The role of macro-aggregation in regulating enzymatic depolymerization of soil organic nitrogen

The role of macro-aggregation in regulating enzymatic depolymerization of soil organic nitrogen.

Supporting Information

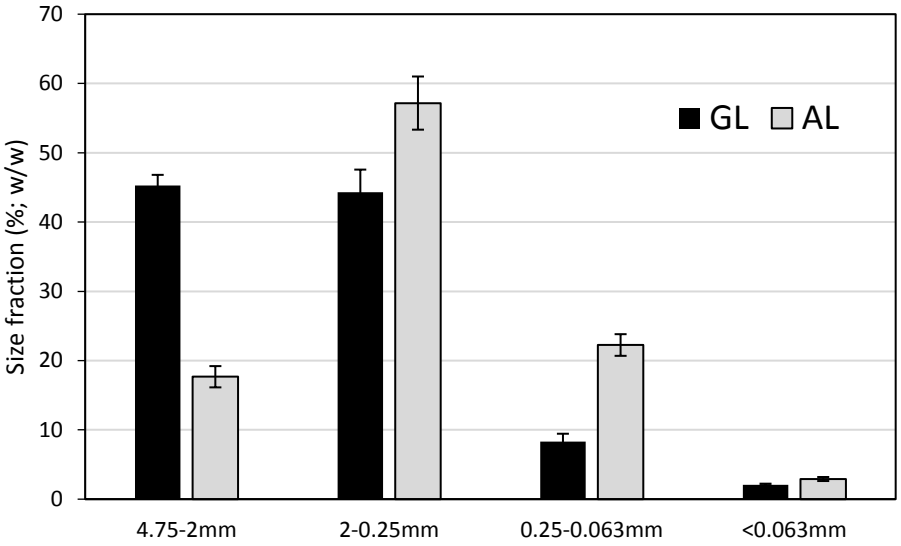
Author names and affiliations

Jumpei Fukumasu[a,b], Liz J. Shaw[b,*]

[a] Graduate School of Environmental and Life Science, Okayama University, 3-1-1 Tsushimanaka, Okayama 700-8530, Japan

[b] Soil Research Centre, Department of Geography and Environmental Science, School of Archaeology, Geography and Environmental Science, University of Reading, Whiteknights, P. O. Box 233, Reading RG6 6DW, UK

* Corresponding author. Tel.: +44 (0) 118 3786971; fax: +44 (0) 118 3786666. E-mail address: e.j.shaw@reading.ac.uk (L.J. Shaw).



Supplementary Fig. 1. Initial distribution of soil among four different size fractions as obtained by dry sieving. Data are expressed as a percentage of the total mass of soil <4.75 mm. Data are mean ± standard error (n =6 for grassland (GL) and n = 5 for arable (AL) soil).

Supplementary Discussion: Decreased protease activity in response to disaggregation in grassland soil.

Comparison of depolymerase activities between aggregated and disaggregated soil (Table 2, main article) revealed no effect of aggregation on individual enzyme activities, with just one exception: protease in GL soil. Potential explanations for why protease activity in disaggregated GL soil was decreased compared to corresponding activities in aggregated soil include: (1) despite the use of a pestle and mortar for physical disruption as opposed to more aggressive ball-milling, disaggregation increased accessible soil surface area and thus some proteases were rendered less active through adsorption on to mineral surfaces (Burns et al., 2013; Kleber et al., 2007); (2) in air-dried soil prior to the start of assays, enzymes were active (Manzoni et al., 2014; Warren, 2016) and disaggregation exposed proteases to inactivation via decomposition; (3) disaggregation exposed native protein which might have competed with assay substrate (casein) for depolymerization during the assay (Zimmerman and Ahn, 2011). Possibility (3) seems most plausible because it accounts for why disaggregation effects on protease activity were differentially pronounced in GL soil (greater N content).

References

Burns, R.G., DeForest, J.L., Marxsen, J., Sinsabaugh, R.L., Stromberger, M.E., Wallenstein, M.D., Weintraub, M.N., Zoppini, A., 2013. Soil enzymes in a changing environment: Current knowledge and future directions. Soil Biology and Biochemistry 58, 216-234.

Kleber, M., Sollins, P., Sutton, R., 2007. A conceptual model of organo-mineral interactions in soils: Self-assembly of organic molecular fragments into zonal structures on mineral surfaces. Biogeochemistry 85, 9–24.

Manzoni, S., Schaeffer, S.M., Katul, G., Porporato, A., Schimel, J.P., 2014. A theoretical analysis of microbial eco-physiological and diffusion limitations to carbon cycling in drying soils. Soil Biology and Biochemistry 73, 69–83.

Warren, C.R., 2016. Do microbial osmolytes or extracellular depolymerisation products accumulate as soil dries? Soil Biology and Biochemistry 98, 54–63.

Zimmerman, A.R., Ahn, M.Y., 2011. Organo-mineral-enzyme interaction and soil enzyme activity. In: Shukla, G., Varma, A. (Eds.), Soil Enzymology, Soil Biology, vol. 22. Springer-Verlag, Berlin, pp. 271-292.