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An inductive model of hyporheic flowpath geometry and dynamics during baseflow recession

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Decades of effort have focused on hyporheic residence times as a key control on ecological processes. However, flowpath geometry has received relatively little attention despite a recognition that processes are expected to be heterogeneous in space. The objective of this study is to assess changes in hyporheic flowpath geometry and potential downwelling locations through baseflow recession in two headwater streams of contrasting geological control. Specifically, we address the questions (1) where do observed hyporheic flowpaths downwell from the stream?, and (2) does downwelling location change with in-stream discharge during seasonal baseflow recession? To answer these questions, we conducted four replicate solute tracer studies in each of two headwater mountain streams through baseflow recession, monitoring tracer concentrations in the stream and in a network of riparian and hyporheic piezometers. Using these data, we develop a simple model to calculate apparent downwelling locations of hyporheic flowpaths and estimate the associated probability of downwelling along the stream centerline. Key conclusions relate flowpath geometry and timescale to geological setting and hydrological forcing.