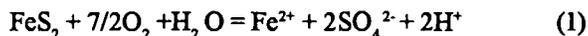


Acid-generating/neutralizing conditions within Nova Scotia coal mines: relationship to different mining methods

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Pyritic coal (up to 7%) is mined from the Morien Group of the Carboniferous Sydney Basin, Cape Breton, Nova Scotia. Interaction with the atmosphere oxidizes the pyrite to create Fe^{2+} , SO_4^{2-} and acid (H^+) through the reaction:



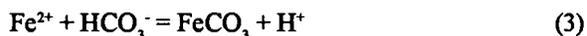
The products are carried down into the mine waters or immersed as water levels rise in flooded mines. High SO_4^{2-} values within the mine waters indicate that significant amounts of pyrite have undergone dissolution. Despite this, many waters do not show the low pH and high metal content commonly associated with acid mine drainage. This is due to acid neutralization by the dissolution of other minerals within the mine setting. An example is calcite dissolution:



Neutralization follows a mineral sequence with an associated pH. The general order is calcite/dolomite (6.5-7.5), siderite (4.8-6.3), and gibbsite (4.0-4.3). Calcite is the most reactive mineral and the metal content is low due to the high pH. Gibbsite is the least reactive and the metal content is high. Six populations were distinguished from three mine areas. The 1B Shaft was buffered by calcite in the top portion of the shaft, by siderite in the bottom portion and by gibbsite when the shaft was pumped for a day or more. The gibbsite buffered waters were high in metals and were derived from the underlying 1B Colliery. The flooded Lingan Colliery waters were siderite buffered and the underlying Phalen Colliery waters were calcite

buffered despite being derived from the Lingan Colliery.

The mining method greatly affects the acid generation and neutralization reactions. 1B Colliery was mined by the room and pillar method, which left pillars to support the roof. This left a large surface area of coal exposed to the atmosphere and oxidation. In addition, a supported roof limited the interaction of the mine waters with the overlying roof-rock that was rich in siderite. The Lingan and Phalen collieries utilized the retreat longwall mining method which removes all the coal over a large area, greatly reducing the amount of pyrite available for oxidation. In addition, this mining method causes the roof to collapse down to the floor, which fractures the roof, creating a siderite-rich rubble that fills the vacant space. As a result, the Lingan Colliery waters are buffered by siderite and are low in most metals. Waters flowing from Lingan to the underlying Phalen Colliery must travel through carbonate-rich zones. There they are buffered by calcite which raises the pH and causes iron to precipitate in siderite through the reaction:



The resulting Phalen waters are very low in metals. 1B Shaft waters are also buffered by the minerals within the shaft face. The transition from calcite to siderite buffering occurs in the general area of the Backpit Limestone.

Any future pumping to reduce water levels in the mines may dramatically reduce treatment cost by pumping waters from the retreat longwall workings and avoiding workings mined by room and pillar methods.