

Potential for Hydrogen Generation in Underground Mines

JULIEN DECLERCQ¹ ROB BOWELL² MICHAEL HERRELL³
ERIC OELKERS⁴

¹ SRK Consulting, Churchill House, Churchill Way,
Cardiff CF10 2HH, Wales, UK, jdeclercq@srk.co.uk

² SRK Consulting, Churchill House, Churchill Way,
Cardiff CF10 2HH, Wales, UK,

³ SRK Consulting, 1066 W Hastings St, Vancouver, BC
V6E 3X2, Canada

⁴ UCL, Earth Sciences, 5 Gower Place, London WC1E
6BS, UK

Mine gas explosions present a serious safety threat in the worldwide mining industry in terms of potential loss of life, production and financial. The production of hydrogen by serpentinization in ultramafic-hosted hydrothermal systems is a well-documented process that has been studied in the context of the origin of life, exotic habitats and astrobiology, and hydrothermal alteration of the ocean floor. This study aims to model hydrogen generation and potential explosibility associated to the case study of an underground mine hosted within mafic rocks.

Hydrogen generation has been calculated by 1/ estimating the exposed surface area of mafic minerals, e.g. serpentine and olivine, within the mine workings. 2/ by applying experimentally determined alteration rates allowing us to define a kinetic predictive model of hydrogen release by serpentinization.

Subsequently hydrogen explosivity has been determined by tracking, within the gas mixture present in the stopes, the predicted hydrogen proportion in a hydrogen, nitrogen and oxygen ternary diagram with respect to their flammability envelope (Dwyer et al, 2003). This potential was further explored in the case of a simplified atmosphere (O₂, N₂, H₂ and CO₂) using the revised Le Chatelier method (Cheng et al. 2012).

The explosibility of the mine gas mixture has been explored in a sensitivity study of rate dependence and the results compared to other real-world examples.