



AUSTRALIAN  
EARTH  
SCIENCE  
EDUCATION

# Soil Contamination

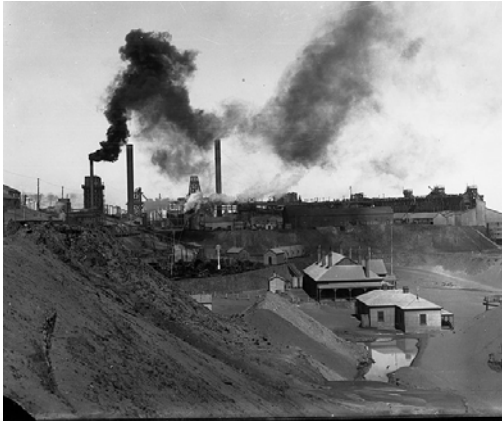
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## Soil contamination causes

- Industrial activities (mining, smelting, manufacturing)



Broken Hill Mine circa 1915 (The History Trust of South Australia, public domain)

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Acid mineral drainage is a major hazard from sulfide ores and their tailings. Sulfuric acid dissolves metals and metalloids from the rock and these are deposited downstream in sediments.

Dust containing lead is a major contaminant in mining areas like Broken Hill. Dust and smoke from the smelting process can release arsenic compounds and mercury into the air. These later settle out into soil.

Tailings containing toxic metals may be blown off site and deposited elsewhere.

The burning of coal for power and manufacturing releases mercury, which settles out in soil and water.

A comparative study in China (Yang, et al. 2018) found that mine-affected areas had higher concentrations of copper, lead, cadmium and arsenic in soil and vegetables. The heavy metal values ranged from 2.5 x (lead) to 10 x (cadmium) greater than in the unaffected areas.

## Soil contamination causes

- Solid and liquid waste from households and businesses



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Household and industrial chemicals, such as solvents and paints, seep into and contaminate soil if stored or disposed of incorrectly.  
Flakes of old paint often contain lead, which can contaminate soil.  
Batteries and old thermometers may contain mercury.  
Plastic waste breaks into smaller pieces that are incorporated into soil. These often absorb other harmful pollutants, concentrating them in the upper soil layers.

## Soil contamination causes

- Petroleum products released into the environment



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Petroleum products contain a range of toxic organic and inorganic chemicals. These may enter the environment through small spills and leaking tanks at petrol stations and storage facilities, or via spills from extraction or shipping.

## Soil contamination causes

- Transportation exhaust



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Leaded petrol was phased out by 2002, but it has left a toxic legacy of fine lead particles along roads and stormwater drainage areas.

## Heavy metal contamination

- Pollutants referred to as 'heavy metals' include
  - Lead
  - Arsenic
  - Cadmium
  - Copper
  - Mercury
  - Nickel
  - Zinc
  - Chromium



Mercury in bottle (2005, public domain)



Native lead crystals (Rob Lavinsky, [iRocks.com](http://iRocks.com) – CC-BY-SA-3.0)

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Heavy metal contamination refers to a range of elements, some of which includes the metalloid arsenic.

## Cadmium - sources

- Found in sulfide ores of zinc, lead and copper
- Released by smelting, burning fossil fuels and incinerating rubbish
- Deposited in soils
- Main use: NiCad batteries



55% of cadmium produced is used in rechargeable batteries (Wikimedia Creative Commons)

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Cadmium is found in sulfide ores of zinc, lead and copper. It is released into the environment from smelting, burning fossil fuels and incinerating rubbish. It is released into the atmosphere and deposited in soils.

Today, most cadmium is manufactured for Nickel-Cadmium (NiCad) rechargeable batteries. It is the most common heavy metal contaminant in China.

## Cadmium – effect on humans

- Taken up by plants and consumed in food
- Concentrated in kidneys and liver
- Causes kidney damage
- Inhalation leads to lung cancer



XRF used to measure metal contaminants in soil (L Cheung/ USDA 2018, public domain)

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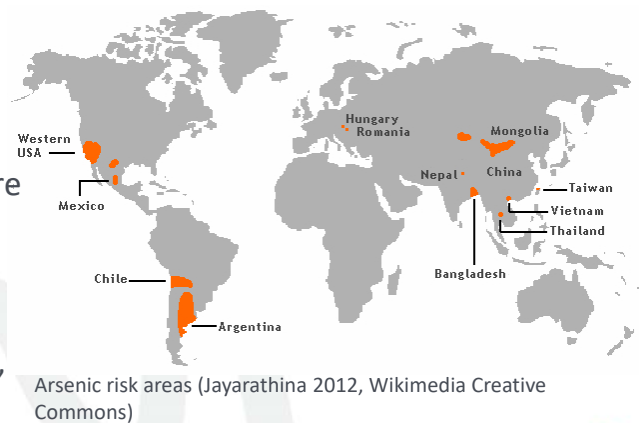


Cadmium is taken up by plants and consumed in food. It accumulates in the kidneys and liver and is only excreted in tiny amounts.



## Arsenic – sources

- Naturally high in groundwater in some areas
- Released into atmosphere from smelting
- Industrial use in metal alloys, glass, wood preservatives, pesticides, etc.



Arsenic occurs in high levels in the groundwater of Argentina, Bangladesh, Chile, China, India, Mexico and the USA.

Arsenic is used industrially in metal alloys, glass-making, pigments, textiles, paper, wood preservatives, metal adhesives, leather-making and pesticides.

## Arsenic – effect on humans

- Acute poisoning causes vomiting, diarrhoea and stomach pain, followed by numbness, cramping and death
- Chronic exposure causes skin lesions, cancers, heart attack, diabetes and lung disease



Arsenic poisoning signs (A Ghosh/ REACH 2015, Wikimedia Creative Commons)

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People are exposed by drinking water or eating and smoking (tobacco) plants grown in soils containing arsenic.

## Lead – sources

- Mining and smelting
- Manufacturing and recycling
- Leaded paints and fuels
- >75% for vehicle batteries
- Also used for pigments, solder, ammunition, etc.



Lead-acid motorcycle battery (Cjp24 2017, Wikimedia Creative Commons) [ausearthed.com.au](http://ausearthed.com.au)



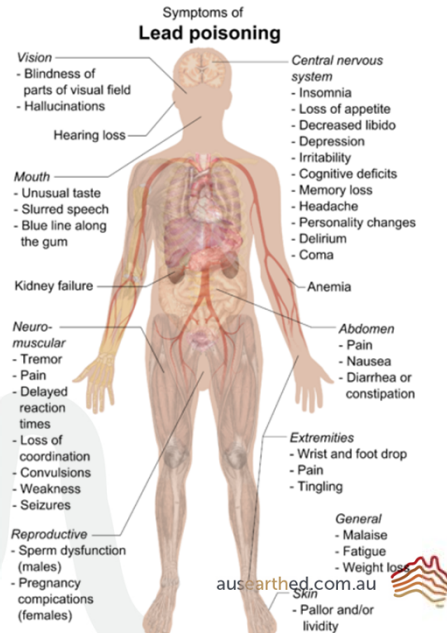
Lead contamination comes from mining, smelting, manufacturing, recycling, leaded paint and leaded fuels.

More than 75% of global lead use is for lead-acid batteries in vehicles. It is also used for pigments, paints, solder, lead crystal glassware, ammunition, jewellery, toys and some cosmetics.

## Lead – effect on humans

- **No safe exposure level**
- Interferes with brain development in children
- Causes high blood pressure and kidney damage in adults
- Exposure in pregnancy leads to miscarriage, premature birth and low birth weight

Lead poisoning symptoms (M  
Hägström 2015, public domain)



Lead levels in topsoil are linked to lead levels in children, because children play outside and put their hands in their mouths. This is particularly dangerous, as lead damages the developing brain. In addition, children absorb 4-5x as much lead as adults from the same dosage.

## Significance of lead contamination

- Lead poisoning known for at least 2,000 years
- Childhood exposure leads to reduced IQ, short attention and aggression
- WHO estimates that in 2004, lead exposure was responsible for 143,000 deaths and 0.6% of global burden of disease



Lead poisoning signs on knee X-ray (A Datir, Wikimedia Creative Commons)

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## References

- Photographs without attribution are from Canva images, free use.
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