Microbial Activity in Anthracite Contaminated Soils

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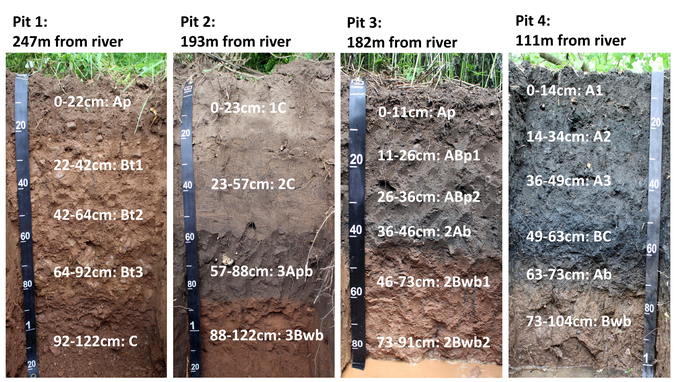
BACKGROUND & RATIONALE

- Extensive coal mining in eastern Pennsylvania anthracite region
- Coal processing wastewater discarded into waterways, and fine coal waste products discarded into piles (culm banks), causing infiltration into local streams and ecosystems
- The Schuylkill and Lehigh valleys contain alluvial soils with high concentrations of geogenic carbon from infiltration
- Impact of anthracite contamination on microbial activity and carbon cycling in soils currently unknown
  - ➢ Anthracite contamination may inhibit microbial activity and reduce respiration rates
  - ➢ Increased carbon concentrations may stimulate microbial activity and increase respiration rates
- Respiration rates of soils impacted by spatial availability of organic matter in soil matrix and chemical characteristics of organic matter
- **Objective: Quantify microbial activity and decomposability of organic matter in soils by measuring respiration rates of soils relative to soil mass and C mass in a lab incubation**

STUDY SITE & SAMPLE COLLECTION

- Samples taken from Schuylkill River floodplain in State Game Lands No. 234 in Montgomery County, PA
- Sample sites chosen with increasing distance from Schuylkill River (fig. 4)
  - ➢ Pit 4: Closest (highest anthracite contamination)
  - ➢ Pit 1: Farthest (lowest anthracite contamination)
- Samples taken from each soil horizon in each pit, identifiable in soil profiles (fig. 1)

FIGURE 1: Soil profiles of pits 1-4 and their horizons



METHODS

- After collection, soil samples air dried and sieved to <2mm
- 2 repetitions of 3 sets of 21 5ml soil samples measured and rewet to 55% water-filled pore space (WFPS) (fig. 3)
  - ➢ 55% WFPS allows for optimal microbial activity
- Samples incubated over period of 20 days
- Headspace air sampled incrementally throughout incubation
- Respiration rates quantified by measuring CO_2 concentrations in sample headspace air with LICOR LI-7000 Infrared Gas Analyzer (fig. 2)

FIGURE 2: LICOR LI-7000 with drierite column for H_2O removal and magnesium perchlorate column for CO_2 removal

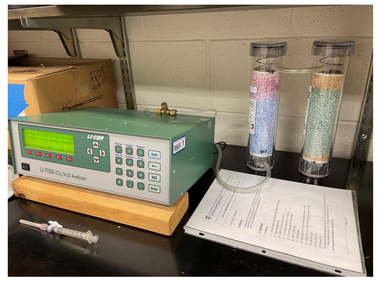


FIGURE 3: Soil samples: 3 replications of 21 samples and 2 blank control tubes

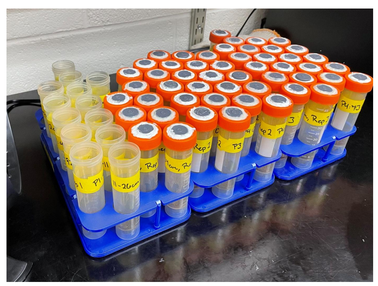


FIGURE 4: Location of State Game Lands No. 234 and proximity to Schuylkill River

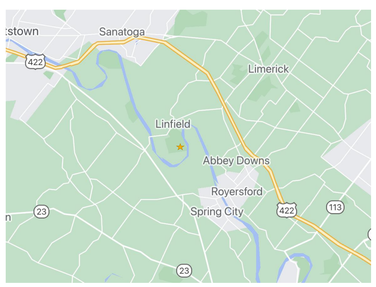


FIGURE 5: Respiration rates relative to soil mass

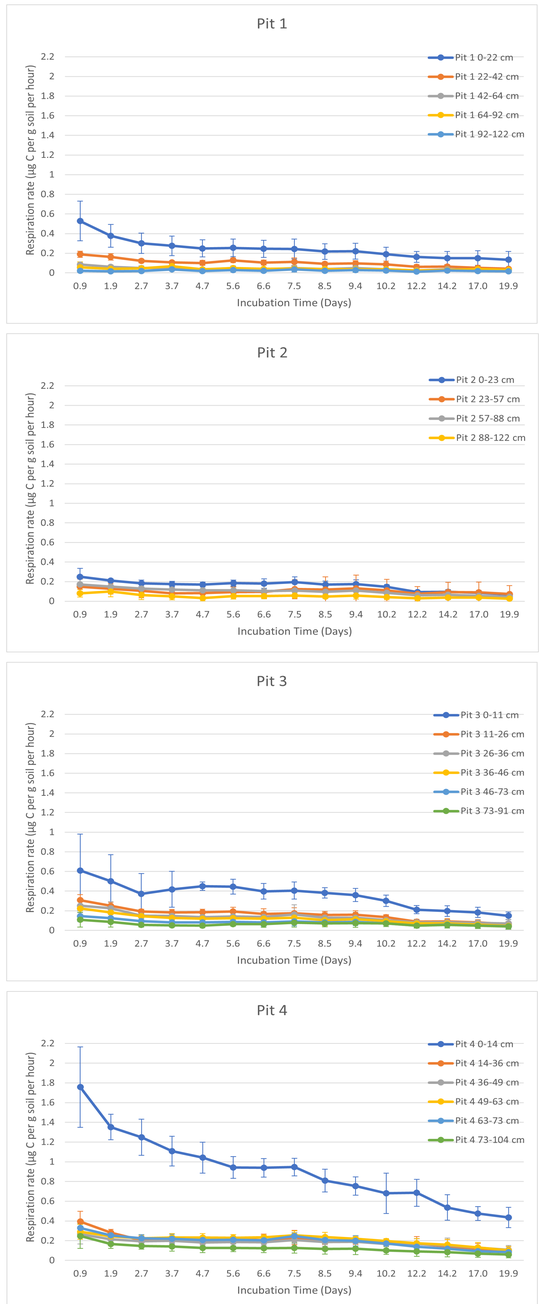
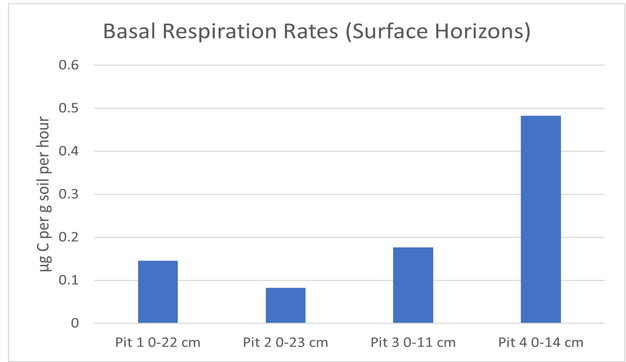


FIGURE 6: Cumulative respiration

Sample	µg Carbon	Sample	µg Carbon
Pit 1 0-22 cm	657.28	Pit 3 0-11 cm	917.51
Pit 1 22-42 cm	268.12	Pit 3 11-26 cm	447.48
Pit 1 42-64 cm	135.71	Pit 3 26-36 cm	367.29
Pit 1 64-92 cm	130.34	Pit 3 36-46 cm	305.55
Pit 1 92-122 cm	83.54	Pit 3 46-73 cm	234.57
Pit 2 0-23 cm	485.23	Pit 3 73-91 cm	201.75
Pit 2 23-57 cm	323.57	Pit 4 0-14 cm	1711.01
Pit 2 57-88 cm	261.95	Pit 4 14-36 cm	431.50
Pit 2 88-122 cm	152.14	Pit 4 36-49 cm	359.29
		Pit 4 49-63 cm	386.98
		Pit 4 63-73 cm	426.40
		Pit 4 73-104 cm	316.64

FIGURE 7: Basal respiration rates of surface horizons (average of final three rates)



RESULTS & CONCLUSIONS

- Pit 4 surface horizon presented highest respiration rates relative to soil mass
- Of all surface horizons, Pit 1 showed highest respiration rates relative to carbon mass, while Pit 4 showed lowest respiration rates relative to carbon mass
- Respiration rates tend to decrease with depth, likely due to a decrease in available organic matter
- Higher geogenic carbon concentrations result in higher rates of organic matter decomposition, but concentrations and rates do not increase proportionally
- Results indicate need for further investigation into dynamics of organic matter decomposition in anthracite contaminated soils and impact of anthracite contamination upon microbial community structure

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