

ABANDONED MINES

Problems, Issues and Policy Challenges for Decision Makers

Santiago, Chile
18 June 2001

SUMMARY REPORT



Chilean Copper
Commission



UNEP
United Nations
Environment Programme
Division of Technology,
Industry and Economics

WORKSHOP REPORT

This report summarizes the presentations and discussions of the first Pan-American Workshop on Abandoned Mines, held in Santiago, Chile, 18 June 2001.

Copies of this Report and all the papers presented during the Workshop are available on the following websites:

- Mineral Resources Forum (www.mineralresourcesforum.org)
- Chilean Copper Commission (www.cochilco.cl)

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Preface

In April 2001, the United Nations Environment Programme (UNEP) and the Chilean Copper Commission (COCHILCO) discussed the possibility of co-hosting a Workshop on Abandoned Mines, to be held just before a COCHILCO-Mining Ministries of the Americas (CAMMA) Pan-American Workshop on Mine Closure.

Mining is an economic activity that has been practised in the Americas for hundreds, and in some cases, thousands of years, attracted by the regions rich deposits which include gold, silver and copper. However, mine closure is an aspect of mining where historic practices and contemporary, evolving community and government expectations do not coincide. The need to deal with the closure issue is increasing, owing to public health and safety issues and, more recently, to increased awareness of environmental contamination and the importance of environmental preservation. Inadequate, improper or neglected mine closure results in abandoned mine site problems. Abandoned mines and mine closure issues can therefore be considered as two sides of the same coin.

The topic of abandoned mines is also difficult because of the associated financial and legal liability implications. UNEP has been trying to raise the profile of this important but so far neglected issue for a number of years, and was pleased to have the opportunity to co-sponsor this Workshop with COCHILCO.

The Workshop, which was attended by government representatives of ten countries, was the first international meeting to consider the many issues surrounding the topic of abandoned mines. What exactly are abandoned or orphaned mines? Are these terms interchangeable? What are the environmental and social risks related to abandoned mines? What kind of criteria are needed to prioritize these risks? Is a regional or global inventory a prerequisite for action? What are the legal liability issues? What types of financial mechanisms exist? And, most importantly, who will pay to mitigate these sites?

The Workshop questionnaire, papers and presentations, together with this Summary Report, provide a resource for all stakeholders who wish to carry this discussion forward, either nationally, regionally or internationally. All available papers are available on the websites of UNEP (www.mineralresourcesforum.org) and COCHILCO (<http://www.cochilco.cl>).

UNEP and COCHILCO hope that the summary of this Workshop will provide a good starting point for future international discussions, as it is only through partnerships that the goal of environmentally sensitive, socially responsible, sustainable mineral development will occur.

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Chilean Sponsors: Chilean Copper Commission (COCHILCO)
 UN Economic Commission for Latin America and the Caribbean
 (CEPAL)

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OVERVIEW OF WORKSHOP PROGRAMME AND DISCUSSIONS

This Overview describes the sequence of the workshop programme, the discussions and the questions raised. Because of the sensitivity of the topic of abandoned mines to both governments and industry, it was the consensus view that no conclusions would be attributed to the Workshop. As this was the first international meeting on the subject, it was considered more important to table as many of the issues as possible to set the stage for future meetings.

Opening

The Workshop, co-hosted by the United Nations Environment Programme (UNEP) and the Chilean Copper Commission (COCHILCO) was held at the facilities of the United Nations Economic Commission for Latin America and the Caribbean (CEPAL). It was opened by representatives of the three organizations.

On behalf of the Executive Secretary, Mr Eduardo Chaparro (CEPAL) welcomed everyone to the CEPAL headquarters and went on to say that this was an important issue in a region where mining has been present for hundreds of years.

Mr Luis Maturana (COCHILCO) welcomed participants from ten nations on behalf of Mr Patricio Cartagena (Executive Vice-President COCHILCO) to Santiago, Chile, and said he welcomed the opportunity to co-host this important discussion.

Ms Wanda Hoskin (UNEP) welcomed everyone on behalf of UNEP and acknowledged COCHILCO for agreeing to co-sponsor this first international discussion on abandoned mines. In her opening remarks, Ms Hoskin indicated that remediation of abandoned mine sites is one of the major outstanding environmental problems related to mining. Even though it may be a legacy of inadequate or neglected mine closures in the past, it is an issue that has real environmental, social and economic implications today. Furthermore, the public image of mining today is shaped as much by its legacy as by today's much improved operating practices.

Objective of the Workshop

The objective of this Workshop was to *start* discussion in several areas including:

- a) What is our current state of knowledge with respect to abandoned mines in each of our countries?
- b) What criteria should be used to prioritize remediation efforts (community safety issues, air and water pollution problems, environmental degradation, remediation to prepare the land for other uses, etc.)?
- c) How should responsibility and costs be shared—neither governments nor industry nor communities have the financial resources to solve this issue alone?
- d) What do you recommend as the next step in this discussion?

Abandoned Mines Issue: Problems, Issues and Options. The first presentation addressed the *Abandoned Mines Issue: Problems, Issues and Options*. Wanda Hoskin reflected on

some of the work UNEP has been doing for a number of years (see Appendix 1). Ms Hoskin noted that the causes of inaction and lack of real progress in addressing this issue relate to: the fact that mine closure practices have changed; that expectations related to proper mine closure have changed; the lack of clearly defined or assumed responsibility; the lack of definition of what *is* an abandoned mine site; the absence of criteria and standards of rehabilitation; and the real and perceived cost of rehabilitation.

The environmental, social and economic problems associated with abandoned mine sites are serious and global. They affect all former mining countries: Brazil, Canada, France, Philippines, South Africa, the United States, etc.

The physical impacts of abandoned mine sites include: altered landscape; unused pits and shafts; land no longer usable due to loss of soil, pH, or slope of land; abandoned tailings dumps; changes in groundwater regime; contaminated soils and aquatic sediments; subsidence; and changes in vegetation. These problems have social and economic impacts on countries and individual communities due to: loss of productive land; loss or degradation of groundwater; pollution of surface water by sediments or salts; fish affected by contaminated sediments; changes in river regimes; air pollution from dust or toxic gases; risk of falls into shafts and pits; and landslides.

Some countries are starting to address the issue and the purpose of the Workshop was to share what each of the Latin America and the Caribbean countries are doing, and to discuss how sharing of information could be mutually beneficial to countries in the region. Participants were challenged to explore innovative approaches to dealing with abandoned mine sites by considering, amongst other things:

- models of shared responsibility;
- how to turn liabilities into assets by governments making adjustments to land use, land occupancy or site ownership definitions;
- revision of the liability concepts associated with abandoned sites;
- maximizing potential for commercial exploitation;
- developing low-cost remediation procedures or techniques;
- scheduling remediation over a lengthy but pre-determined period; and
- new approaches to remediation funds.

The challenge to all stakeholders—governments, industry, communities and environmental groups—is to be creative in finding solutions to this issue and not to get bogged down in apportioning blame for past wrongs.

Overview and Status of this Issue in the Americas

The second presentation was given by Eduardo Chaparro (CEPAL). CEPAL has done a significant amount of work in this area and has noted that the level of awareness about the issues associated with abandoned mine sites varies from 'some' (Caribbean, Colombia, Chile and Brazil) to 'none' (in the Andean region).

Mr Chaparro noted, however, that in Latin America and the Caribbean the fiscal aspects of the problem are more serious than expected, as the economic model does not allow

participation by the state in addressing certain issues. Where, therefore, will the financial resources come from? In addition, the majority of private sector companies consider the use of tax revenues to address this issue as regressive.

Some abandoned mine sites in Latin America and the Caribbean are the result of mining hundreds of years ago, meaning the owner is long gone. They are also the result of owners/operators going bankrupt. In addition, large cities now face the problem of their growth pushing outlying areas towards the edges of abandoned quarry sites. Related problems are now starting to affect people's quality of life. Although there has been some investigation of mining activities and of their environmental impacts over the past 50 to 60 years, it is only during the past 20 years that concepts such as mine closure have been added to the discussion. In this regard, the influence of NGOs and of the environmental policies of the most important mining companies have helped define these new elements, so as to prevent abandoned mines in the future.

Chile

Ricardo Troncoso (Servicio Nacional de Geología y Minería – Sernageomin) presented the mining situation in Chile. Sernageomin's mission is to promote the development of the mining sector in accordance with the policies defined by the Ministry of Mines. It provides specialized services such as on-field studies, capacity building, and evaluation and control for mines, geology and environmental management. The ultimate goal is to create the conditions necessary to promote sustainable and environmentally-friendly development of the mining sector which has played such an important role in economic growth of the country, and is expected to continue to do so in the future.

Chile has been a major producer of copper and gold for hundreds of years, and still is today. Eighty per cent of its mines are in arid areas. At the moment, small-scale mines employing less than 80 workers are still the most common feature of the mining industry. In addition, out of 659 mines, 345 (52.4 per cent) are abandoned. This situation inevitably poses serious threats to the natural environment and community life. For this reason, Sernageomin is developing a system to collect data on mine site conditions. The information will cover general aspects as well as risk assessment analysis, the latter covering everything from workers' health to geophysical impact evaluations, ground and surface water resource contamination, and dust production and disposal. The aim is also to set up and train teams of experts able to carry out periodic site checks and to be consulted in case of need. A region-by-region study of the mining industry is scheduled, and an upgraded version of the software for the evaluation of risk assessment analysis is expected.

Andrea Munoz (CONAMA) stated that the Chilean Environment Ministry has been active in minimizing environmental degradation since 1994. Remediation of environmental degradation is a long term issue. To date, Ministry officials have visited each region in Chile and have held meetings with different agencies to gather information; identify the environmental liability with respect to abandoned mines, tailings dams and waste dumps; and to develop a strategy. However, criteria are needed for risk assessment and to determine priority for action. Costs and benefits will also need to be assessed for an action plan.

Patricio Cartagena (COCHILCO) again described Sernageomin's commitment to minimizing and ideally eliminating the risks which mining sites pose to local communities and the environment at each stage of the exploration and production processes. In particular, he stressed the importance of voluntary initiatives from the mining sector and focused on closure plans (Planes de Cierres) adopted by mining companies under the auspices of Sernageomin. Projects are under study to make closure plans mandatory in the near future, within a wider System of Environmental Impact Assessment (Sistema de Evaluación de Impacto Ambiental).

Closure plans cover several different points including characteristics of the relevant mining sites, their geographical location, their proximity to local communities, and the sensitivity of the environment. The plans describe the actual measures a mining company intends to adopt to restore the pristine environment or to minimize the impacts of its operations. Access to mines may have to be closed or restricted, warning signs have to be visibly in place, spillage of chemically polluted waters has to be strictly controlled, working facilities have to be dismantled and leftover materials removed. Other measures refer to the reforestation of the surface and to the re-arrangement of water basins that mining sites may have altered during their operations.

Mr Cartagena also raised the issue of mining in protected areas and said that, although strictly speaking the topic was not covered by this Workshop, it needed to be addressed as the Washington Convention has banned mining in protected areas.

Peru

Luis Sanchez (Ministerio de Energía y Minas – Dirección General de Asuntos Ambientales) thoroughly defined the closure plans (Plan de Cierre) which have to be drafted and implemented according to existing Peruvian law.

Closure plans must contain detailed information on all the steps the mining company intends to take to preserve the natural environment and protect human health, both among miners and local populations. Closure plans aim to reduce and/or eliminate solid, liquid and gaseous wastes as well as any other adverse effects of mining. Corporate management systems for mining sites must include closure plans as an integral part of mining operations, from survey/exploration of the site to its actual exploitation and to definitive termination of activities. They must also identify the financial resources the company will use to limit impact on the environment, both during production and when activity is over. Closure plans must include measures to preserve air and water characteristics and to prevent soil erosion. Once mining production is finished, the mining facilities have to be removed in a timely fashion and reforestation plans activated. Closure plans have to pay special attention to cases of mining activities in "protected areas". Closure plans have to provide for technical information, such as hydrographic data, in order to guarantee proper management of surface and groundwater resources, geological data, dimensions of the area occupied by the mine, proximity to local communities, physical and chemical characteristics, and climate and other environmental conditions specific to the site. They also have to contain detailed evaluations of the costs of preserving the environment, including legal costs.

Closure plans are sequential, progressive management systems that are deployed as soon as a production objective is reached, in order to minimize environmental impacts. Therefore, closure plans—their name notwithstanding—actually function from the very beginning of a mining operation, through its closure and even afterwards. Where the latter is concerned, depending on the characteristics of each mining site, closure plans can consist both of periodic in-situ checks and of concrete actions such as water treatment or management of water courses.

United States

George Stone (Bureau of Land Management) gave an overview of mining in the USA which has included base metals, precious metals, industrial minerals and coal. The Bureau has estimated that there are between 100,000 and 500,000+ small and mid-size abandoned hard rock mines in the west. Most sites are not posing problems. Of those that are, 25 per cent relate to health and safety matters and 5 per cent to environment, primarily issues of water pollution. There are some 13,000 abandoned coal mines, mostly small and mid-sized in the east. These are causing mainly health and safety problems.

The principle environmental issues relate to water pollution, soil erosion and soil contamination. Social and health impacts relate to: health and safety risks and associated legal claims; cultural and heritage impacts; aesthetics; problems of use and/or occupancy; and increased accessibility of people to the dangers of these sites resulting from use of all-terrain vehicles and from people's quest for adventure.

Remediation costs are excessive and the USA is looking at government programmes related to public awareness and outreach, clean up (especially of safety hazards), water quality and hazardous materials, and science and research initiatives with government and academia. However, there is a difference in the approaches and funds available for remediation of coal and hardrock mine sites.

For abandoned coal sites, the Surface Mining Control and Reclamation Act (1977) allows funds to be collected to redress outstanding problems. Some \$260 million are collected annually from industry and another \$160 million are appropriated from various grants. No such legislation exists for hardrock mining where there are few public funds from general revenue. Some abandoned mines are Superfund sites and, although the Superfund was a novel approach to dealing with contaminated sites, severe limitations have been encountered. Access to public money is complicated by the number of federal and state agencies involved and the fact that governments have multiple priorities. However, the debate in the USA continues on ways to address a range of issues including the need for water quality standards, “Good Samaritan” clauses for site clean up, mixed public-private and private-private ownership, legal issues, climatic conditions, wildlife that has taken up residence in abandoned sites (e.g. bats), and archaeological, cultural and historic preservation.

Roundtable Comments

During the round table session, the *Dominican Republic* indicated a new Environmental Law which will address the issue of abandoned mine sites. Specific mine sites that were causing

acid rock drainage were mentioned but *the* question that needs to be addressed is the source of funds to remediate environmental problems.

Canada explained that jurisdiction over mining is split between the federal government and the provinces. While some provinces like Quebec and Ontario have started to remediate sites, there is a need for a more coordinated approach.¹

Argentina indicated that an Argentina/Canada Workshop on Abandoned Mines was held, in 1996, to examine the question of environmental liabilities. There are some abandoned metals sites and industrial operations only ten kilometres from Buenos Aires. There is a good legal framework as well as the capacity to identify and solve problems. However, there is a need for Latin America and the Caribbean countries to exchange information, and industry needs to be convinced to invest in acid rock drainage solutions.

Mexico explained that mining has been practised in the country for more than 500 years. Under the 1992 law, amended in 1996, the State took responsibility for environmental liability matters but so far this has not been implemented. No national inventory of abandoned sites exists although some data is available in the federal jurisdiction of environmental protection and in the Consejo de Recursos Minerales. A system of prioritization needs to be developed as public concern over this issue is growing.

Non-Technical Issues

Raul Campusano (INGEDER Consulting Ltd.) started this discussion by presenting a number of non-technical issues relating to: responsibility and legal, financial, environmental and social aspects.

With respect to responsibility, he asked, is there a responsibility vacuum? Is there anything to do, or do we just leave things the way they are? Is it a government/State or industry matter? Both entities or neither?

How do we approach the legal issue? Is this a problem? Do we use the regular legal liability approach? Do we forget possible liability and make the State assume the problem? Or, do we search for a creative multi-stakeholder approach?

As always, there are real, costly financial issues. Who pays for what? Is it possible to find low cost remediation procedures and technologies? Should remediation be an 'all-at-once' or a gradual strategy?

What is the true scope of environmental problems? Are there problems? Is there a problem in my country/region/world? How do abandoned mines relate to specific environmental problems?

¹ Canadian officials informed participants of a national Workshop on abandoned mines in Winnipeg, Manitoba, on 26 June 2001. The Workshop agenda included the definition of abandoned mine sites, inventories, a discussion of impacts, the need to prioritize sites, reclamation standards, community issues, health and safety, emergency response plans and the examination of funding models.

Regarding the question of the environment, are there also social problems? Are there problems in my country/region/world? Is there a specific relationship between abandoned mines and social problems?

Finally, are there important links to be considered? What is the present relationship between abandoned mines and mine closure? Are there benefits from working together regionally, (CAMMA, GEMEEDⁱⁱ, etc.).

Case Study: Initial Abandoned Mine Land (AML) Strategies (USA)

George Stone presented the approach that the Bureau of Land Management (BLM) has adopted to remediate the AML problem in the USA. BLM estimates that some 500,000 sites exist, making the problem seem so overwhelming that no action is taken. However, BLM has started outreach and awareness education campaigns, aimed particularly at school-age children. Other low-cost approaches include use of outreach speaking opportunities and web pages on the Internet.

Because the funding issues are political, with politicians wanting to know what will be done while they are in office, clean-up programmes are often divided into phases for purposes of funding approval.

Results are important and these need to be measured in terms of *outcomes*, not just outputs. Rather than claiming credit for cleaning up a dozen sites, it is better to show how the public has benefited from the clean up. For example, making a populated or high-use visitation area safer or restoring a watershed segment for fishing and recreation. BLM is focussing on areas where it is wanted and where the goals complement those of local communities. BLM has also realized that when it comes to on-the-ground solutions, it needs to work within available physical resources, due to the prohibitively expensive costs of transporting soil or removing materials. This means finding innovative approaches to in-situ clean-up actions, applying low-cost mitigation and remediation techniques (such as signs and markers), and working on clean ups that will involve zero or low maintenance costs (such as passive water pollution treatment).

It has been useful to begin with some 3–5 year short-term, small to medium size clean-up projects enabling establishment of a *track record of success* that will be useful for longer-term planning and budgeting.

Because some AML problems are complicated by other nearby industrial activities, it is necessary to ensure that everyone involved plays a role in the clean up. For example, there is a pending clean-up situation in California involving mercury contamination of rivers from past hydraulic gold mining and milling. However, many of the affected rivers cross the central valley. This is one the most fertile agricultural areas in the USA and agricultural

ⁱⁱ CAMMA is the Spanish acronym for the Mining Ministries of the Americas. Created in 1996, it is the only high level regional forum annually discussing mining, minerals and metals issues. CAMMA Mines Ministers meet annually. GEMEED (Group of Experts in Mineral and Energy Exploration and Development) is the working group under APEC (Asia-Pacific Ecomines). Canada, Chile, Peru and the United States are members of both CAMMA and GEMEED.

activities have contributed greatly to run-off of pesticides and herbicides into these same rivers. As a result, Federal, State and local agencies are working together to ensure that all of these pollutants are addressed at the same time

Experience with *inventory* efforts has not been particularly productive. Various agencies have undertaken their own field validation work and have collected data in all sorts of formats. The result is a highly heterogeneous and incomplete corpus of data which is not particularly useful. Some general site location and information on key features to be addressed is more useful, together with a clean-up cost estimate. BLM is also beginning to approach inventory needs based on more focused risk-based approaches. For example, the Bureau is trying to identify specific watersheds that are polluted from AML's. Work can then focus on direct inventory and field work in those areas, on an interagency basis. The use of GIS enables testing various 'what-if' priority scenarios, and knowledge of those scenarios enables flyovers and field work to test proximity of sites to areas of expanded population or high use.

BLM has also found use of complex point-ranking schemes to be of dubious value, as time is then spent explaining why the sites with the most points are *not* the ones being addressed, for various reasons. Prioritization is a matter of perception. Sometimes it makes sense to think of "bands" or groups of sites with common characteristics as being essentially equivalent for funding purposes. Additionally, more often than not, other determining factors influence which sites get addressed first—available agency resources, litigation (or lack thereof!), and external pressures.

BLM has found it effective to combine resources in federal and state *partnerships*. Partnership projects can often obtain the financial resources needed to address overall site conditions. Another step is to make some decisions as to the clean-up standard to be used—mitigation, remediation, restoration, and reclamation can be viewed as a spectrum of possible approaches. Sometimes, it makes sense to implement minimal mitigation measures at many sites, rather than concentrate on extensive restoration or reclamation of a relative few. Furthermore, we cannot solve 150 years of AML problems in the short term; a steady approach to funding and remediation is desirable.

One of the areas *needing improvement* is greater industry involvement. Unfortunately, liability issues continue to hinder this goal. Industry has the technical know-how and the equipment needed to continue to look into market-based incentives and other measures that would enable industry to play a greater role in site clean ups. BLM is also continuing to find ways to involve non-traditional partners, through identifying cross-cutting programme goals and associated resources.

Discussion

During the discussion periods, there was a consensus that abandoned mine sites are posing some degree of environmental, safety and health problems in all countries. There was also agreement that the fundamental issues were financial and legal.

As there are serious economic issues in Latin America and the Caribbean, the abandoned mine sites issue needs to be linked to other national priorities. Policies are needed for territorial management and for energy management. CEPAL explained that 12 countries in Latin America have amended their environmental policies in the last few years but that, in some cases, resulting partnerships have not resulted in benefits. Also, although large or multinational mining companies are now embracing environmental standards, this does not seem to apply to the smaller companies and many mining companies are therefore currently causing environmental damage. Perhaps government efforts are better applied to current issues rather than older ones.

There was discussion on whether the terminology should be: *abandoned*; *orphaned*; *inactive* or perhaps even a new term: *mines at risk*. The term *inactive* was deemed inappropriate as some mines close temporarily for financial or market reasons but they may not be officially “closed” nor “bankrupt”, they are just *inactive* for a period of time. Under the law in the Dominican Republic, the owner of any mine that is inactive for more than six months loses the right to the concession. It may be necessary for each country to use its own term, depending on its own legal system and existing definitions.

There was significant discussion on legal *liability*. What exactly is meant by environmental liability? What is the relationship between environmental liability and environmental damage, and how are these terms linked to risk?

Responsibility for a site came up in a discussion on how money can be found for clean up and remediation. The responsible entity should undertake clean up, but in many cases that entity does not have the financial capability. What then?

Some participants felt that, as it is government which represents society and society has benefited from minerals products, it is government that should initiate and pay for site clean up. CEPAL offered two possible options for funding remediation. First, the State must assume its environmental management role which includes environmental protection. It is therefore directly responsible for abandoned mine sites and should assume the costs of remediation. However, the State does not have such financial resources. The other scenario, is, therefore, to have the market contribute to a remediation fund. All international transactions would include a small premiumⁱⁱⁱ going into an internationally managed fund^{iv} used to address past problems.

A consortium like the Mine Environment Neutral Drainage (MEND) programme, developed in Canada to address acid rock drainage, could be considered to deal with abandoned mine sites.

Another option mentioned related to mine reclamation funds which are now legally required for operating mines in most countries. As continuous mine closure becomes the norm, the money in mine reclamation funds may perhaps come to represent an excess amount. While

ⁱⁱⁱ This could, for example, be in cents per unit.

^{iv} To prevent mismanagement or misappropriation of monies, the fund would be managed by a politically neutral, reputable entity, like the World Bank or UNEP.

there was agreement that reclamation funds (or tax dollars for that matter) would not be used for purposes other than for those for which they were intended, a portion of the interest on excess funds could perhaps be used to remediate abandoned mine sites.

It was also suggested that mineral royalties should be used for remediation, although this represented a minority viewpoint.

Regardless of the money required, in order to have a level playing field, minimum standards for reclamation are required. It is therefore important to ensure that national guidelines or legislation do not create an unintended market externality.

Finally, the discussion focussed on the fact that the fundamental issue in dealing with abandoned mine sites relates to political will. CEPAL offered technical assistance if the CAMMA Ministers wished to make a political decision to address this issue regionally.

Summary

At the end of the Workshop, the co-chairs, Mr Patricio Cartagena and Ms Wanda Hoskin, summarized the day's discussions. The co-chairs agreed that discussion of an important environmental matter had started but there was a lengthy journey ahead. Mr Cartagena was surprised that more had not been said about the role of communities and of companies. He was also surprised that this had not yet come up on the agenda of the CAMMA Ministers. New analyses and new deliberations were needed. Each country needs to generate its own policy and define the issue for itself. However, if the political will could be found, the other issues can be resolved. Furthermore, financing is also a consequence of political will.

The range of options put forward to address abandoned mine sites during the day included:

- a small surtax that should be paid by the market into an internationally managed fund;
- consideration of a type of remediation fund for abandoned mine sites;
- encouraging of retreatment of old tailings piles, given the new technology available;
- consideration of "Good Samaritan" proposals for clean up;
- consideration of opening up of old sites for museums and tourists, and use of associated revenue for site remediation;
- the need to continue to exchanges of views;
- sharing of the costs of rehabilitation by everyone—governments, industry, the market (i.e. consumers);
- construction of a consortium like the Mine Environment Neutral Drainage (MEND) programme in Canada; and
- inclusion of abandoned mine sites in any international mining convention or framework agreement.



Participants from USA, Mexico, Argentina, Chile, Peru and Canada

ABANDONED MINES DISCUSSION PAPER

Abandoned Mine Sites: Problems, Issues and Options Discussion Paper Presented by UNEP

Introduction

One of the major outstanding environmental problems related to mining is that of abandoned mine sites. It is a legacy of centuries old practices and of inadequate, insufficient or non-existent mine closure. The potential costs of rehabilitation, the lack of clearly assigned (or assumed) responsibility, the absence of criteria and standards of rehabilitation and other factors have delayed action by all parties—industry, governments and communities. Yet, land degradation from old mine operations is well known in almost all countries.

While many have seen these derelict sites, and there are many references in the literature, there have been few systematic surveys to quantify how many sites really need attention. There has been even less work to quantify the nature of associated problems so as to prioritize remediation efforts.

As a starting point for an international dialogue on this subject, UNEP has begun to collect information using national or regional inventories in addition to initiating a global survey.

Objective of the Workshop

The objective of this joint Workshop is to *start* a discussion on several areas including:

- a) What is our current state of knowledge with respect to abandoned mines in each of our countries?
- b) What criteria should be used to prioritize remediation efforts (community safety issues, air and water pollution problems, environmental degradation, remediation to prepare the land for other uses, etc.)?
- c) How should responsibility and costs be shared—neither governments nor industry nor communities have the financial resources to solve this issue alone?
- d) What do you recommend as the next step in this discussion?

Abandoned Mine Sites

A review of the work done to date indicates that there is no single definition of an “abandoned mine”. This raises several questions. First, what constitutes an abandoned site? Is it a mining claim, a single shaft or an entire mining area? The second problem is that of ownership—some sites are ‘owned’ by someone others are truly orphaned, i.e. there is no known or living owner but the state may find itself responsible for any clean up. It is the third problem that constitutes an environmental concern—many adits discharge a trickle of acid rock drainage, but is it worth doing something about it? Is there water contamination? Are there dust problems, etc.?

If every shaft, adit and alluvial working is included, the number of ‘abandoned mines’ worldwide will run into millions. However, the fundamental question is how many sites actually constitute an environmental or community safety problem, as an exaggerated figure may dissuade authorities from even examining the problem seriously.

Impacts from Abandoned Sites

In countries with a long mining history the magnitude of the impacts from past mining is often considerable, as environmental regulation of mining activities has, in most cases, only been introduced relatively recently. In the absence of a systematic international survey, the anecdotal evidence given below will help to illustrate the situation.

- *Large areas of dryland forest in Australia that were dug over in the gold rush in the 1860s have still not recovered. There is virtually no topsoil, and the land is covered by only sparse vegetation and stunted trees. It is estimated that more than 150 tonnes of mercury were lost from the diggings to the environment due to inefficient gold recovery processes. On the coast, elevated mercury levels from the contaminated sediments are still found in fish and health authorities have counselled a limitation on consumption of fish caught locally.*
- *Acid drainage from the abandoned Wheal Jane and other mines in the UK has severely contaminated local streams. There is a considerable cost of water treatment of the ongoing drainage discharges and only a few treatment plants are operating.*
- *In Aberfan, the collapse of an abandoned dumpsite swept away a local school with the children and schoolteacher.*
- *A number of major mine sites in the USA are listed as Superfund sites due to the extensive contamination from materials and exposed orebodies left behind.*
- *Abandoned pits and shafts over a large area of uncontrolled past alluvial mining in West African countries poses a serious public safety risk to local people and animals.*

There are many abandoned tailings dams around the world in addition to abandoned mine sites and these could eventually pose environmental and safety problems. There is no complete inventory of tailings dams but their number is certainly in the tens of thousands.

The impact of abandoned sites is significant including: altered landscape; unused pits and shafts; land no longer useable due to loss of soil, pH, slope of land; abandoned tailings

dumps; changes in groundwater regime; contaminated soils and aquatic sediments; subsidence; and changes in vegetation.

Results of such impacts include: loss of productive land;^v loss or degradation of groundwater; pollution of surface water by sediment or salts; fish affected by contaminated sediments; changes in river regimes; air pollution from dust or toxic gases; risks of falls into shafts and pits; and landslides.

In addition to the obvious problems for the community, most of these situations represent a considerable cost to public authorities which are often expected to make the sites secure and prevent ongoing pollution. The public is increasingly demanding action and this visible legacy of the past is producing growing community opposition to current mining activities. The orphan sites problem therefore continues to cast a shadow over all mining at a time when major operators are improving their operations and are trying to improve the image of their sites and their company.

This can be compared with the situation at current operational mine sites where the need for rehabilitation is now expected and often mandated, and for which companies and governments have established legal, financial and technical procedures to ensure that mine sites are rehabilitated to make possible another economic use after the mining operation ceases.

In fact, the case for rehabilitation of abandoned sites is the same as that for active mines. The difference is that the assignment of responsibilities is different. For abandoned sites it often lies with unidentifiable owners, and has thus led to non-action. However, the problems must be dealt with.

Accordingly, there is now a good case for starting to consider how to respond to the orphan sites issue at the international level:

- resource degradation is everybody's problem; it is an issue in every mineral rich country;
- it has a similar public rationale to rehabilitation of existing operational sites;
- it is inevitably a part of the wider debate on sustainable mineral development; and
- it is a part of the image problem for the entire industry, with consequences for companies' future 'license to operate'.

Comparison with Contaminated Sites

Government initiatives on chemically contaminated sites may be a source of lessons that are relevant to the problems of abandoned mine sites (some mine sites may actually fall into the chemically contaminated category at the same time). The origins and history of these problems are similar, beginning at a time when consciousness of them was low, government regulation minimal or absent, and industry's consciousness of preventive action less than it is today. The result has been a large inventory of abandoned industrial sites, sometimes heavily contaminated.

^v In China, mining waste is stockpiled on 2 million hectares of desperately needed land.

But public pressure on chemical risks has led many governments to take action and contaminated site clean-up programmes now have a well-documented history. Perhaps lessons could be learned from some of those programmes and some of the methodologies that have been developed could be applied to the context of orphan mine sites.

Contaminated site programmes have led to the development of national approaches to assessment, preparation of inventories, prioritization, objective setting and development of action plans. Perhaps these programmes could provide useful models for the mining industry.

Some governments have experimented with legal regimes to assign responsibility or, where none can be assigned, to impose a fiscal mechanism levied on the entire industry to pay for the clean up. This so-called “Superfund” mechanism has raised passions as well as money, and there is a view that solving of problems through legal action results in a diversion of substantial amounts of capital away from remedial works. Alternative ways of raising the money have, however, not been identified. We need to think about this issue in a creative and bold way.

Rehabilitation

Apart from any socio-economic aspects, the physical reclamation of an abandoned mine will include some or all of the following measures:

- permanent sealing of underground workings and all mine openings, prevention of water and gas leakage that could cause adverse impacts to neighbouring mines or to the environment;
- ensuring that any open pit or open cut features are stable and do not pose a risk to humans, animals or the environment;
- removal of all material and equipment lying at the surface;
- demolition of surface buildings and structures unless there is a productive use for them;
- all steps necessary to ensure the safety of tailings and slurry ponds, spoil heaps, waste dumps, stock piles and any other surface features that might pose an environmental or human hazard; and
- clearing areas formerly used for the mine surface facilities.

In general, the physical rehabilitation of a mine site will include:

- restoration of surface land including clean up of the premises, levelling the ground and revegetation;
- establishing the nature of any water remaining in the open pit and treating it if necessary;
- ensuring that there is easy access to the water in the open pit to allow animals, children and adults who might fall in a way out, or backfilling the open pit;
- rehabilitation of waste dumps including surface drainage, redesign of slopes to an acceptable angle and revegetation;
- restoration of land affected by mining subsidence including refilling/levelling of the affected ground, wherever feasible, and revegetation;
- rehabilitation of natural water courses directly affected by mining operations;

- collection and treatment of polluted mine water;
- treatment of surface soil wherever this is affected by mining activities; and
- monitoring of results for a specified period after the completion of remediation.

Some Issues and Trends Currently Affecting Options in Rehabilitation

We know that knowledge of rehabilitation techniques, both operational and for abandoned sites, is extensive. It is the lack of clear legal and financing mechanisms and the lack of the willingness on the part of industry, governments and communities to form mutually beneficial partnerships that is holding back action and delaying remediation.

More fundamentally, there is a lack of systematic inventory, meaning that the problem is not sufficiently described for it to become politically important.

Experience with contaminated sites has also shown that a systematic approach to this issue is protracted, expensive to manage and dependent on considerable technical expertise within the administration. Nevertheless, there are now initiatives, mostly in developed countries, and there is some momentum to start sharing experiences.

Governments have reacted more effectively in preventing current mines from becoming “abandoned sites”. For example, in Japan where a national survey found 5,500 abandoned mines, the government has adopted a two-pronged approach to the problem. Where original owners exist, they remain responsible for the safety of the mine and the prevention of all pollution. Where the original owner cannot be found, or in case of bankruptcy, local and national governments tackle the problem jointly.^{vi} In other countries, some governments apply rehabilitation regulations and fiscal mechanisms to current operators. Some of these experiences, including the setting of performance targets, will be useful in addressing the orphan sites issue.

At the same time, industry's approach to environment has become more comprehensive and mature and presents some new options for cooperative approaches. Refinement of formal environmental management systems and tools such as ISO 14000, Environmental Impact Assessment and environmental accounting have made environmental programmes a part of mainstream corporate management. There has also been a move towards more life-cycle oriented approaches, with supply-chain management and extended producer responsibility now being taken more seriously by larger companies.

The recent acceptance by industry of the need for some voluntary measures and codes on environment to complement government regulation has resulted in action on a range of matters that have not so far been regulated. Consideration of these and other approaches needs to be applied to abandoned sites.

Industry is also becoming more involved in the global and national policy debates on sustainable development. Through various environmental codes, business charters and other commitments, companies are now more conscious of the need to address social issues, to adopt ethical positions, and to acknowledge that sustainable development is about values as

^{vi} Information from two papers presented by Metal Mining Agency of Japan at the 3rd Asia Pacific Training Workshop on Hazardous Waste Management on Mining, Beijing, China, September 2000.

much as about economics. Their commitment to sustainable mineral development now needs to be applied practically.

Conclusion

Although there have been few attempts at quantification, it is generally understood that the issue of abandoned or 'orphan' mine sites is a major unresolved environmental and social problem for the industry, for communities and for governments. Potential impacts include a range of health and safety problems, and extensive economic impacts due to resource degradation and water pollution. So far, there are only a small number of systematic programmes to deal with the issue. However, experience with similar problems in contaminated industrial sites and with rehabilitation of operational mines has provided sufficient elements to allow for a serious start on the abandoned sites problem.

**APPENDIX 2
QUESTIONNAIRE (English)**

Issues and priorities concerning abandoned mine sites

Country

The information requested below will be compiled into a background report for a forthcoming international conference on abandoned mine sites. Your assistance in providing information from your own sources in accordance with the elements laid out below would be greatly appreciated. If you do not wish to be quoted personally, please indicate this in your response. All information received will be aggregated by country.

Please note: the information requested is specific to abandoned and orphan mine sites which currently have no owner or operator. The questionnaire does NOT relate to operating mines sites where a legally responsible and financially viable operator exists.

While precise definitions vary from place to place, for this study abandoned sites and orphan sites refer to mine sites and mineral operations that are: no longer operational; are not actively managed; not rehabilitated; are causing significant environmental or social problems; and for which no one is currently accountable for the site's remediation or rehabilitation.

An estimate of the number of abandoned mine sites in your country/province by type. Give details of any survey that has been carried out. Attach tables or charts if available. (please quote sources of information. Do NOT attach a list or locations of mines or specific details here).

Tailings.....
Sand & gravel.....
Underground.....
Alluvial.....
Smelter.....
Other.....

1. Details of documented environmental impact arising from abandoned mine sites, (please quote sources of information)

Area of degraded land (square km, hectares, acres)
Pollution of air
Water surface.....
Contamination of soil or groundwater.....
Impact on flora and fauna.....
Erosion of soil.....
Spread of weeds or vermin.....
Subsidence/ collapse of land.....

2. Details of documented social or health impact, (please quote sources of information)

Safety hazards from old mines or structures.....
Loss of water or land resources.....
Loss of income.....
Other.....

3. Published figures or estimates of remediation costs (if known) of abandoned sites (please quote sources of information)

at the national level.....
for selected areas or cases.....

4. Examples of remediation programmes for abandoned sites where information is available, including remediation of abandoned sites sponsored by companies

.....
.....

5. Examples of re-mining old abandoned sites where this has led or is expected to lead to total site rehabilitation

.....
.....

6. Examples of government policy or regulation instruments or programmes aimed at abandoned mine sites, including policy, regulatory or fiscal instruments

Policy.....
Regulatory.....
Fiscal.....

7. Contact names and addresses of individuals responsible for or knowledgeable about abandoned mine sites

.....
.....

8. Significant reports, conference papers, books or articles dealing with abandoned mine sites

Conference papers.....
Books.....
Articles.....

9. Name/address of person(s) to contact for further information

.....
.....

10. I can be quoted..... not quoted.....

11. Other information you wish to provide

APPENDIX 3
QUESTIONNAIRE (Spanish)

Cuestionario

Materias y prioridades concernientes a sitios mineros abandonados

País

La información solicitada más abajo será compilada en un informe de antecedentes para una reunión venidera acerca de sitios mineros abandonados. Su asistencia en proveer información de sus propias fuentes de acuerdo con los elementos descritos más abajo, será muy apreciada. Si no desea ser citado personalmente, por favor indíquelo en su respuesta. Toda la información recibida será agregada por país.

Por favor, note que: la información solicitada es específicamente acerca de sitios mineros abandonados y huérfanos que en la actualidad no tienen dueño u operador. Este cuestionario NO se relaciona a sitios mineros en operación en donde existe un operador legal responsable y económicamente viable.

Aun cuando definiciones precisas varían de lugar a lugar, para este estudio, sitios abandonados y sitios huérfanos se refieren a sitios mineros y operaciones mineras que: no son actualmente operacionales; no son activamente gestionadas; no están rehabilitadas; causan significativos problemas medioambientales y sociales; y por los cuales nadie es responsable de la remediación o rehabilitación del sitio.

Una estimación del número de sitios mineros abandonados en su país/provincia por tipo. Dar detalles de cualquier encuesta que se haya hecho. Adjunte tablas o gráficos si están disponibles. (por favor, cite las fuentes de información. NO adjunte aquí una lista de localidades de las minas o detalles específicos).

Desechos.....
Arena & grava.....
Subterráneo.....
Aluvial.....
Fundición.....
Otros.....

Detalles de impacto medioambiental documentado que surgen de sitios mineros abandonados (por favor citar fuente de información).

Area de tierra degradada
(km cuadrados, hectáreas, acres)
Polución del aire
Superficie del agua.....
Contaminación del suelo o agua subterránea.....
Impacto en la flora y la fauna.....
Erosión del suelo
Propagación de maleza o insectos.....

Hundimiento/ colapso de tierra.....

Detalles de impacto social o de la salud documentados, (por favor citar fuente de información).

Riesgos de seguridad que provienen de minas o estructuras viejas.....

Pérdida de agua o recursos de la tierra.....

Pérdida de ingresos.....

Otros.....

Cifras publicadas o presupuesto del costo de remediación (si se conocen) de sitios mineros abandonados (por favor citar fuente de información).

A nivel nacional.....

Para áreas o casos selectos.....

Ejemplos de programas de remediación para sitios abandonados donde hay información disponible, incluyendo la remediación de sitios abandonados patrocinados por compañías.

.....
.....

Ejemplos de re-explotación de sitios viejos abandonados donde esto ha llevado o se espera que lleve a la rehabilitación total del sitio.

.....
.....

Ejemplos de instrumentos de política o regulación de gobierno o programas dirigidos a los sitios mineros abandonados, incluyendo políticas, e instrumentos regulatorios o fiscales.

Política.....

Regulatorio.....

Fiscal.....

Nombre de contactos y direcciones de individuos responsables de/o con conocimiento sobre sitios mineros abandonados

.....
.....

Reportes significativos, disertaciones en conferencias, libros o artículos relacionados con sitios mineros abandonados

Disertaciones en conferencias.....

Libros.....

Artículos.....

Nombre/dirección de persona(s) a contactar para más información.

.....

Me puede citar..... no citar.....

Otra información que usted desee proveer.

APPENDIX 4 ANNOTATED AGENDA

Chairs: Patricio Cartagena and Raul Campusano (COCHILCO); Wanda Hoskin (UNEP)

MONDAY, 18 JUNE, 2001

- 09:00 Opening, Welcome and Introductions
- Eduardo Chaparro on behalf of the Executive Secretary of United Nations Economic Commission for Latin America and the Caribbean (CEPAL)
 - Luis Maturana on behalf of the Chilean Copper Commission (COCHILCO)
 - Wanda Hoskin on behalf of United Nations Environment Programme (UNEP)
- 09:15 Abandoned Sites Problem: A Challenge for Society (Wanda Hoskin)
- 09:45 Overview and status of this issue in the Americas:
- Regional Overview (Eduardo Chaparro)
 - Chile – Servicio Nacional de Geología y Minería (Ricardo Troncoso)
 - United States – Bureau of Land Management (George Stone)
 - Chile – Comisión Nacional del Medio Ambiente (Andrea Muñoz)
 - Dominican Republic (Marco Perez)
 - Canada (Manitoba – Cristine Kaszycki)
 - Argentina (Roberto Sarudiansky)
 - Mexico (Marguarita Lozada)
 - Chile – Chilean Copper Commission (Patricio Cartagena)
- 11:30 Discussion of Non-Technical Issues: Responsibility Vacuum; Legal Liability; Financing Issues; Scope of Environmental and Social Problems; Linkages to Consider (Raúl Campusano)
- 12:00 Round Table Discussion
- 12:30 *Lunch*
- 15:00 Case Studies
- Initial Abandoned Mine Land Strategies (George Stone, USA)
- 16:00 Discussion - How do we go forward? What is the *right* terminology? How can we afford the clean up? Is there a need for a partnership, multi-stakeholder approach? How can progress be made? What are the priorities for action?
- 16:30 Summary (Patricio Cartagena and Wanda Hoskin)

**APPENDIX 5
PARTICIPANTS LIST**

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ABOUT UNEP

UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

UNEP works closely with stakeholders to provide a common information and knowledge base which assists government and industry in making environmentally sound decisions.

ABOUT THE UNEP DIVISION OF TECHNOLOGY, INDUSTRY AND ECONOMICS

The mission of the UNEP Division of Technology, Industry and Economics (UNEP DTIE), is to help decision-makers in government, local authorities, and industry develop and adopt policies and practices that:

- are cleaner and safer;
- make efficient use of natural resources;
- ensure adequate management of chemicals;
- incorporate environmental costs; and
- reduce pollution and risks for humans and the environment.

UNEP DTIE activities focus on raising awareness, improving the transfer of information, building capacity, fostering technology cooperation, partnerships and transfer, improving understanding of environmental impacts of trade issues, promoting integration of environmental considerations into economic policies, and catalysing global chemical safety.

ABOUT THE CHILEAN COPPER COMMISSION

The mission of Cochilco is to elaborate, propose and implement policies that promote the permanent development of the mining sector, both public and private. Furthermore to enforce and monitor the accurate and timely compliance with laws, regulations and procedures as well as to safeguard the interests of the State in its enterprises, helping to formulate long term goals and evaluating their fulfilment to ensure that the objectives of the State-owned companies and the optimal use of State's resources are achieved.



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MRF

Mineral Resources Forum

Mineral Resources Forum - Environment is an Internet framework for international co-ordination on the theme of minerals, metals and sustainable development, promoting the exchange of knowledge, experience and expertise in the impact of mining, mineral processing and metals on the natural environment; the mitigation of environmental damage; and planning for mine closure and disposal of hazardous wastes.

www.mineralresourcesforum.org

