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Naturally occurring asbestos

The issue of Naturally Occurring Asbestos (NOA) received some attention at this year's Australian Earth Sciences Convention in Melbourne in July. Articles were published in newspapers in Melbourne and Sydney and subsequently disseminated widely on the internet. Marc Hendrickx expands on some of the information provided in the published articles.

Asbestos is one of the few natural substances known to cause cancer. Since recognition of the dangers posed by inhalation of asbestos fibre, Australia has played an important role in developing policy, guidelines and regulations to reduce the risks associated with asbestos exposure.

Current Australian government policy, guidelines and regulations have largely dealt with commercial and industrial asbestos sources as well as the effects of asbestos mining. Naturally occurring sources of asbestos have largely been overlooked as a potential source of exposure. This is despite numerous well documented occurrences of asbestos minerals in rocks and soils throughout the country (eg MacNevin, 1970; Taylor, 1955; King, 1957).

The purpose of the presentation at the AESC (Hendrickx *et al*, 2006) was to highlight the issue and discuss the role geoscientists could play to better inform the public of the risks associated with NOA. The paper highlighted the need for State and Federal geological surveys to take a leading role in developing policy, risk maps, investigation guidelines and regulations that would allow for better management and planning for NOA in the future.

Issues surrounding NOA in Australia have previously been raised (eg Stewart, 1984), however little attention was paid at the time. With current concerns over asbestos exposure, increased litigation and particularly new research (for example Pan *et al*, 2005 – see below) it is an opportune time to revisit the issue.

NOA refers to those fibrous minerals that are found in rocks or soil and that may be released into the air by human activities or weathering processes. If NOA is not disturbed and fibres are not released into the air, then it is not a health risk

Development in many parts of rural Australia, including road and urban construction, farming, forestry and landscaping, risks disturbing NOA-bearing rocks and soils. In some parts of the country, rocks and soils containing NOA may have already had a history of disturbance through farming, forestry or quarrying and could have been a source of asbestos exposure not previously recognised.

Asbestos is a commercial and not a geological term. The term is used for six minerals that can have an asbestiform habit. These minerals can also crystallise in other non-fibrous morphologies and care needs to be taken when these minerals are identified. The six minerals included in the commercial definition are: chrysotile (white asbestos), riebeckite (otherwise known as crocidolite or blue asbestos), cummingtonite-grunerite (otherwise known as amosite or brown asbestos), tremolite, actinolite and anthophylite. Chrysotile is a serpentine-group mineral; the other forms of asbestos are amphiboles.

Other minerals, not included in the commercial definition of asbestos, may also crystallise in a fibrous habit under the right conditions. When asbestiform, some of these minerals may have similar physical properties to asbestos and may pose similar health risks. Examples include: erionite, winchite, brucite,

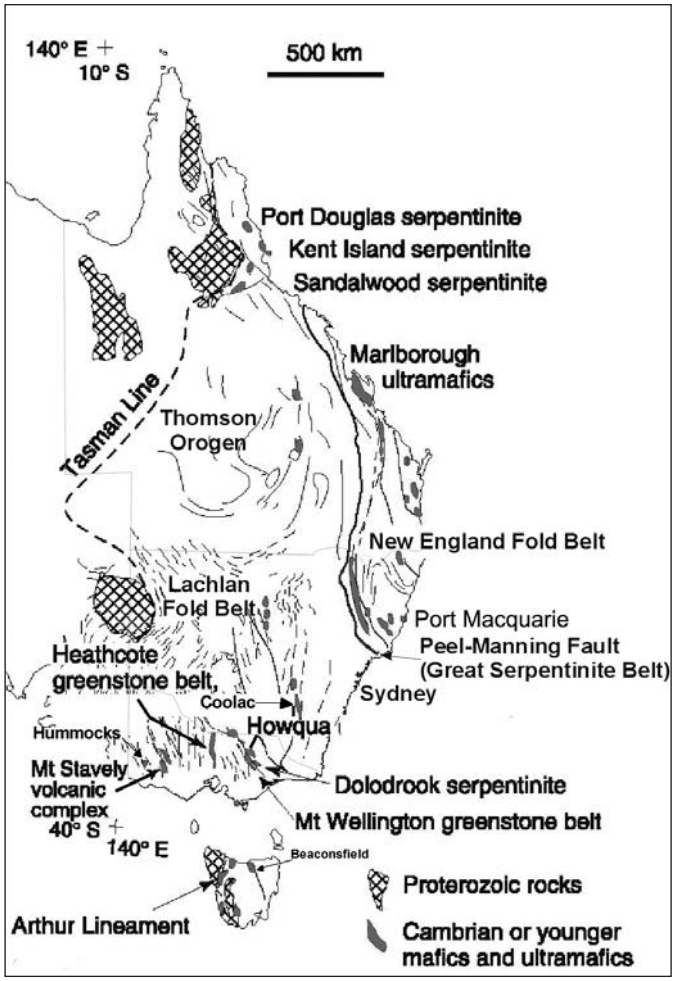

Figure 1. Map of eastern Australia illustrating occurrences of ultramafic and mafic rock belts that may have potential for NOA (after Spaggiari et al, 2002).

tourmaline, palygorskite, and sepiolite. Erionite is a member of the zeolite group and is a known human carcinogen with similar potency to amphibole asbestos (Emri and Demir, 2004).

In Australia asbestos is found in association with a number of different rock types. In eastern Australia (Qld, NSW, Vic and Tas) the most common occurrence of asbestos is in serpentinite belts, generally associated with fault zones (Figure 1). Chrysotile and tremolite-actinolite are the common forms of asbestos in eastern Australia while riebeckite (crocidolite) is the main asbestos mineral in South Australia and Western Australia.

In New South Wales, serpentinite occurs in the Tamworth-Nundle-Barraba area, in a belt north west of Grafton that includes Baryugil and in an extensive tract that stretches from near Young in the north, to near Tumut and Kiandra in the south (MacNevin, 1970). Most of these serpentinite belts outcrop in remote areas, but a number of asbestos-bearing serpentinite belts are found near or inside the township boundaries of Gundagai, Orange and Port Macquarie. Asbestos is mainly chrysotile but tremolite is also known to occur. Omitting the mined deposits (eg. Woodsreef, Baryugil and Jones Creek near Gundagai), the amount of NOA in these rocks is generally small (<0.1%) but may locally be as high as high as 10%, or more, in small outcrops (Figures 2 and 3).

In Victoria, serpentinite is known from 'The Hummocks' in western Victoria; along the Heathcote Greenstone Belt (Kilmore-Dookie), in the Upper Howqua River area, in the Dolodrook River Greenstones and in a few isolated occurrences in the Limestone Creek area (Birch, 2003). The outcrop at 'The Hummocks' was previously quarried for road materials (Kellaway and Rhodes, 2002). Talc mined near Heathcote caused itchiness due to contamination by actinolite (Edwards, 1998).

In Tasmania, serpentinite in the Beaconsfield district was mined for asbestos last century (Taylor, 1955). Serpentinite is also known to host asbestos deposits elsewhere in Tasmania (Taylor, 1955).

South Australia has produced only minor quantities of asbestos. About 1000 t of blue asbestos (crocidolite) was mined from a series of small deposits near Robertstown and Truro 50-120 km north of Adelaide. Tremolite asbestos is also known to occur in the area. The deposits are hosted by carbonate rocks: Skillogalee Dolomite and Auburn Dolomite of the Burra Group in the Robertstown area, and dolomitic limestone of the Cambrian Hawker group near Truro (King, 1957). Asbestos is also known to occur in a few areas on the Eyre Peninsula (Johns, 1961).

In Western Australia, banded iron formations in the Hamersley Ranges contain blue asbestos veins that were mined at Wittenoom. Asbestos veins are also well documented in the greenstone belts and these may be a source of concern if disturbed.

Considerable work has been done on NOA in a number of countries. In the USA, NOA is recognised as a significant health issue. In California NOA has been found in serpentinite belts in residential areas in El Dorado County and subsequently in other serpentinite belts and other rock types in other counties (Clinkenbeard *et al*, 2002). Californian and US federal government authorities, particularly the USGS and EPA, have spent considerable resources in dealing with the issue and perhaps lead the world in terms of (delete) providing guidelines, risk maps and regulations (eg Clinkenbeard *et al*, 2002). Research undertaken in California includes a recent medical study that found that residential proximity to NOA is significantly associated with increased risk of malignant mesothelioma (Pan *et al*, 2005). Malignant mesothelioma is one of three primary diseases associated with asbestos, the other two being asbestosis and lung cancer.

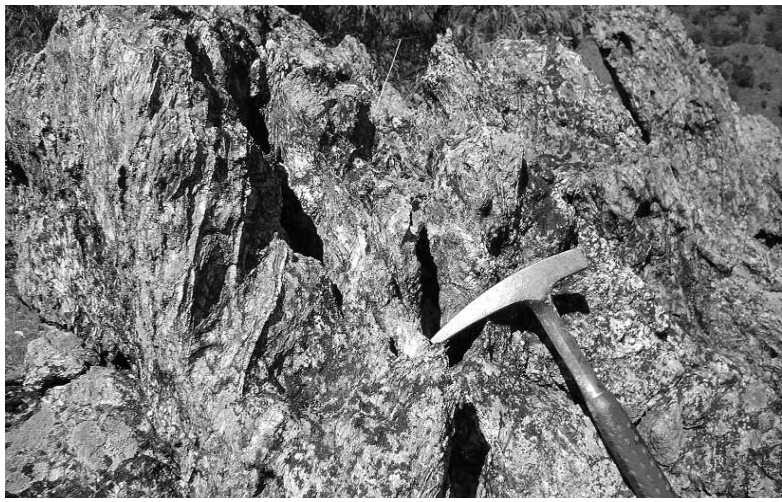

FIGURE 2. Outcrop of serpentinised harzburgite from the Coolac Serpentinite, NSW, with approximately 10% cross-fibre veins of chrysotile asbestos.

FIGURE 3. Cut slab of serpentinite from the Coolac Serpentinite, NSW, showing spaced array of asbestos veins up to 3 mm in thickness. Asbestos minerals (mainly chrysotile), comprise about 30% of the rock volume. Photo by Brenda Franklin.

In Greece, the condition known as 'Metsovo Lun' is named after a town in northwestern Greece where locals used a source of whitewash that was contaminated with tremolite asbestos (Sakellariou *et al*, 1996). Tremolite asbestos and erionite are known to have caused malignant mesothelioma when used in whitewash in villages in Turkey (Emri, 2004). In New Caledonia,

natural white wash, known locally as 'Po', was found to be contaminated with tremolite asbestos (Luce *et al*, 2000). In Da-yao, a rural town in southwestern China, crocidolite in soils is known to have caused malignant mesothelioma (Luo *et al*, 2003)

Geological information should form an important component of the regulatory decision-making process in regard to NOA. Geologists in California have been increasingly involved in assessing the NOA potential of property, prior to land acquisition or property development. Geological information may also be useful in designing site development to avoid potential long-term exposures to NOA or in helping to minimise potential short-term NOA exposures during construction activities. There has been an increased need for this kind of specialist geological advice in eastern Australia.

A recent review by Goldberg (2005) states that: "While exposure in environmental settings is generally much lower than in occupational circumstances, the levels may not be negligible. In studies in which elevated risk of mesothelioma was demonstrated, people typically lived close to naturally occurring asbestos sources, and may have had direct contact with asbestos, when whitewashing houses with material containing asbestos or working in polluted fields. It is thus likely that lifelong cumulative exposure may have been as high (if not higher) as in some occupational settings..."

A study of malignant mesothelioma in Australia between 1945 and 2000 by Leigh *et al* (2002) found that for a small proportion of cases no history of asbestos exposure could be obtained. Of these, a significant amount had high lung fibre counts suggesting an unrecognised exposure to asbestos. Could NOA represent an unrecognised source of exposure?

Further research into NOA is obviously required to answer this question. Data are also required so Australian authorities have sufficient information to make appropriate policy and regulatory decisions

In summary:

- Areas of rocks which contain NOA occur within every state of the Australian continent, in a variety of geologic environments
- Any activity which causes NOA-bearing rocks and soils to be disturbed can potentially result in asbestos fibres being released into the air
- Unintentional, environmental and non-occupational exposure to asbestos dust from natural sources is recognised as a significant geological hazard in California and a number of other countries
- Specialised geological maps and investigation guidelines have been developed by geoscientists in California to help deal with the issue
- Geologists in Australia will need to play a significant role in preparing similar material for Australia
- Further research is required to determine the health risks of NOA in Australia.

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United States Geological Survey
http://www.usgs.gov

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