Geology, geochemistry and hydrogeology of coal mine impacted catchments, West Coast, South Island, New Zealand.

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The West Coast of the South Island of New Zealand hosts an active thermal and coking coal mining industry. The geology is stratigraphically and structurally complex, the topography is steep, the rainfall is several meters per year and the environmental geochemistry is challenging. Most acid mine drainage (AMD) in this region relates to the Eocene Brunner Coal Measures. This sedimentary unit was deposited in delta or estuarine environments with abundant marine sulphate that chemically reduces to form sulphide minerals after deposition. In general, the Brunner Coal Measures have the potential to produce acid mine drainage upon excavation of the rock and subsequent oxidation.

The oxidation of sulphide minerals within the Brunner Coal Measures produce AMD seeps with chemistry that can be acidic and contain elevated concentrations of trace elements such as Zn and Ni. Acidity after formation of AMD is moderated by a series of minerals that occur in different parts of the downstream catchment and include melanterite, jarosite, alunite, schwertanite, ferrihydrite and gibbsite. These minerals buffer the acidity of the system over different pH ranges. The concentration of trace elements in downstream environments does not reach saturation with respect to trace element rich minerals. Some trace elements concentrations are regulated by adsorption onto, or co-precipitation within, Fe and Al minerals. However, other trace elements are conservative within AMD impacted streams and are only attenuated by dilution.

The hydrogeology of many streams draining mine sites in the West Coast region responds rapidly to rainfall and flow rates can increase and decrease by two orders of magnitude within 24 hours. In some areas the acidity of AMD impacted streams is not diluted by rainfall events, instead as flow rates increase the pH and concentrations of acidic cations (Fe and Al) are maintained. This reflects storage of acid in the system in reactive sulphate minerals or rapid oxidation of sulphide minerals in the AMD formation zone.

Geological, geochemical and hydrogeological information from the Garvey Creek Coalfield in the West Coast region is presented. We demonstrate the difficulties relating management of AMD through selective waste rock handling, the geochemistry of storage and release of acid in the AMD formation zone, conservative trace element concentrations and lack of dilution of acid under different flow conditions. All these factors make the West Coast region a challenging environment in which to manage AMD.

Pope, J., MacKenzie, A., Weber, P., 2011. Geology, geochemistry and hydrogeology of coal mine impacted catchment, West Coast, South Island, New Zealand, 25th IAGS, Rovaniemi.