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Effect on a long-term afforestation of pine in a beech domain in NE-Spain as reflected in soil C and N isotopic signature

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The replacement of native beech forests (Fagus sylvatica) by Scots pine (Pinus sylvestris) afforestation may exert changes in soil properties, particularly in soil organic matter (SOM) (Carceller and Vallejo, 1996). Stable isotopic signatures of light elements (d13C, d15N) in soils and plants are valuable proxies for the identification of biogeochemical processes and their rates in the pedosphere (Andreeva et al., 2013 and refs therein).

In this work the C and N stable isotopic analysis is used as a proxy to detect changes in SOM surrogated to the effect of centennial replacement of beech by the Scots pinewood. Two acid soil profiles, developed on quartzites under a humid climate at an altitude of 1400-1500 masl, have been sampled in Moncayo (Iberian range, NE-Spain). For each soil profile three O-layers (litter: OL, fragmented litter OF and humified litter OH) and mineral soil horizons (Ah, E, Bhs and C) were sampled.

Content and bulk isotopic signature of light elements (C and N) were analysed in a Flash 2000 elemental micro-analyser coupled via a ConFlo IV interface to a Delta V Advantage isotope ratio mass spectrometer (IRMS) (Thermo Scientific, Bremen, Germany). Isotopic ratios are reported as parts per thousand deviations from appropriate standards. The standard deviations of d13C and d15N were typically less than $\pm$ 0.05 per thousand, $\pm$ 0.2 per thousand, respectively.

After 100 years since the pine afforestation, no differences on C content were observed in the O-layers, ranging from 30-47% in pine soils and 37-47 % in beech soils. Similarly, no differences on N content were observed in the O-layers, ranging from 1.24-1.86 % in pine soils and 1.70-1.71 % in beech soils. C and N contents decrease progressively in depth with the exception of E-horizons where the lowest C and N content values were found. C/N ratio is higher in pine soil (20.7-38.1) than in beech O soil horizons (21.8-27.5), showing similar behavior with soil depth.

Pine biomass was slightly enriched in 13C as compared to that from beech (OL enrichment factor= 1.24 $\pm$ 0.13 per thousand). Along the soil profile the C isotopic signature (d13C) reflects the main vegetation signature being higher in pine than beech in the organic soil horizons (OL, OF and OH) down to the first mineral Ah horizon. At deeper horizons d13C value tends to equal that of the original beech soil indicating a limited influence of the afforested specie with depth even 100 years after afforestation.

A consistent enrichment in d15N with depth was observed in the two profiles. This N enrichments have been related with progressive N losses being particularly pronounced in forest soils (Szpak, 2014 and refs therein). This phenomenon can be also related to migrations of N forms in a more evolved organic matter. In this view N losses in organic layers under beech seem to be less pronounced that under the alien pine.

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