Geophysical Research Abstracts, Vol. 7, 09694, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09694

Fine sediments and hyporheic exchange in human-altered streams

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Hyporheic exchange is now recognized as critical to healthy stream ecosystems. Recent research has demonstrated that hyporheic exchange results from the coupling of stream and subsurface flow systems as mediated by the stream channel topography and the hydrogeologic properties of near-surface sediments. Development of watersheds for either agricultural or urban uses both alters system hydrology and increases fine sediment loads to streams. Basic studies of the mechanics of particle deposition and hyporheic exchange have shown that accumulation of fine sediments can clog the upper layers of the streambed and drastically reduce hyporheic exchange. These processes and the potential for degradation of streams by increasing fine sediment loads will be discussed. We also conducted a series of field experiments to observe the effects of urbanization on a watershed. The results of these investigations support the connection between deposition of fine sediments in the streambed and hyporheic exchange. In some cases, development of the watershed led to an appreciable decrease in hyporheic exchange related to alteration of the streambed. In other cases, a relationship between fine sediments and hyporheic exchange was still observed, but the properties of the streambed did not change to a sufficient extent to substantially influence hyporheic exchange. These effects were also reflected in changes in ecological processes, notably phosphorus uptake, net primary productivity, and community respiration. These field studies will be discussed as examples to illustrate the role of fine sediment erosion and deposition in human-altered streams.