

## Commodity profile

### ZINC

Zinc, chemical symbol Zn, is a lustrous bluish-white metal. It is mainly used in galvanising steel to prevent rusting, in zinc die-casting alloys and in copper-based alloys, such as brass. Zinc is also essential to the growth of many kinds of organisms, both plant and animal. It is a relatively rare element in the Earth's crust where its average concentration is 70 parts per million (ppm). It combines with sulphur to form the mineral sphalerite (ZnS) which is the main commercial source of zinc. Sphalerite also contains about 0.2% cadmium, varying amounts of iron (up to 10%) and traces of indium, gallium and germanium of which it is the main source. It also occurs naturally as the oxide (ZnO), carbonate (ZnCO<sub>3</sub>) and sulphate (ZnSO<sub>4</sub>).

### Deposits

Zinc is extracted from five main types of deposit, usually as a co-product with other metals, notably lead (Pb) and copper (Cu). It occurs in sedimentary exhalative (Sedex) zinc-lead-silver deposits, in Mississippi Valley type (MVT) zinc-lead deposits, in volcanogenic massive sulphide (VMS) copper-zinc-lead-silver deposits, in skarn copper-zinc deposits and in zinc oxide deposits resulting from the weathering and alteration of primary sulphide mineralisation.

The most important sources of zinc are Sedex deposits in Australia (Mt Isa and Century), USA (Red Dog), India (Rampura) and China (Changba). These are major deposits, found in sedimentary rocks, particularly shales, with reserves and resources in individual deposits exceeding 100 million tonnes and with typical grades of about 10–15% Zn and 2–5% Pb. MVT deposits tend to be smaller, though they often occur in clusters in a single district. They have lower grades, typically 2–6% Zn and 1–3% Pb, and are generally hosted in carbonate rocks. They are less widespread than the Sedex type and mainly occur in the eponymous region, especially in Tennessee and Missouri. VMS deposits are widely distributed: the most important deposits occur in Canada (Kidd Creek and Bathurst), and in Australia (Rosebery and Scuddles). They are smaller than the Sedex deposits but often produce copper as a co-product as well as lead and silver. Few zinc oxide deposits are known, however, the Skorpion deposit in Namibia has recently started production. The largest skarn zinc deposit is the major, newly opened Antamina Cu-Zn mine in Peru. In Europe there are important zinc deposits in Ireland (Navan, Lisheen and Galmoy) that are intermediate between Sedex and MVT styles, and in VMS deposits in Sweden (Boliden) and the Iberian Pyrite Belt.

### Extraction

Zinc is extracted by electrolytic and pyrometallurgical methods. In both methods the sulphide ore is crushed and ground to a fine slurry. The sphalerite is separated from the other minerals by froth flotation to produce a zinc concentrate containing 45–55% Zn.

In the electrolytic process the concentrate is roasted, producing sulphur dioxide, which is the basis of the sulphuric acid that is used to leach the roasted concentrate. Most of the by-products and impurities in the resultant leach liquor are removed by successive precipitation stages ('purification'). The zinc in solution is recovered in a series of electrolytic cells by precipitation on aluminium cathodes from which it is periodically stripped, melted and cast into ingots.

In the alternative Imperial Smelting Furnace (ISF) technology the concentrate is sintered to produce a porous, refractory agglomerate of zinc oxide lumps to facilitate the smelting process. The sinter is then mixed with coke and smelted in a blast furnace at 1000–1050°C. The zinc vapour produced is passed through a fine spray of molten lead that dissolves the zinc, preventing reversion to zinc oxide. The lead-zinc solution is passed to a separating bath, where the zinc evaporates and is tapped off to the zinc refinery, leaving the lead to be recycled. The zinc is further heated until about one-third has boiled off and condensed. The condensate (which contains cadmium) is then treated to produce pure cadmium and high-grade zinc (up to 99.95% purity). The remaining zinc is cooled and treated with molten sodium to produce a 98.5% pure metal for use in galvanising and brass.

About 85% of world production is by the electrolytic process, which has the advantage of producing high grade (99.99% Zn) directly, whereas a further distillation process is needed to achieve this grade from the

ISF product. However the ISF has the ability to handle a wide range of raw materials, particularly mixed zinc-lead ('bulk') concentrates, and ISF plant continues to be built for this reason.

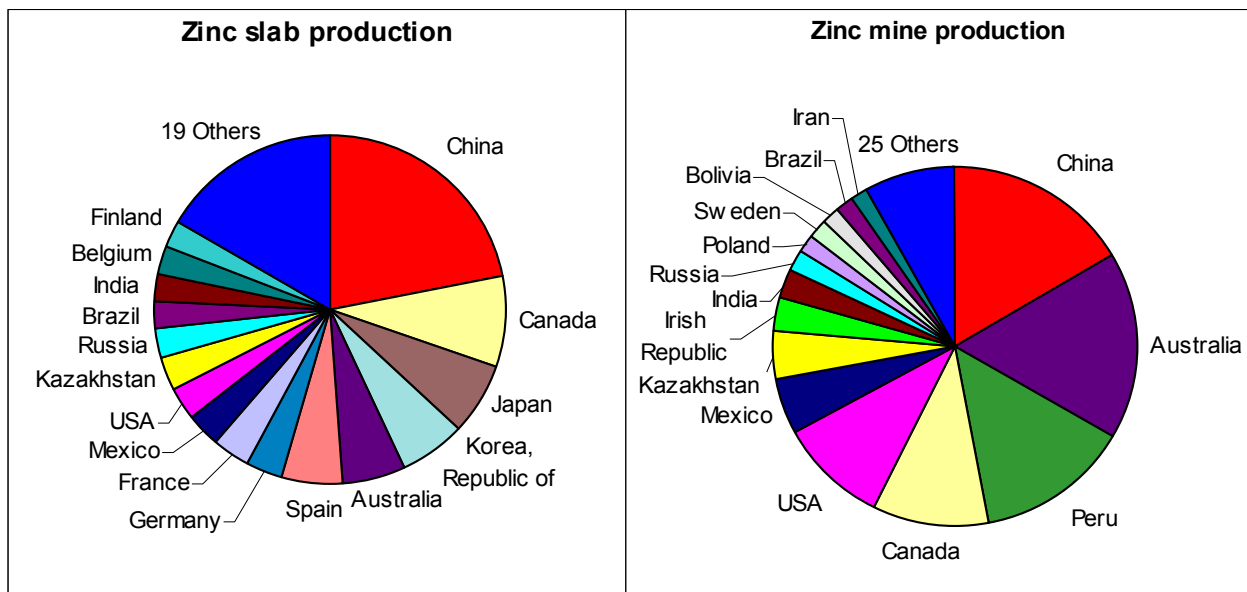
### Specification and uses

Zinc metal is marketed in three grades, Special High Grade (99.995% Zn), High Grade (99.95% Zn) and Good Ordinary Brand (98.5% Zn). Zinc oxide is the most important non-metallic product. In the UK the chief uses of zinc in 1999 were galvanising (49%), die-casting alloys (20%), copper alloys (brasses etc., 14%), rolled zinc (3%), zinc oxide (9%), zinc dust (2%) and miscellaneous (5%). Galvanising has risen markedly in the past decade as an anti-corrosion protection for steel. Die-casting alloys are used where precision casting is required at a moderate cost but with significant strength (competitors are plastics and light metals). Brasses have a wide variety of uses, the most familiar of which are in plumbing and electrical appliances. Rolled zinc is used as in protective sheeting, such as flashing and for the shells of dry batteries. Zinc oxide is used chiefly in rubber manufacture, and also in paints and pharmaceuticals. Zinc dust is used in protective coating applications and paints. Miscellaneous uses are chiefly as zinc chemicals.

### Production, trade and prices

China, Australia, Canada, USA and Peru together account for two-thirds of total world mine production of zinc. A high proportion of mined zinc is a co-product with either lead or copper, with gold, silver, cadmium, sulphur and germanium as important by-products. The largest net exporters of zinc concentrates, by a wide margin, are Australia (1.9 Mt/yr) and Peru (1.4 Mt/yr), followed by Ireland, Sweden and Mexico.

**Production of zinc, 2002 (tonnes)**

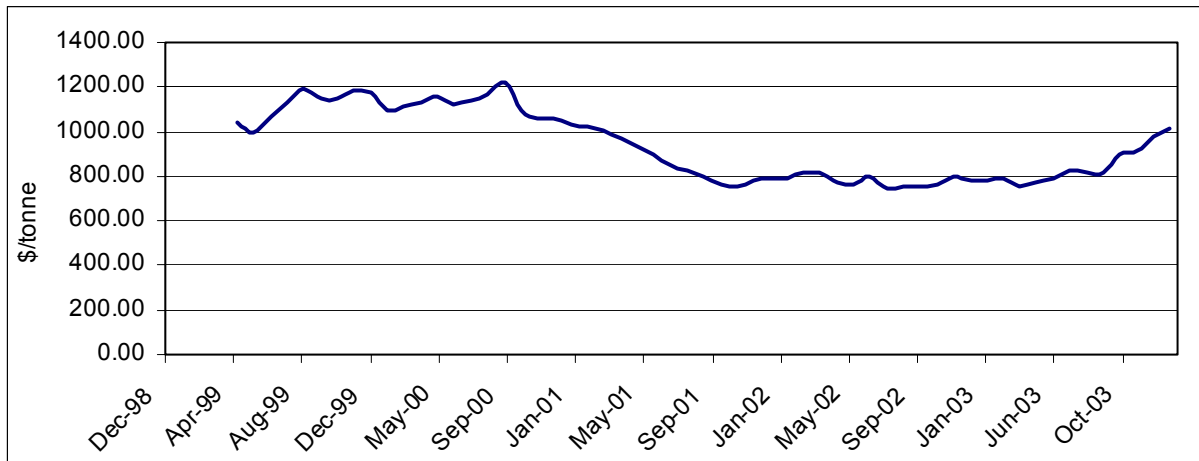


Source: [World Mineral Statistics database, BGS](#)

Slab zinc (refined zinc metal) is produced both by the mining countries and also by several industrialised countries that have little or no mine production and rely on imports of zinc concentrates. The largest of these are Japan, South Korea, Germany, France, Belgium, Finland and the Netherlands. China is the largest producer in terms of both mine and refinery output (16% and 22% respectively of world totals). The largest exporters of unwrought zinc are Canada (0.60 Mt/yr), China (0.47 Mt/yr) and Australia (0.50 Mt/yr). Three EU countries, Finland, Spain and Netherlands, are also in the top ten exporters of unwrought zinc.

Recycling makes a small contribution to supply. The USGS estimates that 90 000 tonnes of zinc was recovered from 'old' ('post-consumer') scrap in the USA in 1999. This is equivalent to 6% of the total apparent consumption of refined zinc in that year. The [International Lead Zinc Study Group](#) gives 30% for the contribution from recycled zinc but this figure is believed to include 'new' or 'process' scrap.

### Zinc: LME average settlement price, May 1999–April 2002



Zinc metal is traded at prices based on the London Metal Exchange (LME) daily quotations for 'Special High Grade' zinc. Prices for concentrates are also based on LME prices with credits for copper, gold and silver and deductions for treatment costs and impurities. As with other base metals, the price of zinc has declined since 2001 from approximately \$1 000/tonne to a 2002 average of \$760/tonne, due to continued oversupply in the face of lagging demand. Along with most other base metals, the zinc price improved in the latter quarter of 2003 and into 2004, after a long period of stability around US\$800 per tonne.

### Zinc in Britain

Zinc has been produced from a number of mines in Britain, with a total production exceeding 650 000 tonnes. It is generally associated with lead mining and recovery of zinc only developed with demand for galvanised iron and brass in the nineteenth century. The most productive areas were north-east Wales (Minera), the Northern Pennine Orefield (Nenthead) and the Isle of Man (Laxey). Other areas with significant production are shown on the map. The Wheal Jane mine in Cornwall produced about 6 000 tonnes/year for a number of years before closure in 1991. There are several areas in Britain with potential for zinc discoveries. The Parys Mountain VMS Zn-Cu-Pb deposit in North Wales, which produced 130 000 tonnes of copper in the 18<sup>th</sup> and 19<sup>th</sup> centuries, is the most promising zinc prospect with current drill-indicated reserves of 4.8 Mt at 6.0% Zn, 1.5% Cu, 3.0% Pb, 57 g/t Ag and 0.4 g/t Au (or over 250 000 tonnes Zn metal). Other prospective areas include: north-western Scotland around the Gairloch VMS Cu-Zn prospect; the Dalradian rocks of the southern Highlands of Scotland which host major Sedex barite deposits; and in south-west England for VMS and Sedex deposits. There is also potential for zinc deposits at depth, below the worked-out mines, in the Central Wales Orefield and the MVT orefields of north-east Wales and the Northern and Southern Pennines.

For further information on these and other zinc occurrences in Britain [follow this link](#).

The largest ISF plant in the world was operated by Britannia Zinc (part of the MIM group) at Avonmouth, Bristol. The plant, which closed in March 2003, was a 'custom' smelter, treating zinc-lead concentrates from a number of sources, chief of which were Australia, Peru, Bolivia and USA. The plant had the capacity to produce 100 000 tonnes/year zinc in three grades and 50 000 tonnes/year lead bullion and 400 tonnes/year cadmium. The lead bullion was refined at MIM's lead refinery (Britannia Metal Refiners) in Northfleet, Kent.

A number of companies in the UK produce zinc alloys for die-casting and other uses, based chiefly on primary zinc metal. The largest of these is Trident Alloys Ltd, in Bloxwich, with a capacity of 50 000 tonne/year die-casting alloy, in addition to other products.

**Location of principal zinc occurrences and refineries in Britain**

