Mine Water and the Environment (2001) 20: 52–54 © IMWA Springer-Verlag 2001

Vladimir Straskraba's Contribution to the Mine Water Literature

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Dedicated to the family of Eva and Vladimir Straskraba

Vladimir Straskraba was a founding member of the International Mine Water Association (IMWA), contributing from its beginning with papers on the water and environmental problems of the mining industry and examples of applied technologies. Vladimir consistently presented interesting lectures at IMWA meetings and published worthwhile papers in its Journal. Although it is not easy to sum up these contributions in a short note, a summary of the papers' conclusions provide an idea of Vladimir's main field of activity and a good bibliography for those entering the field who might be unaware of past literature.

1978. ***Development of a ground water hazard map for an underground coal mine*** (SIAMOS pre-IMWA Granada Congress) (*co-authors: AG Thurman and RD Ellison*) A detailed geological, geotechnical and hydrogeological investigation was performed at a planned underground coal mine in a area offering only limited information. Based on their identification and evaluation of the various hydrogeological parameters and taking in consideration the varying degree of hazard, the authors provided information that influenced the development of the final mining plans. In consideration of the site conditions, the operations were modified to reduce the risks associated with mining. Their map was used to aid in the prediction of ground water inflow during operations.

1979. ***Some technical aspects of open pit mine dewatering*** (Denver Symp) This paper described different dewatering technologies used to improve mine production, slope stability, safety, and pollution control and reduce the cost of mining. The basic methods discussed were: drainage ditches at the land surface and at the bottom of the mine; horizontal drains; vertical wells drilled from the surface and from the benches or pit bottom; dewatering shafts and galleries and combinations of these methods.

1982. ***Dewatering of the Jenkins Open Pit Uranium Mine*** (IMWA Budapest Congress) (*co-author: LE Kissinger*) Slope failures and wet conditions in the pit, along with the possibility of drainage from a river into the mine, raised serious problems during mine planning. A combination of dewatering wells installed from the surface on the perimeter of the pit and horizontal drains in areas of high slope failure potential substantially improved mining conditions and slope stability. This procedure resulted in successful ore recovery from the highly saturated sand strata.

1984. ***Ground water as a nuisance*** (Mine Water and the Environment, Vol 3, No. 1) This paper emphasized the negative aspects of the presence of ground water and how it hinders mining and tunneling. Examples where many lives were lost and considerable expenditures incurred due to groundwater related disasters were given. With the development of scientific hydrogeology and the increased involvement of professionals, the severity of such losses were substantially reduced.

1985. ***Hydrogeology and drainage of copper-cobalt mines in the Kolwezi Area of Shaba, Republic of Zaire*** and ***Application of computer modeling for the design of open pit mine dewatering*** (IMWA Granada Congress) (*co-authors: J Placet & M Holubec*). Hydrologic conditions have always had a considerable impact on mine planning, development and operation. The selection of an optimal long term dewatering scheme for three new open pit mines was based on computer modeling supported by a comprehensive hydrologic study. After installation of many test and monitoring wells, performance of aquifer pumping tests and studies of local surface and ground water hydrology, a three dimensional finite-difference ground water flow model was used. In both papers, this allowed the authors to select a suitable drainage system.

1986. ***Ground water recovery problems associated with open pit reclamation in the Western USA*** (Mine Water and the Environment, Vol 5, No. 4). A considerable number of studies of the hydrologic regimes in reclaimed open pit coal mines have been performed in the western U.S. Most of the studies concluded that the hydraulic properties in the replaced spoil will be similar to, though less homogeneous than, the pre-mining properties of the sandstone and coal aquifers. In any case, the original

flow system is not substantially changed. The content of total dissolved solids, calcium, magnesium and sulfate, when compared with the pre-mining conditions, is increased two- or three-fold. Such elevated levels decline as leaching of spoils reaches an equilibrium. The water in spoils will, in most cases, be suitable for its predominant pre-mine use, stock watering.

1987. ***Hydrologic studies for permitting coal mines in the Western United States*** (IMWA Katowice Symp) Strict environmental laws govern opening of new mines and the extension of existing open pit mines in the Western U.S. Studies of regional and local hydrology are very important parts of any permit application.

1988. ***A study of the potential for surface and ground water contamination by arsenic at the Sunbeam Gold Mine*** (IMWA Melbourne Congress) (*co-authors: JN Shangraw, AJ Silva, A House and P Pyrih*) As testing of the spent ore of the projected new open pit gold mine with heap leach gold recovery indicated a relatively high arsenic content, extensive studies was conducted to address the potential for arsenic contamination. It was concluded that although the seepage through the spent ore disposal would contain an elevated dissolved arsenic content, the hydrologic and geochemical characteristics of the site would prevent arsenic migration into the ground water systems.

1990. ***Environmental occurrence and impacts of arsenic at gold mining sites in the Western United States*** (Mine Water and the Environment, Vol 9, No. 1-4. IMWA Lisboa Symp) (*co-author: R Moran*). Arsenic is frequently a significant component in gold deposits of the Western United States as arsenides, sulfides and sulfosalts. These papers focus attention and research on the use of passive approaches for attenuation of arsenic and other trace metals. Such approaches can be quite effective in removing heavy metals from mine effluents in certain situations, and their effectiveness should be evaluated prior to choosing more expensive active treatment options. Several recommendations for how to deal with the problem are offered.

1991. ***Mathematical modeling of the Konkola Mine Dewatering*** (IMWA Ljubljana (Slovenia) - Pörtschach (Austria), Vol 2) (*co-authors: D Sharma and SE Cole*) In this mine, considered one of the wettest underground mines in the world, dewatering drifts and cross-cut mining, drainage borehole drilling, and water pumping and treatment are important and expensive components of the mining operation. In order to predict ground water inflow and develop drawdowns in various parts and levels of the mine, MODFLOW numerical model simulations were employed after a detailed study of the hydrologic and hydrogeologic characteristics, including extensive permeability tests.

1993-1994. ***The differences in underground mines dewatering with the application of caving or backfilling mining methods*** (IMWA Chililabombwe Symp & Mine Water and the Environment, Vol 13, No. 2) (*co-author: JF Abel, Jr.*) Mining with backfilling has significantly improved ore recovery and grade control in most of the hard rock mines where it has been employed. Such methods have many other beneficial factors such as improved safety, decreased potential of fire, improved ventilation and refrigeration, and decreased dewatering costs for mining. The cut and fill methods reduce subsidence and substantially diminish impacts on the land surface and surface and ground water resources, reducing water inflows into the mines.

1994. ***Study of impacts of a longwall coal mining operation on surface and ground water resources at the Windsor Mine, West Virginia, USA*** (IMWA Nottingham Congress, Vol. 1) (*co-authors: J Franck, W C Bosworth & TW Swinehart*). The impacts of this longwall mining operation on surface and ground water sources confirmed that subsidence effects are predictable and, in most cases, only temporarily impact water resources within a short predictable distance above the coalmine. Longwall mining causes collapse, fracturing, bed separation and bedding plane slip in the roof strata above the seam, producing changes in surface and ground water sources. The height of the disturbed area depends on the thickness of the coal, the mining method, the rate of face advancement, and the geological characteristics of the overburden.

1995. ***Hydrogeological and geochemical aspects of lakes forming in abandoned open pit mines*** (AIH & IMWA Denver Symp) (*co-author: GD Vandersluis & SA Effner*) The formation of lakes in open pit mines has become increasingly important to mine owners, environmental groups, and regulatory agencies. The authors present a method for estimating the rate of pit lake formation and potential quality of water in the lake. Geochemical modeling based on physical parameters and water-rock interactions was used to predict the water quality of lakes forming in open pits. The discussions included hydrogeological, limnological, geochemical and biological aspects.

1998. ***Water control in underground mines - Grouting or drainage?*** (IMWA Johannesburg Symp, Vol. 1) (*co-author: S Effner*). The paper present

examples of water management practices in different underground mines located in various climatic zones. Various hydrogeologic characteristics indicate that the design of water control methods is site-specific and depends on many factors. Dewatering from the surface, and in-mine dewatering boreholes drilled typically above the stopes or into a major water bearing structures are compared against grouting of water-bearing strata. A list of advantages, disadvantages and examples of mines where these methods were applied is presented.

1999. ***Mine closure consideration in arid and semi-arid areas*** (IMWA Sevilla Congress) (*co-author: JA van Zyl Dirk*) Climate is a determining factor in developing and implementing closure plans for mines. A number of closure considerations are generally applicable in arid and semi-arid areas. The paper explores these specific considerations for different mine components: open pit, underground workings, waste rock disposal, tailings impoundments and heap leach facilities. Special attention is paid to water quality in pit lakes and to the use of covers for closure of waste rock dumps, tailings impoundments and heap leach facilities.

Looking at this IMWA publication history, the reader can observe that from the beginning of IMWA, Vladimir greatly influenced his field. However, what is not illustrated, but can be testified to by virtually all of those reading this short tribute, is the friendship and companionship that Vladimir exuded. I know that I am speaking for the entire membership of IMWA in saying that we will greatly miss him.