Government of India
Geological Survey of India
Central Region

Seminary Hills, Nagpur -440006

CGPB /Commt IV/GSI/CR/2009 Dated 19.07.2010

From
The Convenor,
CGPB Committee-IV**,**
Industrial and Fertilizer Minerals, and
Dy. Director General,
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To
The Director
Directorate of Geology & Mining
All State Government

Sub : ***CGPB Committee-IV - Draft Base document on Industrial and Fertilizer Minerals- additional data from the state/region-reg***

Sir,

Kindly find enclosed herewith the draft ***Base document on Industrial and Fertilizer Minerals-(CGPB Committee-IV).****It is requested that additional data pertaining to Industrial and Fertilizer Minerals of* ***your State and*** *field item proposals for the* ***XIIth and XIII th Plan period may kindly be provided to enrich the Base document.*** *The details may be sent to*

mariappan.mohan@gsi.gov.in ***before 28.07.2010.***

Yours faithfully,

(M.MOHAN)
Director, PSS-II
for.Dy.Director General, GSI, CR

Base document (Industrial & Fertilizer Minerals)

Introduction

Increase in modern industrialization means additional mineral consumption by the industries such as steel, cement, fertilizers etc. Occurrence of a major mineral deposit in a backward area stimulates development of the area by way of development in infrastructure and improvement in employment opportunities.

The country is blessed with ample mineral resources and there are still potential areas to be explored. Mineral Exploration Strategy is to be viewed in a long term perspective. Small and isolated mineral deposits are scattered all over the country and is modest investment, these deposits can be mined through small scale mining. New prospects have to be explored and reassessment to be done on number of low grade deposits which are currently being considered commercially unviable even though they are exploitable with commercial success as per global standard.

The base line geoscience data generation carried out by GSI so far has resulted in identification of potential areas. The country requires much more sustained and serious efforts to augment the mineral resources.

Geologically the country is represented by litho units ranging in age from Archaean to Recent. The litho units of similar age, in different areas are of diverse nature causing uneven distribution of mineral distribution. Nevertheless the Archaean rocks in India are the store house of mineral wealth of iron ore, gold and volcanic related massive sulphite deposits. The Archaean rocks are followed by litho units of Proterozoic age which hosts minerals like barite, limestone, dolomite, asbestos, tin, tungsten, manganese, marble, gypsum, phosphorite, graphite and refractories.

Status of Industrial and Fertilizer Mineral Resources

Among the various industrial and fertilizer minerals we have abundant resources of limestone, dolomite, barite, calcite, fire clay, quartz, feldspar, garnet, gypsum, mica, magnetite, pyrophyllite, graphite, mica and silica sand. But minerals like apatite, rock phosphate, sulphur, potash, diatomite, and kyanite are in deficient quantity.

Industrial and Fertilizer Minerals

I Industrial Minerals

a) Limestone – $CaC0_3$:- Used in the manufacture of Cement.

b) Dolomite- Ca Mg $(C0_3)_2$- Dolomites are high Magnesium Limestone and are used in the manufacture of Cement, refractory and chemical industries.

c) Refractories: Kyanite – Al_2 $Si0_5$

Sillimanite – Al_2 $Si0_5$.

Pyrophyllite – Al_2 Si_4 O_{10} $(OH)_2$ – is used in ceramics and talcum powder. Pyrophyllite is also extensively used in insecticides, such as DDT.

Graphite: C- Carbon –used in Refractory industries because of its anti-corrosive nature and high melting point (3000 °C)

Magnesite Mg $C0_3$ – used as refractory bricks.

Fire Clays: are also known as sedimentary clays, residual clays or refractory. Clays – used in Refractories.

d) Quartz,feldspar,mica,wollastonite,vermiculite and zeolites-used in glass and chemical industries.

e)Garnet,asbestos,ilmenite

f) Barite Ba $S0_4$ –It is used in chemical, paint and textile industries.

II Fertilizer Minerals:-

a) Phosphorite - is the Marine precipitate of great economic importance and is the raw material for phosphate fertilizer.

b) Apatite – Ca_5 $(P0_4)3$ (F, Cl, OH) Calcium phosphates with varying amounts of F, Cl and (OH), viz.

fluorapatite – in which 'F' predominate

Chorapatite – in which 'Cl' predominate

Hydroxylapatite – in which (OH) predominate.and is used in superphosphate fertilizer.

c) Gypsum $CaS0_4$ $2H_20$ – is used as Fertilizers

Glauconite: - K (Fe, Mg, Al)2 $(Si_4$ $O_{10})$ $(OH)_2$ – hydrous silicate of iron and potassium with aluminium and magnesium. Glauconite is one of the raw materials in fertilizer industry.

INDUSTRIAL AND FERTILISER MINERALS- INDIAN SCENARIO

The non-metallic industrial minerals give an anchoring lift and support to the metallic industrial world.

Agriculture continues to be the mainstay for livelihood of rural people of India and is the backbone of Indian economy because of its high share in employment. Fertilizer is considered as an essential input to Indian agriculture for meeting the food grain requirement of the growing population of the country. India today is the third largest producer of the nitrogenous fertilizer in the world behind China and USA. The consumption of fertilizers in the country has been showing an appreciable growth in last few years. The consumption of fertilizer need to be further increased to meet our increasing requirement of food in the country. Government is committed to provide adequate fertilizer at affordable price so that farmer does not face shortage of this critical input. Due to raw material shortage, India needs to import substantial quantities of phosphatic raw material and Diammonium phosphate (DAP).

It is need of the hour to view mineral exploration strategy in a long term prospective. Small and isolated mineral deposit has scattered all over the country. So, we should go for ***Sustainable development*** with modest investment, these deposit can be mined through small scale mining. New prospects have to be explored and reassessment to be done on a number of low grade deposit which are currently considered commercially unviable even though they are exploitable with commercial success as per global standard.

Mineral resources are the backbone of industrial development and mineral production plays a significant role in national economy. The limited and near exhaustive resources to the proximity of earth surface dictates us to adopt multidisciplinary and futuristic approach in mineral exploration further below the earth's surface.Unmindful mining of a particular mineral will lead to disaster. So it is pertinent to explore more areas for additional resources to meet present demand and preserve for future generations. Presently mineral search and assessment is being undertaken with special emphasis on deficient commodity of high value as well as ores and minerals of high demand.

Departmental Co-ordination

Regular exchange of data and knowledge base amongst the concerned National and State Agencies as well as public and private entrepreneurs and academic institutions, under the aegis of the CGPB Committee-IV is very important in the national perspective for getting the success in the on-going programmes and delineation of future prospective areas.

International Cooperation

In the light of fast moving world of geoscientific scenario bilateral arrangement, particularly with countries having state of art exploration technology, is the need of the day for acquisition of knowledge base and development of skill.

RESEARCH AND DEVELOPMENT

1. Indigenous technology has to be upgraded through research and appropriate absorption and adoption of technological innovations abroad. Research and development efforts shall be made to improve efficiency in process, operations and also the recovery of by-products and reduction in specification and consumption norms. Efforts will also be directed to evolve low capital and energy saving processing systems.
2. Scientific basis for geology of non-metallic Industrial and fertilizer minerals. Research and development in the mineral sector has to cover the entire gamut of activities from geological survey, exploration, mining, beneficiation, extraction of minerals to development of materials.
3. Appropriate technologies shall be developed to enable indigenous industries to utilize the mineral resources with which the country is abundantly endowed and as substitutes for minerals whose reserves are poor.
4. Research and development shall be oriented to ensure maximum economic recovery of the associated minerals and valuable metals.

Co-ordination Of Research Organisations

Pooling of resources and expertise available in the various R&D Organizations is imperative to meet the challenges and to fulfill the tasks ahead in the mineral sector Research and development activities in the mineral sector are carried out in the educational institutions, national laboratories and R&D units of public and private sector enterprises. Linkages and

interaction between the various institutions engaged in R&D in the mineral sector shall be strengthened to derive the maximum benefit.

Observations/Recommendations

1. Geological Survey of India, Central Region has circulated a dossier on industrial and fertilizer minerals(CR) during the first meeting held in Nagpur on 2nd July 2009. Dossier on industrial and fertilizer minerals from other regions of GSI shall help in identification of areas for regional and detailed exploration.
2. All the regions of GSI and few DGM's have prepared a 5 year rolling plan on industrial and fertilizer minerals.
3. Another important aspect for discussion is beneficiation of low grade ores.
4. With vast geological, geophysical and geochemical data for the entire country the next logical step in exploration will be to take up exploration in Craton-wise and Belt wise.
5. Most of the mineral blocks have been explored by way of drilling upto 200 m depth and resource has been estimated accordingly. The estimated resource shall be enhanced by exploring with deeper boreholes.
6. Recently IBM has lowered the threshold values of many minerals. With this the already estimated resource of many prospects will be enhanced.

RESOURCES OF INDUSTRIAL AND FERTILISER MINERALS

LIMESTONE

The total categories and grade as per UNFC system as on 1.4.2005 is estimated at 175,345 million tonnes , of which 12,715 million tonnes (7%) are under reserve category and 162,630 million tonnes are under remaining resources category.

The production of limestone in 2006-07 at about 179million tonnes increased by 5% as compared to that of previous year.

The production of the limestone at 204 million tonnes in 20008-09 increased by 5% as compared to that in the previous year. Limestone is widely produced in the India. As much as 88% of the total output in 2008-09 was contributed by seven principal state; viz, Andhra Pradesh (22%)Rajasthan (18%), Madhya Pradesh (13%), Gujarat (11%) and Tamilnadu, Chhattisgarh and

Karnataka (8% each). The other limestone producing states shared the remaining 12% of the total production.

BARYTES

The total resources of barites in India as on 1.4.2000 as per UNFC system are placed at 74 million tonnes constituting 46%reserves and 54% remaining resources. Andhra Pradesh alone accounted for more than 94% of country's resources of barytes.

The production of barytes at 1.73million tonnes in 2006-07 registered increased of 50% as compared to that in the previous year.

DOLOMITES

As per UNFC system, as on 1.4.2005 total resources of dolomites are placed at 7,533 million tonnes, out of which 985 million tonnes are placed under reserves category and balance i.e. 6,548 million tonnes under remaining resource category. Gradewise BF/sitering grade accounts for 30% fallowed by SMS (20%), refractory (6%), BF and SMS mixed (4%) and glass (3%) and other remaining unclassified grade(37%)

The production of the dolomites in2006-07 at 4,783 thousand tonnes registedred a meagre increase of 1% as compared to that of previous year.

GRAPHITE

As per as UNFC system, the total resources of the graphite as on 1.4.2005 are placed about 168.77million tonnes comprising 10.75 million tonnes in the reserve category and 158.02 million tonnes under the remaining resource category. Production of graphite at 124 thousand tonnes in 2006-07 increased by 18% as compared to that of preceding year. The output of the graphite reported in terms of run –of –mines (r.o.m.) which contain varying carbon content.

MAGNESITE

The total reserve/resources of magnesite as par UNFC system as on 1.4.2005 are about 338 million tonnes of which reserves and remaining resources are 76 million tonnes and 260 million tonnes , respectively .Substantial quantities of resources are established in Uttarakhand (68%), fallowed by Rajasthan (16%) and Tamil Nadu (13%). Resources are also located in Andhra Pradesh , himanchal Pradesh, Jammu & Kashmir , Karnatka and Kerla.

Production of magnesite in 2006-07 at 242 thousand tonnes decreased by 29% as compared to that in the previous year due to financial problem and lack of demand.

GARNET

The total resource s of garnet in India , as on 1.4.2005 , as per UNFC system is placed at 57.66 million tonnes of which reserve is proved and probable categories together are 20.98 million tonnes . Of the total resources, about 22.27 million tonnes are abrasive grade whereas resources of semiprecious grade are 9,465 tonnes only. Tamil Nadu alone accounts for more than 49% of the total resources fallowed by Andhra Pradesh 26% and Orissa 24% the remaining state together share less than 1percent.

Production of garnet (abrasive) at 852 thousand tonnes during 2006-07 increased by 27% as compared to that in the preceding year.

ILMENITE

As per the UNFC , total resources of the titaniferous magnetite in the country as on 1.4.2005 are estimated at 40.68 million tonnes of which 1.29 million tonnes are placed under reserves category and bulk i.e. 39.39 million tonnes under “remaining resource” category . In addition , about 3.35 million tonnes resources of antatase are estimated in Maghalaya. GSI carried out seabad mapping and placer mineral investigations within the territorial water of India in 2005-06 through marine wing.

In 2006-07 , production of ilmenite. decreased to 692,906 tonnes from 703, 796 tonnes in the preceding year. Tamilnadu is the leading producer of ilmenite contributing 51% of total production, fallowed by Orissa (30%) and Kerala (19%).

MICA

Most of the mica –bearing pegmatites occurs in Andrapradesh, Bihar, Jharkand, Maharashtra and rajasthan.

As per as UNFC system , the total resources of mica in the country as on 1.4.2005 are estimated at 393,855 tonnes out of which 68,570 tonnes are placed under reserves category and 325,285 tonnes under remaining resources category.

Rajasthan lead with 51% share of the total resources followed by Andhra Pradesh (28%), Maharashtra (17%) , Bihar (3%) and Jharkhand (1%)

The production of the mica (crude) at 1, 411 tonnes in 2006-07 decreased by about 33% as compared to the preceding year due to narrow and non productive pegmatite and closer of some mines due to forest law of violation.

The production of mica (waste and scrap) at 2,975 tonnes in 20006-07 decreased by 375 compared to the previous year.

The contribution of Andhra Pradesh was 97% of the total production of the mica (waste and scarp) fallowed by Rajasthan 3 percent.

QUARTZ

As per the UNFC system as on 1.4.2005,the total resourcesof quartz and silica sand in our country are estimated at 3,238 million tonnes out of which 24% i.e. 771 million tonnes are placed under reserves category while76% i.e. 2,467 under the resources category.

Resources of foundry and moulding grades are (20%) , glass grade(10%),and ceramic & pottery grade (10%)and ferrosilicon grade(6%).About 53%resources are unclassified others not known grade.Haryana alone account for 56% resources followed by Rajasthan (8%), Jharkhand (5%), Maharastra (5%), Andhra Pradash (5%), Kerela(4%), Gujrat((3%), Uttar Pradesh(3%) , Karnataka (2%) and Orissa(2%).

The total resources of quartzite in the country as per UNFC system as on 1.4.2005 are estimated as 1,145 million tonnes of which reserves are 99 million tonnes and remaining resource are 10,406 million tonnes.

The production of silica sand at 2.29million tonnes in 2006-07 decreased by about 4% over previous year. Andhra Pradesh the major producing State reported a declineof about 15% incomparison with previous year.

Production of Quartzite at 94 thousand tonnes in 2006 –07 decreased by 14% compared to that of previous year/.The production of quartz at 233 thousand tonnes in 2006 –07 decreased by 23% as compared to that of preceding year due to non –availability of labours and development works.

FELDSPAR

As per UNFC system , the total resources of feldspar in the country as on 1.04.05 are estimated at about 91million tonnes of which 38 million tonnes (42%) are reserves and 53 million tonnes (58%) remaining resources.

By state Rajasthan alone account for about 62% of total resource fallowed by Tamil Nadu (10%) , Bihar and West Bengal 5% each.

The production of the feldspar at 373 thousand tonnes in 2006-07 decreased by 12% as compared to the preceding year.

VERMICULITES

The total resources of vermiculites as on 1.4.2005 as per UNFC system are placed at 2.44 million tonnes of which more than 72% are placed under reserves category. Major resources are located in Tamil Nadu (77%) , followed by Madhya Pradesh (11%), Andhra Pradesh (5%) , Karnataka (4%), Rajasthan(2%) , Jharkhand (1%).

Production of vermiculite at 10,374 tonnes in 2006 –07 increased by 55% as compare to that of previous year.

SILLIMANITES

The total resources of the sillimanites as per UNFC system in the country as on 1.4.2005 are placed at 74 million tonnes. Out of these resources, the reserves are only 11 million tonnes, while about 63 million tonnes are remaining resources. Out of the total resources more than 74% are granular high –grade , while quartz sillimanites rocks and sillimanites bearing rocks are about 20percent.Resources of massive sillimanites of all grade are about 5 percent.

The production of sillmanites at 27 thousand tonnes in 2006-07 decreased by 20% as to that of previous year due to capacity expansion project activity.

FLUORITES

As per the UNFC system, the total resources of fluorite in the country as on 1.4.2005 are estimated at 20.17 million tonnes . out of these 9.21 million tonnes are placed under reserve category and 10.95 million tonnes under remaining resource category.

By state , Gujrat having 13.39 million tones account for 69% of the total resources followed by Rajasthan 5.24 million tonnes (26%), Chattisgarh 0.55 million tonnes (2.7%)and Maharashtra 0.45 million tonnes(2.2%)

The production of fluorite (total)at 2785 tonnes in 2006-07 subsequently decreased compare to that previous year due to pending of renewal of mining lease and want for environment clearance.

PHOSPHORITE

The production of the phosphorite/ rock phosphate at 1759 thousand tonnes decreased by 5% in 2008-09 as compared to the previous year. The entire production was from Public sector. Jhamrkotra mine of Rajesthan State mines ltd. (RSMML) alone accounted for 88% of the total production. The production in India and entire production of the Rajashthan during 2008-09. Madhya Pradesh contributed the remaining 12%of the production. The production of the Dolomite at 4469 thousand tonnes in 2008-09 registered 24% decreased as compared to the preceding year.

GYPSUM

As per UNFC system , the total resources of mineral gypsum in India as on 1.4.2005 are estimated at 1,237 million tonnes,of which 69 million tonnes have placed under reserves category and 1,168 million tonnes under remaining resources category.

Of the total resources, fertilizer / pottery grade account for 79% and cement/paint grade 8 percent ,unclassified grade 12 percent and remaining one percent are shared by surgical plaster and soil reclamation grade.

The production of gypsum at 2.89 million tonnes in 2006-07 decreased by 12% as compared to that of previous year due to less demand and discontinuation of major mines not working permission was granted for want of environmental clearance.

POTASH

As per UNFC system , total resources of potash as on 1.4.2005 are estimated at 21,815 million tonnes of the country . Rajasthan alone contributes (94%) resources , falloed by Madhya pradesh (5%)and Uttar Pradesh the Remaining 1%

SPECIFIC PROJECT AND INTIATIVE

The fertilizer minerals are in deficient quantity and the Government spends crores of rupees on subsidy to the fertilizer industries. With this background the fertilizer minerals were taken-up for documentation under SPECIFIC PROJECT AND INTIATIVE.

Phosphate rock (>20% P_2O_5) is the primary source for the manufacture of phosphate fertilizers which sustain the modern day agriculture to a great extent.Phosphate rocks are commercially exploited from igneous (alkaline) suites and sedimentary (marine) rocks. India has a small exploitable phosphate reserve(Ca 200 million tonnes) mostly within the Proterozoic-Cambrian

sedimentary rocks. These deposits occur in the basins lying in both the peninsular as well as the Himalayan parts of India . The use of Phosphate fertilizer in India has maintained a steady upward trend with an ever increasing demand of rock phosphate .To illustrate the situation ,India's production increased from 7000 tonnes in 1965 to 5,50,000 tonnes in 1980 yet leaving a requirement gap of more than one million tonnes of rock phosphate to be imported from other countries.

The exploration programme for sedimentary phosphorite in India gained impetus after the discoveries of mussoorie and birmania deposits in Uttar Pradesh and Rajasthan respectively in the later half of of nineteen sixties.The largest phosphorite deposit of the country(64 mt reserve) was discovered at jhamarkotra, situated 26 Km SSE of Udaipur in Rajasthan .

Phosphorite distribution.

From the economic view point there is an uneven distribution of the phosphorite resources in the country.Bulk of deposit lie in the southern part of Rajasthan and north –western corner of Madhya Pradesh within the ensemble of the Proterozoic Aravalli Supergroup. Jhamarkotra ,Maton,Dakankotra,Kharbaria-ka-Gurha, Sallopat and Jhabua deposits in the Aravalli Supergroup together account for more than 80% phosphorite resources of the country. Perhaps the best documented belt in the Himalaya is the Mussoorie syncline which holds large resources of low grade ore (16-18% P_2O_5) .

Phosphorite deposits in the central part of peninsular India are located within the Bijawar Group (Upper Proterozoic) at Hirapur and Lalitpur in the States of M.P and U.P. respectively. In the southern part of the peninsula a very extensive and potential phosphorite deposit awaits detailed exploration in the Cuddapah basin of AndhraPradesh.

Major Phosphogenetic Basins.

a) Aravalli basin of western India.
b) Bijawar basin of north-central India.
c) Cuddapah basin of southern India.
d) Krol-Tal basin of the Lesser Himalayas.

Minor Phosphogenetic Basins

a) Western India.
    1) Birmania
    2) Fatehgarh

3) Jaisalmer
4) Achrol
5) Gandhra.

b) Southern India.
   1) Bhima
   2) Tiruchirapalli

c) Himalayan region

d) Other areas.
   1) Vindhyans
   2) Gondwana
   3) Meghalaya

Potash:

There are no commercially mineable **reserves** of potash in the country and the entire potasic fertilizer requirements are made through import. But we do have indicated resource of 21815 million tonnes of potash as glauconite and polyhalite (in Madhya Pradesh and Rajasthan). Thus rock phosphate and potash resource are confined to central and western parts of the country.

STRATEGIC POLICY

Intensification of nonmetallic industrial mineral and fertilizer mineral exploration activity has been made as top priority agenda by the policy makers in the highest level of the Government owing to the spiraling demand of the commodity by the primary mineral industrial sector since last decade. In this backdrop, the importance of both long and short term policies in the realm of exploration as well as co-ordination among all the concerned National and State Exploration Agencies and also private entrepreneurs have increased many folds.

Short term policy

(1) Collation of existing database and subsequent selection of blocks have to be made for concentrating sub-surface exploration.

(2) Multi-organizational concerted efforts are necessary for upgrading the confidence level of the resources followed by mine feasibility study. In essence, there has to be a synergistic approach between regional and detailed exploration.

(3) Low altitude aero-geophysical multisensor surveys both by fixed wing and heliborne over large expanse of potential terrain.

(4) Deep drilling of potential targets for identification and confirmation of the concealed ore body

Long term policy

Synthesis of available geological database reveals that in future the possibility of substantial accretion of shallow level resources with quarriable prospect is really meager. In this backdrop a strategic shift has to be made by introducing geo-statistical analyses for prognostication of potential areas as well as multidisciplinary approach (basin modeling, geophysical survey, remote sensing techniques etc) for concept oriented search in accordance with the current global models, along the following lines.

(1) Geo-statistical analyses of available database to prognosticate the potential areas (both spatially and vertically) in all needed reserves as a prelude for formulation of exploration programme.

(2) Multi-parametric geophysical surveys and remote sensing studies, particularly in covered terrains, to delineate areas for future exploration.

(3) In the light of the state of the art knowledge base, generation of relevant data set (chemical, petrological, geotechnical etc.), required in course of regional exploration to examine the possibility of new findings for alternate and optimal utilization of the resource.

(4) To frame exploration strategy for minerals having poor resource cum reserve base in locales of favourable geological milieu.

(5) Development of innovative technologies for the assessment of quality and processing properties and for the production and processing of raw materials

(6) Geological and economic evaluation of prospects and regions.To re-orient the organizational methodology to undertake collaborative venture with private entrepreneurs.

(7) To devise a multidisciplinary concept oriented programme of regional exploration by GSI (nodal agency for regional exploration) in association with all National and State exploration agencies .

(8) High precision laboratory studies with induction of state-of-the art equipment.

(9) These processes can be better understood by application of geochemistry, hydrothermal alteration studies, fluid inclusion, new geochronological methods, isotopic studies, radiogenic tracers, computer based simulation and remote sensing.