



# Exploring for minerals.

Exploration drilling at Weld Range iron deposit, Western Australia (Sinosteel Midwest Corporation Ltd)

## 02 EXPLORING FOR MINERALS IN AUSTRALIA A GUIDE FOR INVESTORS

Australia is one of the world's leading exploration and mining nations and a major source of minerals and metals.

Australia's exploration and mining success is underpinned by its highly prospective geology, quality geoscientific databases and information systems, a strong legal framework, a proven mining and petroleum tenement system, a stable and welcoming investment environment, and a world-class services sector. The value of these is reflected in Australia's consistent high ranking in international investment surveys relating to the industry.

### Prospectivity

#### Australia's Mineral Resource Base

Australia's Economic Demonstrated Resources (EDR) of zinc, lead, silver, nickel, rutile, zircon, uranium and brown coal are the world's largest. EDR of bauxite, black coal, copper, gold, iron ore, ilmenite, lithium, manganese ore, niobium, tantalum and industrial diamond rank in the top six worldwide.

#### Diversity of Australia's Mineral Endowment

Over 70 types of mineral deposits of economic significance are known in very old (Archean) to very young (Quaternary) rocks, and over a wide range of geological settings. From these, more than 23 mineral commodities are produced in significant amounts. Australian mineral production comes from about 300 mines including mines in world-class deposits of most major mineral commodities.

#### Australia is an Under-Explored Continent

Discoveries continue to be made in both proven (brownfields) and greenfields provinces. Since 1990, more than twelve new, world-class mineral deposits have been discovered. Significant discoveries are being made in established mining districts even in regions where there has been production for over 100 years. The past decade has seen the discovery of or substantial addition to resources at significant deposits across the country.

Australia's high mineral potential is demonstrated by:

- › favourable geological settings including new greenfield regions;
- › extensions of known mineralised provinces beneath thin cover; and
- › ongoing discoveries of deposits.

Australian mineral exploration has been particularly successful in discovering new deposits and delineating additional resources at known deposits. Factors contributing to this exploration success include:

- › a rich mineral resource endowment;
- › the existence of a comprehensive and high-quality geoscientific knowledge base;
- › application of advanced geological concepts and technology;
- › well developed scientific services support;
- › a relatively flat topography with low and sparse vegetation cover facilitates exploration and physical access; and
- › a very strong mining-related goods and services sector.

Despite an imposing and long history of discovery, the Australian continent remains effectively under-explored, particularly at depths of greater than a hundred metres.

#### Mineral Resources

Australia has substantial deposits of major minerals that can be recovered profitably under current conditions. Despite high levels of production, the extent of Australia's economic demonstrated resources (EDR) for the major mineral commodities have generally been maintained, or increased, through new discoveries and incremental increase in resources at known deposits over the past three decades.

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Resource levels for selected commodities are shown in the following table:

COMMODITY	UNIT	ECONOMIC DEMONSTRATED RESOURCE	SUB ECONOMIC DEMONSTRATED RESOURCE	INFERRED RESOURCES
Bauxite	Mt	6.2	1.6	0.91
Black Coal (recoverable)	Gt	39.2	8.2	66.7
Brown Coal (recoverable)	Gt	37.2	55.1	101.1
Copper	Mt Cu	77.8	7.6	34.2
<b>Diamond</b>				
Gem & near gem	Mc	91.9	99.7	14.3
Industrial	Mc	95.7	103.8	14.9
Gold	t	6255	1601	4596
Iron Ore	Gt	24.0	1.9	28.9
Lead	Mt Pb	26.8	7.1	18.6
<b>Mineral Sands</b>				
Ilmenite	Mt	212.3	23.9	123.2
Rutile	Mt	22.9	6.65	32.1
Zircon	Mt	39.1	9.95	36.5
Nickel	Mt Ni	26.4	2.1	20.9
Silver	kt Ag	61.4	18.2	30.0
Tantalum	kt Ta	51	15.8	80
Uranium	kt U	1163	16	500
Zinc	Mt Zn	53.1	8.6	21.9

Source: Australia's Identified Mineral Resources 2009 ([www.ga.gov.au/products/servlet/controller?event=GEOCAT\\_DETAILS&catno=69951](http://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=69951)).

### Key commodities

**Gold:** Gold occurs and is mined in all States and the Northern Territory. The Yilgarn Craton in Western Australia is Australia's premier gold province with major Archean greenstone-hosted deposits such as Kalgoorlie, Granny Smith and Boddington. South Australia's Gawler Craton hosts the major iron oxide copper-gold-uranium Olympic Dam deposit. In the Northern Territory the low sulphide quartz vein Callie deposit in the Tanami region is of world-class size. Australia's eastern States, Tasmania, Victoria, New South Wales and Queensland host many substantial gold deposits in a range of styles and provinces including, for example, Bendigo (Vic) (low sulphide quartz veins), Cadia (NSW) (porphyry gold copper), Henty (Tas) and Vera-Nancy (Qld) (epithermal). The discovery of the Tropicana deposit (5 million ounces of gold) in the Albany-Fraser Belt, Western Australia, highlights the potential for major new gold discoveries in Australia. Ongoing exploration suggests that Tropicana may be the first discovery in a new gold province.

**Nickel:** Australia is one of the world's leading nickel producers with production based on substantial resources of both sulphide and lateritic nickel in Western Australia. Major deposits of both forms of resources occur in the Yilgarn Craton in Western Australia. The first major sulphide deposit discovered was at Kambalda and has subsequently been followed by numerous small and a number of major deposits such as Mt Keith, Perseverance and Yakabindie. Major lateritic deposits in the Yilgarn include Murrin Murrin, Cawse and Ravensthorpe. Significant potential for further discoveries exists and is highlighted by ongoing discoveries in the Yilgarn Craton such as the high-grade Spotted Quoll deposit in 2007. In addition, active exploration for lateritic nickel is continuing in New South Wales and Queensland.

**Copper:** Copper production is centred primarily on the major deposits at Olympic Dam in the Gawler Craton of South Australia and Mount Isa which produce more than two thirds of Australia's copper output. Other significant production comes from Ernest Henry, also in the Mt Isa region,

Northparkes and Cadia-Ridgeway in Lachlan Fold Belt of central New South Wales, and Telfer in Western Australia. There is also production from a number of smaller deposits. Proterozoic iron oxide copper-gold deposits dominate Australia's copper resources with the Olympic Dam deposit being the largest and production has started from the significant Prominent Hill (SA) deposit. Exploration programs are in progress in the Gawler Craton (South Australia), the Lachlan Fold Belt (New South Wales), the Rocklands project in the Mt Isa region of Queensland and encouraging exploration results have been reported from Western Australia at the DeGrussa copper-gold prospect where intersections returning over 27% copper have been reported.

**Zinc:** Australian zinc production and resources are dominated by the world-class sediment-hosted stratiform deposits of the MacArthur – Mount Isa belt extending from the Northern Territory to northwest Queensland, notably the McArthur River, Century, and Mt Isa deposits, and Broken Hill in western New South Wales. Other important zinc deposits include Cannington

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in the Mt Isa district and Endeavor (Elura) in central western New South Wales. There is also production from Tasmania, Western Australia and elsewhere in Queensland.

**Lead:** As for zinc, Australian lead production and resources are dominated by the world-class deposits of the McArthur – Mt Isa belt – notably Cannington – and the Broken Hill deposit in western New South Wales. Other significant deposits include Endeavor (Elura) and those of the Lennard Shelf. Mining commenced in 2006 at the Magellan deposit in the Western Australia's Yilgarn Craton.

**Coal:** Substantial resources of coal occur in all Australian States but are predominantly in the eastern States. The principal black coal deposits occur in the Bowen Basin, Queensland and the Sydney Basin, New South Wales. Numerous large scale mining operations are active in both Basins including Goonyella, Peak Downs, and Newlands in the Bowen Basin and Mt Arthur, Hunter Valley, Mt Thorley and Ulan in the Sydney Basin. Both Basins have large deposits of premium metallurgical and thermal coals for domestic consumption and particularly export. A surge in exploration has seen attention focussing on other coal-bearing basins including the Surat and Galilee Basins in Queensland, the Gunnedah Basin in New South Wales, the Arckaringa Basin in South Australia and the Canning Basin in Western Australia. While most interest is in coal for export there is a growing coal seam gas sector that is actively exploring for coal seam gas in New South Wales and Queensland. In Victoria, major brown coal deposits in the Latrobe Valley provide the primary fuel for the State's power stations.

**Iron ore:** Australia's premier iron ore province is the Hamersley Basin in Western Australia's Pilbara region. The province hosts many deposits ranging in type from premium high-grade hematite ores to channel iron deposits. The two major deposits in the province are the Mt Whaleback and Mt Tom Price deposits which yield premium high-grade hematite ore for export. Increasing production is being sourced from smaller mines in Western Australia's Yilgarn Craton. Substantial exploration programs are in progress for

iron ore in the Hamersley Basin and Yilgarn Craton of Western Australia, elsewhere in Western Australia, and in the Northern Territory, South Australia, Tasmania with minor exploration in New South Wales and Queensland. Exploration in recent years has delineated very large deposits of magnetite ore such as at Kara in Western Australia where a resource of over 1 billion tonnes of magnetite ore has been discovered.

**Bauxite:** Australia hosts major bauxite deposits that support the production and export of alumina and aluminium. The principal deposits of world-wide significance are at Weipa in Queensland and at Gove in the Northern Territory. In addition other large deposits are located at Aurukun in north Queensland and in the Darling Ranges in Western Australia to the south of Perth.

**Mineral sands:** Australia is the world's leading supplier of mineral sands (ilmenite, rutile and zircon) with production from New South Wales, Queensland, South Australia and Western Australia. Exploration resulted in new mineral sands provinces being discovered that have potential to ensure Australia remains a major supplier into the future. Production from the Murray Basin is well established and resources are known in New South Wales, Victoria and South Australia. A major new mineral sand province has emerged, the Eucla Basin in South Australia, where zircon rich deposits such as Jacinth and Ambrosia have been developed and resource at other deposits have been delineated. More recently mineral sands deposits have been discovered in the Eucla Basin in Western Australia and these are being investigated.

**Molybdenum – Rhenium:** Further highlighting the potential of Australia to host major mineral deposits was the 2008 discovery of the Merlin molybdenum and rhenium deposit, in northwest Queensland. This deposit is one of the world's largest and highest grade deposits and contains over 80 000 tonnes of molybdenum and over 13,000 kilograms of rhenium. The surrounding areas are highly prospective for further discoveries of similar deposits.

### Exploring for minerals

Modern exploration uses a multi-disciplinary approach drawing on advanced knowledge in geophysics, geochemistry and geology, and new exploration tools. New and adapted exploration technologies and techniques have been developed for exploring beneath the cover materials that blanket extensive areas of the Australian continent. Chief amongst these has been the application of state-of-the-art geophysical surveys to define the distribution of rock types and structure at and beneath the surface, and identify anomalies potentially related to the presence of mineralisation. Multi-element geochemical exploration techniques have been developed to detect subtle anomalies associated with mineralisation in the regolith-dominated terrains common in Australia. Advances in understanding ore-forming processes are providing new insights into Australia's mineral prospectivity. Similarly advances in data processing, GIS systems and visualisation technologies enable on-line access, integration and rapid analysis of a wide range of high quality geoscientific data available from government, industry and other sources to assist in improved selection of prospective areas and delineation of exploration targets.

### Precompetitive geoscience information

The Commonwealth, State and Northern Territory Governments recognise the importance of high-quality geoscientific information in assessing mineral and petroleum prospectivity and the stimulation of exploration. They undertake major geoscience programs to support mineral and petroleum exploration in Australia. These programs provide the explorer with precompetitive geoscience information and datasets, particularly covering important areas, as a basis for exploration in both proven and greenfields mineral provinces.

The Australian governments have recognised the importance attached by industry to access modern high resolution geophysical data, including regional gravity, deep seismic surveys and high-resolution airborne magnetic data. A new Radiometric Map of Australia has been released to assist

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exploration for uranium and thorium as well as heat flow studies and the assessment of Australia's geothermal resources. Processed data from an Australia-wide airborne geophysical survey was used to adjust all the radiometric data held in the National Radiometric Database to a common standard. The levelled database was then used to produce the first Radiometric Map of Australia.

The new geophysical data are supported by new geological maps, databases of geochemical data and mineral occurrence/deposit information, GIS datasets, reports and interpretative products and made available to potential explorers either via the Internet or as other products in digital formats. The Australian Government and several State/Northern Territory governments are undertaking geoscientific programs to acquire a range of geological and geophysical data to support exploration. The Australian Government is continuing its \$59 million, five year program to acquire new seismic reflection survey data, and airborne electromagnetic (AEM) and other geophysical data.

To facilitate the ready access to these data an information collaboration between Geoscience Australia and its State and Northern Territory counterparts established a national geoscience Internet portal. The portal, [www.geoscience.gov.au](http://www.geoscience.gov.au), provides one point of entry to fundamental geoscience data and information. Investors and explorers can access geoscience information at a national level and further refine their searches down to regional and local scales via pathways to the relevant State and Territory datasets.

Under a common policy adopted by the Australian, State and Northern Territory Governments fundamental geoscientific data is provided free of charge via the Internet or at the marginal cost of transfer. This policy enables ready access to government data for all, including companies and consultants.

