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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2013
Geography

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RESOURCE BOOKLET

Refer to this booklet to answer the questions for Scholarship Geography 93401.

Check that this booklet has pages 2–24 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

CONTENTS

Note: The resources in this booklet focus on the mining of metallic minerals. Coal, diamonds, gravels, and rocks are not in this category.

INTRODUCTION

Definitions

Mining is the process of extracting useful **minerals** from the surface of the Earth, including the seas.

A **mineral**, with a few exceptions, is an inorganic substance occurring in nature that has a definite chemical composition and distinctive physical properties or molecular structure.

Ore is a metalliferous mineral, or an aggregate of metalliferous minerals and gangue (associated rock of no economic value), that can be mined at a profit.

Alloy is a metal made by combining two or more metallic elements.

Mining of metals has occurred for millenia. By 4 000 BC, people were using copper to make implements. The Roman Civilisation and the European Industrial Revolution of the 18th and 19th centuries, all made significant use of metals, and mining continues to be of importance today. The metals that make items such as mobile phones, motor vehicles, building structures, and high-tech products, are essential to modern infrastructure. As the economies of less-economically developed countries grow, and as new technologies develop, the demand for metals increases.

Mining plays a significant role in the economies of many developing nations, contributing substantially to exports and GDP. In case studies conducted in Chile, Ghana, and Brazil, mining is helping to reduce poverty and improve HDI scores faster than in non-mining areas.

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Figure 1: Wiluna Gold Mine, Western Australia

About 2.5 million people around the world are employed by 'formal' mining companies. These companies operate under financial and legal regulations and often belong to industry associations. An example of a formal mining company operation is the Wiluna Gold Mine in Western Australia. **Figure 1** shows the underground portal, starting from the bottom of the bulletin pit. The green lights indicate the proper operation of the ventilation system.

The 'formal' mining industry is dominated by large multinational companies. The top six largest mining companies worldwide (based on market value) are shown in **Table 1** below.

Table 1: Top six mining companies worldwide based on market value

Note: Values are based on The Financial Times Global 500 (March 2012).

Company	Headquarters	Market Value (US$ billion) March 2012	Number of employees and/or contractors	Number of countries operating in	Main minerals mined
BHP Billiton	Australia/UK	179.5	100 000	25	Aluminium Copper Iron ore Manganese Metallurgical coal Nickel Silver Uranium
Vale	Brazil	124.5	110 000	> 38	Nickel Iron ore and iron ore pellets Manganese ore Ferro alloys Aluminium Copper
Rio Tinto	Australia/UK	107.2	68 000	40	Iron ore Bauxite Alumina Aluminium Copper Molybdenum Gold Uranium Titanium Dioxide
Xstrata	UK/Switzerland	51.2	70 000	> 20	Copper Zinc/Lead Nickel Alloys
Anglo American	UK	49.5	100 000	> 20	Copper Iron ore Nickel Platinum
Barrick Gold	Canada	44.1	20 000	12	Gold Silver Copper

Artisanal miners (miners working with hand tools or small-scale equipment) also mine a substantial amount of some metals as shown in **Table 2** below.

Table 2: Artisanal and small-scale mining proportion of world production of various metals (2011)

Mineral	Main uses
Aluminium	Usually as an alloy in: drink cans, packaging, aircraft, bicycles, cars, trucks, construction (eg window frames)
Bauxite	An ore that is the main source of aluminium
Cobalt	Used to make high strength alloys used in: turbine blades, jet aircraft engines, medical implants, jewellery, and in industrial processes
Copper	Electrical wiring, roofing, plumbing, industrial machinery, electric motors, heat exchangers
Gold	Coins, jewellery, medicine – injections for rheumatoid arthritis, photography, satellites, industrial use as electrical connectors
Iron ore	Key ingredient of steel: used in structural engineering, ships, cars, machinery
Lead	Building construction, electrodes in car batteries, bullets, radiation shields
Manganese	Used in steel production
Molybdenum	Mainly used as an alloy in aircraft parts, electrical contacts, industrial motors, steel alloys
Nickel	Used in stainless steel, electroplating, rechargeable batteries, and as an alloy
Platinum	Vehicle emission control devices, jewellery, turbine engines, bullion bars, catalyst in chemical reactions
Silver	Coins, jewellery, mirrors, photography, electronics, medical uses, control rods used in nuclear reactors
Tantalum	Laboratory equipment, as a substitute for platinum, tantalum capacitors in electronic equipment, eg mobile phones, DVD players, video game systems, and computers
Titanium	Used in steel as an alloy, fireworks, aerospace, and industrial applications
Uranium	Military uses as a high density penetrator to destroy armoured targets, as a radiation shield, nuclear power plants
Zinc	Anti-corrosion agent used to coat other metals, eg steel, as a compound in paint, photocopiers, medical uses, wood preservative

The World Bank estimates that there may be between 15 million and 20 million people working in this sector in 30 countries, with up to 100 million people being women and children depending on this form of mining for their livelihood. Artisanal miners are often poorly educated and driven by poverty, mining in remote rural areas. Conditions are often harsh, with few regulations governing mining practices, poor safety, and little money earned.

Today, metals are usually mined using either surface mining methods such as open pit / open cast techniques, or underground techniques. Production for most commodities is currently spread around the world as shown in **Figure 2** and **Figure 3**.

Figure 2: Share of world production, % 2008

Figure 3: Location of world mining by region, 1850 to the present (world mining is measured as the total value at the mine stage of all metals produced in all countries)

Growing populations, rapid urbanisation, and increasing industrialisation, especially of countries such as China, Brazil, India, and South Africa, has resulted in increased demand for minerals globally. …

Figure 4: Production by mining method, 2011

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Figure 5: Georgius Agricola

…Thus, although Agricola raised many of these issues in the context of European mining in the sixteenth century, the current debate is on a truly global scale, and the inextricable links between the substantively larger scale of present mining, and the associated environmental-social impacts and benefits.

CASE STUDIES

AFRICA

Opportunities abound in African mining

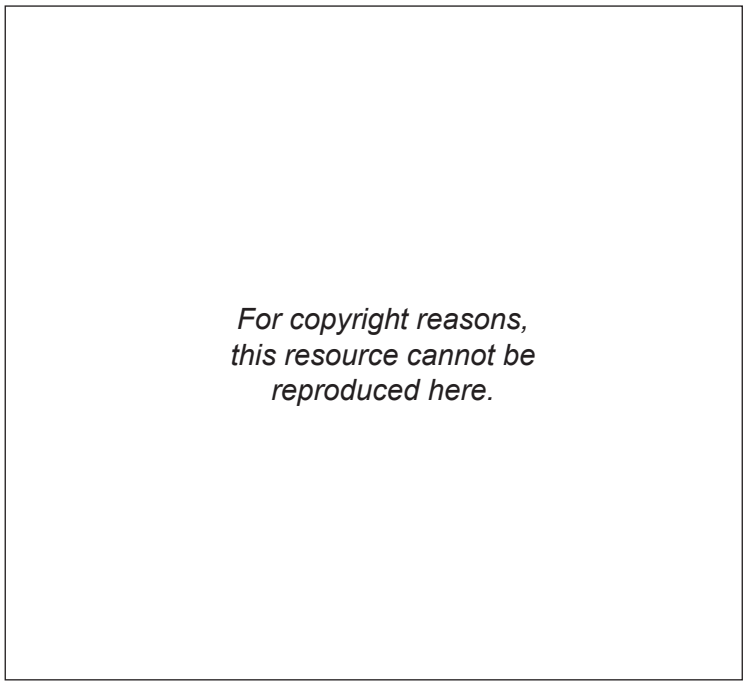
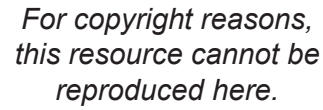


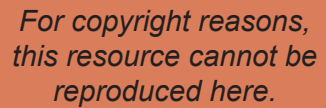
Figure 6: Africa's mineral resources

The growing global demand for energy, and high commodity prices for minerals, have resulted in significant growth in the mining industry in Africa.…



…However, right across the continent, governments are seeking new ways to squeeze more out of foreign-owned firms growing rich off what lies beneath Africa's soil.

Miners in small-scale mining, as well as in large-scale mining, are often migrant workers, living without their families and within disrupted social contexts. …



…This means that miners often have no proper legal titles to their claims, resulting in 'hit and run' mining with no environmental, health, or safety precautions.

Burkina Faso

Figure 7: Environmental impact of mining in West Africa

In many parts of Africa, there is concern about the extent of the environmental damage caused by mining, and steps have been taken to address these concerns. …

Figure 8: The Bissa Gold Company operations

… "Currently, it is not easy to get a house for rent, and even if one is found, the price is very high", says Mamadou Pierre Celestin Zoungrana, mayor of the municipality of Sabcé.

AUSTRALIA

Table 3

GDP per capita (2012)	US$43 300	
Major exports	Iron ores and concentrates	20 %
	Coal; briquettes	19 %
	Petroleum gases	8 %
	Gold	4 %
	Petroleum oils, crude	4 %
Major imports	Cars	8 %
	Petroleum oils, crude	6 %
	Petroleum oils, refined	5 %
	Gold	4 %
	Medicaments, packaged	4 %

Australia is the world's largest exporter of iron ore, lead, and zinc. …

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Figure 9: Iron ore piles in the Pilbara, Western Australia

… Much of the country is in an economic decline, due partly to the high value of the Australian dollar, kept high by the huge demand for minerals from China and India, satirised in **Figure 10**.

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Figure 10: The success of mining

In Western Australia and the Queensland mining belt, demand for workers is high. …

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…Few workers' become involved in the local community, helping with service groups, or volunteering. In the home communities, the absence of fathers and husbands creates social problems.

Robert McGregor from New Zealand has been a FIFO worker at a mine near Darwin for 7 years. …

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…In the past two years, 1 000 members of New Zealand's armed forces have been recruited by Australian mining companies, leaving the Navy, in particular, short-staffed.

Australia's Aboriginal communities against uranium mining

As a mining giant prepares to open a major uranium mining site in Western Australia, the clamour for the state to once more ban mining of the radioactive mineral has become louder. …

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Figure 11: Anti-uranium protestors in Kalgoorlie

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…The Western Desert Lands Aboriginal Corp, representing the Martu, has signed uranium exploration agreements in the area with at least two companies.

Tarkine exploration boom

Miners are preparing for an exploration boom in Tasmania's north-west after the Australian Government rejected a bid to put large parts of the area on the national heritage list.

Figure 12: Tasmanian Tarkine Wilderness area

Figure 12 shows Tasmania's resource-rich Tarkine Region, which is also home to the largest temperate rainforest in the southern hemisphere. …

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…"From purely environmental terms, it would have been something that would have been a wonderful thing to be able to do, but you have to take into account the impact on people, and taking that impact into account meant that I simply couldn't go with the Heritage Council's recommendations", he said.

PERU

Table 4

GDP per capita (2012)		US$10 900
Major exports	Gold	25 %
	Gold content	15 %
	Refined copper and copper alloys	7 %
	Petroleum oils, refined	5.7 %
	Flour or meal for animal feed	5.4 %
Major imports	Petroleum oils, crude	9 %
	Petroleum oils, refined	5 %
	Cars	4 %
	Automatic data processing machines	2 %
	Motor vehicles for transporting goods	2 %

One old saying well-known by Peruvians is: "Peru is a beggar sitting on a golden bench". …

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Figure 13: What does Peru export?

… Profits from mining have soared, thanks partly to rising commodity prices. Low taxes in Peru have also helped.

How can mining help communities?

Mining can help communities to generate income and to create opportunities for growth for other businesses. It contributes indirectly through investments, enabling better social services (schools, medical clinics, and so on) and catalysing improvements in physical infrastructure. Large mining operations can be found to invest substantially in local economic development, through providing training, social services, and public goods, such as clean water, transport, energy, and infrastructure.

Barrick helps out

In 2008, the large mining company Barrick decided to contribute $2 million over a three-year period to help improve child nutrition and maternal health near its mining operations in the Ancash and La Libertad regions of Peru. …

… 14 centres of early stimulation and nutrition have been established, including 2 in the local government facilities.

Adverse effects of mining in Peru

Despite the benefits to the Peruvian economy, most local mining communities have experienced few improvements in social welfare as a result of the mining boom. …

Figure 14: Environmental or social impact assessment?

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…Vulnerable groups harmed when mining ceases due to job losses, as well as essential public goods and services.

Figure 15: A dilemma of development

The Santa Ana Project – protesting mining

"The Santa Ana Project is located 140 kilometres south of the city of Puno in Peru", the website of the Vancouver-based Bear Creek Mining Corporation says, describing the new silver mine it was about to open in 2012. …

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Figure 16: Concepción Consechoke

…We were warned that we would get shot if we went on strike again, but we are prepared to die".

PAPUA NEW GUINEA

Table 5

GDP per capita (2012)		US$2 700
Major exports	Gold	35 %
	Gold content	22 %
	Petroleum oils, crude	11 %
	Wood in the rough	8 %
	Palm oil, crude	6 %
Major imports	Petroleum oils, crude	10 %
	Petroleum oils, refined	10 %
	Motor vehicles for transporting goods	5 %
	Parts for use with hoists and excavation machinery	4 %
	Self-propelled bulldozers, excavators, and road rollers	3 %

Much of Papua New Guinea (PNG) is mountainous and covered in tropical forest. About 80 % of PNG's population of 6.3 million, live in rural areas that have rugged relief, lacking modern infrastructure and facilities. Mining is hampered by the terrain, land ownership issues, and the lack of infrastructure.

As world demand for minerals increases, PNG is experiencing increasing exploration and extraction of these resources. **Figure 17** shows the location of mining projects in the country in 2011.

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Figure 17: PNG Chamber of Mines and Petroleum Map (2011)

Porgera Gold Mine

The Porgera Gold Mine began production in PNG in 1990. …

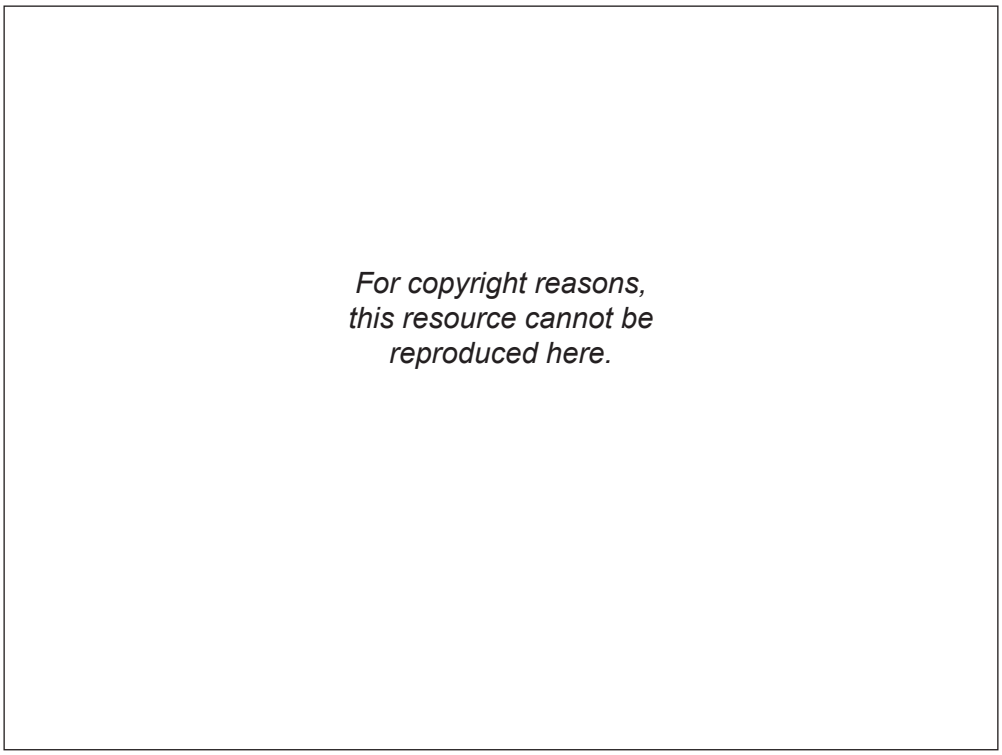

Figure 18: Porgera Gold Mine

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… Safety practices are poor, with tunnels sometimes unsupported, and many using mercury in order to extract gold, often without using gloves or masks, absorbing or inhaling the mercury vapour as a result.

While financial, social, and educational benefits accrue from mining, questions are being asked about the environmental impacts. …

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Figure 19: Nautilus seabed mining potential impacts

… Supporters of the venture claim it will cause fewer problems than mining on land and have a smaller footprint. Steve Rogers, the CEO of Nautilus, says it will not affect fish or coral because the mining will be so deep down.

ACKNOWLEDGEMENTS

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