P393-TH

RATES OF NITROGEN AND CARBON FLUX FROM AND WITHIN THE AMINO ACID POOL IN A GRASSLAND SOIL

Timothy KNOWLES[1], Richard EVERSHED[1], Roland BOL[2] and David CHADWICK[2]

1. Organic Geochemistry Unit, Bristol Biogeochemistry Research Centre, School of Chemistry, University of Bristol, Cantock's Close, Bristol, BS8 1TS, UK.
2. Institute of Grassland and Environmental Research, North Wyke, Okehampton, Devon, EX20 2SB, UK.

The availability of biologically accessible forms of nitrogen can control the diversity, dynamics and functioning of many ecosystems including soils (Vitousek *et al.*, 1997). Although the cycling and interconversions between inorganic forms of nitrogen in soils are relatively well understood, much less is known about the fate of organic nitrogen containing compounds. The use of organic fertilizers such as farm wastes are currently of much importance. Every year in the UK, 45 million tonnes of manure are deposited directly onto fields by livestock in addition to 67 million tonnes collected from farm buildings and yards to be spread on fields (Chambers *et al.*, 2000). A considerable proportion of the organic nitrogen applied to soil in this way is proteinaceous; hence it is important to develop a molecular understanding of the fate of both the nitrogen from proteins and amino acids and the associated carbon once in the soil. Our aim is to: i) determine the relative rates of mineralization or assimilation of amino acid nitrogen by soil microorganisms; ii) characterize the products of these processes; and iii) identify the organisms responsible for carrying out these transformations.

In order to investigate the fate of the C and N from free amino acids in a grassland soil, several amino acids with varying chemical properties and positions in biosynthetic pathways were added to the soil as dual labelled (^{15}N and ^{13}C) tracer compounds. The changes in the δ^{13}C and δ^{15}N values of these amino acids over time gives an insight into the turnover rates of amino acids in soil. The δ^{13}C and δ^{15}N values of other amino acids and different C and N containing organic compounds (such as phospholipid fatty acids and amino sugars) in addition to inorganic N compounds will facilitate the elucidation of the rates of flux of C and N from the free amino acid pool into other compounds and compound classes within the soil.

A mixture of 5 amino acids (glycine, proline, lysine, glutamic acid and arginine) was added to small lysimeters (~10 cm deep, ~2 cm diameter) containing 10 g soil. These were then incubated for time-periods of up to 32 days. The δ^{13}C values of the added amino acids show a biphasic exponential over time decay of the form $y = C_1 e^{(-K_1 x)} + C_2 e^{(-K_2 x)} + P$ with an initial rapid rate of loss of label followed by a slower second decay phase. The other

endogenous amino acids in the soil show a sharp rise from their original natural abundance levels to $\delta^{13}C$ values comparable to those of the added amino acids by day 2 of the incubation before following a similar rate of decay. A similar pattern was observed in the $\delta^{15}N$ values of amino acids; however the initial loss of label was slower than in the case of C. This is thought to be due to the mineralised nitrogen staying within the soil and being re-assimilated by the soil microbial community. The $\delta^{15}N$ values of amino acids which are closely related by their biosynthetic pathways appear to equilibrate rapidly, whilst those between biosynthetically distant amino acids do not. This is not observed in the $\delta^{13}C$ values of the amino acids, perhaps due to the mobility of carbon 'building blocks' (such as acetyl-CoA) within cells. The $\delta^{13}C$ values of phospholipid fatty acids rose to a maximum at 2 days indicating the use of amino acid C as a C source for the biosynthesis of other important compound classes.

This work forms part of a wider study to investigate the fate of organic N and the C associated with it from agricultural wastes in grassland soils. This will include incubation studies of soils with dual-labelled intact protein and animal wastes.

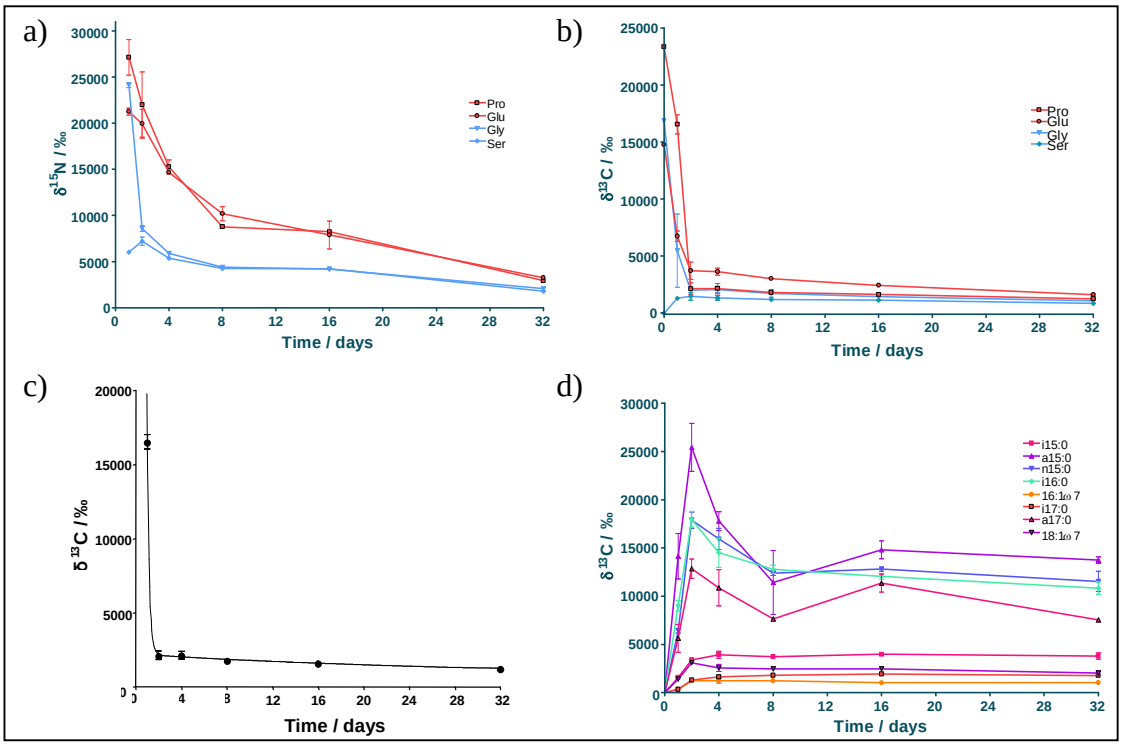

Figure 1. a) $\delta^{15}N$ and b) $\delta^{13}C$ values of AAs from different biosynthetic pathways; c) $\delta^{13}C$ values of proline with a two-phase exponential decay model applied and d) $\delta^{13}C$ values of bacterial phospholipid fatty acids

REFERENCES

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