

GOLD



Indian Minerals Yearbook 2016

(Part- II : Metals & Alloys)



55th Edition

GOLD

(ADVANCE RELEASE)

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MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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8 Gold

Gold is a soft, shiny, yellow element that is the most easily shaped metal. It occurs in veins and alluvial deposits. It is durable, resistant to corrosion and a good conductor of heat and electricity. Gold is generally believed to be a symbol of security and prosperity. Gold is a relatively scarce metal in the world and a scarce commodity in India. The country is a minor producer of gold but boast huge demand for the metal mainly in jewellery and ornament sector. The domestic demand is mainly met through imports. Properties of gold which make it useful for industrial consumption are malleability, ductility, colour, resistance to corrosion, high electrical conductivity, lustre and therapeutic effects of some of its salts.

RESERVES/RESOURCES

As per NMI data based on UNFC system, as on 1.4.2015, the total reserves/resources of gold ore in the country have been estimated at 501.83 million tonnes. Out of these, 17.22 million tonnes were placed under reserves category and the remaining 484.61 million tonnes under remaining resources category. The total reserves/resources of gold (primary), in terms of metal stood at 654.74 tonnes. Out of these, 70.09 tonnes were placed under reserves category and 584.65 tonnes under remaining resources category. The resources include placer-type gold ore in Kerala estimated at 26.12 million tonnes containing 5.86 tonnes gold metal.

By States, largest resources in terms of gold ore (primary) are located in Bihar (44%) followed by Rajasthan (25%), Karnataka (21%), West Bengal (3%), Andhra Pradesh (3%), Jharkhand (2%). The remaining 2% resources of ore are located in Chhattisgarh, Madhya Pradesh, Kerala, Maharashtra and Tamil Nadu. In terms of metal content, Karnataka remained on top followed by Rajasthan, Andhra Pradesh, Bihar, Jharkhand, etc. (Table-1).

EXPLORATION & DEVELOPMENT

GSI, HGML and MECL carried out exploration for gold in 2015-16. Gold, along with other minerals

continued to be the principal thrust area for exploration by GSI in Andhra Pradesh, Arunachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

HGML conducted exploration in its mining lease areas viz, Hutti, Hira-Buddini and Uti Gold Mines in Raichur district in Karnataka. Details of exploration activities undertaken in 2015-16 by various exploration agencies are furnished in Table- 2.

PRODUCTION & STOCKS

The production of gold ore at 535 thousand tonnes during 2015-16 increased by 20 % as compared to that in the previous year. The quantity of ore treated also increased from 545 thousand tonnes in 2014-15 to 552 thousand tonnes during 2015-16. There were five reporting mines of gold ore in 2015-16.

The average grade of gold ore produced in India during 2015-16 was 3.05 g/t as against 4.22 g/t in 2014-15, whereas, that of gold ore treated was 2.67 g/t in 2015-16 as compared to 2.89 g/t in 2014-15.

Production of primary gold in 2015-16 at 1,323 kg decreased by 8% as compared to that in the previous year. No production of Secondary gold was reported for more than 7 years. In addition, HINDALCO, an Aditya Birla Company, extracts gold from imported copper concentrates. During the process of copper refining, the gold and other precious metals like silver and selenium are also recovered at the plant located in Dahej, district Bharuch, Gujarat. The production of by-product gold by HINDALCO was 9,089 kg in 2015-16 as compared to 8,547 kg in 2014-15.

Karnataka was the leading producer of primary gold accounting for 99% of the total production. The remaining production was reported from Jharkhand (Tables- 3 to 7).

The average daily employment of labour in 2015-16 was 3,408 as against 3,429 in the previous year.

**Table – 1: Reserves/Resources of Gold as on 1.04.2015
(By Grades/States)**

(In tonnes)

State/Grade	Reserves				Remaining Resources						Total Resources (A+B)		
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333		Reconnaissance STD334	Total (B)
		STD121	STD122			STD221	STD222						
All India :Total													
Ore (Primary)	10404349	6401725	422100	17228174	1925669	1303000	1968176	30333248	70136727	233608305	145336333	484611458	501839632
Metal (Primary)	53.41	16.26	0.42	70.09	7.69	3.85	12.1	128.65	143.8	227.44	61.12	584.65	654.74
Ore (Placer)	-	-	-	-	-	-	-	-	2552000	23569000	-	26121000	26121000
Metal (Placer)	-	-	-	-	-	-	-	-	2.29	3.57	-	5.86	5.86
By States													
Andhra Pradesh													
Ore (Primary)	-	3902725	-	3902725	655133	-	889515	291000	55000	6980031	-	8870679	12773404
Metal (Primary)	-	8.49	-	8.49	2.45	-	3.57	1.08	0.17	23.78	-	31.05	39.54
Bihar													
Ore (Primary)	-	-	-	-	-	-	-	-	-	128884860	94000000	222884860	222884860
Metal (Primary)	-	-	-	-	-	-	-	-	-	21.6	16.0	37.6	37.6
Chhattisgarh													
Ore (Primary)	-	-	-	-	-	-	-	-	600000	4241033	-	4841033	4841033
Metal (Primary)	-	-	-	-	-	-	-	-	1.8	3.71	-	5.51	5.51
Jharkhand													
Ore (Primary)	9349	-	-	9349	-	-	-	-	5146952	4203337	767000	10117289	10126638
Metal (Primary)	0.07	-	-	0.07	-	-	-	-	3.61	10.26	0.62	14.49	14.56
Karnataka													
Ore (Primary)	10395000	2499000	4221000	13316100	1270536	1303000	1078661	24979968	8204595	16020324	37673000	90530084	103846184
Metal (Primary)	53.34	7.77	0.42	61.53	5.24	3.85	8.53	120.73	28.67	38.29	43.78	249.09	310.62

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Table – 2: Details of Exploration Activities for Gold, 2015-16

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
GSI							
Andhra Pradesh							
Kurnool	Gani- Kalava area	1:2000	1	3	472.7	324	A G-3 investigation of Gold and associated minerals was carried out. Detailed geological mapping in the Gani block was done. Drilling in Kalava east, south and Gani block has been carried out. In view of encouraging gold values obtained during FS 2014-15, drilling of 800 m has been taken up in the blocks of Kalava east, south and Gani block. Three boreholes (320.10 m in Kalava south block) were completed. Though the boreholes intersected sulphidic quartz veins, chemical analyses of core samples from Kalava south block are not encouraging. Borehole AGK-2 analysed 42 ppb to 100 ppb Au in 3 samples; rest of the samples analysed <25 ppb Au. Analytical results for Au from 15 core samples of AGK-3 revealed 34 ppb Au from just one sample and 3 samples from quartz veinlet analysed 0.21 to 0.3% Cu. Analysis of all the core samples from AGK-4 are also not encouraging and analysed <25ppb Au. The chert vein in shale analysed 0.14% x 0.4 m Cu. In Kalava east block, 2 boreholes (AGK-2 & 8) were proposed. Drilling of the borehole AGK- 1 has been completed and results of chemical analysis of drillcore samples are awaited. Drilling of the borehole AGK-8 is under progress. Drilling of 3 boreholes of Gani block is yet to be initiated.
Arunachal Pradesh							
Lower Subansiri	Papumpare & Bomdila	LSM	75	-	-	-	A G-4 stage investigation was carried out for Gold and associated mineralisation in metasedimentary sequence. Three limonitised, ferruginised and gossanised zones having an approximate cumulative thickness of 10 m are observed in the garnet-mica schist near Posa-Potin road section. One zone is exposed in the trench dug about 140 m in the southern extension of this section. One band is exposed in the northern bank of the river in the northern extension. The bands have a general NE-SW trend with steep NW dip. Boudinaged quartz veins having width of 2 to 50 cm veins running parallel to foliation in garnetiferous quartz-mica schist are seen in many places. However, these zones have not yielded any significant gold values.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Jharkhand							
West							
Singbhum	Bishrampur Jaikan area	1:1000	0.5	-	-	226	A G-4 stage investigation was carried out in the vicinity of Bishrampur-Jaikan area. Analytical results of 20 bedrock samples and 20 trench samples have been received from chemical laboratory. Bedrock samples do not show gold value. However, one trench sample from tuffaceous phyllite with quartz vein shows 100 ppb of Au. The mapped area is occupied by Iron Ore Group of rocks which consists of phyllite, tuffaceous phyllite, slaty phyllite, cherty quartzite, chlorite schist, quartz, quartzite, and chert. At places, the tuffaceous phyllite is intruded by numerous quartz veins along the foliation, which show boxwork and limonitisation at places.
Ranchi	Birgaon	1:1000	1.013	-	-	240	A G-4 stage investigation was carried out with reconnaissance survey for gold in Birgaon Block has been initiated in April, 2015. The objective is to assess gold potentiality and to establish the geological and structural control of mineralisation in Babaikundi-Birgaon sector. The value of gold ranges from 0.07 ppm to 0.29 ppm in 3PTS samples and 0.07 ppm in 1 BRS sample in quartzite. Also, the IP results show one 200 m-wide & 1200 m-long anomalous zone of IP values ranging from 10 mV/V to 25 m V/V indicating possible mineralisation.
	Nauhari-Rasuri	-	-	-	-	-	A G-4 stage investigation was carried out with study area comprising of volcano-metasedimentary sequences between the Singhbhum Craton in the south and the Chhotanagpur Gneissic Complex in the north, which has undergone low to medium grade metamorphism and belongs to Paleo to Mesoproterozoic age. Sporadic sulphide mineralisation of copper, lead and gold mineralisation are found along these shear zones.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Jharkhand (Contd.) Ranchi	Sindauri East block	-	-	10	1519	650	General exploration was aimed at delineating gold mineralisation in Sindauri East block. The work involves collection of 250 trench samples (PTS: both soil & rock from trench) through 12 trenches for establishing the correlation between surface and subsurface mineralised zones in the area. A total of 100 petrological samples were collected from surface and subsurface core samples for the study of petrography including ore petrography. A total of 20 quartz vein samples were collected from subsurface core samples for the study of fluid inclusion. Surface geophysical survey and borehole geophysical logging (both IP & SP) have been carried out in Sindauri East block.
Karnataka Dharwar	Bangaragatti Block	1:1000	1	10	1006	200	A G-3 stage investigation for gold was carried out. Trench samples and bed rock samples were collected in order to delineate auriferous zones in the BIF band. An area was mapped in detail with systematic trenching in BIF at every 50 m interval. Gold mineralisation is associated with sulphidic facies in sheared and intensely silicified BMQ bands which are criss-crossed by quartz veins. The sulphides are mainly pyrite and pyrrhotite occurring in fresh and oxidised forms. Cubic crystals of oxidised pyrite are seen embedded in the schistosity and foliation planes of lithounits and their removal imparts the rock units a boxwork. Detailed mapping has brought out one major band. The band is highly oxidised and folded isoclinally. Oxidised and fresh sulphides with boxwork all along the strike are present, and bedrock contains 0.70g/t/2m-1.64 g/t/3 m gold. All the boreholes were planned to intersect at a vertical depth of 60 m. The auriferous zone in boreholes BG-14 (0.41g/t/2 m), BG-18 (0.79 g/t/1 m), BG-15 (0.62g/t/ 2 m), BG-16 (0.33 g/t/1.55 m) was proved.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Karnataka							
Haveri	Budigudda Block	1:1000	1.5	-	-	256	A G-4 stage investigation for Gold was carried out. Shimoga schist belt was taken up with the objective to assess the auriferous potentiality of the sulphidic BIFs. Required number of samples have also been collected for petrographic (5 nos.), petrochemical (5 nos.), ore microscopic (5 nos.) and trace elements (5 nos.) studies. The BIF which have been targeted for auriferous potentiality are restricted mainly to the ridges and confined within 70-80 m width. The mapped block may be divided into two parts namely, southeastern and northwestern, respectively. The southeastern side (950 m long and 90 m wide) hosts three main BIF bands along with several unmappable thin bands all confined over a width of about 30-40 m. Band-1 is established over a strike length of 700 m with average width of 1.5 m. Analytical results indicate that trench samples and bedrock samples from this band contain 60 ppb to 1.3 ppm Au. Band-2 is 80 m east of Band-1 and is established over a strike length of 1000 m with average width of 0.97 m. Trench samples and bedrock samples from this band contain 40 ppb to 0.70 ppm Au. A total of 128 cu m has been excavated in 23 trenches at regular intervals. Bedrock samples have also been collected wherever necessary. Analytical results indicate Au mineralisation ranging from 30 ppb to 21.25 ppm. Ore microscopic study reveals the presence of euhedral pyrites mainly in disseminated forms within argillite as well as in BIF. They are mostly in unaltered forms and rarely seen as inclusions within magnetite. Panning of sediments from the mapped area also shows presence of gold grains. All the bands show disseminations of pyrite cubes throughout the mapped area. However, consistency in Au mineralisation is better in the southeastern part compared to northwestern part. Analytical results of other associated elements like Cu, Pb, Zn, As, Ag, etc. have also been received but none of the elements show any correlations with Au. Future course can be decided after receiving all the analytical results.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Karnataka							
Haveri	Maruthipura Attigere block	1:2000 1:12500	1.5 100	9	1000	124	A G-3 stage investigation was carried out for assessment of gold mineralisation. This work includes different components such as drilling, detailed mapping in the southern part of the block to check continuity of BIF bands and large scale mapping in the western part of block. Shear zones resulting protomylonite and ultra-mylonite were identified from which systematic sampling was carried out as these zones are favourable loci for gold mineralisation. Detailed mapping was carried out in the southern continuity of Maruthipura-Attigere block. This block contains several BIF bands with argillite-wacke rocks. Width of these bands varies from 2 m to 4 m in the limb portion and 6-7 m in hinge portion.
Shivamogga & Davangere	Yerekatte & Siddapura	1:12500	150	-	-	233	A G-4 stage investigation with a project titled, "Preliminary investigation of gold in and around Yerkatte-Siddapura area in part of Shivamogga and Davangere districts of Karnataka" was carried out with the objective of assessment of gold and associated minerals and to bring out the structure and control of mineralisation in detail. Out of seventy- nine BRS samples analysed, five samples have >550 ppm Zn. Only one out of 100 trench samples contains 81 ppb gold. This trench is carried out in manganiferous banded quartzite. Rest of the samples have < 25 ppb gold.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Karnataka							
Tumakuru	Ajjanahalli block	-	-	10	2118.20	-	A G-3 investigation was carried out. BIF-hosted Ajjanahalli Gold Prospect bounded by latitudes 13°42' 36"N and 13°43' 12"N; longitudes 76°42' 36"E and 76°43' 12"E forming part of Sol toposheet no. 57C/9 and 10 is a well-known deposit, situated in meta-turbidite-dominated Chitradurga greenstone belt of Dharwar Craton. Detailed mapping during 2011-12 has delineated eight BIF bands having cumulative strike length of 6000 m in southern part of Block-G, and during 2012-13, a total of 11 BIF bands with cumulative strike length of 14480m have been delineated in northern part of Block-G. G-3 investigation was proposed during 2014-15, involving drilling to establish the depth persistence and potentiality of the mineralised zones delineated by G-4 investigation. During 2014-15 in Ajjanahalli block-G, G-3 stage of exploration was carried out. Nine boreholes (from AGG-1 to 9) of 1094.25 m cumulative length have been drilled. All the boreholes were drilled targeting the mineralised zones at 1 st level (60 m vertical depth) with borehole interval of 100-150 m. In borehole AGG-1 average gold content is 2.30g/t/2.0 m whereas in borehole AGG-2 the same mineralised zone continues with 0.80g/t/2.0 m and 0.73g/t/1.5 m of gold. In AGG-3, gold content is 0.33g/t/1.5m. In borehole AGG-4, the average gold content is 0.20g/t/2.0 m. In AGG-8, average gold content is of 0.67g/t/1.5 m. During the FS 2015-16, G-3 stage of exploration was continued and 5 boreholes (KTAC-10 to 14) of 1023.95 m cumulative length have been drilled. Boreholes were planned to intersect the mineralised zone hosted in the western most BIF band. A borehole AGG-10 average gold content is 0.893 g/t/1 m, whereas in borehole AGG-11 mineralised zones were intersected with 0.823 g/t/4.5 m, 1.5g/t/0.5 m, 1.275g/t/0.5 m, 1.4g/t/0.5 m, and 0.68g/t/1.5 m of gold. In AGG-12, gold content is 0.31g/t/0.5 m. The length of mineralised zone will be calculated after receiving all the chemical analysis data. Sulphide mineralisation such as pyrite, pyrrhotite and arsenopyrite occurs as disseminated specks, veins and stringers along foliation/ fracture planes in BIF band as well as in carbon phyllite unit. Gold mineralisation is confined to sulphide facies of BIF, sheared and silicified in nature hosting thin quartz-carbonate veins and veinlets. Gold mineralisation is epigenetic in nature in this area.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Karnataka							
Tumakuru	Basavanagudda block Vagre area	1:2000	1.5	-	-	333	A G-4 investigation to assess the Gold potential of the area was carried out. "Exploration of gold in Basavanagudda Block has been taken up to assess the gold potential of the area. The work component includes detailed mapping, 100 cu m of trenching and collection of 100 bedrock samples and 100 trench samples. The entire 1.5 sq.km area depicts a synformal fold defined by three major BIF bands. Basavanagudda block forms an integral part of Ajjanahalli Gold Field and gold has been reported from BIF. The BIF bands at hinges are limonitised, slightly silicified and intruded by thin quartz veinlets in all directions. Boxworks formed by sulphides are also noticed at the fold hinges and the major sulphides are pyrite and chalcopyrite. BIF is slightly brecciated at places and shows recrystallised haematite layers. Ore microscopic studies indicate presence of disseminated pyrite and chalcopyrite grains within BIF. Fragmentation and intergrowth of sulphides are noted within a few BIF samples. The analytical result of 179 samples are received and the Au values varies from 25 ppb to 700 ppb. The samples collected from the hinge zones detected with values 0.025 g/t/2 m, 0.0236 g/t/6 m and 0.616 g/t/4 m, respectively. The results obtained from the rest of the BIF samples are not encouraging. The area between the peripheral fold hinges and innermost hinge can be considered as a mineralisation zone with moderate Au values (25 ppb to 700 ppb).
Madhya Pradesh							
Tikamgarh	Gotet area	-	-	-	-	226	A G-4 stage investigation was taken up in Gotet area with an objective of detailed study of shear zone and its environment for gold and sulphide mineralisation. The mapped area exposes rocks of Bundelkhand Granitic Complex (BGC) which include hornblende granite, medium-grained grey biotite granite, porphyritic biotite granite, coarse-grained biotite granite, medium-grained pink biotite granite and fine grained biotite granite intruded by gabbro, quartz vein/reef and pegmatite veins. Mineralisation is represented either by vein or disseminated type, which includes minerals like pyrite, chalcopyrite, malachite, bornite, covellite and sphalerite. Pronounced sulphide mineralisation is confined within the hornblende-bearing granite, which is controlled by NW-SE and E-W-trending shear zone associated with alteration zones. The analysis of bed rock samples so far received reveals Au: <25 ppb; Ag: 1 to 5 ppm (12 samples); Pb: 15 to 400 ppm (29 samples); Cu: 25 to 1800 ppm (31 samples); Zn: 25 to 605 ppm (28 samples); Ni: 15 to 265 ppm (22 samples); Co:10 to 165 ppm (30 samples); As: 1 to 11 ppm (29 samples); Bi: 0.1 to 11.5 ppm (40 samples); Mo: 12 to 1086 ppm (5 samples).

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Maharashtra							
Gondia	Ghotitola & Bothli,etc. area	1:12500 DM 1:2000	50 1	- -	- -	55 -	G-4 stage investigation was carried out around Ghotitola, Bothli, Mendki, Ghatbori Teli and Ghatbori Kheri villages of Gondia district with an objective to assess gold and basemetal mineralisation. Primary sulphides such as chalcopyrite and pyrite are observed in fresh outcrop. Secondary sulphides like bornite (?) and covellite are found, where as malachite is present as surface smears. Amphibolite also shows malachite stains at certain places. Petrographic studies of metapyroxenite reveal that the pyroxenes are altered to amphiboles along their cleavage plane due to addition of water in the system, indicating hydrothermal activity. In some relict pyroxenes of metapyroxenite, sulphide minerals are found deposited along these cleavages and fractures. Ore microscopic studies of metapyroxenite reveal that sulphides viz.(descending order of abundance) chalcopyrite, pyrite, sphalerite, covellite and pentlandite; occur as fine disseminations. Ilmenite surrounded by sphene is also observed. Out of 23 bedrock samples analysed, only 08 samples (metapyroxenite) show presence of Au; its concentration varies from 30 ppb to 130 ppb. Cu concentration varies from 1000 ppm to 0.15%.The Au value in all the soil samples and trench samples analysed is below detection limit.

The analytical results show that metapyroxenite of Ghotitola does not carry any significant anomaly of Au. Overall nature of mineralisation is very sporadic and it is restricted to a few patches within the metapyroxenite. Therefore, this prospect does not seem to be encouraging.

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Table - 2 (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Maharashtra							
Sindhudurg	Kudal	1:12500	-	70	-	189	A G-4 stage investigation was carried out with reconnaissance survey for Gold, PGE, Ni and Cr in Precambrian terrain of Kudal-Kasal-Kunkavale-Vagde areas with the objective to target causative bodies for Au, PGE, Ni and Cr anomalies brought out by geochemical sampling in the period from 2001 to 2003. This was a two-year item initiated in 2014-15. The area is located in 4 blocks namely i) Kudal ii) Kunkavale-A iii) Kunkavale-B and iv) Kunkavale-C. Based on the analytical data (PGE, Au, Ni & Cr) available for all the four blocks, significant results for Au, Ni & Cr are obtained only from Kudal block and PGE from Kunkavale-A block. In Kudal block, Au value varies from < 25 (below detection limit) to 62 ppb. The maximum value of gold (62 ppb) was recorded in a sample (BRS) from Banded Iron Formation (BIF). The other higher values of 43 ppb and 36 ppb of Au are from laterite and BIF respectively in the same block. Twelve BRS from Kudal block have Cr values >500 ppm and 3 BRS have Ni >300 ppm. The highest value of Ni is 988 ppm in BRS and 996 ppm in SSS, whereas the highest value of Cr is 3070 ppm in BRS and 3292 ppm in SSS in Kudal block. The causative body for higher values of Cr and Ni in Kudal block is curvilinear mafic-ultramafic body. In Kunkavale-A block, the causative body for higher values of PGE is laterite which may be underlain by ultramafic rocks. Based on the analytical results of BRS and SSS, the outline of the causative mafic-ultramafic body has been demarcated. In SEM-EDX studies native Au, pyrite, arsenopyrite, Ni-phases have been identified which confirm the results of chemical analysis.
Rajasthan							
Banswara	Bhukia area	-	-	-	350	-	A G-4 stage investigation for gold-copper mineralisation in between Bhukia West Block was carried out. All the boreholes made positive intersections and intersected 1.10 to 9.45 m thick sulphide zones containing 5 to 8% sulphides. Study of cores has revealed that mineralisation is mainly associated with alteration zones (amphibolisation, tourmalinisation, biotitisation and epidotisation) in the form of dissemination, stringers, veinlets and massive zones of pyrrhotite, arsenopyrite and chalcopyrite. Analytical results of core and channel samples indicate anomalous values of gold and copper but zones could not be formed.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Rajasthan							
Banswara	Makanpura area	1:2000	1	4	500	252	A G-4 investigation for gold and associated mineralisation in Makanpura area was carried out. Surface indications of mineralisation are seen in the form of old workings, gossan/ferruginisation, malachite staining and silicification. Four mineralised zones (MZ-I to MZ-IV) have been delineated on the basis of surface evidences from east to west, which vary in length from 100 m to 280 m and in width from 4 m to 20 m. Eleven channels are laid across these mineralised zones. Mineralisation in the area is mainly present within grey carbon phyllite, massive marble, metabasic rock and chlorite phyllite. Study of the borehole cores shows that primary sulphides occur mainly in carbon phyllite, metabasics, massive marble and chlorite phyllite. The sulphide mineral assemblage is represented by pyrrhotite, pyrite and chalcopyrite in order of decreasing abundance. These minerals occur as dissemination, vein, stringers and veinlets. The width of sulphide zones along boreholes varies from 3.00 m to 22.20 m and visual estimate of sulphides ranges from 5 to 10%. Analytical results of basemetals pertaining to borehole MPH-1 indicate 0.20% cut-off grade of copper zone (6.65 m thick) with 1.14% Cu (average). Analytical results of some of the channel samples received so far also indicate anomalous values of copper and zinc.
Banswara	Dungaripara Nawa Khera area	-	106	-	-	411	A G-4 stage investigation for gold and associated mineralisation was carried out. A total of 27 cu m of pitting/ trenching has also been carried out. Surface evidences of mineralisation includes presence of gossan zones, old workings, malachite stains, epidotisation, feldspathisation and silicification. Five gossan zones have been identified and demarcated in mapped area: <ul style="list-style-type: none"> 1. Gossan at the contact of phyllite and grey dolomite marble near Undwala village, approximately 600 m long and 20 m wide. 2. Gossan / ferruginised-silicified zone in phyllite/ dolomitic marble intercalations near Doliapada village, which is about 500 m long and 25 m wide. 3. Gossan developed at the contact of amphibole marble and bluish grey phyllite, south of Padi-Khera village, which is approximately 250 m long and 25-30 m wide.

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Table – 2 (contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
							<p>4. Ferruginisation /gossanisation at the contact of grey banded marble and bluish grey phyllite near Sadri village which is approximately 200 m in length and 20 m in wide.</p> <p>5. Gossan in bluish grey banded phyllite near Padi-ka-Khera village approximately 150 m in length and 20 m in width. Mineralisation has been recorded near Kundli village in ferruginised quartz vein having specks of chalcopyrite and pyrite. A small zone of mineralisation (chalcopyrite along with malachite stain) and alteration in the form of epidotisation and feldspathisation has been observed in the banded quartz amphibole rock near Dharma village over a strike length of 10 m and width of 2 m.</p> <p>Anomalous values of REE varying from 829 to 1979 ppm have been recorded in 6 samples from granite exposed near Miyasa, Murasel and Goj areas. Analysis of pyrite-bearing grey quartzite to the west of Dolipada recorded Zn content of about 784 ppm. Analysis of two channel samples and five grab samples collected from a 500 m long and 25 m wide gossan zone exposed near Dolipada village recorded zinc and lead, whose concentration range from 210 ppm to 0.75% and 100 ppm to 0.19%, respectively.</p>
Pratapgarh	Mahuri Khera - block	-	-	4	517	-	<p>A G-3 stage investigation for gold and associated basemetal mineralisation was carried out. Exploration of gold-copper mineralisation by drilling in Mahuri Khera area was taken up based on encouraging gold and copper values in channel samples collected from the area during 2014-15. During 2015-16, four boreholes of cumulative length 516.80 m were drilled to test the depth continuity of 800 m long mineralised zone (MZ-1). Surface evidences of mineralisation are in the form of gossan, ferruginisation, silicification, wall-rock alteration, old workings and malachite/azurite staining. Indication of mineralisation is also seen in the form of intense silicification and hydrothermal alteration. Fresh sulphides in the form of pyrite and chalcopyrite are recorded in dolomitic marble and tourmaline bands. Based on these surface indications, seven mineralised zones have been identified. Four borehole (MKH-1 to 4) were planned at 100 m intervals to intersect the mineralisation zone MZ-1. Drilling in these boreholes proved subsurface continuity of the surface mineralisation zones.</p>

(Contd.)

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Table – 2 (Concl.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Uttar Pradesh							
Sonbhadra	Mahakoshal group	-	-	-	-	-	<p>The sulphide zones (1.10 m to 9 m) are recorded mainly in the altered dolomitic marble and massive dolomitic marble with sparsely spaced alteration veins. The main sulphide minerals are pyrite, pyrrhotite, chalcopyrite and arsenopyrite in decreasing order of abundance. The sulphide minerals are, in general, medium to fine grained and occurs as fine dissemination, veins, veinlets, stringers and smears. Analytical results of core samples received so far have revealed the presence of 4.25m thickness zone with 0.26 % average copper content.</p> <p>A G-4 stage investigation was carried out east of Bihwa area for assessment of gold and associated mineralisation. Generally, foliation-parallel quartz veins host sulphide mineralisation. The sulphide mineralisation observed in disseminated form in quartz veins and quartz-carbonate veins intruded phyllite. Sulphide mineralisation is also observed in BIF. Drill core samples of quartz veins contain pyrite, arsenopyrite at various levels in disseminated form. The BIF as banded magnetite chert contains pyrite and arsenopyrite at various levels. The analytical results of bed rock samples, received so far, show gold values ranging from <0.05 ppm to 0.23 ppm in quartz veins, BIF and quartzite. Analytical results of samples, of quartz vein exposed in a trench show Au value of 0.23 ppm. The sporadic high values of Cu (<i>i.e.</i> 173 ppm and 195 ppm); sporadic high values of Pb (1355 ppm and 982 ppm); Zn (207 ppm and 147 ppm) and As (3364 ppm, 2122 ppm and 1859 ppm from quartz vein, quartzite and BIF) are obtained.</p>
HGML Karnataka							
Raichur	Hutti	(UG) 1:400	1954 m	09(surface) 25(U/G) 19(by Co.)	1543 2700 490	13732	As on 31-03-2016, reserves/ resources of gold ore were estimated at 9.39 million tonnes with 5.34 g/t Au under proved and 0.59 million tonnes with 4.58 g/t Au under probable category.
-do-	Hira-Buddini	1:400	-	-	-	900	About 0.475 million tonnes of proved reserves of gold ore with 3.94 g/t Au were estimated.
-do-	Uti	-	-	-	-	1403	Total mineable reserves are estimated at 2.17 million tonnes ore with 2.59 g/t Au.
MECL							
Jharkhand Ranchi	Parsi West block	1:1000	0.5	10	1564	1242	As on 31.03.2015, reserves/resources of gold ore were estimated at 0.365 million tonnes with 1.644% g/t Au at 0.50 g/t Au cut-off and 0.181 million tonnes with 2.644 g/t Au at 1.0 g/t Au cut-off. The total insitu gold metal content is 608.446 kg under UNFC code 331 & 332.

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Table – 3: Producers of Gold, 2015-16

Name and address of the producer	Location of the mine	
	State	District
The Hutti Gold Mines Co. Ltd, Hutti, Dist. Raichur 584 115 Bengaluru- 560 047, Karnataka.	Karnataka	Raichur
Manmohan Industries (P) Ltd, Shantiniketan, 286, New Patliputra Colony, Patna, Bihar.	Jharkhand	Singhbhum (East)

**Table – 4: Production of Gold Ore
2014-15 and 2015-16
(By States)**

(In tonnes)

State	2014-15		2015-16 (P)	
	Ore Produced	Avg. Grade (g/t)	Ore Produced	Avg. Grade (g/t)
India	447278	4.22	534907	3.05
Jharkhand	3999	3.15	4153	3.55
Karnataka	443279	4.22	530754	3.05

**Table – 5: Gold Ore Treated
2014-15 and 2015-16
(By States)**

(In tonnes)

State	2014-15		2015-16 (P)	
	Ore treated	Avg. Grade (g/t)	Ore treated	Avg. Grade (g/t)
India	544718	2.89	552390	2.67
Jharkhand	3999	3.15	4153	3.55
Karnataka	540719	2.89	548237	2.67

**Table – 6: Production of Gold, 2013-14 to 2015-16
(By States)**

(Quantity in kg; Value in ₹'000)

State	2013-14		2014-15		2015-16 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	1564	4225317	1441	3602722	1323	3214623
Primary						
Gold	1564	4225317	1441	3602722	1323	3214623
Jharkhand	8	22728	11	30615	13	35871
Karnataka	1556	4202589	1430	3572107	1310	3178752

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**Table – 7: Production of Gold, 2014-15 and 2015-16
(By Sectors/States/Districts)**

(Quantity in kg; Value in ₹'000)

State/District	No. of mines	2014-15		No. of mines	2015-16 (P)	
		Quantity	Value		Quantity	Value
India	5	1441	3602722	5	1323	3214623
Public Sector	3	1430	3572107	3	1310	3178752
Private Sector	2	11	30615	2	13	35871
Primary Gold	5	1441	3602722	5	1323	3214623
Andhra Pradesh	1*	-	-	1*	-	-
Kurnool	1	-	-	1*	-	-
Jharkhand	1	11	30615	1	13	35871
Singhbhum East	1	11	30615	1	13	35871
Karnataka	3	1430	3572107	3	1310	3178752
Raichur	3	1430	3572107	3	1310	3178752

* Only Labour reported.

Gold Bullion

Production of gold bullion in India is reported both in primary and secondary forms and includes gold recovered from imported copper concentrates. The total production of gold bullion during 2015-16 which was at about 10,412 kg increased by about 4 % as compared to 9,988 kg in the previous year (Table - 8).

**Table – 8 : Production of Gold Bullion
2013-14 to 2015-16**

(Quantity in kg; Value in ₹'000)

Year	Quantity	Value
2013-14	9209	24833062
2014-15	9988	25320142
2015-16 (P)	10412	25359408

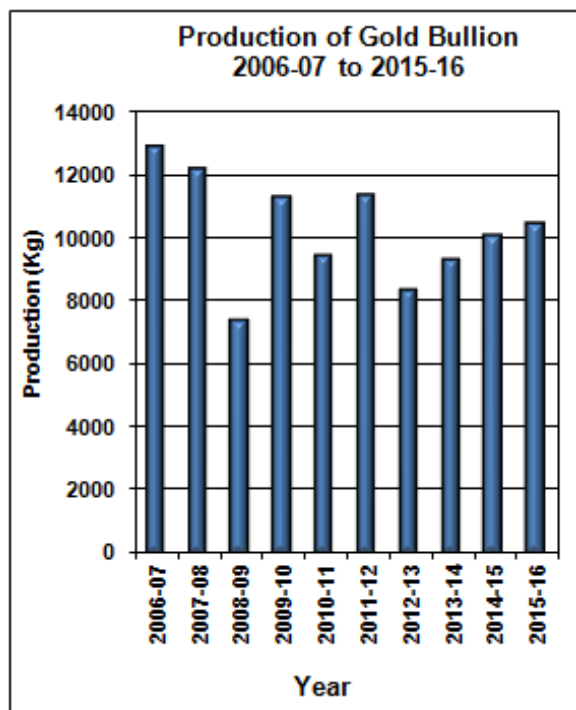
Note: Includes gold recovered as by-product from copper concentrates by Hindalco Industries Ltd in Gujarat.

MINING & MILLING

Presently, HGML is the only Public Sector Company producing gold in the country. While in the Private Sector Manmohan Mineral Industries Pvt. Ltd is engaged in mine production of gold at Kunderkocha, in Singhbhum East district,

Jharkhand by underground method of mining. HGML operates mines at Hutti, Uti and Hira-Buddini in Raichur district, Karnataka. The total installed capacity of Hutti mine is 7 lakh tpy gold ore. Implementation of mechanisation of mining operations at Hutti mine was in progress. The production of ore at the mine was 5,24,617 tonnes during 2015-16. Sub-level and LDBH stoping methods are used to exploit the gold ore. In the Uti mine, mining was carried out by opencast method till the year 2006 and thereafter by underground method. The ore from this mine is transported to Hutti mine by road for processing at the mills. The present mine production as reported in 2015-16 was 23,562 tonnes of ore. Underground exploratory mining too is in progress. Several operations at Hira-Buddini old unit, such as, exploratory mine development and deepening and re-equipping of main shaft are in progress. The production of the mine was 68 tonnes during 2015-16. Exploratory mine development using compressed air jackhammer drilling and electrical hoist in the shaft is presently underway. Based on the developmental work and feasibility, the locomotive loaders, wagon drills and other required machinery will be used to increase the ROM.

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The new ore processing plant based on modern technology (SAG and Ball Mill) with a capacity of 2000 TPD has been operational at Hutti underground gold mine since 2010. At the Hutti Mineral Treatment Plant, the r.o.m. of -8" size is crushed. The final product from crushing plant, i.e. -10 mm size is stored in a 1,500 tonnes capacity fine ore bin for subsequent treatment, i.e., grinding. The Milling/Grinding process of gold ore employs two distinct grinding techniques. The first technique involve grinding that is in two stages, i.e., primary grinding followed by secondary grinding for adequate comminution. The processes involve one primary mill and three tube mills which constitute one stream of grinding in which pebbles and smaller size balls are used as composite grinding media.

There are two such streams and strake tables are used to collect coarse gold as concentrate for this circuit. In the second technique, grinding is done by four ball mills of different sizes and each of them is an independent circuit in which large size balls are used as grinding media. In these circuits, Knelson concentrator is used to collect coarse gold as concentrate. In all the milling techniques, cyclones are in closed circuit with the mills so as to get the required sizes (80% passing 75 micron) for the subsequent treatment process.

The concentrate collected from both the techniques is upgraded on James Table. The upgraded concentrates are roasted, magneted and finally smelted into bullion buttons.

All the cyclone overflow, i.e., finely ground ore in the form of slurry from the two streams of first technique and 4 streams of second technique join together in a distributor box from which finely ground ore slurry is fed to High Rate Thickener for thickening purpose. The thickened pulp (60% solid w/w) thus obtained from thickeners is subjected to cyanidation process in which cyanide accessible gold in slurry makes complexes with cyanide in presence of oxygen and dissolves in solution at high pH. To increase the oxygen potential of slurry, H_2O_2 is added in addition to compressed air. The cyanidation or leaching process is carried out in a series of mechanically agitated agitators of different sizes.

The cyanide leached pulp is then fed to two Carbon-in Pulp (CIP) plants. The CIP plants are of 1,000 tpd size each and are parallel in circuit. The objective of CIP plant is to absorb the dissolved gold in activated carbon from the solution.

The gold-loaded carbon is removed from the CIP plant periodically, subjected to acid and alkaline wash and then eluted in four elution columns with 1.0% NaOH and 0.1% NaCN solution at 95 °C for a period of 60 hours. The solution is then passed through four electrowinning cells in which gold is deposited on steel wool cathodes. The gold loaded steel wool cathodes are manually removed periodically, subjected to acid digestion, drying and smelting to obtain bullion buttons. The bullion buttons thus obtained from table concentrate and steel wool are cast into bullion bars weighing 4 to 11 kg and then despatched for sales.

In the past, gold was produced by the Central Government undertaking, namely, BGML. BGML earlier mined and processed the ore from Chigargunta reef in Chittoor district, Andhra Pradesh, Mysore Mines of Kolar Gold Fields in Karnataka and Yeppamana mine in Anantapur

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district, Andhra Pradesh. All activities of BGML were stopped and BGML was closed w.e.f. 1.3.2001 under Section 25 (O) of the Industrial Disputes Act, 1947 in terms of Ministry of Labour, Government of India's order dated 29.1.2001. To augment gold production in the country, as per XI Plan document, Chigargunta and Bisanthan mines deserve active consideration for opening and commencement of operations.

Gold is sometimes recovered from the pregnant (Simple gold bearing solution) solutions by adding zinc to form soluble zinc cyanide and precipitate of gold & silver. The pregnant solution can also be passed through activated carbon which absorbs dissolved gold. Gold from either process is cast into bars, bullion and dore (when it contains silver), which must be further refined to remove impurities, such as mercury, arsenic and copper. Some ores cannot be treated by cyanide processing as gold in them is in small inclusions or even by solid solutions in minerals, such as pyrite. This gold is generally recovered by roasting which converts pyrite into porous iron oxides containing small grains of gold that can be dissolved by cyanide.

DEVELOPMENT

HGML is the 40th member of the World Gold Council and the first one from India.

The Deccan Gold Mines Ltd (DGML), India's first and largest listed gold exploration company, collected rock and stream sediment samples and analysed them. DGML has plans for geophysical studies and drilling prospects at areas located in proximity to existing old mines and also at earlier explored areas in Hutti belt, Manglur belt, Dharwar-Shimoga belt in Karnataka; Attapadi Project in Kerala; and Ramgiri belt in Andhra Pradesh. The main prospects for gold at Ganajur and Karajgi have progressed into advanced stages of exploration and existence of high grade gold bearing zones in the prospect have been established. Exploration is being conducted in Hutti belt at various prospects, viz, in Hutti Mine north prospect, Hirenagnur prospect, southern and northern continuity of Uti mine lodes, Uti

Temple prospect, Chincherggi prospect, Buttapur prospect and Yalkal prospect. In south Hutti RP block, the investigations are going on in Tuppadhur-Buddini prospect, Maski prospect, Ashoka prospect and Sanbal prospect.

DGML in Joint Venture with JB Group examined the available data to select the area for reconnaissance studies. The detailed geological mapping and systematic channel sampling have revealed the 5 sub-parallel zone of gold mineralisation in Hesdaba prospects and Asaleyta prospects in Dgibouti.

Birla Copper Complex of Hindalco Industries Ltd situated at Dahej, district Bharuch, Gujarat has an installed capacity of 15 tpy for gold recovery from imported copper concentrates.

HCL which recovers by-product secondary gold from indigenous copper ores at its ICC plant in Jharkhand has an installed capacity of 698 kg per annum gold recovery plant. This plant, however, did not report production since 2007-08.

NMDC has secured a gold mining lease in Bulyangombe area in Tanzania.

A study on Techno-economic Feasibility of Ajjanahalli Gold Mine of M/s. Hutti Gold Mines Ltd, Hutti, district Raichur, Karnataka was carried out by Mining Research Cell, TMP Division of IBM. The project has been completed and the report was submitted to the party. The details have been discussed in the chapter on 'Research & Development' provided in Vol. I of this title.

POLICY

Foreign Direct Investment (FDI) up to 100% in Mining Sector in respect of gold is eligible for automatic approval.

Gold being a specified mineral, Mineral Concessions, viz, reconnaissance permits (RP), prospecting licences (PL) and mining leases (ML) for gold are granted by the State Governments after prior approval of the Central Government.

In the revised Export-Import Policy, comprised in the Foreign Trade Policy (FTP), 2015-20, gold ores and concentrates are under freely importable

category. Under Heading No.7108, the import of non-monetary gold metal also falls under Free category subject to RBI regulations, while import of gold metal in monetary form is restricted.

ENVIRONMENTAL CONCERNS

Gold is recovered from ores by two main methods, both of which affect environment. Earlier, for recovery of gold, amalgamation processes were used in which ore was mixed with mercury that selectively dissolved gold which was then recovered by evaporation. Mercury from these operations was never recovered and remained as pollutant in many old mining areas. The cyanide process is based on the property of precious metals in forming soluble complex ions with cyanide anion. Cyanide does not dissolve quartz, iron oxides and other common gangue minerals and yields a relatively simple gold-bearing solution known as pregnant solution. In some gold mines, gold is dissolved from the ore by crushing and grinding followed by mixing with cyanide solution in large vats.

Cyanide is a highly toxic compound and requires special handling. During ore treatment, pH of cyanide solution must be kept at about 11 to prevent cyanide from reacting with hydrogen ion to produce HCN, a deadly gas. Although less toxic substitutes of cyanide are known, it is not yet clear whether such substances will be cost-effective or environment-friendly.

DEMAND & CONSUMPTION

Jewellery accounted for major consumption of gold, i.e., 85%, followed by electronics 6%, medal and coins 2% and other sectors 7%. The Industrial demand especially in the Electrical Sector for gold is mainly on account of its excellent thermal and electrical properties. Besides, a significant amount is consumed in dentistry and medicine. Continuing research has discovered new applications for gold as catalyst and in nano-technology. No proper estimation of gold demand in the country could be attempted due to lack of proper consumption data of the end-use industry. However, from overall evaluation it is seen that India has a traditional and stable market for gold consumption. There is increase in demand from Ornamental and Electronic Sectors. Gold is considered a valuable asset, for investments and bank reserves. A huge gap exists between demand and indigenous production which is likely to continue.

SUBSTITUTES

Platinum and palladium substitute gold to some extent, but their use is influenced by price relationship and by an established consumer preference for gold. Silver can be a substitute, but it offers less resistance to corrosion. Gold-plated palladium and bright tin-nickel can be used in electronics. Titanium and chromium-based alloys can be used in dental work. High prices encourage substitutes, particularly base metal clad with gold in Electronic & Electrical Industry and in jewellery products. No metal or alloy substitute has all the properties of gold, and therefore, the emphasis is only on reduction of gold content rather than substitution.

WORLD REVIEW

The estimated world reserves of gold were about 57,000 tonnes of metal. The gold reserves are mainly located in Australia, Russia, South Africa, Indonesia, USA, Peru and Brazil. The world reserves of gold are provided in Table-9.

The world mine production of gold was estimated at 3,110 tonnes in 2015. China contributed about 14% to the world's total mine production of gold followed by Australia (9.1%), Russia (8%), USA (7.1%) and South Africa & Peru (5.1% each) (Table-10).

**Table – 9: World Reserves of Gold
(By Principal Countries)**

(In tonnes of gold content)

Country	Reserves
World: Total (rounded)	57,000
Australia	9500
Brazil	2400
Canada	2400
China	2000
Ghana	990
Indonesia	3000
Mexico	1400
Papua New Guinea	1500
Peru	2400
Russia	8000
South Africa	6000
Uzbekistan	1700
USA	3000
Other countries	13000

Source: Mineral Commodity Summaries, 2017.

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**Table – 10: World Mine Production of Gold
(By Principal Countries)**

(In tonnes of metal content)			
Country	2013	2014	2015
World: Total	3014	3066	3110
Argentina	52	72	71
Australia	268	274	278
Brazil	80	81	80 ^e
Canada	134	152	159
Chile	51	46	43
China [@]	428	452	450
Colombia	56	57	59
Ghana	190	139	113
Indonesia	60	69	92
Kazakhstan	43	50	64
Mali ^e	46	45	47
Mexico	120	118	125
Papua New Guinea	56	58	60
Peru	151	140	145
Russia	230	249	256
South Africa	160	152	145
Sudan	70	73	82
Tanzania	43	41	46
USA	228	210	212
Uzbekistan ^e	90	102	102
Other countries	458	485	483

*Source: World Mineral Production, 2011-2015.
@- Metal production,*

According to Gold Fields Mineral Services Ltd (GFMS), annual review of world gold supply and demand, the total global supply of gold in 2015 was 4,306 tonnes, a slight decrease compared with 4,310 tonnes in 2014. It included an estimated 27 tonnes in global primary production and 128 tonnes of net increase in producers stock. Gold recovery from old scrap increased for the first time in 5 consecutive years by 15 tonnes to 1,173 tonnes.

The 12 leading gold-producing countries, in decreasing order of production were China, Australia, Russia, USA, Canada, Peru, South Africa, Mexico, Uzbekistan, Indonesia, Ghana and Sudan. These countries together accounted for 70% of global production. The next 12 leading gold-producing countries accounted for almost 20% of global gold production.

Prices

The gold prices have increased from US \$ 1276.5 per ounce to US \$ 1277.40 per ounce during 2016.

Argentina

In 2015, gold production was estimated at 64,000 kg, 7% more than that in 2014. Much of the increase was due to the first full year of production from Goldcorp's Cerro Negro Mine, which produced 15,800 kg of gold during the year. In 2015, Barrick's Veladero Mine produced 18,700 kg of gold, a 17% decrease compared to the production in 2014 owing to lower ore grade.

Australia

In 2015, gold production in Australia was 277,800 kg, 3,837 kg more than the previous year. Much of the increase was from the two leading gold production mines Newmont and Tanami mines, both of which increased their throughputs of higher grade ore. Together these mines produced about 5,880 kg more gold in 2015 than in 2014. Production increases also were associated with recently restarted or newly commissioned mines, which included Kathleen Valley (Ramelius Resources Ltd) and Old Pirate (ABM Resources NL), which together contributed about 3,000 kg of gold in 2015.

Canada

Canada's gold mine output increased slightly in 2015 to 152,747 kg. Production increased primarily owing to the startup of the Goldcorp's Eleonore Mine, which produced 8,340 kg of gold in 2015. Production increases were reported by a number of other mines. The Detour Lake Mine produced 15,700 kg of gold in 2015, 11% more than that in 2014. Agnico Eagle Mines Ltd's La Ronde and Goldex Mines produced 8,330 kg (up by 31%) and 3,590 kg of gold (up by 15%), respectively.

Chile

In 2015, gold production was 42,501 kg, an 8% decrease compared with the production in 2014 primarily owing to production decreases at the country's leading gold mines Centinela (70%) and Marubeni Corp. (30%). In 2015, gold production at the Centinela copper-silver-gold mine decreased by 20% from that of 2014 to 5,050 kg owing to a decrease in the average gold mill-head grade and lower throughput.

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China

In 2015, production was estimated to have been constant at 450,000 kg compared with 2014 figures. Although gold production from gold mines decreased slightly, production from non-ferrous metal mining increased by 7%. According to the China Gold Association, China's gold consumption (which includes bullion consumption) in 2015 was 985,000 kg, a 4% increase compared with 2014 consumption.

FOREIGN TRADE

Exports

The exports of gold (non-monetary & monetary)

increased to 1,35,275 kg in 2015-16 from 70,796 kg in 2014-15. The exports in 2015-16 were almost to UAE (99%) and to Switzerland (1%) (Tables- 11 to 15).

Imports

Imports of monetary and non-monetary gold increased to 9,68,075 kg in 2015-16 from 9,15,473 kg in 2014-15. The share of Non-monetary: Other Unwrought forms, was 9,59,841 kg. Imports of gold were mainly from Switzerland (48%), UAE & USA (9% each), Ghana (8%), South Africa (5%) and Dominican Rep. (4%) in terms of volume (Tables-16 to 20).

**Table – 11: Exports of Gold (Non-monetary & Monetary) Total
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	70796	174423808	135275	325665937
UAE	69981	172515079	134271	323336851
Switzerland	800	1882087	1000	2323815
Hong Kong	5	1776	2	5178
Guinea	-	-	1	50
Singapore	-	-	1	43
Australia	5	12828	-	-
Other countries	5	12038	-	-

**Table – 12: Exports of Gold, Non-monetary : Other Unwrought Forms
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	70790	174421703	135272	325660716
UAE	69980	172514750	134271	323336851
Switzerland	800	1882087	1000	2323815
Guinea	-	-	1	50
Australia	5	12828	-	-
Ghana	5	12038	-	-

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**Table – 13: Exports of Gold Non-monetary
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	70796	174423808	135275	325665937
UAE	69981	172515079	134271	323336851
Switzerland	800	1882087	1000	2323815
Hong Kong	5	1776	2	5178
Guinea	-	-	1	50
Singapore	-	-	1	43
Australia	5	12828	-	-
Other countries	5	12038	-	-

**Table – 14: Exports of Gold-clad Metals/Base Metals, NES
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	2	-	-
Germany	++	2	-	-

**Table – 15: Exports of Gold, Non-monetary , Other Semi manufactured Forms
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	6	2105	3	5221
Hong Kong	5	1776	2	5178
Singapore	-	-	1	43
UAE	1	329	-	-

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**Table – 16: Imports of Gold (Non-monetary & Monetary): Total
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	915473	2106580447	968075	2074874964
Switzerland	499811	1221503115	467231	1111591264
UAE	103840	254900282	90027	216926702
Ghana	28241	64388217	82092	181150973
USA	81984	165484297	85896	148274564
South Africa	43241	104705618	43554	103264490
Australia	40079	98290226	20359	48498055
Tanzania	17509	36100293	16939	31239214
Peru	8877	12953017	19043	30755563
Colombia	8521	17999946	15787	28865072
Dominican, Rep	28580	16698178	42631	24894845
Other countries	54790	113557258	84516	149414222

**Table – 17: Imports of Gold, Non-monetary: Other Semi-manufactured Forms
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	12097	24134381	8201	19175265
UAE	566	1396874	5665	13576495
Ghana	1668	3865587	839	1760473
Switzerland	200	484213	700	1610851
USA	2453	5095869	448	992275
Hong Kong	63	161097	218	537466
Peru	1676	2022623	132	246628
Italy	62	153290	96	241326
Spain	141	308226	50	112249
UK	15	36290	12	29124
Singapore	27	64562	14	25985
Other countries	5226	10545750	27	42393

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**Table – 18: Imports of Gold, Non-monetary: Other Unwrought Forms
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	903374	2082446048	959841	2055623069
Switzerland	499611	1221018902	466531	1109980413
UAE	103274	253503408	84362	203350208
Ghana	26573	60522630	81253	179390500
USA	79530	160388420	85435	147251873
South Africa	43241	104705618	43554	103264490
Australia	40079	98290226	20358	48497234
Tanzania	15300	31359397	16939	31239214
Peru	7201	10930394	18911	30508935
Colombia	8253	17428471	15787	28865072
Dominican Rep.	28580	16698178	42631	24894845
Other countries	51732	107600404	84080	148380285

**Table – 19: Imports of Gold, Non-monetary , Powder
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	2	18	33	76630
USA	1	7	13	30417
Hong Kong	-	-	10	23404
Spain	-	-	10	22809
UK	1	11	-	-

**Table – 20: Imports of Gold-Clad Metal / Base Metals, NES
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	3959	++	4965
USA	++	3713	++	4705
Germany	-	-	++	183
Canada	-	-	++	77
Japan	++	246	-	-

GOLD

FUTURE OUTLOOK

Historically, investors have purchased gold as a safe haven, hedge against economic failures, portfolio diversifier and store of wealth. In 2016, anticipated global consumption of gold is expected to increase, because consumption in jewellery and other industries is expected to increase alongside the increasing gold price. Domestic gold production is expected to increase, and worldwide gold production is expected to remain unchanged in 2016 owing to the startup of new mines, the ramp up of recently developed mines and the selective mining at some mines to increase ore grades and reduce operating costs, being offset by the shutdown of high cost operation.

India is a traditional and stable market for gold consumption. The present and future production of gold will not be sufficient to meet the ever increasing demand. Therefore, efforts will be required to reduce the gap between production and demand. The projected import at the growth

rate of 11% during 2012-17 are 9,305 tonnes at an average of 1,861 tonnes per year, as per the report of the Working Group for 12th Five Year Plan (of the erstwhile Planning Commission of India). During the 12th plan period, gold production is projected at 28 tonnes from mines and 16 tonnes as by-product, totalling 44 tonnes by 2015-16, this after factoring in the expansion of existing producers and the proposed new mines that were in the pipe-line under the Private Sector, viz., MSPL, Geomysore, Deccan Gold, etc.

As per the World Gold Council's report, 2017 "GST's impact on India's gold market ", GST represents a radical step forward for India's economy. While it could present short-term challenges to the Gold Industry. It will boost the economy and make the Gold Industry more transparent to the benefit of gold buyers. This should support India's gold demand, which is expected to be between 650-750 tonnes in 2017-18, and touching to 850-950 tonnes by 2020.