Stable hydrogen and carbon isotope ratios of methoxyl groups during plant litter degradation.

Abstract:
Stable hydrogen and carbon isotope ratios of methoxyl groups (\(^{2}\)Hmethoxyl and \(^{13}\)Cmethoxyl values, respectively) in plant material have been shown to possess characteristic signatures. These isotopic signatures can be used for a variety of applications such as constraining the geographical origin and authenticity of biomaterials. Recently, it has also been suggested that \(^{2}\)Hmethoxyl values of sedimentary organic matter of geological archives might serve as a palaeoclima-t/hydrology proxy. However, deposited organic matter is subject to both biotic and abiotic degradation processes, and therefore an evaluation of their potential impact on the \(^{2}\)Hmethoxyl and \(^{13}\)Cmethoxyl values would allow more reliable interpretations of both isotopic signatures. Here, we investigated this potential influence by exposing foliar litter of five different tree species (Sycamore maple, Mountain ash, European beech, Norway spruce and Scots pine) to natural degradation. The foliar litter was sampled at nine intervals over a 27-month period, and the bulk methoxyl content as well as the \(^{2}\)Hmethoxyl and \(^{13}\)Cmethoxyl values were measured. At the end of the experiment, a loss of the bulk methoxyl in the range of ~40-70% was measured. Linear regression analysis showed no dependence of \(^{2}\)Hmethoxyl values with methoxyl content for four out of five foliar litter
samples studied (R(2) in the range of 0.03 and 0.36, p> .05). On the contrary, the ?(13)Cmethoxyl values showed significant linear correlations for the great majority of the foliar litter samples (R(2) in the range of 0.51 and 0.73, p< .05). The litter species with the greatest methoxyl loss (Mountain ash, Scots pine and Norway spruce) showed the strongest (13)C enrichment, by up to ~5?. Since ?(2)Hmethoxyl shows no systematic overall change during the course of degradation, we propose that there is considerable potential for its use as a palaeoclimate proxy for a wide range of geological archives containing, for instance, fossil wood or sedimentary organic matter. Care would need to be taken if ?(13)Cmethoxyl values of degraded organic matter are used for palaeoclimate/-environmental investigations.