Geophysical Research Abstracts
Vol. 14, EGU2012-11197, 2012
EGU General Assembly 2012

Soil organic matter stabilization in grazing highland soils from the Andean Plateau

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Grasslands comprise approximately 40% of the earth′s land area and play a critical role in the global carbon cycle. Apolobamba is a grazing highland located in the Andean Plateau where sustainable vicuna (Vicugna vicugna) management programme is carried out. Understanding the soil properties and the organic matter dynamics is fundamental to determine the grazing impacts in the carbon reservoirs. However, the labile and recalcitrant fractions of C have not been widely studied under field conditions, especially in high grasslands. The objectives of this survey were to: (i) achieve a soil characterization through general physico-chemical properties and (ii) study soil organic matter stabilization through recalcitrant and labile carbon budgets in Apolobamba. Regarding the lastly vicuna censuses carried out in the studied area, eight representative zones with different vicuna densities were selected and soil samples were collected. Other characteristics were also considered to select the study zones: (1) alpaca densities, (2) vegetation communities (3) plant cover and (4) landscape and geo-morphological description. Recalcitrant and water soluble organic carbon were determined as well as recalcitrant index. General soil characterization showed strongly acid and no saline soils with high cation exchange capacity and sandy-loam and loam textures. Total nitrogen contents indicated no limitation for the native vegetation growth. In general, no relationships were found among general soil properties, vicuna and alpaca densities; however, zones with highest alpaca density could be prone to soil erosion based on the available P distribution and the texture results. Additionally, a negative alpaca grazing influence in the soil organic carbon stocks was observed. On the other hand, high soil recalcitrant carbon contents (3.7 ± 0.3 kg m-2) and recalcitrance index (0.8 ± 0.1) were found. Likewise, labile C exhibited similar values to those obtained from researchers conducted in grasslands. These observations could be positive aspects in the preservation or stabilization of the soil mineral particles and the long term carbon sequestration. We suggest that the soil C stabilization mechanisms in mountain grassland may be affected by the lower temperatures and acid soil pH. In conclusion, Apolobamba could have a significant reservoir of stabilized soil organic matter. However, there is an urgent need to establish soil protection strategies against the alpaca overexploitation in order to protect the organic matter stocks and to continue with the vicuna sustainable management in the Andean Plateau.

Keywords: carbon reservoirs, highland soils, recalcitrant carbon, vicuna