RIO18 21st World Congress of Soil Science
21 WORLD CONGRESS OF SOIL SCIENCE
Sunday 12 – Friday 17 August 2018
Rio de Janeiro, Brazil
Rio de Janeiro August | 12 - 17

Sulfidization process in Acid Sulfate Soils of Senegal, West Africa

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Sulfidization is the process by which sulfides accumulate. It refers to soil materials rich in sulfides and is therefore best exemplified in anaerobic, humus-rich tidal marshes, poorly drained or waterlogged soils, where the main form of inorganic S in soils is sulfide. The coastal region of west central Senegal is a low-lying land raising only a few meters above sea level. This situation allows seawater to flow very far inland through the main channels and into the estuaries of tidal rivers. The intrusion of seawater results in the formation of saline and acid sulfate soils. The objective of the present study was to investigate acid sulfate soil properties on two landscape positions (floodplain and low terrace) in the coastal plain of the Saloum river basin, West-Central of Senegal, in order to determine the incidence of the landscape position on the formation and distribution of potential acid sulfate soils (PASS) and actual acid sulfate soils (AASS). Soil profiles were described according to the World Reference Base. The reaction of pyrite to 30% hydrogen peroxide (H_2O_2) was tested. Soil pH and electrical conductivity, total Fe, dithionite-soluble Fe, oxalate-extractable Fe, total sulfur and water-soluble sulfate were measured. Mineralogy analysis was performed by X-ray diffractometry. The results show sulfidization processes more active and sulfidic material more present in the floodplain site. They support the presence of PASS in the floodplain and represent the major soil-forming process on this lowest landscape position. The natural drainage of the floodplain during the dry season leads to pyrite oxidation and sulfiricization processes in the upper layers of soil profiles (Fe^{2+} oxidized to Fe^{3+} and S^{2-} to SO_4^{2-}). This explains the presence of jarosite and lepidocrocite in the topsoil and central soil horizons. Conditions for jarosite hydrolysis are however more favourable in the low terrace AASS (complete pyrite oxidation to jarosite) than in the floodplain PASS (presence of Fe^{2+} in the reduced subsoil and Fe^{3+} in the oxidized topsoil). This supports the lowest pH values (3-5) of low terrace soils. The most determining parameter remains ultimately the topography, which controls the impact of marine influence. Lower landscape position supports active sulfidization process and the formation of PASS in the floodplain whereas higher landscape position leads to ongoing sulfiricization process and presence of AASS in the low terrace.

Keywords: *acid sulfate soils sulfidization sulfiricization Senegal West Africa*