A136 Microbial Ecology and Soil Geochemistry in a Multi-Individual Grave

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After attending this presentation, attendees will have learned the differences in soil chemistry resulting from human decomposition. This presentation will increase attendees' knowledge of human decomposition processes, particularly as they pertain to the soil environment. This presentation will allow attendees to understand the differences in soil biology and biogeochemistry at different depth points in a human grave.

This presentation will impact the forensic science community by increasing understanding of variables related to postmortem interval estimation, burial location/site disturbance, and human skeletal DNA degradation. Therefore, this research is expected to inform models or practices relating to such areas.

Soil is a dynamic environment with multiple interacting physiochemical (pH, moisture, ion exchange capacities, redox potentials, and oxygen content) and biological processes (microbial communities).[1] These interacting features constrain cadaver decomposition within a burial environment; however, it is unknown how soil chemistry and biology differ at different depths within a human grave. Results may have significant implications for assessing skeletal degradation (or preservation) within a burial environment.

A burial containing three individuals was interred for four years prior to initiating this research. Soil samples were collected during disinterment at four depths surrounding the bodies within the grave: 0-5cm (surface; above interred individuals); 30-35cm (level with the shallowest bones); 70cm-75cm (base/floor of the grave); and 85-90cm (below the grave). Control samples were collected from undisturbed ground 5m away from the grave as well as from a control grave that had been excavated and backfilled without bodies simultaneous to interment. All soils were analyzed for microbial respiration, pH, conductivity, nitrate (NO_3^-), nitrification potential, NH_4^+, Dissolved Organic Nitrogen (DON) and Dissolved Organic Carbon (DOC), as well as extracellular enzymes (Leucine Aminopeptidase (LAP); N-Acetyl-β-Glucosaminidase (NAG); Phosphodiesterase (PDE); β-D-Cellulobiosidase (CB)). Bacterial (16S recombinant DNA (rRNA) gene) and fungal (ITS gene) abundances were quantified using quantitative Polymerase Chain Reaction (qPCR) and universal primers. Nematodes were also extracted from soil samples to assess population dynamics.

The soil at the base of the grave (70cm-75cm) exhibited significantly elevated microbial respiration rates, elevated DOC, DON, NH_4^+, soil gravimetric moisture, conductivity, and pH compared to surface and 30cm-35cm samples. Nitrification potential and NO_3^- were elevated at 30cm-35cm compared to surface or base-of-grave samples. There was a significant change in NAG enzymatic activity throughout the grave, with the greatest values measured at the base of the grave, indicative of microbial turnover. A mixed soil and adipocere sample collected from within the ribcage of an individual contained the highest activity of LAP and PDE enzymes, indicating that within heterogeneous regions of the grave, protein and cell wall degradation persists after four years.

Mean 16S gene abundances, reflective of bacterial presence, decreased with depth from 5.22×10^9 16S rRNA gene abundances at a depth of 0cm-5cm to 5.78×10^7 16S rRNA gene abundances at a depth of 85m-90cm. The presence of fungi initially increased from an average of 7.14×10^8 ITS gene abundances at 0cm-5cm to 2.56×10^9 ITS gene abundances at 70cm-75cm, then proceeded to decrease to 2.01×10^6 ITS gene abundances at 85cm-90cm. Bacterial and fungal gene abundances were highest in the mixed soil/adipocere sample described above (at ~40cm), consistent with persistent biogenic degradation of interred individuals. In addition to changes in bacterial and fungal communities with depth, nematodes demonstrated changes in community diversity, evenness, and richness with depth. Nematode community richness declined with depth, with no detectable nematodes at a depth of 85cm. Nematode evenness was variable within the grave compared with transect soils, and there was a marked shift in community composition toward bacterial and fungal feeders in the mixed soil/adipocere sample.

This study provides a characterization of soil biology and chemistry at different depths within a multi-person grave. Results provide novel insights into environmental changes within a grave that may inform our understanding of postmortem interval estimation, burial location/site disturbance, and human skeletal DNA degradation.

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Reference(s):

1. Forbes S.L. Potential determinants of postmortem and postburial interval of buried remains. In: Tibbett M., Carter D.O., editors. *Soil Analysis in Forensic Taphonomy: Chemical and Biological Effects of Buried Human Remains.* CRC Press, 2009; 225–46.

Burial, Microbial Ecology, Taphonomy

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