IMPACT OF AN ABANDONED COAL MINE ON GROUNDWATER CHEMICAL FEATURES

(S. Pedro da Cova, N Portugal)


Jornal Vivacidade: Mineiros de S. Pedro da Cova - Março 2015

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In Museu Mineiro de S. Pedro da Cova
http://portoarc.blogspot.com/2017/02/electrico-xiii.html

INTRODUCTION

Coal mining activities cause worldwide important environmental impacts in coalfield surrounding areas, namely the degradation of water resources quality and the resulting effect on biodiversity and human health. The Douro Coalfield region, located in northern Portugal, comprises a number of mining sites including the abandoned mine of S. Pedro da Cova, which has been exploited for nearly two centuries (1795-1970). The S. Pedro da Cova mine is located close to a population centre and social infrastructures, and is surrounded by agricultural fields, were groundwater from mine drainage galleries is used for irrigation purposes without any caution regarding its chemical and biological composition. Clear signs of impact on water quality have been observed for years, namely sulphurous odour, temperature higher than background values and thick iron oxide deposits, which justified a more detailed hydrogeochemical study.

The main objectives of this project are to identify and characterize hydrogeochemical changes induced by coal mining and to create a hydrogeological conceptual model of the mine. The impact of the contaminated water is insufficiently known, and the effect on human health is, so far, unpredictable.

METHOD

Samples from surface water points located upstream (A1 ■) and downstream (A4 ■) from the mine galleries, as well as groundwater from two mine drainage galleries (A2 and A3 ■) and from a spring free from mining influence (A5 ■) were collected over four campaigns, from April until December 2017.

Fig. 1 - Sampling points (Image from Google Earth, 2017).

Water temperature, pH and electrical conductivity were measured *in situ*. Laboratory analyses included the determination of total alkalinity and total hardness, colour, turbidity, total phosphorus, total nitrogen, silica, total organic carbon, chemical oxygen demand, major ions and metals.

RESULTS

The hydrogeochemical features of water affected by coal mining are distinct from water free from such influence.

Groundwater from mine drainage galleries is hard in nature, with high electrical conductivity values which are indicative of inorganic dissolved solids. The hydrogeochemical *facies* of these groundwaters is Ca-Mg-SO_4, while groundwater and surface water free from mining influence present Cl-Na *facies*.

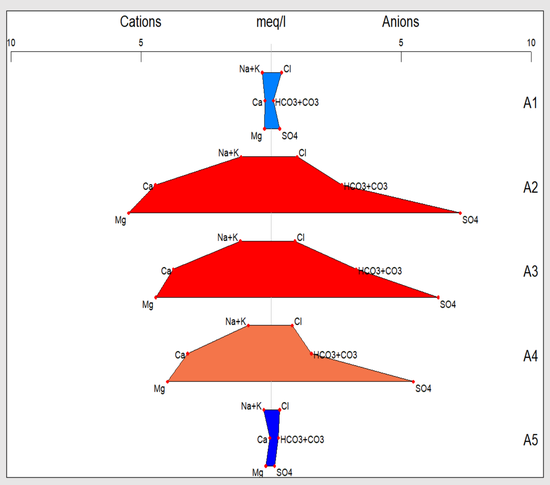


Fig. 2 - Stiff diagram representing average 2017 values (n=4).

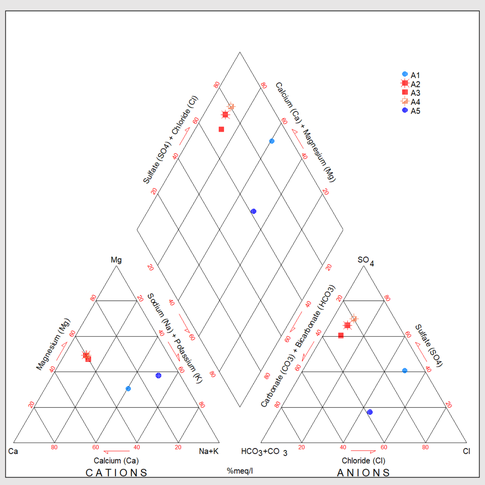


Fig. 3 - Piper diagram representing average 2017 values (n=4).

Iron and manganese concentrations are almost 1000 times and 100 times above the reference samples, respectively, also affecting the water taste and colour. The hydrogeochemical results clearly point out the existence of water-rock interaction in groundwater circulating in the shallow rock massif, including the underground mining structures. The most important interactions encompass sulphides (from pyrite and arsenopyrite).

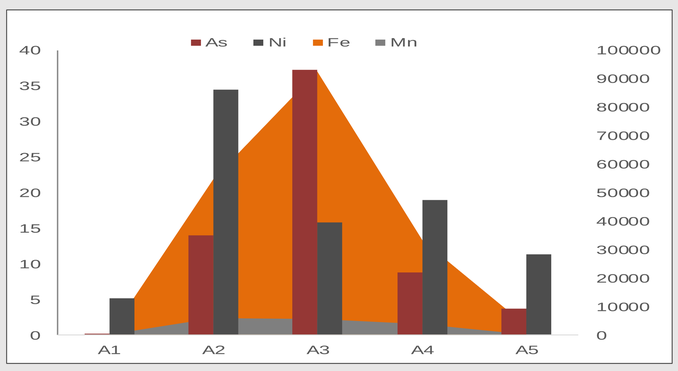


Fig. 4 - Metal concentration in water samples (mean 2017 values; n=4; µg/L)

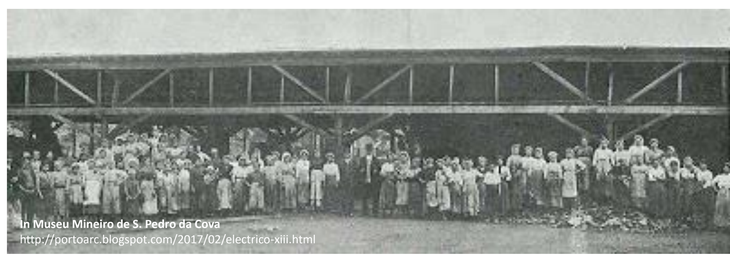
The higher fluoride content in groundwater from galleries, along with a temperature greater than the mean annual air temperature is an important finding, which points to a mixture between groundwater circulating in the shallow rock massif, along the mine galleries and wells, and thermomineral water following deeper circulations paths.

This study also revealed that impacted waters contain a higher metal content, especially iron, manganese, nickel and arsenic that may cause various health hazards such as cancer.

The overall quality of groundwater from mine drainage galleries revealed severe contamination and, therefore, should not be used for domestic or agricultural purposes.

CONCLUSION

Mining activities may cause important impacts in water resources from the operational, economic and safety perspective. The study results demonstrate important hydrogeochemical changes and contamination resulting from coal mining, which represent a concern that should be of urgent societal interest given the high relevance for the region. The dissemination of the results is expected to contribute for scientific knowledge and to provide valuable information for decision makers regarding the mitigation or reclamation of environmental impacts.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