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Nitrogen release from forest soils containing sulfide-bearing sediments

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Soils containing sediments dominated by metal sulfides cause high acidity and release of heavy metals, when excavated or drained, as the aeration of these sediments causes formation of sulfuric acid. Consequent leaching of acidity and heavy metals can kill tree seedlings and animals such as fish, contaminate water, and corrode concrete and steel. These types of soils are called acid sulfate soils. Their metamorphic equivalents, such as sulfide rich black shales, pose a very similar risk of acidity and metal release to the environment. Until today the main focus in treatment of the acid sulfate soils has been to prevent acidification and metal toxicity to agricultural crop plants, and only limited attention has been paid to the environmental threat caused by the release of acidity and heavy metals to the surrounding water courses. Even less attention is paid on release of major nutrients, such as nitrogen, although these sediments are extremely rich in carbon and nitrogen and present a potentially high microbiological activity.

In Europe, the largest cover of acid sulfate soils is found in coastal lowlands of Finland. Estimates of acid sulfate soils in agricultural use range from 1 300 to 3 000 km2, but the area in other land use classes, such as managed peatland forests, is presumably larger. In Finland, 49 500 km2 of peatlands have been drained for forestry, and most of these peatland forests will be at the regeneration stage within 10 to 30 years. As ditch network maintenance is often a prerequisite for a successful establishment of the following tree generation, the effects of maintenance operations on the quality of drainage water should be under special control in peatlands underlain by sulfide-bearing sediments. Therefore, identification of risk areas and effective prevention of acidity and metal release during drain maintenance related soil excavating are great challenges for forestry on coastal lowlands of Finland.

The organic and inorganic nitrogen concentrations in drainage water from forested peatland catchments underlain by black shale bedrock have been monitored during a 5-year-period, and they show higher values compared to control areas. In addition, soil solution from seven spruce dominated forests belonging to the Finnish permanent monitoring programme of the EU-Forest Focus-FutMon / pan-European ICP forests Level II network was monitored over a 10-year-period. At one of the sites the chemical properties of the soil reflect the formation of an acid sulfate soil presenting clearly higher nitrogen concentration compared to other sites.