The influence of surface mining on catchment response in Elk Valley, BC

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BACKGROUND

Coal mining in Elk Valley, British Columbia involves a process of stripping upper elevations of vegetation and soil, breaking up rock to access buried coal, and creating new landforms from the waste-rock which consequently changes the drainage patterns in these valleys.

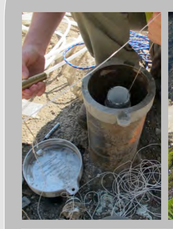
Drainage from catchments affected by mining can have periods of increased concentrations in dissolved solutes and changes to their hydrological response.

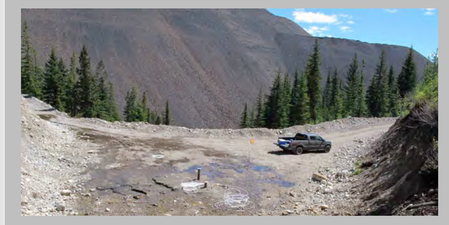
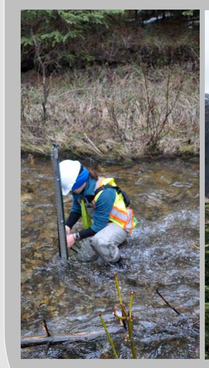
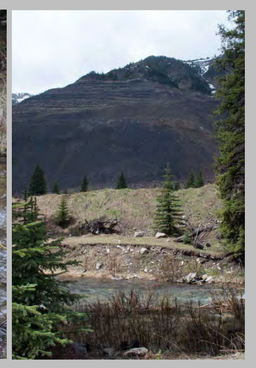
It has been identified that there is a need to better understand the effect mining and waste-rock landforms have on catchment hydrology, including water balance components and runoff rate, timing and pathways.

RESEARCH OBJECTIVE

Using a paired catchment approach, examine the influence of mining and new waste rock landforms on runoff quantity and quality.

METHODOLOGY



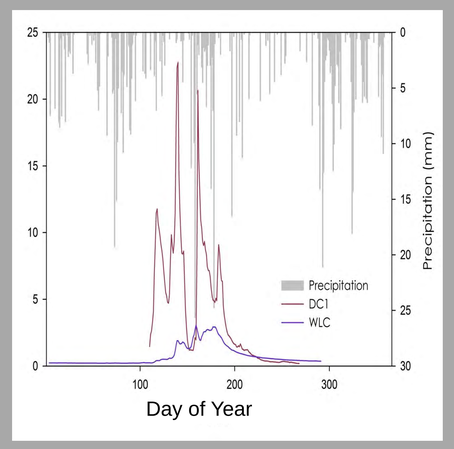
~Hydrometric data used to assess the differences in runoff volume and timing

~Stable isotopes utilized to identify sources of water that contribute to streamflow

~Hydrochemistry used to examine the influence of surface mining practices on runoff pathways

~Supplemental water balance information

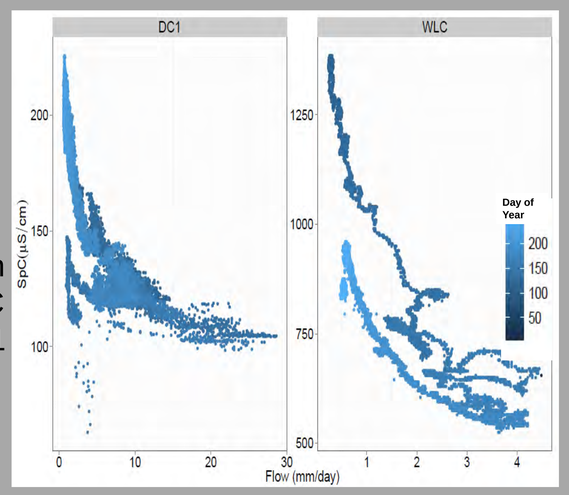
RESULTS

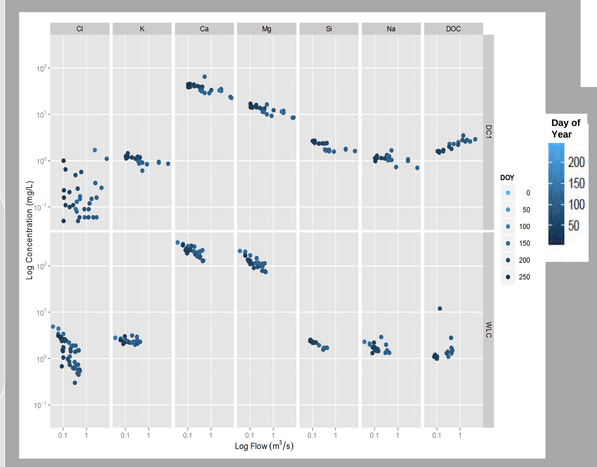


~WLC has lower total flows when normalized for catchment area than DC1

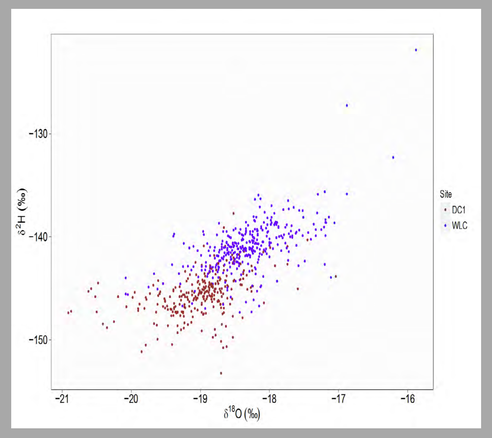
~DC1 is flashier and responds more quickly to precipitation events and freshet

~Specific Conductance (µS/cm) is an order of magnitude greater at WLC compared to DC1



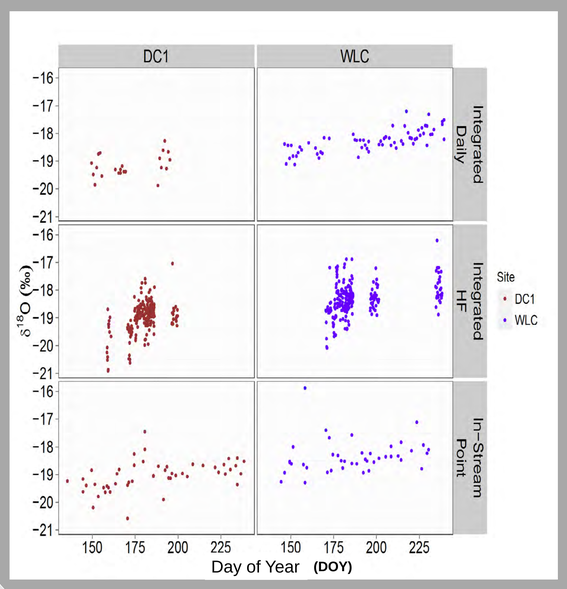


~Log Q-concentration of major ions at WLC approach slopes of -1 indicating dilution mechanisms whereas slopes are less steep at DC1 suggesting greater chemostasis



~DC1 has a more depleted isotope signal than WLC

~Suggests WLC more influenced by rain than DC1

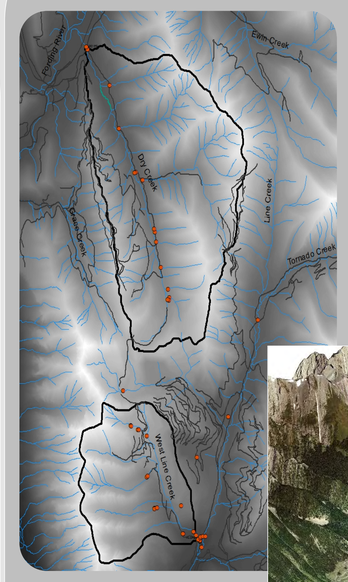


~Both streams show enrichment with time

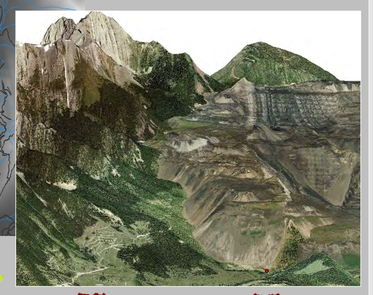
~Considerable high-frequency variability

~Stable isotope collected in situ (as a point measurement) and using an autosampler for values integrated over longer (daily) and high-frequency samples (3 h) during storm events and over the course of subsequent recessions

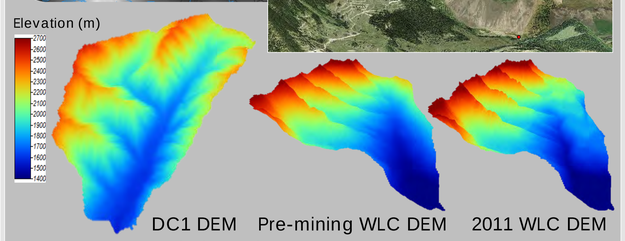
STUDY SITE



Streams
Roads
Sites



Elevation (m)



DC1 DEM Pre-mining WLC DEM 2011 WLC DEM

Dry Creek (DC1)
Area: 25.5 km²
~20 % harvested,
No Waste-Rock
Lithology:
Limestone

West Line Creek (WLC)
Area: 10.7 km²
Waste-Rock area: ~4 km²
Lithology: Limestone, highly fractured bedrock

DISCUSSION

~WLC and DC1 have considerable differences in the timing and magnitude of flows, dissolved ion concentrations and stable isotope values

~Data from 2012 suggest large volumes of waste-rock act to delay runoff response, particularly during freshet

~During storms, high frequency isotope sampling suggest less 'new water' contributes to WLC as isotope response is dampened

~Vegetation cover at DC1 reduces rainfall inputs, possibly resulting in more depleted snowmelt signal

~Differences in flow-SpC relations highlight the influence of surface mining on water-chemical interactions and flow pathways

~Ongoing research will evaluate the influence of mining on transit times and expand monitoring to a broader range of mine-influenced and reference sites

ACKNOWLEDGMENTS

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