ECONOMIC GEOLOGY

e – Learning Material: Unit-3

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Metallic Mineral Deposits

Precious Metals - GOLD

Gold was the earliest metal mined by the mankind

The references of gold mining are seen in holy scriptures like the Rid Veda, the Puranas, the shastras, the Hebrew, creek and Roman literatures, etc.

INDIA

- **Between 1967 and 1998 about 19 tons of gold has been mined from the KGF, 2 tons from Ramagiri & about 20 tons from Hutti Gold Mines – a total of about 41 tons**

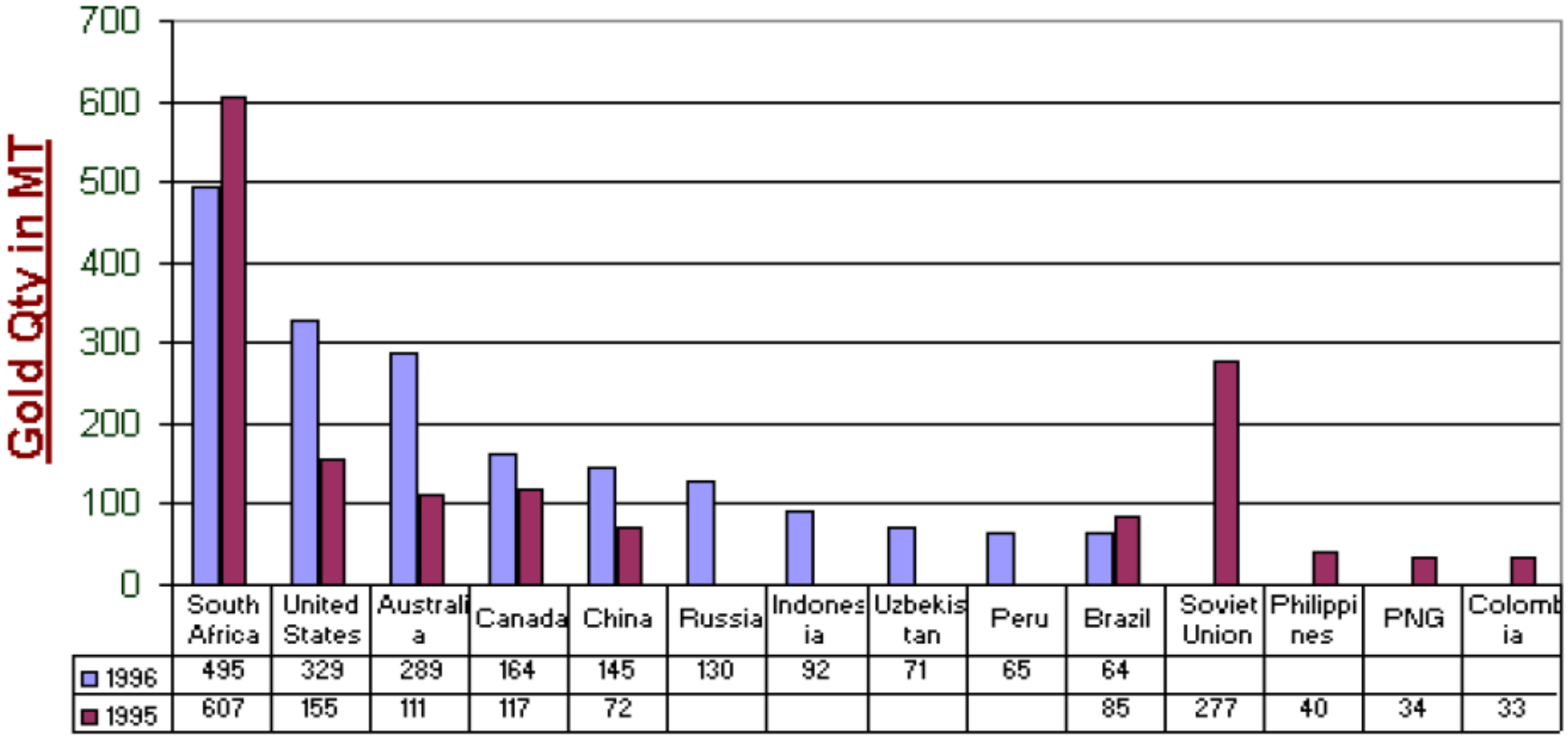
- **India's current production is only3 tons/annum from its only producing mine at Hutti and about 6 tons as a by product of copper mining**

- **The South Africa is the leading producer with 40 % of total world production, Russia – 17%, USA 7%, Canada 6.6 %, Australia 5%, India – 0.1 %**

Gold potential of the Indian terrain

- **There were over a hundred gold mining centres in the early part of the last century & these were mostly operated by the Britishers. The mines were located in parts of Kolar, Hutti, Gadag, Chitradurga & Shimoga in Karnataka; Wynad & Nilambur in Kerala; Kotagiri & Dharmapuri in Tamil Nadu, Ramagiri & Jonnagiri in AP State; Kunderkocha, Lawa, Mayisara & Sonapet in Jharkand; Sonadehi in Chhattisgarh; Parsori & Pular in Maharashtra. Gold panning by local people is a prominent activity in many parts of India.**
- **From a total of 127,242 tons of gold metal produced in the world, 76,500 tons came from precambrian terrains (Archaen & proterzoic). A major portion of India, barring the Indogangetic alluvial tract & Deccan lavas, is composed of precambrian rocks – yet our contribution to the precambrian gold resource is a meagre 1.17% (900 tons of which has come from a single precambrian belt ie Kolar)**
- **Gold-bearing potentiality of a geological terrain can be expressed in terms of kilograms of gold per sqkm area comprising gold metal already produced + gold reserve in the ground identified by exploration & available for mining in the future. For Western Australia this index works out 50kg/sqkm, for Canada 55kg/sqkm and for S. Africa it is 80kg/sqkm. In comparison the index for India is a mere 1.6kg/sqkm (excluding Kolar) inspite of the fact that India has been known for wide spread gold mining in the past. Surely there is much scope for finding new mineable gold resources in the country.**

Top 10 Gold Producing Countries : 1995 & 1996



	South Africa	United States	Australia	Canada	China	Russia	Indonesia	Uzbekistan	Peru	Brazil	Soviet Union	Philippines	PNG	Colombia
1996	495	329	289	164	145	130	92	71	65	64				
1995	607	155	111	117	72					85	277	40	34	33

Mineralogy of Gold

Chemical Formula	Au
Composition	Gold, with small amounts of silver; sometimes also copper and iron
Variable Formula	(Au,Ag) ; (Au,Ag,Cu,Fe)
Color	Golden yellow to brass yellow
Streak	Golden yellow
Hardness	2½ - 3
Crystal Forms and Aggregates	(Isometric) Dendrites, wires, nuggets, encrustations, and small flakes are the common forms. Octahedral, dodecahedral, and cubic crystals also occur, but they are uncommon and are often distorted. Crystals usually have some level of hopper growth.
Transparency	Opaque
Specific Gravity	15.5 - 19.3
Luster	Metallic
Cleavage	None
Fracture	Hackly
Tenacity	Ductile and malleable
Other ID Marks	Excellent conductor of electricity

Distinguishing Similar Minerals	Pyrite **and** Marcasite **(also known as "Fools" Gold - different streak (black), less dense (4.8 - 5.2), harder (6 - 6½)** Chalcopyrite **- different streak (black), less dense (4.1 - 4.3), harder (3½ - 4)**
Commonly Occurs With	Quartz**,** Pyrite**,** Arsenopyrite**,** Silver**, Limonite**
Complex Tests	**Soluble only in aqua regia and fuming HCL** **(Aqua regia** - (HCl),(HNO3) Mixture of hydrochloric and nitric acids. It is an extremely destructive mixture and can dissolve gold and platinum, as well as many other minerals

Note:
Aggregate **composed of skeletal or tree-like formations (**Dendrites**)**
Aggregate **composed of long, slender, curvy, interwoven** wires**.**
Nugget - Compact, waterworn, amorphous **mass, found in** placer deposits**.**
Encrustations**: A disorganized, crusty, mineral coating that can be thin or thick.**

The Breckenridge District of Colorado is well known for fine wire crystal gold specimens. The area was very rich in the early days and many fine specimens like this one were melted down for their bullion.

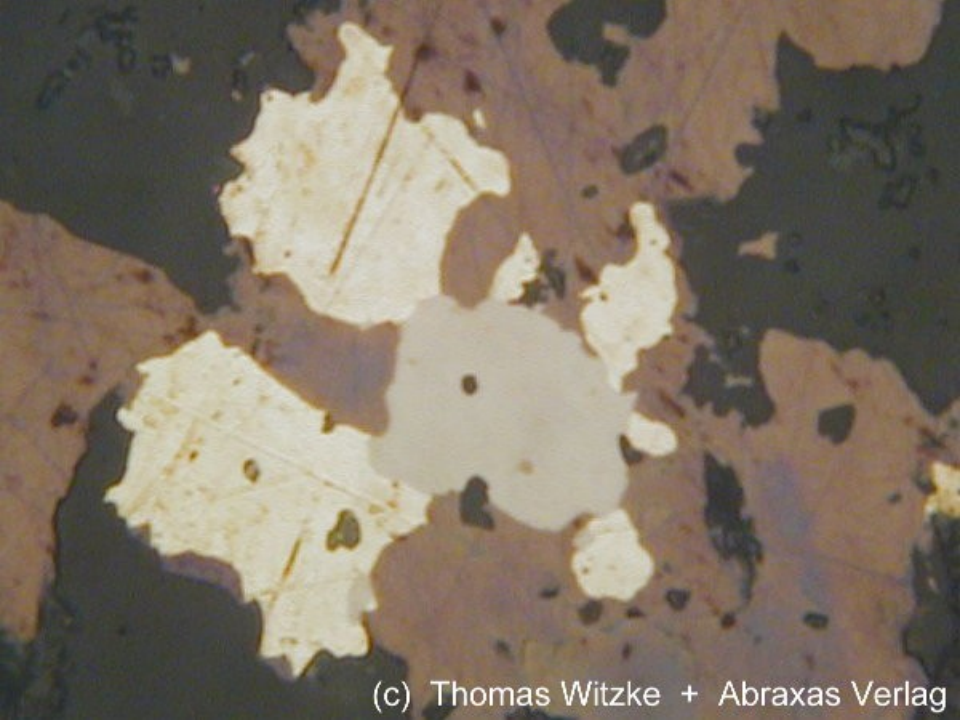
Gold

Comments: Well crystallized bright metallic gold specimen.

Location: Red Ledge mine, Nevada Co., California. **Scale:** 3.5 x 6 cm in size.

Gold, Silver

Mineral:	Gold: Au Silver: Ag
Comments:	Very well crystallized Electrum (Silver rich gold) on quartz. The analysis gave 31.47% silver.
Location:	Verespatak (now Rosia Montana), Transylvania, Romania.
Scale:	2.8 x 3.4 cm.



Mineral: Arsenopalladinite: **Pd8(As,Sb)3**
Isomertieite: **Pd11Sb2As2**
Gold: **Au**
Bornite: **Cu5FeS4**

Comments: **Light grayish grain of intimately intergrown isomertieite and arsenopalladinite (in the center of the picture), with pale yellow gold and brownish to violet bornite. Polished section (from microprobe analysis) in reflected light.**

Location: **Noril'sk, Putoran Mts, Taymyrskiy Autonomous Okrug, Eastern-Siberian Region, Russia.**

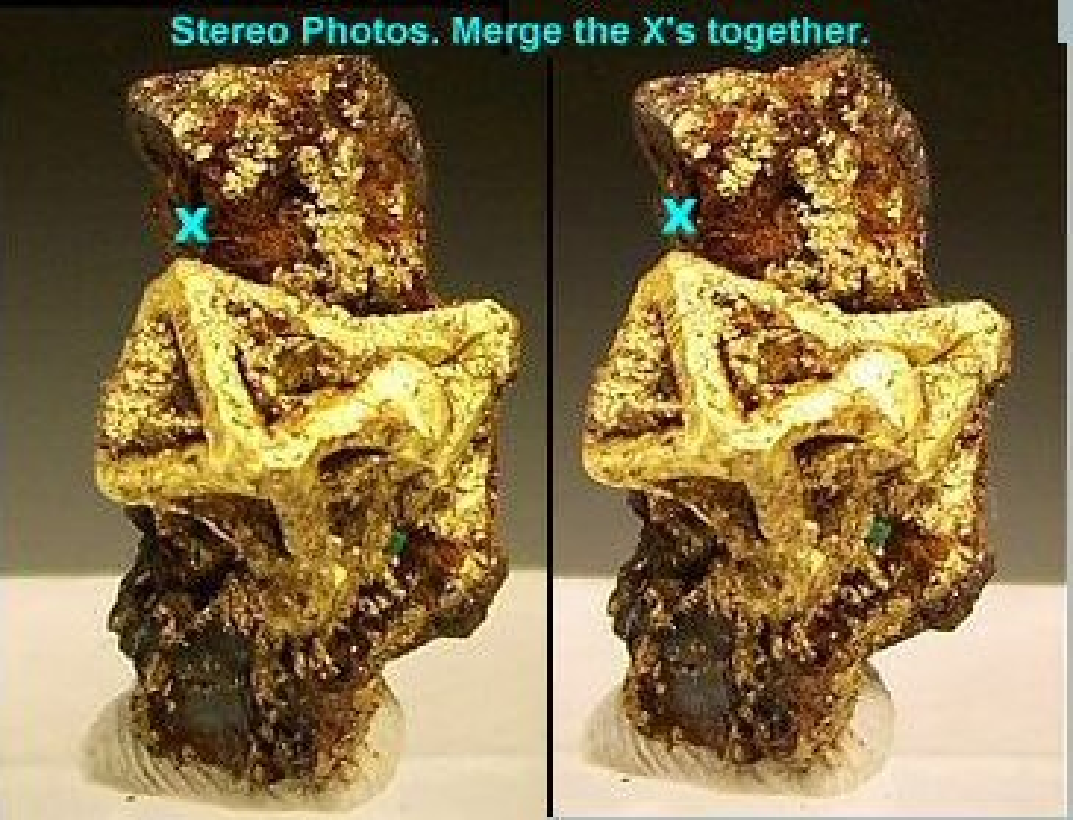
Scale: **Picture size 0.1 mm.**

Mineral: Gold: Au

Petzite: Ag3AuTe2

Comments: Dark, stubby petzite crystals with native gold on quartz.

Location: Rosia Montana (Verespatak), Transylvania, Romania.

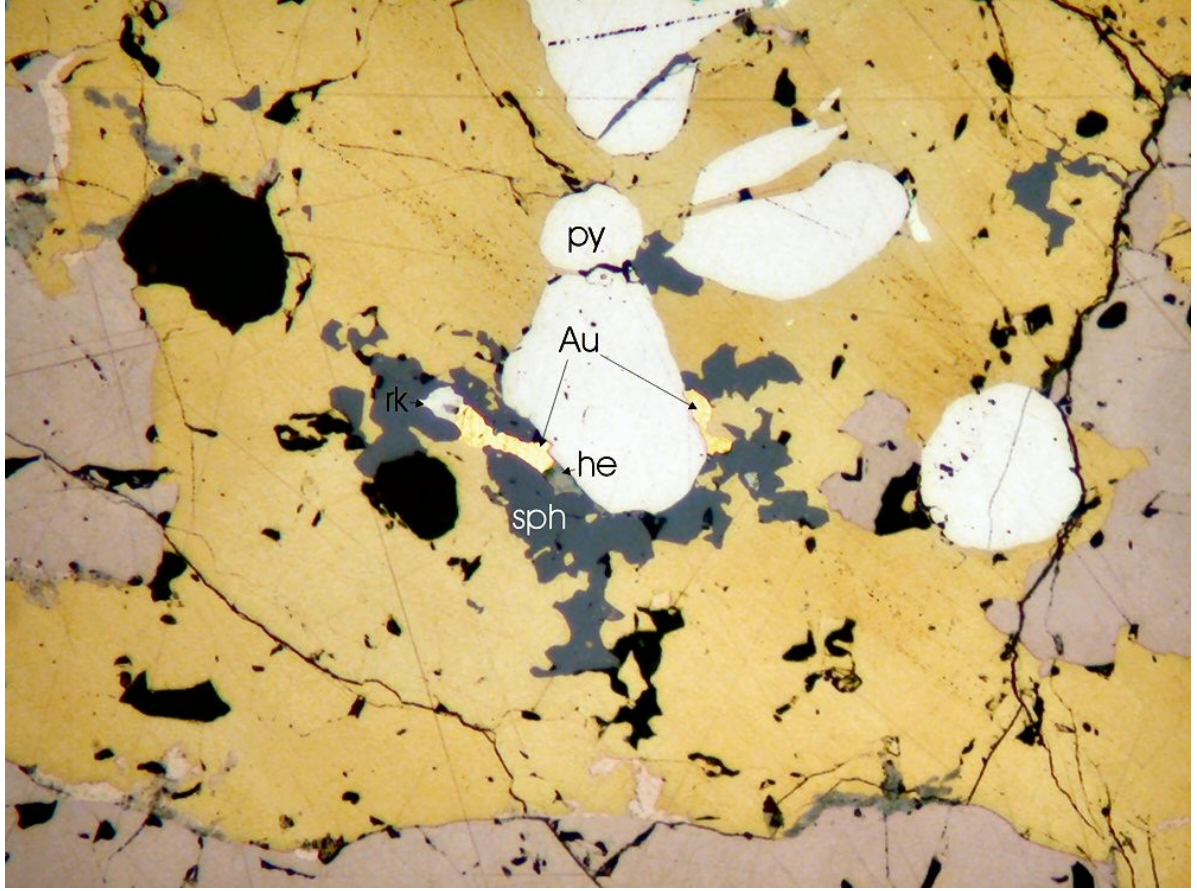


Mineral: Gold: Au

Comments: Two skeletal octahedral crystals of gold. Stereo pair images..

Location: Berezovsk Mine, Russia.

Scale: Crystal size 1.1 cm.



Mineral: Gold: **Au**
Rucklidgeite: **(Bi,Pb)3Te4**

Comments: **Polished section (PPL) image of sphalerite(sph)-chalcopyrite ore associated with hessite (he), rucklidgeite (rk), pyrite (py) and native gold (Au).**

Location: **Level 1070 m., Massive sulphide deposits of the Hanson-Flin Flon-Snow Lake, Manitoba, Saskatchewan, Canada.**

Scale: **Picture Size 0,12 mm.**

GOLD is neither the rarest nor the most valuable metal, yet it is part of the foundation of trade and commerce, and has many uses because of its metallic properties. Ancients who found native gold prized it, and gold, beautiful and easily worked, is still widely used in jewelry. A soft metal (H. 2.5), it is sometimes alloyed with copper to harden it and make it go further. Pure gold is 24 carats; hence 14 carat gold is 14/24 or about 60 per cent gold. Gold is found in quartz veins, sometimes with pyrite. The gold may occur within the pyrite itself—giving fool's gold a real value. Gold may occur in metamorphic rock and occasionally in sediments where it has been redeposited. Only rarely is visible gold found in gold ore. It usually cannot be seen at all. Some of the commercial ores contain only 0.1 ounce of gold for each ton of rock.

GOLD NUGGET— Cal.

Gold in quartz with pyrite—Cal.

Xipe, God of Spring—
ancient gold work from Mexico

Mining gold with sluice and pan.

As gold deposits are eroded, the heavy gold (Sp. Gr. 19.3) is concentrated in stream beds where grains, flakes, and even nuggets may be found by washing away the lighter sand in a gold pan or a sluice. From these placer deposits miners have gone on to search for the original veins or "lodes." Here the gold may be found as flecks in the quartz and, rarely, as octahedral crystals. Gold is malleable; color pale to golden yellow; metallic luster. It occurs as a compound with tellurium in such minerals as sylvanite $(Au,Ag)Te_2$ and calaverite, $AuTe_2$. Gold may also be recovered from other metallic ores.

GOLD CRYSTAL 0.1 in.

GOLD ORE—Lead, S. Dak.

Gold, 48 mm, El Dorado, California, U.S.A.

Gold, 68 mm, Eagle's Nest Mine, California, U.S.A.

Gold
Au

CUBIC ● ●

Properties: C – gold-yellow; S – yellow; L – metallic; D – opaque; DE – 19.3; H – 2.5-3; CL – none; F – hackly; M – octahedral and cubic crystals, skeletal and dendritic aggregates, leaves, nuggets.
Origin and occurrence: Primary hydrothermal in ore veins, also in contact metamorphic deposits and pegmatites. Placer deposits are secondary. It occurs with pyrite, arsenopyrite, quartz, sylvanite, calaverite, krennerite and other minerals. Beautiful leaves and crystals of gold found in many localities in California, USA (Colorado Quartz mine, Nigger Hill and others). Fine leaf gold comes from Rosia Montana, Romania. The best crystals, skeletal octahedra, up to 50 mm (2 in) have been found in alluvial sediments near Gran Sabana, Roraima Shield, Venezuela. Gold wires up to 110 mm ($4^{5}/_{16}$ in) long were very rare in Ground Hog mine, Gilman, Colorado, USA. The largest known sheets of crystallized gold occurred in the Jamestown mine, California, USA, where a cavity, which yielded 49 kg (108 lb) of golden leaves, was discovered on 26.12.1992. The largest measures about 300 mm ($11^{13}/_{16}$ in) and has about 25.79 kg (56 lb 13 oz) of gold on it. Typical aggregates of fine gold wires come from Farncomb Hill near Breckenridge, Colorado, USA. Fine crystals were also found in Berezovsk, Ural mountains and in the Lena River basin, Siberia, Russia. Fine scales and larger nuggets from placer deposits were found in Klondike, Alaska; Tuolumne County, California, USA and in Ballarat, Victoria, Australia. Fine dendritic aggregates occurred in the Hope's Nose, Devon, UK. A unique find of leaves up to 100 mm (4 in) was made in Krepice near Vodnany, Czech Republic.
Application: practically the only source of gold as a metal; used in jewelry, electronics and medicine.

Mercury
Hg

TRIGONAL ● ●

Properties: C – tin white; L – metallic to adamantine; D – opaque; DE – 13.6; M – liquid at temperatures above -39°C (-38.2°F); R – very poisonous fumes.
Origin and occurrence: Hydrothermal in low-temperature ore deposits, also connected with hot springs. It is associated with cinnabar, calomel and other Hg minerals. It occurred in Almaden, Spain;

Gold
Au

CUBIC ● ●

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USES of GOLD

Gold has been used as a precious metal throughout the history of mankind. Most of the gold produced goes into the monetary reserve and forms a monetary base for currency.

This is due to its resistance, beauty, rareness, and the fact that it is very easy to work with. Many exotic gold ornaments from the past have been found. In India it is used in the textile Zari work.

Especially noteworthy are the golden ornaments from the tombs of the Pharaohs in Egypt, where gold masks, statues, coins, and much jewelry was archeologically excavated. Gold has been used for coinage throughout the centuries, and is currently accepted internationally as a standard value. Nowadays, the main use of gold is for jewelry.

As pure gold is easily bent and dented, it is always alloyed with other metals when used in jewelry. This makes it more durable and practical for ornamental use. The purity of the gold based on the alloyed metal is measured in karat weight. The karat measurement determines the percentage of gold to other metals on a scale of 1 to 24 , with 24 karats being pure gold.

Due to gold's distinctive properties as a metal, it has several industrial uses. It is used in photography, dentistry, coloring, and is currently being studied for cancer treatments.

Varieties of Gold

The color of pure gold is bright golden yellow. Besides for strengthening the gold, other metals may be alloyed with gold to give the gold distinct color tinges. The different types of gold are based on the particular color tinge:

Rose Gold - Gold with a slightly reddish hue, caused by copper

White Gold - Pale, almost silver-colored gold, caused by nickel (and sometimes zinc or platinum)

Green Gold - Gold with a slightly greenish hue, caused by copper and silver

Blue Gold - Gold with a slightly bluish hue, caused by iron

Mode of Occurrence and Origin

Gold occurs mainly in tw forms

1) Lodes and 2) placers

(i) Lodes Deposits

The lode deposits are primary in nature. The Primary gold deposits occur in intrusive rocks (dyke rocks) having composition of diorites, quartz – diorites and granites and their metamorphic equivalents

Gold is found commonly associated with sulphides of non-ferrous and related metal like chalcopyrite, sphalerite, galena, arsenopyrite, pyrite and antimonite

Quartz and limonite are the main gangue associates

The iron hats (gossan) or limonites at times contain appreciable quantities of gold.

Gold mostly occurs in quartz-vein (where yellow brown or blue quartz has been found to be favourable carrier for example: Kundrakocha, Singhbhum district, Bihar)

These quartz veins also known as lodes or reefs, which contain either native gold or gold sulfides and tellurides.

Mode of Occurrence and Origin…

(i) Lodes Deposits….

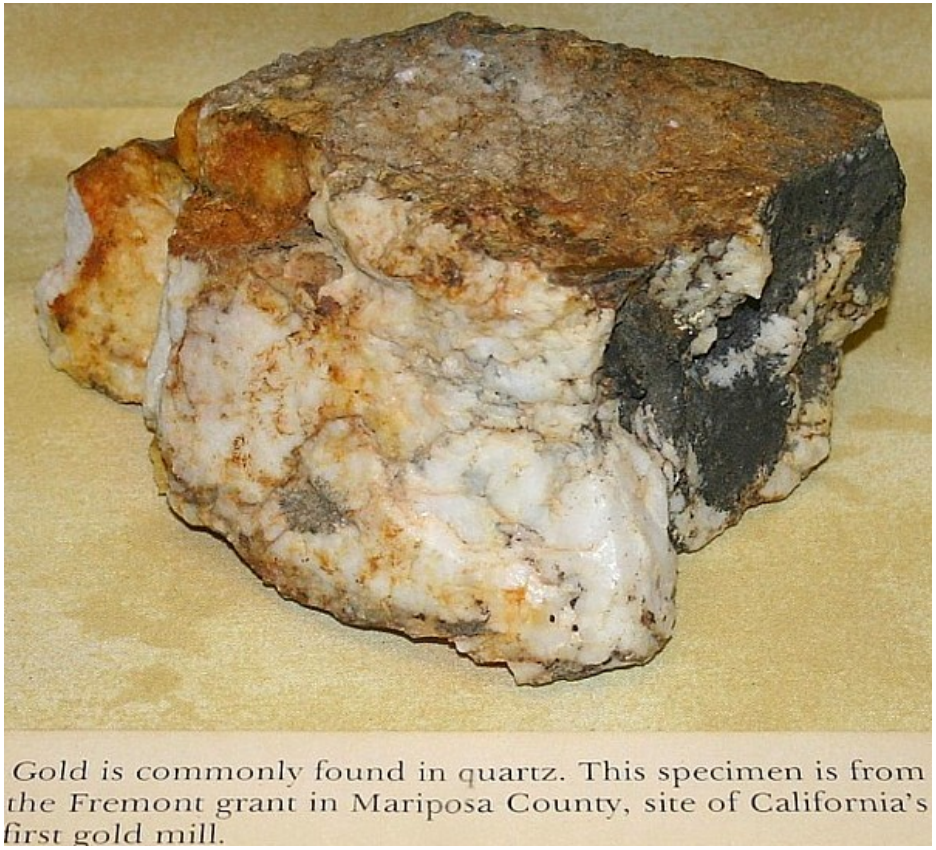
The lode deposits are mostly formed through igneous emanations during the last stages of chilling of magma which came up along some opening like fissures, faults, fractures, shear zone and folds to upper layers of earth crust

During cooling of magma gold crystallises in native state or in combination with other elements like Ag, Cu, Hg, Sb, Bi, Se, Te, As and S depending upon their physical and chemical conditions prevailing there

The Bulk deposits are formed at the end stages of differentiation they are hydrothermal in origin with accumulation of gases and water which act as carrier e.g. Kolar gold field.

A few lode deposits are formed at various stage of processes e.g. Magmatic segregation deposits (Utah Gold hill, Gold curry, etc.) and Contact metasomatic deposits (Montana Cable Mine, British Columbia)

Narainswamy et al (1960) state Kolar gold deposit formed by the high temperature hydro-thermal mineralization



Gold is commonly found in quartz. This specimen is from the Fremont grant in Mariposa County, site of California's first gold mill.

Gold load deposits with Quarz reef

Gold Ore
California

Small bits of gold are scattered through this piece of mesothermal vein quartz from the mother lode region of California. The gold is mostly concentrated around the edges of dark colored spots of iron oxide that were likely originally clots of pyrite. This is very rich gold ore.

These are crystals of Calaverite - a gold, silver and tellurium mineral. This is very high grade gold ore from the Cripple Creek district in Colorado. Many old time miners mistook this type of mineral for low grade sulfides, but this silvery metallic material probably is 40 percent gold by weight. Tellurides are often associated with rich ore - and that was true at Cripple Creek as it was elsewhere.

Gold does not commonly combine with other elements, but there are exceptions. These are the telluride minerals such as Calaverite. This very rich gold ore specimen came from the El Paso gold mine in the Cripple Creek district in Colorado.

(ii) Placer Deposits

Placer deposits are sourced from pre-existing gold deposits and are secondary deposits.

Placer deposits are formed by alluvial processes within rivers, streams and on beaches.

Placer gold deposits form via gravity, with the density of gold causing it to sink into trap sites within the river bed, or where water velocity drops, such as bends in rivers and behind boulders.

Often placer deposits are found within sedimentary rocks and can be billions of years old, for instance the Witwatersrand deposits in South Africa.

Sedimentary placer deposits are known as 'leads' or 'deep leads'.

Placer deposits are often worked by fossicking, and panning for gold is a popular pastime.

Laterite gold deposits are formed from pre-existing gold deposits (including some placer deposits) during prolonged weathering of the bedrock. Gold is deposited within iron oxides in the weathered rock or regolith, and may be further enriched by reworking by erosion. Some laterite deposits are formed by wind erosion of the bedrock leaving a residuum of native gold metal at surface

This very large nugget gold specimen contains significant quartz and is from Alaska. It's rounded shape shows the signs of wear and tumbling in a river environment.

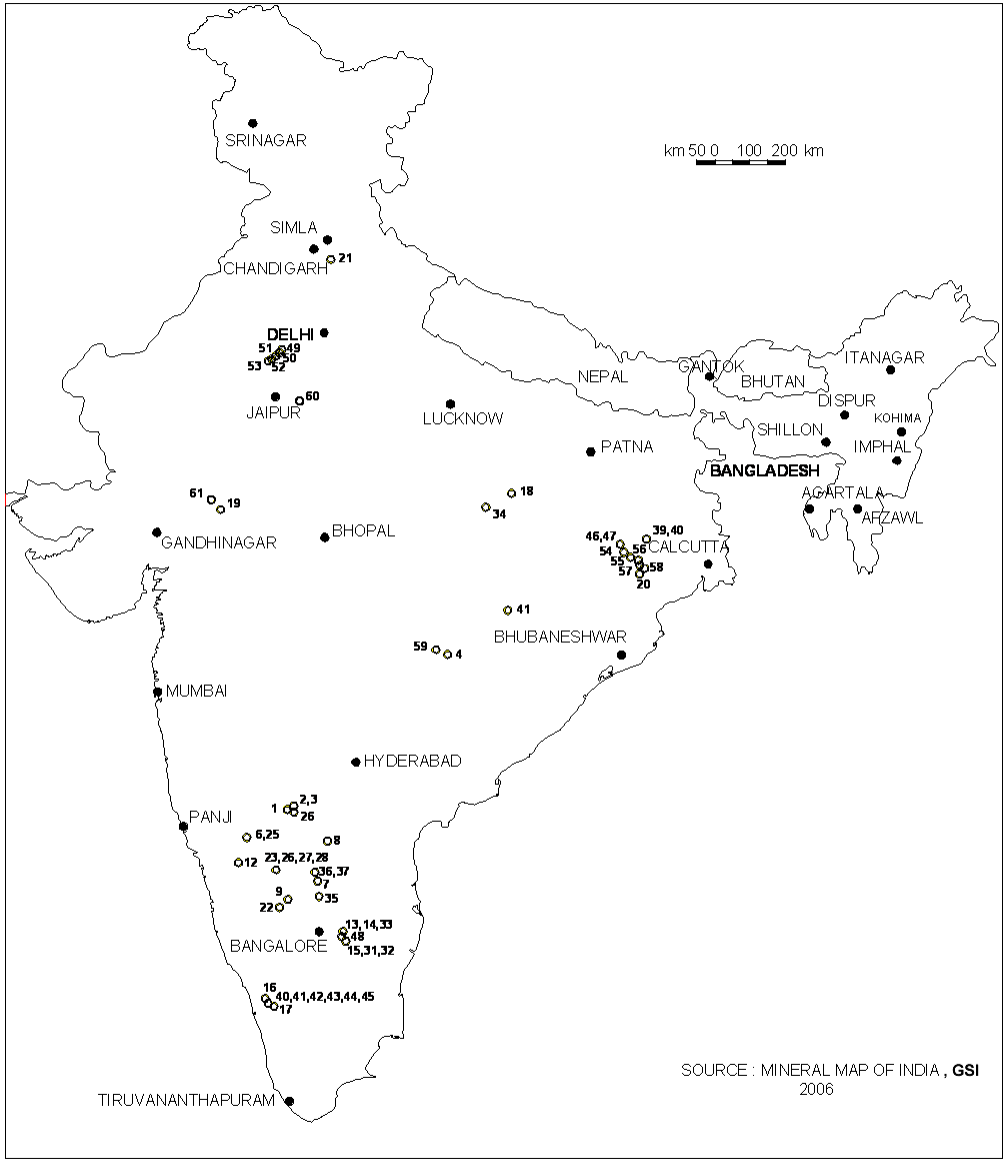
Montana Bob Dansie assembled this fantastic collection placer of gold using various Minelab metal detectors. He dug each flake, one nugget at a time. Most if this placer material is from Arizona, but it also includes some gold from other locations. The upside down jar with the small gold contains several pounds of small flakes and pieces placer gold.

These angular pieces of gold have not been shaped by the flows of a stream. They were mined on the hilltop near the rocks in which they were formed. They are from California and were also recovered by the author.

This is a piece of gold ore from the famous Witwatersrand gold deposits of South Africa. The ore consists of conglomerate pebbles mostly of quartz, in a sandy matrix, with abundant pyrite in the cement. The gold, which occurs in the cement but not in the pebbles, is closely connected with the pyrite and is not visible to the naked eye. It is generally agreed that this auriferous conglomerate represents an ancient placer, although the gold and pyrite have been re-disolved and moved around or recrystalized after emplacement. Most geologists see these ores as fossilized placer deposits altered by heat and water flows.

The vast majority of gold mined in Nevada is tiny - microscopic in size. However a small percentage is large and here is an example of a pan full of gold taken from the Round Mountain Mine in Nye County. Only about 3% of their total production is coarse like this, but even 3 % of all their gold is a large quantity. The round Mountain Mine is operated by Kinross and is located North of Tonopah in Nye county. Check out this web page if you want to learn more about Nevada's Rich Micron Gold deposits.

Gold Distribution in India



GOLD AND ASSOCIATED METAL PROSPECTS IN INDIA

1. Hutti Gold mine, Au, W
2. Uti block, Au, W
3. Wandalli-Hira-Bundhini-Chinchergi, Au, W
4. Sonadihi, Au
5. Hossur Champion block, Au, W
6. Mysore Sangli mine, Au, W
7. Ramagiri-Kotapalle Gold Field, Au
8. Dona tample, Au
9. Ajjanahalli, Au
10. G.R.Halli, Au
11. Kampinokote, Au
12. Chinmulgund, Au
13. Kolar Gold Field, Au, W
14. Old Bisanattam mine, Au,W
15. Mallaapakonda, Au, W
16. Nilambur valley, Au
17. Attapadi Valley, Au
18. Gurhar Pahar, Au
19. Anandpuri-Bhukia, Au
20. Kunderkocha, Au
21. Mubarakpur-Una area, Au
22. Bellara, Au
23. C.K. Halli, Au
24. Attikatti block, Au
25. Kabuliyatkatti block, Au
26. Chinchergi, Au
27. Hira Budini, Au
28. Kadoni, Au
29. Sanbal, Au
30. Tuppadhur, Au
31. Chigarkunta block, Au
32. Maharajagadai, Au
33. Surapalle prospect, Au
34. Gullaldih, Au
35. Penukonda prospecat, Au
36. Bhadrampalle, Au
37. Ramapuram, Au
38. Honnali, Au
39. Lawa, Au
40. Myscra, Au
41. Sonakhan, Au
42. Phoenix mine, Au
43. Solomine mine, Au
44. Alpha mine, Au
45. Harewood mine, Au
46. Pahardiha, Au
47. Imaliya, Au
48. Kudithainapalle, Au
49. Singhana-muradpur-pancheri, Cu,Au
50. Madhan-kudan, Cu,Co,Au
51. Akwali-kolihan,Cu,Au
52. Chinchroli-surahara-dholamala,Cu,Au
53. Satkui Cu,Au
54. Turamdih,Cu,Au
55 Tamapahar,Cu,Au
56. Rakha,Cu,Ni,Co,Au
57. Surda-mosabani,Cu,Au
58. Baharagora, Cu,Au
59. Pular-parsori-ranmangli-thutanbori,Cu,Au
60. Dhani Basri, Cu,Au
61. Dugocha,Au

Distribution of Gold in India

All gold productions of India have come from the vein deposits (lode deposit) and very little from placers.

The vein deposits may be further classified into

1) **Principal deposits (active mine) which are at the moment producing gold. E.g. the Kolar and the Hutti gold fields**
2) **Potential deposits which at one time or other have produced gold and may hold promise of turning out to be commercially important. e.g. Anantour gold field (Andhra), Gadag gold field (Karnataka) and Wynad gold field (Tamil Nadu)**
3) **Minor occurrences which have not been fully assessed or have been explored to some extent and found to be importants**

Age	Types of deposits	Category	Locality and geological details
Dharwars	A. Lode Deposits	1.Principal deposits (Active mines)	(a) Kolar (Karnataka): Gold is associated with champion quartz-lodes and sulphide bearing reefs, especially oriental lode with schist belt, belonging to hypothermal class (b) Hutti (Karnataka): Gold is associated with quartz-reefs within metabasalts, represented by greenstones passing into chlorite-schist
		2.Potential deposits (abandoned mine)	a) Ramgiri, Anantpur dist (A.P). The auriferous belt, 150-200m wide and comprising quartz-vein zone is spread over a strike length 15km within schistose rock b) Gadag (karnataka): associated with Qz vein with greenstone for 50 km c) Wynad, TN: associated with quartz reefs within biotite gneiss and hornblende-granulite d) Kundrakocha, Bihar: quartz vein with cherty phylite

Age	Types of deposits	Category	Locality and geological details
Dharwars	A. Lode Deposits	3.Minor Occurrences	Gooty (Anantpur dist), Bisanatham (Chittoor) and Gavanikonda (Kurnool) of A.P. Sithaura (Nalanda), Sonapet (Ranchi) and Pahariha, lowa and Mysara (Singhbhum) of Bihar Alech hills (Jamnagar) of Gujarat Kojhikoda and Cannore (Kerala)
Pleistocene & Recent	B.Placer Deposits		Gold washing carried out in the alluvial and gravel beds of many rivers in parts of Assam, Bihar andH.P. The rivers subansiri, lohit, Dihang, Buri, Dihang, Buri and Janglu of Assam-Arunachal Sona, Subernarekha and South keol of Singhbhum Several streams different part of India

State	Proved	Probable	Possible	Total	Remarks
Andhra Pradesh					
(i)Ore (million tonnes)	1.396	1.583	3.861	6.840	Primary Gold
(ii) Metal (tonnes)	6.0	7.4	18.3	31.7	Reserve
Bihar (Kundrakocha)					Primary Gold
(i) Ore	-	-	0.008	0.008	Reserve
(ii) Metal	-	-	0.1	0.1	
Karnataka					
(i) Ore	6.855	6.063	0.695	13.613	Primary Gold
(ii) Metal	32.6	29.4	2.9	64.9	Reserve
Kerala					
(i) Ore	-	2.552	22.198	24.750	Both primary and placer gold reserve
(ii) Metal	-	2.3	2	4.4	
Madhya Pradesh					
Ore	-	-	1.7	1.7	Primary Gold Reserve
India Total Reserve					
Ore	8.251	10.198	26.162	45.211	
Metal	38.6	39.2	23.3	101.1	

Reserves of Gold in India

(Recoverable Reserves as on 1.4.1990)

as on 01.04.2005

Reserves						Remaining resources								
Mineral	Unit	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnai-ssance	Total	Total resources
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
Gold Ore (primary)	tonne	15554089	1075868	2623994	19253951	-	-	1724132	27062651	83529855	118635315	140083333	371035286	390289237

World Distribution: Many localities for fine specimens. In Russia, in Siberia, along the eastern slope of the Ural Mountains; important localities near Yekaterinburg (Sverdlovsk), as at Beresovsk; in the Miass district; large crystal groups from along the Lena River, Sakha. Sharply crystallized from Romania, at Ro¸sia Montan˘a (Verespatak) and S˘ac˘arˆımb (Nagy´ag).

In Australia, many occurrences, as at Bendigo, Ballarat, and Matlock, Victoria; along the Palmer River and at Gympie, Queensland; from Kalgoorlie, Western Australia, with gold telluride ores, also very large alluvial nuggets. At the Porgera mine, Mt. Kare, Papua New Guinea.

The world's most important gold district is the Witwatersrand, Transvaal, South Africa, which, however, only rarely produces crystalline material. In Canada, especially in Ontario, in the Porcupine and Hemlo districts.

In the USA, in California, in the Mother Lode belt of the Sierra Nevada, with fine examples from both lode and placer deposits. In South Dakota, from the Homestake mine at Lead, Lawrence Co.; in Colorado, wire and leaf gold from Breckenridge, Summit Co.; in Lake Co., at Leadville; in Alaska, in lode mines in the Juneau district and placers along the Yukon River. Near Santa Elena, in the Grand Savannah River region, Venezuela, a placer producing exceptional skeletal crystals.

A bonanza gold rush occurred at Serra Pelada, Par´a, Brazil.

PROSPECTING GUIDES

1.Host Rock and Associated Minerals

- Intrusive rocks of composition diorites, quartz-diorites and granites are found to be suitable host rocks of primary gold
- The associated minerals are sulphides of non-ferrous and the related metals such as chalcopyrite, sphalerite, galena, arsenopyrite, pyrite and stibnite besides quartz and limonite
- In vein deposits yellowish brown or blue quartz has been found to be favourable carriers of gold
- The limonite or iron hat (gossan) is also of great interest

2.Rock Examination

- The outcrops of quartz veins, silicified rock and quartz boulders should be examined carefully for visible gold specks or sulphide minerals
- Free gold is often found confined to fine cracks

3. Soil-Cover Areas

- In soil cover areas, the soil under uprooted trees, animal burrows, rain-rill, etc may be examined for mineralised fragments of quartz or other rocks
- The gravels of river channel are looked for mineralised fragments

PROSPECTING GUIDES

4. Pebble and Boulder Tracinhg

- Find out the primary gold lode by tracing the mineralised quartz fragments pebble or any other rock in the river gravel upstream

5. Panning

- Panning is the principal prospecting method in case of placer gold
- The samples should be taken from the lowest layers of gravels (near bed rock)

6. Specimen Collection

- A specimen/sample for chemical analyses should be one to two kg with small fragments of rock taken from different perts of ore body

7. Soil-Cover Areas

- The gold values of 2 g/tonne and above are suggestive of the area for detailed exploration
- The value 4 g/t are indicative of economic deposit worth mining

Precious Metals - SILVER

Silver is a precious metal next to gold

Silver is a metallic chemical element with the chemical symbol Ag and atomic number 47.

A soft, white, lustrous transition metal, it has the highest electrical conductivity of any element and the highest thermal conductivity of any metal.

The metal occurs naturally in its pure, free form (native silver), as an alloy with gold and other metals, and in minerals such as argentite and chlorargyrite.

Most silver is produced as a by-product of copper, gold, lead, and zinc refining.

Silver has long been valued as a precious metal, and it is used to make ornaments, jewelry, high-value tableware, utensils (hence the term silverware), and currency coins.

Today, silver metal is also used in electrical contacts and conductors, in mirrors and in catalysis of chemical reactions. Its compounds are used in photographic film and dilute silver nitrate solutions and other silver compounds are used as disinfectants and microbiocides. While many medical antimicrobial uses of silver have been supplanted by antibiotics, further research into clinical potential continues.

The world mine reserve of silver is estimated at around 420 million kg

85% of above from USA, Canada, Mexico, Peru, Russia, Africa, Japan and Australia. Amongst Mexico is the topest

Silver mining through open pit and underground operation

Physical Properties of Silver

Cleavage: None
Color: Silver white, Gray white, Gray, **Specific gravity:** 10 - 11, Average = 10.5

Diaphaneity: Opaque

Fracture: Hackly - Jagged, torn surfaces, (e.g. fractured metals).

Habit: Arborescent - "Tree like" growths of branched systems (e.g. silver).

Habit: Dendritic - Branching "tree-like" growths of great complexity (e.g. pyrolusite).
Habit: Massive - Uniformly indistinguishable crystals forming large masses.

Hardness: 2.5-3 - Finger Nail-Calcite

Luminescence: Non-fluorescent.

Luster: Metallic, **Magnetism:** Nonmagnetic, **Streak:** silver white

Melting point: 1000^0C

Metallic conductor: Heat and electricity

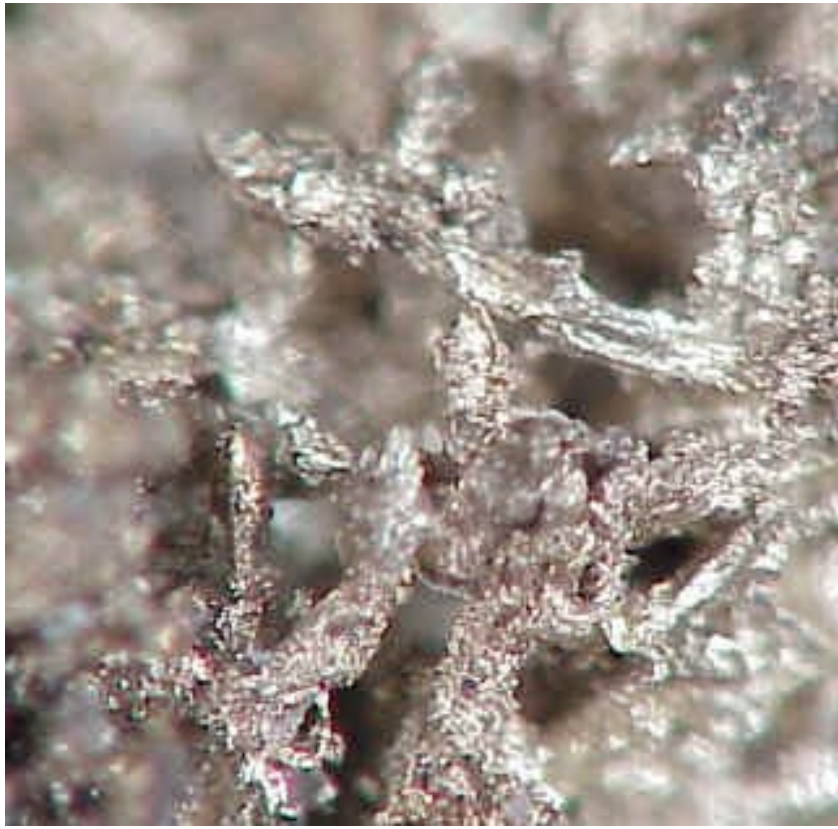
Atomic Mass	107.8682
Atomic Number	47
Name Origins	Anglo Saxon, siolfur = "silver": Latin, argentum
Year Discovered	Prehistoric
Discovery Credits	Known to ancient civilizations.
Remarks	Soft, malleable metal with characteristic silver sheen. Stable to water and oxygen but attacked by sulfur compounds in air to form black sulfide layer. Dissolves in sulfuric and nitric acid. Used in photography, silverware, jewelry, electrical industry, and glass (mirrors). Diagnostic tests: Easily reduced on charcoal using a blowpipe or propane torch after roasting the sample forming a malleable silvery bead. Silver, along with lead and mercury form white, insoluble chlorides from aqueous solutions.

Silver Minerals and their Characters

Minerals	Chemical Comp	Chief Characters
Native silver	Ag (usually associated with small amounts of other metals – Cu, Au, Pt, Hg, Pb, Zn, Bi, etc.	Usually filiform, arborecsent or massive
Argentite (Silver glance)	Ag2S	Blackish gray in colour and streak, metallic lustre
Stephanite (Brittle Silver Ore)	Ag5SbS4	Iron black in colour and streak, brittle, H= 2-2.5, sp.g = 6.26
Prousite (Light red silver Ore)	Ag3AsS3	Commonly granular and massive, red in colour and streak, H = 2-2.5, Sp.g. = 5.55-5.64
Pyragyrite (Dark red silver ore)	Ag3SbS3	Commonly massive, black to cochineal red in colour and streak H= 2-3, sp.g. 5.7-5.9
Ceragyrite (Horn Silver)	AgCl	Usually massive and wax like and also in encrustations, pale shades of grey. Some times greenish or bluish streak, shining, H = 2-3, sp.gr = 5.8
Hessite	Ag2Te	Lead grey, metallic, sectile, H = 2.5, sp.gr = 8.4

Native Silver

Native Silver



Arborescent habit silver crystals etched out of calcite
Origin: Kongsberg, Norway
Sample size: 3 x 3 x 1 cm

Native Silver with Lead

Rich lead - silver ore from the famous mines of Wallace, Idaho. These mines have been mined to very deep levels below the surface.

Native Silver with sulphur

This sulfide rich silver ore from Nevada is dark gray and colored by a heavy content of metallic sulfides. The rich silver minerals pyrargyrite and stephanite boost the silver content of this bonanza grade ore.

Silver on galena
Origin: Comstock Lode, Storey County, Nevada, U.S.A.
ex. John Sinkankas Collection
Sample size: 2 x 1.75 x 0.5 cm

Mineral: Silver: Ag

Comments: Numerous fine, silver wires to 4 mm in diameter attached to a matrix of massive white calcite and minor sulfides.

Location: Himmelsfahrt mine, near Freiberg, Saxony, Germany.

Scale: 4 x 4.5 x 6 cm.

Silver with copper
Origin: Keweenaw Peninsula, Houghton Co., Michigan, U.S.A.
Sample size: 2.7 x 2.1 x 1.5 cm
Photo courtesy of:

Argentite

Mineral: Acanthite: Ag2S

Argentite: Ag2S

Chemical Formula: Ag2S

Composition: Molecular Weight = 247.80 gm

Silver 87.06 % Ag

Sulfur 12.94 % S

Empirical Formula: Ag2S

Environment: Low temperature ore veins.

IMA Status: Not Approved IMA

Locality: Mexico, Saxony, Great Britain and Kongsberg, Norway are notable localities. Link to MinDat.org Location Data.

Name Origin: After the Latin, argentum, meaning "silver". From the Greek, akanta, meaning "arrow." Argentite is stable above 179 C. Acanthite is stable below 179 C.

Comments: Dark metallic acanthite crystals up to 3 mm. Most of the crystals are a cubic habit, so the acanthite is pseudomorphing the original argentite.

Location: San Juan de Rayas Mine (Rayas Mine), Guanajuato, Mun. de Guanajuato, Guanajuato, Mexico.

Scale: 18x12x12 mm.

Physical Properties of Argentite

Cleavage: {001} Poor, {110} Poor

Color: Black, Lead gray.

Density: 7.2 - 7.4, Average = 7.3

Diaphaneity: Opaque

Fracture: Sectile - Curved shavings or scrapings produced by a knife blade, (e.g. graphite).

Habit: Arborescent - "Tree like" growths of branched systems (e.g. silver).

Habit: Blocky - Crystal shape tends to be equant (e.g. feldspars).

Habit: Skeletal - Crystals form crude outlines with missing faces.

Hardness: 2-2.5 - Gypsum-Finger Nail

Luminescence: Non-fluorescent.

Luster: Metallic

Magnetism: Nonmagnetic

Streak: black

Stephanite Ag5SbS4

Chemical Formula: Ag5SbS4
Stephanite is 68.5% Silver by weight.

Colors: Dark Gray to black.

Its streak is black.

Hardness: 2

Density: 6.2 to 6.3

Cleavage: The cleavage is perfect parallel to (010) and the fracture uneven.

Crystallography: Orthorhombic

Stephanite crystallizes in hemimorphic orthorhombic crystals. The crystals are highly modified, 125 forms having been identified upon them. They have usually the habit of hexagonal prisms, their predominant planes. Crystals are usually small. Also twinned in pseudohexagonal crystals.

Luster:. Sub-metallic to metallic

Optics: (Refractive Index) Opaque

Stephanite Ag5SbS4…

Composition, Structure and Associated Minerals:

Stephanite, though a comparatively rare mineral, is an important ore of silver in some mining camps. It is found associated with other sulphantimonites of silver, etc. Crystals usually short prismatic and tabular parallel to the base. It occurs massive, in disseminated grains and as aggregates of small crystals. Analyses indicate a composition very close to the requirements of the formula Ag5SbS4.

Occurrence, Localities and Origins:

The mineral is associated with other silver ores in the primary ores and the secondary zone of enrichment of veins at Freiberg, Saxony; Joachimsthal and Pribram, Bohemia; at Guanajuato and Arizona, Sonora, etc., at many points in Mexico, Peru and Chile and other mines in the Rocky Mountain region and at many points in Mexico and Peru. It is particularly abundant in the ores of the Comstock Lode, and other silver deposits in Nevada, and of the Las Chispas Mine, Sonora, Mex. It is formed at low to moderate temperatures.

Proustite

Chemical Formula: AgAsS3 (Light Ruby Silver)Sulfo-arsenite of silver, silver is 64.5 % by weight. May contain a small amount of antimony substituting for arsenic.
Colors: Ruby Red to Brownish red
Its streak is deep red to brownish black.
Hardness: 2.0
Density: 5.5
Cleavage: Imperfect, but it is easily sectile, and can be cut with a knife like lead.
Crystallography: Rhombohedral
Found in pointed crystals, but more commonly occurs as granular and massive forms.
Luster:. Adamantine luster. Transparent to translucent. High refractive index.

Composition, Structure and Associated Minerals:

Proustite, or light ruby silver, is isomorphous with pyrargyrite. It differs from the latter mineral in containing arsenic in place of antimony. It occurs both massive and in crystals, and like pyrargyrite is an important silver ore. The mineral occurs in veins associated with other compounds of silver such as native silver, acanthite (argentite), stephanite, and sometimes with galena and arsenopyrite. It is most commonly found in the zone of secondary enrichment of silver veins, but also is formed as a primary ore mineral in some near surface epithermal systems rich in silver.

Occurrence, Localities and Origins:

Overall, proustite is a fairly rare mineral, occurring in silver veins associated with various other sulpharsenites and sulphantimonites. It is generally less abundant than pyrargyrite. Found in the silver mines of Saxony; Bohemia; at Chaftarcillo, Chile, in fine crystals; common in the silver mines of Peru and Mexico. Found in Colorado in the silver mines of the San Juan Mountains and elsewhere; in various epithermal silver districts in Nevada, etc.

Handsome crystal specimens of proustite occur at Freiberg and other places in Saxony, at Wolfach in Baden, at Markirchen in Alsace and at Chanarcillo in Chile. It is associated with pyrargyrite and with other ores of silver. In parts of the western United States it is quite abundant, more particularly in the Ruby district, Colorado, at Poorman lode in Idaho, and in all other localities where pyrargyrite occurs. In some locations it is an important silver ore

Pyrargyrite

Chemical Formula: Ag3SbS3
Pyrargyrite is 59.7% Silver by weight.
Also known as Dark Ruby Silver.
Colors: Dark Gray to black.
The mineral is apparently opaque and its color is grayish black in reflected light, but is transparent or translucent and deep ruby red in transmitted light.
streak is purplish red.
Hardness: 2 to 2.5

Density: 5.85
Cleavage: The cleavage of pyrargyrite is distinct parallel to R(1011). Its fracture is conchoidal or uneven.
Crystallography: Orthorhombic
Crystals are usually distorted and often with complex development, and frequently twinned.
Luster:. Adamantine, transparent to translucent.
Optics: (Refractive Index) 2.9 (very high index of refraction)

The Comstock lode district was perhaps the largest single silver ore find ever made in the USA. The Comstock lode is famous for its ore bodies of bonanza grade silver ore rich in sooty silver sulfide minerals like acanthite (formerly known as argentite). The ore also contains considerable other sulfide minerals and some free gold as well.

The Comstock is famous for great bonanzas of crushed, mineralized quartz, in part exceedingly rich in silver minerals, were found at intervals along the lode, especially in chambers or vertical fissures probably produced by normal faulting of the hanging wall. The ores consist of quartz and some calcite, in places banded with pyrite, galena, chalcopyrite, sphalerite, and finely distributed rich silver minerals. The valuable minerals are mainly native gold, acanthite (argentite), stephanite, and polybasite.



Origin: Elura Mine (Endeavor Mine), Booroondarra, Cobar, Robinson Co., New South Wales, Australia
Sample size: 5 x 4 x 75 mm
Dendritic crystallized native silver on a small amount of matrix with minor calcite.
Origin: New Nevada Mine, Batopilas, Andres del Rio District, Mun. de Batopilas, Chihuahua, Mexico
Sample size: 20 x 5 x 35 mm

Iron black in colour and streak, brittle, H= 2-2.5, sp.g = 6.26

Ag5SbS4		
Silver	68.33 %	Ag
Antimony	15.42 %	Sb
Sulfur	16.25 %	S

Mineral: Silver: Ag
Stephanite: Ag5SbS4

Comments: Thick, ropy, native silver wires with blocky, well-crystallized stephanite on white and tan calcite matrix.

Location: Freiberg, Erzgebirge, Saxony, Alemania, Germay.

Scale: Picture size 3 cm.

The sooty black colored material in this specimen is cerargyrite, an important ore of silver. In many deposits located in desert regions, silver sulfide minerals like acanthite (argentite), stephanite, and polybasite or oxidized by exposure to air and water into a silver chloride, also known as cerargyrite. as a result, this type of silver ore is only found near the surface. Once miners get down below the water table, this type of mineral and ore will disappear and only sulfides will be found in its place. This rich specimen was taken from the Tonopah Divide mine, in the Divide district of Nye County, Nevada.

Telluride minerals such as calaverite, are also important silver ores in some mining districts. This sample of rich gold and silver ore comes from the Cripple Creek district in Colorado. The mossy metallic colored mineral on this specimen is calaverite, a mineral rich in both gold and silver.

In the Calico District, deposits of silver chloride in fissure veins, and in small fractures and pockets in volcanic tuffs and sandstones, probably of the Pliocene series. Below the oxidation zone, rich chlorides give way to silver bearing sulfides as shown in this specimen. They occur in Southwestern California, in that portion of the State belonging to the Great Basin geologic province. The ore was thought by Lindgren to have come in heated solution from below and to have filled the fissures and overflowed, forming the surface deposits in the tuffs. They are considered epithermal in origin.

Rhodochrosite and silver ore, Peru:
This beautiful specimen of silver ore comes from the country of Peru in South America. The dark colored minerals are the ones which are silver bearing, while the red and pink colored crystals are Rhodochrosite, a common manganese mineral that is found in a number of silver ores.

Mode of occurrence and Origin

- Silver ores occur in a variety of ways such as
- Veins, stringers and disseminations, replacement deposits, contact metamorphic deposits or alluvial
- The upper part of the silver deposits like Ceragrgyrite (AgCl), Bromyrite (AgBr) and Iodyrite (AgI) are weathered and form the gossan in the surface
- Hydrothermal solutions might be responsible in bringing about the replacement or cavity filling deposits
- Massive or load replacement of silver-lead ores are numerous
- The most of the world's silver is from the fissure veins of mesothermal and epithermal types

Hydrothermal deposits

Silver grains to 2-3 mm in granitic matrix
Origin: Sophia mine, Wittichen, Schwarzwald, Germany
Sample size: 5 x 6 x 2 cm

Silver occur in veins

Vein and leaf silver in two large fractures 4 and 3.5 cm long.
The exposed silver is aver 1 cm in length.
Origin: O'Brien mine, Cobalt, Ontario, Canada
Sample size: 6.5 x 4 x 2 cm

Distribution

- In India there is no silver deposit at present
- Silver is found associated with lead, zinc, copper and gold
- The Galena of Rajasthan, Andhra Pradesh, Uttar Pradesh and Bihar are argentiferous
- Lead-zinc samle from Zawarmala mine, udaipur Rajasthan have 18ppm silver
- The lead occurrences in Heasatu-Belhathan belt, Bihar and Birgana, UP are found to be argentiferous galena

Production

- In India silver is recovered as a by-product from the smelting od lead, zinc, gold and copper
- The production of silver during 1990-91, 91-92, 92-93 respectively 35, 38 and 47 thousand kg

Precious Metal - Platinam

Platinum was first found in the alluvial deposits of river Pinto in Colombia, S America from where it was taken to Europe in 1735 by Spanish Mathematician Antonio de Ulloa

No workable platinum deposits in India.

The Ural mountains of Russia where platinum was discovered in 1819

Canada, Africa, Australia, S America and Alaska are the other main producing countries

Natural Platinum Crystals

Platinum Nugget, California

Mineralogy - Platinam

Chemical Formula: Pt

Colors: Steel-gray with a bright metallic shine.
The color of platinum is a little more gray than that of silver. Its streak is also gray.

Hardness: 4 to 4.5
Hardness unusually high for a metal.

Density: 14 to 19 depending on impurities

Cleavage: None

Crystallography: Isometric
Usually found in small grains or scales. Sometimes in irregular masses and nuggets of larger size. Crystals very rare and commonly distorted.

Luster:. Bright metallic luster.

Optics: (Refractive Index): Opaque

- **It is malleable and ductile, a good conductor of electricity, and it is infusible before the blowpipe except in very fine wire.**

- **Its melting temperature is 1755.**

- **Platinum is unattacked by any single acid, though soluble, like gold, in a mixture of hydrochloric and nitric acids (aqua regia).**

- Platinum is a rare metal which occurs almost exclusively native and in fine scale and minute grains

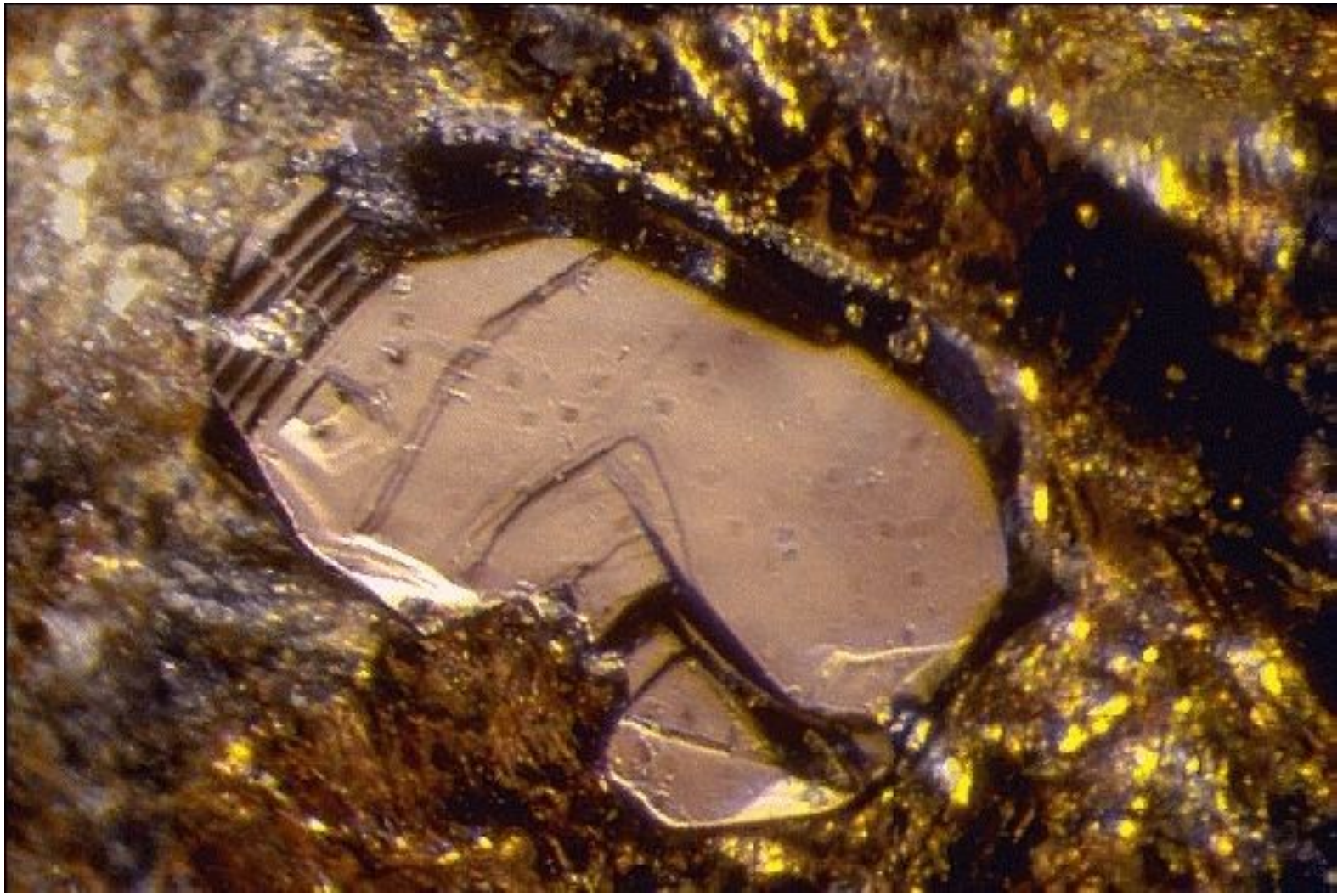
- Platinum is usually alloyed with several percent of iron and with smaller amounts of iridium, osmium, etc.

- The amount of metallic platinum present seldom exceeds 80 per cent.

- Though the metal occurs usually in grains and plates, nevertheless its crystals are sometimes found. On them cubic faces are the most prominent ones, though the octahedrons, the dodecahedrons and tetrahexahedrons have also been identified. Like the crystals of silver and gold, those of platinum are frequently distorted.

- **Platinum is a rare metal which occurs almost exclusively native and in fine scale and minute grains in the following forms**

1. **Native state – Element Platinum**
2. **Arsenide – Sperrylite (PtAs2)**
3. **Aresen-sulphide – Cooperite (Pt (As,S)2)**
4. **Alloyed with other metals of its group**



Sperrylite
Sperrylite in chalcopyrite

Formula: PtAs2

Crystal system: cubic

Crystal class: 2/m -3

Sperrylite - PtAs2

Colour: tin-white

Diaphaneity: opaque

Luster: bright metallic

Habit: crystals cubic or cubo-octahedral,
may be highly modified

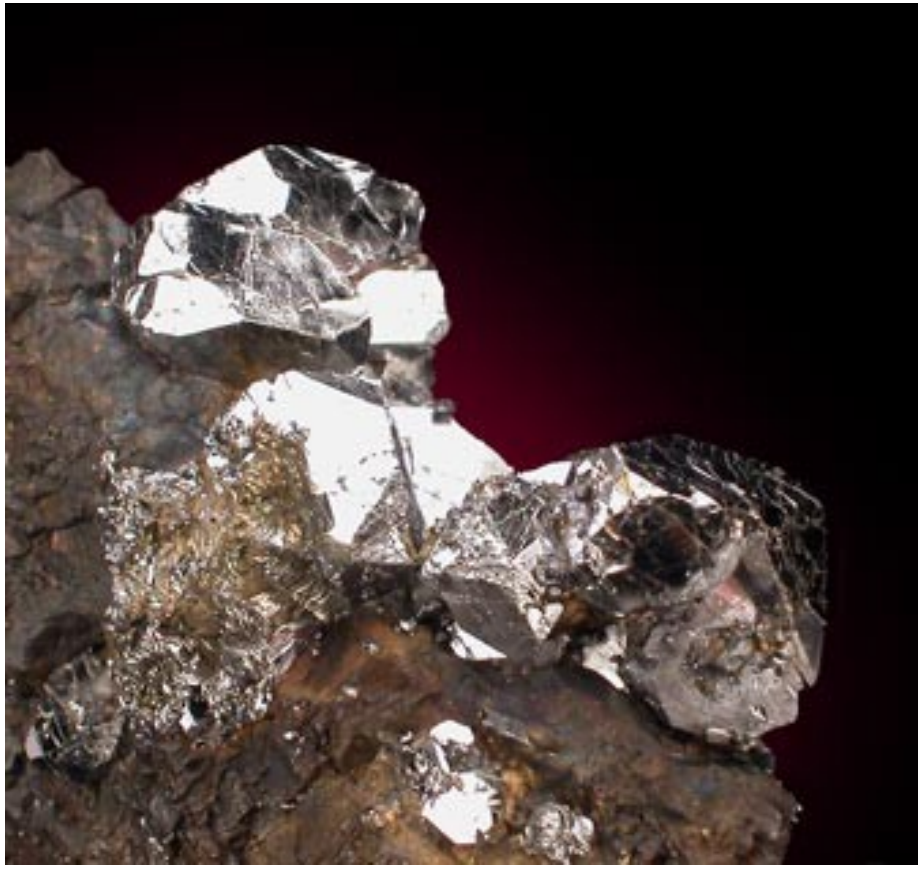
Hardness: 6 to 7

Specific gravity: 10.46 to 10.6

Cleavage: 1; {001} distinct

Tenacity: conchoidal, brittle

Streak: black



Sperrylite

Origin: Oktyabr'sk mine, Norl'sk, Krasnoyark ray, Yaymyrskiy Nats. Okrug, Siberia, Russia
Sample size: 2 x 5 x 4.5 cm

Cooperite

Formula: (Pt,Pd,Ni)S

Cleavage: None

Color: Steel gray.

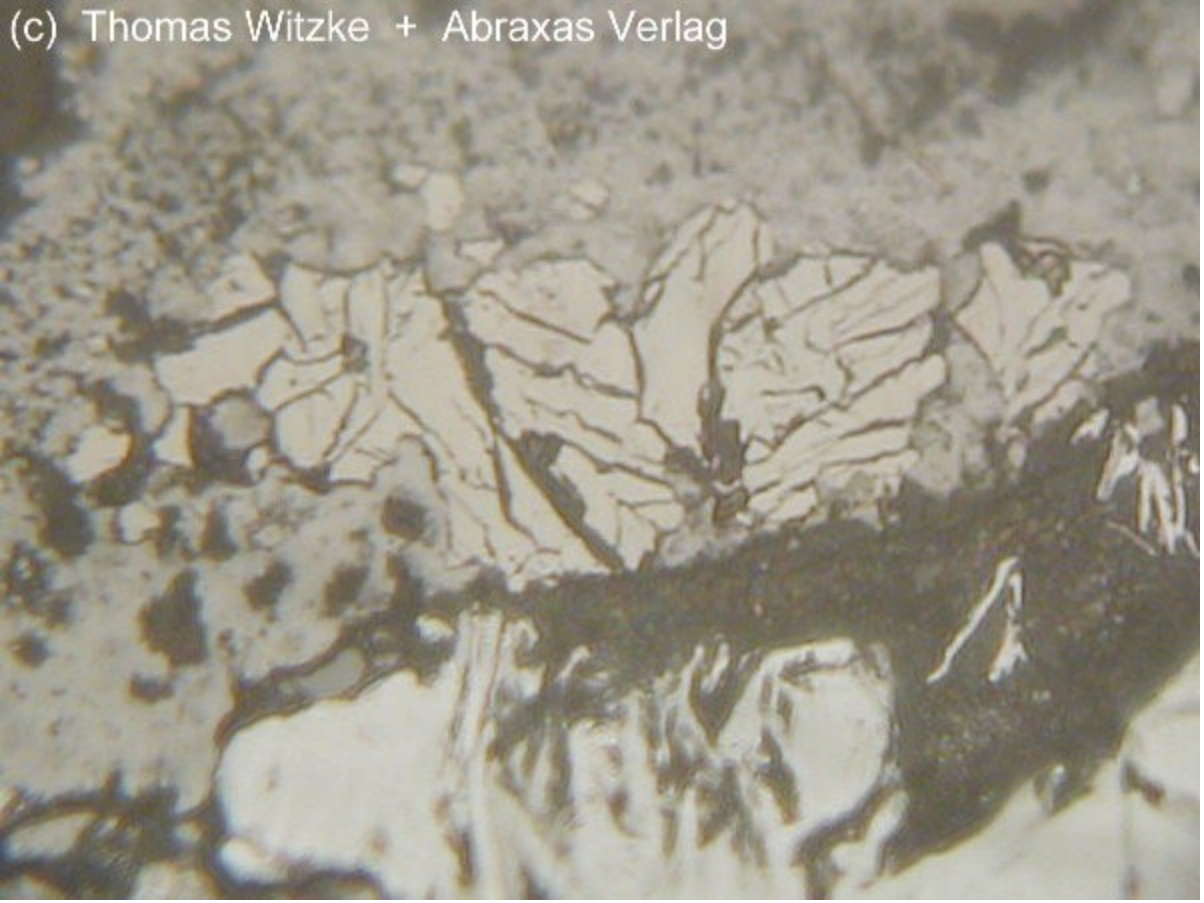
Density: 9.5

Diaphaneity: Opaque

Fracture: Conchoidal - Fractures developed in brittle materials characterized by smoothly curving surfaces, (e.g. quartz).

Hardness: 4-5 - Fluorite-Apatite

Luster: Metallic



Cooperite
Formula: (Pt,Pd,Ni)S

Creamy-grayish fractured grains of cherepanovite with gray granular cooperite, white massive grains of iridian ruthenian platinum and white crystals of iridian ruthenian osmium. Polished section in reflected light

Origin: Placer Deposit, Northern Pekul'nei River, Pekul'nei Range, Chukotka (Tchukotka) Okrug, Chukot Peninsula, Far-Eastern Region, Russia
Picture size: 0.12 mm

MODE OF OCCURRENCE AND ORIGIN

The platinum may occur in five modes

1. Early Magmatic Concentrations
   - ❖ Disseminations: Sparse dissemination with chromite in dunite. E.g. Urals, Alaska, Colombia
   - ❖ Segregations by fractional crystallization – e.g. Rustern burg, S.Africa
2. Late Magmatic concentrations

- ❖ Immiscible liquid segregations – e.g. Vlackffontein, S.Africa
- ❖ Immiscible liquid injections – e.g. Sudbury, Canada

3. Contact Metasomatic Deposits – e.g. Potgietersmast, S.Africa
4. Hydrothermal – e.g. Waterburgs, S.Africa & Sudbury, Canada
5. Placers – e.g. Urals, Colombia, Alaska

- Platinum are primarily found in ultrabasic rocks, usually associated with chromite and nickel ores
- In Ural mountains it occurs sparse disseminations with chromite in dunites
- The erosion of the platinum rich ultrabasic rocks has yielded placer deposits in Urals, Alaska, Colombia
- In South Africa, the platinum associated with dunite pipes of the differentiated Bushveld igneous complex, chromite and nickel-sulphides of the complex
- The platinum associated with the nickel-copper sulphide deposits - Immiscible liquid segregations – e.g. Vlackffontein, S.Africa

Metallogenic Epochs

- Late mesozoic to Early Tertiary: Occurs in Zambales, Phillipines as the ‘Alpine’ type. The minor occurrence in Dhangawan Bauxite, M.P., India
- Late Palaeozoic: Occurs in Alpine type of ultramafic intrusion related Hercynical folding movement in Ural mountains, Russia and dunitic rocks of New Zealand
- Precambrian: Occurs in stratiform type of Bushveld Igneous complex, Transvaal, South Africa. Late magmatic injection in frood Breecia, Sudbury, Ontario, Canada. The placer occurrence reported in Assam, West Bengal and Bengal

Distribution: No workable deposits has so far been located in India. But some small occurrences reported

1. Assam: Platinum associated with gold was reported by Dalton & Hanny in the sands of the Noa Dihing River observed by Mallet (1882). The source for this platinum is ultrabasic suite Patkoi range

2. Bihar: Dunn (1937) recorded the occurrence of platinum associated with gold in the sands along the Gurma river near Dhadka. The origin of such platinum may possibly be connected with basic intrusive rocks

3. Karnataka: The gold washings of the Kolar mines have shown traces of platinum

4. Madhya Pradesh: H.L. Chibber found traces of platinum in a sample collected from the bauxite deposit of Dhangawan on Jabalpur – Katni road

5. Tamil Nadu: The stratiform magnesio-chromites laminated with ultramafics of Sittampundi complex have indicated presence of platinum and palladium.

6. West Bengal: A sample of alluvial gold from Guram river have the minute grains of platinum (Chatterji, 1937)

The Hindu dated 02/07/2010

Evidence of huge deposits of platinum in State

The two prospects are in Namakkal and Coimbatore

SITE MAPPING: *Chief Minister M. Karunanidhi being briefed on the mineral resources in the State by GSI scientist N.P.Nathan, at the Secretariat in Chennai on Thursday.* – PHOTO: DIPR

Special Correspondent

CHENNAI: The Geological Survey of India (GSI) has found two significant platinum prospects in Tamil Nadu, according to Santha Sheela Nair, Secretary of the Union Ministry of Mines.

The two prospects are in Sittampundi of Namakkal district (covering Karungalpatti, Chettiyampalaiyam and Tasamapalaiym blocks) and Mettupalayam of Coimbatore (Solavanur, Mallasayakkampalaiyam and Karappadi blocks).

Describing them as "good discoveries," Ms Nair told reporters on Thursday that "we are at the scientific stage where there is an evidence of substantial deposits of platinum which needs to be explored further to understand the exact location and quantities."

The GSI was engaged in the exploratory work for the last three years. As of now, exploration was carried out up to 30 metres. If explored further, – say 200 to 300 metres, scientists of the GSI were of the view that "the potential will be even greater, both in quantity and quality," the Mines Secretary said. Earlier, in the presence of Chief Minister M. Karunanidhi, Ms. Nair and senior officials of the State government at the Secretariat, GSI Director-General N.K. Datta and Tamil Nadu Minerals (TAMIN) Chairman and Managing Director K. Manivasan signed a memorandum of understanding.

Ms. Nair said the MoU was signed to facilitate further exploration of mineral development of the State. By associating with the GSI, the TAMIN would be able to diversify its activities. At present, the organisation was focussing on granites.

Pointing out that there were greater possibilities for collaboration with the State agency, N.P. Nathan, senior scientist in the GSI, said other minerals such as limestone, magnesite and iron ore could be covered. The Union Secretary reiterated that many more levels had to be crossed before reaching the stage of mining. Under the existing constitutional framework, mineral wealth belonged to States, which would receive royalties.

Durai Murugan, Law Minister, and K. Shanmugam and Rajeev Ranjan, Principal Secretaries for Finance and Industries, were present when the MOU was signed.

Tamil Daily
Dinamani
dated
02/07/2010

பிளாட்டினத்தை அறிய ஆய்வுப் பணிகள்

தமிழக அரசு ஒப்பந்தம்

தமிழகத்தில் பிளாட்டினத்தை கண்டறிவதற்காக சென்னையில் முதல்வர் கருணாநிதி முன்னிலையில் வியாழக்கிழமை செய்து கொள்ளப்பட்ட ஒப்பந்தம்.

சென்னை, ஜூலை 1: தமிழகத்தில் நிலத்துக்கு அடியில் உள்ள பிளாட்டினம் படிமங்களை கண்டறிவதற்கான ஆய்வுப் பணிகளை மேற்கொள்ள இந்திய புவியியல் ஆய்வுத் துறை மற்றும் தமிழ்நாடு கனிம நிறுவனம் இடையே புரிந்துணர்வு ஒப்பந்தம் செய்து கொள்ளப்பட்டுள்ளது.

இந்த ஒப்பந்தம் முதல்வர் கருணாநிதி முன்னிலையில் தலைமைச் செயலகத்தில் வியாழக்கிழமை செய்யப்பட்டது. இதுகுறித்து, தமிழக அரசு வெளியிட்ட செய்தி:

தமிழகத்தில் நிலத்துக்கு அடியில் படிந்துள்ள பிளாட்டினம் கனிமத்தைக் கண்டறிவதற்காக இந்திய புவியியல் ஆய்வுத் துறை கடந்த மூன்று ஆண்டுகளாக ஆய்வு செய்து வருகிறது.

இந்த ஆய்வின் பயனாக, இதுவரை மேட்டுப்பாளையம் முதல் நாமக்கல் வரை பல்வேறு பகுதிகளில் நிலத்துக்கு அடியில் பிளாட்டினம் படிமங்கள் இருப்பதாகக் கண்டறியப்பட்டுள்ளது.

இந்த பிளாட்டினம் கனிமங்களை வணிக நோக்குடன் ஆய்வு செய்யவும், அந்தக் கனிமங்களை பயன்படுத்தி பல்வேறு தொழில்கள் தொடங்கவும் ஒப்பந்தம் செய்து கொள்ளப்பட்டுள்ளது. மேலும், புதிய இடங்களில் கனிமங்கள் குறித்து ஆய்வுப் பணிகள் மேற்கொள்ளவும் விரிவான அளவில் நடவடிக்கை மேற்கொள்ள இந்தப் புரிந்துணர்வு ஒப்பந்தம் வகை செய்கிறது.

ஒப்பந்தத்தில் இந்திய புவியியல் ஆய்வுத்துறையின் தலைவர் என்.கே.தத்தா மற்றும் தமிழ்நாடு கனிம நிறுவனத்தின் தலைவர் மற்றும் மேலாண்மை இயக்குநர் க.மணிவாசன் ஆகியோர் கையெழுத்திட்டனர்.

இந்த நிகழ்ச்சியில், சட்டத் துறை அமைச்சர் துரை முருகன், மத்திய சுரங்கத் துறைச் செயலாளர் சாந்தா ஷீலா நாயர், தமிழக நிதித்துறை முதன்மைச் செயலாளர் க.சண்முகம், தொழில்துறை முதன்மைச் செயலாளர் ராஜீவ் ரஞ்சன் உள்ளிட்ட பலரும் உடனிருந்தனர்.