STRONTIUM ISOTOPE RATIOS AS TRACERS OF WATER MOVEMENT IN A GROUTED MINE

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Abstract. Acid Mine Drainage continues to discharge from the formerly grouted Omega coal mine near Morgantown, West Virginia. It was originally grouted to prevent subsidence, the oxidation of pyrite, and to neutralize any remaining AMD. Strontium isotope ratios are being utilized in a study that is attempting to determine the source of the discharge and the effectiveness of the grouting procedure.

Additional Key Words: AMD, remediation, CCB

Introduction

Coal combustion byproducts (CCB) were injected into portions of the now-closed Omega coal mine in West Virginia in 1998 in an effort to remediate acid mine drainage (AMD). Water continues to discharge from both grouted and ungrouted areas. The origin of the discharging water could be surface or shallow subsurface flow, areas of the mine that were not grouted, or the grouted area. To evaluate the effectiveness of the grouting project, it is necessary to determine the source of the current mine discharge. Different portions of the hydrologic system, such as the grouted area of the mine, are likely to have distinct strontium (Sr) isotope signatures. The isotope ratio of dissolved Sr in mine waters is generated through leaching reactions with solid materials in the flow path. Therefore, the isotopic ratio of discharging waters can be related to interactions with different parts of the mine hydrologic system.

Results

There are two horizontal boreholes discharging from the grouted and ungrouted portions of the Omega coal mine and six other sampling points around the downdip perimeter of the mine.

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Five sets of water samples have been collected and analyzed to determine the concentration and isotopic ratios of the Sr. The concentration of Sr in the samples obtained from the grouted portion was as high as 1500 μg/L versus <500 μg/L in the ungrouted part of the mine. Waters discharging from the grouted portion of the mine have $^{87}Sr/^{86}Sr$ ratios of ~0.71406, whereas waters discharging from the ungrouted portions have ratios ranging from 0.71510 to 0.71590 (typical 2-σ uncertainty ~0.00002).

Discussion

Strontium substitutes readily for the calcium ion when calcium-bearing minerals are forming. When these common minerals are broken down through weathering, Sr is released into the hydrologic system. The result is that Sr is ubiquitous in the natural environment. Typical $^{87}Sr/^{86}Sr$ ratios for today's ocean water fall at ~0.70906. For calcareous shales of this region, typical ratios fall near 0.71600. Although the difference between the ratios is relatively small, they are considered to be diagnostic.

Summary

These results strongly suggest that the Sr isotope ratios are recording interaction with grouting material and that this method will be effective for quantifying solid-water interaction in different parts of the mine.