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Laboratory investigations into the potential for transformation of POC to dissolved and gaseous forms

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In eroding peatland systems POC is the dominant component of the fluvial carbon flux, with POC flux to up to circa 80 g C m-2 yr-1. The fate of this POC has remained uncertain, however, and at present many carbon models exclude POC flux from estimations of atmospherically active carbon budgets. Recent work on headwater systems with high POC concentrations has demonstrated that POC:DOC ratios decrease rapidly downstream, hypothesised to be due the physical and microbial breakdown of POC in the fluvial system and transformation of soil carbon to dissolved and gaseous phases.

To assess this hypothesis, laboratory investigations of the potential for transformation of POC to dissolved and gaseous forms were undertaken. POC derived from an exposed gully face was mixed with stream waters collected from Upper North Grain, an eroded peatland catchment in the South Pennines, UK, to simulate typical storm flow suspended sediment concentrations. The solutions were agitated using a magnetic stirring system for one week and subsamples of the solution were extracted at intervals of 0.5, 1, 1.5, 2, 3, 4, 5 and 6 hours, and 1, 2, 3, 4, and 7 days. Samples were analysed for POC and DOC concentration using a Shimadzu total carbon analyser and absorbance was measured spectrophotometrically at 254, 400 465 and 665 nm wavelengths as a proxy for DOC quality. In a parallel experiment CO_2 emissions to the mixing flask were measured using an infra-red gas analyser (IRGA). To isolate the role of microbial versus physical breakdown, both experiments were replicated with POM and streamwater which had been sterilised by gamma irradiation. The experiments were further repeated to assess the impact of variations in pH and the initial DOC concentration of the stream water on rates of POC conversion to on DOC and CO_2.

The results of these experiments will be presented here. Initial results show that peat-derived POC was found to be reactive in streamwater, leading to a rapid in DOC within 24 hours of the start of mixing experiments, thought to occur via physicochemical processes. Mixing of POC with streamwater also led to rapid CO_2 emissions, possibly via a DOC intermediary, and overall CO_2 production exceeded that of DOC. These results strongly indicate that POC is actively converted to other carbon forms in high-POC waters over the timescale of water residence in typical UK river systems, and that a high proportion of this carbon is emitted to the atmosphere as CO_2.