ABSTRACT

Benjamin Colman
UC Santa Barbara

**Controls on carbon mineralization in subsurface soils in California annual grasslands**

In most soil profiles, the concentration of organic carbon in soil decreases with soil depth and the carbon residing in deeper soil horizons is mineralized very slowly (Brady and Weil 2002)(Trumbore 2000). It is not clear why the rates of mineralization of subsurface soil organic matter (SOM) are so low and why the residence times of C in subsurface soils are so long. Is the C physically protected, rendering it physically inaccessible to microbial mineralization? Or is subsurface SOM so chemically complex that microbial mineralization is inhibited? Or could the accumulation and persistence of C in these subsurface horizons be due to nutrient imbalances that limit microbial activity? While a large number of studies have looked at organic C concentrations through the profile, we have a very poor understanding of the controls on microbial mineralization of organic C through the profile. This gap in our knowledge is particularly glaring considering that the total amount of carbon residing in subsurface horizons can be significant. Although C concentrations decline sharply with depth, the volume of soil residing in subsurface horizons is large; over 50% of the carbon in 1m deep soil profiles is found below 30 cm in depth (Batjes 1996). Understanding the dynamics of subsurface C pools is especially important if we want to understand how anthropogenic disturbances – including increased nutrient loading rates, soil acidification, and the physical disturbance of subsurface soils will affect the large reservoir of organic C contained in subsurface soil horizons. Existing literature has primarily focused on the effects of anthropogenic disturbance on soil processes and carbon fluxes in the surface soil horizons, largely ignoring the deeper soil carbon pools. The goal of this study is to understand the mechanisms and controls on microbial C mineralization of SOM through the soil profile. There are four possible explanations for the decrease in C turnover rates (the decrease in microbial mineralization of SOM) with soil profile depth. Decomposition is limited by:

**H1: Physical protection afforded by soil structure (i.e. protection in aggregates).**

**H2: Physical protection afforded by organo-mineral complexation.**

**H3: Chemical protection due to recalcitrance of organic matter.**

**H4: Nutrient availability.**

This project has been designed to explicitly test these 4 hypotheses in order to better understand organic C dynamics throughout the soil profile. Soils will be collected from various different depths throughout representative soil profiles at three annual grassland sites in California: Sedgwick Reserve, Santa Ynez Valley; Hastings Reserve, Carmel Valley; and the McLaughlin Reserve, north of Davis. The three sites lie along a precipitation gradient and we expect the three sites to have quantitatively different soil C distributions through the soil profiles.
REFERENCES:
European journal of soil science. 47: 151-163.
Saddle River, NJ, Prentice Hall.
Trumbore, S. E. (2000). “Age of soil organic matter and soil respiration:
Radiocarbon constraints on belowground C dynamics.” Ecological Applications
10: 399-411.