Stability of Soil Organic Carbon Pools Across a Rangeland Agricultural Management Gradient

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INTRODUCTION

Soil organic carbon (SOC) is a reservoir for plant nutrients as well as a key component in soil aggregation, water holding capacity, and biogeochemical processes. Changes in SOC can influence C, N, and P cycling and climate change. SOC is affected by management (1) through modification of the landscape (e.g., deforestation) or (2) through changes to management practices (e.g., grazing, fertilization). However, the potential for SOC to buffer climate change has been questioned due to the high variability of C and N cycling in different ecosystems. Research on SOC dynamics in rangelands is essential for understanding the impact of climate change on SOC dynamics.

RESULTS

1) Investigate the stability of SOC pools (unprotected versus protected) across a gradient of rangeland agricultural management practices.

2) Examine SOC stability across the various plant communities, which result from interactions between management, soil, topographic, edaphic, and ecological factors.

3) Physically occluded carbon was assessed by wet sieving soils with a microaggregate isolator into coarse particulate organic matter (CPOM) (<250um), silt plus clay (m), and coarse sand (>53um).

4) Ultrafiltration fractions were further broken down into two sub-fractions: particulate organic matter (POM) and soluble organic carbon (SOC).

5) We extracted carbon and nitrogen by dual extraction methods for HWC and soils, respectively.

6) All fractions were analyzed for total carbon and total nitrogen by Shimadzu for HWC and Costech for soils.

Figure 1. Soil Fractionation and Treatment Scheme. Each group of factors were treated with wet sieving. Table 1: Distributions of C contributed by each fraction at different scales in A and AB horizons. The carbon enrichment in each fraction is expressed as a percentage. A/C fraction ratio of the concentration of C in each fraction to the total C in the soil was calculated. The Rangeland Watershed, Six (Agroecology), and O’Geen (California Soil Resource) laboratories for their support and collaboration.

DISCUSSION

Different degrees of carbon enrichment were found across three scales in both A and AB horizons (Fig. 2). In the A horizon, the C fraction was indeed higher across the management gradient. Across fractions, however, the SOC pool had the highest C, followed by microaggregates, then the old pasture and, finally, the irrigated pasture. At the C fraction basis (Table 1), the C fraction basis was found to be the most stable carbon in the POM fraction. Interestingly, there appeared to be no differences in SOC in the soil's available carbon.

Carbon enrichment is one of many ecosystem services provided by the rangeland. Our results show that SOC enrichment is closely related to plant productivity in the rangeland. Despite the presence of forested systems and adjacent grasslands, our investigation of protected and unprotected C pools within the study area is closely related to management practices found in the agroecosystem, such as intensive management systems, the irrigated pasture, and more stable C pools than the less intensive management system, the oak woodland.

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