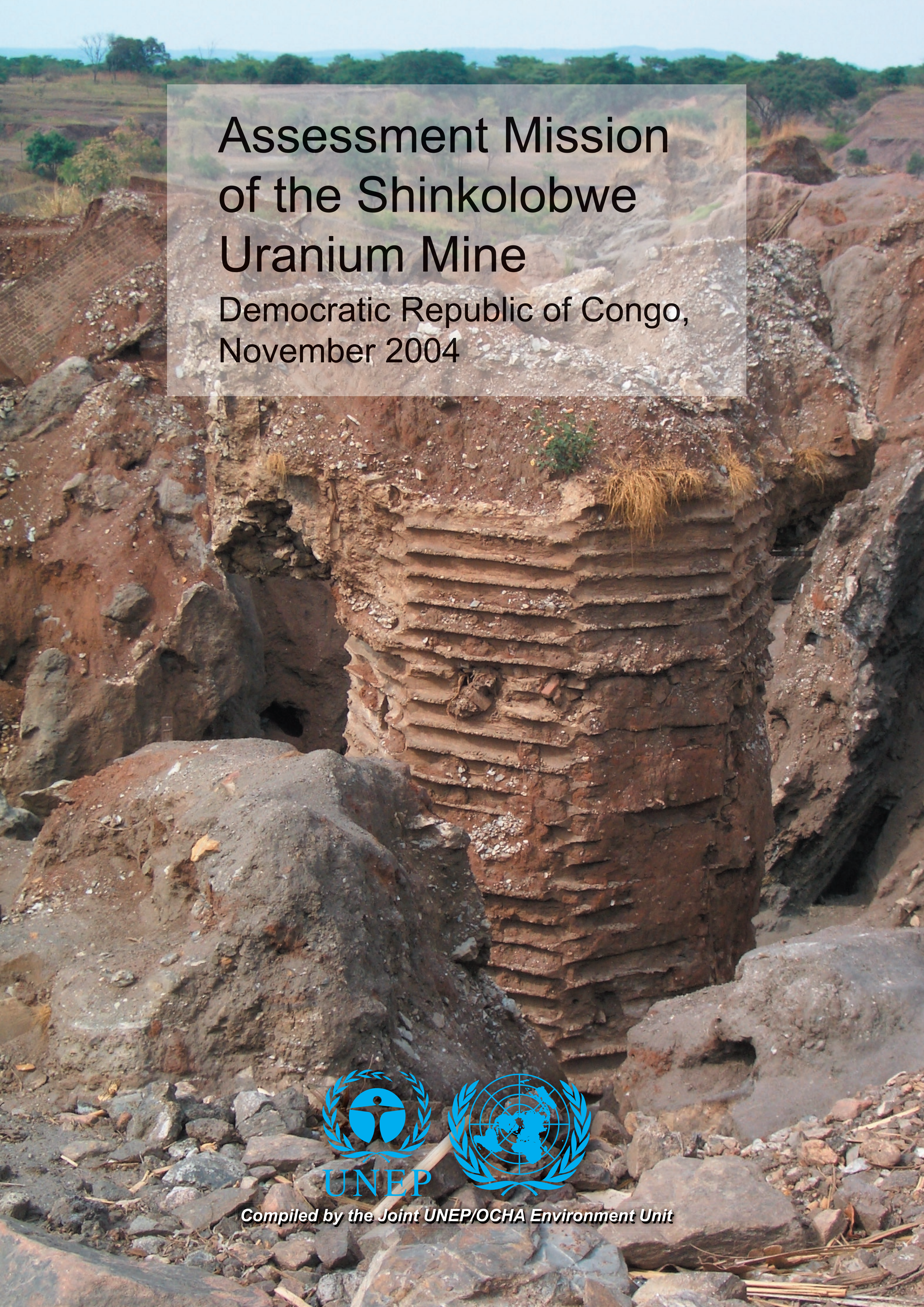
Assessment Mission of the Shinkolobwe Uranium Mine

Democratic Republic of Congo, November 2004



UNEP

Compiled by the Joint UNEP/OCHA Environment Unit

The Joint UNEP/OCHA Environment Unit

The Joint UNEP/OCHA Environment Unit is a partnership between the United Nations Environment Programme (UNEP) and the UN Office for the Coordination of Humanitarian Affairs (OCHA). It both mobilises and coordinates emergency assistance to countries facing environmental emergencies and natural disasters with significant environmental impacts by providing assistance for emergencies such as chemical and oil spills, industrial and technological accidents, forest fires, and other natural disasters with significant damage to the environment and human health.

See the map on the back page to see where we have been active.

Published in Switzerland, 2004 by the Joint UNEP/OCHA Environment Unit

Joint UNEP/OCHA Environment Unit
Palais des Nations CH-1211 Geneva 10
Switzerland
Tel. +41 (0) 22 917 3484 - Fax +41 (0) 22 917 0257
http://ochaonline.un.org/ochaunep

Compiled and edited by:
Andrew Robinson, Green Ink Publishing Services

Cover photo: A survey of the Shinkolobwe mine site shows the extent of mining activities. The column is a 'negative' of the former mine shaft that was closed with concrete in 1961.

Assessment Mission of the Shinkolobwe Uranium Mine

Democratic Republic of Congo, November 2004

Compiled by the Joint UNEP/OCHA Environment Unit

This summary report is based on the five expert technical reports prepared by the assessment team members following the October – November 2004 mission to the Democratic Republic of Congo (DRC). These reports include: mining, radiological, environmental, health and humanitarian.

UNEP

Assessment Mission of the Shinkolobwe Uranium Mine

Democratic Republic of Congo, November 2004

Table of Contents

Shinkolobwe former uranium mine

Source: UNOSAT, 2004

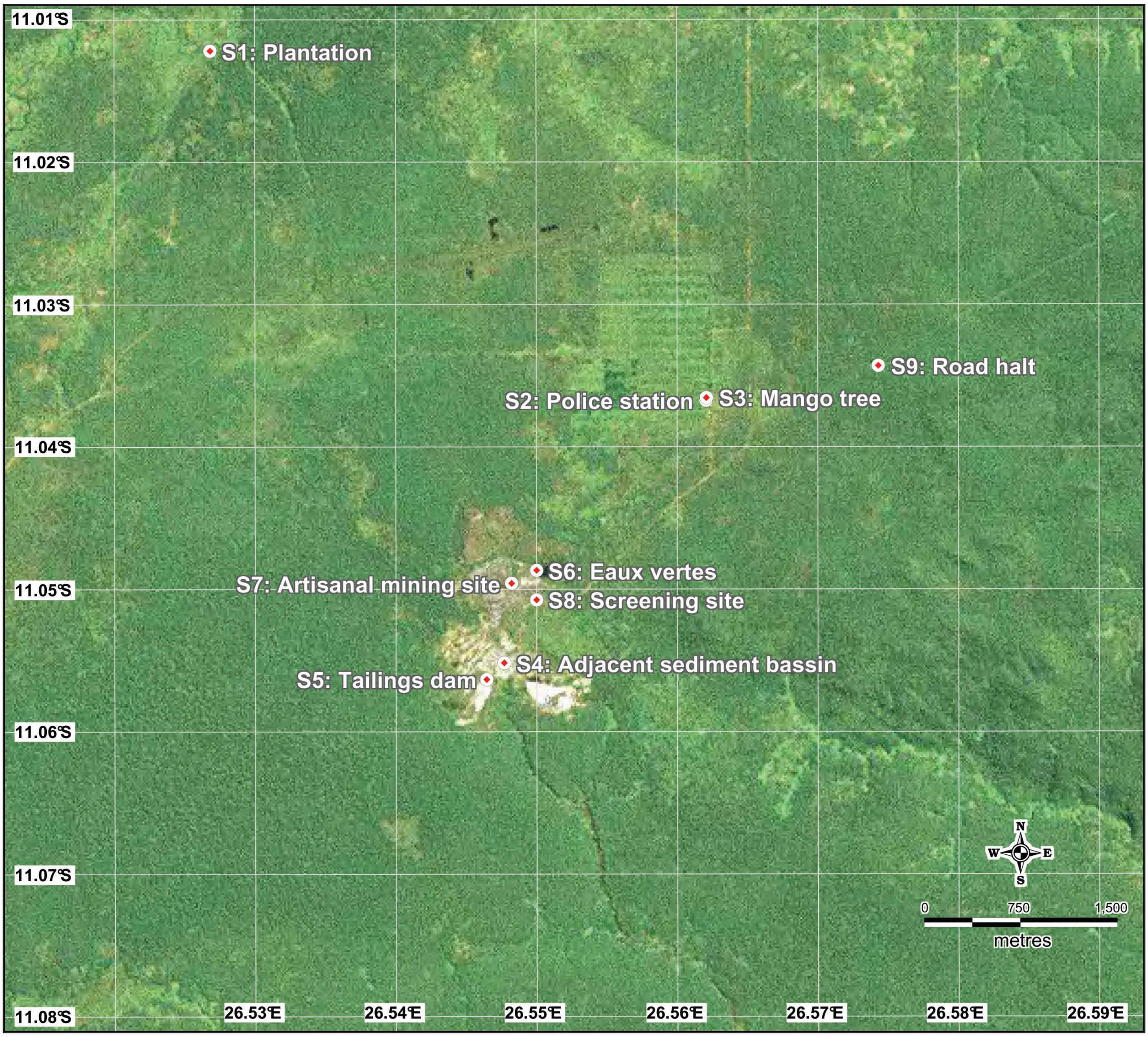


Image credit: USGS, Univ. of Maryland
Image Processing: UNOSAT


Mined area


Settlement/
infrastructure


River through forest

GPS point

Satellite image acquired 1 May 2001
Landsat ETM+, path 173, row 068

Near natural colour representation
using bands 3, 2, 1, and 8 as
Red, Green, Blue and Intensity
Spatial resolution: 15 m
Datum: WGS84
Projection: UTM35

1. Summary

In July 2004, eight people were killed and 13 seriously injured in a partial collapse of artisanal workings at the Shinkolobwe mine in the Democratic Republic of Congo (DRC). Following the accident, fears concerning the harmful consequences of the mine's exploitation on the environment and the population, particularly radiological, were quickly brought to the forefront as existing rumours elaborating on an illicit uranium trade and child labour increased.

Located 35 km west of Likasi in the southern province of Katanga, Shinkolobwe had been industrially exploited for its uranium and radium deposits between 1921 and 1959. Its uranium was used to create both the Hiroshima and Nagasaki atomic bombs. Closed in 1961 following independence from Belgium, the mine's two main access shafts were sealed by concrete. At the end of the 1990s, however, artisanal exploitation of copper and heterogenite – an ore containing cobalt – developed throughout the DRC, including Shinkolobwe, as the world's demand for cobalt increased. With the renewal of activities, a mining village developed on the site as the extraction of ore represented the only source of income for miners and their families. Until the July collapse, on site mining activities continued to grow despite a 28 January 2004 Presidential Decree prohibiting any artisanal mining at Shinkolobwe. The DRC Government subsequently closed the mine and requested that a full assessment be carried out to evaluate the impact of the mine's partial collapse.

Responding to the request for international assistance from the Minister for Solidarity and Humanitarian Affairs of the DRC, the Joint Environment Unit of the United Nations Environment Program (UNEP) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) set up an inter-agency mission comprising experts from UNEP and OCHA, the World Health Organization (WHO), the International Atomic Energy Agency (IAEA), and the United Nations Mission in the Democratic Republic of Congo (MONUC). From 25 October to 4 November 2004, the mission assessed the current state of the mine and evaluated the causes of its partial collapse. Though the site had been evacuated and was devoid of any activity, the expert team also evaluated environmental impacts, including contamination by heavy metals, as well as humanitarian and health concerns linked to mining activities and ionising radiation exposure.

The mission team found that the collapse resulted from an anarchistic exploitation of the site with no respect for mining safety regulations. The grounds remain unstable due to unskilful and rapid underground excavation and poorly managed mineral waste deposits. The risk of further collapse, therefore, remains very high.

No evidence was found that uranium had been exploited in the former Shinkolobwe uranium mine. The collapse was not a result of a nuclear or radiological accident and, within the enclosed perimeter of the mine, did not lead to increased exposure to ionising radiation. It is possible, however, that future collapse could lead to such a risk.

Artisanal Mining: A livelihood activity throughout the developing world

It is estimated that up to 13 million people in the developing world practise artisanal mining. Characterized by low levels of mechanization, unknown quantities of ore deposits, few safety standards, poorly qualified personnel and low productivity, artisanal mining is often undertaken illegally and with little consideration of environmental impacts. The unemployed and underemployed in poor countries are increasingly resorting to such practices because they see a livelihood opportunity. Minerals become 'the natural resource of last resort' and offer a more secure income than agricultural farming. *Source: ILO, 1999*

Results indicate that the site is contaminated by naturally occuring radioactive materials (NORM). Readings showed that the miners' chronic exposure to radioactivity was probably higher than international safety standards allow. To prevent future accidents and long-term exposure to such risks, it is strongly recommended that the Shinkolobwe mine site be definitively closed and access restricted. To evaluate the extent of potential external (off-site) contamination, transport routes, mineral depots and processing (smelting) plants in the Likasi area were also examined.

Soil, dust, sediment and water samples were taken both on- and off-site. These will be analysed in a laboratory to determine their concentration of cobalt, nickel, copper, and uranium and to evaluate the potential medium and long-term risk on the population and environment. The mine collapse itself did not have any harmful effect on the environment. A final technical environmental assessment report will be published once sample analysis is complete.

Throughout the course of the mission, the WHO expert met with personnel from various health institutions, villagers, former Shinkolobwe miners and traders, and other stakeholders to help identify any health concerns in connection with the collapse and assess the general health of the local population. No evidence of the impact of radiation exposure on the population could be found due to lack of available data. This report, however, includes recommendations aimed at strengthening local health services for the population.

The humanitarian affairs experts sought to evaluate living conditions on the site and identify any child labour. Though no mining was ongoing during the course of the mission, several testimonies confirmed that children had been present on site. Lack of adequate services, such as health and schooling, were also mentioned. Despite such poor conditions, the mine's closure had a negative impact on the population's standard of living. The community's 15,000 people were forcibly removed and dispersed. Miners moved towards other less profitable artisanal mine sites in the area, whereas villagers simply moved to their fields.

Shinkolobwe is representative of similar situations in Africa and elsewhere in the developing world. A strong link exists between rural poverty, environmental protection and this type of livelihood activity. Alternative income opportunities must be developed and integrated in parallel to artisanal exploitation if new livelihood options are to be found for these rural poor. A holistic, multidisciplinary approach within the context of poverty alleviation is essential to address this problem and avoid further human and environmental catastrophes.

This report summarises the mission team's findings and analysis provided in their respective technical reports, including placing artisanal mining in its economic, legislative and institutional environment. The corresponding conclusions and recommendations are included in Chapters 4 and 5 respectively.

Rapid and poorly managed mining has led to unstable grounds.

2. Mission

2.1 Artisanal mining

Although no official definition exists for artisanal mining, the activity can be characterized by:

- Exploitation of marginal and/or very small deposits, which are not economically exploitable by mechanized mining
- Lack of or limited use of mechanization and a lot of physically demanding work
- Low level of productivity and inefficiency in exploitation and processing (low recovery value)
- Low level of occupational safety and health care
- Poor qualification of personnel
- Low salary and income levels, chronic lack of investment capital, and lack of social security
- Women and children are frequently found working on the site
- Insufficient consideration of environmental issues.

Source: IIED, 2003.

2.2 Brief history

The Shinkolobwe mine is situated in the African "copper belt", in the southernmost part of the Democratic Republic of Congo (DRC). Located 35 km west of Likasi in the Kambove territory, Katanga Province, the mine is within Katanga's rich copper-cobalt zone which contains considerable quantities of uranium, copper, cobalt, and nickel. The mine was industrially exploited for radium and uranium from 1921 to 1959 by l'Union Minière du Haut-Katanga, currently known as Gécamines. Installations at that time were safe and activities were implemented within the safety requirements of the time. All formal mining activities ceased in 1961.

Towards the end of the 1990s, artisanal miners were permitted to return to Shinkolobwe in order to mine heterogenite. Increasing world demand for cobalt – found in heterogenite, coupled with the DRC's mining industry liberalization in the year 2000, promoted a surge of unemployed persons towards the artisanal mining trade as the work was considered a good source of income and more reliable than agriculture. The *Exploitants Miniers Artisanaux du Katanga* (EMAK) – an organisation responsible for providing an operating framework for artisanal miners and traders and ensure site safety on artisanal exploitation sites conceded to it by Gécamines – officially decided on 4 April 2000 to exploit the site. From that moment, more and more artisanal workers, generally with little experience, arrived on site in search of employment.

Shinkolobwe proved to be a rich heterogenite deposit. By 2001, the mine had become Katanga Province's largest mined heterogenite deposit. Its cobalt contents ranged from 2 to 6 per cent. At its highest level of productivity, artisanal production was estimated at 12,000 tons per month. In 2004, Shinkolobwe's population reached approximately 15,000 people, including 6,000 artisanal miners.

Rumours of an illicit uranium trade and of the harmful consequences of mining activities on the environment and population began to spread. A Presidential Decree on 28 January 2004 ordered the mine closed. It was not immediately implemented and, on 8 July 2004, a partial collapse of the mine caused the death of 8 people. A further thirteen people were hospitalised in Likasi with serious injuries.

In response, the government moved decisively to close the mine. The village was evacuated and burnt to the ground. Some inhabitants moved towards their agricultural fields, while artisanal workers shifted to neighbouring towns or other artisanal mining sites located within the province.

2.3 Problem description

In Shinkolobwe, artisanal mining is carried out with no respect for mining safety regulations. Among the workers, women and children are both reportedly present. The local population does not benefit from any protective measure, and the debris from the mined ore is not sheltered from the elements, which could lead to slippage.

Mining heterogenite, particularly on this site, could expose miners both to a high risk of uranium irradiation and heavy metal contamination. Chronic exposure to ionising radiation, as well as the inhalation of particles or the consumption of water or vegetables containing heavy metals can, over time, cause a number of pathologies such as cancers, leukaemia, and congenital malformations.

Poor mining practices expose workers to undue risks.

In industrial cases, mining can be a highly polluting activity. Ore processing requires large quantities of chemicals (acids, solvents) which can also produce toxic waste (cyanided baths, heavy metals, etc). Some of these activities can also occur on artisanal sites, though to a lesser degree and more frequently on diamond or gold mine sites. No such processing activities were reported at Shinkolobwe.

The Ministry for Solidarity and Humanitarian Affairs of the DRC, following an inter-agency mission report carried out immediately after the accident, raised the need for evaluating the radioactive effects and related environmental impact (surface and ground water, air, soil and croplands) arising from this event. The need to evaluate working conditions, child labour in particular, as well as public health, was also expressed.

Subsequent to an official request for assistance from the Minister, the Joint UNEP/OCHA Environment Unit set up an inter-agency assessment mission comprised of experts from the Kinshasa and Lubumbashi offices of the United Nations Mission in the DRC (MONUC), the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO). The mission visited the DRC from 24 October to 4 November 2004.

2.4 Assessment team

The assessment team was composed as follows:

- Team Leader, Joint UNEP/OCHA Environment Unit, Switzerland
- Associate Expert in Humanitarian Affairs, Joint UNEP/OCHA Environment Unit, Switzerland
- Independent Environmental Expert, Corps Suisse d'aide humanitaire (CSA), Switzerland
- Mining Engineer and specialist in small-scale and artisanal mining, Bureau de recherches géologiques et minières (BRGM), France
- Manager of Health Programmes, World Health Organisation (WHO), DRC
- Principal Counsellor in Humanitarian Affairs, OCHA, DRC
- Manager of Humanitarian Affairs, MONUC Lubumbashi, DRC
- Waste Safety Expert, International Atomic Energy Agency (IAEA), Austria
- Programme Officer, Ministry of Solidarity and Humanitarian Affairs, DRC

According to the expertise of the team members, three teams were formed: scientific, humanitarian and medical.

2.5 Objectives and methodology

Mining study (BRGM)

The mining activities and accident causes were evaluated and placed in the broader context of Katanga Province by assessing the economic, legislative and institutional arrangements associated with artisanal mining. The study also looked to establish the ore's distribution circuit and downstream commercial production by examining transport routes, storage depots and ore smelting plants in the Likasi area to evaluate the potential reach of any contamination.

Careful evaluation of the Shinkolobwe site was carried out. Unannounced visits were made to various depots and treatment/smelting plants in the area to ensure that the observed activities were representative of routine operations. Interviews were carried out with various mining sector stakeholders, and documents such as the DRC's Mining Code and statutes of mining organisations were gathered and analysed (Lamouille, 2004).

Radiological risks (IAEA)

Following the initial rapid mission to the Shinkolobwe mine site, key concerns of MONUC staff based in Lubumbashi included:

- the possibility that miners could have experienced acute exposure to ionising radiation during mining activities or as a result of the collapse
- the possibility that uranium had been illegally mined
- that the transport and processing of Shinkolobwe ore could lead to radioactive contamination of sites in and around Likasi (MONUC Lubumbashi, 2004).

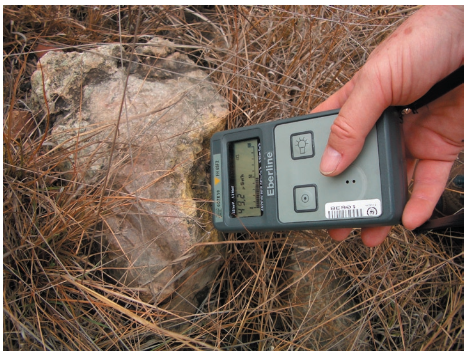
The major potential pathways for persons to receive a dose of ionising radiation and become radioactively contaminated at the mine site would be (Waggitt, 2004):

- direct exposure to gamma radiation from uranium minerals in the ore body or waste heaps associated with the site
- inhalation of the radioactive gas Radon and its decay products
- inhalation of dust containing radioactive particles
- ingestion of radioactive particles through dust or soil on hands, clothing or foodstuffs, or by drinking contaminated water
- the bio-accumulation of radioactive metals in plants and animals that may be used for food by the local population (fish, tubers, roots, fruits, etc.).

There were also potential risks of radioactive contamination for the community in and around the mine area and at any location where mineral processing took place.

Readings of ambient gamma dose rates and 'suspected' areas were taken with specialised measurement equipment to establish the site's natural background radiation levels. At locations where radiation readings were higher, a larger number of readings were carried out to establish the size of the affected area. Personal exposure measurement equipment was worn during fieldwork to establish the levels of radiation exposure actually experienced on site. The two most potentially exposed team members, based on their assigned tasks, wore the dosimeters.

Drainage lines were examined around the area to establish if there was any major movement of radioactive contamination off-site through surface flow of potentially contaminated water.



Readings of gamma dose rates were carried out throughout the site.

Gamma dose rate measurements were also undertaken at locations along the haulage route from Shinkolobwe to Likasi, especially within mineral depots and smelting plants, to establish if any contamination had been spread along this transport corridor and around the town. The same gamma readings methodology was used for each stack of ore bags or bulk samples found (Waggitt, 2004).

Environment (CSA):

To understand the environmental impact of mining activities at Shinkolobwe, the CSA specialist needed to assess:

- the risk of pollution from ore processing, storage and use of chemicals, and storage of ore and waste products
- the risks resulting from artisanal mining by examining the processing, packing, transport and storage of the ore, as well as the storage of processing waste
- the level of soil, groundwater and surface water contamination in the vicinity and in the mine perimeter.

The investigation was carried out in three phases:

1. Definition of the mission's general framework during discussions with concerned Ministers and representatives from international organizations (MONUC, OCHA, UNEP).
2. Discussion of the operational details and evaluation of the situation during talks with Shinkolobwe mine owners, depot owners and local authorities in Lubumbashi and Likasi.
3. Evaluation through visual inspection, measurement of the radioactivity and sampling at the time of three successive visits to the mine.

Soil sampling can reveal potential heavy metal contamination in the area.

The samples were taken within the whole of the perimeter of the mine, in particular (i) in each area of recent mining activity; and (ii) at sites marked by increased radioactivity.

Soil samples were taken in the principal depots visited by the mission as some of Shinkolobwe's ore was reputedly stored in Likasi. A total of twenty two samples were taken to evaluate the level of heavy metal contamination at Shinkolobwe and around Likasi: 12 soil, one dust, 5 sediment and 4 water (Pasche, 2004).

The samples were brought back to Spiez Laboratory in Switzerland (Swiss NBC Defence Establishment) where the contents of heavy metals, including actinides, will be determined through Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

Health (WHO)

Objectives for the WHO assessment included:

1. identifying health problems in connection with the mine collapse
2. assessing the health of Shinkolobwe's population
3. providing recommendations to reduce the public health risks in the area; and
4. sharing results and recommendations to promote improved health services in the region.

The following methods were used: (i) observation of the Shinkolobwe site; (ii) interviews with personnel from various health institutions, former Shinkolobwe miners currently residing in Sandra, the Head of the Shinkolobwe locality (currently in Mifundu), and of the EMAK management committee members; and (iii) close examination of reports, files and patient dossiers to collect data in connection with pathologies related to radioactive exposure and/or the absorption and the inhalation of heavy metals (Ekwanzala, 2004).

Humanitarian (OCHA)

OCHA team members examined the humanitarian aspects related to the mine, such as the working conditions of artisanal miners and, in particular, any evidence of child labour. OCHA was also concerned with the conditions under which the evacuation of 15,000 inhabitants was carried out and whether any remediation or employment substitution measures were proposed to the miners and their families.

The team examined the site and carried out interviews with former Shinkolobwe miners, members of mining organisations – EMAK and the *Service d'Assistance et d'Encadrement du Small Scale Mining* (SAESSCAM), Gécamines staff, various health centre personnel, and local authorities. In Kinshasa, the mission held high-level meetings with DRC Government representatives as well as representatives of UNICEF, United Nations Development Programme (UNDP), the ILO, and local OCHA and MONUC offices. Research was also carried out on the country's economic and political situation and on the artisanal exploitation of mining resources in Katanga Province (Dupin and Mialaret, 2004).

Agricultural land near the mine site provided some of the village's food needs. Soil samples were taken from the area for analysis.

2.6 Limitations and constraints

The findings of the environmental and radiological assessments are based on data collected from a relatively small number of sample locations visited in a short time span. It was not possible to undertake a complete and systematic characterisation of the site with respect to physical, chemical and radiological hazards. Nor could all the consequent risks be assessed due to lack of data. Time constraints also precluded an extensive investigation of the claims that artisanal ore processing plants exist around Likasi.

The underground workings at the mine site were considered too dangerous to enter. The radiological risk to miners was therefore estimated on worst case scenarios based on radiological data collected at the surface and the experience of team members.

An attempt to sample airborne dust was made by using small personal portable air pumps fitted with filters. However, a number of technical problems and the general lack of dust due to recent rains rendered this part of the exercise inconclusive.

The lack of accurate maps of the area made location of sampling sites difficult to place in relation to the overall site layout and its position in the landscape. This is important in terms of assessing possible exit pathways for contamination in surface water runoff.

No miners were present on site, which would have enabled the team to verify work practices and better assess radiological doses to workers and associated health risks. This also made the analysis of the humanitarian situation difficult to assess. Nevertheless, a certain number of former miners currently staying in the locality of Sandra were identified. The mission went to Sandra, ten kilometres from Shinkolobwe, and was able to speak with some of them.

3. Findings

The collapsed tunnel is located approximately 3 metres behind the small yellow sign.

The former industrial mine site, the site of artisanal exploitation and the "green lake" – the water filled former open pit mine – were the subject of the Shinkolobwe assessment. The analysis of the site, transport routes from the mine, depots and foundries around Likasi, as well as the results based on various interviews and document research is provided below. The corresponding conclusions and recommendations are presented in the following chapters.

Mining (BRGM)

The principal shaft of the former industrial mine is located in the middle of the artisanal mining area. This would indicate that the area was considered of sufficiently low economic value to establish the access infrastructure and sterilize a significant volume to ensure mine stability. Currently, industrial structures, such as concrete foundations and a part of the treatment plant's metal frame, are the only remains of the original processing plant.

Artisanal mining started officially in 1998 southwest of the old industrial quarry at the centre of the uranium mine's principal shaft. The ground water level, visible in the old open pit quarry, is approximately 40 m from the surface, indicating that the former industrial mine, located at -79 m from the surface, is most likely totally submerged. For combined geological, geometrical and technical reasons, miners exploited only the oxidized zone near the surface. No link can therefore be established between the industrial uranium mine and the artisanally exploited heterogenite layer.

Artisanal activities

The mission was unable to observe ongoing artisanal activities. However, observation of the site and the work that had taken place showed that an anarchistic extraction was carried out with no respect for basic mining techniques or safety regulations. The mining method used, based on observation and interviews, required a team of six people:

- 2 miners to quarry the ore
- 1 to fill bags of ore
- 2 conveyors to carry the bags to the surface
- 1 on stand-by to relieve the miners.

Rudimentary methods were used to prevent slippage.

Mining activities were carried out with rudimentary tools: picks, shovels, battery operated flashlights, woven plastic bags, rope, etc. Local wood was cut down and primarily used to protect rock cuttings and entrances to the wells.

Only the highest grade ore - 2 to 6 per cent cobalt content - was sought and cut down by skimming. Lower quality ore was abandoned in the tunnels or amongst the debris. Ore quality was simply assessed "with the eye". No chemical analyses were carried out.

The exploited mining area presents itself in the form of a large crevasse with several holes. Accessing the ore was done by removing surface layer or by digging shafts, usually vertical. Sometimes exceeding a depth of 10 m, these shafts have openings which vary from 1 to 2 m in diameter depending on the thickness of the exploited layer. Tailings and debris were simply dropped near shaft openings. This extraction method, exacerbated by people in search of a quick and reliable income through the heterogenite sales, wholly explains why the accident occurred.

From the mining area, the ore was put into 50 kg bags and then carried manually to loading or storage areas. Areas used to enrich the cuttings through the use of metal grids and nettings were observed. Sieves were used to separate the coarse rock from the finer fractions richer in heterogenite. No other enrichment process was detected. The ore was processed in foundries or exported.

Linking artisanal mining to regional development

The authorization of artisanal mining practices in a context where a growing number of people are searching for new income opportunities created uncontrolled and dangerous mining activities. The rush of activity increased the quantities of ore extracted for export, thus contributing to the mineral production detriment in the country. The difficulty in controlling production and mineral value, as well as poor distribution control, induced the construction of cobalt and copper foundries close to towns such as Likasi and abroad, particularly Zambia, without taking environmental impacts into account.

Yet, the legislative and regulatory context of artisanal mining in the DRC took an important turn with the publication of the July 2002 Mining Code. It stipulates that "*official cards are delivered to artisanal miners... eligible to work who request for them and who commit themselves to respecting safety and hygiene, and environmental protection regulations in the artisanal zones, in accordance with the methods which are laid down by the Mining Law…*" The code also considers small-scale mining (semi-industrial and more or less mechanized) in parallel with artisanal exploitation.

The granting of dedicated mining zones is a difficult process. According to interviews, the Ministry of Mining has since decided to grant six sites dedicated exclusively to artisanal mining in order to ensure that all mine owners operate legitimately and under proper supervision and monitoring. Following the request of the Mining Minister, allocated sites integrating the concept of "acceptable mineral content" were selected by Gécamines upon the creation of the *Service d'Assistance et d'Encadrement du Small Scale Mining* (SAESSCAM). These mining areas are to be regulated and an operating framework is being established through SAESSCAM. Activities will be tied to the small- and medium-scale mining industry.

Such considerations are probably transposable to existing artisanal mines in the region, but also to gold or diamond mining. Speedy implementation of the Mining Law would allow for a better control of exports and limit fraudulent activities on tonnage and content. Small processing industries could also be controlled in agreement with acceptable environmental conditions. Joint implementation of these various components would therefore help launch the regional economy and could limit the disorganised and unstructured rise in artisanal mining (see recommendations, page 21).

The site, a large crevasse with many holes, is highly unstable.

Ground stability

Adopted mining practices had the miners dig by following what was deemed the highest-grade ore. This promoted the creation of a random network of tunnels in multiple directions (vertical, diagonal, horizontal), sometimes very close to one another. Human abundance on the site and the general disorder of related activities further promoted the risk of accident.

The collapse, therefore, is not related to the exploited substance and has no relation to the presence of uranium. The intensity of abrupt underground work has greatly weakened the area, increasing the risk of further collapse. The debris and mineral waste placed near the mouths of tunnels, sometimes supported by wood or bags, encouraged potential slippage. Enormous cracks appear on the ground, indicating great instability of the underground works.

Production line

The heterogenite production line – from ore extraction to the transport of raw products and/or local processing (smelting) – was also subject to evaluation during the mission. Understanding the production system is important as it makes it possible to trace the ore's distribution circuit and its commercial products downstream and is likely to show the extent of any potential radioactive contamination outside the site.

Foundries in the Likasi area were visited by the mission team.

Fifty kilogram bags were loaded on trucks at Shinkolobwe bound for Likasi. A relay village had been established on the route for various supplies and purchases. Transport routes leaving the site show low levels of radiological contamination caused by falling ore dust from trucks.

The WAMICO, SOMIKA, and Group BAZANO depots were visited in the Likasi area, as well as the Tshalumkambo depot. Each of these depots at one time stored ore bags from Shinkolobwe, though no bag was found at the time of the visit. The storage area at both WAMICO and Tshalumkambo is rudimentary. Bags are exposed to rain and stored directly on the ground where a concrete slab should be. This could lead to heavy metal leaching and potentially contaminate the ground water.

The COMIN (Congo Minerals) and Africom SPRL foundries were visited to determine the origin of treated ores and how radioactive material was regarded. No resellers or smelters were prepared to accept radioactive material, no matter the originating site, due to potential client refusal, particularly with countries from the European Union (EU) and Organisation for Economic Co-operation and Development (OECD). Some resellers use an established cut-off value before accepting the ore to ensure its saleability. Ore from Shinkolobwe, on order of the Governor, is not accepted, although its radioactivity is generally lower than ore coming from, for example, the Kolwezi mine, northwest of Likasi. The mixing of ore with limestone and coke is carried out manually in the foundry in order to support employment. Two new foundries are currently in construction for AMAN Metal Industries and Groupe BAZANO. The customers are international corporations.

Mining production support structures

In 2002, the Government, with the support of the World Bank, carried out a restructuring of Gécamines to improve the investment climate. One of the objectives was to strengthen the Ministry of Mining and improve the tax framework for investment to facilitate growth in the private sector and rebuild the economy and the mining industry in particular. A total of 12,000 of 36,000 staff left "voluntarily", 2500 in the Likasi area alone. Gécamines staff know-how was dispersed and many of these people moved into artisanal mining activities (traders).

To "carry out Government policy as regards artisanal mining" the *Exploitants Miniers Artisanaux du Katanga* (EMAK) organisation was created in Lubumbashi on 19 February 1999. EMAK purports to offer a technical, professional and unionised framework with resources coming from its member contributions. Members include miners, craftsmen, traders and all those related to artisanal mining production. EMAK works in collaboration with the Service des Mines by ensuring transparency of production activities and promoting the Mining Code. The association acts as a union by acting as an intermediary between Gécamines and miners requests on subsistence, health, product purchasing, and the responsibility of miners with respect to accident risks. To widen its activities, EMAK hopes that the Government will allocate to it zones reserved for artisanal mining, as envisaged in the Mining Code.

On 28 March 2003, a decree from the Ministry of Mining created the *Service d'Assistance et d'Encadrement du Small Scale Mining* (SAESSCAM) as a technical public utility equipped with financial and administrative autonomy. Not yet established in Katanga, SAESSCAM aims to:

- popularise on site mining safety requirements and ensure their strict application;
- provide a technical framework for artisanal workers and incite them to form mining co-operatives;
- promote the integrated development of local communities where artisanal and/or small-scale mining activities are on-going thanks to the retrocession of intended quota rights for these communities;
- to apply the Mining Code and its subsequent operational obligations.

SAESSCAM's objectives are particularly relevant. Any support to make it operational would be beneficial for the development of the artisanal and small-scale mining sector. Its position as a public organization related to the Ministry of Mining reinforces its legitimacy.

Work in synergy between SAESSCAM and EMAK could involve a complementary distribution of their respective mandates. The first could work from the institutional point of view (promotion, control, safety, best practices) and the second, more operational, could continue to play its role as a co-operative guiding the artisanal sector on site.

Radiological assessment (IAEA)

Observation of the former mine and mill area revealed the presence of remnant plant items and infrastructure including buildings, concrete foundation slabs and decantation vessels. Inadequately contained uranium mill tailings with no erosion covers were found, as well as rehabilitated sedimentation ponds.

The gamma survey readings are within the range that would be expected on the site of a former uranium mining and milling facility that has not been remediated in any significant manner. All measurements taken on site and on bags of heterogenite showed high levels of radioactivity. These exceed the standards established by the International Commission on Radiological Protection. The dosimetry results for the mission members indicated that the average exposure over the period spent on site was of the order of 7μSv* per day, which equates to approximately 2.5mSv per year. This is in excess of the permitted public dose rate for a practice of 1mSv/yr.

Little of the original uranium mine infrastructure remains.

There is no regulation or control of radiological protection nor is there a responsible party currently operating at the site. The present dose rates indicate that there may be a radiological safety issue at the site. The site is littered with items that may well be heavily contaminated but could not be adequately inspected due to time and resource constraints as well as physical safety issues.

Measured radioactivity at certain places indicated very high rates (waste areas); though do not present a risk of acute contamination. However, prolonged exposure to ionising irradiation, contamination by ingestion of certain heavy metals dissolved in drinking water and food, and the inhalation of heavy metal particles in dust can have harmful effects on the health of individuals.

** Sievert (Sv): The SI unit of radiation dose equivalent or equivalent dose*

Poor storage of mineral ore can lead to ground pollution through leaching.

Environment (CSA)

The visit to the mine showed that neither exploiting the mine nor the accident which occurred on site posed any immediate environmental risk. Thirteen samples were taken on site as a systematic sampling was not considered necessary: 7 soil, one dust, 3 sediment and 2 water (including the "green lake"). Results presented below remain preliminary as laboratory analyses have not yet been completed.

The accident had no harmful consequence on the environment. The extent of the collapse is limited. No substance remains on site which could lead to sudden environmental pollution. Moreover, no source of secondary risk – hydrocarbon deposit, corrosive substances, chemical waste or poisons – was found within the mine's perimeter. General observations conclude that off-site water run-off (external drainage) did not contribute to any external contamination.

From a radiological perspective, the measured levels of activity are insufficient to create an environmental problem.

In most depots, ore bags from various mines in the area are stored directly on the ground with no protection from the weather. This rudimentary storage system could lead to pollution of the ground by leaching. The hydrological characteristics of the Likasi area could not be established with certainty, but an aquifer appears to be located 30 to 70 meters under the city. It is not excluded that this aquifer may be polluted by heavy metals and other substances leached from the storage areas during the abundant rainy season.

The existence of a small temporary aquifer (only during the rainy season) was also reported. Located two to three meters deep, such an aquifer would be very vulnerable to pollution generated from such basic storage facilities. In turn, the Panda river which runs below and partly feeds the city could also be contaminated. Two water, two sediment and 5 soil samples were therefore gathered in the area for analysis.

Once the final analysis of all samples has been completed, the environmental technical report will be updated and published.

Health (WHO)

Shinkolobwe is part of the Mukumbi health area, which falls under the Kambove health zone. The Mukumbi area has no functional health centre, thus the population has no access to formal health services.

In Shinkolobwe, private health stations operated by unqualified personnel provided dubious health care. These stations were not integrated in the health care system of the Zone, and did not benefit from the supervision of the central health services of Kambove - Bureau Central de la Zone de Santé (BCZS). Several pharmacies had settled in the community distributing drugs of unknown origin and quality.

The medical information system in the Kambove health Zone and Likasi town is limited to diseases with epidemic potential. No data exists in connection with pathologies related to radiation exposure, consumption of heavy metals, or the inhalation of heavy metal

Potential ground water contamination is of concern for Likasi's population.

particles. The hospitals which were visited do not have registers for cancers, cause of death, or congenital malformations. The capacity of these medical centres to detect pathologies associated with these exposures in an early stage is very low. However, an increase in the number of lung disease was noted by staff since the construction of foundries near Likasi began. In general, information in connection with these diseases does not exist. When it does exist, it is basic and unreliable.

Anxiety and reactions to questions from miners at the Sandra locality are due to the perception by the population of the potential health risk associated with radiation exposure. Miners also recognized that living conditions in the mines are poor due to the lack of safeguard and protective measures, poor hygiene, water access and health care. However, the immediate benefit drawn from artisanal exploitation carries over any other consideration. The occurrence of diseases related to radiation exposure and other heavy metals was not evident.

Humanitarian (OCHA)

The artisanal mining sector represents a legitimate work and livelihood option for a large number of individuals living in or near an urban environment (in particular Likasi, Kolwezi, Lubumbashi). A large part of the area's economic activity revolves around the mining sector.

Workers typically draw lucrative salaries from artisanal mining in comparison with other traditional activities, such as agriculture and animal rearing. Depending on mineral content, the price of a 50 kg ore bag is sold between 400 and 1500 Congolese francs (1 to 4 US dollars). Despite such economic advantages, working conditions remain both difficult and dangerous (see *Mines assessment*).

The population of Shinkolobwe was primarily comprised of young people who worked as miners, conveyors or traders. It was not possible to assess actual working conditions or child labour on site as there was no activity during the course of the mission. The assessment team found the site deserted, guarded by armed police officers. The village had been destroyed and burned.

Based on interviews, education as well as food and water conditions during operation were as follows:

- Only the first two years of primary school were assured.
- The procurement of agricultural products was ensured by villagers, both for their consumption and for resale to miners. Food provisions were also procured from Likasi.
- The population drank well water or from the Kasolo river, over 6 km away. For its domestic needs, some people sometimes used water from the "green lake", most likely contaminated by uranium and heavy metals.

According to EMAK, no membership card was provided to children less than 15 years of age. However, several sources confirmed that children took part in mining activities, particularly in the transport of ore bags.

The population of Shinkolobwe was forced to evacuate in August 2004 by order of the provincial Governor. The village was burned to the ground to dissuade any possible return. This decision was accompanied by:

- the prohibition of traders to buy ore from Shinkolobwe;
- a return of all ore bags stored in Likasi from this site;
- prohibition to wash any ore in the rivers of Likasi within a 15 km radius;
- moving the miners to other non-uranium mining sites.

A large number of Shinkolobwe miners (possibly up to 3,000) have apparently resettled in the locality of Sandra where they continue to work as artisanal miners. However, cobalt contents, and therefore revenues, are lower than those of Shinkolobwe. The assessment team sensed great dissatisfaction amongst the former Shinkolobwe miners. Their dissatisfaction could lead to their return in the near future, particularly as no remediation measures or alternative income opportunities were provided.

4. Conclusions

The conclusions and observations in this section are drawn from the analysis of the site of Shinkolobwe as well as the depots and foundries visited during the mission.

Mission team members assess the stability of a ground tunnel.

1. **The partial collapse is a direct consequence of the anarchistic exploitation of the mine**
Mining activities at Shinkolobwe were carried out in an ad hoc way with rudimentary tools (shovels and pickaxes), with no respect for mining safety or regulations. No mechanization was detected.
This type of extraction promotes ground instability, endangering the people involved in the activity. The focus of miners on heterogenite contributed to a rush by the rural poor to adopt this activity, accentuating the risk of accident. The physical safety aspects of the site presented a severe risk and prevented examination of underground workings. Signs of future mine collapse are evident, blocks are detaching themselves from the walls on the southern side, open cracks attest to the permanent instability of the grounds.

2. **No large scale environmental consequences**
The collapse had no harmful effect on the environment and no immediate environmental risk resulting from the site's exploitation was noted. There has been no nuclear or radiological accident at Shinkolobwe either leading to, or as a result of, the collapse at the mine. Final conclusions will follow once sample analysis has been completed.

3. **No acute radiological risk detected**
The entire site is contaminated with naturally occurring radioactive materials (NORM) over a considerable area to varying degrees, which is consistent with improperly controlled mining rehabilitation. Waste rocks with varying degrees of uranium mineralisation may be found all over the site and could represent a radiological safety hazard. The mission found no evidence of widespread elevated radiation levels to indicate there was an acute risk of overdose or exposure to ionising radiation.

4. **Lack of radiation protection exposed workers to radiological risk**
There was no evidence of any regulation system or radiation protection and safety management plan or procedures at the site for the public or workers. Chronic exposures to miners in the underground workings and at some locations on the surface are expected to have been in excess of the accepted international safety limits for radiation workers (an average of 20 mSv/yr). There is also potential for significant dust and radon inhalation for miners in the underground workings. The annual public dose limit for radiation exposure (1 mSv/yr) could have been exceeded by visitors to the site who stayed longer than 100 days.

5. **No uranium mining was found**
Tailings from the former industrial uranium mining operations are exposed and have been "mined" in a few locations. Significant uranium content was not shown. This is consistent with artisanal practices and no evidence of uranium mining or concentration processes were identified.

6. **Slight contamination possible along transport routes**
Transport routes from the site may show some minor levels of radiological contamination; this would be as a consequence of ore dust falling from trucks.

7. **No uranium or radioactive material traded or processed**
None of the larger dealers/smelters encountered are prepared to accept radioactive material due to potential problems with end user customers, especially the European Union (EU) and OECD countries. Resellers consider the presence of radioactivity as a penalizing factor and radioactive batches, no matter their origin, are refused. Dealers had systems in place to check dose rates of all incoming materials using an established cut off value. Samples of slag from 2 smelting operations were located and inspected, and found to have low levels of radioactivity, in the range that could be considered background.

Mineral ore bags are poorly stored in several Likasi area depots.

8. **Improper ore storage could lead to ground water contamination**
Prior to evacuation, the ore, contained in bags, was stored in various regional depots. This rudimentary storage of ore bags in the depots could lead to a pollution of the ground by leaching (heavy metals) and contaminate surface and ground waters.

9. **Low radioactivity at depots may still be a health concern**
One smaller depot was found to have a small stockpile of ore (~2 tonnes), reputedly from Kolwezi, that gave higher than normal gamma readings (5-6 μSv/hr). The gamma dose rate alone for a worker standing adjacent to this stockpile for 12 hours per day would be in excess of the 20 mSv/yr limit for designated radiation workers.

10. **No artisanal processing plants revealed**
The mission found no true artisanal smelting locations. The processing sites seen in Likasi were relatively small but appeared professional in their approach. Smaller plants are currently under construction at several locations in and around Likasi.

11. **Lack of alternative livelihood options**
No remediation or alternative employment options were identified by the mission for miners and their families following evacuation. Overall dissatisfaction noted during interviews in Sandra implies that a return to Shinkolobwe is possible, particularly as Shinkolobwe miners have no plan to convert to other activities. An adequate framework to support these people is therefore essential. Should workers return to the site, other collapses with further human casualties could occur.

12. **Current practices are disruptive to industry and good resource management practices**
The rush to artisanal mining, related to the difficult employment situation in the area, applies particularly to poorly qualified workmen. As practiced today, such mining is disruptive for industrial activity as the lack of quality control combined with the rush of miners on several sites has led to the exportation of large quantities of rough ore with low mineral content. Employing a large number of workers on site is contrary to good management practices. The selection and skimming of mineral resources (selection of the high-grade ore) in this context promotes a waste of resources. The non-management of the mine (excess rock ore and tailings) sterilizes potentially exploitable zones through waste products and lowers the quality of the residual mineral.

13. **Institutional weakness**
It is necessary to give the means for the Ministry of Mining to apply the Mining Code and ensure that artisanal mining is conducted in accordance with the law. This is particularly important as the presence and involvement of children, particularly in the transport of 50 kg bags of ore, was reported. Overall, it is necessary for working and safety conditions to be improved on artisanal mining sites.

A conflict of competencies and interests was noted between EMAK and SAESSCAM, two organisational structures that purport to support and represent artisanal miners. EMAK claims to provide a framework for miners and traders and is negotiating directly with Gécamines for the allocation of unused concession

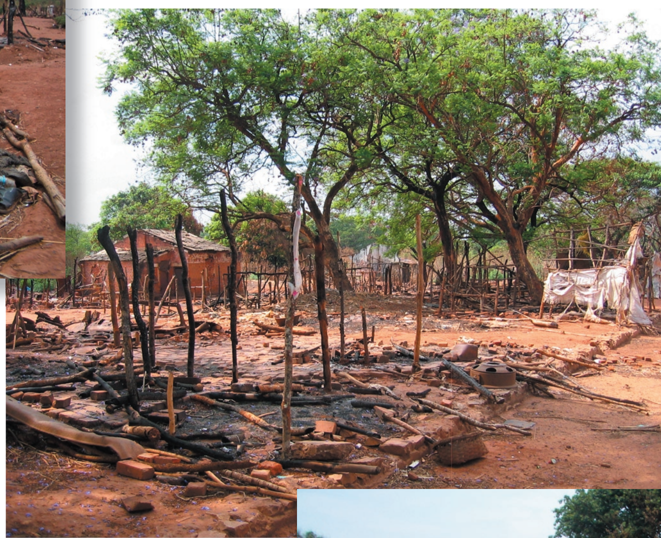
mines (200 exist at present). On the other hand, SAESSCAM plans to establish itself in Katanga in order to provide a framework for artisanal activities and miners. The latter will have to then implement activities in the six sites open to artisanal mining (see box, page 13). To date, neither structure has the capacity to ensure that artisanal exploitation is carried out while guaranteeing a respect of national regulations.

14. No causal link established due to lack of reliable health data

Due to lack of information no cause-effect relationship was established between exposure to irradiations, consumption or inhalation of heavy metals and the health of the exposed population. The data relating to the diseases associated with these phenomena are not collected by the medical centres. This situation results from the low capacity of the health zones to detect such pathologies and the weakness of the health and diseases monitoring system which does not integrate the associated illnesses.

15. Lack of operational health facilities in areas dominated by known diseases

The general situation of miners remains precarious owing to the fact that they do not benefit from any social or medical protection. The Mukumbi health area does not have any operational health centre. The epidemiological profile of area's population is dominated by malaria, acute respiratory infections, and diarrhoeal diseases. Many cases of typhoid fever and bacillary dysentery are also present. Poor living conditions and promiscuity explain the resurgence of diseases such as tuberculosis, sexually transmitted diseases and HIV/AIDS.



Despite the current condition of the burnt village, a return is possible if the site is not closed and no remediation measures are implemented.

5. Recommendations

1. Close and monitor the site
The central and provincial authorities must move to close the mine site definitively due to the very high probability of further collapse. In the short-term, joint MONUC/OCHA missions, in co-operation with provincial mining authorities and Gécamines, should periodically go on site to make sure that the area is made safe and that no mining activities have restarted. Full cooperation should be granted in providing MONUC and OCHA access to the site.

2. Limit site access
To protect the population, access to the site must be guarded by a fence and physically supervised by the authorities.

3. Full site characterisation and decontamination
It is strongly recommended that a complete assessment and characterisation of Shinkolobwe be implemented. This would provide a full assessment of the site's radiological and environmental risks, as well as a long-term management and remediation plan.

A complete assessment would allow for a full site characterisation.

As Shinkolobwe has never been cleaned or rehabilitated, a complete decontamination of the site is advisable. Within such a framework, whose diagnosis remains to be made, the abandoned infrastructures, tailings and mineral waste rock could be deposited in the quarry following a site clean-up. The remaining contaminated residues should be sequestered according to best waste safety and management practices, such as embankment and topographic remodelling. A monitoring system with respect to potential radiation emissions would have to be established for a minimum period of 10 to 20 years.

4. Provoke further mine collapse
Detonation of explosives in the various remaining open shafts would make it possible to collapse these holes, sterilize the area and prevent access to artisanal miners. Such work should be carried out by mining or public works professionals. Prior to doing so, measures to minimise any dissemination of radioactive or other dust would need to be put in place.

5. Implement remediation measures
The authorities must continue their efforts to identify the six sites meant for exclusive artisanal exploitation within Katanga Province. Relocated miners, including those at Sandra, remain dissatisfied and would prefer to find a more profitable artisanal site. Employment alternatives or remediation measures are necessary for these people in order to prevent a return to Shinkolobwe.

6. Set up a mining association framework
A professional support and counselling structure must be operational on artisanally mined sites to avoid further accidents and promote good natural resource management practices. The SAESSCAM should establish itself in Katanga province and provide a framework for activities carried out by artisanal miners on these six sites. Both the objectives and respective mandates of EMAK and SAESSCAM must be defined anew in order to clearly establish the prerogatives of each entity. Gécamines should be more involved in order to better manage the various interests of mining stakeholders - from artisanal and small-scale miners to industrial operations.

7. Set up an inter-agency monitoring group
An inter-agency monitoring group in connection with artisanal mining should be set up in Kinshasa and Lubumbashi. The group would include the United Nations Development Program (UNDP), the International Labour Office (the ILO), UNICEF, WHO, OCHA and MONUC. The Kinshasa group would work in collaboration with the relevant governmental organisations to make follow-up recommendations to this report and support the Government in defining an integrated intervention strategy and action plan: Ministry of Mining (SAESSCAM and Environmental Protection Division); Health; Primary, Secondary and Professional Education; Environment and Conservation; and Solidarity and Humanitarian Affairs. This plan should include:

a) access to basic services by the local population;
b) a technical and organisational support framework as well as work health and safety aspects for artisanal miners; and
c) the prohibition of child labour at mine sites.

Proper enforcement of regulations would avoid creating the dangerous work situation seen above.

The Lubumbashi group would be responsible for carrying out periodic missions on artisanal mining sites in the province to assess the activities implemented within the framework of the action plan. The group should also have access to specialist advice from other agencies, the IAEA for example, as required.

8. Enforce the Mining Code
The authorities must ensure that artisanal mining activities conform to the mining code while ensuring basic services for miners and their families.

9. Organize public awareness campaigns
Public awareness campaigns on the health issues and good mining practices should be organized in the Kambove and Likasi areas.

10. Find alternative income sources and livelihood options
Considering the increasing popularity of artisanal mining, solutions for generating complementary incomes must be identified to help stabilize family incomes and allow for the schooling of children. Examples include agriculture and animal breeding. Such measures also help improve sanitary conditions and promote social cohesion. These activities can be effectively relayed by rural communities on the ground once functional co-operatives can be set up. In this regard, cooperation could be sought with the relevant international organisations (diversification of activities, conflict arbitration, health, schooling and child labour amongst other things).

11. Manage known resources (particularly heterogenite)
The Government should undertake a reassessment of its known natural resource potential in order to optimise the distribution of resources to the various mining operators within Katanga and the country. This could be carried out by:

i. Granting resource access to artisanal miners on sites whose mineral deposits (tonnage - content) is compatible with this type of activity. Open cast mining is preferred to the more complex and dangerous underground activity.
ii. The attribution of small and medium scale artisanal zones should pass through a targeted inventory of resources. This inventory should include the amount of existing natural uranium.
iii. A laboratory should be established, supervised by SAESSCAM, with two objectives: systematically establish the ore content of various metals (value contained) and measure any potential ionising radiation.

12. Promote secure working conditions for artisanal mining

In a context of regional development, national authorities should optimise the exploitation of mining resources by respecting the country's mining code and:

i. decrease the risks by defining mining methods
ii. ensure the training of technical supervisors at the Gécamines and/or the Ministry for the Mines or SAESSCAM by selecting required knowledge and expertise within these three entities
iii. ensure proper training of miners on mining techniques by these trainers (ii), through demonstrations and the use of proper equipment
iv. implement awareness campaigns to disseminate proper mining methods and share positive and negative experiences with other miners, particularly with respect to safety.

In the short term, authorities could begin these activities on the six sites to be allocated for artisanal mining.

13. Control the copper and cobalt production line

Control of the mineral resource production line, at the national level, requires an integration and collaboration of institutional services and professional organizations at the technical, operational, administrative and legal levels. This control will contribute to the improvement of living and working conditions, particularly for the artisanal mining population.

- To control production from extraction to marketing requires strengthening the links between related stakeholders. A support structure could be created, a 'Support group for small-scale miners' for example, which would be made up of a qualified multi-disciplinary team with various expertise related to small-scale mining. The group would adopt a promotion, mediation, and expertise sharing role by proposing to the contractor a quality assurance system through all stages of project development. Pilot demonstration centres could be established. A partnership could be established with State services and NGOs. Targeted activities would be organized to sensitise and educate artisanal communities.
- Partial mechanization should be considered to allow for increased production.
- Promote and strengthen an industrial and social fabric by moving from the informal (artisanal gathering) to formal sector — small and medium-sized enterprises (SME). The emergence of small mining companies will contribute to the area's development.
- State and/or Gécamines support to establish feasibility studies of the projects, and thus facilitate their potential access to financing.
- Support SAESSCAM and make it fully operational (financial and technical aid).
- In parallel, the Mining Ministry should define the prerogatives of SAESSCAM and EMAK to optimise their effectiveness and create synergies between stakeholders.

New smelting plants are being built in the Likasi area.

Items 11 to 13 could be included in a pilot project to include technical, economic, social and environmental aspects (institutional and operational).

14. Proper mineral storage in depots

Mineral/ore bags in depots should be stored under shelters and on a concrete foundation so as to avoid any risk of soil or water contamination.

15. Establish the hydrological characteristics of the area

Research should be carried out in the Likasi region to define the hydrological characteristics. This would also make it possible to better assess the impact on surface and ground waters from poor mineral storage conditions.

16. Control the effluents and heavy metals content
A control and monitoring system for gas and liquid effluents coming from the furnaces which treat or will treat ore, as well as for heavy metal content in the ground and water, should be set up.

17. Establish a functional regional health services system
A working and reliable health services system must be established in the area to meet the needs of the population. Such a system requires:

i. training health services staff in Kambove and Likasi in detecting, monitoring and responding to diseases related to irradiation, and the consumption and inhalation of heavy metal particles
ii. setting up registers for cancers, congenital malformations and cause of death in hospitals and health centres in Kambove and Likasi town
iii. helping make the Mukumbi health centre operational to ensure adequate medical coverage for the area's population
iv. establishing a provincial emergency preparation and response plan
v. leading an epidemiological investigation in the concerned health Zones to determine any causality between exposure to ionising irradiations or heavy metals on the one hand and the associated diseases on the other.

18. Support the area's health system
The WHO should contribute to setting-up a working health system in the Mukumbi health zone. It should also help strengthen the diseases monitoring system in both the Kambove health zone and Likasi town.

Better resource management, mining and storage practices, and a working health system would greatly help the local population.

References

Dupin, J.-C., and Mialaret, M., 2004. *Evaluation de la situation humanitaire à la mine uranifère de Shinkolobwe*, République Démocratique du Congo, 25 octobre – 4 novembre 2004. OCHA (United Nations Office for the Coordination of Humanitarian Affairs), Geneva, Switzerland.

Ekwanzala, M., 2004. *Evaluation de la situation de santé à la mine uranifère de Shinkolobwe*, République Démocratique du Congo, 25 octobre – 4 novembre 2004. WHO (World Health Organization), Kinshasa, RDC.

Global Witness, 2004. *Rush and Ruin: The Devastating Mineral Trade in Southern Katanga, DRC*. Global Witness Report, September 2004, Washington D.C., USA.

Hentschel, T., Hruschka, F., and Priester, M., 2003. *Artisanal and Small-Scale Mining: Challenges and Opportunities*. International Institute for Environment and Development (IIED) and World Business Council for Sustainable Development (WBCSD), London, England.

International Institute for Environment and Development (IIED) and World Business Council for Sustainable Development (WBCSD), 2002. *Breaking New Ground - Mining, Minerals, and Sustainable Development: The Report of the MMSD Project*.

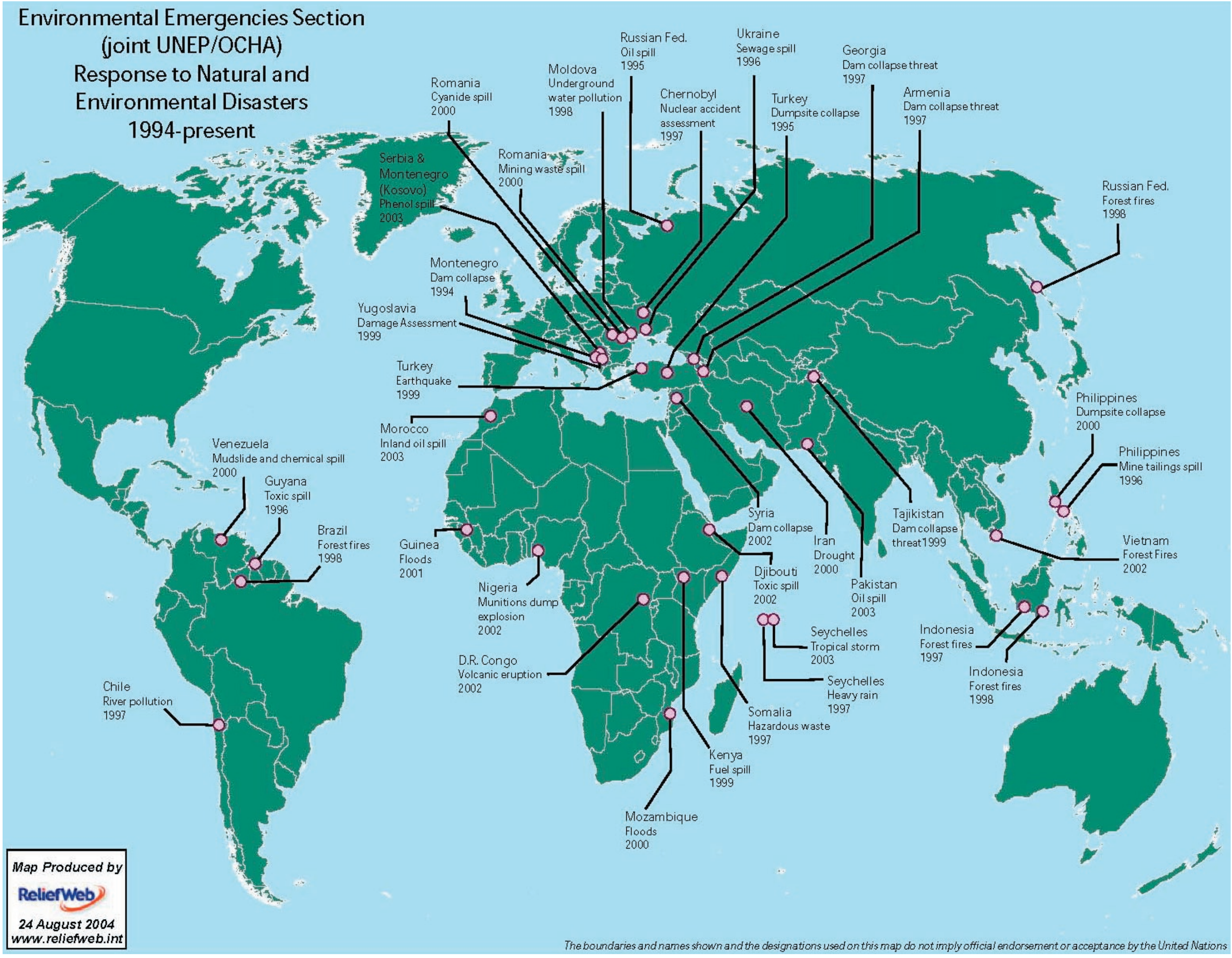
Labonne, B., and Gilman, J., 1999. *Towards building sustainable livelihoods in the artisanal mining communities*. Paper presented at the Tripartite Meeting on Social and Labour Issues in Small-scale mines, ILO, Geneva, 17-21 May 1999. ILO (International Labour Organization), Geneva, Switzerland.

Lamouille, B., 2004. *Evaluation de la situation minière artisanale sur la mine d'uranium-cobalt de Shinkolobwe, République Démocratique du Congo*. Joint UNEP/OCHA Environment Unit, Geneva, Switzerland.

MONUC Lubumbashi, 2004. *Rapport de mission effectuée à Likasi et Shinkolobwe le 14 juillet 2004*. United Nations et al., July 2004.

Pasche, A., 2004. *Eboulement de la mine de Shinkolobwe (République Démocratique du Congo) : Mission d'évaluation du 25 octobre au 4 novembre 2004, Rapport sectoriel: environnement*. Joint UNEP/OCHA Environment Unit, Novembre 2004, Geneva, Switzerland.

Waggitt, P., 2004. *Radiological Report on an Inter-Agency Mission to the Shinkolobwe minesite, Democratic Republic of Congo, 24 October to 4 November 2004. IAEA (*International Atomic Energy Agency), 16 November 2004, Vienna, Austria (not an official publication).



The Joint Unit's key functions include:

Monitoring
Continuous monitoring and ongoing communication with an international network of contacts.

Notification
Prompt notification and dissemination of emergency information in the event of an environmental disaster.

Information
Serving as an effective focal point for providing technical information such as maps and satellite images, scientific information and other expert assistance that can be channelled directly to requesting countries.

Brokerage
Facilitating contact between an affected country and donor countries who are ready to assist and provide needed response resources.

Assistance
Mobilise multilateral assistance from the international donor community when requested to by countries affected by environmental emergencies. OCHA Emergency Cash Grants may also be released in certain circumstances.

Assessment
Arrange for the urgent dispatch of international experts to conduct impartial and independent assessment of the environmental impacts of an emergency.