Environmental Studies
FACT SHEET
www.curriculum-press.co.uk
Number 200

Mining in hot, arid areas

There is great potential for the development of mineral resources in hot, arid areas. Oil and gas in the Middle East, copper in Chile, southwest USA and Australia, and uranium mining in Australia illustrate the potential riches that occur in hot, arid areas. Exploitation may be difficult because many of these areas are remote, and investment in transport is expensive. In addition, housing and basic utilities such as water, energy, waste disposal need to be provide at the mines and in the settlements where miners live.

Copper mining in Arizona, USA

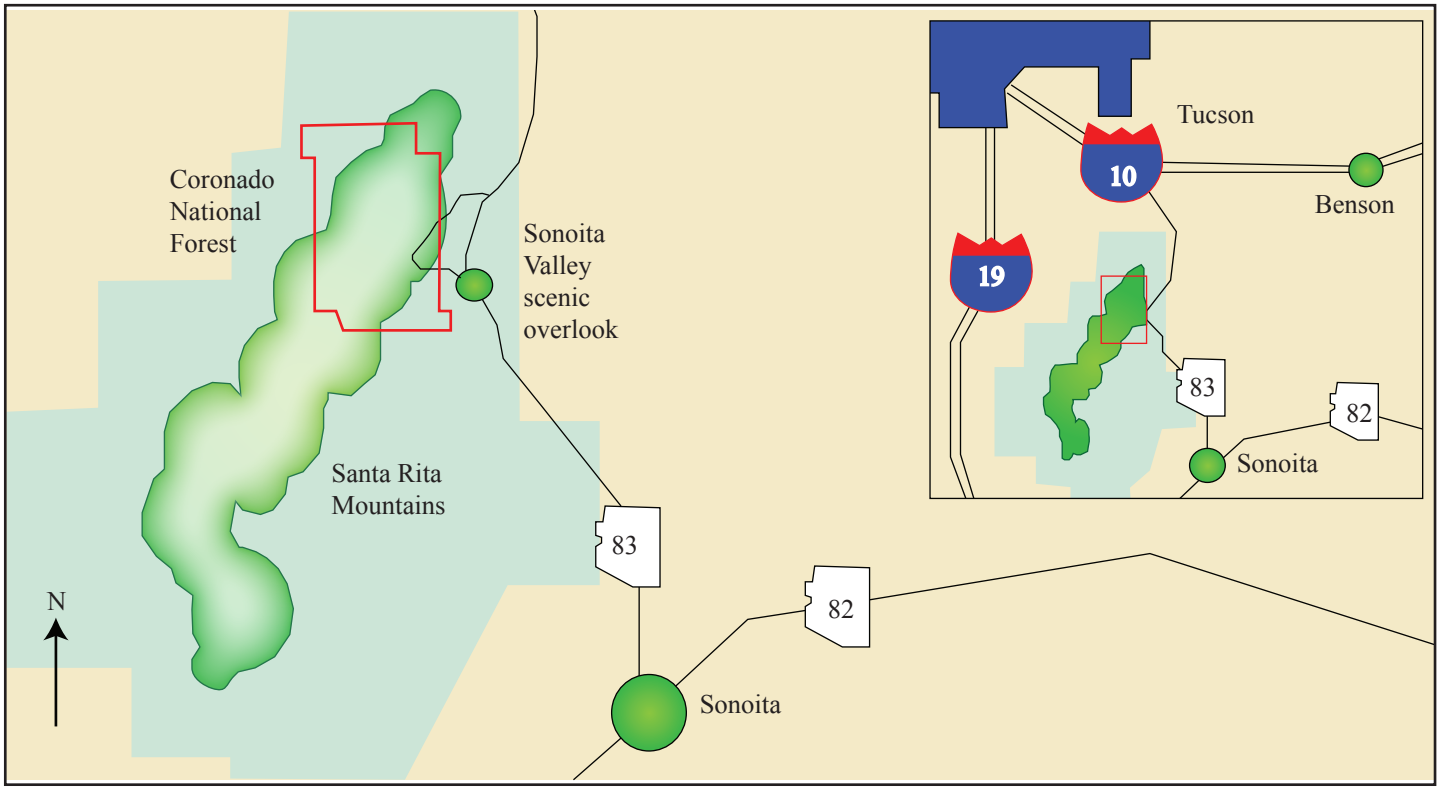
Mining produced over one million tons of copper in the USA in 2010, worth over $8 billion. The major mining states were Arizona, Nevada, New Mexico and Montana. These accounted for more than 99% of domestic production. Copper and copper-alloy products were used extensively in the construction industry, electric and electronic products, transport equipment, consumer products and industrial machinery and equipment. Recycling of old, scrap converted to refined metals and alloys produced a further 160,000 tonnes of copper.

About 65 % of the USA's copper is mined in Arizona. Copper first became the focus of mining in the Santa Cruz Valley and elsewhere in southern Arizona beginning in the late 1880s. By 1907, southern Arizona led the world in copper production. Over 10,000 jobs are related to copper mining and refining. In 2005, there were 72 mining companies operating 126 mines in Arizona. Copper provides about 75% of Arizona's non-fuel mineral production. On top of that, 70 sand and gravel quarries operated throughout the state. The direct and indirect economic impact of copper mining is estimated at over S12 billion annually.

Arizona contains a band of copper which spreads from the south-east to the north-west and also contains lead, zinc, gold and silver deposits. Some of the early mines, such as Bisbee and Jerome, have become tourist attractions rather than continuing as mining centres. Arizona is one of the most heavily mined states in the country and a major copper producer. The Government Accountability Office estimates that there are roughly 50,000 abandoned hard rock mining sites in the state, contributing to environmental problems such as contaminated water and soil.

In the early 1900s, 30% pure ore (600 pounds of copper per ton – 2000 pounds) was the average copper content. By the 1930s, ore purity (concentration) had fallen to approximately 4%. Newer mining technologies were developed to process ore with low mineral content, and today it is common to mine ore with a purity of just 0.35%—only 7 pounds of metal per ton!

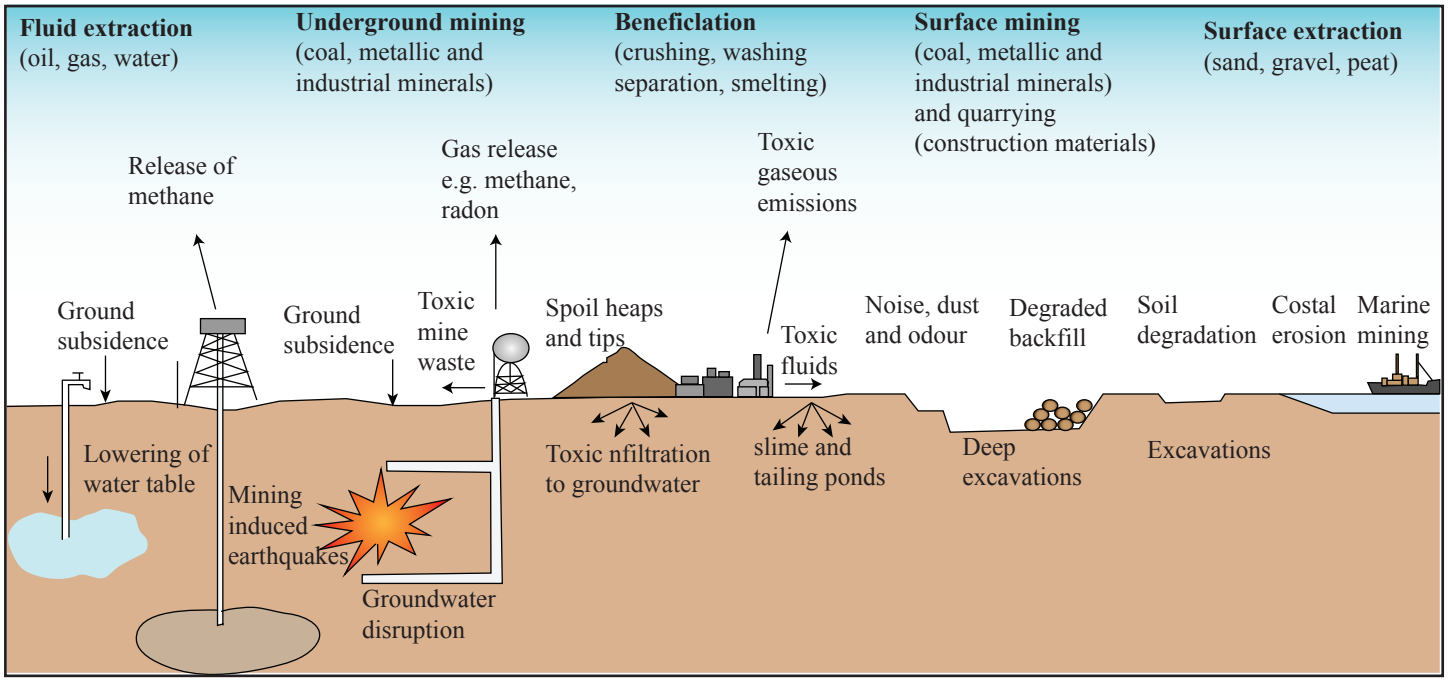
Fig. 1 Proposed mine at Rosemont Ranch, Arizona



Rosemont Copper, Arizona

Rosemont Copper is a copper mining project in Pima County, Arizona, an undeveloped area approximately 50 km southeast of Tuscon (Fig. 1). In general, opponents argue that open-pit copper mines pollute surrounding air and water supplies with mercury, lead, arsenic or other elements and that the mine will damage regional tourism.

Fig. 2 Methods of extracting resources and their potential impact on the environment



Proponents argue that the project will create jobs, generate tax revenue and reduce American dependence on foreign sources of copper.

The Rosemont Copper Mine is projected to earn about $7 billion in profit over the course of its 21-year lifespan and become the third largest copper mine in the USA.

The controversy over the proposed Rosemont Copper mine revolves around potential risks to the environment, with water being a major concern.

Table 1 The arguments for and against Rosemont Copper

Arguments in favour of the proposal	Arguments against the proposal
▪ Copper is an essential component of a clean-energy economy. For example, hybrid cars contain twice as much copper as conventional cars. ▪ The mine would import 105% of the water needed for operations and leave a 5% net water gain to the Tucson Active Management Area basin. ▪ The used land will be reclaimed from the beginning of the mine's operations. ▪ The mine would create a much-needed economic boost to the region, directly employing 400 people for at least 19 years and support 1,700 indirect jobs. Historically, mining jobs are among the highest paying positions in Arizona, and experienced workers in the copper industry in the southwest can earn an average of $59,000 or more per year. ▪ The project would support ancillary industries – contractors and vendors providing goods and services to the mine operation during the nearly two decades of operation.	▪ Open-pit copper mines such as that proposed by Rosemont pollute the air and nearby water supplies with mercury, lead arsenic or other poisons. ▪ The mine structures would be visible from Arizona State Route 83, a designated scenic route. ▪ The economies of the Santa Rita Mountains communities are largely driven by outdoor recreation and tourism. Even modest impact from the Rosemont Mine could discourage tourism to the region, and destroy more than the number of new jobs the mine would create. ▪ Mining jobs represent a small percentage of total Pima County jobs. Jobs created by the proposed Rosemont mine would represent less one percent (0.3%) of total employment in Pima and Santa Cruz counties.

A place of great natural beauty, popular among rock climbers and campers, a part of Tonto National Forest known as Oak Flat has been under federal protection from mining since 1955, by special order of President Eisenhower. On the nearby San Carlos Apache reservation, many consider Oak Flat to be sacred, ancestral land – the home of one of their gods and the site of traditional Apache ceremonies. Resolution Copper Mining, a subsidiary of British-Australian mining conglomerate Rio Tinto, has sought ownership of the land for a decade. Resolution Copper will swap roughly 7.8 square miles of land scattered across Arizona for roughly 3.8 square miles of Tonto National Forest, which includes Oak Flat.

Historical records show that vast amounts of land once under Apache control were carved out of the reservation by the U.S. government to enable mining at the turn of the century. Private companies extracted a fortune in minerals with minimal benefit to the tribe.

The destruction of Oak Flat and dumping of mining byproducts will reduce the town of Superior's appeal as a tourism destination. The Town Council wants the company to pay a mining tax, amounting to one-tenth of 1 percent of the value of the ore. But the copper ore lies outside town limits and the company doesn't need Superior's blessing to proceed.

Resolution Copper has plenty of supporters in town who are eager for an economic boost. The company says the mine will bring 1,400 direct jobs and more than $60 billion in economic value over the project's estimated 60-year lifespan.

Resolution Copper may be able to mine the land with little regard for the environmental impact. Under the terms of the land swap legislation, the company is required to work with the U.S. Forest Service to do an environmental impact study under the National Environmental Policy Act, or NEPA, but it is also guaranteed to get the land, no matter what the study shows. Once the land is in private ownership, NEPA obligations no longer apply.

Avoiding a more traditional method of mining as too expensive, the company announced it will use a cheaper method called block cave mining, which will result in a crater two miles wide and up to 1,000 feet deep, destroying the surface of the land. Block cave mining will also generate nearly a cubic mile of mine waste, which the company proposes to leave on a parcel of Forest Service land, just outside the town of Superior.

Resolution Copper has already completed work on a new exploratory shaft. Reaching a depth of 7,000 feet, it is the deepest shaft in North America. Tourism and outdoor recreation account for nearly $3 billion annually in Santa Cruz and Pima Counties. The mine site falls in the middle of three important wildlife corridors used by the only known jaguar in the United States. Habitat destruction would also threaten various endangered cactus, frog, fish, and bat species.

Rosemont Copper expects to mine 550 million tons of ore and an additional 1.3 billion tons of waste rock. Most of this rock would be heaped in massive piles called tailings. Intended as an aural and visual buffer between the mine and the highway, the tailings could rise several hundred feet. Arizona's other copper mines consume around 25 gallons of water for every pound of copper produced, but Rosemont's usage could be less than one-third that amount. The trade-off is a more energy-intensive process that would cut into the company's profit but show its commitment to corporate social responsibility. Industry and mining make up about 5% of Arizona's total water use (approximately 126 billion gallons per year).

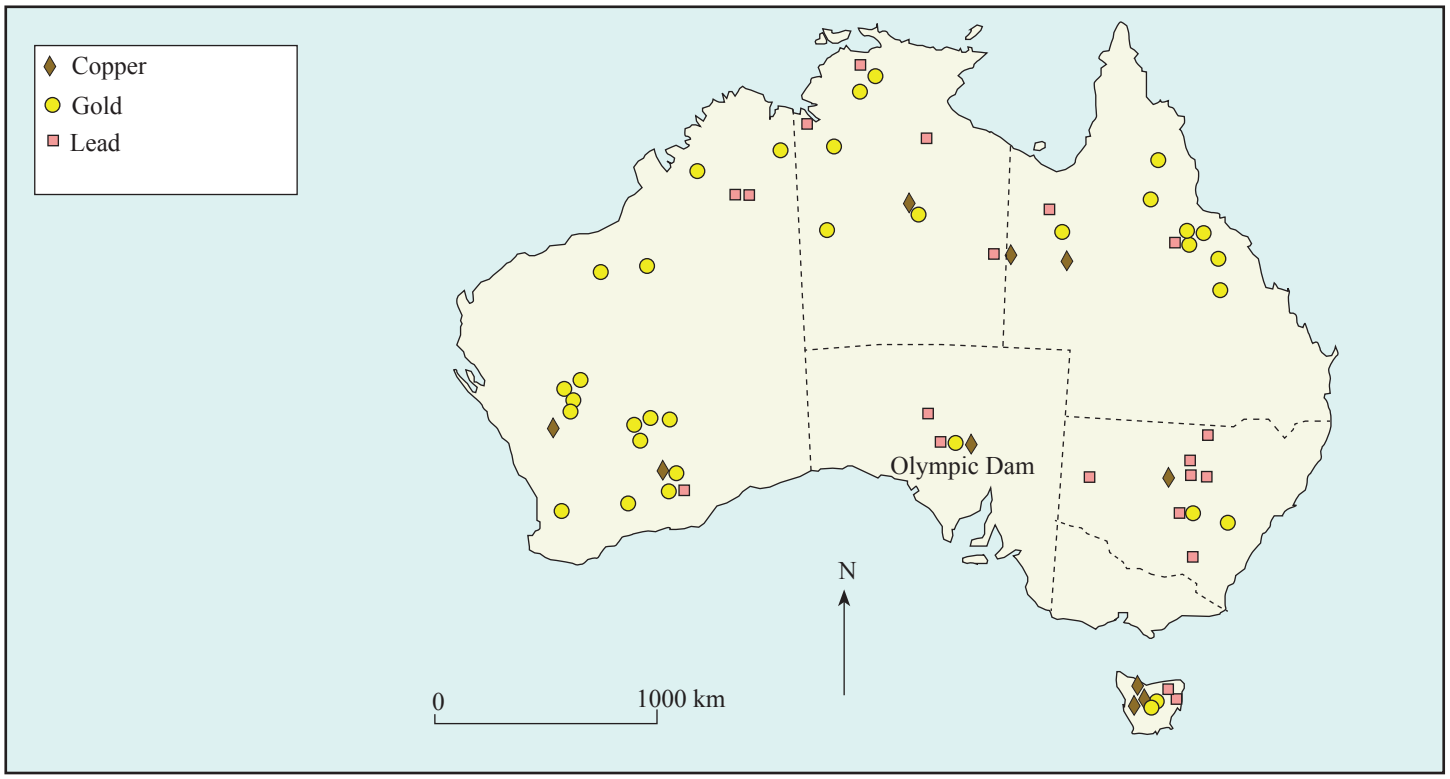
Uses of copper

- Copper is an excellent electrical conductor. Copper wiring made possible the widespread use of electricity.
- The average US house has over 400 pounds of copper for electrical wiring, pipes and appliances such as microwave ovens and refrigerators.
- Copper is required for semiconductors, cell phones, computer chips, and other advanced technology.
- Nearly 50% of the copper consumed annually in North America comes from recycled material.

Industry and mining comprises about 5% of Arizona's total water use (approximately 126 billion gallons per year). In 2010, fresh water consumption at a concentrator plant was around 200 gallons per ton of ore.

Olympic Bay mine, South Australia

Fig. 3 Location of Olympic dam, South Australia



Australia has large reserves of uranium, gold, titanium, coal and manganese. Mining provides many jobs in desert area, where alternative opportunities exist. The mine has a capacity of around 200,000t of copper and 4,300t of uranium per annum. Over 70% of the mine's earning come from copper, and 25% from uranium. Gold and silver make up the rest. Olympic dam is owned by BHP Billiton. Most of the workers in the mine live in the two nearby towns of Roxby Downs and Andamooka.

The mine is more than 500km from the coast, so there are major difficulties in transporting materials, as well as expense. The mine also requires a large amount of water – the mine uses water from 12 desalination plants as well as water from the Great Artesian Basin. Environmentalists fear that the Basin's water table will drop, and that there will be impacts of streams and rivers in the area, and some of the species they support. It is believed to use 35 million litres of groundwater daily.

Mining has a negative impact on soil and vegetation. Both are removed for the construction of the mine, roads, railways and pipelines. Even the movement of vehicles and people can spread weeds and other exotic species.

In addition, open cast mining is an eye-sore, and can be visible for a great distance. Mining is also a major source of dust, and dust storms are linked with increases in respiratory problems.
Uranium and copper are treated with chemicals. Waste water from the treatment plants may contaminate groundwater and streams. Plans to expand the mine were put on hold in 2012 following falling commodity prices. In addition, the South Australia government wanted to diversify the economy rather than increase its reliance on mineral developments.

Table 2 Climate data for Tuscon, Arizona

		J	F	M	A	M	J	J	A	S	O	N	D	Mean
Temperature Mean Value	C	12.0	14.3	16.8	21.1	26.0	31.2	34.2	33.1	29.8	23.6	16.6	12.3	22.58
Precipitation Mean Monthly Value	mm	17.0	17.3	22.4	5.6	3.0	3.3	21.1	24.4	21.8	16.5	16.8	25.4	16.22

Conclusion

Hot, arid areas offer great potential for mining. However, operations may be difficult due toa combination of climate, remoteness, and environmental fragility. However, they may bring short-term economic benefits to areas with few economic options.

Questions

1 How might the climate experienced in Arizona (Table 2) affect mining operations?
2 Summarise the advantages and disadvantages of the proposed Rosemont copper mine.

Suggested answers

1 Water shortages are common in hot, arid areas. Water may have to be imported from afar, or produced from desalination plants, or extracted from groundwater. Over-use may lead to decreased water availability and have a negative impact on ecosystems. In addition, water is needed for those working in the mines under hot, difficult conditions.

2 The advantages include
- it will create many jobs (400m direct and 1700 indirectly)
- it will bring much income to the area
- it will reduce dependence on foreign sources of copper
- it will support linked industries.

On the other hand, there are many disadvantages
- it pollutes air and water
- the mine and its waste are major eye-sores
- it will discourage tourism to the area
- the number of jobs created is relatively low

References

https://www.youtube.com/watch?v=5woCaxXB7Jk for a video on block cave mining

Watch US land grabs from the Apaches
http://america.aljazeera.com/watch/shows/america-tonight/articles/2015/2/20/in-arizona-the-governments-copper-grab-leaves-apaches-in-the-lurch.html

http://arizonaexperience.org/live-maps/active-mines
For an interactive map showing Arizona's current mining operations.

http://www.quazoo.com/q/playlist=-1&scid=250976&scn=Olympic%20Dam,%20South%20Australia&scd=s2&fItemID=-1&fColID=-1&fditem=&fvid=true&itn=Olympic%20Dam%20-%20South%20Australia&iturl=http%3A%2F%2Fwww.youtube.com%2Fv%2F8ubnhkCV22U%3Fversion%3D3%26d%3DAUZkUmkVIzpqGtvKt768EIEO88HsQjpE1a8d1GxQnGDm%26app%3Dyoutube_gdata&itimg=&itembd=8ubnhkCV22U&itimgw=0&itimgh=0&ct=1425400768583 for an Environmental Impact Assessment by Olympic dam

Acknowledgments: This Factsheet was researched and written by Garrett Nagle. *Curriculum Press, Bank House, 105 King Street, Wellington, Shropshire, TF1 1NU*
 ISSN 1351-5136