

OPINION

of the French Agency for Food, Environmental and Occupational Health & Safety

regarding the
“Natural asbestos outcrops” solicited request
State of knowledge concerning exposure, health risks and
management practices in France and internationally

ANSES's public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

1. CONTEXT AND PRESENTATION

There are many natural outcrops of asbestos in France. The largest of these are located in the Haute-Corse *département* and in New Caledonia, but outcrops are also found in certain regions of mainland France.

In December 2007, the Ministries of the Environment, Health and Labour requested that AFSSET¹ conduct a study on natural outcrops of asbestos in France. France has many natural asbestos outcrops, the largest are located in Haute-Corse and New Caledonia, but others are found in some regions of mainland France.

The Ministries' request focused on a critical review of the literature in the fields of epidemiology, metrology and assessment of population exposure on asbestos-bearing ground, and on the study of practices for managing natural outcrops in other countries faced with this problem.

This work comprised an international literature review on inhalation exposure during outdoor activities on asbestos-bearing grounds to all types of asbestos having a regulatory or internationally-recognised definition. The scope of this study excludes certain specific cases which have already been examined or will be handled in a separate expertise context:

- Any exposure *via* manufactured materials containing asbestos;

¹ Became ANSES on 1 July 2010: <http://www.anses.fr>

- Risks to workers exposed during past industrial activities;
- Nickel mines in New Caledonia which may potentially release asbestos.

The results of the study will be used to help local policymakers and risk managers define practical preventive measures adapted to the land, and will yield more information on metrology in the specific open air environment.

2. ORGANISATION OF THE EXPERT APPRAISAL

For this "non-risk assessment" expertise, ANSES conducted the study internally.

Two consulting companies were commissioned to conduct a critical review of the literature and a study of practices in countries other than France and the United States, as these two countries had already been dealt with internally by the Agency.

The agency also consulted five expert *rapporteurs* with complementary skills in epidemiology and metrology who provided support with the literature review.

3. DESCRIPTION OF THE METHOD

The work undertaken was based on a review of different publications (reports, scientific articles, various memos, information booklets, etc.) supplemented by interviews with some of the authors of these documents and with local players who had campaigned in connection with this problem. The report thus presents an inventory of how natural outcrops of asbestos are managed in France, distinguishing between Haute-Corse, New Caledonia and mainland France, as well as in other countries faced with this issue.

For France, the report identifies firstly the measures undertaken to protect both the general population and those at risk from occupational exposure, and secondly the various recommendations already issued by local or national bodies. These measures and recommendations have been grouped into several topics, including recognition of the risk (mapping), urban planning, management of works, management of waste from asbestos-bearing ground, information and communication, and medical supervision of affected populations.

At the same time, a literature search was undertaken in order to conduct as comprehensive a survey as possible of the different countries concerned by asbestos outcrops. This was followed by a search for the different information available on risk management practices for natural asbestos outcrops in these countries, and interviews with government authorities and/or scientific organisations likely to be concerned by this issue in each of the countries involved, for which one contact (at least) had been identified.

4. CONCLUSIONS AND RECOMMENDATIONS

The recommendations proposed to prevent exposure and risks come purely from technical considerations and are valid at both national and local levels.

Their implementation will require clear prioritisation taking into account other relevance criteria outside the scope of the study (local feasibility constraints, existing regulations, etc.).

4.1. Recommendations for the mapping and metrology of asbestos

In order to identify and characterise the different sources of environmental exposure to asbestos, appropriate tools should be developed and used. These include:

- specific mapping of the probability of asbestos presence;
- study of the potential for emission and dispersion of asbestos-bearing rocks;
- metrology campaigns on rocks and solid materials that may contain asbestos (rubble, soil, coatings, etc.), conducted by geologists;
- atmospheric metrology campaigns conducted by specific organisations.

Mapping (presence and emission) is a tool, sometimes defined by a regulatory framework (Italy), used for pinpointing first-priority situations. In France, this approach relies on the involvement of BRGM geologists assigned to cover the entire national territory. Thus, geology experts should continue to produce detailed (1/10,000 to 1/25,000) maps of potential presence and emission in mainland France, Haute-Corse and New Caledonia. Implementation of this mapping should be centralised as far as possible (on a national or territorial scale) in order to optimise the processing and overall management of information relating to an area, with the dual purpose of preserving the memory of the sites and disseminating consistent information. The mapping approach does have some limitations, however, particularly when risk assessments are conducted by non-geologists.

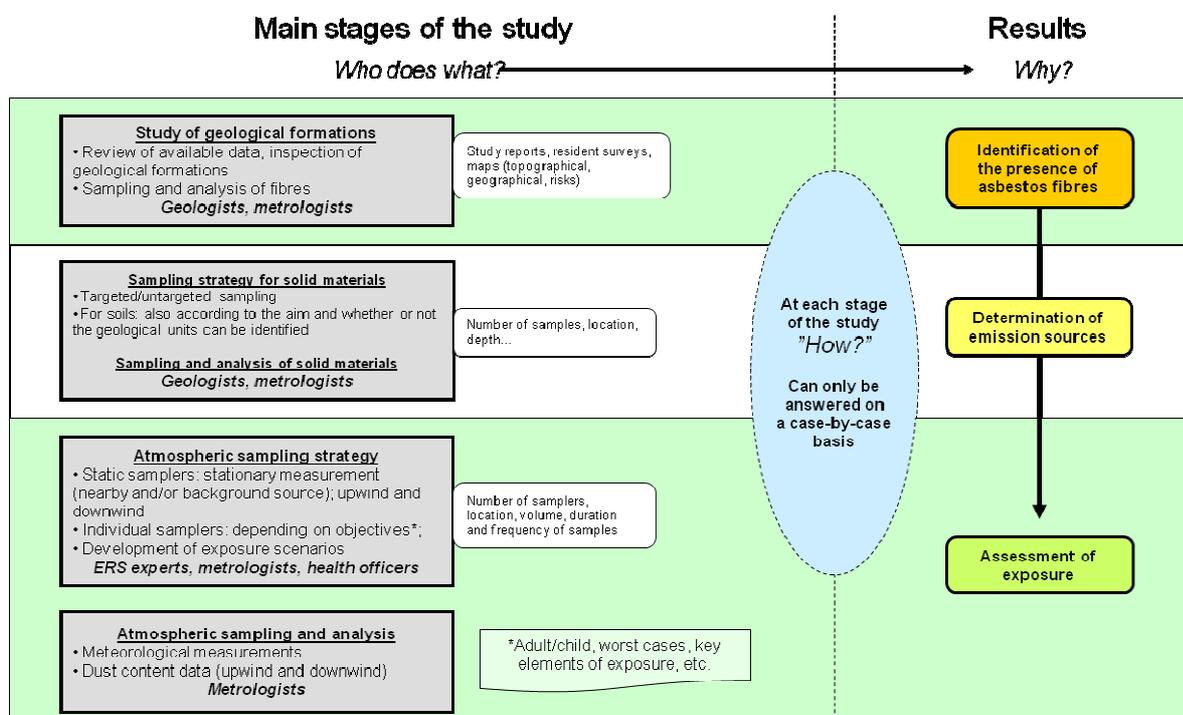
This descriptive approach can then be considered primarily on land designated for construction in regions of occurrence, as a decision support tool, but it must be accompanied by a quantitative approach to assess the actual exposure of populations in the region concerned. In France, assessing the presence of asbestos in solid materials is mainly based on an expert opinion, confirmed by field descriptions and asbestos analyses. In order for sites to be assessed in a consistent manner, it would be better if only specially qualified experts, such as approved hydro-geologists, were authorised to conduct such assessments.

This approach makes it possible to define the study area where the population is likely to be exposed and should be combined with atmospheric measurement campaigns. Two methodologies are complementary when conducting measurement campaigns to assess levels of exposure:

- characterisation of asbestos concentrations in the air from stationary sampling in general populations living near asbestos-bearing areas, over a long duration in normal activity situations (background).
- measurement of exposure peaks from individual sampling in specific identified situations (based on exposure scenarios, for example) such as those capable of emitting asbestos fibres, and in unfavourable conditions in the outcrop areas

(playgrounds, cultivated land, recreation fields, roads surfaced with asbestos-containing debris), even to characterise non-occupational exposure.

Based on the literature review, a structured approach to assessing environmental exposure to asbestos can be outlined by the figure below:



When designing a study, the general approach should include a technical section relating to the sampling and analysis method (standard, method validated in the laboratory, etc.). The atmospheric sampling strategy must take into account several criteria in order to be representative of the situations to control and to define the location: the period, type, number and duration of samples to be taken and the equipment to be used. Information should be available on the complete characterisation of the pollution source, weather and activity conditions. In field studies, the measurement of asbestos concentrations in outdoor air is generally based on the recommended method for measuring asbestos concentrations in buildings (static samplers). Before the implementation of a measurement campaign, this method, which has been standardised for the indoor environment, must be adapted to the outdoor field conditions, the study context and objectives (reference to an occupational or environmental standard, determination of the degree of urgency of the clean-up, description of the key elements of exposure). In summary, while a general approach can be followed when designing an exposure investigation plan, on the other hand, the sampling and measurement strategies as such should be designed on a case-by-case basis according to the aims of the studies.

To improve the harmonisation of methods and the quality and consistency of experimental results, there would be considerable added value in developing guides corresponding to French issues concerning environmental asbestos, based on documents already available in other countries. Thus, methodological guides written in the United States refer to soil surveys and the investigation of potentially asbestos-bearing sites during school construction projects. They are unique in presenting guidelines on investigating the site,

themes for writing the investigation report, the role and legal involvement of each actor and the decisional standpoints to be adopted according to the results of the investigations.

The establishment of a specific regulatory framework for the external environment is recommended. It would mandate the monitoring of risk areas (defined by mapping, population density, etc.) and provide information for the introduction of management measures, where needed.

As with measurements of dust content in buildings², the establishment of a regulatory framework for the appointment (e.g. certification or accreditation) of organisations authorised to measure (sampling/counting) the concentration of asbestos dust in the general outdoor environment could guarantee valid exposure measurements to decision makers. As an indication, the terms of accreditation mainly include the following:

- The type of accreditation (sampling/counting);
- The sampling or analysis equipment (number and type of pumps and sampling heads or apparatus needed for the preparation and reading of filters available to the organisation, to be distributed to the sites where appropriate);
- Experience gained in asbestos dust measurement;
- Participation in an inter-comparison campaign for counting using transmission electron microscopy, organised annually by the National Research and Safety Institute (INRS) for the analysis and counting of asbestos fibres.

Tailoring the regulations, based on the standard being drafted, “Friable Asbestos - Qualification”³, could also be considered in order to impose the concept of specific qualifications for companies authorised to work on asbestos-bearing ground. This regulatory change could yield results on the specific protection measures for workers required to deal with natural asbestos outcrops.

Standard methods suitable for outdoor sampling could also be developed for atmospheric measurements in these specific environments. Some sampling parameters are not specific to the outdoor environment and can be taken from the French Standard NF X 43-050. These include the type of filter, type of sampling head, fraction sampled and processing of the sample. In contrast, the rate, volume and duration of sampling must be adapted to the outdoor conditions (weather, expected concentrations, distance from the emission source, field constraints). In this context, specific studies to test the validation parameters must be implemented by specialised laboratories with special knowledge of the field.

As with the analytical conditions, the systematic application of a quality process with regard to samples (rate control, blank samples, etc.) will improve the reliability of the results.

4.2. Health data related to natural outcrops of asbestos

4.2.1. Conclusions of the health findings established near natural asbestos outcrops

The investigation of the health effects and the methodologies used in situations of natural outcrops, and more generally in situations of environmental exposure to asbestos, have

² Article R1334-18 of the French Public Health Code

³ Draft Standard AFNOR/X46A on the removal and containment of asbestos-containing materials, friable or not, carried out in the outdoor environment or not, and specific qualifications for the companies involved. <http://www.afnor.org>

been addressed in very diverse ways in different parts of the world, making it difficult to compare the situations and possible excess risks calculated with each other. Moreover, these studies often lack a clear definition of the population at risk, especially since they have no control group for comparison. The natural sites are often in rural areas, and only small populations are affected (often just a few villages), making it difficult to conduct real etiological studies. For rural populations living on or near naturally-occurring geologic asbestos deposits (Turkey, Greece and Cyprus: the first case studies were conducted in the 1970s), high incidences of mesothelioma (a specific indicator of exposure to asbestos fibres) have been observed in the absence of precise data on the pattern of exposure (early exposure, large cumulative doses, the toxicity of amphiboles mainly found in natural exposures, or a combination of these parameters).

A literature review concluded that, despite a poorer understanding than for occupational exposure, the accumulated indices do point to a health effect for environmental exposure to asbestos. Irrespective of the sources of exposure, industrial, para-occupational or domestic, an excess risk of mesothelioma was observed in the presence of asbestos. However, approximately 20% of mesothelioma cases in industrialised countries cannot be explained by occupational exposure to asbestos.

Studies of natural sources show that exposure from birth leads to equivalent or longer latency periods compared to those from occupational exposures, with diseases typically appearing at around 50 years of age.

Based on the studies presented and the latest scientific findings on environmental exposure to asbestos, it appears that there is conceivably a potential risk of asbestos-related diseases for populations near natural outcrops that have not been exploited on an industrial scale but that may have been modified by human activity. The risk arises, or is increased, if the materials are deployed or used locally: regional development (building, roads, paving, etc.), use of a whitewash such as *pō* or *luto*, manufacture of household articles, etc.

4.2.2. Haute Corse :

Concerning the situation in the Haute-Corse *département*, epidemiological data are available for the north-east region of Corsica, an area rich in asbestos deposits and the site of the Canari Mine which closed in 1965. In 1993, apparently without any occupational exposure being identified for populations in this area, a study described in detail 14 cases of mesothelioma in patients who had spent their childhood in north-east Corsica (villages remote from the Canari Mine) and in the city of Bastia. The authors presented their study as a reliable indicator of the health risks near natural outcrops, estimating at around 10 cases per 100,000 residents the annual incidence of mesothelioma in this region of Corsica.

In Murato, a village in Nebbio built on an area of natural asbestos outcrop in north-east Corsica, 41% of the population over 50 years old examined had pleural plaques. In this district, the mass concentration of tremolite fibres was 40 times higher inside homes than in the control village (44 ng/m³ in Murato compared with 1 ng/m³ in Vezzani) and the concentrations outdoors were almost 200 times higher in the district of Murato (72 ng/m³ in Murato compared with 0.4 ng/m³ in Vezzani).

A cross-sectional study showed a prevalence of pleural plaques three times higher in north-west Corsica, which is a granite region. According to a second study, the percentage of patients with pleural plaques born in villages with asbestos deposits was close to 95%, compared with 58% for the 'control' villages.

In response to a request from the Prefect of Corsica relating to the assessment of the health impact of environmental exposure to asbestos on populations in Corsica, three measurement campaigns were conducted by the Haute-Corse departmental health authority (DDASS) in 2001, 2002 and 2003. The aim of these campaigns was to better understand atmospheric concentrations of asbestos fibres and to interpret them according to the emission sources. These campaigns were spread over extended periods and endeavoured to conduct a very broad study of geographical sites which were known for environmental asbestos. They also sought to identify the activities responsible for the exposure peaks.

Six sites were selected: Bastia, Bustanico, Corte, Moïta, Murato, Rutali and L'Île Rousse.

These measurement campaigns were combined with an assessment of the risk of death from lung cancer and cancer of the pleura (or pleural mesothelioma) in three of the six districts. Regarding the districts of Bustanico and Murato, the average individual excess risk associated with a lifetime of continuous exposure to levels of 2.6 to 5 f/L of amphiboles for mesothelioma would be around 1.2 to $2.2 \cdot 10^{-3}$ for men and 1.9 to $3.6 \cdot 10^{-3}$ for women, and for lung cancer would be around 3 to $5.7 \cdot 10^{-4}$ for men and 0.6 to $1.1 \cdot 10^{-4}$ for women. Regarding the district of Bastia, the average individual excess risk associated with a lifetime of continuous exposure to a level of 1.3 f/L of chrysotile for mesothelioma would be around $2 \cdot 10^{-4}$ for men and around $3.4 \cdot 10^{-4}$ for women, and for lung cancer would be around $1.5 \cdot 10^{-4}$ for men and around $0.29 \cdot 10^{-4}$ for women.

Given the high levels of risk of mesothelioma and especially lung cancer expected from non-environmental exposure to asbestos, it may be difficult to identify the excess risk associated with environmental exposure at the sites being considered with an epidemiological study. Another campaign to measure atmospheric levels of asbestos fibres is underway (DDASS Haute-Corse, 2009).

Several authors have stressed the limitations and uncertainties of their estimates, although they draw attention to the fact that the dust levels found during earthworks indicate the very high exposure of personnel engaged in this work if measures are not taken to avoid fibres being blown around. Managing product debris is particularly significant since it can potentially contaminate the environment and thus expose nearby populations to serious risks.

4.2.3. New Caledonia :

Studies in the early 1990s identified a high rate of mesothelioma with characteristics more indicative of environmental exposure to asbestos. This excess of mesothelioma was limited to Melanesian ethnic groups and certain predominantly rural regions, which led to a subsequent focus on the traditional use of pö⁴. Subsequent studies showed that a significant contribution to this environmental exposure to asbestos could come from materials emanating from the local rock and used in the villages, such as pö.

A case-control study on all respiratory cancers was then established in 1993. Its results showed a very strong association between the use of pö and the risk of mesothelioma in both sexes, and lung cancer in women (in whom the risk increases for smokers); however, no association with lung cancer was observed among men, probably due to lower exposure. In this study, the highest atmospheric concentrations of asbestos fibres were

⁴ In some Melanesian villages the interior and exterior walls of houses are typically coated with a whitewash made from a friable rock found near human settlements, referred to locally as pö.

identified during the preparation of pö, on the paths, and inside the homes while engaging in domestic activities. The data from this early research led to more in-depth investigation.

Based on these identified sources, some studies have endeavoured to assess the same population's exposure to asbestos fibres in order to assess the risk of death from lung cancer and mesothelioma. Despite the establishment of developed exposure scenarios, the exposure has not been sufficiently well characterized.

It has however been possible to deduce some general data from this work. General atmospheric concentrations are low (less than 1 fibre/L) and certain circumstances (domestic activities, traffic on the paths) can give rise to high concentrations of asbestos fibres, of the order of several tens of fibres per litre of air or more. A health risk assessment study, according to the same excess mortality risk models proposed by the INSERM collective expertise in 1997, allowed the authors to propose trends in excess lifetime risk (until the age of 80 years) associated with continual exposure to asbestos.

Nevertheless, the authors consider that these data provide a plausible order of magnitude that enables measures to be considered to reduce exposure. The individual lifetime excess risks vary from $3.4 \cdot 10^{-4}$ to $47 \cdot 10^{-4}$ depending on the scenario. The authors emphasise that the existence of exposure peaks considerably increases the average level of exposure and therefore the risk. The potential existence of such peaks should be taken into account in any future estimate of exposure levels.

4.2.4. Other countries faced with asbestos outcrops

Despite the limitations and potential selection bias inherent in the method used, the vast majority of cross-sectional studies analysed enable the prevalence of pleural plaques to be determined in areas with natural asbestos outcrops and/or near asbestos mines. The main results are presented in the table below.

Table 1 : Prevalence of pleural plaques related to environmental exposure to asbestos (cross-sectional studies)

Country	Populations	Prevalence	Exposure	Fibres	References
Austria	Farming population without known occupational exposure to asbestos	5.3%	Outcrops (former mine)	Tremolite Serpentine Actinolite	Neuberger et al., 1978
Bulgaria	Breeders or tobacco growers Mine workers excluded	3.9%	Near the mine	Anthophyllite Tremolite	Zolov et al., 1967
China	Farmers in the province of Da-Yao (used for roads, coatings, etc.)	19.8%	Outcrops	Crocidolite	Luo et al., 2003
United States (Libby)	Residents with no particular exposure	6.7%	Near the mine	Vermiculite	Peipins et al., 2003
	Residents with particular environmental and/or domestic exposure	14.4% to 26.1%	Near the mine	Vermiculite	Peipins et al., 2003
Finland	Majority of farmers in 10 rural districts in the east of the country	2.8%	Near the mines (former mines)	Anthophyllite	Raunio et al., 1966
France (Corsica)	Entire north-east region	3.7%	Outcrops	Chrysotile Tremolite	Boutin et al., 1986
	Inhabitants over 50 years old in the village of Murato	41.0%	Outcrops	Chrysotile Tremolite	Rey et al., 1993a and 1994
Greece (Almopia)	Inhabitants over 40 years old from 7 rural villages Wall coatings	24.2%	Outcrops	Chrysotile Tremolite	Sichletidis et al., 1992
Greece (Metsovo)	Inhabitants of 3 exposed villages Wall coatings	Men: 34.7% Women: 21.5%	Outcrops	Chrysotile Tremolite	Bazas et al., 1985
	Inhabitants of 4 exposed villages Wall coatings	45.5%	Outcrops	Chrysotile Tremolite	Constantopoulos et al., 1985
	Inhabitants under 40 years old from 4 exposed villages Wall coatings	1978-82: 28.6% 1998-2002: 0%	Outcrops	Chrysotile Tremolite	Manda-Stachouli et al., 2004
Turkey (Anatolia)	Inhabitants over 20 years old, Wall coatings	18%	Outcrops	Tremolite	Coplu et al., 1996
	Inhabitants of at least 30 years old from 11 villages Wall coatings	14.4%	Outcrops	Tremolite Actinolite Anthophyllite Chrysotile	Metintas et al., 2005
Turkey (South East)	Village inhabitants Wall coatings	6.5%	Outcrops	Tremolite Chrysotile	Yazicioglu et al., 1980

Among asbestos diseases, pleural mesothelioma is the most studied in the context of environmental exposure, because of its specificity, whether in situations of natural outcrops, near mining facilities, or in asbestos processing facilities.

The main results of cohort studies are presented in the table below (Table 2). There are other incidence figures, which are often estimates based on cases diagnosed in hospital or in records or monitoring programs, and related to the population of the affected area. Thus, in Turkey, the estimate is 220 cases per 100,000 person-years (PYs) in Tuzkoy, 170 to 870 cases per 100,000 PY in Karain, and 5 to 10.5 cases per 100,000 PY in the south-east of the country. In Greece, the incidence was estimated at 50 cases per 100,000 PY in Metsovo.

Table 2 : Incidence of mesothelioma and relative risk (RR) related to environmental exposure to asbestos (cohort studies).

Country	Populations	Incidence / 100,000 PYs*	RR and CI at 95%	Exposure	Fibres	References
Australia	Women and children residents (including para-occupational and domestic exposure)	590 (women) 320 (children)		Near the mine	Crocidolite	Rogers and Nevil, 1995**
	Including para-occupational and domestic exposure	26	1.59 [1.09-2.33] by log (f/ml)	Near the mine	Crocidolite	Hansen et al., 1998***
	Including para-occupational and domestic exposure	25 to 275 depending on time since 1 st exposure		Near the mine	Crocidolite	Reid et al., 2008
Greece (Metsovo)	Monitoring of incidence, use of <i>luto</i> ceased in the early 1980s	37 (1980-84) 14 (1985-94)	-	Outcrops	Tremolite Chrysotile	Sakellariou et al., 1996
Turkey (Anatolia)	Inhabitants of at least 30 years old from 11 villages, use of rocks (rough plaster, insulation, etc.) Based on 24 cases observed in a cohort of 1886 villagers: 12/12 M/W versus 0.7/0.5 for 100,000 inhabitants, expected according to data on the Turkish population.	114.8 (M) 159.8 (W)	-	Outcrops	Tremolite Actinolite Anthophyllite Chrysotile	Metintas et al., 2002****

*PYs = person-years.

** Incidence rates estimated by calculation from data on the duration of residence and exposure.

*** The incidence rate increases with the residence time and cumulative exposure levels.

**** Very high risk compared to other regions of the world and comparable to the risk of a worker occupationally exposed to asbestos.

The main case-control studies identified in this work relate to California and New Caledonia for situations of natural outcrops, and Australia and South Africa for populations living near mining and asbestos processing sites (Table 3). In particular, the study of Pan et al., in 2005, shows a linear dose-response relationship between the distance to outcrop areas and pleural mesothelioma.

Table 3 : Risk of mesothelioma related to environmental exposure to asbestos (case-control studies)

Country	Populations	OR and CI at 95%	Exposure	Fibres	References
South Africa	Residents with exclusively environmental exposure	All mining regions: 19.6 [3.7-105] NW Cape (crocidolite): 32.7 [8.1-131] NE Transvaal (chrysotile and/or amosite): 12.7 [1.9-84.7]	Near the mine	Crocidolite Chrysotile, Amosite	Rees et al., 1999
Australia	Excluding workers, including para-occupational exposure	2.73 [1.94-3.82] by log (f/ml)	Near the mine	Crocidolite	Reid et al., 2008
France (New Caledonia)	Users of pö; the indicator is the use of pö and not the asbestos measurements	40.9 [5.15-325.0]	Outcrops	(Tremolite)	Luce et al., 2000
United States (California)	Results adjusted on occupational exposure	0.937 [0.895-0.982] for a distance of 10 km	Outcrops	Serpentinite	Pan et al., 2005*

* a 6.3% reduction in risk every 10 km.

Regarding lung cancer, although the link with asbestos has been established, it is more difficult to identify a relationship between environmental exposure and this kind of cancer (Neuberger et al., 1984). In New Caledonia, the link between lung cancer and the use of pö is only found among Melanesian women; however in principle women receive more exposure than men as they stay longer in their homes and carry out most domestic activities.

Finally, few publications have examined the links between environmental exposure and asbestosis, a disease known in the workplace to be linked to high concentrations of asbestos. Cases have been reported in China (1.4% among farmers aged over 40 years) in a region of natural asbestos outcrops where asbestos-bearing rocks are used for road surfaces and to make wall plaster or stoves (Liu et al., 1990, Luo et al., 2003), as well as in Turkey, where a cross-sectional study found a fibrosis prevalence of 15.6% among 63 villagers in Anatolia (Baris et al., 1988b). Similarly, a high asbestosis mortality rate in Libby, Montana has been reported (Horton et al., 2008). Nevertheless, it also appears that environmental exposure in addition to occupational exposure could increase the risk of asbestosis. Thus, in a recent published study conducted in workers at six major industrial asbestos processing facilities in Turkey, the authors showed an independent effect of environmental exposure on the occurrence of asbestosis, after occupational exposure had been taken into account. In this study, those born in an area with natural asbestos outcrops were considered to be environmentally exposed (Akkurt et al., 2006).

4.3. Recommendations for medical monitoring plans and research

The studies included in the report highlight the risk of disease to populations near natural asbestos outcrops. It is necessary to clearly define these potential areas and study populations potentially at risk.

In other countries such as the US, medical monitoring plans (which contribute to the improvement of health knowledge) has been highly effective in screening for diseases and initiating management measures (Table 4). In particular, following studies by the ATSDR, the US-EPA⁵ announced in June 2009 a state of public health emergency on the site of Libby in north-west Montana. Under the US regulatory system, this is the first time a public health concern relating to environmental contamination of a site by asbestos has been determined.

The various authors cited in the report described their studies' limitations in identifying cases of diseases related to environmental asbestos. These data also corroborate the need for increased medical monitoring plans in areas at risk, capable of the early identification of any increases in disease.

Table 4 : Summary of medical monitoring plans

Country	Regulation	Status	Prospects
France / Haute-Corse	No specific provisions recorded	PNSM including, since 2006, the <i>départements</i> of Corsica A plan for mandatory reporting of mesothelioma is underway (Measure 9 of the Cancer Plan 2009-2013)	No establishment of systematic screening of persons exposed to levels considered low to moderate For situations of high environmental exposure (documented by the InVS / geographical criteria to be developed), recommend a review of the health status of populations and information on the risks associated with asbestos Need for a discussion involving all stakeholders with the development of a specific programme under State responsibility
New Caledonia		Local cancer register	Extend the PNSM to New Caledonia
United States / California		Study in El Dorado Hills using data from the state of California cancer monitoring programme	
United States / Montana		Screening programme in Libby in 2000-2001 Review of mortality in Libby (1979 / 1998) Tremolite register	Request for the creation of a register for residents and workers in Libby Five-year programme (2008 / 2013) mainly aiming to increase health surveillance

Thus, medical monitoring, through a census and study of mesothelioma cases, should be continued and centralised in a national programme covering the entire territory. In this respect, it would be preferable for the National Mesothelioma Monitoring Programme (PNSM) to be extended to New Caledonia, or failing that, for partnerships to be set up with the New Caledonia cancer register.

Resources should be provided to ensure that distinctive regional features are better taken into account (for example in Corsica: the prevalence of cases should relate only to the

⁵ US-EPA press release. Available on:

<http://yosemite.epa.gov/OPA/ADMPRESS.NSF/d0cf6618525a9efb85257359003fb69d/0d16234d252c98f9852575d8005e63ac!OpenDocument>

Haute-Corse *département*, and not the entire region since there are no cases in the Corse-du-Sud *département*). In this, the proposed mandatory reporting of mesothelioma will provide useful information.

The resources deployed for monitoring these programmes can also be used for epidemiological surveys, particularly for case-control studies as they apply more to rare diseases and are therefore suited to analysing the health impact of exposure to asbestos.

In order to conduct studies that could reduce the main confounding factors in the scientific literature mentioned in the report, data could be generated on natural outcrop sites independent of any professional context, or on regions prohibiting the extraction and use of asbestos, in order to assess the potential risks without the mobilisation of asbestos-containing material by human activity.

Knowledge could be improved of other fibre types not recognised in the regulations as being varieties of asbestos, such as erionite⁶, fluoro-edenite⁷, or antigorite⁸. Being by definition unregulated, they are systematically excluded from field surveys. However, they are suspected of causing similar diseases to those of recognised asbestos fibres. Their toxicity should be studied more precisely if the occurrence of these fibres is confirmed in France and New Caledonia.

⁶ Family of zeolites. The classification by the European Union and the International Agency for Research on Cancer equates to fibres considered to be asbestos

⁷ Family of amphiboles. Preventive measures are applied in Italy

⁸ Family of serpentines. The toxicological profile has not been established, but their presence is known in New Caledonia

4.4. Recommendations for the management of asbestos outcrops

Several reports published on the problem of natural asbestos outcrops, particularly for New Caledonia and Haute-Corse, offer risk management recommendations, the earliest dating from the 1990s. Some of them have only been implemented in recent years. These measures are today largely based on local initiatives. They do not seem to be valued at the national level, nor are there any exchanges between the regions concerned. For example, regarding the management of work on asbestos-bearing ground, the sharing of experience between New Caledonia and Haute-Corse seems just to be beginning.

Note that, apart from the United States and Italy, few of the 38 countries identified as having natural outcrops on their territory have management schemes in place. The two countries mentioned have in particular implemented regulatory measures and other management measures (restriction of access, soil covering and stabilisation, communication campaigns, etc.) to prevent the risk of exposure to asbestos fibres from natural outcrops.

To ensure the success of the literature's recommendations applicable to France, the use of local expertise is essential, and more support at the national level would contribute to the success of these field activities.

4.4.1. General clarification of the regulations and strengthening of collaboration between competent authorities

The regulatory means that could be applied are subject to different legal interpretations. According to many of the interviewed stakeholders, the difficulties implementing local measures to prevent and reduce the risks related to natural asbestos outcrops are closely linked to a shortfall in the regulatory requirements specific to the problem of natural asbestos outcrops.

This shortfall can be noted both for the rules on protection of workers and those relating to the general population.

Given the currently available information on asbestos, in addition to workers who may be subjected to high exposure (e.g. from excavation), priority should be given to measures for preventing or reducing exposure of populations living in asbestos-bearing areas.

Resolving legal interpretations either through regulatory texts (e.g. modification of existing texts, new provisions, etc.) or non-regulatory ones (e.g. circulars with official interpretations) would ensure for the competent authorities concerned the likelihood of greater uniformity in control measures within the country and a greater emphasis on risk prevention, particularly in the areas of planning, implementation of construction and urban development work, and management of debris and waste. These texts should be explicit, incorporating specific measures for asbestos-bearing ground.

There are working groups and local consultation groups in both Haute-Corse and New Caledonia. Their longer-term continuation should be ensured and the dissemination and application of their work improved. Indeed, it seems essential to support national authorities with local expertise, which has proven itself on a number of management initiatives, in order to implement other relevant risk reduction and prevention measures, information campaigns to populations and communication of feedback.

National-level coordination, in collaboration with the local authorities, should also aim to gather as much health and geology data as possible. This compilation work would have several benefits:

- Allow information to be disseminated more easily to the different stakeholders concerned and made public;
- Enhance and promote exchanges and sharing of feedback;
- Generalise and impose recognised practices and recommendations by retranscribing them in the regulations where appropriate;
- For such monitoring, it would be preferable for publication to take place at intervals of a few years.

4.4.2. Management practices

Measures relating to urban development

Works carried out on natural outcrops are a major source of emissions. Unlike other countries such as Australia or the United States, France has no specific regulatory measures, only the general framework of protection of workers applies, as well as local initiatives (Table 5). In this general framework there is no clear guidance on how the measures apply to natural outcrops. However, the presence of asbestos-bearing ground should be taken into account in any proposed construction or urban development works.

Specific detailed instructions should be provided to stakeholders (prime contractors, contracting authorities, companies, subcontractors, etc.) and all necessary measures must be taken to protect workers and surrounding populations, through for instance a mandatory compliance plan submitted to the authorities for approval.

It would be preferable to rely on documents produced by the Haute-Corse Labour Inspectorate and the Government of New Caledonia. These describe the good practice measures to be taken into account at each stage of a works project, from its conception to the making safe of exposed ground and debris generated by the work. They could provide the basis for specific regulations applicable to work performed on natural asbestos outcrops.

Table 5 : Summary of works on outcrops

Country	Regulation	Status	Prospects
France / Haute-Corse	French Labour Code ⁹ : 1/ Operations regarding building and civil engineering : L.4531-1 and following (client obligations) L. 4532-5, R. 4532-6 (obligations of client to detect asbestos before work begins); L. 4732-2 interlocutory proceedings for failure to comply with the provisions resting with the client; 2 / Works on asbestos-bearing land: R. 4412-94 -113 (joint provisions: training, OEL, dust control, work organisation, waste, exposure documents); R. 4412-139 to -148 (special provisions for building and civil engineering operations carried out on asbestos-bearing land) 3 / Non-subcontracting employers: L. 4535-1 and R. 4534-1	Specific note of the Haute-Corse Labour Inspectorate: <i>"méthodologie pour la protection des travailleurs sur les chantiers de bâtiments et de travaux publics en terrains amiantifères"</i> [Methodology for the protection of workers on building and public works construction sites on asbestos-bearing ground] Meetings and letters to inform/remind construction companies, first-level customers, trade unions, etc. Training by the French organisation for risk prevention in the construction industry (OPPBT) on the risks when working on asbestos-bearing ground Prevention contracts between volunteering companies and the South-East Regional Health Insurance Fund (CRAM Sud-Est) Partnership charter between volunteering first-level customers and the CRAM Sud-Est Multiple inspections by the local Labour Inspectorate Injunctions or increases in the "work accident and occupational diseases" contribution rate for certain defaulting companies	2009/2012 Regional Action Plan of the CRAM Sud-Est Application to introduce special provisions in the regulations for works, waste, local authorities Application for the right to an immediate halt to construction work by inspection officers from the Labour Inspectorate Application for regulations for agricultural work on asbestos-bearing ground, extension of the regulations applicable to transport
New Caledonia		Multiple visits to construction sites by the Labour Inspectorate Training by the French National Institute for Labour, Employment and Professional Training (INTEFP) Technical forum on risk prevention in areas of naturally-occurring asbestos Guidelines for writing and implementing a prevention plan for work in asbestos-bearing areas (DTE, CAFAT, SMIT)	Significant current changes in labour regulations concerning building sites in areas containing asbestos. Develop identification of asbestos-bearing routes on mining concessions, prior preventive geological studies during development works, etc. Application for consultation with the New Caledonia geological service prior to any infrastructure projects
Australia	Regulations in the state of New South Wales for work on natural outcrops (Exemption Order)	Measures in New South Wales: in-depth diagnosis in case of discovery, then monitoring and control plan	
United States / California	General framework for the protection of workers Special provision on the measures to control asbestos in the air for construction, grading, extraction and surface mining operations Special provisions for El Dorado County: Measures aiming to reduce the emission of asbestos dust from soil during works (reduction plan, information, etc.)	Documents intended to accompany work on natural asbestos outcrops (Cal EPA, ATSDR, US EPA, Fairfax County, etc.)	
United States / Virginia	General framework for the protection of workers Special provisions for Fairfax County: Directive on performance standards for sources of actinolite/tremolite in soils, Directive on the obligation for monitoring and reporting (prior compliance plan)		

⁹ See (in French) : <http://www.travailler-mieux.gouv.fr/amainte.html>

In France and abroad, there is no regulatory provision for restricting access to sites. However measures can be taken, like in the United States for example, to temporarily prohibit access to a site while a plan for management and possible rehabilitation is developed.

Restricting access to asbestos-bearing sites remains the first-priority measure to be considered either permanently, or pending soil covering. It must first be applied to sensitive sites such as establishments open to the public, areas visited regularly by the public (playgrounds, camp sites, etc.), areas with exposed asbestos outcrops and quarries of asbestos-bearing rock.

In terms of urban planning, prior to any project, information campaigns relating to environmental asbestos could be implemented, like in California, which requires a certain amount of information to be disclosed or measures to be implemented before any building sale or construction can take place. This can lead to projects being modified or constructability in outcrop areas being limited.

Thus, at the district level, the presence of asbestos in urban areas and close to cities or homes should be provided for in planning documents. It would be preferable to define, according to the risk associated with asbestos-bearing ground, methods for limiting constructability in outcrop areas, by adding information on asbestos-bearing ground to the planning documents and by encouraging the relocation of projects, in order to avoid as far as possible earthworks on asbestos outcrops. Similarly, it is also important that the presence of asbestos-bearing ground be an additional criterion (of reserve, or even refusal) in the drafting of planning documents and the issuing of building permits. These measures should primarily concern high-density urban areas such as the city of Bastia.

Moreover, regarding individuals, the sale of property in areas that may contain asbestos should be dependent on the communication of information on this potential risk to the purchaser. The introduction of a diagnosis procedure could be based on existing maps, and possible sampling of earth or rocks.

Management of backfill and waste

Given the scientific knowledge now acquired on the potential risks associated with the mobilisation of large quantities of asbestos-containing materials, debris and waste should be taken into account and managed appropriately and specifically (by protecting operators and isolating unused asbestos-containing materials), from the creation of the construction project through to the excavation, processing, packing, transport and storage phases.

There is conceivably an important analogy with the management measures already in place for waste from materials containing asbestos. To this end, it would be preferable to clarify the regulations by explicitly defining the conditions for treating debris containing asbestos that is extracted from asbestos-bearing ground. This could include, for example, their place in the classification of hazardous waste, as is the case, at the same percentage, with industrial materials containing asbestos.

As in California, the on-site reuse of excavated debris for backfill is to be preferred when immediately covered by a layer of clean material (topsoil, fine sand, sand-gravel aggregate, etc.). Any other use of debris, when there is a risk of exposure, should be prohibited (road embankments, parking areas, etc.). This residual debris should be transported to specific waste storage centres which need to be identified and developed, and whose legal status remains to be defined.

4.4.3. Other recommendations applicable to France whose effectiveness has been demonstrated

Exposed asbestos-bearing ground identified in the immediate vicinity of the population (housing, play areas, busy roads, etc.) should be covered with soil, uncontaminated rock, tar, or revegetation with simultaneous temporary prohibition of access. Several countries, principally the United States, have demonstrated the effectiveness of these arrangements in rehabilitating land. Conversely, covering paths with serpentinite, as has been practiced in New Caledonia, should be prohibited, to avoid contaminating other sites through the movement of asbestos-containing materials.

Local communication and information initiatives have provided essential advice and achieved significant results in the prevention of risks related to exposure to asbestos (Table 6)

Table 6 : Summary of Communication and Information initiatives

Country	Regulation	Status	Prospects
France / Haute-Corse	No specific provisions recorded	Information and communication campaigns for the general population, municipalities, construction companies, contracting authorities, etc. (press, information leaflets, methodological notes, specialised journals, etc.)	Extend and continue the information and communication campaigns by adapting the message according to the target, as well as the awareness campaigns for construction professionals
New Caledonia		Awareness and communication campaigns for the general population, professionals, medical personnel, authorities, etc. (briefing, press conference, press, notifications, etc.)	Develop an information programme for populations, local authorities, companies, etc. (fact sheets, awareness leaflets, leaflets on techniques for development works and the measures undertaken, websites, etc.)
Italy		Communication campaigns to local authorities, the general population, etc. (scientific publications, inadequate in terms of communication)	Plan for a good practice guide for the region of Emilia-Romagna
United States		Programme of public participation, communication campaign for the general population, local and federal authorities, professionals, etc. (fact sheets, specific leaflets for schools, etc.)	Develop information tools such as notices for notarial deeds, newsletters, information panels, etc.

In addition, training activities, the establishment of prevention contracts, partnership charters, and raising the awareness of different stakeholders must be encouraged and combined with site inspections or injunctions for companies. Simultaneously, all local stakeholders (central government, local authorities, elected officials, tribal representatives, associations, companies and populations) involved in understanding and managing the risks associated with asbestos-bearing ground, and implementing preventive measures, must be informed, on a level that depends on their skills and knowledge (targeted communication) and according to their need (progressive information), with regard to:

- the existence of risks related to outcrops,
- the nature of these risks,
- and the associated means of prevention and protection.

This network should also serve to educate the general public.

In line with the previous recommendations, mapping (as described in Section 1) should also be discussed in terms of information and risk management systems. There are tools to address other areas, such as technological or natural risks¹⁰, which have demonstrated

¹⁰ See the portal for the prevention of major risks (in French): <http://www.prim.net>

their usefulness. A similar application for natural asbestos outcrops would have an undisputed added value.

Six copies issued

The Director General

Marc Mortureux

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