Use of Compost in Remediation of Metal Polluted Soil

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Research Objectives

Following on from the previous work we wanted to;

- Look at transformation of metals whilst composting using different feedstocks

- Investigate whether compost could be used to remediate metal polluted soil

Step 1: Composting

- Produce compost from a mixture of greenwaste, sewage sludge and paper de-inking sludge
- Co-compost soil from a highly polluted mine site with the same feedstocks
- Follow the transformation of metals during composting in both treatments

Experimental Setup

- Feedstocks mixed in the ratio GW:SS:PF 35:30:35 on dry weight basis

- For composting the contaminated soil the feedstocks were mixed in the same ratio but then mixed 50:50 with the soil on dry basis

Location of Parys Mountain Mine

Contaminated Soil

- Taken from waste piles from calcining process (oxidation)
- Not much vegetation on material
- Sieved to 1cm

Cu 3234 mg kg^{-1}

Zn 213 mg kg^{-1}

As 101 mg kg^{-1}

Pb 10700 mg kg^{-1}

Composting Process

- Composting carried out in 1m^3 bags
- Turned every 2 weeks for first 2.5 months then every month for 4 months
- Temperature recorded and samples taken.
- Total metals and sequential extraction of metals carried out as well as standard analysis of compost (nutrients, organic matter)

Sequential Extraction Procedure

Zeien & Brummer

Fraction	Extraction Agent
F1 Mobile	1M NH_4NO_3
F2 Easily Available	1M $NH_4OAc.$ (pH 6)
F3 Occluded in Mn-oxides	0.1M NH_2OH-HCl + 1M $NH_4OAc.$ (pH 5.5)
F4 Organic bound	0.025M NH_4EDTA (pH 4.6)
F5 Occluded in amorphous Fe-oxides	0.2M $NH_4Oxalate$ (pH 3.25)
F6 Occluded in crystalline Fe-oxides	0.1M Ascorbic acid in 0.2M $NH_4Oxalate$ pH 3.25
Residue	HNO_3 Digestion

Bags weighed

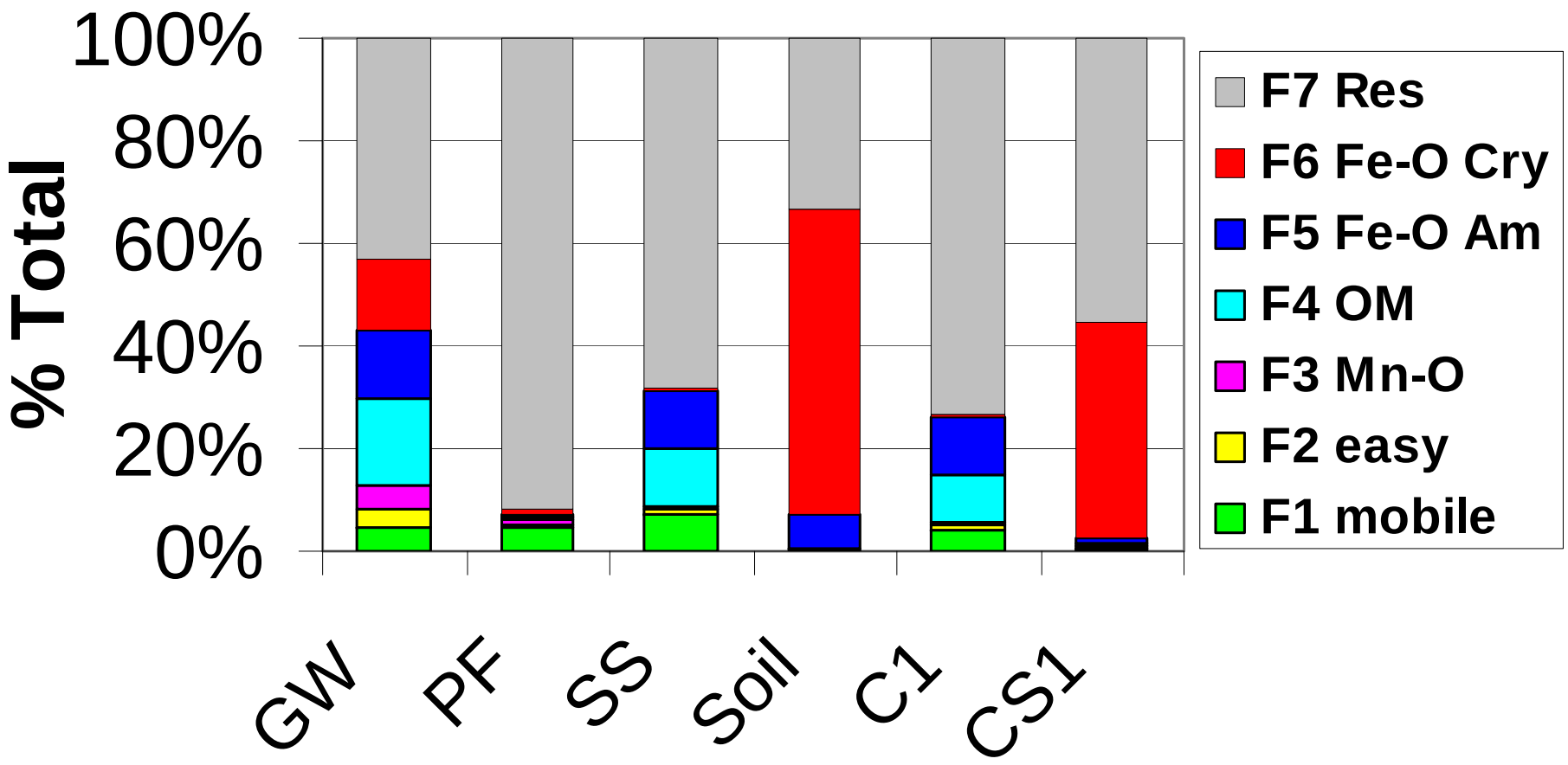
Bags cut so compost falls out

Compost mixed and put in a new bag

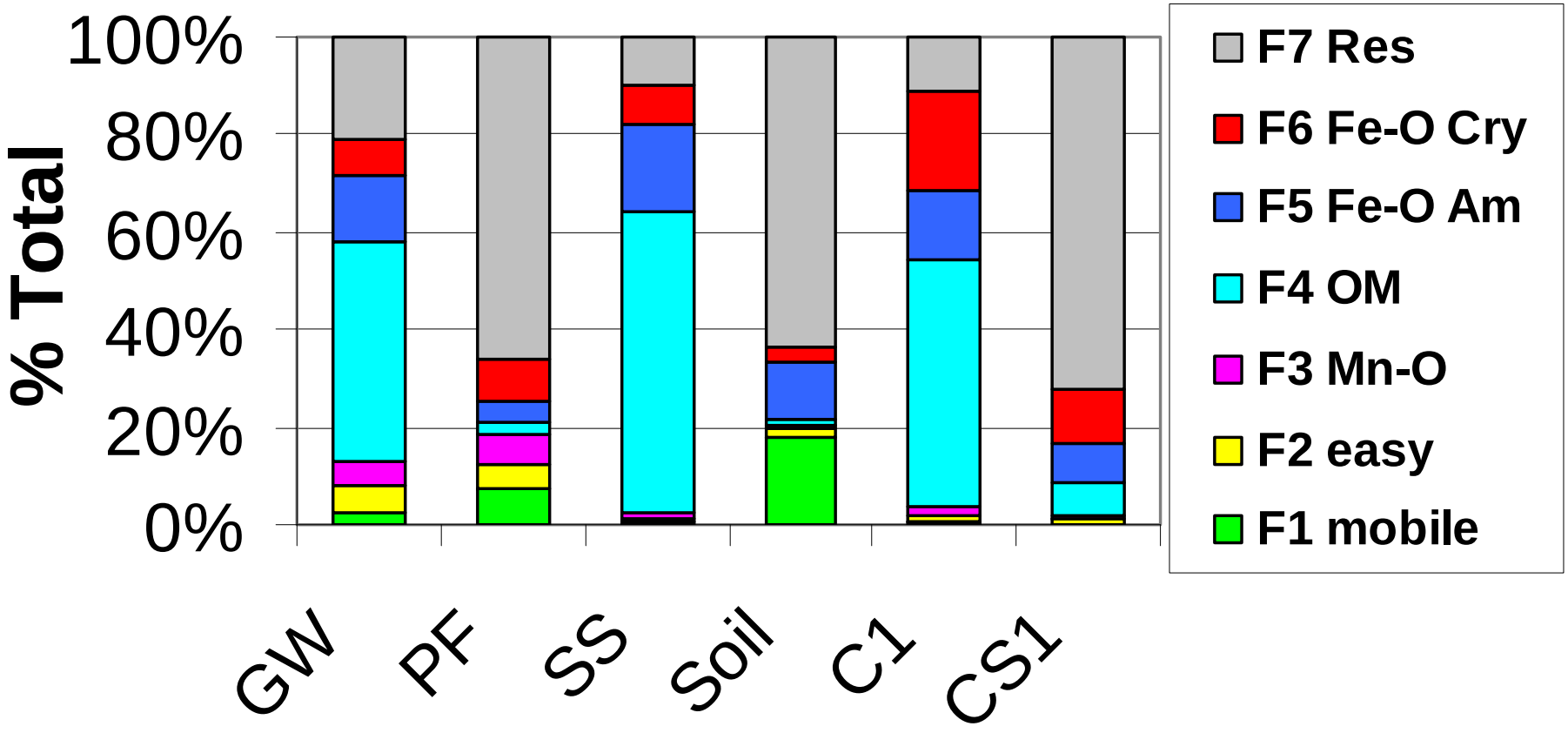
Total Metals at Time 0

	Cr mg kg^{-1}	Ni mg kg^{-1}	Cu mg kg^{-1}	Zn mg kg^{-1}	As mg kg^{-1}	Cd mg kg^{-1}	Pb mg kg^{-1}
Greenwaste	25	23	43	59	7.0	3.4	56
Paper fibre	27	21	257	32	3.1	3.1	17
Sewage Sludge	49	31	336	377	4.3	2.9	257
Soil	15	5.7	3234	214	101	3.8	10673
Compost	41	30	250	174	6.0	3.7	114
Compost +Soil	18	12	1962	188	185	3.5	5721

Sequential Fractionation of Copper at Time 0



Sequential Fractionation of Lead at Time 0



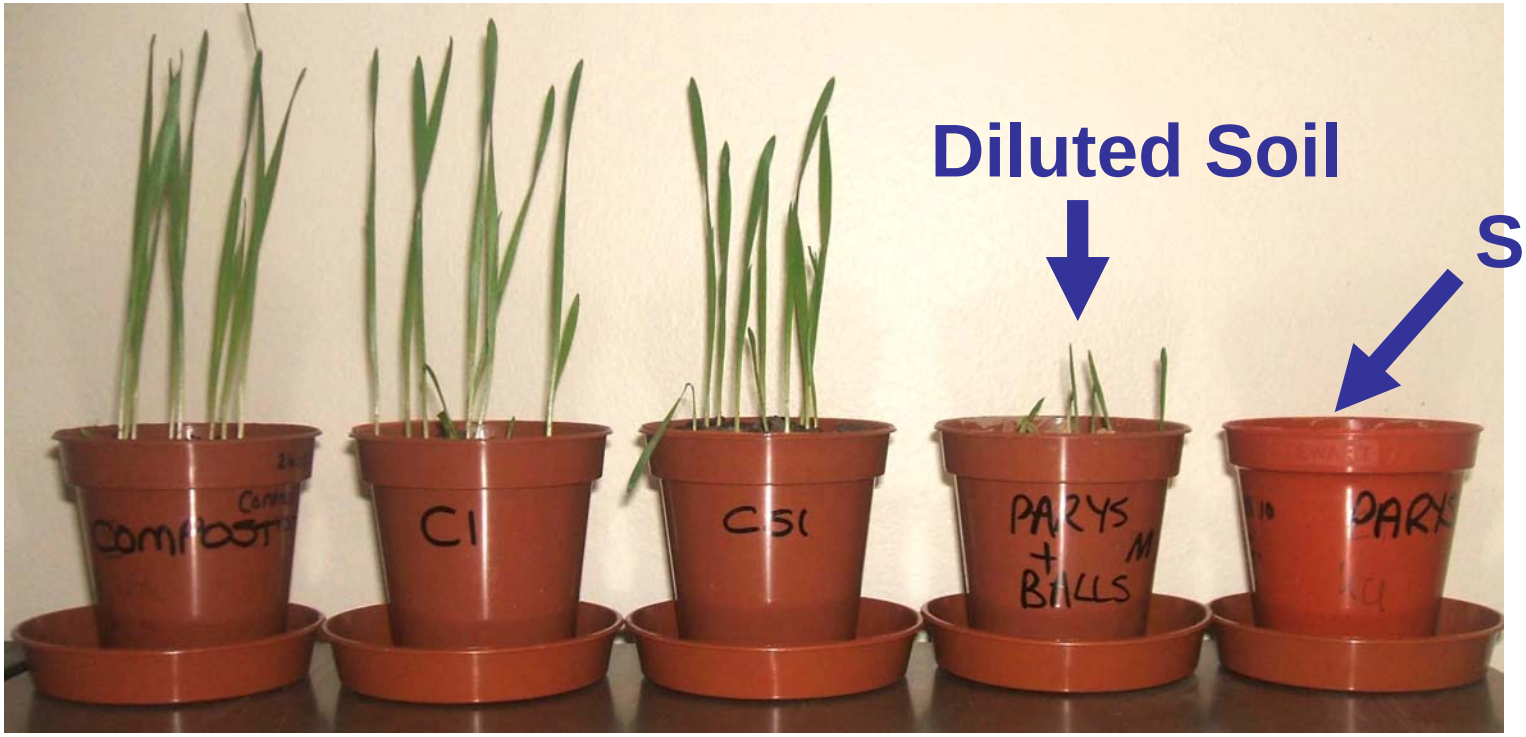
Step 2: Greenhouse Experiment

- **Question:** Are metals bound more strongly when polluted soil is co-composted or when it is mixed with compost afterwards
- **Question:** Does compost reduce available metals more than just by dilution
- **Trial:** Pot experiment using acid tolerant wheat

Treatments and Analysis

- **Treatments:**
  - Soil + Compost
  - Co-composted soil
  - Diluted soil (polystyrene balls)
- **Analysis:**
  - Pore water metals
  - Plant metals (shoots)
  - Plant biomass

Pre-Trial: 1 week growth



Greenhouse Trial Setup

- Mixed compost with same amount of soil as co-composted soil treatment
- Diluted soil with polystyrene balls to same extent as for compost
- Placed in 7.5L pots with pore water samplers
- Left for 1 month

Next Step

- Take samples of each treatment for sequential extraction
- Plant acid tolerant wheat
- Extract pore water at start, middle and end of experiment
- At end of experiment measure wheat shoot biomass and wheat metal content