Fe partitioning and bioavailability in plant ash and char

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Fires are an integral feature of many terrestrial ecosystems. The transformation of vegetation through wildfires and anthropogenic burning can significantly alter soil properties and impact nutrient cycling and bioavailability. Burnt plant material is a source of metal micronutrients such as Fe and Mn to soil, however, the forms of iron that enter soil following fires have not been well characterized. In this study, sequential chemical extractions were used to determine Fe partitioning in charred and ashed plant litter collected in Iceland from coniferous and deciduous trees, grasses, legumes and forbs, and compared with Fe fractions in fresh litter.

Dilute HCl was used to extract iron in easily reducible and amorphous forms, which comprised a significantly higher proportion of total extracted iron in charred and ashed samples for nearly all plant types compared to unburnt litter samples. In contrast, the proportions of dithionite-extractable Fe (ferric (oxyhydr)oxides) and Fe in organic matter determined by hydrogen peroxide treatment were generally lower in burnt plant residues. HCl-extractable Fe represents the most bioavailable iron pool [1], suggesting that both partial and complete combustion increase iron bioavailability in plant material. Iron in other plant-available forms, including water-soluble and exchangeable Fe, was found to be negligible in burnt samples. The easily reducible iron fraction in ash and char is likely to be highly mobile and subject to leaching in soils [2] following burning events. Based on previous work that found greater amounts of easily reducible Mn in soils following fire, the effect of fire on Fe cycling between plants and soils may have some similarities to that of Mn [3].

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