Effects of flooding on iron solubilization in soils

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Solubilization of iron (Fe) oxides in soils has strong influences on phosphorus (P) sorption and plant productivity (Fe^{2+} toxicity). Seasonal flooding is hypothesized to change the red-ox status of Fe^{3+} (Fe^{2+}) and Fe oxide stability to varying extents under different ecological conditions. The stability of Fe oxides were thermodynamic analyzed using Fe^{2+} concentrations, Eh, and pH in soil solution for a variety of seasonally-flooded soils in arctic, temperate, and tropical regions (forest and paddy system). In continuous permafrost zone (Canada), permafrost-affected soils of black spruce forest are seasonally flooded due to summer thawing impermeable permafrost table. The surface soil solutions were under-saturated with short-range order Fe oxides (ferrihydrite). The soil solutions in deeper horizons are supersaturated with short-range order Fe oxides, consistent with the high concentrations of oxalate-extractable Fe oxides. In tropical forest soils (Indonesia), soil solutions are under-saturated with short-range order Fe oxides, but they are supersaturated with crystalline Fe oxides (esp., lepidocrocite). This suggests solubilization and re-precipitation of short-range order Fe oxides. This process is promoted in the soils of riparian zone. The highly reducing condition of tropical paddy soils (Indonesia) promoted solubilization of goethite and hematite, which caused Fe^{2+} toxicity. The red-ox cycles in temperate paddy soils (Japan) caused solubilization of lepidocrocite and supersaturation with short-range order Fe oxides after drainage. This process caused P solubilization and translocation of Fe oxides in deeper horizons.

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