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Organic Carbon Stabilization of Soils Formed on Acidic and Calcareous Bedrocks in Neotropical Alpine Grassland, Peru

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Increasing evidence shows that Neotropical alpine ecosystems are vulnerable to global change. Since soils in the alpine grasslands of the Peruvian Andean region have large soil organic carbon (SOC) stocks, profound understanding of soil organic matter (OM) stabilization mechanisms will improve the prediction of the feedback between SOC stocks and global change. It is well documented that poor-crystalline minerals and organo-metallic complexes significantly contribute to the OM stabilization in volcanic ash soils, including those in the Andean region. However, limited research has focused on non-ash soils that also express significant SOC accumulation. A pilot study of Peruvian Andean grassland soils suggests that lithology is a prominent factor for such carbon accumulation. As a consequence of contrasting mineral composition and pedogenic processes in soils formed on different non-volcanic parent materials, differences in OM stabilization mechanisms may be profound and consequently may respond differently to global change. Therefore, our study aims at a further understanding of carbon stocks and OM stabilization mechanisms in soils formed on contrasting bedrocks in the Peruvian Andes. The main objective is to identify and compare the roles that organo-mineral associations and aggregations play in OM stabilization, by a combination of selective extraction methods and fractionations based on density, particle size and aggregates size.

Soil samples were collected from igneous acidic and calcareous sedimentary bedrocks in alpine grassland near Cajamarca, Peru (7.17°S, 78.63°W), at around 3700m altitude. Samples were taken from 3 plots per bedrock type by sampling distinguishable horizons until the C horizons were reached. Outcomes confirmed that both types of soil accumulate large amounts of carbon: 405.3±41.7 t/ha of calcareous bedrock soil and 226.0±5.6 t/ha of acidic bedrock soil respectively. In addition, extremely high carbon contents exceeding 90g carbon per kg soil were found in the upper 30cm of the soils on calcareous bedrock. Ongoing processing and prospective work focusses on unraveling the OM stabilization mechanisms in both soil types. For this a novel combination of selective extraction methods, size and density fractionation and advanced molecular characterization techniques (pyrolysis GC/MS) is used.