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Factors affecting the mobilization of DOC and metals in a peat soil under a warmer scenario

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Most climate change models predict an increase of temperature of 3-5ºC in Southern Europe by the end of this century (IPCC 2007). However, changes in summer precipitations are more uncertain, and although a decrease in rainfall inputs is forecasted by most models, the magnitude of this effect has not been assessed properly (Rowell & Jones 2006).
Peatland areas are very sensitive to climate change. In Galicia they survive in upland areas where cold temperatures and continuous moisture supply allow their presence. Besides abiotic factors, alterations in soil fauna activities can also affect peat turnover. Among them, enchytraeids are usually the most numerous invertebrate group in these systems and both temperature and moisture content regulate their abundances and vertical distribution. Previous studies have demonstrated that changes in their populations associated to increasing temperatures can significantly affect metal mobilization, namely iron and aluminium, together with an important decline in the acidity of the soil solution, which possibly eliminates one of the critical mechanisms restricting DOC release (Carrera et al., 2009). In this study we investigated whether changes in water content of the peat soil and soil invertebrate activities associated to increasing temperatures could alter the mobilization rates of Fe and Al and in turn, DOC. 72 undisturbed soil cores (6 cm diameter x 10 cm deep) with their associated vegetation were taken from a blanket bog in Galicia (NW Spain). Back at the laboratory they were sliced horizontally into two layers, (0-5cm and 5-10cm) which were defaunated by means of a wet extraction. Thereafter, the two soil layers derived from the same core were introduced in each microcosm by placing them in their original position but separated by a 1 mm nylon mesh to allow the vertical movements of the organisms. Half of the experimental units were adjusted to the used moisture values observed in the field (80% SWC, H1), whereas in the remaining half the moisture content was decreased to a lower value so that the activities of the soil organisms remained unaffected (60%, H2). Sixty enchytraeid individuals were inoculated into 18 units of each moisture treatment resulting in two animal treatments (+E and –E). Nine replicates of each treatment were incubated at 14ºC and the rest were maintained at 19ºC. Changes in enchytraeid populations during incubation were monitored by using a parallel series of 120 experimental units consisting of plastic containers which contained defaunated soil samples (two soil layers) separated by the nylon mesh and with the two moisture treatments as the microcosms (H1 and H2) following the same procedures as before. Next, the same number of enchytraeids was re-inoculated in half of these experimental units (+E and –E).

The experiment run for 13 weeks; every 15 days, enchytraeid numbers, DOC, Fe and Al content in the leachates collected from each individual layer were determined.

Results showed that both high temperature and moisture values promoted enchytraeid reproduction, with most individuals concentrated in the upper layer. This abundant enchytraeid population favoured the mobilization of DOC, Fe and Al to the soil solution.

These findings suggest that modifications in soil faunal populations due to abiotic changes could enhance organic matter decomposition, contributing to the destabilization of these peatland systems. Increasing leaching of dissolved organic matter and metals could have negative implications, not only in terms of possible feed-backs to global warming but also as potential contaminants for aquatic ecosystems.

References

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