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Ministry of Mines  
Indian Bureau of Mines

# INDIAN MINERALS YEARBOOK 2018

VOLUME - II  
METALS & ALLOYS



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# PREFACE

Indian Minerals Yearbook–2018 (IMYB–2018) is the 57th Edition in its series and comprises three Volumes. This book titled ‘Metals & Alloys’ is the second Volume and it contains 19 Reviews of important metalliferous minerals, metals and alloys produced in the country and comprehensively covers details of the country’s ferrous, non-ferrous, strategic and precious metals and their related metallurgical industries. Each of the 19 Reviews provides valuable insights on resource/reserve positions, usage, consumption, R & D, trade, world scenario and future outlook of the metalliferous minerals, metals/alloys. The data coverage of this Edition, i.e., IMYB-2018 pertains to the year 2017-18.

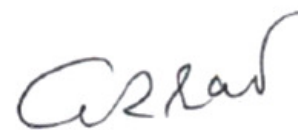
Attempts have been made to comprehensively cover the Metal Industry in India at the micro-level with inclusions of all recent updates. It has been our continuous endeavour to improve upon the coverage of the Yearbook and to present a complete perspective of all domains that have relevance to minerals and metals to the fullest extent possible.

This Yearbook is the outcome of the joint efforts of the Bureau’s Mineral Economics Division and Mining & Mineral Statistics Division. While preparing this Volume, inputs have been drawn from the reports of various Divisions of IBM. Various survey reports/annual reports, technical journals, periodicals of various organisations, including the affirmative responses received from the Mineral Industry on statutory and non-statutory basis have also been referred and inputs from related websites too were resourced and incorporated wherever necessary, during the compilation & formulation of this Volume.

The Bureau is indebted to Central and State Government Departments, Public Sector Undertakings, Public and Private Companies and Research Organisations, Mineral-Based Industries & Associations concerned with mines, minerals and mineral-based industries for their support & cooperation in lending and sharing information. It is firmly believed that this Edition of IMYB, i.e., IMYB–2018 is in the lines of its predecessors and will serve the interest of all its referring/reading clientele who in the past have reposed such unshakable faith in the authenticity of the data/information published in the Series.

New Delhi

Date: 04.09.2019



(DR K. RAJESWARA RAO)

IAS

Additional Secretary &  
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# EXPLANATORY NOTES AND SOURCES

The statistics presented in this publication are in metric units and the prices quoted are in the Indian currency unless otherwise stated.

The stage of measurement of quantity is normally the mine output which refers to the form in which the minerals are extracted. It also includes the usual processing operations done at the mine site to render the ore marketable. Exceptions to the above definition are gold and silver for which the metal output is considered, and for copper, lead & zinc, the concentrates.

The value of the mineral is reckoned in terms of the Ex-Mine Price which represents the sale value of the mineral at the mine site. The value of production of minerals is calculated by multiplying in each case the quantity of production and pit's mouth value per unit as furnished by the mine owners in the returns under MCDR 1988 in all cases except captive mines where the value is calculated on the basis of the cost of production. In case of fuel minerals, the production value figures in respect of coal & lignite are supplied by the Office of the Coal Controller, Kolkata, on annual basis. Regarding petroleum and natural gas (utilised), value published by the National Accounts Division, Central Statistical Office, is used. Value of sulphur produced as by-product from fertilizer plants and oil refineries is not included in the value of mineral production. The value of non-ferrous metals is furnished by the respective units. The export valuation is on the basis of free on board (f.o.b.) inclusive of export duty, wherever such duty is levied. The basis of valuation of imports is the cost, insurance and freight (c.i.f.) value.

Break-ups may not add to total in some tables due to rounding-off.

## Sources

The statistical data presented in this publication have been taken from a large number of sources as listed below:

### Minerals other than fuels, atomic minerals and 'minor minerals'

The basic data relating to major minerals except coal, petroleum and natural gas are collected by IBM under Rule 45 of the MCDR, 1988 framed under the Mines and Minerals (Development and Regulation) Act, 1957. These Rules cover all the States and Union Territories of the Indian Union and apply to all minerals except i) petroleum and natural gas, ii) coal, lignite and sand for stowing, iii) minor minerals, and iv) any mineral declared as prescribed substance by Atomic Energy Act, 1962. Data on sulphur are collected from fertilizer plants and oil refineries.

### Ilmenite, rutile, monazite, rare earths and zircon

Indian Rare Earths Ltd; Kerala Minerals and Metals Ltd; Department of Atomic Energy, Mumbai, and Private Sector producers and processors.

### Fossil fuel

a) Coal and lignite

Coal Controller, Kolkata and the Coal Directory of India.

b) Crude oil and natural gas

i) Economics and Statistics Division of the Ministry of Petroleum & Natural Gas, Government of India, New Delhi, and  
ii) Indian Petroleum & Natural Gas Statistics, Ministry of Petroleum & Natural Gas, Government of India.  
iii) Basic Statistics on Petroleum & Natural Gas, Ministry of Petroleum & Natural Gas, Government of India.  
iv) National Accounts Division, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.

### Minor minerals

Respective State Governments. 'Minor minerals' are defined in Clause (e) of Section 3 of the Mines and Minerals (Development and Regulation) Act, 1957. The current list of 'minor minerals' includes minerals, such as, building stones, gravel, ordinary earth, ordinary clay, ordinary sand other than sand used for prescribed purposes (i.e. used for other than refractory, ceramics, metallurgical, stowing in coal mines and optical purposes, and in manufacture of silvicate cement, sodium silicate, pottery and glass), boulder, shingle, chalcedony or impure quartz pebbles (used for ball mill purposes or filling for boreholes or for decorative purposes in buildings), limeshell, kankar, and limestone used in kilns for manufacture of lime used as building material, murrum, brick earth, fuller's earth, bentonite, road metal, rehmatti, slate and shale used for building material, stones used for household utensils, marble, quartzite and sandstone when used for purpose of building or for making road metals and household utensils and saltpetre. In addition to the minerals already declared, 31 more minerals have been declared minor minerals vide Notification S.O 423(E), dated 10th February, 2015, namely, (i) Agate, (ii) Ball Clay, (iii) Barytes, (iv) Calcareous Sand, (v) Calcite, (vi) Chalk, (vii) China clay, (viii) Clay (Others), (ix) Corundum, (x) Diaspore, (xi) Dolomite, (xii) Dunite or Pyroxenite, (xiii) Felsite, (xiv) Felspar, (xv) Fireclay, (xvi) Fuschite Quartzite, (xvii) Gypsum, (xviii) Jasper, (xix) Kaolin, (xx) Laterite, (xxi) Limekankar, (xxii) Mica, (xxiii) Ochre, (xxiv) Pyrophyllite, (xxv) Quartz, (xxvi) Quartzite, (xxvii) Sand (Others), (xxviii) Shale, (xxix) Silica Sand, (xxx) Slate and (xxxi) Steatite or Talc or Soapstone.

<b>Trade statistics</b>	Monthly Statistics of the Foreign Trade of India, issued by the DGCI&S, Kolkata
<b>Prices</b>	
a) Minerals	<ul style="list-style-type: none"> <li>i) Principal producers and exporters</li> <li>ii) Coal Controller, Kolkata</li> <li>iii) Industrial Minerals (UK)</li> <li>iv) Basic Statistics on Indian Petroleum &amp; Natural Gas, Ministry of Petroleum &amp; Natural Gas, Government of India.</li> <li>v) DGCI&amp;S, Kolkata (Import Value)</li> </ul>
b) Metals	<ul style="list-style-type: none"> <li>i) Producers and exporters</li> <li>ii) Reserve Bank of India Bulletin</li> <li>iii) World Metal Statistics (WBMS)</li> <li>iv) London Metal Exchange (Website)</li> <li>v) Minerals &amp; Metals Review (Monthly/Yearly)</li> </ul>
<b>World information &amp; statistics</b>	<ul style="list-style-type: none"> <li>i) Mineral Commodity Summaries (USGS)</li> <li>ii) World Mineral Production (BGS)</li> <li>iii) Minerals Yearbook (USGS)</li> <li>iv) World Metal Statistics (WBMS)</li> <li>v) Mineral Industry Surveys (USGS)</li> <li>vi) Canadian Minerals Yearbook</li> </ul>
<b>Minerals Consumption</b>	Data obtained on statutory and non-statutory basis from industrial units consuming minerals/ores. Data have also been obtained in some cases from Central Government Ministries. The consumption indicated relates to the number of reporting units in the organised sector only. Estimated consumption data is based on statistical norms in vogue.
<b>Reserves/Resources</b>	Reserves/resources of minerals in India have been taken from National Mineral Inventory prepared by IBM as per UNFC system. The source of information for the world resources of minerals is given against each mineral.
<b>Port facilities</b>	Annual Report of the Ministry of Shipping, Indian Ports Association, Major and Minor Port Authorities and exporters of minerals.
<b>Research and Development</b>	IBM's Ore Processing Laboratory, National Laboratories under the Council of Scientific & Industrial Research, and Ore Dressing Division of BARC and R&D laboratories in the Public/Private Sector.
	Besides, Annual Reports of various Ministries of Government of India, Annual Reports, Brochures and Websites of Public Sector undertakings and private companies, Bulletins concerned with minerals and mineral-based industries, etc. were also referred.

### **Information /data Liability Disclaimer**

The reviews as presented in the Indian Minerals Yearbook are the product of the concerted efforts of in-house authors. In preparation of manuscripts, the authors resourced data/information from various sources, such as, published information on the internet, various publications, Annual reports etc. Major chunks of information have actually been collated internally from the different Divisions of Indian Bureau of Mines which regularly and routinely are in the cycle of gathering data /information through correspondences.

All these sourced information/data that get included in the General/Mineral Reviews are subjected to analyses, interpretations and sometimes extrapolations in the case of paucity of data. There have been instances when the data have been used '*as it is*' hence it is recommended that the readers apply discretion in discerning the data for their further utilisation for general or scientific purposes.

Indian Bureau of Mines while processing of the sourced data/information undertakes its best efforts to ensure accuracy and to verify that the data published have been selected on the basis of thorough scientific judgement. However, IBM would make no warranties to that effect, and shall not be liable for any consequent damage that may result from errors or omissions in the database contained therein.

# ABBREVIATIONS

The abbreviations and symbols/units used in the Publication are as follows:

AMD	Atomic Minerals Directorate for Exploration and Research	IREL	Indian Rare Earths Ltd
APMDC	Andhra Pradesh Mineral Development Corp. Ltd	ISRO	Indian Space Research Organisation
BALCO	Bharat Aluminium Company Ltd	JPC	Joint Plant Committee
BARC	Bhabha Atomic Research Centre	JV	Joint Venture
BGML	Bharat Gold Mines Limited	KCC	Khetri Copper Complex
BGS	British Geological Survey, UK	KMML	Kerala Minerals & Metals Ltd
BIS	Bureau of Indian Standards	LAPL	Large Area Prospecting Licence
BISAG	Bhaskaracharya Institute of Space Applications & Geo-Informatics	LME	London Metal Exchange
BOT	Build, Operate, Transfer	MALCO	Madras Aluminium Company Ltd
BSMDC	Bihar State Mineral Development Corp. Ltd	M(A)R	The Mineral (Auction) Rules
CAPEXIL	Chemical and Allied Export Promotion Council	MCDR	Mineral Conservation and Development Rules
CBM	Coal Bed Methane	M(EMC)R	The Minerals (Evidence of Mineral Contents) Rules
CCI	Cement Corporation of India Ltd	MCR	Mineral Concession Rules
c.i.f.	Cost, Insurance and Freight	MECL	Mineral Exploration Corporation Ltd
CMDC	Chhattisgarh Mineral Development Corporation	ML	Mining Lease
CMPDI	Central Mine Planning & Design Institute	MMDR Act	Mines & Minerals (Development & Regulation) Act
CSO	Central Statistical Office	MMTC	Minerals and Metals Trading Corp. Ltd
DAE	Department of Atomic Energy	MoEFCC	Ministry of Environment, Forest and Climate Change
DES	Directorate of Economics & Statistics	MoU	Memorandum of Understanding
DGCI&S	Director General of Commercial Intelligence and Statistics	MSS	Mining Surveillance System
DGH	Directorate General of Hydrocarbons	MTS	Mining Tenement System
DGM	Directorate of Geology and Mining	MSTC	Metal Scrap Trade Corp. Ltd
DGPS	Differential Global Positioning System	NA	Not Available
DMG	Directorate of Mining and Geology	NAS	Not Available Separately
DMF	District Mineral Foundation	NALCO	National Aluminium Co. Ltd
EEZ	Exclusive Economic Zone	NCMT	National Centre of Mineral Targeting
EU	European Union	ND	Not Determined
FDI	Foreign Direct Investment	NELP	New Exploration Licensing Policy
FIMI	Federation of Indian Mineral Industries	NES	Not Elsewhere Stated
f.o.b.	free on board	NFL	National Fertilizers Ltd
f.o.b.t.	free on board trimmed	NLC	Neyveli Lignite Corporation Ltd
f.o.r.	free on rail	NMDC	National Mineral Development Corp. Ltd
GMDC	Gujarat Mineral Development Corp. Ltd	NMET	National Mineral Exploration Trust
GSI	Geological Survey of India	NMEP	National Mineral Exploration Policy
GVA	Gross Value Added	NMI	National Mineral Inventory
HCL	Hindustan Copper Ltd	NML	National Metallurgical Laboratory
HGML	Hutti Gold Mines Co. Ltd	NRSC	National Remote Sensing Centre
Hindalco	Hindalco Industries Ltd	NTPC	National Thermal Power Corp. Ltd
HZL	Hindustan Zinc Ltd	NQ	Not Quoted
IBM	Indian Bureau of Mines	N/v	Near Village/s
IMMT	Institute of Minerals & Materials Technology (Formerly RRL, Bhubaneswar)	OIL	Oil India Ltd
		OMC	Orissa Mining Corporation Ltd
		ONGC	Oil and Natural Gas Corporation Ltd
		PMKKKY	Pradhan Mantri Khanij Kshetra Kalyan Yojana

(Contd)

**Abbreviations (contd)**

PL	Prospecting Licence
PPP	Public Private Partnership
RP	Reconnaissance Permit
RRL	Regional Research Laboratory
RSMML	Rajasthan State Mines and Minerals Ltd
SAIL	Steel Authority of India Ltd
SBICAP	SBI Capital Markets Limited
SCCL	Singareni Collieries Company Ltd
SDF	Sustainable Development Framework
SEZ	Special Economic Zone
SMC	Sikkim Mining Corporation Ltd
STD	Standard (Code of UNFC)
TAMIN	Tamil Nadu Minerals Ltd
TAMRA	Transparency, Auction Monitoring and Resource Augmentation
TERI	The Energy and Resources Institute
tpd	tonnes per day
tpy	tonnes per year

**Abbreviations (concl)**

TSL	Tata Steel Ltd (formerly Tata Iron and Steel Co. Ltd)
TW	Territorial Waters
UAE	United Arab Emirates
UK	United Kingdom
UNFC	United Nations Framework Classification
USA	United States of America
USGS	United States Geological Survey
UT	Union Territory
VE	Visual Estimate
VISL	Visvesvaraya Iron & Steel Ltd
w.e.f.	with effect from
(e)	Estimated
(P)	Provisional
(R)	Revised
(U)	Under reference
---	Nil
++	Negligible

**UNITS**

cm	centimetre	t	tonne
m	metre	'000 tonnes	thousand tonnes
mm	millimetre	lkm	line kilometre
cu m	cubic metre	ct	carat
'000 cu m	thousand cubic metres	g	gram
m cu m	million cubic metres	kg	kilogram
sq m	square metre	₹	Indian rupees
km	kilometre	₹ '000	thousand rupees
ha	hectare	kWh	kilowatt-hour
sq km	square kilometre	s	second

**Conversion Table**

Troy oz	31.1035 g	cwt	112 lb
kg	2.2046 lb	foot	0.3048 m
tonne	Metric ton of 2,204.6 lb	Crone	Ten million
ton	Long ton of 2,240 lb	Lakh	Hundred thousand



# Classification of Reserves/Resources of Various Minerals as per United Nations Framework Classification (UNFC) System

The classification of reserves/ resources of various minerals based on UNFC system were first prepared by IBM as on 1.4.2000 and later, as on 1.4.2005. Reserves/resources are furnished mineralwise in State Reviews and gradewise and statewise in Mineral Reviews. Quinquennially updated resources for 43 minerals as on 1.4.2010 and for 25 minerals as on 1.4.2013 have been included in this Edition of Indian Minerals Yearbook in State Reviews and Mineral Reviews. The amendment to Mineral Conservation & Development Rules, 1988 vide Gazette Notification No.185 dated 17.4.2003 makes it statutory for all non-coal major mineral mine-owners to report their reserves data as per UNFC and also for Mining Lease applications to submit mining plans accordingly. Detailed guidelines, definitions, etc. concerning UNFC were issued by IBM on 3 June 2003 and published in the edition of Mineral Conservation & Development Rules, 1988.

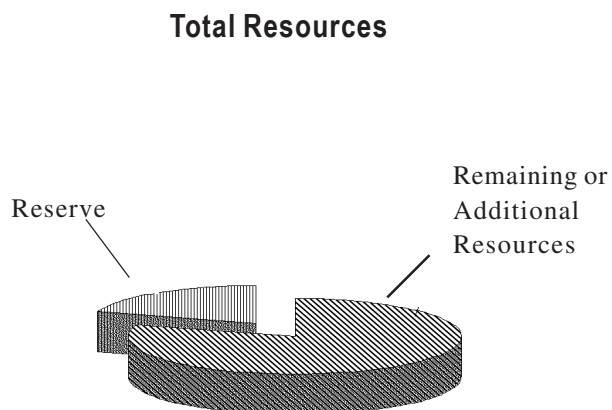
The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation, i.e., reconnaissance, prospecting, general exploration and detailed exploration, generate resource data with a clearly defined degree of geological assurance. These four stages are, therefore, used as geological assessment categories in the classification. Feasibility assessment studies form an essential part of the process of assessing a mining project. The typical successive stages of feasibility assessment, i.e., geological study as initial stage followed by prefeasibility study and feasibility study/mining report are well-defined. The degree of economic viability (economic or sub-economic) is assessed in the course of prefeasibility and feasibility studies. A prefeasibility study provides a preliminary assessment with a lower level of accuracy as compared to that of a feasibility study which assess the economic viability in detail.

It is a three-digit-code-based system, the economic viability axis representing the first digit, the feasibility axis, the second digit and the geologic axis, the third digit. The three categories of economic viability have codes 1, 2 and 3 in decreasing order. Similarly, the three categories of feasibility study have also codes 1, 2 and 3 while the four stages of geological assessment

are represented by 4 codes, i.e., 1 (detailed exploration), 2 (general exploration), 3 (prospecting) and 4 (reconnaissance). Thus, the highest category of resources under UNFC system will have the code (111) and lowest category, the code (334). The various terms used in this classification and their definitions in brief are as follows:

## Total Mineral Resources

Reserve plus Additional or Remaining Resource comprise the Total Resource, or Total Resource minus Reserve gives the Remaining Resource.



## Diagrammatic Representation of Reserve and Resource

### A. Mineral Reserve

Economically mineable part of measured and/or indicated mineral resource.

#### (i) Proved Mineral Reserves (111)

Economically mineable part of Measured Mineral Resource.

#### (ii) Probable Mineral Reserves (121 & 122)

Economically mineable part of indicated or in some cases, a measured mineral resource.

## **B. Mineral Resource**

A Mineral Resource (Remaining or Additional Resource) is the balance of the Total Mineral Resources that have not been identified as Mineral Reserve.

### **(i) Measured Mineral Resource (331)**

That part of mineral resource for which tonnage, density, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence, i.e., based on detailed exploration.

### **(ii) Indicated Mineral Resource (332)**

Tonnage, density, shape, physical characteristics grade and mineral content can be estimated with reasonable level of confidence based on exploration, sampling and testing information, location of borehole, pits etc.

### **(iii) Inferred Mineral Resource (333)**

Tonnage, grade and mineral content can be estimated with low level of confidence inferred from geological evidence.

### **(iv) Reconnaissance Mineral Resource (334)**

Estimates based on regional geological studies and mapping, airborne and indirect methods, preliminary field inspections as well as geological inference and extrapolation.

### **(v) Prefeasibility Mineral Resource (221 and 222)**

That part of an indicated and in some circumstances measured mineral resource that has been shown by prefeasibility study as not economically mineable or can become economically viable subject to changes in technological, economic, environmental and/or other relevant conditions.

### **(vi) Feasibility Mineral Resource (211)**

That part of measured mineral resource, which after feasibility study has been found to be economically not mineable.

## **Definition of Uneconomic Occurrence**

Materials of estimated quantity, that are too low in grade or for other reasons are not considered potentially economic. Thus, Uneconomic Occurrence is not part of a mineral resource. If quantity and quality are considered worthy of reporting, it should be recognised that an Uneconomic Occurrence cannot be exploited without major technological and/or economic changes, which are not currently available.

## **Mineral Occurrence**

A mineral occurrence is an indication of mineralisation that is worthy of further investigation. The term mineral occurrence does not imply any measure of volume/tonnage or grade/quality and is thus not part of a mineral resource.