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Distinctive soil organic matter composition in a precipitation contrast of a Hawaiian Andosol

Thiago M. Inagaki (1,3), Katherine Grant (2), Carsten W. Mueller (1), Johannes Lehmann (2,3), Louis A. Derry (2), Ingrid Kögel-Knabner (1,3)

(1) Chair of Soil Science, Technical University of Munich, Freising, Germany (thiago.inagaki@wzw.tum.de), (2) Soil and Crop Sciences, Cornell University, Ithaca NY, USA , (3) Institute for Advanced Study, Technical University of Munich, Garching, Germany

Volcanic Andosols are recognized by their strong capacity to accumulate soil organic carbon (SOC), and for presenting a singular aggregation pattern. However, the factors which govern their SOC storage and aggregation hierarchy are still poorly understood. In addition, many methods of fractionation are proposed for these soils and there is no consensus regarding the ideal methodology. In this way, the objective of this study was to evaluate the soil organic matter (SOM) properties of an Andosol through CN analysis, NMR spectroscopy, and Scanning electron microscopy (SEM) + NanoSIMS analysis in the soil mineral fraction testing different dispersion treatments. We tested three Andosol samples from two different sites of the Kohala region – Hawaii with contrasting precipitation levels. The samples tested were as follow: 1784-60 (altitude-average depth cm) and 1784-80: subsoil samples from 0.5-0.7 and 0.7-0.9 m depth, respectively, with annual mean precipitation of 1784 mm and altitude of 1194 m; and 2286-50: subsoil sample from 45-60 cm depth, with annual mean precipitation of 2286 mm and altitude of 1501 m. We performed the SOM fractionation using ultrasonic dispersion at 1500 J ml-1, wet sieving and sedimentation. Five fractions were obtained as follow: free particulate organic matter (fPOM), 4000-63, 63-20, 20-2 and < 2μm, respectively. We made the fractionation procedure in two sets: with and without a pre-dispersion treatment with Na saturation to test its influence on the SOM characterization. The C content and distribution was analyzed in all the fractions, and the NMR and SEM+NanoSIMS analysis were carried out in the fraction <2μm of 1784-60 and 1784-80 samples. Overall, the pre-dispersion treatment with NaCL saturation did not influence the C content and its distribution, as well as the SOM composition observed by NMR and NanoSIMS analysis. More than 90% of the soil mass was concentrated in the fractions below 20 μm (i.e. 20-2 and <2μm). The <2μm fraction was the most representative for the evaluated Andosol, accounting with 83% of the C content and 74% of the soil mass for the three samples evaluated overall. The 2286-50 presented a higher C content than the other samples specially for fPOM and 63-20 μm fraction. The C and mass distribution along the fractions, on the other hand, was similar between the different soil samples. We observed a great difference in the SOM composition between the 1784-60 and 2286-50 samples in the mineral fraction (<2μm) through NMR spectroscopy. 2286-50 overall presented a dominance of alkyl-C, while 1784-60 presented higher amounts of carboxyl-C and O/N alkyl groups, which can be possibly be explained by differences in the mineral composition of each sample. Also the NanoSIMS analysis demonstrated distinct spatial differences in the distribution of 12C- and 12C14N- in organo-mineral associations at the micro scale between the two sites. The results of this study suggest that mineral interactions in the smaller size-fractions (<2μm) can be the key to explain the mechanisms of C storage in Andosols and that the pre-dispersion treatment with NaCL does not provide significant changes in the SOM study.