Particle size distribution and mineralogy of Brazilian Ferralsols:

Significance for the structure and hydraulic properties

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The Cerrados Biome is one of the major regions of Brazil with 24% of the Brazilian territory (204.10^6 ha). It is mainly located in the center of Brazil and corresponds to the whole Central Plateau. About 49% of the soils are Ferralsols and approximately 79.10^6 ha of these soils are dedicated to agriculture. The main characteristics of Ferralsols are a poor horizonation, a weak development of the macrostructure, and a strong submillimetric granular microstructure. The objective of this work was to evaluate the influence of the mineralogy on the structure and hydraulic properties of Ferralsols. The Ferralsols (F) studied were selected according to the mineralogy of the $<2\mu m$ fraction along a regional topossequence across the Brazilian Central Plateau. The soils F1, F2, F3 and F4 were located on the South American Surface and F5 and F6 on the upper Velhas Surface, F7 and F8 on the intermediate Velhas Surface, F9 and F10 on the lower Velhas Surface. A semi quantify method was used to compare the mineralogy of the clay fraction. Chemical composition obtained with from sulfuric acid extraction was used to estimate the kaolinite, gibbsite, goethite and hematite content. Goethite and hematite content was also estimated using the soil color (hue, value and chrome). The soil-water retention curve was determined by using undisturbed samples, using the centrifugation method at -1, -6, -10, -33, -300, and -1500 kPa. The saturated hydraulic conductivity was determined in the field using the Guelph permeameter procedure. The Ferralsols studied were classified in according to the RKGb ratio.They are gibbsitic for the soils F1, F2, F3, and F4 and kaolinitic for the soils F5, F6, F7, F8, F9, and F10. Results did not reveal a clear link between the mineralogy and the development of structures that for all diagnostic horizons a weak compound medium sub - angular blocky and strong very fine granular structure. The little differences of structure observed between the soils studied were attributed to the nodules. The clay content ranged from 520 to 780 $g.kg^{-1}$, except for F4 where it was 300 $g.kg^{-1}$. Results also showed a relationship between the mineralogy, expressed in terms of RKGb, and the clay content, evidencing a positive correlation up to RKGb = 0.60 for F1, F2, F3 and F4, located on the South American Surface. Then, for RKGb>0.60, the clay content showed a decreasing trend (F5, F7, F8 and F9) on the Velhas Surface. That difference can be explained by difference of parental material and pedological evolution. The soils on the South American Surface are well developed and were derived from meta-sedimentary clastic rocks, while the soils on the Velhas Surface are less developed and they were derived from colluvial sediments originating from South American Surface. There is no correlation between the total porosity and clay content, the RKGb ratio and the saturated hydraulic conductivity. On the other hand the saturated hydraulic conductivity was positively correlated with the volume of pores with equivalent diameter >300µm.

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belonged to moderate class. Saturated hydraulic conductivity in situ was high in B horizon and the effect of particle size distribution was large in C horizon

137-35 674a A. Reatto

Particle Size Distribution and Mineralogy of Brazilian Ferralsols: Significance for the Structure and Hydraulic Properties.

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The Cerrados Biome is one of the major regions of Brazil with 24% of the Brazilian territory (204.10^6 ha). It is mainly located in the center of Brazil and corresponds to the whole Central Plateau. About 49% of the soils are Ferralsols and approximately 79.10^6 ha of these soils are dedicated to agriculture. The main characteristics of Ferralsols are a poor horizonation, a weak development of the macrostructure, and a strong submillimetric granular microstructure. The objective of this work was to evaluate the influence of the mineralogy on the structure and hydraulic properties of Ferralsols. The Ferralsols (F) studied were selected according to the mineralogy of the <2µm fraction along a regional toposequence across the Brazilian Central Plateau. The soils F1, F2, F3 and F4 were located on the South American Surface and F5 and F6 on the upper Velhas Surface, F7 and F8 on the intermediate Velhas Surface, F9 and F10 on the lower Velhas Surface. A semi quantify method was used to compare the mineralogy of the clay fraction. Chemical composition obtained from sulfuric acid extraction was used to estimate the kaolinite, gibbsite, goethite and hematite content. Goethite and hematite content was also estimated using the soil color (hue, value and chrome). The soil-water retention curve was determined by using undisturbed samples, using the centrifugation method at 1, -6, -10, -33, -300, and -1500 kPa. The saturated hydraulic conductivity was determined in the field using the Guelph permeameter procedure. The Ferralsols studied were classified in according to the RKGb ratio.They are gibbsitic for the soils F1, F2, F3, and F4 and kaolinitic for the soils F5, F6, F7, F8, F9, and F10. Results did not reveal a clear link between the mineralogy and the development of structures for all diagnostic horizons which have a weak compound medium sub-angular blocky and strong very fine granular structure. The little differences in structure between the studied soils were attributed to the nodules. The clay content ranged from 520 to 780 g.kg^{-1}, except for F4 where it was 300 g.kg^{-1}. Results showed a relationship between the mineralogy, expressed in terms of RKGb, and the clay content, presenting a positive increase up to RKGb = 0.60 from F1, F2, F3 and F4, and a decreasing trend for RKGb>0.60 from F5, F7, F8 and F9. Those differences in trends can be explained by the rather different origin of the parental material and the pedological evolution. The soils from the South American Surface are well developed and were derived from the meta-sedimentary clastic rocks, while the soils from the Velhas Surface are less developed and were derived from colluvial sediments originated from the South American Surface. It was not found significant correlation between the total porosity and clay content, as well as the RKGb ratio and the saturated hydraulic conductivity. However, the saturated hydraulic conductivity was found to be positively correlated with the volume of pores with diameters >300µm

137-36 674b R. Kodesová

Field and Numerical Study of Chlorotoluron Transport in the Soil Profile Affected by Non-Equilibrium Flow.

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Single-porosity, dual-porosity and dual-permeability models in HYDRUS-1D were applied in this study to simulate non-equilibrium water flow and contaminant transport in soil porous media. The field and laboratory experiments and numerical study were performed for five different soil types. The transport of chlorotoluron in the soil profile was studied under field conditions in 2004. The herbicide Syncuran was applied on a four square meter plot using an application rate of 2.5 kg/ha of active ingredient. Soil samples were taken after 5, 13, 21, 35, 55, and 150 days to study the residual chlorotoluron distribution in the soil profile. The chlorotoluron mobility in the monitored soils increases as follows: Haplic Luvisol 1 = Haplic Luvisol 2 < Haplic Cambisol < Dystric Cambisol < Greyic Phaeozem. The herbicide transport was in both Cambisols slightly affected by a preferential flow and highly affected in Greyic Phaeozem. Total contents of remaining chlorotoluron in the soil profile correspond with the herbicide mobility. The highest herbicide degradations were at locations with lower observed mobility and herbicide was present mainly in the top layer. The experiments were repeated in 2005 at four locations (Haplic Luvisol 1, Haplic Cambisol, Dystric Cambisol and Greyic Phaeozem) at different experimental plots. Chlorotoluron mobility and persistence corresponded with those observed previous year except in Greyic Phaeozem, where the effect of preferential flow was not so evident. The adsorption isotherms were obtained for two horizons (humic horizon and subsurface horizon) using a standard laboratory procedure. The adsorption isotherms obtained on the soil samples taken in different years slightly differ. The reason may be seasonal soil property changes and heterogeneity. The chlorotoluron mobility characterized by the adsorption isotherms corresponds with the chlorotoluron mobility observed in the field in 2004 and 2005 except for Dystric Cambisol. In spite of very high adsorption obtained for this soil type the field mobility appears to be higher due to a high content of fine and coarse gravel that causes reduction of the specific surface area of soil particles and reduction of a flow profile. The reduction of adsorption properties should be considered in numerical simulations of herbicide transport processes in such soils. The soil hydraulic properties were defined using the multi-step outflow experiments performed on the 100 cm3 undisturbed soil samples. The code HYDRUS-1D and the numerical inversion were used to analyze the cumulative outflow and the soil-water retention data points to obtain hydraulic parameters characterizing different soil-water flow models: the single-porosity model, the dual-porosity model, and the dual-permeability model. The ratios of different pore domains were estimated based on micromorphological studies. Soil water retention curves were also determined using the sand tank and pressure plate apparatus. The saturated hydraulic conductivities were measured using the constant head test. The chlorotoluron transport under field conditions was simulated using the single-porosity, dual-porosity, and dual-permeability models in HYDRUS-1D. Despite having similar total soil hydraulic prosperities for different flow models, the simulated chlorotoluron transport was different. Chlorotoluron transport in both Luvisols was less or more successfully approximated with the single- and dual-porosity model. Chlorotoluron concentrations in the soil profile simulated using the dual-permeability model were closer to observed values when chlorotoluron transport was affected by preferential flow then those calculated with the other two models.

137-37 768a M. Hayano

Effect of Dry Layer Thickness on the Evaporation from Surfaces of Different-Sized Glass.

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Wind tunnel experiments were conducted to study the evaporation from Glass Bead (GB) surfaces in a shallow container placed on a weighing lysimeter. On the upper beads surface, the momentum roughness length was changed with the GB diameter of 2-mm, 5-mm, 12-mm and 30-mm in relation to wind speed variation. Dry layer(DL) thickness beneath the top beads surface could be reduced by controlling the ground water level in the container. Under these conditions, the evaporation rate (Ev) was measured and compared with that from the water surface (Ewater). The results were expressed as a rate of retardant evaporation (1-Ev/Ewater). The 2-mm GB with 5-mm DL thickness reduced evaporation by 60%. However, the 30-mm GB, with 5 mm DL thickness did not affect the evaporation rate. The comparison between the 20 mm and 40 mm DL thickness revealed that although the effective evaporative surface areas were similar, the evaporation rates were at par. These results suggested that evaporation was affected not only by the vapor pressure deficit but also the wind effect on the surface beneath the upper bead surfaces.

137-38 768b A. Kasraian

Effect of Agricultural Sulfur on Chemical Properties and Hydraulic Conductivity (under Saline-Sodic Conditions) of Different Calcareous Soils from Dry Region of Iran.

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The use of elemental sulfur is of special interest in Iran since most soils are calcareous and elemental S, as a byproduct of the petroleum industries, is readily available. Recently the National Petrochemical Company (NPC) of Iran, has produced an agricultural sulfur (AS) that contains 90% pure sulfur and 10% bentonite. As the production of this compound is in the experimental stage, relatively little information is available on its disintegration and subsequent oxidation to sulfate in the salt-effected calcareous soils. The present study was initiated to improve the understanding of the disintegration rate of AS in soil, base on determination of changes in some of the chemical properties. Six soil samples were collected from different sites of a dry region of Fars province of southern Iran and AS produced by NPC of Iran, was thoroughly mixed with 2kg of soil at the equivalent rates of 0,2,4 and 6 ton per ha. The samples were incubated under room temperature and moisture content of field capacity for 8 weeks. And pH and EC values as well as sulfate, total nitrogen (N), phosphorous (P), Iron (Fe), manganese (Mn), zinc(Zn), and copper (Cu), concentrations were determined. The results showed that the disintegration rate was very low, and only 1.5, 2.3 and 2% of the applied AS levels (i.e., 2, 4 and 6 ton per ha) were oxidized to sulfate, respectively. The results of pH and EC values in AS level, resulted in no signification changes in the nutritional constituents (except Mn) of the tested soils. To study the hydraulic conductivity under saline-sodic conditions the soils were dried, ground, and passed through a 2-mm sieve. Columns of soil samples were saturated with solution of 100 meq ( ) with sodium adsorption ratios (SARs) of 5, 10, 15 and 20 and subsequently leached with distilled water. The "Sensitive Index" or SI concept was used to obtain a very general index of the magnitude of structural deterioration and reduction in the HC of the tested soils. In general (1) regardless of SAR level and AS rate, the SI values, the percentages of expansion and dispersion of the soil columns leached with different saline-sodic solutions, were different for tested soils. Increases in SAR level resulted in decreases in the SI values and initial height of soil columns; but although, increase in the SAR level from 5 to 10 resulted in decreases in the percentage of dispersion, there was no significant difference between the effect of SAR 10 and SARs 15 and 20. (2) Application of AS resulted in no significant (statistical) effect on the SI values of the tested soils, but was associated with (somehow) a modifying effect of the degrees of expansion and dispersion of the soil columns, which indicated the improving effect of A S application on the structure of tested soils under saline-