers at field scale has been an increasing research field in the past years, as an attempt to forecast the environmental consequences of water management practices. Those models generally simulate transfers only in the vertical dimension, and take into account the most important processes occurring during transfers, e.g. convection, dispersion, diffusion, mineral dissolution and precipitation, and exchanges with the clay fraction. This last process is often neglected. If not, it is commonly considered in soil science that (i) the exchange capacity of a soil is constant in time and (ii) that only cations are involved in exchange processes.

Those assumptions are contradictory with results we obtained when monitoring soil solution evolution in an irrigated field in north Senegal. Using LeachM code and field monitoring, we demonstrate (i) that transfers and associated processes cannot explain the observed cation and anion concentration evolution in time, (ii) that the exchange capacity of the soil under reducing conditions (when the soil is flooded) can be two or three times more elevated than the exchange capacity of the dry soil (before cultivation), (iii) that this increase in exchange capacity is due to clay structural iron reduction, (iv) that the corresponding cationic free exchange sites could adsorb hundredth of times more cations than brought by irrigation water in the same time, and (v) that this process is reversible, at the end of the cropping season, when the soil is dried. Furthermore, free-iron oxides probably modify the anion balance when iron is reduced.

These results are very important for understanding soil functioning and solute transfers in temporary reduced soils, which is often the case in irrigated lands, because they completely modify the soil solution composition when transfers occur, and because very big amounts of ions can be fixed (when reducing the soil) and released (when oxidizing the soil). The corresponding processes are of great importance for predicting environment evolution in relation with water management practices.

ONZIÈME RÉUNION DU GROUPE DE RÉFLEXION

SUR L'ÉTUDE DE LA SOLUTION DU SOL

EN RELATION AVEC L'ALIMENTATION DES PLANTES

(GRESSAP)

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