Module III

Social Aspects and Communities

PLANNING FOR CLOSURE & SUSTAINABILITY INDICATORS

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Can minerals development and metals production be undertaken without damaging the environment or undermining the socio-economic development opportunities of civil society; and, can the benefits of minerals and metals production and use be distributed amongst stakeholders equitably?

A key imperative is planning for closure from the outset and responsible closure implementation.

How can Sustainability Indicators help?

- Corporate Citizenship Unit/MERN research agenda - Planning for Closure and Sustainability Indicators
- Public Policy provides the framework but companies have the capacity, opportunity and responsibility to make the requisite changes in strategy to ensure responsible closure
- Research, community action and societal pressure can provide the impetus, arguments and tools to support business to make those changes to ensure responsible closure
- Sustainability Indicators can help to direct those changes, evaluate progress and communicate sustainable i.e. closure activities to stakeholders

Point of Entry

Sustainable Development - an intra-and inter-generational development process defined by sustained improvements in human health and well-being, quality of life and ecosystem health (8th MERN - TERI - INER Research Workshop 1998)

Corporate strategy - the prime-mover in ensuring minerals and metals production and use contributes to, and does not detract from, these constituents of sustainable development (MERN Research 1991-2000)

Corporate social responsibility (CSR) - key to operationalising the strategic role of mining and metals companies in sustainable development

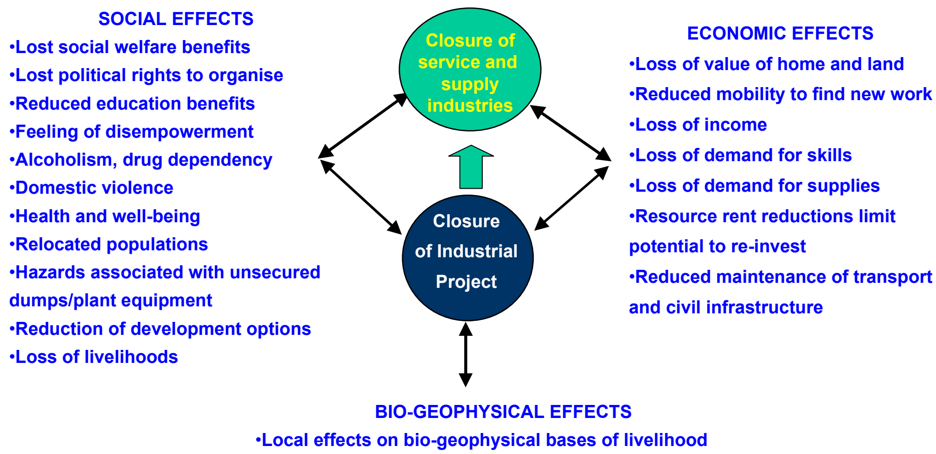
Implies responsible planning for closure strategy:

– Sustainability Indicators can help define and communicate progress

Sustainability Indicators: MERN - TERI - INER Research Challenge

- To develop indicators that are meaningful, credible and relevant to different stakeholders and that are sensitive to varying perceptions and values
- To design an indicator development methodology that suggests strategic options, that is also an internal learning process, and that evaluates and communicates progress towards sustainable development according to meaningful, credible and relevant milestones
- To contribute to knowledge about corporate strategy and performance, and impact on workers and local communities

Plant Closure Socio-Economic Effects



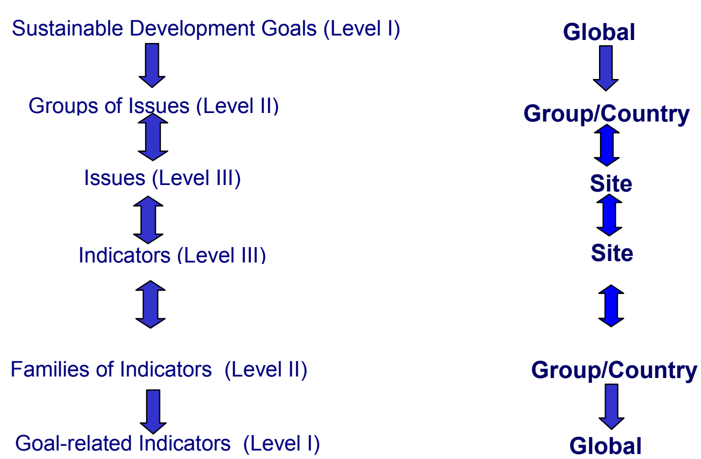
Key Advantages of Planning for Closure from the Outset

- Prevents Pollution
- Establishes effective environmental management strategy
- Facilitates ongoing social adjustment of local community and workforce
- Spreads costs and helps identify future benefits e.g. alternative economic land use
- Improves chances of generating increased well-being and sustainable development of mining regions throughout mine life-cycle and after closure

Sustainability Indicators and Planning for Closure

The following sets of indicators establish some of the issues that a pro-active closure strategy should address and relevant performance indicators.

Sustainability Indicators Framework



Global Sustainable Development Goals (Level I)

Social Sustainability

- Enhanced health, well-being and quality of life; social equity and human rights protection and promotion

Environmental Sustainability

- Environmental Protection and clean technology diffusion

Economic Sustainability

- Sustainable economic growth and enhanced intra- and inter-generational equity with respect to economic welfare

Level I, II and III Issues/Indicators

Goal (Level I)	Social Sustainability - Responsible Planning for Closure
Family/Group (Level II)	Social Legacy
Issue/Indicator (Level III)	Sustaining Local Community Development and Education Programmes
	Lasting Partnerships
	Participatory Monitoring System

Level I, II and III Issues/Indicators

Goal (Level I)	Environmental Sustainability -
	Responsible Planning for Closure
Family/Group (Level II)	Pollution Prevention/Containment
Issue/Indicator (Level III)	Mineral Recovery Process
	Tailings Disposal Process
	Monitoring Performance Plan
	Mitigation Plan
	Process & Storm Water Management System
	Waste Rock Management System

Level I, II and III Issues/Indicators

Goal (Level I)	Environmental Sustainability - Responsible Planning for Closure
Family/Group (Level II)	Reclamation / Rehabilitation
Issue/Indicator (Level III)	Quality of Baseline Data
	Quality of Impact Assessment
	Biodiversity Conservation
	Site Reclamation
	Revegetation

Level I, II and III Issues/Indicators

Goal (Level I)	Environmental Sustainability - Responsible Planning for Closure
Family/Group (Level II)	Stewardship and Post-Mining Land Use
Issue/Indicator (Level III)	Overall Restoration of Land Area
	New Habitats Created
	Post Mining Land-Use Benefits

Level I, II and III Issues/Indicators

Goal (Level I)	Economic Sustainability - Responsible Planning for Closure
Family/Group (Level II)	Economic Retrospect
Issue/Indicator (Level III)	Socio-Economic Benefits to Local Communities
	-Services
	-Supplies
	-Jobs
	-Economic Diversification

Level I, II and III Issues/Indicators

Goal (Level I)	Social Sustainability Responsible Planning for Closure
Family/Group (Level II)	Indigenous Peoples Ethic Integrity
Issue/Indicator (Level III)	Proper consultation (ILO 169)
	World Bank OD 4.20 applied
	Intercultural EIA/SIA/EMS
	Intercultural Compensation System
	Participatory / intercultural Monitoring System
	Training / Employment opportunities
	Culturally compatible development programs

MINE CLOSURE - THE 21ST CENTURY APPROACH

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1. INTRODUCTION

Mining is an economic activity that has been occurring for hundreds, and in some cases thousands of years, and mine closure is an aspect of mining where historic practices and evolving community expectations do not meet. Some closed mine sites do not meet the standards now expected by the community, governments and best industry practices. It is a topic whose relevance has emerged in the past decades due first to increasing awareness of public health and safety issues and, more recently to increased awareness of environmental contamination and environmental preservation.

Unlike other industrial operations where buildings are frequently torn down after their economic life is past and so are not reminders of past practices which would not be acceptible today, mine closure problems from the past are visible today. Mine closure is also an area of operations where institutional and legal frameworks have evolved significantly over the past decades in response to changing public, government and industry expectations. Mine closure is an area where blame for problems is easy. As well, it is an issue that brings industry practices, government policy and regulations with respect to environmental protection and community expectations together. Standards have and will continue to evolve, but this doesn't mean ever changing yardsticks.

What is mine closure? Essentially the objective is to leave a mine site in a condition which is safe and stable, limiting further environmental impact so that the mining tenements can be relinquished for alternative land use. Mine reclamation refers to the restoration of land affected by mining for further economic use. Mine closure and mine reclamation are not after-thoughts. They need to be planned from the beginning of an operation.

2. OVERVIEW OF INTERNATIONAL CONSIDERATIONS RELATED TO MINE CLOSURE

Mine closure has become a topic of broader discussion in the past 20-25 years during which time the institutional and legal frameworks that govern the practice of mine reclamation have evolved in response to changing expectations.

In 1987, the Brundtland Commission resulted *inter alia* in the well-known definition of sustainable development namely that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Brundtland report provided material for environmental groups, pressure from which has resulted in a more vocal public demanding that governments create stronger legislation to compel the mining industry to be more environmentally sensitive.

In June 1991, an International Round Table Conference on Mining and Environment was organized in Berlin. Although mine closure was not broadly discussed, the *Berlin Guidelines* provided an initial outline of "necessary environmental guidelines and strategies on mining with emphasis on developing countries". In many countries, environmental impact assessments, now required by law, are the vehicle under which companies are required to produce a closure plan in significant detail.

In 1992, United Nations Conference on Environment and Development (also know as the Rio Conference), produced Agenda 21, the programme for environmental management for the 21st Century. It emphasized the need for adoption of environmental guidelines for natural resources development. Since 1992, UNEP and other international agencies have been asked to provide environmental guidelines for the mineral sector. In 1997, DESA and UNEP compiled *Environmental Guidelines for Mining Operations* and these discussed approaches to implementation, monitoring, enforcement and participation.

In 1994 an International Conference on Development, Environment and Mining was co-sponsored by the World Bank, UNEP and the International Council for Metals and the Environment (ICME). The purpose was to share ideas, perspectives, information and solutions with respect to the challenges surrounding sustainable mineral development. Key conclusions, *inter alia*, were that:

Environmental regulations do not act as a disincentive to investment provided that the regulations are realistic, transparent and stable.

The objective of rehabilitation of mine sites should be to restore them to a self-sustaining ecosystem that is as close as practical to its original state prior to mining activity. There is a need for mechanisms that ensure the availability of funds to finance rehabilitation.

Principles of environmental management are being adopted by industry and these are seen as a vital part of efforts towards continuous improvement. The management systems being adopted depend on regulations and on corporate cultures. These systems are part of the industry's efforts to demonstrate that mining is compatible with environmental protection.

In 1998, UNEP produced *Case Studies on Tailings Management* in partnership with the ICME. UNEP also developed a training manual on *Mine Rehabilitation for Environment and Health Protection: A Training Manual* with the World Health Organization to introduce mine personnel to new skills as information and training are at the heart of any new approach.

3. Environmental Liability and Site Rehabilitation

Every phase of the mining sequence involves some degree of ground disturbance. The objective of site rehabilitation is protection of public health and safety and the return of the site and its surroundings to economic use and/or a sustainable ecosystem. In many dry countries, we can see the tracks and scars of exploration covering many square kilometres of land that will never be mined. Techniques can now be used to reduce the extent of disturbance, but some rehabilitation will always be needed.

During mining operations, much ground is exposed to the elements. Closure usually involves sealing underground mines and rehabilitating, regrading, stabilizing and revegetating open pit operations.

New operations try to minimise land disturbance, plan for soil and waste storage, undertake progressive revegetation and land management. In fact, experience has demonstrated that a well managed mine that follows strict environmental stewardship principles throughout its operations will be easier and less costly to reclaim. A key issue is where, when and how to dispose of mine spoil, tailings and other mine waste so that these operations are both safe and have a minimal environmental impact now and in the future.

Following closure, the site needs to be restored to some predetermined plan. Today, the more progressive mining companies start planning for closure before the first operations commence so that the costly need to re-handle material, reshape landforms and restore degraded environments at the last moment is minimised.

At many sites however, the damage has already been done, in which case rehabilitation in a post-project sense is required. These situations are invariably expensive, often with no clear view of where the funds will come from. Post-project rehabilitation needs to be intensely practical and cost-effective. In many cases the objective will be to make a site physically and chemically secure rather than planning for a productive after-use. Time may be one of the tools relied upon to do over many years what technology and intensive care could otherwise achieve in a few months at more active sites.

One issue, however, is that in many cases there are no final standards to which a site must be returned to and every mine and mine environment is unique. Increasingly, consultations need to occur between the company, the community and its stakeholders and the government as to what the final site plan should look like. Ultimate relinquishment of the mine site by the company is impossible unless closure standards are established.

The issue of legal and financial responsibility is at the heart of many rehabilitation projects. For new projects, legislation may set performance targets in terms of environmental impacts and long-term land-use, perhaps enforced through financial bonds or securities that guarantee the public purse against defaulting companies. The rehabilitation procedures may already be evaluated at the EIA stage and stipulated as obligations in the project permit.

Many companies now see their relationships with the public as being at least as important as regulatory compliance. Public acquiescence of mining as a future activity is strongly influenced by its vision of ecological performance at today's sites. The rehabilitation of sites which leaves a public asset in terms of farmland, recreation reserves or nature habitat has become an increasingly common policy of mining companies. Site rehabilitation in these cases goes beyond the mere physical stabilisation of slopes and pits and providing a vegetation cover at the least cost.

Health and safety has long been regarded as a workplace issue, with objectives being limited to physical safety and protection from exposure to toxics. While these are still important, additional concerns include public safety from structures during and after operation, the fate of hazardous materials and wastes which may have been buried at the site, and about public security of the land after closure.

Beyond the confines of the mine, mining wastes, if not properly contained, can potentially affect public health in both nearby communities and surrounding ecosystems. Mine wastes may include cyanide compounds, heavy metals, radionuclides and asbestos (though never all in one waste stream). These can become solubilised or carried as suspended particles in waters leaching from the waste sites. This leachate, together with drainage from the mine, is often highly acidic or saline, and may also carry a high sediment load. The common incidents of contamination, which could ultimately affect public health or well-being, are pollution of drinking water supplies, aquatic ecosystems including fishing grounds, agricultural soils and urban areas.

As environmental and safety issues continue to evolve, all aspects of mine management must be reviewed from time to time to see if they are still relevant. Old practices may no longer be acceptable, as in the use of certain chemicals or in the standards of disposal. New techniques become available in slope stabilisation, in revegetation and in monitoring. It is necessary for supervisors and managers to remain up-to-date with the latest techniques in order to constantly improve environmental performance. For this, a constant link with environmental and technical research and development as well as with the changing environmental priorities of governments is an absolute necessity for all managers.

4. The Legacy of Inappropriate/Insufficient Mine Closure – Abandoned Mines

One of the major outstanding environmental problems is that of abandoned mine sites, a legacy of centuries old practices, 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 as well as 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 need attention. There has been even less work on trying to quantify the nature of associated problems so as to priorize remediation efforts.

UNEP has begun to compile information associated with the few national or regional inventories that exist although these are mostly in developed countries. These surveys are still ad-hoc and based on internal data collection in only some agencies (eg. abandoned sites on national park lands).

This is an important environmental issue on which we hope to make progress over the next year. In the meantime, if Workshops such as this one on mine closure can contribute to the development and implementation of good closure plans and technologies, the number of future abandoned or orphaned mines will surely diminish over time.

5. Mine Rehabilitation for Environment and Health Protection - Training

Building capacity to implement new policies in government and industry has been a major activity for UNEP. The work includes making information available to a wide range of professions, preparing trainers manuals, stimulating the upgrading of training curricula in institutions, and holding training workshops. In 1998, UNEP produced a training manual on *Mine Rehabilitation for Environment and Health*

Protection. The manual is designed as an applied, hands-on guide to address the rehabilitation of disturbed land, particularly as it applies to mining lands. It is a practical, factual method whereby rehabilitation techiniques can be applied.

When the decision has been made to decommission and close down a mine, the site rehabilitation plan should be brought to its final stages. In many countries and for many companies, rehabilitation is an on-going process as part of their operations. Unless an alternate use has been agreed upon with the nearby community, all physical facilities such as buildings, conveyor belts, silos and chimney stacks should be removed and all logistics features such as roads and power lines should be appropriately rehabilitated. Also, closure monitoring needs to be established and continued into the next stage, namely the post-closure period.

Post closure is the period following the shut-down and rehabilitation of the mine. If all environmental impacts have been appropriately and acceptably addressed, there may be a situation where the owner can ``walk away`` from the site. Monitoring however, will be required over a specific period of time to ensure that all the remedial work that has been carried out is stable and secure and functioning. Given that mining companies have little interest in their closed mine sites, there may come a time when this post-closure monitoring becomes the responsibility of a third party with funding from some type of insurance bond.

Under other active care conditions, a site may have to undergo perpetual maintenance. This would be in addition to the post closure monitoring. Even under passive care conditions, continual or periodical inspections and monitoring should take place.

6. Financial Issues

As with all mining operations, there are real and significant financial considerations with respect to mine closure and site rehabilitation, especially given that closure and rehabilitation occur at a time when the operation is no longer financially profitable. This is one major reason why governments are increasingly requiring companies to provide guarantees for mine closure, sometimes referred to as reclamation funds prior to a mine opening. It is important that these funds be established in accordance with both best accounting practices and in accordance with the tax provisions in the mine's jurisdiction (in some jurisdictions, these funds are required by law).

There are a range of financial surety instruments ranging from irrevocable letters of credit, performance bonds, trust or reclamation funds, insurance policies or other guarantees. It is important that these funds become auditable items on a company's books so as to be reported on. It is recommended that these funds be established under law and receive monies from the earliest days of operations. Company closure plans should be updated regularly so as to be prepared in the event of the need for a mine to be put under care and maintenance or in the event of premature closure. Governments have a role in setting the policy and tax frameworks for these financial instruments.

7. Social Issues

Although often neglected, the social effects of mine closure are often as adverse as the environmental and economic effects. In many countries in recent years, mine closures have exceeded new mine openings resulting in a significant number of workers being displaced. This situation is expected to continue in many countries including South Africa, Canada and China over the next decade. With hundreds of thousands of workers displaced, consideration needs to be given to issues of income, skills training, worker mobility (although many workers do not want to move), physical, and mental well-being and alternative patterns of work. Mine closures represent a significant social and cultural upheaval as well as having financial implications for the country.

While there are no easy answers to these challenges, many companies are starting to discuss mine closure impacts with the community in advance of mine construction and operation. This is the case for the new copper zinc mine of Cia Minera Antamina (CMA) in Peru. Antimina, a consortium of Rio Algom, Noranda, Tech and Misubishi Corp has discussed with the community elders what they would like to see left in their community after the mine operators remove their equipment. Even now, certain mine facilities are being designed and built with community after use in mind.

8. Institutional and Legal Issues

While current policy and legislative frameworks vary widely around the world, it is increasingly important that countries formulate clear, stable and predictable policies for industry to follow. These policies can evolve but should not fluctuate nor be unequally applied. It is equally important to recognize that each mine is unique, that some flexibility will be required as the mine operates and that artisinal, hardrock and coal mines and aggregate operations are different.

9. Future Issues

While it is clear that current best practices and regulations in many countries require mine closure plans, the challenge remains as to how to ensure that some companies don't cut corners in an effort to remain competitive. Further, what is the best way to ensure that small and medium sized companies, of which there are many more, also commit themselves to environmental stewardship and best practices. Globally, government environmental policies vary greatly and, it is important to recognize the contribution mining makes to national economies.

Abandoned mines present more legal and financial challenges than technical ones. The threat of future liability imposed on third parties that attempt to clean-up sites is a deterrent to progress. Under the laws of several countries, liability for toxic pollutants is retroactive with no statute of limitations meaning that present owners are responsible for the property in perpetuity even if they were not involved in the original mine. Work is underway in some countries to address this problem through "good Samaritan" clauses or other similar mechanisms.

There are several outstanding financial policy issues including: how can mine closure and reclamation funds be integrated into artisinal, small and medium sized operations? How can financial surety options be realistic, flexible and sufficient to address mine rehabilitation yet not so burdensome as to push companies into bankruptcy or deter them from commencing operations? What are the options to meet the financial burden of reclaiming abandoned mine sites, many from more than one hundred years ago?

The social challenges are also very real. Just as environmental impact assessments became the tool for measuring a mine's environmental impact, social impact assessments may become the tool to address social impacts. Perhaps these two mechanisms may become juxtaposed into socio-environmental impact assessments which *de facto* occurred recently in Canada with the proposed Voisey's Bay project.

10. CONCLUSIONS

It is possible that mining in the 21st century could become a model of an economically viable, environmentally sensitive, socially responsible industrial sector producing sustainable and decentralized benefits to foster other activities and increased capacities in the communities which will endure long after a particular mining operation closes.

In order for this to occur, a true partnership needs to emerge in association with each individual mining operation. Industry is challenged to assume greater environmental stewardship and communicate with nearby communities in all aspects of their operations. As the mining industry is often judged by its weakest member, good companies are urged to pressure those which give the industry a bad name to improve their environmental and social performance. National governments need to articulate clear policies and rules for environmental impact assessments including mine closure and site rehabilitation.

And what is UNEP's role? We are working with mining schools trying to ensure that the broad range of environmental issues are incorporated into the different subject curricula. We are currently improving access to environmental information primarily through the environment portion of the joint UNCTAD-UNEP website (www.natural-resources.org/environment). We are partnering with the Coalition for Environmentally Responsible Economics (CERES) in the Global Reporting Initiative which represents

The first global framework for corporate sustainability reporting encompassing environmental, social and economic issues – the *triple bottom line*. Should we consider insisting that companies must always report on closure planning and actual closure in their environmental report?

UNEP's mission is to provide leadership and encourage partnerships with the private sector and help decision makers in government and local authorities and industry develop and adopt policies and practices that are cleaner and safer, make efficient use of natural resources, incorporate environmental costs and reduce pollution and risks for humans and the environment. We try to stimulate policy debates like this one on mine closure as this is a critical environmental and social component of mining operations and remains a challenge for us all.

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CORPORATE SOCIAL RESPONSIBILITY AND THE CASE OF SUMMITVILLE MINE

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ABSTRACT

A growing literature is developing parallel to increasing "voice of society" concerns about corporate social and environmental responsibility. Emerging research suggests that, while public policy might provide the framework for the internalisation of previous external environmental damage costs, it is corporate strategy that can make the difference between environmental disaster and pollution prevention, and responsible business practice is defined by its anticipative and pro-active approach to ensuring that pollution is prevented and mine closure us accompanied by clean-up and reclamation. The Summitville gold mine, an abandoned open pit and underground operation in Colorado is often described as an 'environmental disaster' and the most notorious example of inadequate design, poor operation and failed environmental management at a mining operation in the US, past or present. Now a Superfund site, and the subject of numerous legal suits and counter-suits, its unplanned and sudden closure and abandonment in December 1992 has had profound implications for environmental protection, the costs and benefits of remedial treatment, technology issues and the regulatory process in both the USA and globally.

Of great import are the factors that influenced the development of events at Summitville, and these are discussed in two broad areas: corporate strategy during the development and operation of the site; and, the regulatory framework within which the mine was permitted, operated and abandoned. Finally, the implications of the abandonment of Summitville mine for the wider mining industry, regulatory authorities and the policy literature in this field, are discussed.

Keywords: Corporate social responsibility; Mine closure; Superfund; Environmental management; Acid rock drainage.

CORPORATE SOCIAL RESPONSIBILITY

While in financial terms, the designation as a 'disaster' is probably true, with in excess of $150 million so far being spent from public monies on remedial work at the site since its abandonment, it is less clear as to whether the site is a 'disaster' in terms of impacts on the physical environment and potential risks to human health. It is not the purpose of this paper to merely review the wealth of technical, regulatory and legal literature that relates to Summitville. Instead, it analyses the chain of events that culminated in the abandonment of the site in 1992 and post-abandonment remedial work by the US Environmental Protection Agency (USEPA); and draws out the implications for corporate strategy. This is undertaken within the context of growing demands from society for the mining industry to be more socially and environmentally responsible for its long-term indirect as well as direct effects.

The development of the concept of corporate social responsibility has fast expanded since the days when it was considered that: "… the social responsibility of business is to increase profits…" (Friedman, 1970). For example, Andrews (1988) argued: "… corporate strategy …is the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organisation it is or intends to be, and the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, customers and communities…". And, more recently, Drucker (1993) stated "….[corporate] citizenship means active commitment. It means responsibility. It means making a difference in one's community, one's society, and one's country…..".

Corporate social responsibility is defined here as the internalisation by the company of the social and environmental effects of its operations through pro-active pollution prevention and social impact assessment so that harm is anticipated and avoided and benefits are optimised (Warhurst, 2000a). The concept is about companies seizing opportunities and targeting capabilities that they have built up for competitive advantage to contribute to sustainable development goals in ways that go beyond traditional responsibilities to Shareholders, employees and the law.

The drivers of these changes include (Warhurst, 1998):

- Globalisation, liberalisation and increased foreign direct investment world-wide
- Societal pressures, which are increasingly expressed as demands to address quality of life impacts, consultation, accountability and disclosure, and are sometimes pushed by special interest groups (e.g. NGOs)
- Regulation, which is increasingly becoming more integrated across the three environmental media of land, water and air and covers impact assessment and planning for closure
- Financial drivers, that is environmental and social conditionality applied to the granting of credit, equity investment or political and environmental risk insurance
- Supply chain pressure, which includes purchaser's growing requirements for audited and verified environmental and, more recently, social proficiency
- Peer pressures from other companies and reputational management
- Internal pressures from employees and shareholders; and finally
- The natural dynamic of environmental change itself, such as climate change and rising sea levels.

It is in the context of the evolution of these drivers for enhanced corporate social responsibility that the Summitville mine operation was developed, operated and closed which, in part, accounts for the world-wide critical appraisal that accompanied its acquisition of "superfund" status.

As mining has continued along the path of mechanisation and automation, the direct links *via* employment and financial benefits for local communities have diminished, reducing the acceptability of mining in the eyes of local stakeholders and posing new challenges to companies in terms of preventing pollution affecting local communities' livelihoods and health and finding new ways to deliver benefits in the form of social development or community projects[1]. In a more general sense, the image of the industry has become increasingly battered since the rise of general environmental awareness in the 1970s and 1980s, with each new environmental incident adding a further dent. This has left the industry prey to small but vociferous pressure groups, which are able to command the environmental and ethical high ground, and as public opinion continues to swing against the industry, so this is increasingly reflected in regional and central governments' attitude towards the sector as a whole, particularly as the role of mining in generating GDP declines. This has become apparent in the past 3-4 years in the US, with the federal government taking an increasingly confrontational attitude towards the industry despite the major bridge building that has occurred between environmental regulatory agencies and the industry during that same time. Summitville mine is an operation that is often quoted by pressure groups to represent much that needs to be addressed by today's mining industry. However, the real situation is more complex than any such simplistic assessment, and involves broader elements of corporate strategy and regulatory control that must also be considered. This paper seeks to contribute to that process through:

- Reviewing of the events leading up to and taking place during the operation and post-abandonment at Summitville and their environmental consequences
- Suggesting some implications for corporate management and strategy
- Drawing some conclusions of relevance to the emerging field of corporate social responsibility.

OVERVIEW OF EVENTS – FROM PERMITTING TO ABANDONMENT (1982-1992)

Summitville mine is located in Rio Grande County, Colorado (USA) at an average elevation of 11,500 feet. Surrounded by the Rio Grande National Forest, the site is bounded to the north by the Wightman Fork of the Alamosa River and to the east by Cropsy Creek. Cropsy Creek meets Wightman Fork near the north eastern perimeter of the site. This also represents the downstream boundary of the site (Pendleton *et al*., 1995). Wightman Fork enters the Alamosa River approximately four and a half miles downstream of the confluence with Cropsy Creek. Annual precipitation at the site (1,400 mm, mainly as snow) significantly exceeds water lost through evaporation (610 mm per annum).

Before 1870, when mining for gold began, the site consisted of uplands, wetlands and South Mountain. Since that time, mining has radically altered the local topography and biophysical environment. Although placer mining took place on Cropsy Creek and Wightman Fork from 1870 to 1873, it was extensive underground mining of the north-eastern flank of South Mountain between 1873 and 1940 that had a far greater disruptive impact due to the creation of access roads and waste disposal sites. In the late 1960s, Wightman Fork was also diverted to the north of the site to enable

[1] Natural Resources Cluster of the World Bank: Business Partners for Development Papers produced by Mining & Energy Research Network, Corporate Citizenship Unit, Warwick Business School, UK: Carter, 2000; Carter & Kapelus, 2000; Molloy, 2000; Warhurst, 2000b, Warhurst 2000c.

the construction of a large tailings pond. Consequently, by the 1980s, when the chain of events that lead to the eventual abandonment of the site and its classification as a Superfund site, there already existed a considerable legacy of land and water contamination over and above that resulting from the occurrence of natural mineralisation in the region (as detailed by Posey et al. (2000), natural mineralisation upstream of Summitville has an impact on water quality of the Alamosa River downstream of the site).

The principal owners of the surface and mineral estates of the area that encompassed the Summitville mine at the time of the events described in this paper were Aztec Minerals Corporation, Gray Eagle Mining and South Mountain Minerals Corporation. In 1984 the owners leased the property on which Summitville mine is located to Galactic Resources Inc. (GRI), and its wholly owned subsidiary Summitville Consolidated Mining Company Inc. (SCMCI), which designed, built and operated the final mine facility.

Operational design and environmental management in the context of declining gold prices.

Groundwater at the site occurs in a number of discontinuous and shallow perched aquifers. Some of these shallow systems discharge waters to the surface on a seasonal basis. Bedrock throughout the site is highly fractured and numerous springs and seeps occur, linked to the annual precipitation cycle (Pendleton et al., 1995). Rainstorm-related seeps also arise, particularly during the month of August. Therefore, it is clear that water management was always going to be a serious issue at the site.

In terms of setting the environmental baseline, SCMCI were required to create no incremental impacts in addition to those already in existence. They met the permitting requirements set at the time, and were not required to clean up prior mining impacts. The baseline conditions were assessed at the site and submitted to the Colorado Mined Land Reclamation Board (CMLRB) and were accepted as being adequate as judged against the standards across the state operating at the time of the submission. From the outset, the decision not to address past pollution suggests that a potential future problem was being built into the project and; from a corporate social responsibility perspective, we can note a regulatory framework that did not require past pollution to be addressed that could be interpreted as storing up problems for the future.

Beginning in 1984, SCMCI, the designer and operator of the final mining operation at the site, excavated waste rock and ore to create an open pit on the northeastern flank of South Mountain. The excavated material was either dumped in waste piles along with fines (undersize material) or placed on heap leach pads prior to the recovery of gold. Waste rock was also used extensively in the construction of roads, embankments and parking areas on the site (Pendleton et al., 1995).

Initially, there were plans to process separately the two types of ore found in the deposit: clay ore and vuggy silica ore. Indeed, a separate crusher and conveyor system was installed for each ore type. However, plans to agglomerate and leach the clay ore never came to fruition, and the ore remained stockpiled with the dedicated crusher and conveyor almost unused (Pendleton et al., 1995). One explanation for the latter was the high cost of the process in the context of the decline in gold price from nearly US$800 in 1982 to half that amount by the time operations began in 1986. The decline in gold price also exerted pressure on the operator to begin production as quickly as possible, without a fully detailed plan. Further problems arose as SCMCI changed consultants during the construction process, compounding continuity and management problems.

Although the abandonment itself was sudden, with the benefit of hindsight, there were indications of trouble ahead before the dramatic fall in gold price. For almost one and a half years before the abandonment, GRI and SCMCI had been subject to State agency mandates, requiring them to evaluate contaminants being released from the site. They were also required to develop remedial measures with the aim of eventual site reclamation (Pendleton et al., 1995).

In the period prior to the abandonment, other state and federal agencies were also involved in the monitoring of the mine site and the surrounding areas. Environmental and operational management issues identified at the site included:

- The permit was issued and construction commenced before a number of critical issues were fully resolved, on condition that they would be resolved later on. In a very real sense, planning never caught up with what was happening on the site. This particularly relates to closure planning.

- Difficulties in maintaining the integrity of the liner system under the heap leach pad, following its construction during the winter. Concerns regarding bank financing of the operation and the fear of reducing the potential profitability of stock options made to senior staff appear to have generated significant pressure on contractors to remain on schedule with the liner construction despite extreme weather conditions (Wilkinson, 1997). Deadlines that related to bank loan commitments also appear to have been a contributing factor (Danielson, *pers. comm*). Moreover, a number of changes were also made to the design of the liner system that were neither submitted to the state regulators for approval nor properly considered prior to implementation (Danielson *et al*., 1994).

- Leaks were detected between the upper and lower liners, and through the lower liner within a week of beginning heap leach operations in June 1986. This leaked effluent was subsequently pumped back onto the heap leach, further aggravating the overall water imbalance (1,400mm per annum precipitation against 610mm per annum evaporation) at a site where the leach portion of the project was initially envisaged as being zero discharge (Colorado Court of Appeals, 1996) through water entrainment in the leach material, enhanced evaporation and “aggressive” surface water management.

- Failure to stop construction and repair the liner when significant leakage became obvious also contributed to the unfolding environmental impacts and liabilities.

In 1989, SCMCI obtained approval for a process water treatment plant. However, this plant was unable to meet the water treatment standards required, and SCMCI then sought and obtained permission to allow for land application of the treated process water. This application was to be undertaken at a controlled rate to allow evaporation and percolation into the ground and attenuation of the contaminants. However, the company obtained approval for a land application system as an interim response without making it clear that it did not own all the land that it wished to use for the application. When the company failed to obtain permission to use the neighbouring land, it increased the rate of application on the land that it did own, contributing to overload flows to Wightman Fork and Cropsy Creek (Colorado Court of Appeals, 1996). It is worth noting that many of the clean-up standards were considered futile at the time by SCMCI due to the existing contamination from historical mining activity and natural mineralisation.

Each of these issues reflects significant failures in planning, and operational and environmental management in the face of increasing financial pressure to enter and continue the production phase in the context of declining gold prices.

Site abandonment and crisis management

The day before SCMCI petitioned for bankruptcy, the company submitted a revised reclamation plan to the Colorado Division of Minerals and Geology (CDMG) and the Colorado Mined Land Reclamation Board (CMLRB) that included additional costs ranging between $20.6 and $38.6 million. Had this plan been accepted, the company would then have been required to provide additional funds in the form of a bond amounting to the projected costs of reclamation (Pendleton et al., 1995). In the aftermath of the abandonment, some of the remedial measures presented in the plan were actually implemented by the USEPA (Miller *et al*., 1995) (see below).

On 1 December 1992, GRI alerted authorities of the State of Colorado that they intended to declare bankruptcy and abandon operation of the site on 16 December, 1992 (Pendleton et al., 1995). At this time the fluid level in the cyanide heap leach pad was five feet below the emergency spillway (giving a storage capacity, assuming normal precipitation, of 2-3 months) and contained an estimated 160 million gallons of cyanide and metal-bearing waters. It was also anticipated that any failure in pumping capacity from the heap leach underdrain would result in the direct discharge of acidic cyanide-bearing effluent into Cropsy Creek and subsequently Wightman Fork, a tributary of the Alamosa River, (Pendleton et al., 1995). These two immediate threats apparently could not be dealt with at State level and a request was made for emergency response assistance from Region VIII of the USEPA on 4 December 1992, under the Emergency Response Fund of the Superfund. USEPA personnel and contractors, working with SCMCI staff ensured that the necessary water circulation and treatment were continued to remove the immediate threat of direct effluent discharge (Pendleton et al., 1995).

Bonding as a mechanism to assure environmental responsibility

In retrospect, reclamation bonds at the site could be deemed to have been inadequate. Indeed the initial bond was set in 1984 before the Superfund system was sufficiently understood by the mining community and before Colorado had an effective mine permitting structure. The mining permit issued in 1984 required a reclamation bond of $1.3 million This applied to the grading, shaping and capping of surface wastes, but did not include a component for heap detoxification, water treatment or remediation. An additional surety of $0.9 million posted in August 1989 covered a "one-time" rinse of the heap, but this still did not include water treatment costs. An additional bond of $5 million was posted on June 21, 1992 following the realisation that major revisions would be required to the reclamation plan. By the autumn of 1992, with site grading completed, and the commencement of water treatment, the company requested and obtained the release of $2.5 million. On site abandonment, therefore, the surety bond was approximately $4.7 million (Filas and Gormley, 1997). However, this was effectively to guarantee performance of a predefined reclamation plan, rather than to address potential "disasters" or sudden site abandonment. Additionally, much of the bond was effectively worthless as it was in the form of equipment (such as the water treatment plant) which could not be removed from the site. Also, the non-payment of taxes led to tax liens senior to the reclamation lien.

Long-term environmental issues

In terms of pollution issues, the post-closure environmental concerns largely mirrored the concerns that were extant prior to abandonment (e.g. water contamination by cyanide and heavy metals); rather it was the scale of potential impact that changed following abandonment by SCMCI. The environmental issues of concern are summarised below:

Acid Rock Drainage

Surface drainage from the site ultimately reported to Terrace Reservoir, approximately 17 miles downstream of the confluence of the Wightman Fork and Alamosa River. From there it continued to the San Luis Valley where homes, farms and ranches depended on wells or river water for potable drinking and agricultural water supplies (Pendleton et al., 1995). As such, the movement of contaminants into surface and ground waters was the principal concern. Prior to mining, shallow water flow was controlled by non-mineralised faults in the rock mass and the permeable vuggy silica zone (Plumlee *et al*., 1995b). Sub-surface workings then became the major controlling factor via the creation of drainage adits. These were in turn modified by the creation of the open pit, which aided the transfer of water into the sulfide-rich mine workings below (Plumlee et al., 1995b).[2]

Although it was the potential release of cyanide that catalysed the mobilisation of state and federal staff and the involvement of the USEPA at the site, it was the generation of acid rock drainage (ARD) that represented the most significant of the long-term environmental risks. ARD at Summitville is among the most acidic and metal-contaminated in Colorado (Plumlee et al., 1995a) and has been an issue for many decades. The situation was aggravated by water-soluble secondary salts (e.g. iron and copper sulphates) formed by the evaporation of metal-contaminated acid waters during dry periods in summer and autumn. These salts subsequently re-dissolved in rainwater and snowmelt to form highly acidic, metal-rich waters. Therefore, the major long-term challenge was ultimately to prevent the oxidation of sulphides and dissolution of secondary metal salts, particularly from the numerous waste piles situated on the site (Plumlee et al., 1995a).

Waste rock piles

The initial assumption that since the ore body was in the oxidised zone associated wastes would not generate acid, was proved to be incorrect. Substantial quantities of sulphide minerals were present in the oxidised zone as pockets, and these were removed along with the gold-rich oxide mineral assemblage. Failure to properly identify potential acid-generating material inhibited the implementation of

[2] Part of the remedial plan submitted the day prior to notice of abandonment was to assess the possibility of reconfiguring the pit to increase surface run-off, and reduce infiltration to ground water (Miller et al., 1995).

pollution prevention from the outset and also had severe detrimental impacts on the capacity of the waste management plan to deliver an appropriate level of environmental protection. As gold present in sulphide minerals was not amenable to cyanidation, SCMCI limited the amount of sulphide-rich material reporting to the leach pads, instead dumping it on waste piles. These extensive sulphide-rich waste piles became a major source of ARD, exacerbated by poor and haphazard waste management practice. For example, at least one of the waste piles was dumped on a spring-fed bog, which increased the volume of ARD generated and the release of metals into solution (Pendleton et al., 1995).

Waters from the waste piles and adits ranged in pH from 2.3 to 3.2 and contained extremely high concentrations of metals and other elements. In general, the waters from the waste piles were of lower pH and higher metal concentrations than the discharges from the adits (Plumlee et al., 1995a).

Reynolds Adit

Although there are other adits on the site, Reynolds Adit was the most significant as it was the lowest of the historic underground workings (Roeber *et al.*, 1995) (approximately 200 feet lower than Chandler Adit, and 550 feet lower than Iowa Adit). Reynolds Adit was used to lower the water table at the Summitville site and thus reduce the costs of pumping. Flow-rates varied between 380 $l\ min^{-1}$ up to an average peak of 1,500 $l\ min^{-1}$ during the spring when snowmelt was occurring (Pendleton et al., 1995).[3] As it drained the mineralised zone of South Mountain, dissolved metals in the discharge from the adit were relatively high. Prior to 1988, copper was present at 20-30 $mg\ l^{-1}$. However, it appears that the excavation of the open pit (the floor of which was about 300 feet above the adit) promoted infiltration of water and oxidation of the ore, and in 1989 the concentration of dissolved copper began to rise, reaching approximately 130 $mg\ l^{-1}$ by 1992. In June 1993, copper reached its highest documented concentration of 650 $mg\ l^{-1}$. Work by Plumlee et al. (1995a) indicated that iron, aluminium, zinc and arsenic showed a similar increasing trend in concentration. The quantity of metal discharged from Reynolds Adit was equal to that discharged from the remainder of site, including the waste piles.[4]

REMEDIAL ACTION AT SUMMITVILLE: RETROSPECTIVE RESPONSIBILITY

Cropsy Waste Pile, Cleveland Cliffs Tailings Pond, the Beaver Mud Dump, the open pits and the underground workings were identified as the major sources of ARD on the site (Ketellapper *et al.*, 1995). These were the priorities for a three phase programme[5] of remediation which was chosen on the basis of cost effectiveness and potential efficacy from five alternatives (Ketellapper et al., 1995; Ketellapper and Christiansen, 1998).

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[3] Although undocumented flows up to 6,000 $l\ min^{-1}$ have been reported.
[4] The amount of copper released from the entire mine site was up to 4.1 $t\ day^{-1}$, approximately half of which was discharged from Reynolds Adit prior to its plugging in 1994.
[5] Each phase of the remedial plan had a voluntary contribution of 10% from the State of Colorado (Williams, 1995). Phase III also involves a potential nine year period of flushing of contaminants from the areas beneath the sites of Cropsy Waste Pile, Cleveland Cliffs and Beaver Mud Dump prior to their removal to the open pits (Williams, 1995).

Waste backfilling

The three phases were designed in order to remove acid generating rock from saturated areas, to backfill the open pits and also reduce infiltration into the underground mine workings (Ketellapper and Christiansen, 1998).

- Phase I and Phase II consisted of the lining of the north and south open pits with a clay liner and two feet of lime and subsequent removal of the majority of Beaver Mud Dump, Cropsy Waste Pile and Cleveland Cliffs Tailings Pond to the lined pits. Approximately 3.6 million m^3 of acid generating waste were relocated to the pits during the period 1993-1996.
- Phase III included capping and vegetation of the infilled south pit in 1995 and revegetation of the sites from which waste had been removed (Ketellapper et al., 1995). The north pit backfilling is continuing (Ketellapper and Christiansen, 1998) and eventually it is planned that this will also be capped.

Active treatment of ARD from Reynolds Adit in the form of a portable interim treatment system (PITS) using caustic soda solution as the precipitating agent, was installed in July 1992 (Logsdon and Mudder, 1995; Roeber et al., 1995). The coagulated and flocculated sludge was disposed of on the heap leach pad. This was subsequently backfilled to the open pits.

In 1995, the area around the tailings pond was excavated and re-designed as the Summitville Dam, which was to serve as a catchment area for the majority of flows generated on the site and to facilitate water treatment through a single central facility (Ketellapper and Christiansen, 1998). At present, the Dam has a capacity of 3.4×10^8 L and the treatment facility a capacity of 3,400 L min^{-1}.

Adit plugging

In January 1994, Reynolds Adit was plugged in order to reduce the discharge and re-establish pre-adit hydrologic conditions (Plumlee et al., 1995b). Some discharge continues from the adit due to fractures in the rock around the plug (Plumlee et al., 1995b). Plugging was suggested in the remedial plan lodged by SCMCI the day before abandonment as a means of saturating the workings and controlling the ingress of oxygen (and oxidation of sulphides) (Brown, 1995). The assumption that saturation will control sulphide oxidation is not necessarily correct due to the presence of ferric iron (a strong oxidant) in secondary salts. However, plugging is also expected to promote the movement of water through the rock mass, increasing the opportunities for attenuation.[6]

The full effects of plugging and pit capping have yet to be determined in terms of source reduction of acid, metal-laden waters. However, it is assumed that if land reclamation and revegetation on site is successful, that water treatment may no longer be a continuous necessity as preventative measures improve water quality (Ketellapper and Christiansen, 1998) due to the reduced infiltration of water and the

[6] Based on batch tests, the attenuative capacity of the rock mass (assumed to act as a porous body) for copper was calculated as at least 123,000 t and for zinc at 11,000 t. This capacity could theoretically hold all the copper present in the ore body above the elevation of Wightman Fork and 25% of the total zinc present in the same portion of the ore body (Brown, 1995).

return of the sub-surface environment to its pre-mining anoxic state.[7] This preventative approach is potentially important when it is considered that to date nearly 55% of the project costs (approximately $65 million) have been spent on water treatment (Ketellapper and Christiansen, 1998). By way of comparison, adit plugging has accounted for approximately 1% of the total project cost, yet may well have contributed significantly to source reduction in the short-term.

However, capping and flooding of the workings above the Reynolds Adit will not completely stop water flow into the pit area as cavity-bearing silica outcrops and faults outside the backfilled and capped area may allow groundwater recharge of the area beneath the cap (Plumlee et al., 1995b). Therefore, any cavity-bearing or faulted areas may also have to be isolated or capped.

Equally, adit management through the use of plugs may only reduce the metal loading in the short-term, depending on the future movements of subsurface water and their expression at the surface via seeps, springs and streams. Water may also exit through adits at higher elevations as the head of water builds. Redirecting water from one route (e.g. by adit plugging) may lead to greater metal loading if that water is forced through more highly mineralised wastes or in-situ workings. At Summitville this occurred when seeps reappeared on the north side of the site (due to the plugging of adits) and water passed through the North Waste Dump (waste rock pile).

Seeps and springs

Prior to backfilling of the wastes to the open pits, seeps and springs drained the various waste dumps (with at least one waste dump positioned on a spring-fed bog). Historic (pre-mining) seeps and springs are marked by deposits of ferricrete (precipitates of iron oxide/hydroxide minerals that occur as iron-rich acidic groundwater flowed to the surface) (Plumlee et al., 1995b). These gave some indication of the possible discharge points that might re-activate when Reynolds Adit was plugged (in 1994). Since the plugging of the adit, seeps east and north of the open pit have either started or increased in flow rate (Plumlee et al., 1995b), typically at sites of historic flow. In particular, seeps bearing increased metal loads appear to be the result of water passing though the North Pit Waste Dump

The removal of the priority waste dumps to the open pits was considered likely to reduce the significance of new seeps and springs. However, with the plugging of Reynolds and Chandler Adits, the historic seeps and springs along the northern site boundary are considered likely to be of greater significance as groundwater flow returns to its pre-mining pathways. These discharges, however, need to be viewed in the context of other natural sources of acidity and dissolved metals in the Alamosa River basin (Plumlee et al., 1995a) et al et al et al

ANALYSIS: CORPORATE STRATEGY AND ENVIRONMENTAL IMPLICATIONS

The legacy that SCMCI inherited was, in retrospect, a considerable one - with Summitville a site that had been subjected to massive and continuous surface disturbance, accompanied by fundamental changes to ground and surface water flow paths. There existed little historic documentation of the nature of wastes disposed of

[7] Equally important of course are any changes in the acceptable concentration of metals in waters discharged from the site.

around the site. Undoubtedly, changes in operational responsibility since the site was first worked in 1872 were an important factor in determining the final environmental impact of the site, as contaminating wastes were deposited or discharged and responsibility for them was “lost” by subsequent owners and leasing companies.

From the perspective of SCMCI and GRI, inheritance of a legacy of on- and off-site environmental problems could have been mitigated in part by a proactive and thorough baseline survey of existing conditions from the outset of their involvement. More importantly, the leasing of the site itself might have been reconsidered had GRI considered environmental liabilities previously identified in a mine feasibility study undertaken by Anaconda in 1983 (Anaconda, 1983). This had contributed to Anaconda's assessment that the mine development was not economically viable. The issue of environmental liabilities appears to have been ignored by GRI.

Irrespective of the fact that it inherited a significantly contaminated and disturbed site, SCMCI failed to address the issue of social responsibility and its environmental implications. It had in its power the capacity to predict potential ARD generation from waste piles (through, for example, the application of static and kinetic leach tests). It also had the opportunity to take the necessary steps to avoid acid generation by implementing various waste management control options (e.g. isolation of sulphidic material and minimisation of the exposure of sulphide-rich altered clay zones in the open pit). Evidence suggests it followed neither of these routes.

Furthermore, SCMCI did not appear particularly adept at meeting the requirements of day-to-day operation and rehabilitation on-site. Although permits require reclamation on closure, no studies are required to prove that the company involved can actually achieve the proposed reclamation targets (Williams, 1995). This gap between apparent capacity and reality seems to have been a significant factor for SCMCI. Radical changes were made to Colorado’s mine permitting laws as a result of this (see Danielson and Nixon, 1999 for further details relating to changes in permitting and bonding in Colorado).

There has been a considerable debate as to whether Summitville is sufficiently different from other mine sites to justify the higher level of expenditure that has occurred, as summarised in Table 1, and if the risks to human or wider ecosystem health were as large or significant as originally anticipated. According to Williams (1995), Summitville is far from unique in terms of type and location. Neither is it the only mine being addressed under the USEPA’s Superfund programme. However, it is the first of the modern heap leaching gold mines to be addressed in this way, and it is also the sole mine on the Superfund list for which the associated watershed has not been irretrievably degraded by historic mining activity. Notwithstanding, it should be noted that other factors such as local geochemical conditions, construction of logging roads, accelerated erosion and tourism have also been quoted as significantly degrading the quality of the river (Mendonca, in NAM, 1997).

Table 1. Costs of remedial action at Summitville mine (data from Ketellapper and Christiansen, 1998)

ACTIVITY	COST	COMMENTS
Water treatment	US$65 million (to end of 1997)	Includes treatment of cyanide bearing water from the heap leach pad and ARD
Source removal and pit capping	US$32 million (to end of 1997)	Does not include cost of capping the north open pit
Adit plugging	US$1.7 million	Total cost – plugging programme completed
Recontouring and reclamation	US$45 million (estimated)	Cost of recontouring and capping the heap leach pad was US$15 million. Estimated cost to complete site reclamation is US$30 million

Therefore, relative to other mining-related Superfund sites, the Summitville Mine is a potential long term economic “sink” as more money is poured in to prevent deterioration of water quality in the Alamosa River basin.

Some researchers have questioned whether the total estimated investment of $150 million in remediation will ultimately prove worthwhile given the other non-mining related pressures on water quality in the region (Mendonca, in NAM, 1997). This seems to be borne out in part by the recent work of Posey *et al*. (2000) that defines the significant contribution to water quality deterioration of natural acid drainage formation (*i.e.* that which is not anthropogenic in origin) and earlier work by Bove *et al*. (1995) indicating that acid generation in the Alamosa River basin predated mining activity by millions of years based on the local and regional geology. Other researchers have stated that considerably less investment was required to achieve an acceptable level of remediation. This last point may have some justification, given that the purpose of Superfund clean-ups is to reduce or eliminate risk to human or ecosystem health, not to return a site to its pre-industrial condition (Wilkinson, 1997). Notwithstanding any of these points, the Superfund programme cannot have clean-up goals at Summitville beyond pre-mining water quality conditions.

The events leading up to the incidents at Summitville are generally well understood (although as with any human endeavour, the written word can only paint a rough picture of cause-and-effect relationships). It is accurate to say that none of the different actors were entirely blameless and that none were entirely to blame, and that the permitting and regulatory frameworks shaped events as much as the mismanagement at the corporate strategy level that occurred during site development and operation. The regulatory framework as it existed at the time could be considered in part a catalyst for the events that followed – leeway and loopholes combined with a lack of a strategy of corporate social responsibility will often lead to unforeseen and undesirable effects. However, the design, implementation and enforcement of regulations are complex procedures, and as with many human activities, can be undermined by human fallibility. Regulatory frameworks must evolve, as must the industry, to incorporate lessons from past shortfalls in compliance and performance. In Colorado at least there are clear signs that the regulatory framework has adapted to ensure a greater degree of regulatory control over all stages in the mining process – from permitting through to eventual closure.

SCMCI has been the subject of a great deal of 'retrospective criticism' (based, in part, on applying 1990s standards to a 1980s operation) as a result of its corporate strategy and inability or unwillingness to remain with the confines of the regulatory framework. Although regulation (in the form of the Colorado Mined Land Reclamation Act of 1976) was limited in its scope and relatively lenient, SCMCI was deemed to have violated a number of key provisions under the Act, for example, partially or completely changing or omitting design features outlined in its permit application without consulting either the CDMG or CMLRB (Danielson et al, 1994). Indeed, on 2 May 1996, SCMCI pleaded guilty to 40 felony violations of federal environmental laws at the Summitville site, and was fined $20 million. SCMCI entered guilty pleas to charges of conspiracy, unauthorised discharge of pollutants, failure to make required reports and making false statements or documents. The company was indicted in June 1995 along with the mine's environmental manager Tom Chisholm. Additional charges were filed against the mine, Chisholm and the general manager Samye Buckner in November of the same year.

Although the SCMCI operation did undoubtedly cause greater oxidation of sulphides and release of metals (see, for example, water quality data in Van Zyl, 1996), it begs the question of whether it is appropriate to criticise the company for that increased ARD generation at the time when the mining, regulatory and environmental communities did not have the same awareness of acid drainage as is nowadays the case. Against this must be balanced the fact that neither a pro-active nor an integrated approach to environmental management and pollution prevention was apparent in the strategy of SCMCI at Summitville. All this, of course, is in the context of a regulatory framework that limited the regulators' capacity to intervene directly.

There are, in any case, specific lessons to be learned from Summitville, including the necessity of effective isolation of sulphidic wastes from water and oxygen in wet climates[8] and the need to reduce the effects of wet-dry cycles and the concomitant build-up of secondary metal salts. Seeps and springs need to be properly documented before mining takes place to ensure acid-generating wastes are not placed near them (Plumlee *et al*., 1995b). Perhaps the most pertinent fact is that these points are largely accepted as being in line with definitions of "best practice" and - based on years of costly experience within the industry – common sense approaches to water and waste management. However, it appears that dissemination of best practice within the industry in the area of ARD is not as effective as it could be. This could be considered to typify the whole issue of ARD; an increasing knowledge base is being generated about preventative and control methods, yet it continues to feature as a major environmental problem.

Conclusions: Corporate Social Responsibility: Towards Environmental Performance Beyond Compliance

Summitville is proof that the potential for substantial environmental impact remains a reality even at modern mine sites, as indeed, Danielson *et al*. (1994) note.

[8] In wet climates, the absence of neutralising minerals in the ore or host rock indicates that the risks of ore exploitation may be high in the context of ARD generation. The movement of ARD off-site in the absence of buffering capacity is also aggravated (Plumlee et al., 1995b). One could question whether such deposits should be worked at all.

But equally, it can be used to demonstrate that a number of discrete factors need to occur in sequence for such disastrous pollution events to occur, and in the majority of cases most mining operations in well regulated and enforced regimes cannot truly be considered “the next Summitville waiting to happen”. There is however a risk that the resultant “over-regulation” of operations in certain countries (e.g. the USA, Canada and Australia) may cause the problem to be transferred to countries where regulation is less stringent, or cannot be enforced.

Moreover, the Summitville case demonstrates that there were other strategies that SCMCI and GRI could have followed that would have been more socially responsible and have yielded fewer negative implications

Mining – barring a paradigm shift in technology – by its very nature will continue to have impacts on the physical environment, be they transient, temporary or permanent. It is perhaps easier now to envisage a time when negative environmental and social impacts can be properly managed, minimised or eliminated throughout the industry. Technological change and the development of effective environmental management systems have contributed significantly to merit this optimism. Against this must be balanced the benefits that the extraction and processing of mineral resources can bring. Although impacts continue, the mining industry is largely unlike that of 50 or even 25 years ago. However, the relationship between most stakeholder groups and mining companies is based largely on past, rather than present, performance and impacts. It is unreasonable to suggest that every mining site is a “Summitville waiting to happen” – although undoubtedly there are many that represent a serious environmental and/or social risk beyond that which is acceptable. Equally, it is problematic to criticise retrospectively or prosecute companies that can be shown to have met regulatory obligations in place at the time of starting operations. Notwithstanding this view, the new concept of a corporate strategy of social responsibility does address the fact that there indisputably exists a pro-active role that can be played by business; and, the Summitville case illustrates how, in one situation, corporate strategy might have been implemented differently, The burden of responsibility, however, may need to be shared with government (Tilton, 1994). Where voluntary initiative has not been taken, in those cases where companies have actively sought to exploit loopholes in regulation or have stepped outside of the regulatory process as part of a purposeful policy to achieve internal strategic or operational targets, there is still a need for strict regulatory enforcement. It is not always easy, or even possible, to differentiate between these two scenarios of “responsible but misconceived compliance” or “opportunistic compliance”. Even in the case of Summitville, some would argue that the nature of the regulatory framework aggravated the likelihood of a pollution event.

The task that the industry faces, it is suggested here, is communicating effectively the difference between these two scenarios to stakeholder groups by pro-actively addressing pollution that has resulted in cases of “misconceived compliance” and by isolating, rather that protecting, opportunistic polluters.

How can the wider industry distance itself from specific incidents as they continue to occur at various locations around the globe? One potential answer lies in the emerging capacity to allow consumers (via intermediaries such as manufacturers and fabricators) to differentiate between sources of metals, and apply pressure through the supply chain on poor performers. Through an overarching framework of environmental and social performance indicators (ESPIs), it would be possible to audit companies at corporate and site-specific levels. This auditing process might be undertaken by an independent body, for which funding could be partially derived from a premium applied to metals from “quality assured” sites (with part of the premium also passing to the company in question). This approach is of course open to abuse, particularly in countries where regulatory frameworks and enforcement are weak, or where corruption is endemic, but the concept is not without precedent (e.g. the accreditation of timber producers under a general theme of “sustainability”).

The Proceedings of Summitville Forum ’95 contains a whole gamut of opinion and evidence from the narrowly technical and scientific, through to the sociological which could be considered to be more value-laden. What is almost more important than the content of the proceedings is that this range of opinion exists as it does, demonstrating that the same incident when viewed from different perspectives can lead to so many diverse assessments.

Events such as occurred at Summitville will undoubtedly occur again sporadically and it is important that lessons be drawn from this case to reduce the likelihood of future pollution.

In a more general sense, conclusions that can be drawn from this case include:

- Modern as well as historic mining may be associated with environmental problems.
- Proactive baseline monitoring and ARD prediction, monitoring and management from the outset are of paramount importance.
- Environmental liabilities need to be assessed and addressed before new mining begins or when ownership of a site changes - responsibilities need to be defined from the outset.
- Management capacity, as much as technical expertise, is paramount in putting together the elements of what could be considered good practice in ARD and other pollution prevention and management.
- A cost-effective approach by the industry must be to anticipate and plan effectively, proactively preventing environmental damage rather than reacting to *post-facto* damage.

Todd and Struhsacker (1997) contend that the past performance of the mining industry as represented by old or abandoned operations does not represent what will happen at new and modern sites. This point is certainly borne out by the results of their (limited) survey. However, it is interesting that a notable absentee from the mines that they considered was Summitville. While using Summitville as a “stick” with which to beat the industry cannot be justified, on account of the specific circumstances of that site, neither can the experience of such modern sites, where significant errors have occurred, be ignored. By failing to analyse the problems the industry runs the risk of failing to learn from past experience and meet its societal obligations to plan for optimal and acceptable environmental performance at future sites.

The Summitville story is a useful demonstration of what is meant by corporate social responsibility in operational terms. It demonstrates first, that regulatory weakness - the failure of the public policy framework – is not the sole cause of environmental pollution. It shows that there is not "one way" to do mining. It suggests that different companies can achieve good or poor performance. It demonstrates, secondly, that companies can take different strategic options. They are neither bound by regulation nor need to be limited by it, where experience dictates superior strategies to prevent pollution or manage environmental impacts in innovative ways.

Therein lies the operationalisation of the concept of corporate social responsibility – the pro-active implementation of a strategy of internalising responsibility to protect the environment and mitigate negative social impacts, even where the regulatory framework has not anticipated a problem and the safeguards put in place wouldat the outset have been considered, albeit erroneously, as adequate.

At present the mining sector is judged by its worst performer, therefore, the Summitville story warrants analysis; and, we are not suggesting our conclusions are the only ones that could be drawn. There is a misconception, within a broad sector of society, that mining is necessarily polluting and that this is the only way it can be done. The analysis above suggests the industry needs to address how best to differentiate between three key categories of corporate strategies and to demonstrate their different implications to a critical public:

- Poor environmental performers exhibiting mismanagement, technical blunders and an abuse of a weak regulatory regime or regulatory loopholes
- A compliant performer that is within the law but exhibits poor performance on account of regulatory weakness or failings and a genuine failure to predict pollution in spite of best efforts
- Good environmental performers that endeavour to select socially responsible corporate strategies irrespective of regulatory requirements so as to prevent pollution, avoid disaster and ensure mining truly contributes to sustainable development goals.

It is in the power of individual companies to choose which category they operate in, and clearly we have a situation world-wide where companies can be empirically located by virtue of their performance in each of these categories. The first step forward for business, however, is to define which strategic option is to be pursued and, secondly, those companies following the third "strategic option" may need to differentiate themselves from other companies and report comprehensively to interested stakeholders on their performance beyond compliance. By the same token, it is becoming even more important for a discerning public and for critical special interest groups to encourage and recognise those companies that are distinguishing themselves and are behaving responsibly, so as to help ensure an upward trajectory of improvement continues.

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ENVIRONMENTAL SITUATION OF OPEN-PIT MINING IN BUENOS AIRES PROVINCE, ARGENTINA. CASES ANALYSIS

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INTRODUCTION

Buenos Aires Province have a privilege place in the Argentinean mining activity, contributing with a 37% to the national production. This prominent place responds so much to the good quality of its materials as to the geographical location of the deposits, near the big consumption centers.

The mining activity of the province is sustained fundamentally by the item application rocks (90%), to which they continue in order of importance the non metal-bearing minerals (10%), being insignificant the metal-bearing production. The application rocks (granites, limestones, dolomites and clays) concentrate mainly on the mountainous ridge denominated Sierras Septentrionales or Tandilia System (Figure 1).

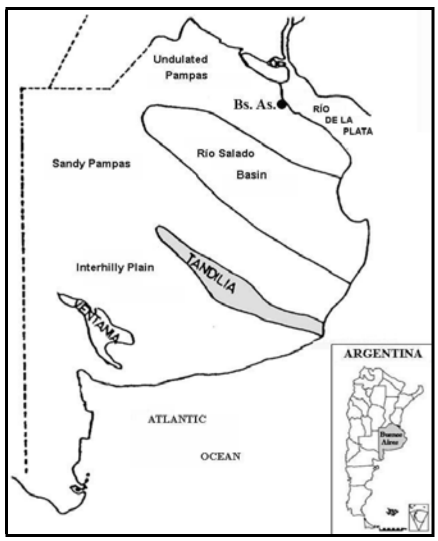

Figure 1. Geologic environments of Buenos Aires Province.

The mining productive structure in this area is essentially linked to the construction industry. The extracted materials respond to three different uses: as basic materials, as ornamental elements and as raw materials for other materials production. These application materials are extracted in open-pit quarries of big dimensions, being the current centers of exploitation restricted to a few sectors, close to the urban centers. A growing require in the national and international markets, actually offers interesting possibilities for the activity expansion.

The consequences that the extractive activity has on the environment can be considered from two different points of view. On one hand, it is a non renewable resource, for the human scale of time, that is wasting away to a high rate. On the other hand, they take place a series of negative and/or positive effects on different components of the environment (air, water, soils, vegetation, fauna, landscape) and human populations. According to the rate of extraction of the resource, the impacts on the landscape prevail because of, in most of the cases, the areas are not subjected to rehabilitation processes in the mine closing stage.

The areas of main production of granitic rocks are located in Tandil and Olavarría, those that represent 80% of the provincial production (fundamentally of broken stone). In this contribution they will be analyzed as examples these two districts that have a different environmental problematic: 1) Tandil case: a conflict with an important social component generated by the presence of quarries in a residential and tourist area; 2) Olavarría case: development of exploitations in an area with an important industrial and mining activity.

Geological Setting

In Buenos Aires province emerge two mountainous ridges of general orientation NW-SE: Sierras Septentrionales (Tandilia System) and Sierras Australes (Ventania System), of different geological characteristics and ages, and separated to each other by a wide inter-hilly plain (Figure 1).

The Tandilia System is located among the parallel 36º30' and 38º00' of south latitude and among the meridians 58º00' and 62º00' of west longitude. It extends along about 350 Kms, with a maximum width of about 60 Kms in the central part (Figure 2). It is constituted by a precambrian crystalline basement: Buenos Aires Complex (Marchese and Di Paola, 1974), on which rely on, unconformitly, sedimentites of the Upper Precambrian (Sierras Bayas Group; Poiré, 1987) and Lower Paleozoic (Balcarce Formation; Dalla Salda and Iñiguez, 1979). Its structural style is of blocks limited by faults (Borello, 1969). Several authors have carried out works referred to the mineral resources of the county, among them: Angelelli (1975), Angelelli et al., (1973; 1976) and, among the most recent: Dominguez and Schalamuk (1992; 1999).

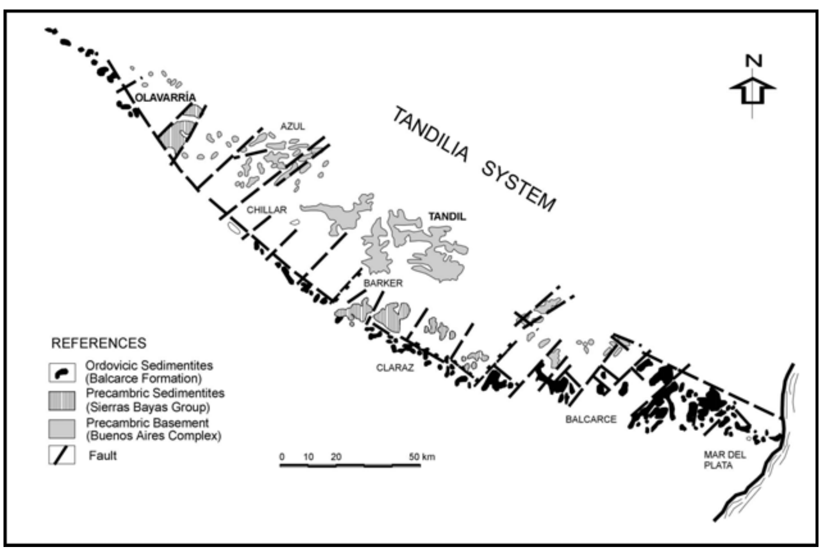

Figure 2. Simplified geological map of Sierras Septentrionales.

The extractive activity of Buenos Aires Province (Table 1) registers their biggest development in different localities along the Sierras Septentrionales: In Olavarría and Tandil granites and dolomites are exploited in blocks (as ornamental materials) and crushed (for the construction industry and as fusing). Limestones are extracted in Olavarría and Barker (for the cement industry and lime elaboration). Refractory and other clays are also exploded in this area (for common bricks, cement and light aggregates) in Olavarría, Balcarce and in the belt Chillar-Barker-Claraz. Quartzite exploitations are concentrated in Balcarce-Mar del Plata area (for construction arid use and as abrasives), and also in Barker area.

Table 1. Mining production of Buenos Aires Province (measure unit: tons)

	1993	1994	1995	1996	1997
Clays	2.557.487	1.974.786	2.535.852	2.981.428	2.828.921
Limestone	4.807.869	4.624.360	4.361.020	5.132.920	4.749.539
Blocky dolomite	381	725	250	277	—
Crushed dolomite	59.432	132.100	538.990	792.700	77.545
Blocky granite	38.972	47.644	85.390	89.377	50.214
Crushed granite	2.968.760	3.209.200	4.210.540	5.290.000	6.779.084

The Ventania System has a longitudinal development of 150 Km, with a maximum width in the central area, of 60 Km. The dominant structural style is folding, with subordinate faults, and it is geologically integrated by paleozoic sedimentites and granitic intrusions. Until the present the mining activity of the Sierras Australes is poor and it is limited to the exploitation of granites for broken stone, gravels and sands.

In the whole Pampean Plain, it is necessary to mention the exploitation of the saline bodies for sodium chloride (common salt) and sodium sulfate (for the chemical industry, tanneries, refrigerators, etc.). The exploitations of hardpan and selected soils are also important in several sectors, sands are extracted in the coastal area while shell sands and calcareous in Magdalena-Cerro de La Gloria area.

Legal Aspects

The legislation that governs the open-pit exploitations in Buenos Aires Province is framed in national and provincial dispositions, also existing some municipal ordinances.

National dispositions:

Mining Code, sanctioned by the National Congress in 1886 (Law 1919): it governs the rights, the obligations and the procedure for the acquisition and exploitation of the mining properties in the Argentinean territory.

Mining Bring up Law, sanctioned by the National Congress in 1995 (Law 24.498): it incorporates important reformations to the Mining Code as for the domain of the mining properties.

Environmental Protection Law for the Mining Activity, sanctioned by the National Congress in 1995 (Law 24.585): it establishes the necessity to present an environmental impact and restoration report, with a detailed analysis of the transformations that can cause the project in the earth, water, air, flora and fauna and a proposal for the mitigation, rehabilitation or restoration of the altered environment.

Provincial dispositions:

Environment Law of Buenos Aires Province, sanctioned by the Provincial Congress in 1995 (Law 11.723): its objective is the protection, conservation, improvement and restoration of the natural resources and of the environment in general in Buenos Aires Province.

Regulation Decree Nº 3431/93 of Buenos Aires Province Government. It establishes the presentation and periodic bring up to date of a plane of mining works and plan of exploitation for the inscription in the Registration of Mining Producers.

Disposition 068/99 related to the Art. 4º Inc. F of the Regulation Decree Nº 3431/93 of Buenos Aires Province Government. It establishes the presentation of a Project of Technical Feasibility for the mining exploitations.

I. Tandil Case

Tandil city is located at the bottom of the Sierras Septentrionales, at about 400 kms of the Federal Capital, with a population of 150.000 inhabitants, being the traditional economic activity the agricultural-cattleman, followed by mining activity.

The exploitation of the granitic stone is a centennial activity in the Tandil district. Toward the beginning of century it constituted an important activity for the local economy, because of the excellent quality of the materials and the presence of qualified manpower in the area. Most of the production was dedicated to the paved of streets and, in smaller proportion, to the public buildings ornamentation. The handmade activity required intensive manpower and the extraction capacity was relatively low, for such reasons it was valued positively by the community. The mechanization reached by the middle of this century was diversifying the uses given to the stone: construction of railroad embankments, arid for the asphalt production, support for asphalt streets. The generation of polished plaques of granite allowed its use in buildings and interiors lining.

At the moment the mining productive structure in this sector is essentially linked to the construction industry. The production of Tandil district corresponds basically to the extraction and benefit of "granites". These last ones constitute the basic materials of the Tandil mining activity, having about 9 stone quarries with mill and classification plants, several of them along the access roads to the city.

In the last decade a very promising alternative activity has appeared: the tourist industry, because of the natural beauties of the mountains and their landscape. At the moment the Tandil community is passing by a social conflict that faces to the mining sector with the rest of the local society.

Problem Description

The urban growth of Tandil determined that quarries that originally were located in rural or suburban areas, they have remained within or adjacent to residential areas and in the visual basins of the main tourist circuits. The evolution of the environmental conscience and the development of conservative attitudes of the environment, on one hand, and the peak of the tourist activity based on the natural beauties, for the other one, they have determined a growing valuation of the mountains by the community. At the same time, the emergence of new extraction centers (Olavarría) with lower production costs, originated a substantial decrease of the production of broken stone, with the consequent decrease of manpower occupation by this industry.

The municipal authorities, as a response to the generated problem, have dictated a series of legal dispositions:

1. *Municipal Decree 348/72*: it establishes an Area of Conservation of the Landscape defined by the polygonal traced at the back part and at a thousand meters of the routes 30, 74 and 226. This norm prevents to enable exploitations that modify the hills profile that can be observed from any point located in the interior of the polygonal or that they affect to the superior third of the hills.

2. *Municipal Decree 1085/79*: it prohibits the installation of new exploitations inside the area defined by the polygonal and fixed a 10 year term for the definitive eradication of the existent quarries.

3. *Municipal ordinance 4133/87*: abolish the previous ordinance, but it maintains the prohibition of installation of quarries in the area and the impediment of taking the quarry fronts to heights that reach the superior third.

4. *Municipal ordinance 6543/94:* establish a differential tax to the stone, with higher values inside the polygon.

From the actual municipal normative the local authorities impel a clear politic of relocation of the extractive activity. The affected managers, at the moment in fiscal rebelliousness and ignoring the municipal competition in the topic, they have to find an alternative solution to this conflict that extends in the time and reach every time bigger importance.

II. Olavarría Case

The Olavarría city is located in the most western part of Sierras Septentrionales, at about 370 kms of the Federal Capital, with a population of 120.000 inhabitants, being the traditional economic activity the industrial and mining followed by agricultural-cattleman activity.

Since 1880 the calcareous rocks of Olavarría have been used in a rudimentary way for lime production. In 1919 the industrial cement production begins and continues until the present time with a sustained rhythm. The use of the granite in this area began in 1885 with the production of paving stones and blocks, being mechanized in 1911 for the obtaining of broken stone. Around this exploitations several mining settling arose (current cities of Sierra Ghica, Sierras Bayas, Villa Fortabat).

Actually about 30 quarries of diverse materials are in exploitation (limestone, clay, dolomite, crushed and blocky granite, etc.) far from Olavarría city, as well as different industrial plants: elaboration of polished plaques and tiles, lime and cement factories, all of them located in the Industrial Park of Olavarría.

In this case, contrary to the one outlined for the Tandil district, social conflict are not registered because of the characteristics of the main activity in the area.

Problem Description

The aspects to be considered in this case contemplate two basic questions. On one hand the optimization in the exploitation of a non renewable resource that represent an important work source for the local population. On the other hand the control of the negative effects that the activity has on the different components of the environment: air, water, soils, vegetation, fauna and landscape.

On these components the effects depend in great measure on the type and applied method of exploitation. In the case of the application rocks, with surface mining activities, there exist impacts on the atmosphere by emission of powders, gases and smoke; impacts by noise and vibrations of the detonations; impacts on the water by contamination with particulate material and chemical substances; impacts on the vegetation by the removal of the same one, on the fauna by the habitats alteration and on the landscape by the modification of the vegetation and the geomorphology, the generation of big holes and accumulations of residual material.

Discussion

Tandil Case: existing the technical possibility to transfer the quarries to areas far from tourist and residential areas, the companies of the sector have the possibility to continue with their activity in other areas, being adapted by this way to the municipal requirements. But they find several obstacles of economic nature: opening of new fronts of exploitation, increment of the cost of the freights, relocation of the infrastructure, etc. Therefore, to carry out the relocation in a real form a political and economic decision that accompanies it, is necessary.

At the same time it should be foreseen the use to be given to the holes after the abandonment of the areas in exploitation, either integrating them to the tourist circuits (as old mines visits) or to diverse recreational activities.

Olavarría Case: since the activity has a strong influence in the development of the regional economies, mainly in the generation of work source, as much the companies as the population present a good predisposition in the acceptance and effective execution of the normative that take to a rational and appropriate exploitation of the natural resource.

Being the extractive mining one of the bases of the local economy in this area is indispensable the execution and pursuit of the effective norms making special stress in the measures of security and restoration of the abandoned places.

Of the outlined problems it comes off the strong influence of the society in the development of the regional economies and their disposition to face and/or to solve the problems related to the affectation of the environment. The Tandil case, in contrast with the Olavarría case, show a typical case where the mining activity is being displaced by an alternative activity as the tourist one, without existing, for more than ten years and so far a solution to the problem.

Therefore it is outlined the necessity of planning and ordination territory measures of long term so that, it will not be necessary in the future to improvise solutions facing similar situations.

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MINING WITH COMMUNITIES

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A "sustainable mining community" needs to be considered in terms of the principles of ecological sustainability, economic vitality and social equity. These principles apply over a considerable time span, covering both the life of the mine and post-mine closure. The legacy left by a mine to the community after its closure is emerging as a significant consideration in its planning. Progress towards sustainability is made when value is added to a community with respect to these principles by the mining operation. A series of case studies are presented to demonstrate the diverse potential challenges to achieving a sustainable mining community. These are drawn mainly from overseas developments, where many Canadian companies are now building mines. The paper concludes by considering various approaches to foster sustainable communities and the role of community consultation and capacity-building.

1. INTRODUCTION

Globally and domestically, the politics of mining are increasingly being played out at the local community level, monitored closely by a diversity of media and non-governmental organizations around the world. Investors, insurance companies, banks, governments, and citizens will want little to do with an industry that is seen as indifferent to the present and future socio-economic and biophysical welfare of local communities. This is a message that has been communicated loudly by international organizations such as the International Council on Metals and the Environment and the World Bank to individual mining companies themselves. Mining companies must now pursue their interests in a way that also promotes those of the local communities in regions where they are operating. The long-term sustainability and viability of both the mining industry and its related communities justifies attention. Improving environmental performance is critical to ensure that the environment is protected but it does not necessarily ensure the social health and welfare of any associated mining community.

2. SUSTAINABLE MINING COMMUNITIES

A mining community is one whose population in some part is significantly affected by an associated mining operation. This may be through the provision of direct employment or some other impact arising from mining, albeit environmental, social or economic impact. The community can range in size from a city (which for example could be serving as a base for distant fly in-out operations, or a centre for supplies and financing) to a village (which relies extensively on local mining). Communities vary in their profile and perceptions about mining and needs. In Canada alone 128 communities rely on mining[1]. They share several common characteristics. Many have faced the impact of reduced employment in their mines. This trend has been associated with increasing mechanization and automation, economies of scale, declining commodity prices, and depleted reserves as exploration and mining companies tend to move offshore. In Canada, and offshore, many mining communities are based in remote regions and have few opportunities for diversification. There are, therefore, numerous challenges to achieving a viable mining community.

A sustainable mining community is one that could realize a net benefit, from the introduction of mining through to the closure of the mine and beyond. In practice, this would mean that a community was supported by "three fundamental pre-requisites for sustainable societies" outlined by George Francis[2]:"ecological sustainability, economic vitality, and social equity. As an ideal, sustainability meshes well with the desires of most people to achieve decent levels of health and well-being, in pleasant surroundings, with strong community networks, and a diversity of opportunities for work and fulfillment."

The challenge for any mining company is to engage in an equitable partnership with the associated community that leaves a lasting legacy of sustainability and well-being for the community, avoiding environmental degradation and social dislocation. Mining communities differ significantly in terms of culture, political orientation, geographical location, environmental characteristics and collective attitudes towards resource development. Nevertheless, there tends to be a common characteristic shared amongst communities that have had a poor relationship with a mining company: this is the perception that miners are intruders into their environment, culture and history. Such a feeling may particularly be the case where the community has no mining tradition and the benefits from mining have not been cooperatively determined nor equitably shared. How this perception can be minimised and a durable relationship created is key to building a sustainable mining community. The following case studies suggest that while mining companies are increasingly aware and taking initiatives, particularly in the area of remediation, the industry still needs to continue to develop and address appropriate principles of sustainability.

3. Case Studies of Mining Community Development

A widespread perception in the mining industry is that the public sees it as a low-tech, polluting and avaricious industry. In 1994, a US opinion survey conducted by Roper Research, ranked the mining industry in 24^{th} place in terms of public popularity, behind the tobacco industry[3]. A large contingent of society sees mining primarily as a hazardous activity, accompanied by an acute environmental impact. This view is perhaps strongest amongst urban dwellers who experience little direct benefit from mining, despite being the largest consumers of its products. Rural communities may welcome mining activities as a means to improve their quality of life. It is important, however, that the environmental impact of the mining activity does not pose any unacceptable risk to the associated communities.

A prominent case study has been the mining operation of Ok Tedi Mining Ltd. (OTML), which has been operating since 1984 in Papua New Guinea (PNG). It is owned by BHP Ltd. (52%), the PNG Government (30%) and Inmet Mining Ltd (18%). BHP reported in 1999 that "Since the project began, it has not been able to construct planned tailings or waste rock storage facilities. As a consequence, these materials have been progressively discharged to the river system under Government permit. During the reporting period, a total of 83 million tonnes of material entered the river system from the mining operation, of which 15 million tonnes was subsequently removed in the course of the dredging trial in the Lower Ok Tedi"[5]. ENGOs and community leaders have taken a strong and united stance against what they have termed one of the "World's Worst Mining Disasters" [*]. They noted that these kinds of mining practice would not be allowed to take place in Canada or Australia; as such they questioned why it was allowed to take place in PNG. A recent OTML Mine Waste Management Project considered the possible means to reduce the mine's environmental impact with engineering, social and environmental evaluations, including a risk assessment. It studied four options offering potential solutions, including closing the mine in 2000. It concluded that: "the issues are complex, and none of the options have identified a way to prevent mine waste causing environmental damage. For example, the studies show that:

The current projected environmental impacts in the river system exceed those previously expected.

Dredging will not have the environmental benefits originally expected and impacts in the river system will continue to worsen with or without dredging.

Early closure of the mine appears to be the only option that will significantly limit the projected environmental impacts of the mine.

From a social perspective, early closure appears the least attractive option, effectively stopping the social and economic benefits that would accrue from continued operation and orderly closure in 2010."[5,6]

Through the process, the communities have been provided with employment, land rent, royalties and the provision of educational facilities as well as other community development projects, but are the tradeoffs acceptable? Must immediate improvements in the physical health of a community and the provision of employment come at the cost of long-term ecological consequences to the environment? Achieving a balance between ecological and social health can be a complex challenge, particularly in communities where there is little opportunity for economic diversification. This is not to say that the resolution of such problems will be easily achieved. Some governments anxious for revenues may encourage mining in unsustainable circumstances or where it is difficult to find technical solutions to environmental problems. In such situations, it would be sensible to either await technical solutions to eliminate the problems or pursue political or social alternatives. In spite of the significant social benefits provided to communities, companies need to adopt an approach to integrated environmental and social assessment.

Another case study in the Pacific region is the Porgera mine, operated by Placer Pacific since 1990, that has adopted a similar practice of mine waste disposal,

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(*) The ENGOs (Environmental Non-Governmental Organizations) included the Mineral Policy Center, MiningWatch Canada, Mineral Policy Institute, MineWatch UK, Calancan Bay Villagers Support Coalition, the Environmental Mining Council of British Columbia, Friends of the Earth, Pacific Environment and Resources Council, Project Underground, and others endorsed the position of Pacific-based NGOs. Source: Mineral Policy Centre, "One of World's Worst Mine Disasters gets worse; BHP admits massive environmental damage at Ok Tedi Mine in Papua New Guinea, says mine should never have opened" Press Release, August 11, 1999, http://www.mineralpolicy.org/media/index.php3?nav=3&inc=release&release=11

discharging about 17,000 tonnes of tailings per day into a tributary of the Porgera River. Treated tailings and waste rock are discharged, predominantly as fines (80% minus 0.065 mm). At a monitoring station 160 km downstream from the mine, the total concentration of heavy metals in water is very high but the dissolved metals "do not exceed the PNG Government compliance criteria"[8]. As the area close to the mine is scarcely inhabited and because the local population does not currently use the rivers for food and water, the mine and independent consultants do not see health risks associated with riverine disposal practices. This perspective, however, does not include consideration of the cumulative environmental impacts of such practices. In addition, multinational firms claim that they apply the same environmental practices in less developed economies that they do in their own country. It is no longer considered enough to ensure that the compliance criteria meets that only of the host country; a country that urgently needs foreign investment. According to one member of an ENGO: "Now that BHP finally acknowledges the severity of the damages it has caused at the Ok Tedi mine, an ecological disaster the company has for years denied in engagements with concerned NGOs, it will be interesting to see whether Placer Dome Inc. will finally respond to calls for that company to stop dumping its tailings from the nearby Porgera Mine into the same river system," said Catherine Coumans of the Calancan Bay Villagers Support Coalition and Mining Watch Canada.

Placer Dome is engaged in monitoring the environment and providing social benefits similar to those at the Ok Tedi mine. About 1900 people are directly employed by the mine and Porgera's Community Affairs Department has actively been developing a set of social and business programs such as: professional training, business development, retail and wholesale supermarket, bakery complex, community schooling, health services, sports, community consultation, youth and women's assistance[9]. This level of assistance is not something the government and communities can easily give up despite the long-term environmental implications. The issues relating to a mine and its community are broad and complex. Who is ultimately responsible for making the decisions about whether a mine should go ahead, or whether or not it should remain open: the host central government, the company, or the local community? Mining companies often refer to their application of the same standards and approaches to mining in poorer, less industrialized countries as are applied in highly developed industrial countries. If such intentions are to be credible in the eyes of the watching international community, then responsible decision-making cannot be abrogated by the companies to governments or communities. This is not what is meant by encouraging community participation. Companies themselves need to take a precautionary approach, use their expertise, and make the decision about whether or not the geological and other conditions are in place to ensure that a property can be operated and closed in an environmentally safe manner.

In contrast to its Ok Tedi situation, BHP has introduced a holistic life cycle management approach to its Island Copper mine on Vancouver Island, Canada. This mine, started in 1971 and closed in December 1995. It employed as many as 900 people with an annual payroll of US$ 25 million, producing 1.4 million tonnes of copper, 1.1 million ounces of gold, 11.8 million ounces of silver and 59 lb of rhenium. The mine had a distinct approach to tailings disposal. Its daily production of 50,000 to 60,000 tonnes of tailings was disposed over the ocean floor, 650 feet below sea level. The mine's economic contribution to the community and region was generated from a payroll of US$ 650 million, with spending on supplies and services of US$1.5 billion over its twenty five year life. The mine was instrumental in promoting the availability of the physical assets (power, water, building, dock and cleared land) for other commercial and industrial uses. As well, the mining company provided to the community a US$ 1.3 million sewage treatment plant, 400 houses, support to build a new hospital, an ice arena, swimming pool, theatre and parks. The flooded 530 acres, 1320 foot deep pit has been used for commercial production of Atlantic salmon smolt. A company has purchased the buildings and dock facilities to establish the commercial production of crayfish and sturgeon. With almost half the population of Port Hardy directly dependent on Island Copper's payroll, most mine employees became actively involved in all aspects of community life. This helped to ensure that common goals were met. The company implemented two programs to assist employees in job retraining and educational upgrading. A total of 155 employees found jobs through the training program. Other sustainable local initiatives took place to create new businesses opportunities such as: tourism, a seaplane base, wood processing, fish processing and a marina. About 800 acres of land have been returned to the Crown that is negotiating this with various companies, such as pulpwood chipping plant, copper processing plant, etc. The main lesson learned by the company was that the personnel employed during the operation as well as the community should be involved in the closure process[10].

In other parts of the world, particularly in developing areas, some remote communities may not be prepared to change their life styles to accept new concepts of development, if they perceive a loss of important cultural and spiritual values even when this may represent improvements in material standards[11]. Community antagonism is often most intense when foreign exploration companies start to work on such sites. Thomson and Joyce[12] have explored the complex relationship between the community and geological exploration companies. The local community quite naturally, views exploration companies (usually junior companies) in isolation, with little knowledge or interest of the larger picture within the mining industry and its competitive challenges. The level of expectation created in a community usually does not follow the company's expectation or ability to invest. Not infrequently, in the initial phases of a project, the community views the drilling step as ore production. The expectation of having jobs and benefits from "the company" may well be frustrated within a matter of months.

A recent example of such a misunderstanding occurred in the Brazilian Amazon region, related to the village of Cachoeira do Piriá, 250 km from Belém, capital of the State of Pará. This region experienced a significant gold rush that lasted from 1980 to 1990. The area attracted 10,000 people that included 5,000 miners. A junior mining company, Brazilian International Goldfields (BGZ), with headquarters in Vancouver, secured an option in September 1998 to purchase two granted mining concessions at Cachoeira Para State from the Toronto based TVX Gold and CCO Mineração. BGZ started an intense drilling program (2200 m) conducted by Brazilian geologists. For the 2000 inhabitants of the recently created municipality of Cachoeira, the reactivation of the "mining" camp was a spark of hope for the community. This was originally generated in the eighties by the gold rush in which about 5,000 artisanal miners extracted almost 4 tonnes of gold from superficial ore. Currently the village is struggling from the aftermath of mining activity with few employment opportunities. Most of the easily extractable soft ore has been depleted and a handful of miners are producing minor quantities of gold through the reprocessing of tailings. Sparse crops of rice, cattle farming and timber cutting and milling are now the main economic activity of the village. With an enormous potential for gold, major international companies are exploring the Greenstone belt in the region. The main geological targets are peripheral to the town with 700,000 oz of gold defined to date. Prior to the company's discussions with the Mayor of the Cachoeira municipality, there was a plan to build houses over old informal mining pits, shafts, adits and tailing sites left by the previous miners. BGZ reached an agreement with the Mayor for a moratorium regarding any further urban development within these areas until exploration was conclusive and to select alternative sites suitable for urban habitation. As part of establishing a community relationship program, the company employed over 20 people to help in site preparation and geological sampling. Their salaries were 30 to 50 per cent higher than the norms for that region of Brazil. After 3 to 6 months, the work was completed and most employees were laid off, as expected. Unfortunately, when the drilling activity stopped and the company turned to compiling the data, the local people lost hope in the possibility of having a mining operation in the short term and re-started building houses on top of mercury-contaminated tailings ending the moratorium.

In the discussions with the Mayor, mining had been openly supported by the municipality and the community because they expected that it could bring long term economic benefit to the town. The mining company would, for example, provide water to the town from the local Piria River. This generated particular interest. The water supply would be a lasting benefit from mining activity. However the desire was for it to happen immediately. There was little understanding of the process and steps that are required to establish a company sponsored operation. The drilling and feasibility studies would have to precede any investment in infrastructure. Drilling has recommenced on the Cachoeira property under a joint venture between BGZ and major gold producer Gold Fields Limited. Discussions with the community continue. Some artisanal miners are still struggling to survive by extracting gold from tailings and small ore bodies on the property[13].

The behaviour of local people in the remote areas of the Amazon is not atypical of communities when faced with "foreign-owned" mining operations that do not appear to bring long-term benefits. In the case of Cachoeira, local people do not want to invade the cattle farms of the region, since the latter are viewed as "productive" and are associated with the local landowners. In contrast, foreign companies are seen as rich "gringos" with an obligation to provide jobs for all community members. In the case of mining, the community does not distinguish between a major and a junior company. Even domestic companies from outside the region can be viewed as intruders.

As noted in the case above, the reaction of a community to the prospects for a mining operation in its vicinity may be volatile and unpredictable, particularly when the level of poverty is high and mining is the only potential economic activity. This is a serious problem for sustainability, particularly when one considers the huge numbers of people dependent on marginal forms of mining employment. In 1993, for example, it was estimated that about six of the world's 30 million mineworkers were engaged in artisanal mining in more than 40 countries, extracting over 30 different types of mineral substances[14]. The International Labour Organisation estimates that currently the number of artisanal miners is around 13 million in 55 countries and rising, which leads to the belief that 80 to 100 million people worldwide depend on this activity as a livelihood[15] (Table 1). Gold, due to its ease of trading and independence from any government monetary instability, is by far the main mineral being extracted. Experts have estimated that 1 in 900 Latin Americans are employed in gold and silver artisanal mining[16]. Some countries are facing severe social and environmental problems derived from poor mining and processing practices associated with a lack of economic alternatives[13].

Table 1. Employment in artisanal mining.[15]

Continent	Number of Miners (million)
Asia/Pacific	6.7 - 7.2
Africa	3.0 - 3.7
Latin America	1.4 - 1.6
Developed countries	0.4 - 0.7
Total	11.5 - 13.2

It is difficult for developed countries to grasp the scope and scale of the artisanal mining problem in developing countries. Concepts such as conservation, heritage values and aesthetics that are commonly established principles in developed countries, are superseded by concerns for survival and employment in poorer countries where choices are few and there is no luxury to plan beyond the immediate future. In December 1999, the World Trade Organisation meeting in Seattle, brought to the public's attention many important points related to the fragility of developing countries in establishing their trade protocols. The International Labour Organisation (ILO)[17] estimates that 250 million children between the ages of 5 and 14 work in developing countries, half of them full time, and tens of millions of them do so in exploitative and harmful conditions. In the mining sector, particularly in artisanal mining operations, ILO estimates that the number of children could be as high as 250,000. Most children work to support their families. Their parents are aware of the hazards and risks associated with the rudimentary mining activity but see no economic alternative. In some cases this is the way to keep the families together. Jennings[17] reports that the main reasons for child labour in small-scale mining are: poverty, lack of incentives to go to school, no prospects for regular employment, lack of co-ordinated policy to stop child labour, lack of enforcement, a reluctance to invest in small-scale mining to improve performance and social benefits for rural communities. Governments and mining companies all over the world are generally not well prepared to deal with issues related to artisanal mining, let alone those related to child labour in potentially marginal/illegal activities. The World Trade Organisation meetings also highlighted another important point; many powerful and vocal organizations are no longer prepared to allow trade and development to take place without equal attention being paid to such adverse social (and environmental) impacts.

The conservative tradition of rural politics in developing countries also poses a considerable obstacle to the creation of a trusting environment between governments and miners. Many governments impose rules on artisanal miners trying to force them to be part of the formal economy. Rarely is assistance provided to help these miners to employ legally and technically sound practices. Cultural, social and political constraints serve as barriers to meaningful consultation exercises with stakeholders and in developing a consensus approach to common concerns. These problems are part of the historical legacy of developing countries.[18]

One of the most interesting projects in communities with a traditional history of artisanal mining has been evolving in the interior of Venezuela, in the preparation of a project to extract 48,000 tonnes of gold ore daily from the Las Cristinas deposit. Placer Dome Ltd. faced significant social tension when they became a partner with a Venezuelan public company in 1994 to develop the project. The community of 2800 people, mostly artisanal miners and families, had already suffered some significant economic destabilisation from the relocation to new settlements out of the property in 1992. Unauthorised mining became evident as a potential problem. This also represented, however, a livelihood for 40% of the active population. With the escalation of the tension in the area, the company proposed a co-habitation program, establishing a project with the participation of the local community to create 126 ha within the company's property to initiate a small-scale mining operation. The company invested US$ 1 million in this project to foster a stable relationship between itself and the community. After an extensive effort to organise the miners and provide a legal framework for the operation, a training program was started. This program focused on the introduction of safety and environmental considerations and the improvement of life quality. A Mining Centre was created in 1997 including: a recreation area, cooking facilities and infirmary. Mercury was banned from the property and in 1999 the individual work of 200 miners changed to a more co-operative organisation with 50 miners receiving salaries and establishing production goals. Currently about 2 kg of gold is being produced per month and the mine is managed by a Miner's Association[19,20]. Unfortunately, the co-habitation solution has only involved a small contingent of people and, as yet, it does not provide economic diversity for the community, during and after mine closure. These efforts at this mine should be carefully examined. This case demonstrates that companies do see community participation as an important and viable approach to contemporary mining practices. Moreover, this company is recognizing that social instability and discontent (an important factor in political risk assessment) can play a far greater role in determining the ultimate success of a mining operation than has been historically calculated in mineral investment decisions.

4. Sustaining the Community

Today, as any mining company knows if it has experienced poor relations with local communities, sustaining the community is integral to sustaining an effective and respected operation. As noted earlier, a sustainable mining community should be based on the principles of ecological sustainability, economic vitality, and social equity. Examination of case studies shows a wide variation in circumstances and approaches taken historically.

The traditional route to a sustainable mining community has tended to focus on a three-step approach. The first was to establish infrastructure to support and nurture the workforce. Mining companies in Canada, for example, set high standards in being the driving force to create towns and infrastructure with medical, educational and utilities support. Noted examples of towns, planned specifically to support mining operations, include Leaf Rapids in Manitoba and Fermont in Québec. Some of the communities that grew within such towns and infrastructure have evolved further through diversification, whilst others have wilted after the departure of the mine on closure. The second step was to generate sustained employment through discovering and mining all available ore deposits in the locale. Communities such as Flin Flon and

Snow Lake in Manitoba, for example, have been sustained by the continued discovery and operation of many ore deposits within reasonable proximity to these towns. The third step generally was to leave infrastructure such as roads, power, and housing to local communities when the mine was closed or in remote areas to demolish it. The planning for mine closure has been only a relatively recent development and its scope and practice is still evolving. In the past, contributing infrastructure has been viewed by many companies as leaving a major asset and donation to the communities. While the hard infrastructure remained, the soft infrastructure (social considerations) and the environmental residues were left primarily as responsibilities of government. Experience has shown, however, that bricks and mortar are no substitute for enlightenment, education and organization. Villages left behind by mining companies can become shanty towns, as the example in the Amazon region has demonstrated. If their location is appropriate these may be fortunate enough to become tourist destinations as resorts or heritage sites, such as New Denver or Barkerville in British Columbia. Today, in both highly developed and developing economies, the approach to creating a sustainable mining community has changed. There is now a requirement to contribute to the ecological integrity or viability of the local bio-physical environment, to diversify the economy into different areas, and to consider long-term community sustainability.

The advent of developing mines as long-distance commuting (LDC) or “fly-in fly-out” operations has added a further dimension to planning for sustainable mining communities. The first use of LDC in Canada was at Asbestos Hill in Quebec in 1972. In LDC operations, remote mineral deposits are mined without the development of the traditional mining town. It brings its own set of implications for rural and remote communities. LDC work cycle rotations have an impact on small communities and family life, particularly if that community has not experienced this type of mine employment previously. A greater concern for declining mining communities is the prospect that they may be “flown-over” by companies that may choose to hire mine employees from larger regional centres rather than from the smaller, more remote towns. On the other hand, LDC operations can be far less environmentally disruptive if the alternative is to build a new mine town. Significant environmental (socio-economic and biophysical) costs accompany the building of a mining community with its requirements for extensive infrastructure, schools, social and health programs needed to sustain people in a remote setting. A LDC operation can avoid many of these costs by flying in workers from established towns. The opportunities and costs posed by this type of operation for the company as well as for the affected mining towns need to be carefully weighed on a case-by-case basis. In developing countries there may be a reluctance to support LDC rather than promote the enhancement of a local workforce, for example, Placer Pacific's Porgera mine was originally intended to be operated on a fly-in, fly-out basis, but these plans were dropped at the request of the PNG government[21].

The attention of mining companies to the surrounding social environment has historically been devoted to the reduction of conflicts or compliance of legal requirements rather than its long-term sustainability. Sassoon[22] highlights the importance of a serious Environmental (and Social) Impact Assessment (EIA) as a commitment for companies to establish environmental management, not use it as a simple document to pay lip service to legislation. One will often hear of community consultation and it has increasingly been practiced throughout the world. Consultation has been intrinsically part of Environmental Impact Assessment in many countries as a way to provide companies with some thoughts and guidelines about how to interact effectively with communities. Basic strategies are offered by social scientists to reduce the difficulties companies have when dealing with the public[23]. The community needs to fully understand the mining project and its costs and benefits. This type of communication can serve as a basis for its involvement in a joint problem-solving process. From the community's perspective, such a consultation can result in a far better understanding of the proposal issues covered in the EIA and can contribute to a successful working partnership[24].

5. Community Consultation and Capacity-building

Consultation, can make the life of a company somewhat easier but it will not in itself achieve community sustainability. What is being suggested here is a significantly more fundamental change, a change that is related to questions of power, resources, and control. Resource-based communities throughout the world, including those in Canada, have historically been at the mercy of events and decisions happening outside their control; whether it be fluctuating world prices, foreign-owned companies, international trade organizations, or domestic governments that primarily serve the interests of the politically influentially urban, metropolitan regions. At the heart of the problem then is a question of social equity. Until community members themselves feel that they are partners in decisions that intimately affect their own lives and the environment in which they live, little progress on the path to sustainability will be achieved. As some analysts have pointed out, what is required is "resilience through local governance"[25]. With "volatility, uncertainty, unpredictability and at time incalculability" the norm, then a flexible, adaptable local process is needed, where communities can "withstand the periodic or sporadic economic misfortune that besets all resource communities at some point in time"[25]. Rather than having companies or state governments determine the future and structure of communities, a system of local governance needs to be established. This system of local governance is one that should include all community groups and actors not just the local political representatives. This participation takes place before, during and after mine development. Warhurst et al.[26] have stressed that the socio-economic impact assessment needs to be an ongoing process throughout the life phase of the mine and decommissioning. The authors suggest that the consultation process needs to move from an almost exclusive focus on the operational period of a mine to have similar emphasis during both exploration and closure phases. This pro-active approach reduces misinterpretation in expectations during the exploration and reduces impacts of a mine closure on the communities. The problems of coping with closure at the community level ranges from unemployment and family disruption to destruction of the environment and consequent loss of economic opportunities for communities after closure.

The first step to community sustainability, then, may relate to local capacity-building and local governance. Community members are given choices about how the mine is developed within the community, and how tradeoffs can be made within the constraints of the available financial, social or natural capital. Developing a sense of efficacy and control within the community leads to political, local and social stability. For a community to have long-term resilience in Canada or abroad, Paget and Walliser[25] suggest that local governance can achieve several benefits including:

- embrace and foster a broader concept of community governance;
- elevate social development to a position of at least equal prominence to development efficiency;
- actively involved local residents in the process of making decisions for themselves.

With such an internal capacity, communities are in a stronger position to respond to rapid economic changes and the prospect of uncertain futures generated by external forces.

6. Planning to Add Community Value

The next step is to consider what benefits the community might gain from the development of a mine in the region. If it acts according to principles of sustainability a mine represents an opportunity to add value to its community. Value may include many of the safety, health, and economic benefits mining companies traditionally consider, such as:

- direct employment;
- ancillary economic activity, supporting the mining activity (e.g. mining suppliers);
- water, power supply, transportation and other infrastructure;
- enhanced land quality and agricultural opportunity;
- healthcare, safety improvements;
- educational facilities, programs, scholarships;
- communications and information systems;
- recreational facilities;
- fostering cultural activities;
- alliance with other natural resource or manufacturing activity in the locale;
- diversity: through sponsorship of new economic activity.

Beyond that, however, companies need to think about how introducing a new mine could bring about long term biophysical and socio-economic improvement to a region that is consistent with holistic principles of sustainability. This means that sustainable decisions are not ones that result in zero-sum equations where there is a dramatic trade off between immediate jobs and long-term ecological integrity. As the earlier mine case studies demonstrate, the issues are complex and may not be readily resolved. They will require attention at the level of international trade organizations and decision-making bodies, involving financial institutions, governments, non-governmental organizations, and influential mining associations. It is often at this level where the preconditions are established for local sustainability. Given the current prominence of concerns about tailings dam failures, companies will need to establish their credibility in terms of both the management and design of waste disposal systems. Instituting mechanisms of independent environmental audits and independent environmental reporting would go a long way toward convincing communities and ENGOs that a company is committed to environmental protection[27].

It is not suggested here that the quest for a sustainable community can be readily resolved. An important first step would be to define a general goal. For example, a fundamental decision-making principle for any sustainable mining community development might be: does the mining company operate on an ethical basis in a way which contributes to the well-being of the present community and leaves a sustainable legacy for future generations? In the words of George Francis[2]: "Sustainability is ultimately an ethical commitment based on a belief that the natural world and its component life forms, including humanity, have value in and for themselves".

7. Conclusion

The world's mining industry is facing many challenges with respect to dealing with human interaction with physical and social environments. Many companies have invested considerable resources in technological innovation to increase productivity and competitiveness. Benefits also relate to improved health and safety, as well as quality of the environment. Attention still needs to be given to finding innovative approaches to establishing long-term benefits for the communities created or enhanced by the presence of the mining operation. Developing resilient communities, long-term benefits, and shared decision-making processes may not come easily to mining companies but experience indicates that the diverse needs and requirements of communities must be acknowledged and respected. Such an approach recognizes that community sustainability is not simply another management problem: something that needs resolution much in the way that a technical difficulty might be tackled. It is a completely different philosophy based on a concept of sharing benefits and responsibilities with local communities. This is a philosophy that goes beyond mere co-existence; it is one that promotes concepts of industry-community co-participation in the mine building process. As Canadian mining companies are moving to underdeveloped regions it is paramount to understand how the singularities of poverty and lack of power affects the long-term health of the mining community. Built into that understanding is a recognition that local people need to make decisions about what "benefits" they would like to see to fit their own cultural needs and physical requirements. As such, there is no unique formula. Adaptability, flexibility, responsiveness, and mutual respect for people and the biophysical environment on which we all depend are the principles upon which future mines need to be built if they are to follow a more sustainable path.

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MINING HERITAGE & CLOSURE MINES

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ABSTRACT

The deep and continuous changes that come affecting to technologies used in the mining industry have left a great heritage that a modern average multidisciplinary -and from all the corners of the planet- it is overturned in that constitutes a rich base with that to put heading for a more promising future. A town that is not able to lean on and to defend its past, difficulty will be able to face the future with clear perspectives of progress and obtaining of a better quality of life. The mining heritage is the history of the towns that successively have come using the matters minerals, and therefore it is part of the humanity's history, being for it very necessary today in day that the importance is valued that the extractive activities have possessed and they possess in our to happen daily, and that it is protected to the maximum as generating source of wealth and important alternative to the future development of many depressed mining areas.

INTRODUCTION

A high level of concern exists to international scale to be able to preserve for the future generations all those useful -machines, tools, tackle, etc. - and materials related with the production in the traditional industries that have left outside of use a series of direct testimonies after their closing, as the railways, power-house, industrial facilities of the steel, textile or coal that they are part of our more recent history and that the new technologies, the use of new materials –as plastics, for example- and modern activities have left in disuse and, in many cases, forgotten.

This phenomenon, known by Industrial Archaeology, has its beginnings in the XIX century, but it is not up to 1960 when its diffusion begins and already in the decade of the 70 when it takes doctrine body and it ends up consolidating trying to investigate, to analyse, to register and to preserve the remains of any industrial activity, being begun from then to put in value the materials abandoned by the industry, and to try society takes conscience of its patrimonial value and of the necessity of its conservation for use and enjoyment of the future generations.

The mining heritage tries to preserve, to conserve and to disclose all those elements characteristic of the extractive activity that have had a great protagonist, ending up being denominated mining-metallurgist heritage more openly to be able to include to the final result of the extraction that is the obtaining of the metal.

The mines represent an important heritage, because they are an example that conjugates the geological and mining aspects that we need to protect and preserve for to be able to transmit it and to disclose it and that this way it is known better.

The figure of the natural heritage has always made shade to other considerations –like geological and mining -, being today the figure of cultural park or ecomuseum one that is uniting all the patrimonial aspects. Nowadays there are already many the natural parks that include the protection of the mining heritage inside their enclosures, toward a work of conjunction of values and betting for a new model.

THE MINING-METALLURGIST HERITAGE IN WORLD

Today in day there are many associations and organisations that exist all over the world in behalf of Industrial Archaeology and recently they have arisen a great number of them with the thematic one it specifies and it sums up of the mining activity, aided under the term of mining-metallurgist heritage and that they have been divided of the industrial archaeology constituting for if alone one of the thematic but important association. A clear example of international level is The International Committee for the Conservation of Industrial Heritage (TICCIH) that completed its 25 anniversary in the 2000 that it has a section dedicated to the mining heritage and that it summons a next scientific meeting in June of 2001 in Butte, Montana, U.S.A.

In November of 1998 the European associations (Belgium, Finland, France, Germany, Greece, Ireland, Holland, Portugal, Spain, Great Britain, Slovenia, Czech Republic...), related with the industrial heritage, gathered in Barcelona (Spain) -a petition of the Belgian association agreed - that the 2002 were proposed for the European Industrial and Technical Heritage Year. In November of 1999 it is founded European Federation of Associations of Industrials and Technical Heritage (E-FAITH).

Next we pass to expose shortly which are the most excellent facts that have been happened in some countries with regard to this phenomenon of the Industrial Archaeology and the mining heritage.

In Ireland the organism that takes the responsibility of its conservation is the Geological Survey of Ireland through the Heritage Service created in 1845 and present at this year 2001 will open its doors the National Mining Heritage Centre in the mines of Shalle. In 1996 the Mining Heritage Society is created and already in 1998 they started: the Mining Museum of Arigna, the Glengow Silver and Lead Mines and the Quarries of Liscannor, already existing other projects in march like: the Allihiies Museum, Avoca Mines Heritage it Mines Park, The Bunmahon Cooper Coast -all of them old copper mines - and Castlecomer –on coal mining-, and on the other hand a mine of the age of the Brass in the centre of the Killarney National Park (Puche, 1999).

In United Kingdom, it is in 1959 when the British Archaeology Council founded the National Survey Industrial of Monuments dedicated to the inventory and conservation of monuments. In 1968 the Foundation of the Museum of the Valley of the Iron Bridge is created and nowadays the Ironbridge Gorge Museum, with a surface of 15,5Km^2 and with 300.000 visitors a year, they bills about 10.800 million pesetas lives (about 50 millions $USA); also, there are other important museums like the National Coal Mining Museum and the Peak District Mining Museum, or with smaller entity like the Florence Heritage Mines Centres, in Egremont, West Cumbria. In 1968 he/she took place the First International Congress of Industrial Archaeology. It is also the National Association of Mining History Organisations, NAMHO, from 1979 with 70 entities removed in 40 mine-museums, 20 societies and 10 institutional members, besides some 2000 people, of those that single three societies integrate practically half of these people, that are: Peak District Mines Historical Society Ltd., Northern Mines Research Society and Shoropshire Caving & Mining Club. Other communities are the Association for Industrial Archaeology and Trevithick Society. Also in United Kingdom is the Historical Metallurgy Society.

In Portugal the Geological and Mining Institute has inventoried all the points with interest in mining heritage and it collaborates in several projects in the Pyrite Belt: Mining Park de Cova dos Mouros, Lousal Mines (Grândola), Mine of Aljustrel and Sacred Domingo. The mine of Neves Corvo has already before its closing a musealisation project. It exists enough interest in constituting an Iberian Society for the Defence of Geological and Mining Heritage. From 1980 the Portuguese Association of Industrial Archaeology is developing an important of protection work and divulgation of mining and industrial heritage. Already in 1998 it organised a titled seminar The Archaeology and Mining Museology, in Lousal-Lisbon.

In United States there are many mine-museum of gold, uranium, copper, etc. Some examples can be the Western Museum of Mining and Industry in Colorado Springs, the Black Hills Mining Museum in Lead, South Dakota, Sterling Hill mine in Ogdensburg, in New Jersey underground -mine of zinc -, World Museum of Mining in Butte, Montana, and the National Mining Hall of Fame in Leadville, Colorado, the Crystal Gold Mines, Idaho, the Minnesota Museum of Mining in Chisholm, and the Bisbee Mining & Historical Museum, Arizona. Among the existent organisations are the Society of Mining Law Antiquarians, the Society for Industrial Archaeology and the Mining History Association.

In Canada several mine-museum projects already exist, such as British Columbia Museum of Mining, in Britannia Beach, on copper mining, Bell Island Mines, in Newfoundland, Cape Breton Miner´s Museum, in Glace Bay, Nova Scotia, Atlas Coal Mine Historical Society, in Drumheller, on coal mining, and it is also in Alberta the Association Québécoise pour le Patrimoine Industriel.

In Japan it is of highlighting the Ashio Mining Museum that has received 500.000 visits in one year (Mining Journal, 1999), and other like the Yunooku Gold Mining History Museum.

In Australia the Australian Mining History Association exists from 1995 with more than 130 collective members and singular (Mining Journal, op. cit.). The State Mines Heritage Park & Railway is a good Australian example of the setting in value of the mining heritage.

In Germany it is founded in 1906 the Deutches Museum von Meisterwerken der Naturwiessen chaft a Technik of Munich, by the hand of Arthur Miller who is the precursor of the Industrial Archaeology. As for mining museums, the Deutsches Bergland Musseum in Bochum, inaugurated in 1930, and that today it receives 400.000 visits a year (Mining Journal, op. cit.) and it is located in full carboniferous mining basin of the Ruhr. In 1934 the Musée of Houillére Mine (Saraland Mines - Museum) is founded at Bexbach in the carboniferous basin of the Sarre. Also in Germany is the Society for Mining Archaeology.

In Austria they opens up to the public in 1930 the underground Hinterbrúll gypsum mine, located in Modling that had been in activity during the period 1848-1912.

In Sweden has a good example of ecomuseum with its the Bergslagen Ekomuseum that embraces a mining region constituted by seven municipalities where they can visit mines, foundries, forges, energy power stations, the miners' housings and the bosses' palace-residence and so on. In Switzerland exists the Société Suise d'Historie des Mines.

In France in 1791 it was built museum of the Technique of the World, the Conservatoire des Arts et Métiers in Paris, but it is not until the years 60 is when the Industrial Archaeology is born. In 1960, to initiative of Raymond Aubet, becomes to the Mine Temoin d'Alés a Centre Historical Miner, and in 1966 it founded the Museum of

Nancy's Iron. In 1976 the ecomuseum concept is born in the context of a colloquy in Le Creusot titled Industrial Heritage and Contemporary Society. Exists in France The Association pour L'Étude des Mines et de la Metallurgie under the direction of Le Centre de Culture Scientifique, Technique et Industrielle, and the Equipe Interdisciplinaire d'Étude et de Recherches Arqueologiques -ERMINA- sur les Mines Anciennes et le Patrimoine Industrel. In the last 10 years a mining-tourist centre opens up half yearly, proliferating many mine-museum, historical-mining museums, ecomuseum, museums of the territory, geomining parks, etc., such as the Mine Blue, in Noyant-la-Gravoyère, or the Centre Historique Minier of Lewarde, that overcome the 100.000 visitors a year (Puche, 1996). Other examples are Ecomuseum Le Creusot-Montceau-les-Mines in Borgoña metallurgic-mining region, and Le Musée de la Mine de Cap Garonne.

Also, and with the help of the Spanish Society (SEDPGYM), in Latin America recently several similar American Societies have been created –with objective of the defence of geological and mining heritage-, such as the Oriental Cuban Society (Moa, Holguin), the Nica (Managua, Nicaragua), the Salvadoran (Republic of El Salvador), and the Boyacense (Sogamoso, Boyacá, Colombia). In July 1997 it took place in Quito (Ecuador), in the frame of the 49 International Congress of Americanist, a Industrial Archaeology and Conservation of Mining-Metallurgist Heritage Symposium in Hispanic world. In September of 2001 it will take place in Santiago de Chile that will be Third Latin American Colloquy on it Rescues and Preservation of the Industrial Heritage, as continuation to those carried out in Mexico and Cuba.

THE HERITAGE MINER-METALLURGIST IN SPAIN

By the middle of 1994 an idea arises in Spain –after the International Congress of Mining and Metallurgy in León- and in 1995 fifty people's April -among those that the Spanish joint author of this report was- they take place in Madrid the Assembly foundational of the Spanish Society for Defence of Geological and Mining Heritage (SEDPGYM) being legalised in October 9th of that same year. Today it possesses near 400 partners and carries out a nurtured number of activities that they go from the impression from their Bulletin to the organisation of five Scientific Sessions –the last in the mining district of Linares, Spain November 2000-, being convocated in these moments the sixth –a to take place in Beja, mining district of Baixo Alentejo, Portugal in October 2001-, and that in turn it will be the II International Congress about this topic. Also, this Society carries out other activities along the such year as field trip, exhibitions, cycles of conferences, seminars, collaboration in the foundation of geological-mining museums, etc.

As examples of experiences in those that has put on in value their Mining Heritage, some with more consolidation degree and others with the setting in work of so alone the first phases of wide projects, they can make an appointment the following ones:

Mining museum of Cerain (Guipúzcoa) next to Legazpi, museum project, facilities metallurgical, train mining etc.

Museographical Complex of Mining, in Barruelo of Santullán (Palencia), consistent in a visitable mine, a cultural centre and an interpretation centre with more than 600 m^2 on topics geological-miners.

Museum of the Mining of Castilla-León in Sabero (León) located in the restored building of the old Ironworks San Blas.

Mining Historical museum Francisco Pablo, from 1988, in Almadén (Ciudad Real) -mercury mining.

Museum of Puertollano (Ciudad Real) –coal mining-.

Museum of Gavá (Barcelona), you mine prehistoric of Gavà, (Llobregat) –variscite, sílex, turquoise and oligist -.

Geologic-mining museum of Peñarroya-Pueblonuevo (Córdoba) –coal mining-.

Mine Museum of Cardona salt mountain (Cardener), in Catalonia, the humanity's declared heritage for the UNESCO.

Mining Historical museum D. Felipe of Borbón and Greece, in Madrid.

Mining and Industry Museum –MUMI– El Entrego, Asturias, with 75.000 visit –coal mining-.

Geomining Museum of Spain, in the Geologic and Mining Institute, in Madrid.

Museum Historical Miner of the Union (Murcia).

Mine Museum of Cercs (Bergueda), in Cataluña –coal mining-.

Mining park of Riotinto, with more 2000 m^2 expositives in operation, 22 km of mining railroad in operation, roman necropolis, rail museum, 90 km^2 of visitables areas mining, visitors' housing, ethnographic museum and approved project of mine underground-museum, and that at the moment it receives 40.000 visits a year.

Projects of geological-mining Park of Mazarrón and Archaeoindustrial Park of The Union (Murcia).

Pre-project of Geologic-mining and Industrial Park of Tharsis (Huelva), there has been formed a work commission recently with the mayors of the affected municipalities, unions and people of the mining company and other persons of area.

PERFORMANCE ON THE MINING-METALLURGIST HERITAGE IN PYRITE BELT OF HUELVA (SPAIN)

It is a new way of revitalizing this important legacy of the past conserving the signs of identity of the mining communities and of people that made it possible. In these mining places it has been the print of the different technological advances, the stamp of the nationality of the operating mining companies and some aspects of the life that it was developed in each time.

In the historical pyrite belt of Huelva (Spain) they goes existing certain degree of social understanding on these topics, thanks to the important work that they come carrying out organizations like the Association of Friends of the Railway “Riotinto Mining Area” for some years, all the mines had its mining railway since of which they have been a great quantity of elements that they integrate the important historical mining heritage of the pyrite belt.

On the other hand, since in 1987 the Rio Tinto Foundation was created for the Study of the Mining and Metallurgy, this has impelled in a constant way the preservation of all material that can constitute an important database for investigating futures and it has developed a great project of Mining Park of the mining District of Riotinto, carried out with the support of continuous convocations of School-shop with twice as much objective of to conserve the mining-metallurgist heritage and to form professionals in this and other topics of among the youths of the district.

Something conservation and restoration projects they are that steam machine – that they puts into operation the first days of every month-, railway materials, wooden and metallic mining shafts, and construction of a complete space of Roman gallery is also culminating.

Another important activity is that of the Centre of Historical-mining Investigation of the Foundation, constituted at the moment by the historical archives a lot of mines, cartoteque, library and a great phototeque.

Nowadays great interest exists for the conservation, defence, divulgation and exploitation of this important heritage from diverse organisms and public institutions, such as city councils, Delegation of Huelva and University of Huelva that are summing up for example in restoration of locomotives, archives cataloguing, preparation of projects, realization of defence meetings of mining-metallurgist heritage, industrial archaeology, etc., in different towns and mining centres of the county.

THE MINING HERITAGE AS USE ALTERNATIVE

The essential philosophy of the use of the mining heritage as alternative of development of the mining regions consists on studying the possibilities of recovery of the area from all the points of view, not exclusively from the environmental means or landscape. Any project that it tried to return some areas with big exploitations to their initial natural state not alone would be impossible or inviable but rather it would not be keeping in mind the future socio-economic of communities of environment.

The idea that should prevail is "environmental recovery yes, but without destroying the heritage", since this can be considered as an exploitable resource -after finish mining activity- of such an important value or more than as benefits generated to the mining company and the society by the properly this exploitation.

Also, they must have very in mean necessities so much current as future of communities with purpose of being able to prioritise among possible use alternatives: recreational usage (wetlands and artificial lagoons, schools of risk sports, escalade, rockdromes, amphitheatres), environmental uses, diversion areas, dumping-places, residential areas, agricultural or forest uses, industrial facilities, etc. Also, and in a simultaneous way, it would be necessary to study their patrimonial value, in such a way that if this it was of great interest could optionally to carry out a project of type Museum or geo-mining Park.

What it is necessary to have very clear to undertake this type actions, it is that any project type that it is tried to approach it should conjugate aspects -such multidisciplinary as anthropological, archaeological and historical studies- that try of giving explanation to the changes that have left taking place in the work industrial productive -processes, relate social, technology, etc.-, in ways of life inside the exploitation and in the communities, allowing us everything it the understanding of the missing mining culture and the knowledge of the socio-labor conditions in those that lived.

This type of projects converges toward the denominated ecomuseums, open museums or cultural parks where they gives way the idea of static museums and it is focused toward a more dynamic model and with an important load of human aspects, where the elements are in situ and even in operation, and where you can usually appreciate, also, the manual and artisan work.

MUSEALISATION AND THEMATIC PARKS

The tourism, source of very important revenues for many countries, is an activity that is in constant evolution being continually to adapt to the demands of the market that every day is much more demanding and it requests something more than sun and beach, opting for an interior tourism, a tourism more in consonance with the environment and the country space –rural tourism- and with some strong connotations of cultural type. This joint must be taken advantage of by the organizations defenders of the heritage and to get the enough institutional support to undertake actions guided toward the setting in value of this rich historical-cultural legacy.

In this sense during these last years have increased considerably -so much on the part of the private initiative as public- interest for this type of tourism, what has been translated in the proliferation of great number of museums –musealisation- that have had great importance like source of revenues of depressed areas because of the end of a certain predominant economic activity. This tendency for the mining culture has international character, but it has been developed mainly in the most advanced countries as Japan, USA, the European Union, Canada, etc. In Europe three Mine-museum, Lewarde (France), Wieliczka (Poland) and Kerkrade (Holland), they possess more than 100.000 visits a year (Puche and Mazadiego, 1997).

As example of this new tendency the Ironbridge Gorge -with a surface of 15,5 km^2- is one of the first museums that pursues the objective of the recovery of the industrial heritage. It is located in one of the English valleys of the Serven river in which during the XVIII century that it was a region with a tremendous activity thanks to the exploitations of coal and to the trade of the iron, being the bigger centre producing of iron of Great Britain. Today in day it receives more 300.000 visitors year, with a cash of 10.800 million pesetas, about 50 millions $USA (Puche, 1996).

The Cultural Parks integrate multiple aspects at regional level. As model of this type of parks it can comment Aragon Government (Spain) interest that promulgated a law of creation of cultural parks. As example of this politics it is necessary to mention the Cultural Park of the River Martin, in Ariño, that includes many thematic –rupestrine arts, geology and speleology, fauna, flora, Iberian culture, palaeontology and popular arts- besides creation a Congresses centre in an miners old school of mining company SAMCA. What is pretend with it is it that people become aware of the rich heritage that possesses in the area that values it and mainly that participates in her conservation.

The modern idea that is also pursued today in day is that the Museums be able to interpretation centres, investigation and formation.

CONCLUSIONS

From it has been exposed in this article can be extracted the following conclusions:

1) it exists great concern and international sensitization to preserve the history of the mining and, in consequence, a culture that it needs to be diffused through museum experiences, cultural parks, etc.

2) it is necessary to undertake diffusion actions and development about the necessary protection and defence of great value that it represents the mining heritage, as the humanity's heritage, through the development of projects and publications as well as to generate several activities as courses, shops, conferences, divulgatives meeting from primary school, etc.

3) we have the obligation of preserving for the future this heritage, as historical inheritance that our ancestors have bequeathed us.

4) this task must be multidisciplinary and in her it must involved to communities.

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