Advancing sustainable mine water management through understanding stratification in flooded underground mines

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Extended Abstract

Efficient mine water management is of utmost importance to minimize the drainage of polluted mine effluents. This requirement is driven by a number of factors including environmental protection, regulatory compliance and human health. In addition, economic considerations require a sustainable approach to mine water management, which involves minimizing the use of resources. A critical aspect of this objective is to understand the complex chemical and hydrodynamic processes within the mine pool and to integrate this knowledge to establish viable mine water management practices.

This presentation will illustrate hydrodynamic processes that prevail in flooded underground mines and highlights the importance of density stratification in sustainable mine water management. Investigations were conducted at over 60 ore and coal mines worldwide, ensuring a comprehensive assessment of stratification in different mines (Mugova and Wolkersdorfer 2022). By comparing stratification profiles, mainly depth profiles of temperature and electrical conductivity, cross links between the mine set-up and the occurrence of stratification was comparatively examined. Through the comparative approach, it was intended to find out whether stratification generally occurs in flooded mines and how it can be used for mine water management.

The results of the investigation clearly show that stratification is a common phenomenon in almost all flooded underground mines worldwide. A key finding is that the uppermost stratification, in other words, the boundary between different water bodies with different physico-chemical properties, is in most cases located at the uppermost connected level to the shaft, assuming there is a hydraulic connection (Fig. 1). In cases where stratification was absent, explanations can be provided, mostly attributed to pumping activities. Understanding and considering stratification is proving to be a key factor in mine water management, as it directly affects the quality of water discharged from the mine. This knowledge is invaluable in developing strategies to optimise water treatment planning and in-situ remediation options.

Identifying and sustaining stratification in flooded underground mines has major implications for sustainable mine water management. When stratification develops and remains undisturbed, the required effort for mine water treatment can be reduced. This results from the fact that only water from the upper CF water body (cold fresh) with usually better quality requires treatment or can be even discharged without treatment. In contrast, water from the WM water body (warm mineralised) remains in the deeper parts of the mine. Preserving stratification, for example, by avoiding pumping activities or by restricting water withdrawal to the upper part of the CF water body is highly recommend for sustainable mine water management. It

holds great promise for reducing the resource expenditure of mine water treatment processes, in line with the broader objectives of responsible mining practices.

Keywords: Stratification, mine water management

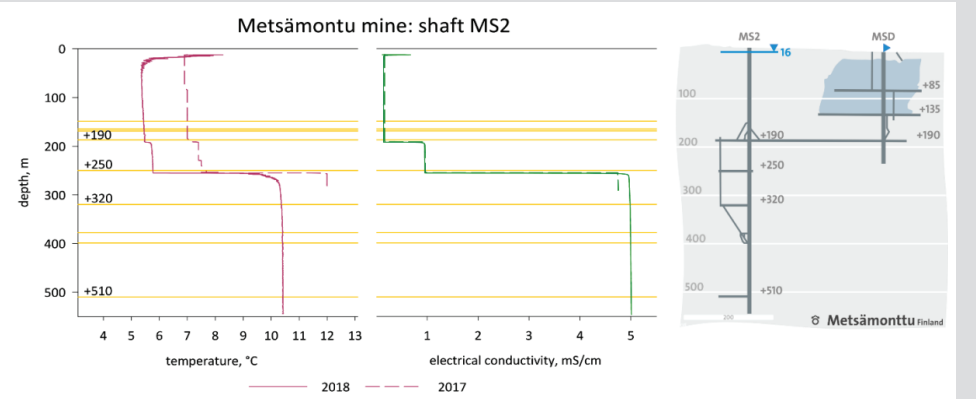

Figure 1 *Temperature and electrical conductivity profiles from 2018 and 2017 of the flooded shaft MS2, Metsämonttu mine in Finland as well of cross section of the mine. Clearly visible is a stratification at levels +190 (first connected level) and level +250. Metsämonttu cross section based on Warma (1975) and maps in the Business Archives Finland, Mikkeli, with permission from Outokumpu Oyj*

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