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More Cyanide Uncertainties

Lessons From the Baia Mare, Romania, Spill – Water Quality and Politics

Robert Moran, Ph.D.

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Mineral Policy Center (MPC) is a non-profit environmental organization dedicated to protecting communities and the environment from the impacts of irresponsible mining. The center's programs and activities include mining-related research; public outreach; regulatory and legislative reform of mining laws; initiatives to improve company practice; and community organizing. MPC is supported by membership and foundation grants.

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Mineral Policy Center, 1612 K Street, NW, Suite 808, Washington, D.C., 20006, Tel: 202.887.1872, Fax: 202.887.1875, E-mail: mpc@mineralpolicy.org,Web address: www.mineralpolicy.org. MPC also has two regional offices; one in Durango, Colorado, and one in Bozeman, Montana.

Foreword

Modern mining for gold and silver owes much of its success to cyanide—a chemical that is both efficient in extracting gold from mined ore, and lethal. Processing chemicals such as cyanide have made it profitable to mine ore bodies with low ore grades. Such ore bodies would have been left unmined in the past. But this efficiency means that today's mines are unprecedented in size and scale. This has led to conflicts over land use and growing concerns about the dangers of cyanide.

Cyanide is a chemical lethal to humans in small quantities; a teaspoon of 2% cyanide solution can cause death. Due to a string of spills and accidents, this method of mining using large quantities cyanide to remove microscopic specs of gold from vast amounts of ore or crushed rock is creating more and more controversy. There is growing concern about both the environmental impacts and human health risks of using cyanide as a processing agent.

In the summer of 1998, in the aftermath of a cyanide spill outside the Kumtor Mine in Kyrgyzstan, MPC published the issue paper ***Cyanide Uncertainties***. In that paper, Dr. Robert E. Moran exploded the myth perpetuated by many in the mining industry that the public need not be concerned about cyanide spills at mines. Dr. Moran pointed out that cyanide does not simply break down into harmless elements when exposed to air and water. He found that the cyanide story is actually quite complex and there is much that is uncertain about the toxicity of cyanide and cyanide breakdown compounds. He also found that while mine operators test for some forms of cyanide, they are typically not required to test for other cyanide compounds, and therefore do not. In essence, these compounds go unregulated despite their potential impacts. Dr. Moran also found that some of the chemicals used to treat cyanide spills such as chlorine based substances are themselves toxic. For example, in Kyrgyzstan, the very chemicals used to remediate the cyanide spill may have caused health problems for hundreds of people.

MPC has found that government regulators and company officials, rather than acting with sufficient caution and sobriety by taking measures to fully safeguard the environment and public, have repeatedly made the mistake of seeking to downplay the risks of cyanide use in mineral extraction in the interest of gaining public acquiescence. Ironically, this failed public-relations strategy has only served to heighten public concern and outrage because the public is too often caught unaware of the dangers posed by nearby mining operations. It is better to be over-prepared for something that never happens, then caught by surprise when a tailings dam breaks and a toxic soup pollutes streams and rivers.

This was certainly the case in Romania, when in January 2000, an estimated 100,000 cubic meters of waste containing cyanide and heavy metals spilled from the Baia Mare re-mining operation in Romania. The spill contaminated the Tisza River and numerous other tributaries of the Danube River for hundreds of miles. Unfortunately, little has changed in terms of government oversight or industry practice. The spills in Romania, and the subsequent devastation of the Danube River tributaries could have been prevented.

This Issue Paper, ***More Cyanide Uncertainties—Lessons From the Baia Mare, Romania, Spill – Water Quality and Politics***, adds to the growing body of evidence that the public should be concerned about the risks associated with the use of cyanide in modern mining and that governments and mining companies have yet to act to adequately address this growing environmental problem. This problem is likely to grow as more and more regions like the one in Romania turn to cyanide processing to extract gold from ores that were previously uneconomical.

Not only does ***More Cyanide Uncertainties*** seek to draw important lessons from the Baia Mare spill, it also finds significant shortcomings with the UNEP report – such as its failure to account for cyanide decomposition products and its use of inadequate water-quality criteria to assess the spill's impacts. For example, the UNEP report failed to report data for most other chemicals in the spill, and the UNEP cites standards and criteria for acceptable levels of cyanide that are higher than those used by other governments, such as Canada. It is time for mining companies to begin using the same environmental performance standards worldwide, as so many claim to do.

What's the solution? The burden should be on industry to prove that cyanide processing is safe. It should also be on regulators to assess these cyanide-related compounds, determine their toxicity, and to enact adequate aquatic and human safety standards. Governments should also reject mine proposals that propose to use cyanide in areas that could threaten sensitive ecosystems. Immediate action, including the following measures, is necessary to prevent the next toxic cyanide spill.

- Mining, or re-mining, using cyanide should not be permitted without adequate baseline data.

- As a pre-condition of mining, companies should pre-pay for mine reclamation and cleanup through guaranteed environmental bonds.

- Immediate industry and government monitoring of all cyanide-related compounds, with public release of the information.

- Establishment of consistent standards for cyanide, cyanide compounds, and metals, by national governments and worldwide.

- Adoption of stricter environmental standards for all mine operations that use cyanide and are funded by public institutions such as the World Bank, OPIC and IFC. Such projects should also be subject to greater public disclosure of information on the use of cyanide and other potentially-hazardous substances.

- Governments should regulate mines, not act as financial partners in mine development. And governments should enact fee and royalty structures, using the fees to create an adequate regulatory infrastructure and fund abandoned mine cleanup.

- Mines should be regulated with the expectation that they will discharge waste, rather than as zero-discharge facilities.

- A citizen oversight board at all mines that use cyanide for processing so that the public has full access to information that might impact human health, the environment, and safety.

- Given the number of cyanide-related mining accidents in recent years, independent environmental audits of all major mines that use cyanide should be conducted to give communities, governments, and even mining companies assurances that these mines are operating safely.

- Long-term monitoring of all cyanide process facilities should be required since many environmental problems, especially acid pollution, may take years to develop.

The contents of this paper were first given by Dr. Moran as an invited presentation at the Meeting on Exploitation of Gold Deposits in Thrace, October 14-15, 2000, Komotini, Greece, organized by the Technical Chamber of Greece. The original title was: ***Lessons From the Baia Mare, Romania, Spill---Cyanide, Water Quality and Politics***.

Introduction

In January of 2000, an estimated 100,000 cubic meters of cyanide and metals-laden wastewater spilled from a Romanian gold-processing facility, killing much of the aquatic life in the Tisza River, a tributary of the Danube. Fish were killed for hundreds of kilometers downstream, all the way to the Danube in Serbia. While environmentally disastrous and economically ruinous for many, this event provides an opportunity to examine some of the claims and potential environmental pitfalls associated with gold mining and processing.

Few technical details have been made public following this event—legal and political pressures have likely hindered the open flow of information. A preliminary technical report covering this spill was prepared by the UNEP in March 2000: ***Cyanide Spill at Baia Mare, Romania***. It can be found on the Web at: http://www.natural-resources.org/environment/baiamare.

Three important conclusions of the UNEP report were:

- "The breach in the retention dam was probably caused by a combination of inherent design deficiencies in the process, unforeseen operating conditions and bad weather."
- Hungarian officials estimated that 1,240 tons of dead fish were present along the Tisza River after the spill.
- "The cyanide plume was measurable at the Danube delta, four weeks later and 2,000 km from the spill source."

According to the UNEP, this gold mining and processing project provided new jobs (150 Romanians directly or indirectly employed; 200 jobs during the construction phase) and brought investments into the local, high-unemployment area. These are positive effects of such a development project.

This paper discusses some of the negative impacts that often accompany such an operation. It is not my intent, herein, to argue that cyanide leach mining/processing should not be permitted, but merely to present some of the additional environmental consequences that may not have been realistically discussed prior to approving such a project. Ideally, the impacted public should decide whether the benefits *to the citizens* are worth the total costs and long-term impacts of such a project. These decisions should be arrived at after full disclosure of all relevant information and an examination of all issues.

It should be noted that on July 7, 2000, the Sidney (Australia) Morning Herald reported that the Hungarian government had brought a legal compensation claim against the mining company, Esmeralda Exploration, for $179 million to cover the environmental damages caused by the spill.

Lessons of Baia Mare

Open-pit mining and cyanide-leach technology, coupled with the increased "globalization" of commerce in the last 20 years have brought gold mining to many less developed regions of the world. Regions where mining once occurred are often targets for new mining operations that use cyanide. The "efficiency" of cyanide as a processing agent allows old deposits to be mined for low-grade ores and can lead to the re-mining of old mine waste (tailings). Previous extraction involved mining local pits, limited underground workings, or alluvial deposits.

The Romanian deposits around Baia Mare had been worked by these simpler methods since at least Roman times. This history is quite comparable to some of the Thracian gold and silver sites, such as Paeonia, Krenides, Mount Pangaeus, Thasos, etc., mined prior to 500 B.C. (T. A. Rickard, 1932--who cites Herodotus, Strabo and other ancient Greek sources).

Historical workings were tiny when compared to modern open pit excavations that may be more than a mile across and often exceed a thousand feet in depth. Since these modern operations generally exploit low-grade ores, they generate tremendous volumes of wastes, often exceeding 95 percent of the mined rock. Interestingly, the operating life of such modern mines may be less than 10 years. The Baia Mare project had a projected life of 10 to 12 years.

The aftermath of the Baia Mare accident reveals numerous potential lessons that should be examined and weighed against the potential economic benefits that *may* result from gold exploitation. For example:

- **Mining or re-mining often begins without adequate *local* baseline water-quality data. Thus, it is frequently not possible to assess responsibility for future impacts.** This was clearly the case in Romania, where no recently collected baseline water-quality samples, surface or ground water, were available. As a result, no actual "yardstick" existed against which the spill data could be compared.

Regulators can sometimes be reluctant to require costly monitoring before a mine has any cash flow. Failure to collect adequate baseline data is becoming an increasingly common problem---especially where re-mining of previously worked sites is involved. The common justification is that any modern activity will improve the previously contaminated situation, therefore regulators need not be vigilant in developing a baseline. Of course, the scale of the modern activity usually dwarfs the historical operation, thus its potential impact may be much greater.

- **Regulatory agencies are not likely to be able to effectively oversee mineral processing activities due to inadequate staffs, lack of funding, and possible**

political conflicts. This is a special concern when the government takes an ownership role in a project. In such situations, it has a conflict of interest and may be reluctant to enforce environmental regulations. The Romanian government had a 45 percent ownership position in the Baia Mare project.

- **Mining company officials usually state that tailings impoundments are zero-discharge facilities and were designed based on conservative engineering assumptions performed by independent consultants.** Mining company representatives and regulators often make such public statements about gold operations, especially during the permit approval process. These same statements were again made by company representatives and regulators, following the Baia Mare spill, in defense of both the facility operations and the degree of regulatory oversight. Such frequently cited "articles of faith" deserve closer examination.

First, no synthetically lined impoundments–either tailings or water dams--are truly zero-discharge facilities. They all leak to some extent, even if the structures do not fail. This is well recognized within the professional community. Numerous western journalists published articles reporting evidence of ground water contamination around the Baia Mare facility that preceded the spill.

Second, it is obvious that truly *conservative* water-balance assumptions were not used in the design of this facility, or it would not have failed in the manner observed. It is true that the failure occurred during a time of unusual precipitation. However, it seems doubtful that the operators had collected adequate *local* precipitation data in order to realistically estimate maximum runoff volumes. This is a common problem at mining sites around the world, and the tendency to underestimate seems to be increasing. When huge facilities filled with toxic chemicals are to be located near human populations, shallow ground water and rivers, it is imperative that **truly conservative design assumptions** be followed.

It is an unfortunate fact that most mining operations receive little or no *independent* environmental scrutiny. The majority of technical consultants hired to review the adequacy of mining structures, assumptions and environmental programs, are selected and paid by the company being regulated. Even when such consultants are supposed to be advising the regulators or project bankers, they are still chosen from a small pool of companies that make most of their income from consulting to the mining industry. They are, thus, in the author's view, reluctant to make recommendations that might be "painful" for their mining clients to hear.

- **Typical cyanide-leach gold wastes are quite complicated chemically,** containing fluids with high concentrations of sediments; cyanide and breakdown compounds (such as free cyanides, metal-cyanide complexes, cyanates, thiocyanates, ammonia, possibly organic-cyanide compounds, cyanogen, cyanogen chloride, and chloramines); numerous metals (for example, arsenic, cadmium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, mercury, molybdenum, vanadium, zinc); non-metals (sulfates, chlorides, fluorides, nitrates, and carbonates may all be elevated); radioactive constituents (such as uranium, radium, gross alpha and beta); organic compounds; and high pH. Commonly, neither regulators nor the public are aware of the actual chemical components or concentrations of such wastes.

The publicly available data from the Romanian spill reported only total cyanide, and selected determinations of copper, manganese, iron, lead, and zinc---for river samples. No detailed analyses of the actual gold-process waste liquids were made public. No *field* measurements (temperature, specific conductance, or pH) were reported. Such measurements are, in some ways, the most useful data for understanding such a spill.

- **High-quality, local analytical laboratories may not exist, making regulatory oversight and assessment of spill impacts incomplete.** Local labs may not be able to perform many of the required determinations (see above). Also, "complete" analyses are expensive. Hence, regulators often fail to require companies to perform such monitoring. The UNEP report stated that analytical results from the various Romanian and Hungarian labs seemed to be in general agreement, but review of the actual data showed significant discrepancies.

Some of the discrepancies could be due to variations in cyanide and metal concentrations that can occur diurnally, due to changes in sunlight and temperature (Grimes, *et.al.,2000*). Apparently, higher concentrations have been observed under conditions of greater light. Thus, the choice of sampling time can be quite important.

More important, it is simply quite difficult to obtain reliable data on the various forms of cyanide and related compounds in water. For example, one may collect waste water samples which, when analyzed, show less than detectable amounts of WAD or total cyanide. However, if the same waters are analyzed using specific techniques for determining, for example, cyanate, thiocyanate, metal-cyanide complexes, etc., significant concentrations can be detected (Moran, 1999, Johnson, *et. al., 2000a and b*). Thus, if only total cyanide determinations are performed—as in the UNEP report---the actual cyanide decomposition products may be missed. Also, it is important to note that thiocyanate and many of the metal-cyanide complexes can convert to free cyanide when exposed to sunlight.

- **Many aspects of the geochemical behavior and toxicity of such complex mixtures are poorly known.** For example, mining literature frequently states that cyanide naturally breaks down quickly, in the presence of sunlight, into relatively harmless, non-toxic substances. A recent report sponsored by the mining and cyanide manufacturing industries (Logsdon, M.J., *et. al.*, 1999) states: "Since cyanide oxidizes when exposed to air or other oxidants, it decomposes and does not persist. While it is a deadly poison when ingested in a sufficiently high dose, it does not give rise to chronic health or environmental problems when present in low concentrations." This statement is misleading and presents a falsely benign picture.

First, cyanide also tends to react readily with many other chemical elements and molecules to form, as a minimum, hundreds of different compounds (Flynn and Haslem, 1995). Many of these breakdown compounds, while generally less toxic than the original cyanide, are known to be toxic to aquatic organisms, and persist in the environment for significant periods of time. In addition, there is evidence that some forms of these compounds can be accumulated in plant tissues (Eisler, 1991) and may be chronically toxic to fish (Heming, 1989; and numerous other studies discussed in Moran, 1999). Nevertheless, regulatory agencies do not require mine operators to monitor for these toxic cyanide-related compounds. Therefore, while much of the cyanide used at mineral processing sites does break down fairly readily, either as a result of natural degradation or the various treatment processes *sometimes* employed, significant amounts of the original cyanide form other potentially toxic compounds that may persist for long periods of time and remain unaccounted for in the monitoring.

Second, there is considerable disagreement about the percentage of cyanide that actually volatilizes into the air. Recent studies by the U.S. Geological Survey (Johnson, *et.al.,1999, 2000a and b)* indicate that most of the original cyanide in spent (leached) ores has been converted to other toxic forms, such as cyanide-metal complexes, cyanate, and thiocyanate. Many of the metal-cyanide complexes can remain stable in the leached ores (and possibly in the bottom sediments of the Tisza River) for decades. The cyanates and thiocyanates are stable in the process liquids for undefined periods of time, but industry observations suggest they can be present for at least weeks to months—depending on the temperature, amount of sunlight, and presence of selected microbes. [Plumlee, et. al.,1995, discuss samples that still contained significant thiocyanate concentrations at least one to two years after active cyanide use had ceased.] They are much more likely to persist if released into the environment during winter when lakes and rivers may have snow and ice cover, less available sunlight, and lower temperatures. Areas with high rainfall and persistent cloud cover also have restricted rates of natural cyanide destruction (Environment Australia, 1998).

The toxicity of cyanide and decomposition products at gold mining sites is most significant to **aquatic organisms, especially fish**. For example, fish are killed by cyanide concentrations in the *microgram per liter* range, depending on the specific fish species. Bird and mammal deaths generally result from cyanide concentrations in the *milligram per liter* range. Additional details on the toxicity of various cyanide forms are presented in Moran (1999) and its associated references.

The UNEP report indicates that elevated total cyanide concentrations were detected for, as a minimum, hundreds of kilometers downstream, for up to four weeks after the Baia Mare spill. Clearly the total cyanide in the Tisza River did not decompose quickly.

- **When such complex fluids spill into a biologically productive river, it is not usually possible to determine precisely which components have caused the toxic responses.** In Romania, the news media and regulators focused their attention on the cyanide content of the spilled mining wastes. They tended to neglect the toxic impacts of the sediments, metals, elevated pH, and other chemical constituents. Thus, the data that have been made public are inadequate to make detailed toxicity conclusions.

- **Commonly used cyanide destruction techniques often release unacceptable concentrations of contaminants.** The more commonly used destruction processes are described in Smith and Mudder (1993), Mudder (1998), and Flynn and Haslem (1995). Only two of the processes are discussed below.

A cyanide destruction technique of interest in Thrace and at other sites is the **INCO** process. This process is often used to treat ores containing iron sulfides, or where iron cyanide complexes are present in the effluents in significant concentrations. It involves the addition of SO_2, air, and a copper catalyst to breakdown cyanide. While this process does greatly reduce free cyanide concentrations, it results in the formation of several other byproducts that may be toxic to aquatic organisms, such as: cyanate, thiocyanate, sulfate, ammonia, nitrate, some free cyanide, and elevated copper concentrations. Such treated effluents may also contain elevated concentrations of other metals. The INCO process also results in the formation of large volumes of calcium sulfate-rich sludges, which increase the process and disposal costs (Yarar,1999). Most Canadian gold sites that use the INCO process are able to generate effluents that meet the discharge standards. However, many of these effluents are still toxic to organisms in bioassay tests (Dr. George Dixon, toxicologist, U. of Waterloo, personal communication, 1999). Thus, these complex solutions produce toxicity effects we don't understand, probably as a result of synergistic effects, or they contain toxic constituents that are not being detected or regulated.

Like cyanate, thiocyanate is normally not monitored or regulated at most mining sites. Nevertheless, it is reported to be toxic to fish at concentrations between 90 and 200 mg/L (Ingles and Scott, 1987). Heming and Thurston (1985), and Heming and others (1985), report thiocyanate toxicity to be between 24 to 70 mg/L thiocyanate, SCN^-, for brook trout. Heming and Blumhagen(1989) report that thiocyanates cause "sudden death syndrome" in trout, partly as a response to stress, and because thiocyanate is accumulated---contrary to much previously published literature. Lanno and Dixon (1994), report that juvenile fathead minnows showed numerous negative effects after chronic (124 days) exposure to thiocyanate: thyroid tissue changes started as low as 1.1 mg/L; reproduction effects were noted at 7.3 mg/L and above; overt goiter was noted as low as 7.3 mg/L. Many of these effects are believed to be controlled by the antithyroid activity of thiocyanate.

It seems important to mention **alkaline chlorination**, an older destruction process, less favored at modern sites, because it was apparently used in a desperate attempt to treat portions of the spilled Baia Mare wastes. Alkaline chlorination involves the addition of chlorine or hypochlorite to decompose most of the cyanide into cyanate. This process, however, causes the production of a highly toxic intermediate compound, cyanogen chloride, which then converts to cyanate. In addition, alkaline chlorination allows the formation of several stable metal-cyanide complexes and is likely to result in the formation of toxic ammonia and chlorinated ammonia compounds---chloramines. Free cyanide can be released when the metal-cyanide complexes break down in sunlight. Cyanates are toxic to trout in the range of 13 to 82 mg/L (Ingles and Scott, 1987).

Chloramines are normally indicated via analysis for total residual chlorine. The U.S. Environmental Protection Agency (1986) states that freshwater aquatic organisms should not be exposed to total residual chlorine concentrations exceeding *11 to 19 micrograms per liter*, and that ammonia is toxic to fish at concentrations between 0.083 and 4.6 mg/L. Thus, ammonia is roughly as toxic as free cyanide to fish.

The UNEP report indicates that hypochlorite was added to some portions of the spilled Romanian wastes. Thus, it is likely that undetermined amounts of toxic cyanates, ammonia, chloramines, and metal-cyanide complexes were formed as a result of this attempt at cyanide decomposition. Clearly, these byproducts were responsible for some of the aquatic mortality.

- **Water-quality, biologic and other regulatory standards are often inadequate, failing to protect populations and resources. Thus, numerous toxic metals, non-metals and cyanide forms will not be monitored in the wastes and discharges.**

The UNEP Baia Mare report compared the surface water sample concentrations to water-quality criteria of the European Commission for the Rhine River---presumably because no such criteria exist for Romanian or Hungarian surface waters. Of coarse, the Rhine is quite contaminated, thus the criteria are very lax for many constituents. They include:

Constituent	Criteria Conc. (mg/L)
Cyanide	0.25
Arsenic	0.005
Lead	0.005
Cadmium	0.003
Chromium	0.025
Nickel	0.01
Mercury	0.0005

The UNEP table has the following footnote: **"NB: In its last revision, the limit values for copper and zinc have been removed; there are also no limit values for manganese and iron."**

Clearly, these criteria are not adequate to protect sensitive aquatic life, and most of the chemical constituents one might expect to be present in such a complex "soup" are not included in the list. ***Also, it is obvious that there are no accepted international standards or criteria governing spills that cross national boundaries.***

For comparison purposes, it is interesting to note some of the British Columbia (Canada) Ministry of Environment, Lands and Parks Water Quality Criteria for Cyanide (B.C. Canada, February, 1986). The weak-acid dissociable cyanide criterion for freshwater aquatic life (30-day average) is less than or equal to 5.0 μg/L; the maximum at any time is 10 μg/L WAD cyanide.

- **Mine monitoring data are frequently not made available to citizens in a useful way.**

Monitoring at mining sites is normally performed by the mining company staff or consultants under their direction. In less developed countries, the data they generate are often released only to the appropriate regulatory agencies, and only a few copies may have been produced. Such data reports are often prepared only once per year, thus the data may not be current by the time it is sent to the regulators. In such situations, the general public may never be allowed to see the results, and what they do see is often outdated. It is also quite common that these reports simply report data, and do not actually interpret and discuss the significance of the monitoring. Such situations create great mistrust between the company and the various stakeholders, and would greatly benefit from citizen involvement in the actual monitoring process.

Most of the detailed water quality and other environmental data resulting from the Romanian spill monitoring activities have never been released to the general public. These include data from universities, government agencies in numerous countries, consultants, and the company.

- **Investigations of mine spills in developing countries are often subsidized by the governments of the operating companies.**

Several governments, for example Canada and Australia, are known to pay for at least portions of mine-spill investigations with public funds, when these events occur in foreign countries. This appears to be a way of protecting the competitiveness of a favored industry. This approach can also ensure that the investigation report is at least "friendly" to the interests of the operating company.

There is no direct evidence that such activities have occurred following the Romanian spill. An example of such an exercise can be found in the "independent" review of the 1998 Kyrgyzstan cyanide spill (Hynes,*et.al.,1998*).

- **Mining geochemical reactions may take many years to develop water-quality impacts. While gold cyanide-leach wastes are normally alkaline (pH 10—12), acid rock drainage (ARD) problems can develop later.**

At Baia Mare, essentially all of the news media focused on the dramatic, cyanide-related aspects of the spill. Because gold-cyanide process fluids are kept alkaline, the potential to develop acid rock drainage may be overlooked. Spent ores or tailings that contain significant sulfide concentrations may become acid after the original buffering compounds and minerals react. These processes may require decades to become visible, and standard geochemical predictive techniques will often underestimate this potential.

A technical team from the U.S. Environmental Protection Agency made an assistance trip to the Baia Mare sites in April, 2000. They specifically noted (see Trip Report, Larry Reed, June 21, 2000) that the tailings were generating acid rock drainage. In the long-term, the ARD probably presents a much more costly contamination problem than does the cyanide and related products. Remediation of long-term ARD problems at U.S. mine sites usually requires the construction and operation of an active water-treatment plant. In many cases, these plants must be run in perpetuity, and may cost $500,000 to several million U.S. dollars per year to operate, depending on the volumes of water involved (Moran, 2000---see http://www.cipma.cl/hyperforum/index.htm).

- **Financial assurance is usually inadequate or lacking, thus mining companies may avoid paying for potential environmental impacts.** This is a special concern where foreign-owned companies use bankruptcy and international laws to avoid financial responsibility. Citizens, thus, subsidize environmental impact costs.

The Romanian government, being a partner in the Baia Mare operation, did not require the company to post any financial bond or other financial assurance. Following the spill, the company was required to pay a fine equivalent to $US170.

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About the Author

Robert Moran, Ph.D., is a geochemical and hydrogeological consultant with more than 29 years of domestic and international experience in conducting and managing projects for private investors, industrial clients, tribal and citizens' groups, non-governmental organizations, law firms, and governmental agencies. Much of his technical expertise involves the water quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water-supply development. In addition, Dr. Moran has significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support. He has been employed by the U.S. Geological Survey, Water Resources Division, several consulting firms, and as a private consultant. He has worked in Kyrgyzstan, Senegal, Guinea, Gambia, South Africa, Oman, Pakistan, Mexico, Peru, Chile, Australia, Greece, Great Britain, Canada, and the United States. Dr. Moran received his doctorate from the University of Texas, Austin. He can be reached via the internet at remoran@aol.com.

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