Kearney Foundation Undergraduate Fellowship
Final Report Summary

Fellowship recipient: Travis Wilson

Project Title: Carbon and Nitrogen Distribution in Geologically Distinct Soils of California

Mentor Professor: Dr. William Horwath

Reporting period: October 2009-November 2010

Background:

The state of California contains a wide range of geologic deposits that produce soils with unique physical and chemical properties. Because soils are a valuable resource which play an important role in ecosystem health, understanding how factors such as mineralogy influence soil properties is imperative. In particular, carbon and nitrogen are especially important for plant growth and are often considered as indicators of soil quality.

Although many studies have shown differences in Carbon and Nitrogen content across different soil types, the type of protection by the mineral matrix (physical vs. chemical) is not well understood. Furthermore, changes in these associations with depth should be explored. This research will use a physical fractionation procedure to try to understand factors influencing C and N distribution in soils with unique mineral composition, and will explore how these factors may influence the soil microbial community.

Objectives:

The purpose of this project is to relate the partitioning of Carbon and Nitrogen in the physical soil fractions (light fraction, occluded fraction, and mineral fraction), and the soil's total microbial biomass to the soil forming environment and the depth within the soil profile. The soil forming factors we are most interested in with regards to this project are time (soil development), parent material, climate, and microbial biomass (organisms).

Major Challenges:

There were several challenges encountered in the duration of this project, most of which occurred during the density fractionation phase of the analysis. The first problem was with our stock of Sodium polytungstate (SPT), the dense solution used in the fractionation procedure. SPT is quite expensive, so we use a method of recycling it for continued use, which normally does not cause any issues, yet after being recycled the solution would be excessively cloudy which required multiple rounds of filtering through glass fiber filters. After filtering, the solution would be clear enough for use for several days before it began to cloud again, which put a time constraint on the fractionation process for each sample. We eventually learned that there was no problem with our recycling method that was causing the cloudiness, but rather

that the manufacturer had changed their process of making the SPT which would cause this problem after multiple uses.

The next difficulty was encountered with the soils we collected that had a high clay content. In the final stage of fractionation when the mineral fraction is obtained, the soil is rinsed with deionized water to rinse any remaining SPT from the sample. With high clay soils, a large amount of colloidal clay particles would get suspended in the rinse water rather than remaining in the sample pellet. Discarding the water, as is normal procedure, would then result in the introduction of error in the mass accounting for each sample fraction. This was remedied by saving the rinse water and drying it so the colloidal clays within it could be weighed and their weight added to the mineral fraction weight.

Another obstacle to progress came when transferring the occluded soil fraction from its sample cup to a scintillation vial for ball milling. Some of the occluded fractions were so small that they became stuck to the filter after drying and were impossible to remove from the filter to put in the vial. The solution was to transfer the whole filter with soil to the vial, and then ball mill that. In order to get the proper carbon and nitrogen percentages of the sample, we had to make a ratio of the occluded fraction weight to the filter weight in order to tell how much of the sample weighed out for C/N analysis was soil and how much was the filter.

Major Opportunities:

Working on this project provided me with many opportunities that I would not have experienced in much of my normal coursework. My first major opportunity was traveling to three research sites in different areas of California to collect soil samples. This was my first exposure to field sampling, characterization, and measurement of soil properties. What I learned on these trips became useful in the lab portion of several soil science courses I took later in the year.

My other opportunities came in the form of learning how to properly manage sample processing and analysis. In the course of this project I learned how to fumigate soils, extract for nitrogen analysis and dissolved organic carbon analysis, fraction soils through density fractionation, and analyze for total carbon and nitrogen on the Costech combustion analyzer just to name a few of the skills I learned.

Progress Summary:

To date, almost all of the analysis for the project is complete. The only remaining work is to micro-balance the remaining eighteen mineral fractions to analyze for C/N on the Costech machine. Once that is complete, the carbon and nitrogen data for each sample fraction can be compiled and compared to the data of samples from different transects, pits, and depths. It will also be compared to the bulk soil carbon data, and soil microbial biomass data to hopefully identify how carbon and nitrogen are stored in California forest soils from different climates and parent materials. Finally, if the data shows significant differences in carbon and nitrogen partitioning with depth, then another sample from a third depth at each site may be fractioned to obtain more data with which to compare.