

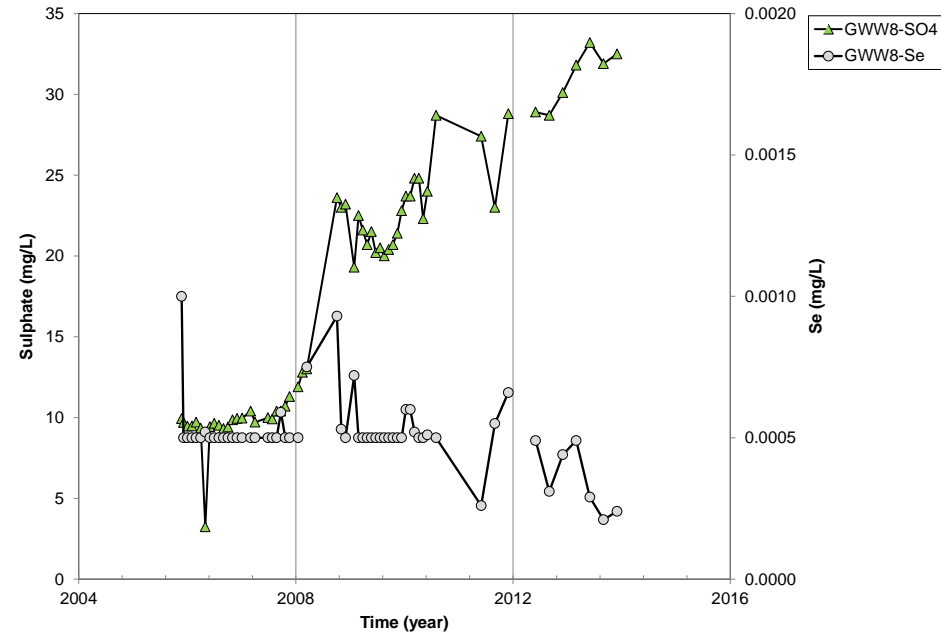
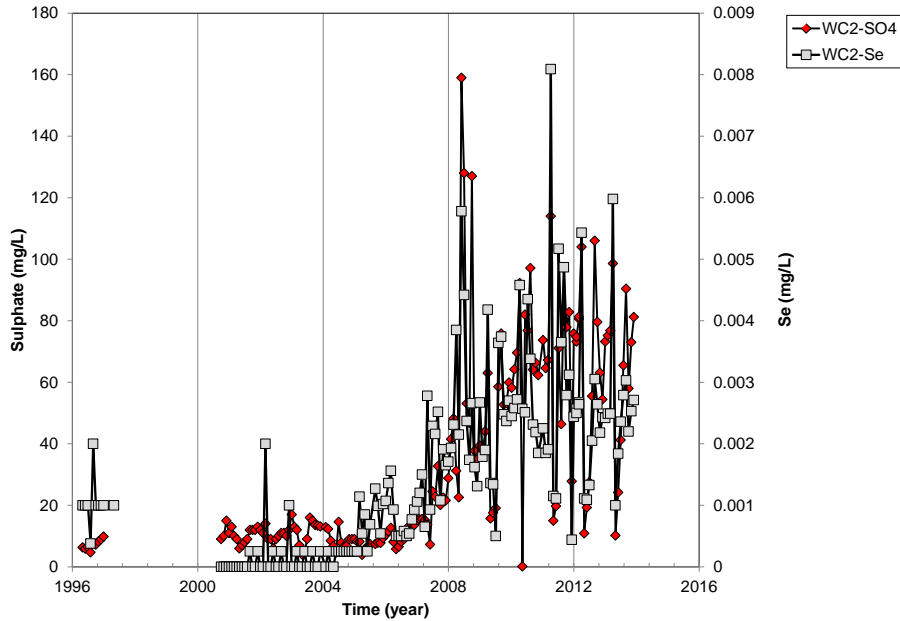
10th ICARDIMWA2015

10th International Conference on Acid Rock Drainage
& IMWA ANNUAL CONFERENCE

Biogeochemical selenium sequestration in unsaturated coal reject piles

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Cutting to the chase...



Presentation Overview

- Background – why the need for the study
- Conceptual model
- Methods – instrumentation and sampling
- Results and Discussion
- Conclusion

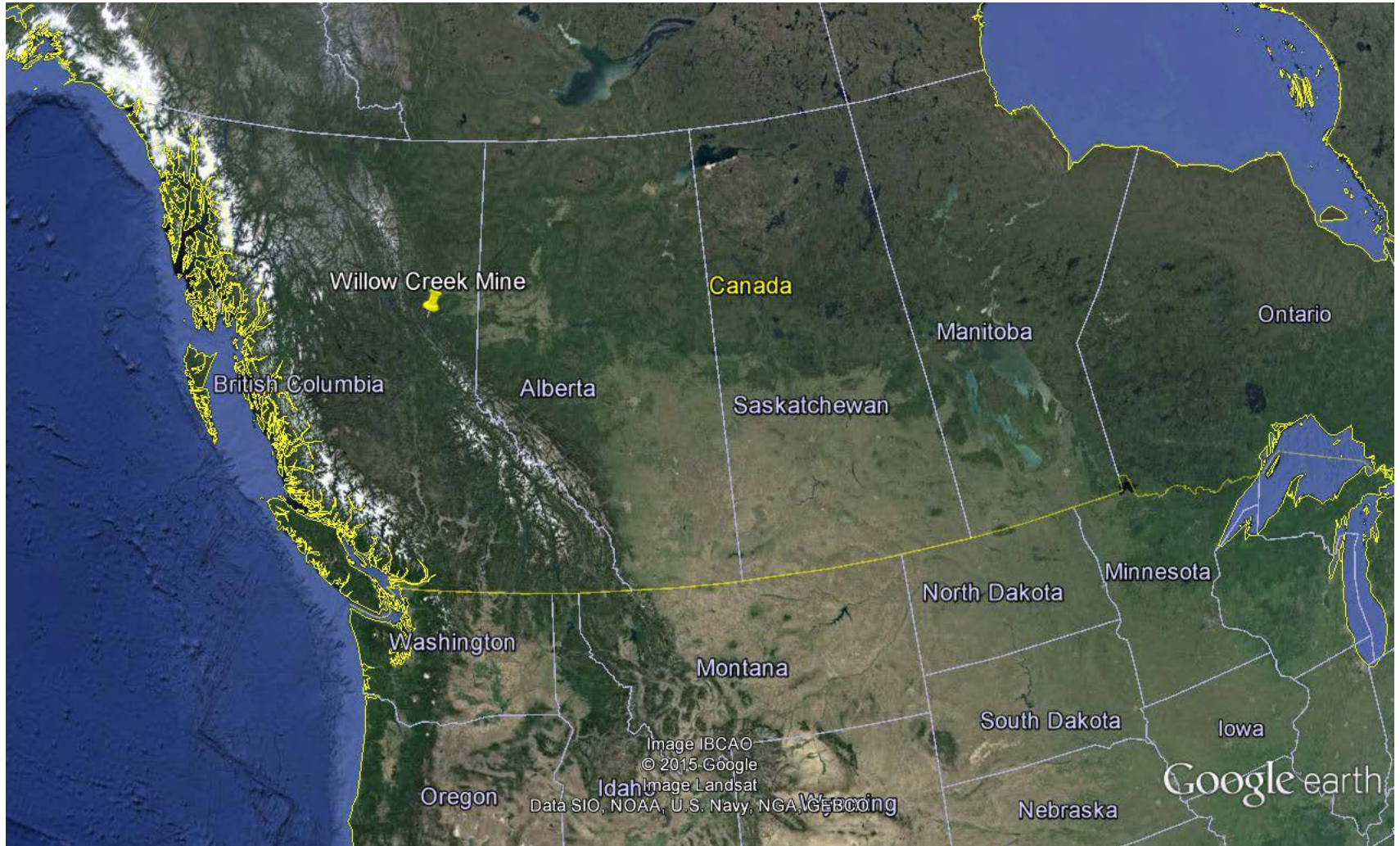
Background

- The objective of this study was to show that *unsaturated* coal reject piles stored on an alluvial fan were not a selenium leaching risk at the Willow Creek Mine
- Permit condition to move CR piles placed between 2005 and 2006
- Basis for concern from prediction studies
 - Including lab and field based kinetic tests designed to maximize weathering rates

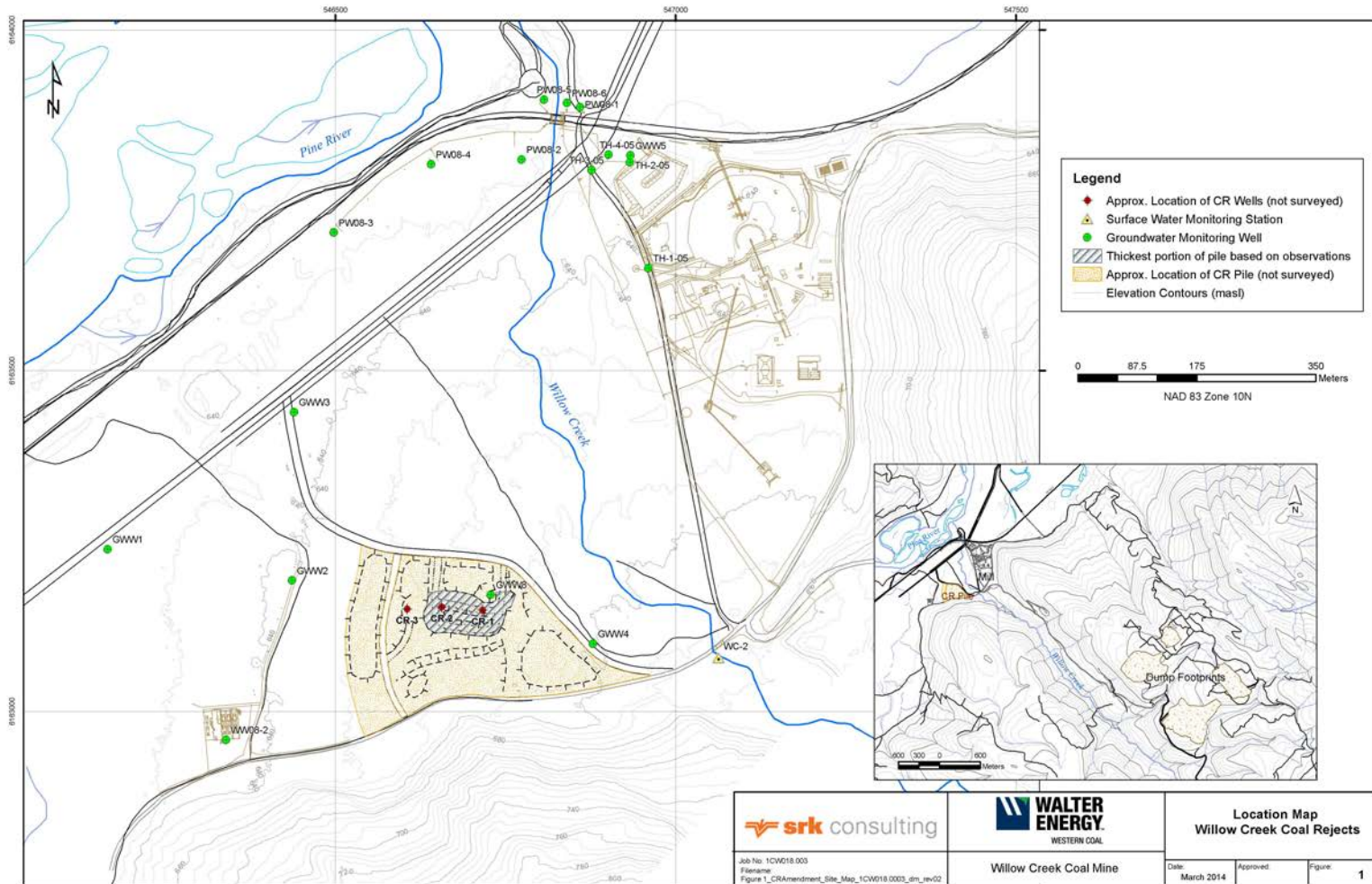
Background

- The WCM is a metallurgical coal mine
- Located in the western Canadian rockies, north-east British Columbia
- Surrounding the coal seams are sandstones, shales, siltstones and mudstones
- CRs produced by density separation methods – organic flotation reagents not used

Background



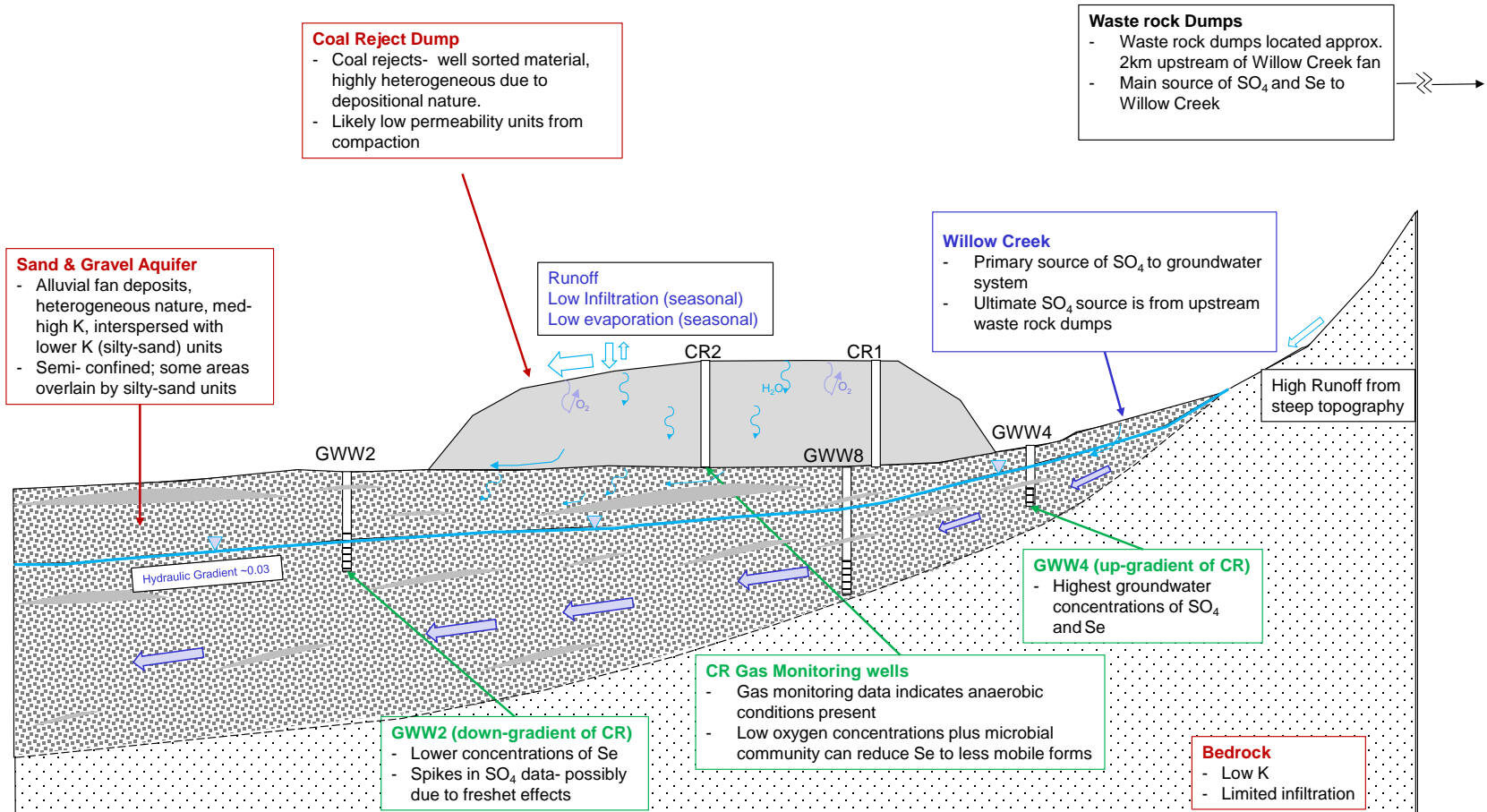
Background



Background



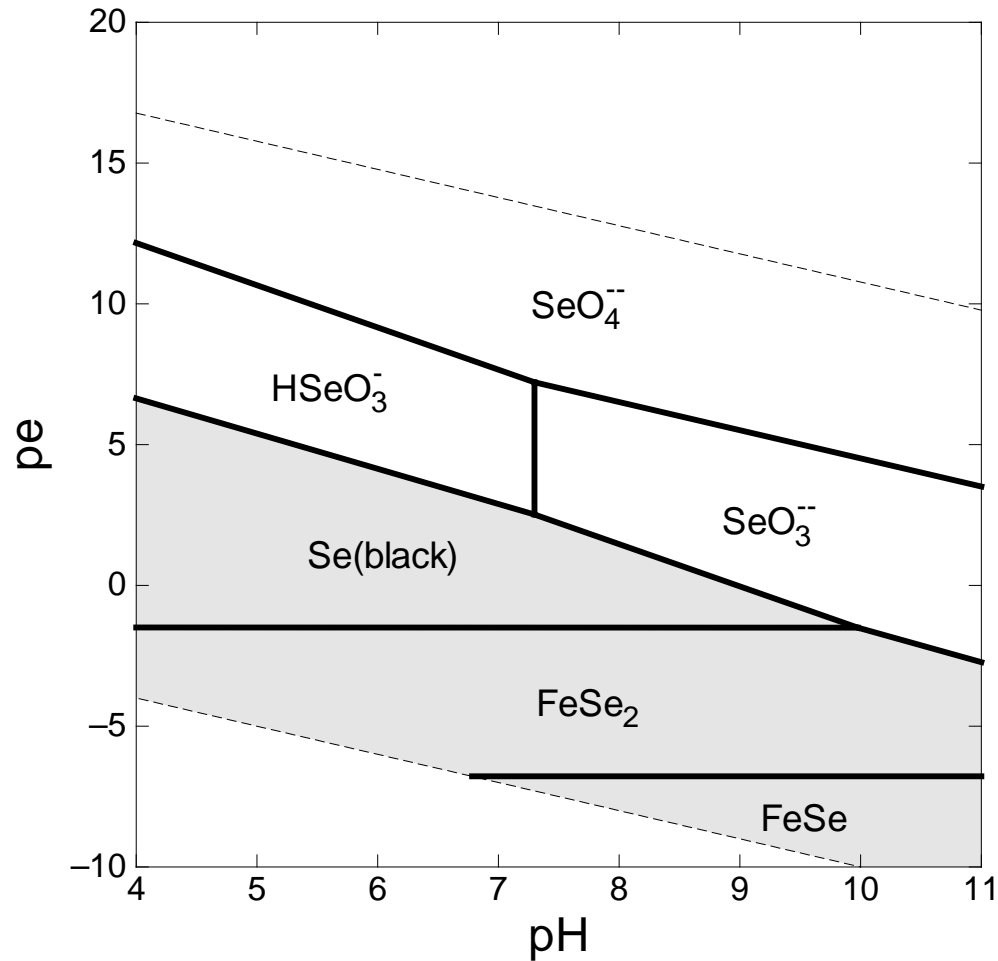
Conceptual Model



Conceptual Model

- Behaviour of selenium under neutral pH is dependent on redox
- Generally, the more reducing, the less soluble selenium becomes

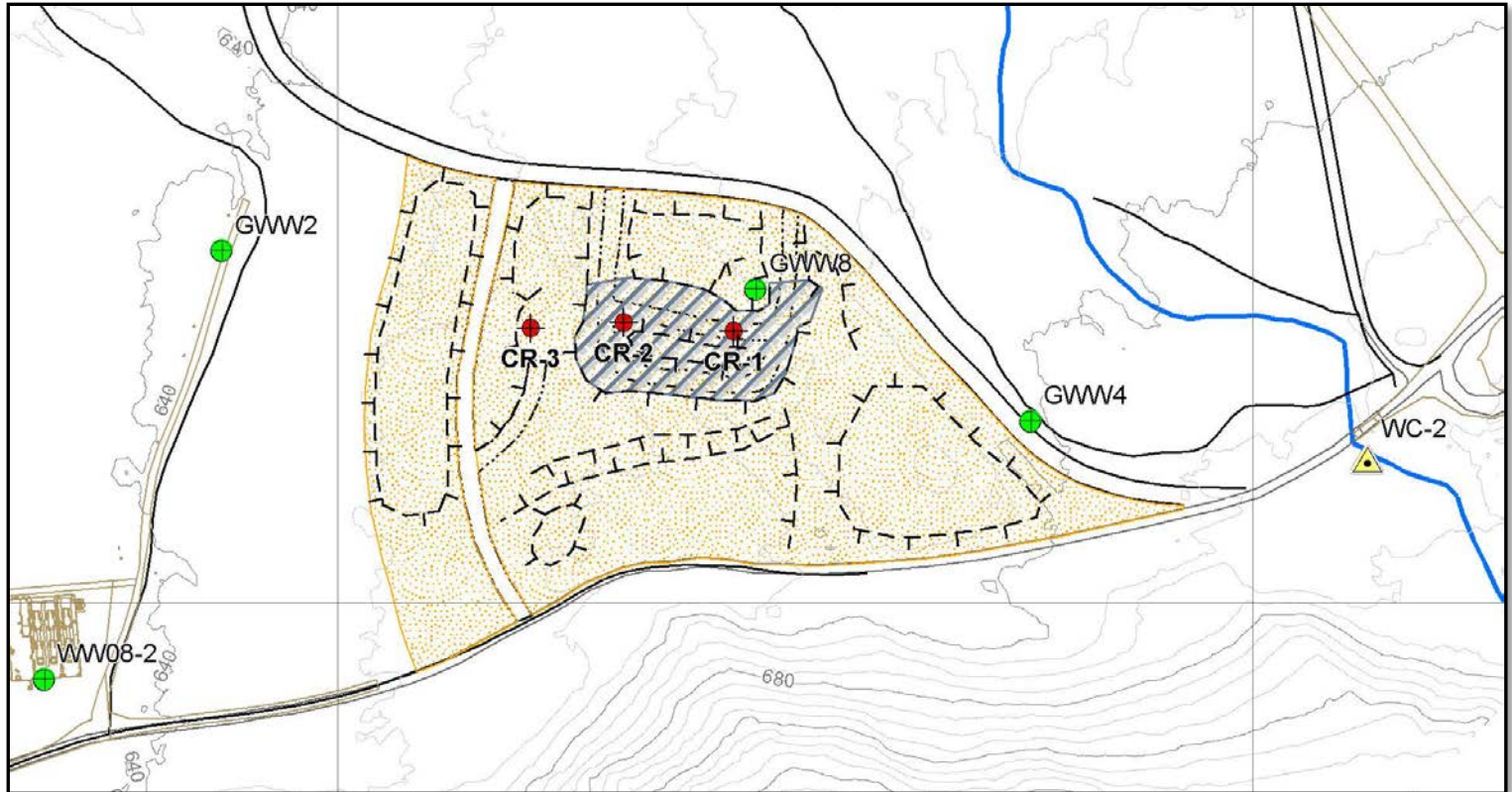
Conceptual Model



Methods

- Operational data (n = 69)
 - Composition, ABA
- Permit application (n = 44)
 - Composition, ABA, mineralogy, humidity cells, field barrel tests, and MWMP
- Instrumentation and sampling
 - CMTs to monitor gas and temperature
 - Aseptic grab samples for microbial community characterization (cultivation for presence/absence)

Instrumentation



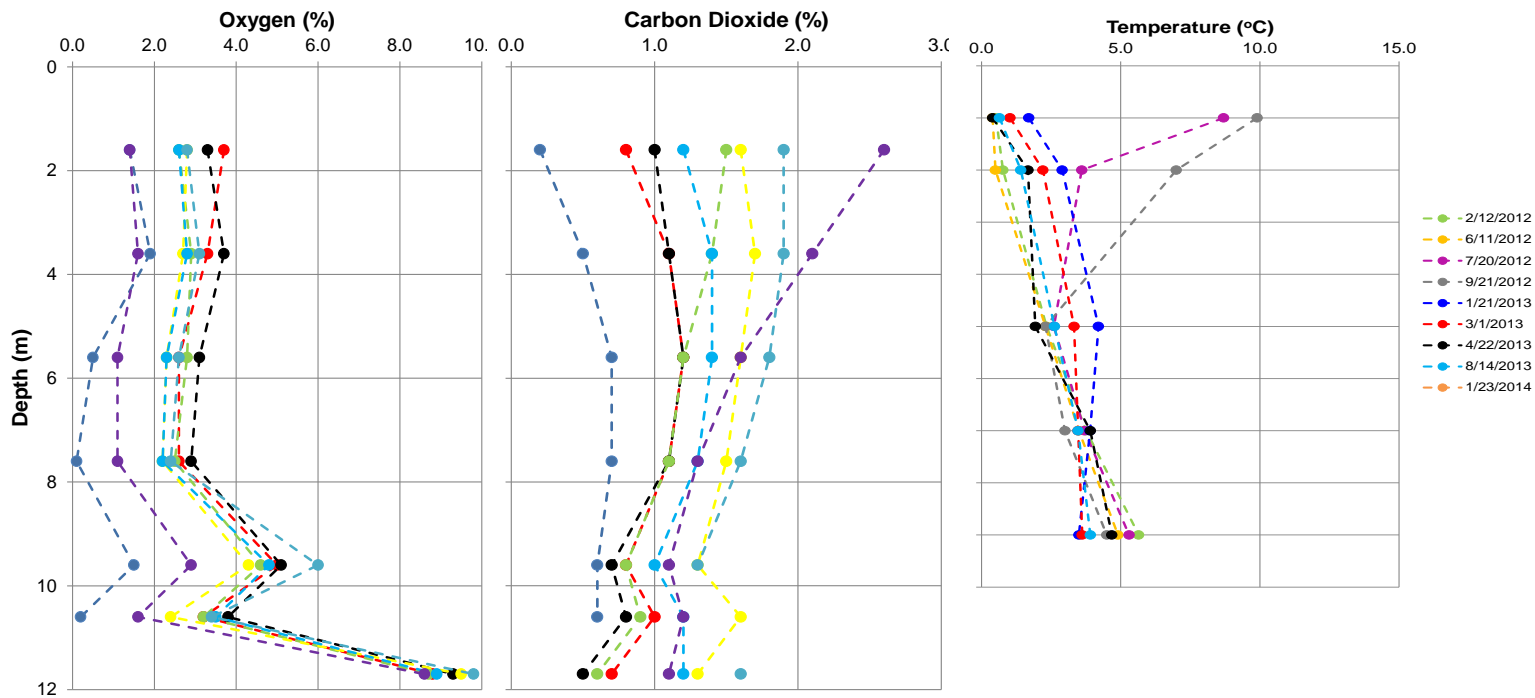
Instrumentation



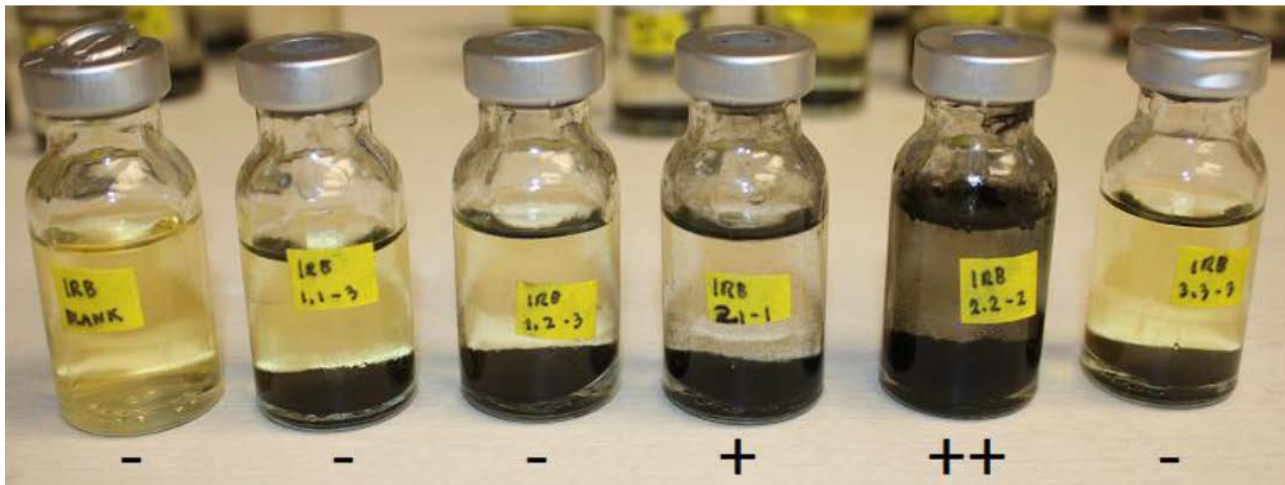
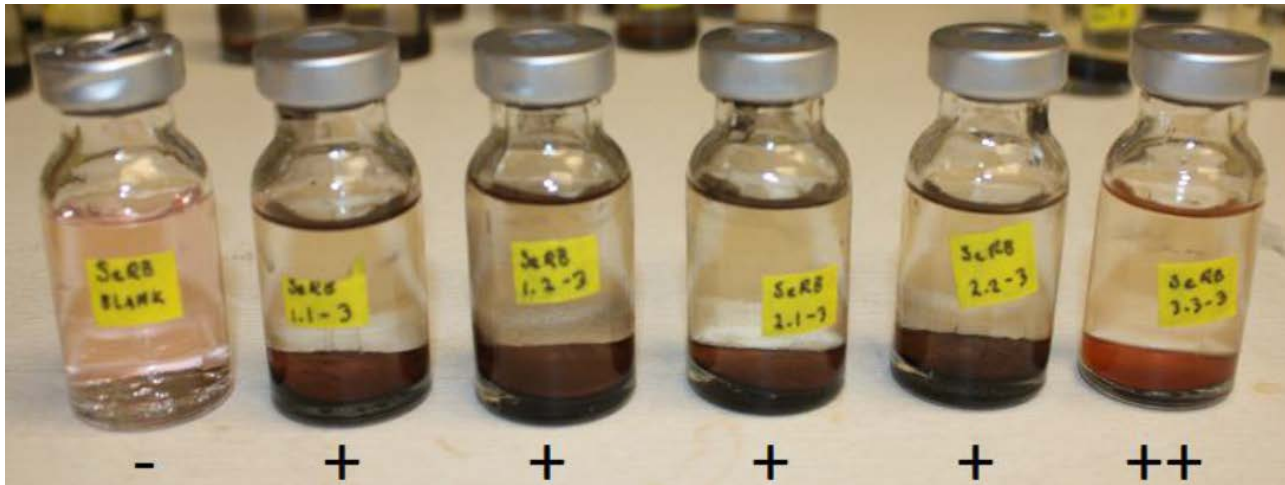
Results: Geochemistry

- **Non-PAG** material with relatively low sulfide sulfur (~0.16%)
- Selenium content approximately **2.6 mg/kg**, which is consistent with other coal in BC, but high relative to typical sandstone (0.05 mg/kg) and shale (0.6 mg/kg).
- **Selenium and sulphur correlated in solids**
 - $r = 0.45$; 99% confidence = 0.31
- Plus mineralogy, leach tests, previous experience indicate **Se and SO₄ from same source**

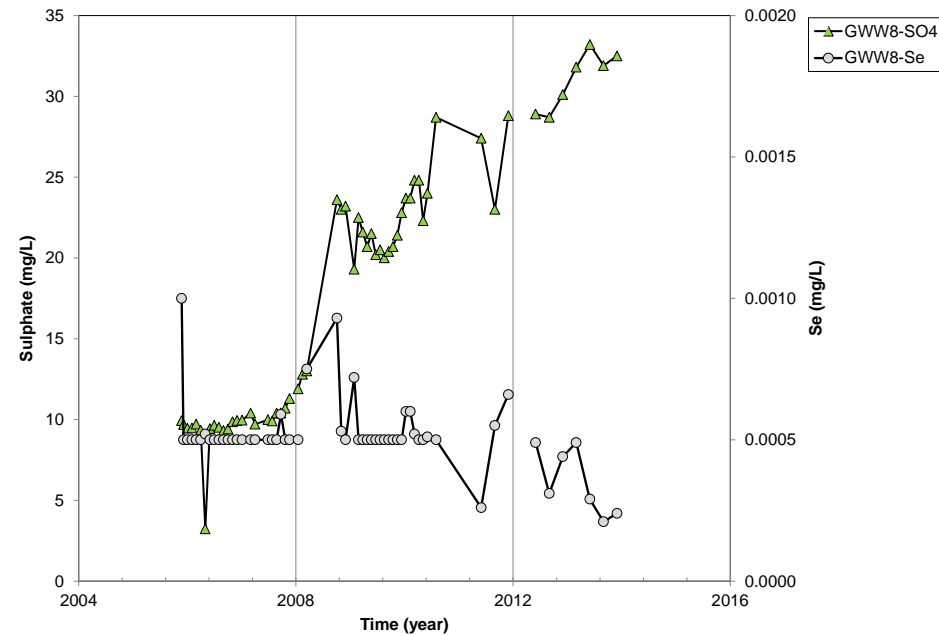
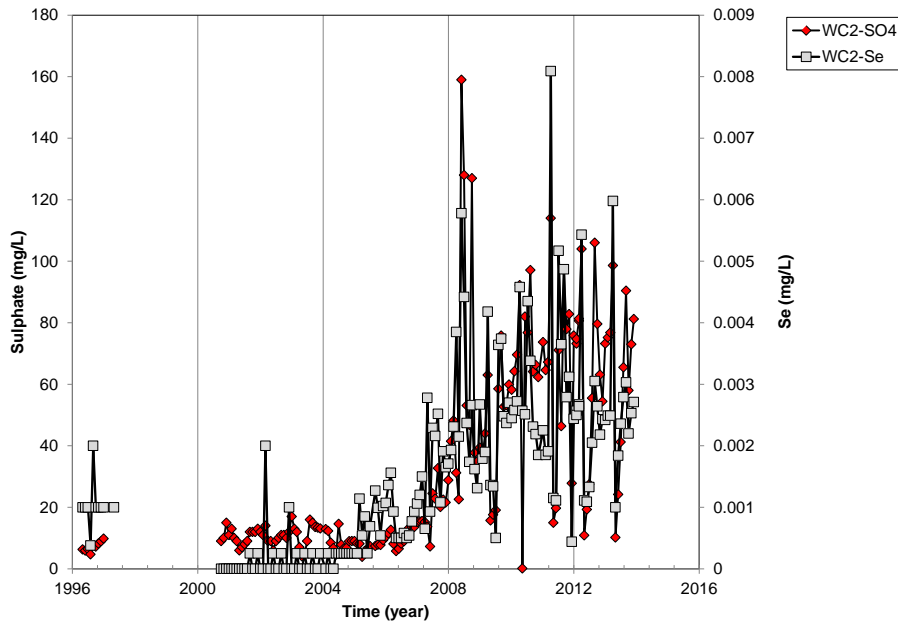
Results: Gas Composition & Temperature



Results: Microbiology



Back to the first slide....



- WC2 sulfate and selenium well correlated ($r = 0.85$; 99% confidence)
- GWW8 sulfate and selenium not correlated ($r = -0.3$)

Conclusions

- Conceptual model supported
- Sub-oxic zones in the unsaturated CR piles support microbial community capable of selenate reduction to more immobile forms
- Recommendation to leave the piles in place and *not* disturb established biogeochemical conditions

Acknowledgements

- Thanks to Walter Energy Inc. for providing field support, operational data and support to publish this work.