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RESEARCH PROGRESS ON THE ACIDIFICATION FEATURES OF COAL MINE DRAINAGE AND ITS CARBON EMISSION EFFECT DURING COAL EXPLOITATION

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Abstract

The acidified mine water can lead to the release of heavy metal ions in rocks, and its direct discharge deteriorates the surface water ecosystem. Water acidification drives the dynamic transformation of dissolved inorganic carbon (CO_2-$H_2CO_3^*$-HCO_3^-) and releases large quantities of CO_2 into the atmosphere. Thus, this process is a noteworthy source of CO_2 that has long been overlooked. From the geochemical perspective, this study analyzes the acidification mechanism of mine water along with its influencing factors. On this basis, the discussion describes the evolutionary characteristics of dissolved inorganic carbon during the migration of acid mine water. In addition, we also clearly demonstrate the characteristics of degassing kinetics and the mechanism of carbon isotope fractionation. There are three fundamental stages of mine water acidification (oxidation of reduced S to SO_4^{2-}; oxidation of Fe^{2+} to Fe^{3+}; hydrolysis of Fe^{3+} to precipitate ferrihydrite). Notably, the corrosion of feldspar silicate minerals also contributes acidity to mine water. The acidification of mine water is controlled by such factors as pH, temperature, dissolved oxygen content, and the action of microorganisms. Evaluating the acid potential of bedrock is vital to any accurate measurement of the total dissolution of carbonate rocks and the carbon emission intensity of mine water. Revealing the DIC sources in mine water, as well as the degassing and carbon isotope fractionation mechanism, is more likely to be accomplished by studying the full-scale evolution of mine water from the aquifer outlet to the mine drainage downstream. Along these lines, the degassing process can be separated into three stages: degassing driven by relieved pressure when mine water pours out during coal mining, degassing arising from the acidification of mine water and the dissolution of carbonate rock, and degassing as a result of the mixture of acid mine drainage and surface waters.

Key words: acid mine drainage, acid potential, carbon emission, oxidation of pyrite, water chemistry

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