Geophysical Research Abstracts
Vol. 21, EGU2019-17706, 2019
EGU General Assembly 2019

Metal source, fate and transport in a major UK abandoned mine watershed: Implications for effective management of mine waste and mine waters in the River Tyne

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In many river catchments impacted by mining pollution there are multiple point and non-point sources of mining pollution. The 3000 km2 River Tyne watershed, north-east England, is no exception. With a long history of base metal mining (particularly for lead and zinc) the river receives multiple inputs of metals from abandoned mine facilities, especially in its headwaters. Many studies have investigated metal source, fate and transport on specific tributaries of the River Tyne known to be impacted by abandoned mine pollution, but here we present data for the entire watershed, using data from multiple studies and capturing data collected at varying temporal and spatial scales.

Long-term synoptic sampling of the River Tyne at the most downstream flow gauging station, across varying hydrological conditions, indicates a total annual zinc flux of approximately 130 tonnes / annum. During storm events very high zinc fluxes are evident over short time periods: up to 5 tonnes of Zn in a period of just 48 hours. More detailed monitoring upstream indicates that the majority of this arises from the River South Tyne, which was the primary mining area in the watershed. Two tributaries of the River South Tyne in particular are well known for their mining pollution. However, whilst the metal pollution issues in these two watersheds are substantial, neither the sum of the metal fluxes from the point sources of pollution, or the total metal flux from each of these rivers, accounts for the total flux measured in the River South Tyne.

Abandoned mine pollution sourced in the headwaters of the River Tyne have impacts all the way to the estuary some 60 km to the east. Our research indicates that there are multiple sources of both point and diffuse mining pollution, and that absolute metal burden increases sharply with flow-rate. Effective management of these problems, to reduce absolute metal flux from terrestrial to marine environments, will necessitate multiple engineering interventions at key points throughout the watershed.