CANADA'S MINING HERITAGE – BALANCING THE HERITAGE PRESERVATION WITH THE ENVIRONMENT, HEALTH AND SAFETY[1]

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Abstract: When developing and implementing mine closure plans at most mine sites in Canada, there is no need to consider the heritage value of mining structures or other features, such as mine head frames. In general, structures are removed at the end of the mine life, and sites returned to something resembling the pre-mining state. However, at some sites, heritage considerations can make mine closure more complex. In Cobalt, Ontario, abandoned silver mines are subject to a mine closure plan and at the same time many of the mines are part of a National Historic Site and are the focus of efforts to increase tourism in the area. This presents challenges for reclamation and can leave those concerned about reclamation at odds with those concerned about heritage. However, the two need not be seen as mutually exclusive. In Cobalt, efforts have been made to preserve historic head frames, mill foundations, and other signs of Cobalt's heritage. At the same time, efforts have been made to assess the potential health risks to visitors to these sites, due to concerns about contaminated soils and other materials. In Cobalt, there is much work still to be done, and lessons still to be learned and applied. Examples from other sites may help inform future work in Cobalt and other areas in Canada where the needs of heritage and reclamation need to be balanced. Relevant experiences at the Britannia Mine Site in British Columbia and heritage sites in the United Kingdom could be considered in planning and implementing future reclamation activities in Cobalt.

Keywords: mining heritage, Cobalt, mine closure, remediation, arsenic, Britannia, Cornwall

Introduction

In recent decades increasing attention has been focused on the importance of mine closure. Gone are the days when it was normal for a mining company to abandon a mine site with no regard for the environmental or safety hazards left behind. Across Canada jurisdictions have in place mine closure legislation and from a technical perspective there is increasing acknowledgement of the need to design mining operations for closure, and to plan for closure from the earliest stages of the mine life cycle. In general the objectives of mine closure are:

- to ensure safety by preventing access to mine openings and other infrastructure;
- to provide for the stable, long-term storage of mine waste;
- to ensure that the site is self sustaining and to prevent or minimize environmental impacts; and
- to rehabilitate disturbed areas for a specified land use.

In Ontario, mine closure is regulated under the *Mining Act*, which requires all mines in the province to submit closure plans. The Act specifies information to be included in a closure plan and also includes the

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"Mine Rehabilitation Code of Ontario" (Schedule 1) which details requirements with respect to mine openings, tailings dams and other containment structures, surface water and groundwater monitoring, metal leaching and acid rock drainage, physical stability of sites, and revegetation.

The Ontario *Mining Act* is silent on whether structures on closed mine sites should be removed. Schedule 1 of the Act specifies that "the physical stability of all surface structures shall be monitored for structural integrity." However, some jurisdictions are more explicit on this issue. For example, the "General Mine Closure Guidelines" of *Mine Closure Regulation 67/99* for Manitoba state that, for buildings "walls must be razed to the ground; foundations should be removed but if they must remain, they must be covered with a sufficiently thick layer of growth media to permit the establishment of self-sufficient vegetation."

While removal of buildings is not required in Ontario, mine closure at most sites does include the removal of buildings. For example, the headframe and other buildings of the North Coldstream Mine were removed and the site was revegetated (Fig. 1) under the Abandoned Mines Rehabilitation Program of the Ontario Ministry of Northern Development and Mines. At most sites this approach is not a concern, and makes the most sense in the context of the objectives of mine closure. However, this practice becomes problematic when these structures are also heritage resources.

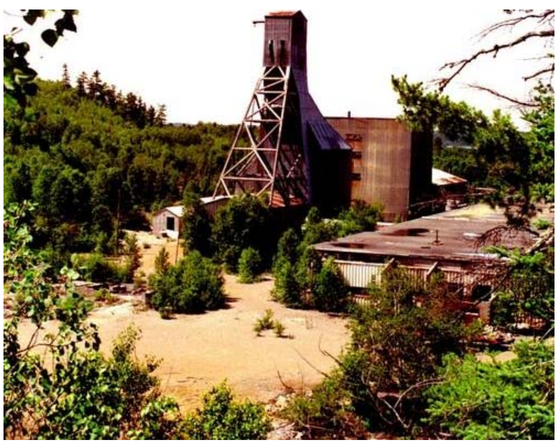

Fig. 1: The North Coldstream Mine near Burchell Lake in Ontario. Taken in 1993 (left) and 2001 (right), the photos illustrate the extent of mine reclamation work carried out on the site by the Ontario Ministry of Northern Development and Mines (photo credit: Ontario Ministry of Northern Development and Mines).

Mining Heritage

Abandoned mine sites are seen by most as eyesores at best, serious hazards at worst. Many, perhaps most particularly those from large cities, expect to see pristine wilderness when they travel to more remote parts of Canada for their summer vacations. They do not expect, or want, to be confronted with the sort of post-industrial "wasteland" all too common around abandoned mines. Yet what many do not realize is the essential role that abandoned mining structures, particularly headframes, play in the collective memory of mining communities. Mine headframes are simple structures, essentially serving as the top of an elevator shaft. Yet headframes are often the only visible sign of the work that goes on deep beneath them. And that is the key to their importance in mining towns.

Scattered across Canada are dozens of communities established after mines were discovered. These communities often continue to identify themselves as "mining towns" long after the mines have closed. For these communities the mining landscape and structures that remain after the mines close become a powerful component of their identity as mining towns and a memorial of a proud past. Thus, in these communities structures such as headframes are not eyesores, but part of their identity (Fig. 2).

In the book “Industrial Cathedrals of the North”, Cobalt author and now Member of Parliament, Charlie Angus, wrote that “Miners talk of specific mines the way sailors talk about individual ships, the way veterans invoke particular battles” (Angus and Palu, 1999). Acknowledging that mining is dangerous and that, sadly, many have lost their lives working underground, Angus added that “When a mine shuts down, the headframe remains as a cenotaph. Tear down this cenotaph and you attack a common memory.”

Fig. 2: Cobalt mine headframes, both now almost 100 years old (photo credit: the author).

The importance of Canada’s mining heritage extends beyond mining towns. Mining, like forestry, agriculture and fishing, has played an important role in the economic, social and cultural development of Canada. Historic mine sites, like old forts or trading posts, or other heritage structures across Canada such as residences, churches, bridges and barns, are part of our collective heritage and an important, living link to our history. Yet, often mining heritage is overlooked in Canada and is something associated with places like the United Kingdom, where mining history goes back hundreds or even thousands of years. But while Canada may lack mining heritage of such age, our mining heritage is no less important.

Mining Heritage in Cobalt, Ontario

In the summer of 1903 silver was discovered in Cobalt, Ontario, about 165 km north of North Bay. The discovery led to a staking rush and explosive growth as the town of Cobalt was carved out of the wilderness. In 1911, Ag production from mines in the Cobalt exceeded 30,000,000 oz. and the population had grown to at least 15,000 (Barnes, 1986). Mining continued until the 1930's, then slowed. Activity renewed in the 1950's then slowly dropped off, and there are no longer any operating mines in the area, though exploration continues (Barnes, 1986).

The mines of Cobalt and the prospectors and miners that discovered them and worked there have left an indelible mark on Canadian history. The discoveries at Cobalt led the way to further exploration in northern Ontario and Quebec, and Cobalt is regarded as the birthplace of hardrock mining in Canada. Cobalt also generated considerable profits for the mining companies and royalties for the provincial government.

The historical importance of Cobalt was recognized in 2002 when the area was declared a National Historic Site. In making this declaration, Parks Canada (2004) noted that it was because Cobalt:

- "is a rare cultural landscape possessing a large number of vestiges and buildings directly relating to the evolution of the hard rock mining process of the early 20th century in Canada; and,
- reflects an important period of hard rock mining in Canada, between 1903 and the late 1920s, that established a more secure investment environment for mining speculation and created financial capital for large-scale Canadian mining development in the first half of the 20th century."

Environmental Legacy

Mining in Cobalt also left an environmental legacy. Waste rock and tailings were disposed of with no regard for the environment. Waste rock was disposed of in dumps that extended outwards from mine headframes (Fig. 3). Tailings were dumped in the closest convenient depression in the land, including lakes and streams (Fig. 4). Waste rock and tailings are high in As because the ore in Cobalt was associated with arsenide and sulfarsenide minerals. Arsenic continues to leach from these wastes and most of the lakes and streams around Cobalt are laden with As. Despite recent remediation projects, Cobalt remains one the largest sources in Canada of releases of As. Estimates of the annual releases of As into Lake Temiskaming range from 10,000 to 18,000 kg – more than all metal mines operating in Canada in 2003, combined. (Beak 2002; Dumaresq, 1993; and Environment Canada, 2006).

There are also concerns that some of the mill foundations and nearby soils, including those at some sites on the Heritage Silver Trail, are contaminated with As and various metals and may pose a risk to those visiting the sites (Pagliarulo and Manca, 2005). The Heritage Silver Trail is a self-guided driving tour of several mine and mill sites in the area.

Fig. 3: Typical waste rock disposal practices in the early silver mines of Cobalt (photo credit: Canada Museum of Science and Technology).

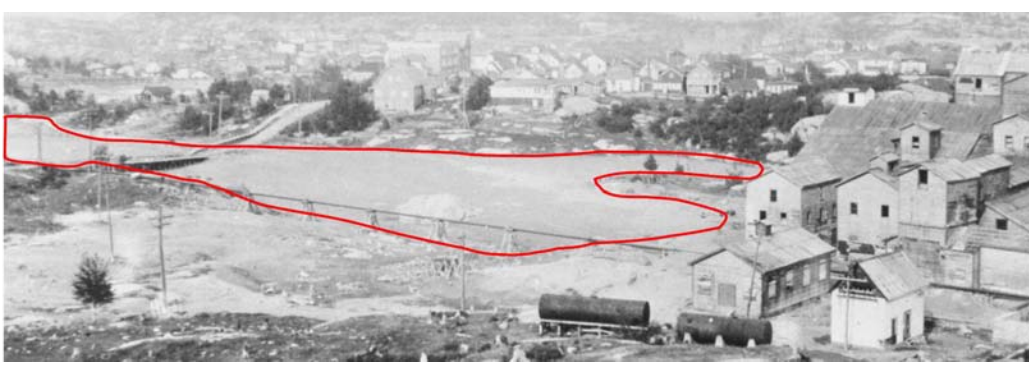

Fig. 4: Typical tailings disposal practices in the early silver mines of Cobalt. Tailings from the mill are outlined in red (photo credit: Cobalt Mining Museum).

The Challenge

The challenge in a place like Cobalt is clear – how to complete mine closure in the area and address the environmental concerns, thereby reducing the risks to the environment and human health, while respecting the heritage and historical legacy of Cobalt. Clearly, it is not an easy task. The challenge is both technical and social.

The technical challenges are related to the need to preserve the visual and structural integrity of heritage resources such as headframes, while remediating sites to reduce risks to the environment and human health. These technical challenges can be considerable. In many cases it is easier and less costly to remove headframes and other structures and to haul away contaminated soils and building materials for safe disposal, rather than to remediate sites in such as way that the heritage structures are preserved. The methods of remediating a site by this approach are well understood, but undertaking remediation that preserves heritage structures is less well understood.

However, the social challenge can be even greater. In some mining communities, efforts to remediate can be greeted with suspicion, for they can be seen as a threat to the community. This is further complicated in communities when the scope of environment concerns are either not understood, or are ignored or denied. Angus and Palu (1999) highlight how sensitive such issues can be in describing the demolition of the headframe of the O'Brien Mine in Cobalt in 1995. There were concerns that the headframe was structurally unsound, and presented a safety hazard. The company owning the headframe bulldozed the site and burned the debris. "The day the company burnt the O'Brien, the old men were gathered outside the post office, all eyes on the black smudge hanging over the timber line. Bill McKnight stood with his hawk face defiant under unruly, white hair barely tamed by a baseball cap. 'They're stealing who we are,' he said, 'Soon there'll be nothing left at all.' The other old ones, as if seeing bits of themselves in the funeral pyre, nodded grimly, 'They shoulda left the damned thing alone,' said one of them shaking his head." (Angus and Palu, 1999).

There has been progress in meeting this challenge in Cobalt. Despite the loss of the O'Brien Mine headframe and several others, many, such as those illustrated in Figure 2 have been preserved. At the same time, some tailings deposits have been remediated in an effort to reduce releases of As, reducing risks to the environment and human health. However, significant challenges remain. Mill foundations pose a significant challenge, particularly those that are contaminated with As and other metals.

In Cobalt, there is no clear path forward to addressing these challenges. Work done to address similar challenges at other mining heritage sites may provide some examples of how to meet these challenges in Cobalt and in other Canadian mining communities struggling to preserve their mining heritage.

Case Study in Mining Heritage – Cornwall and West Devon, United Kingdom

Cornwall and West Devon, in southwestern England, have been home to mining for at least 3,500 years, and by Roman times, Cornwall was already an important source of tin throughout Europe. Mining technology continued to slowly evolve over time, but the 1700s heralded a period of growth in mining in Cornwall. Cornwall became a centre for technological advances in mining and metallurgy and Cornish technology and workers influenced technological advances world wide. From the early 19th century Cornish mines also produced by-product As (Cornish Mining World Heritage, 2006).

In 2006, the mining landscape of Cornwall and West Devon was recognized as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO). In making this designation, UNESCO noted that there are unusual habitats and plant communities in the area that have developed on mine waste. UNESCO (2006) states that "these habitats and plant communities are distinctive precisely because they have adapted to some of the most polluted land in the UK, which has had and continues to have considerable impact, not only on the natural communities on the waste and spoil tips, but on the downstream aquatic and estuarine environments as well. Indeed, the issue of toxicity is a clear manifestation of the interaction of humans and nature in this special environment, and might be given more prominent recognition as an important element of the cultural landscape."

However, UNESCO (2006) also acknowledges the environmental concerns associated with these sites: "spoil heaps associated with the mines and particularly arsenic mines are toxic. There is a need to ensure that access to sites is kept away from potentially toxic areas. The wider issue of dealing with toxic water seepage from spoil heaps and mines is actively addressed by the National Environment Agency." Thus, even with World Heritage Site status, the environmental concerns around Cornwall remain, and efforts to remediate these problems are ongoing.

The mines of Cornwall present some interesting parallels with those in Cobalt. Indeed, some of the surviving works constructed to recover As are comparable in age to some of the sites in Cobalt. However, it has been noted (Sharpe, pers. comm., 2007) that while there are some spoils (tailings) in Cornwall, the problems with tailings may be more extensive in Cobalt, since many of the tailings in Cornwall were dumped into local streams and ended up in the ocean. Nevertheless, the challenges faced in Cornwall – a mining landscape contaminated with As which requires remediation, while respecting the significant heritage value of the landscape and at the same time making the heritage sites accessible and safe for tourists – are very similar to those faced in Cobalt and other mining heritage sites in Canada.

The Botallack labyrinth is a site particularly relevant to some of the mill sites around Cobalt. Mining at the Botallack site dates back to the early 1700s (The Trevithick Society, 2007), and the site, as well as the Levant Mine a few kilometers to the north, host some of the most spectacular historic mine sites anywhere in the world. The mine workings extended under the Atlantic Ocean and the mines were located along cliffs along the shoreline. (Fig. 5). This spectacular location has made the site popular with tourists for decades.

Fig. 5: Engine house of the Botallack Mine. (photo credit: Adam Sharpe)

The Botallack Mine closed in 1895, but early in the 20th century, efforts were made to reopen it, and it was during this period that the labyrinth operated. The labyrinth, constructed in 1906, was intended to recover As associated with the tin ores. The tin ores were roasted in a type of furnace known as a calciner, and the off-gases from the roasting process included As and sulphur dioxide.

The purpose of works such as the Botallack labyrinth was to recover As from these off-gases. The labyrinth consisted of a series of flues adjacent to the calciner. The off-gases were directed through these flues and within the flues the gases cooled and As condensed on the walls as a crystalline deposit or as soot. To ensure adequate cooling of the gases and maximize the recovery of As the flues were folded back upon themselves in zigzag fashion, hence the name "labyrinth" (Sharpe, in press). To recover the As the system would be shut down a couple of times a year and workers would scrape the As from the walls of the labyrinth and haul it out (Society for Industrial Archeology, 2002).

In preparation for site remediation and restoration, samples were collected within and around the labyrinth to assess As concentrations. Within the labyrinth As concentrations ranged from 87 to 25,920 mg/kg. Arsenic concentrations were highest within the interior of the labyrinth itself, as well as in soils next to the chinmey. This was attributed to the fact that these areas were less exposed to weathering (Sharpe, in press). For comparison, As concentrations in 15 samples from two mill sites that are part of the Heritage Silver Trail in Cobalt ranged from 140 to 42,000 mg/kg, with a mean of 6,906 mg/kg. The As concentrations in 48 samples collected from a mill site adjacent to the Trail ranged from 420 to 190,000 mg/kg, with a mean of 29,789 mg/kg (Pagliarulo and Manca, 2005).

Prior to remediation a risk assessment was undertaken and procedures were established to ensure the safety those involved in the remediation work. To remediate the site, hand and machine excavation was used to remove As-bearing materials. The walls of the labyrinth were then scraped and finally cleaned with a high pressure washer. All wastes from the remediation work were collected and disposed of appropriately. To prevent exposure to any residual As the floors of the labyrinth were then covered with a geotextile fabric and a layer of clean material (Sharpe, in press). Once the remediation work was complete and the site was safe for both workers and tourists, restoration work was carried out (Fig. 6).

Fig 6: The Botallack labyrinth As works in Cornwall, UK, before (left) and after (right) remediation and site restoration (photo credit: Cornwall County Council).

Remediation methods used in Cornwall have developed over time, and it has not been possible to remediate and restore all sites the degree of the Botallack labyrinth. For example, the As works of the Levant Mine were remediated in 1995. At that time, it was decided that remediation of the sort later used at Botallack was not possible because (Sharpe, in press):

- it would be difficult and potentially dangerous, given the risks to workers from exposure to As;
- such remediation was unlikely to be achievable without damage to the structures themselves; and
- high levels of residual contamination would remain, posing a hazard to the visiting public.

As a result, two options were considered for the remediation of the Levant site: removal of the structure and excavation of the site down to bedrock or its burial beneath a layer of geotextile covered clean material. It was decided to bury the site in hopes that it could be remediated with more appropriate methods in the future (Sharpe, in press).

Case Study in Mining Heritage – Britannia Mine, British Columbia

The Britannia Mine site is located on Howe Sound in British Columbia, a short distance north of Vancouver. The mine operated from 1902 until 1974, producing Cu as well as Zn, Ag, Au, Cd and Pb (URS, 2002a). A mill which opened in 1923 still stands on the site. Like those in Cobalt, the mill was constructed on a hillside and used gravity to feed ore through the various milling and concentrating processes. It is the last remaining mill of this type in Canada (BC Museum of Mining, 2007). The mill is the home of the BC Museum of Mining and was designated a National Historic Site in 1988. Like the headframes and mill foundations of Cobalt, the mill structure of the Britannia Mine has a key role in community identity. In the words of one long time resident, “as long as the Museum remains open, the grand old mine will always be with us” (www.bcmuseumofmining.org).

Until the late 1950s, this site was accessible only by boat (BC Museum of Mining, 2007). Much has changed since then – Britannia is on the “Sea-to-Sky Highway” from Vancouver to Whistler, which is being upgraded in preparation for the 2010 Winter Olympics. Thus, while the Britannia site presents similar challenges to those in Cobalt, it is a much higher profile site.

The site is well known for significant problems associated with acidic drainage from mine workings higher up the mountain side south of the mill. The efforts to remediate the acidic drainage problems at the site and to treat water discharged into Howe Sound have been documented elsewhere. The focus of this discussion is the mill site itself and the adjacent area on the shores of Howe Sound – the community of Britannia Beach, also known as the “fan area.”

Detailed studies have been conducted in the fan area to characterize the area and risk assessments have been carried out. Metals contamination of soils, groundwater and water and sediments, both freshwater and marine, are widespread in the fan area. The main contaminants of concern are Cu and Zn, but Sb, As, Cd, Cr, Pb, Se, Ag and Sn also occur (URS, 2002b). The human health risk assessment focused on surficial and subsurface soils in the fan area as well as groundwater, intertidal water, and sediments in Britannia Creek and in the intertidal area. This risk assessment concluded that the fan area “does not present a significant risk to the receiving human environment” (URS, 2002a). However, there is potential for adverse environmental effects in both the terrestrial and aquatic environments (URS, 2002b).

Assessment work in the fan area identified a number of sources of metals in the fan area, including residual concentrate located adjacent to the mill, a sedimentation pond and a settling pond, and soils on the slopes adjacent to and above the mill (Golder Associates, 2003a). Thus, while the mill structure itself as not source of contamination, there were materials immediately adjacent to the mill that were sources.

The closure plan for the site identified a number of immediate actions, and actions to be completed in the longer term. Immediate actions in the fan area included (Golder Associates, 2003b):

- removal of residual concentrate;
- excavation of sludge from the sedimentation pond;
- removal of contaminated soils from the slopes adjacent to the mill; and
- installation of a pumping well to control migration of contaminated groundwater into Howe Sound.

These remediation activities were implemented in a manner that respected the heritage resources of the site. But concurrent with the implementation of the mine closure plan, the mill structure has been restored as the first phase of an overall rehabilitation of the historic site. This project as seen as an “opportunity to prove that an environmental liability can be transformed into a social, economic and environmental asset – a legacy that Canadians and the mining industry can be rightly proud of and pass on to future generations” (Britannia Project Team, 2004). The restoration of the mill, now largely complete, is the cornerstone of this project (Fig. 7). One aspect of this project will be public education, which will include an emphasis on the environment and sustainable policies, practices and technologies. Thus, at Britannia, the environmental legacy of the site will be addressed head on and the environmental legacy and the work done to remediate the site and thereby address this legacy, will be a key aspect of the project.

Fig. 7: The Britannia Mill before and after restoration (photo credit: BC Museum of Mining)

Conclusions

Mining has played an important role on the economic, social and cultural development in Canada, and across Canada are numerous towns that identify themselves as "mining towns." In these communities, such as Cobalt, Ontario, mining heritage structures play an important role in the collective memory of the communities, providing an important reminder of the legacy of these communities. Abandoned mine sites are also often host to environmental concerns and remediation of such sites is essential. Yet remediation efforts can be perceived as being at odds with efforts to preserve mining heritage. The challenge in such communities is to complete mine closure and address environmental concerns, thereby reducing risks to the environment and human health, while respecting the heritage resources.

The examples cited, in the World Heritage Sites of Cornwall and West Devon in the United Kingdom, and the Britannia Mine in British Columbia, illustrate that this challenge can be met. Heritage sites with significant contamination concerns can be successfully remediated, reducing environmental releases of contaminants, while preserving the sites and making them safe and secure for tourists visiting the sites. At the Botallach labyrinth in Cornwall, As-bearing soils and wastes were removed, and the site was decontaminated. The site was then restored and is now accessible to tourists. At Britannia, significant concerns related to acidic drainage and contamination have been addressed, while at the same time the spectacular hillside mill has been restored to host a museum. These examples provide illustration that the technical and social challenges of remediating historic mine sites while preserving the mining heritage resources can be achieved.

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