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Characterizing a Northern Temperate fen using multiple tracers, Allequash Creek, Northern Wisconsin, USA

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Allequash Creek flows through an extensive fen in the Trout Lake basin in Vilas County, Wisconsin, USA. The wetland is comprised of heterogeneous peat up to 17m thick, and is underlain by a regionally extensive sand and gravel aquifer. A fiber-optic distributed temperature system was used to demonstrate that groundwater discharges to the creek via both diffuse flow through the peat and focused flow through soil pipes in the peat – a more heterogeneous discharge distribution than seen in streams located in sand and gravels sediments. Stable water isotopes were important for distinguishing sources of water to the fen, which included groundwater derived from a lake located south of the creek and groundwater derived from terrestrial recharge to the north, two sources with very different geochemical signatures.

Samples were collected and analyzed for DOC and tritium concentrations in zones of focused discharge to compare with concentrations in diffuse flowpaths adjacent to these zones. Porewater samples collected in the peat generally contain high dissolved organic carbon (DOC) relative to DOC sampled in the underlying sand and gravel system. Because this is a groundwater discharge area, it is expected that focused discharge samples with low DOC represent rapid travel times through preferential flow paths in the peat, resulting in substantial groundwater discharge to the stream from the sand and gravel aquifer. As a result, residence times are reduced and DOC enrichment as water flows through the peat is limited. In other cases, the DOC in a focused discharge zone is higher relative to the values in the sand and gravel system, indicating that the wetland porewater is contributing flow to the preferential flow through the peat. The different flow regimes are thought to have important implications for nutrient and chemistry budgets in the stream, as well as the location of potential biogeochemical cycling in the watershed.