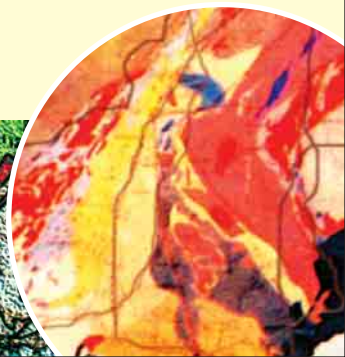
CHAPTER VI

VISION FOR GSI



VISION FOR GSI

VI CHAPTER

6.1.0. Vision, Challenges and Opportunities: Geoscience today constitutes a huge and fast expanding canvas. On the one hand advancements in science and technologies are constantly providing new and previously undreamt of opportunities to explore the near-infinite variety, which comprises the Earth and its systems: the lithosphere, biosphere, hydrosphere and atmosphere. On the other hand globalization in all its socio-economic dimensions is posing new and increasingly complex challenges to science in general and geoscience in particular. Even the term 'geoscience' is undergoing expansive change as the interdependency of processes on Earth is being revealed in more and more detail. The following illustrates some of the issues involved:

- Complexities of measuring, mapping, understanding, modelling and predicting the status and trends of natural and managed resources transcend the traditional structures and require broad interdisciplinary thinking and action.

- We are using more and more natural resources and the way we are utilizing our resources has started to affect our ecosystem more perceptibly and more irreversibly than ever before. All this has the potential impact on our ability to sustain the economy, protect national security and preserve the natural environment.

- The science strategy to meet the challenge of finding the resources to meet increasing demands and to predict and, if possible, mitigate the adverse impacts that we are having on our planet has to be broad and multidisciplinary. The three dimensions which have to be part of any science strategy is firstly the need for an 'ecosystem-based' response. Secondly, the fact that understanding the issues and finding responses involves a very high degree of geospatial information. And finally, the fact that some of the cumulative impact of the changes are now becoming significant enough to be able to be compared with similar events in the geological past. There is, therefore, a temporal dimension spanning geological periods, and study of the geological past will give indications of the trends for the future, and may help shape responses and mitigate effects in diverse areas.

6.1.1. In this background, it is a difficult task to define, for purposes of inclusion or exclusion, the area of work of a national geoscientific organization with any great precision on a long-term basis. New scientific approaches, new interdisciplinary linkages, new demands arising out of socio-economic development and of course, new ecosystemic situations all will have major impact on the work of a national geoscientific organization. At most, and in general terms only, a deterministic principle can be laid down and interpreted from time to time and this principle can take the form of a 'Vision'. The GSI as a national geoscientific institution with a successful record of over 150 years has two major strengths not possessed by any other national organization, which inevitably points to a potential key role in geoscientific activity in the long run:

- It has formidable strength in its ability to produce and manage geospatial information; and

- It has a field presence in all parts of the country which gives it the necessary outreach to collect and manage geoscientific data on new parameters as and when the need arises, with relative economy of effort and low response time not only for itself but for other institutions which are not so fortunately endowed with.

6.1.2. Historically GSI's core competence has been geospatial data collection and geological mapping. This activity will clearly continue to be the *raison-d'etre* of GSI and the basis for the role envisaged in the Vision. In this broad perspective, the Vision for GSI can perhaps be stated as the *aspiration*:

- to *develop into a world class institution for fundamental as well as applied geoscience, always keeping up with the latest technologies and methodologies.*
- to *create a close-knit national geoscientific community through leadership and collaborative partnerships; and*
- to *acquire and provide expertise and widely disseminate geoscientific information to facilitate informed decision-making by policy makers and public and enable use of geoscientific information for sustainable socio-economic development*.

6.1.3. In framing the vision in this manner, a conscious effort has been made to ensure GSI's continued focus on what has been its core competence. A radical change in GSI's mandate is considered inadvisable because of the fact there are already a multiplicity of geoscientific organizations occupying specific niches and coordination rather than functional expansion appears to be the need of the hour in the Indian context.

6.1.4. The following principles emerge from the above, which too should facilitate GSI in further determining its role as the future evolves:

- As a facilitator, GSI need not always and in every area be at the centre of activity centre. It could be an 'incubator' as it has been in the past, developing new areas of expertise that may lead to the formation of new specialized organizations. As a facilitator it could have a passive role, and sometimes be a 'repository' of scientific knowledge, of data, of multidisciplinary expertise. As a facilitator, it could be a catalytic 'clearing house' a one-stop reference centre for geoscientific data, no matter where the activity centre may be.
- As a provider of expertise and disseminator of information to policy makers, commercial users and society, GSI participating a public service. All non-commercial data other than that restricted on considerations of national security must not only be in the public domain, but GSI must constantly ensure that the data is as complete and accurate as technology permits, and is easily accessible to society in a form that would be generally required for socio-economic purposes. To achieve this it would require to development of sophisticated geospatial and multidisciplinary applications on a continuing basis.
- Geoscientific information could be of many kinds. Any new and emerging area of geoscientific activity not within the domain of an existing organization and coming within the purview of GSI's Vision *must* be taken up by GSI as a facilitator to the extent warranted by the requirement of society to ascertain the nature of the geoscience and its implications for understanding its effect on the sustainable management of the ecosystem.
- As an enabler, GSI could be the integrator of scientific data of various scientific disciplines in order to evolve responses to ecosystemic events based on geoscientific considerations.

6.2.0. With a fairly clear perception of GSI's role in terms of its Vision and its core competence, it is now possible to enumerate the major challenges and opportunities in the geoscientific sector and how GSI fits into the scheme of things. In broad terms, these can be classified as:

- *Geospatial survey and mapping*:

Systematic Geological Mapping on 1:50,000 scale is the most basic and fundamental mapping of the terrain and forms the backbone of the National Geoscientific Information and knowledge base. This enables in providing of baseline data to all Earth science related programmes and activities. Geological mapping is supplemented by the systematic geochemical, geophysical and geomorphological mapping of the entire terrain. This is followed by thematic mapping on progressively larger scales to get higher resolution in terms of multithemes including stratigraphy, structure, ore localization etc. International trends point to increased use of aerial and remote sensing techniques on the one hand and integrated execution of national projects for geophysical and geochemical mapping on the other for synergetic use. GSI will clearly need to be the pre-eminent player in this domain at the national level.

- *Natural Resources assessment and inventorisation*:

The demand for natural resources is growing, whether it is for energy or minerals or for something as basic as water. Continuous investments for both survey and assessment is the price a society has to pay for its natural resource security, in order to develop and to conserve its resources, in order to utilize it optimally and to evolve policies and strategies best serving national self-interest in an interdependent and competitive world. Development of new and presently unconventional sources of energy and other resources (including water) hold the key to the sustainable development of society in the future. However, this requires high investments in sophisticated survey and spatial data management technologies including remote sensing, and complex computerization capabilities to produce more detailed and accurate data and information of areas and depths so far unexplored. GSI is already the pre-eminent player except in oil and hydrology. However, GSI's existing activities make it a natural candidate to contribute in subsurface hydrological data generation in specific ways, which GSI needs to further explore.

- *Geoinformatics*.

This involves geoscience data collection and metadata generation, both from surveys and as a designated repository; integration of spatial and non-spatial data, archiving and information presentation and positioning of delivery services. The ultimate objective, in keeping with international trends is to provide access to quality (current, accurate, consistent) and unique (one set of data, collected and maintained by the agency responsible, not necessarily GSI) geospatial and nonspatial data, free of cost and with no restrictions, on the well established premise that systematic use of geospatial information enables more efficient policies, plans and regulatory mechanisms at national, provincial and local levels and this in turn has a multiplier effect on the nature and scale of economic activity. International trends are towards increasingly sophisticated management of data by using domain-enriched software to produce 3D and modelling outputs, in addition to Earth imaging and subsurface imaging applications. While various institutions will collect data, the amount and range of data collection by GSI make it a pre-eminent player in this domain. Though vast amounts of remotely sensed data may not be passing through its hands directly, GSI's ability to interpret and verify the data at the ground level make it indispensable in many ways.

- *Multidisciplinary Geoscience*:

Understanding ecosystems and ecosystem changes in the geoscientific context involves on the one hand study of interaction of ecosystem components in the past, discernable through palaeo-environmental studies and on the other hand it involves geoscientific baseline determination, data collection particularly in relation to glaciers, sea coasts and fragile ecosystems. In Canada, United States of America, United Kingdom and many other countries, the National Geological Surveys are tasked with such issues because of the essential linkage of geosciences to the study of ecosystem that include climate change (now often called global change since climate change brings in its wake a host of other changes). GSI will clearly be an important though not pre-eminent player in this domain. However, GSI can potentially increase its role fundamental geospatial underpinnings .

- *Geotechnical Research and Studies*

Complex geomorphic, geologic and meteoric conditions give rise to potentially catastrophic situations which includes seismic activity, landslides, avalanches, volcanoes, floods/drought, waterlogging, erosion, mass wasting, cyclone, tsunami etc., and this requires adequate preparedness for hazard mitigation. Location specific inputs from geoscience are vital for management and mitigation initiatives. GSI may not be the pre-eminent player in every case; however over time it will develop certain inherent strengths in specific areas and this process needs to be carefully nurtured.

6.3.0. Charter, Missions and Core Activities:

6.3.1. Given the major opportunities and challenges in the geoscientific sector, and given also the Vision for GSI as outlined above, a new charter can be laid down for GSI as follows:

Charter of the Geological Survey of India

1. Enable and facilitate the providing of objective, impartial and up-to-date geological expertise and geoscientific information of all kinds, particularly for decision-making for policy, commercial, economic and societal needs.

2. Systematically document the geology and geological processes of the surface and subsurface of India and its offshore areas using the latest and most cost-effective techniques and methodologies, including geophysical and geochemical and geological surveys.

3. Develop and continually enhance GSI's core competence in survey and mapping through continued accretion, management, co-ordination and utilization of spatial databases (including those acquired through remote sensing) and function as a 'Repository' or 'clearing house' for the purpose and use new and emerging computer-based technologies for dissemination of geoscientific information and spatial data, through cooperation and collaboration with other stakeholders in the Geoinformatics sector.

4. Explore (through ground, airborne, satellite, and marine surveys) and scientifically assess mineral, energy and water resources for the country and facilitate their optimal exploration through proactive information dissemination.

5. Maintain a leadership role in the geological field and develop partnerships with Central, State and other institutions, to create enhanced executional capability and capacity in the field of geology in furtherance of GSI's Vision and the objectives of this Charter.

6. Coordinate geoscientific activities with stakeholders in all sectors related to geoscience in order to help sustainably manage our natural resources, including water.

7. Conduct multidisciplinary as well as fundamental Geoscientific research and studies (including geotechnical investigations, physical, chemical and biological hazard geoinvestigations, climate change geostudies, paleogeostudies etc.), and foster partnerships with State and Central research and academic institutions for the purpose.

8. Actively participate in international collaborative projects to improve our understanding of the Earth and its ecosystems and its geology, including studies related to tectonics, global warming and climate change, and Polar studies.

9. Generally advance the cause of the geoscience by documentation, propagation, archiving and education, including creation and management of museums, monuments and parks, archives, libraries and other facilities for use of students, researchers and the public. In particular constantly endeavour to popularize Geosccience at school and university levels through production and dissemination high quality audio-visual and printed material, and through the medium of the Internet. Also hold exhibitions and special events to bring geoscientific concepts before the public.

6.4.0. GSI's Missions

6.4.1. With reference to the Charter it is possible to identify certain key tasks or Missions, which would constitute the set of core activities:-

- Baseline Geoscience Data generation
- Natural Resources Assessment
- Geoinformatics
- Fundamental & Multidisciplinary Geoscience and Special studies
- Training & capacity building

6.4.2. Baseline Geoscience Data generation

Generation of geoscientific maps on progressively larger scales using better and better survey techniques has been one of GSI's main strengths. This activity through geological, geophysical and geochemical mapping efforts will need to be intensified and completed in a time bound manner through higher resource investments, given the potential returns. Airborne survey and remote sensing techniques will need to be brought to bear in a big way in order to produce state-of-the-art maps of the land mass coastal area and Extended Economic Zone (EEZ) including 3-D maps where appropriate so as to make data available in the public domain for all possible economic or scientific use, or for the public good.

6.4.3. **Natural Resources Assessment**

Search, location and estimation of India's mineral resources too are one of the main activities of GSI.

- In the mineral sector (excluding energy), the tasks before GSI are to:
  - Delineate new target regions through synthesis of multidisciplinary Earthscience data in areas for which potential is yet to be established and take up exploration.
  - Discover concealed ore bodies in the already delineated target areas of obvious geological potential
  - Take up systematic exploration for minerals having poor resource- cum reserve-base or for lower grade mineral ores in locales of favourable geological potential.
  - Re-orient the organizational methodology to undertake collaborative ventures with State level agencies and private entrepreneurs.
- In the energy sector the tasks are to:
  - Augment of the resource base of coal and lignite through coverage of balance potential coal bearing areas [mostly from intermediate and deeper level (i.e., beyond 300m) in concealed areas] by regional exploration at an accelerated pace.
  - Identify of potential Coal Bed Methane (CBM) blocks for exploration and exploitation through basin-wise integration of fundamental baseline information along with simultaneous regional exploration.
  - Generate baseline geoscientific data towards application of alternative exploitation techniques like Underground Coal Gasification (UCG) and Coal to Liquid (CTL)
  - Explore the potential geological formations for geothermal energy resources
  - Conduct research on potential of Gas hydrates
- In the hydro sector the tasks are to:
  - Integrate basin-wise geological and geophysical data to locate potential areas for deep aquifers and study effects of seismic activities on aquifers etc.

6.4.4. **Geoinformatics**

The GSI is and will continue to be an extremely important Geoscientific data generator. However, given the broad range of subjects involved, their complexity and the large number of other important players, Geoinformation management or geoinformatics has to be done by GSI in a way that serves the larger public interest. To access, integrate, and process multidisciplinary data held or collected by different agencies to produce outputs directly usable by a wide variety of stakeholders. Much of the data with GSI is likely to be spatial data, which needs to be integrated with spatial data collected or held by other agencies. In particular Geoinformatics in GSI has to be well-meshed and complementary to the National Natural Resources Management System (NNRMS) which is a geoinformatic system under the Department of Space which uses the data from Indian Remote Sensing Satellites (IRS) to generate spatial

databases relating to forests, wastelands, land use, surface water, wetlands, coastal ecosystems, etc. The Natural Resources Information System (NRIS) project of NNRMS has developed GIS databases and GSI's Geoinformatics must develop synergy with this under the umbrella of the National Spatial Data Infrastructure (NSDI) managed by the Department of Science and Technology which sets down metadata and interoperability standards in respect of Spatial data collected and held by different agencies.

6.4.5. To enable this process to be sustained, GSI will need to:

- Invest in cyberinfrastructure on a continuing basis so as to attain world class geoinformatic capability for using geospatial data
- Develop geoscientific data standards and management policies enabling the data generated or accessed to be integrated with existing databases and allowing access of stakeholders to GSI databases.
- Ensure statutory data filing of geological data including its evaluation authentication and integration with its own data.
- Help create a sustainable data-host to support retention, archiving and dissemination of data sets and development of tools and methods for capture of metadata, establish protocols for functioning as a 'repository', 'clearing house' or 'client', for various types of geoscientific data.
- Use and enable the integration of data from a wide array emerging technologies encompassing gravity, magnetic, electrical, electromagnetic, gamma ray, magnetotelluric sensing including tomography, resistivity profiling and ground penetrating radar etc.
- Develop as part of the NNRMS/NSDI process, capability of managing geospatial data, to produce state of-the-art outputs of Earth images and subsurface images including 3-D visualization and modelling capability and develop policies allowing users easy access.

6.4.6. To be able to mesh with NNRMS, GSI will need to upgrade its State level operational headquarters so has to have full-fledged geoinformatics capability, and effectively interface with State Remote Sensing Centres and State Geomatics Centres. As important as the acquisition and management of data in the issue of information delivery, which comprises systems development and information products. A strong IT resource base, capable of developing applications in the geoscientific domain is crucial to the process. Side by side, in order to reach the wider public a communication & publications unit must be able to produce literature and audio-visual materials of high quality on a sustained basis.

6.4.7. Fundamental & Multidisciplinary Geoscience and Special Studies

Multidisciplinary Geoscience currently encompasses many broad fields including:

engineering geology (geotechnical investigations),

natural hazard studies,

geohydrogeology,

climate change and related studies,

environmental geology,

nanogeology,

biogeology (including medical geology),

extra terrestrial studies etc.

6.4.8. GSI carries out geoscientific investigations to deal with many societal issues amenable to solution using geoscientific or geotechnical tools. In the new paradigm of ecosystem based geoscience, the basic strength of GSI as a generator of geospatial data and as an agency with an all-India presence needs to be fully leveraged in the larger public interest in order that GSI systematically monitor and collect data (where possible on a spatial basis) on a large number of parameters relating not only to landslides and Earthquakes, but also other public-health and public good issues having a geospatial dimension. In this context, it may be pointed out that in the National Action Plan on Climate Change (NAPCC), there are 8 Missions, which include a Water Mission, a Green India Mission, a sustainable Agriculture Mission and a Strategic knowledge for Climate Change Mission. Geoscientific dimensions of these Missions include:

- Soil mapping
- Carbon storage (Carbon sequestration)
- Potential for deep ground water storage systems
- Glacial data (Cryospheric studies)
- Sea surface temperature and salinity
- Sea-level change and coastal erosion studies
- Water quality (presence and spatial distribution of heavy metals, radicals etc.)
- Palaeo-climate studies and modelling etc.

6.4.9. GSI will need to further develop its expertise in these areas and ensure that its survey and mapping activities are adequately coordinated with the requirements for baseline and site specific data in respect of these areas.

6.4.10. **Special Studies:** Geological investigations involve a large number of techniques and methodologies covering many broad fields such as:- Petrology, Geochronology, Palaeontology, Geophysics, Geochemistry, biogeochemistry, Mineral Physics, etc. These geoscientific tools can be applied in diverse fields within as well as outside the geoscientific Sector.

6.4.11. Applied research would include subjects such as concept oriented exploration and ore deposit modelling and may even be multidisciplinary, e.g., matters relating to evolution of life forms, and the relationship with paleoclimatic environment (determined from geological records) which forms part of the subject of biogeochemistry.

6.4.12. An understanding of the Earth and its geological history is the key to an ecologically sustainable development of the planet's resources. To have an understanding of the Earth and its system, fundamental research in the fields of petrology, geochronology and isotope geology, neotectonics and seismotectonics, palaeontology, stratigraphy, and remote sensing is essential and integrating inputs derived from these fundamental geoscience disciplines is necessary to develop a better assessment of the various processes shaping and affecting the Earth.

6.4.13. The need for GSI to carry on with fundamental, applied and multidisciplinary research cannot be overemphasized. On the one hand, the vast amounts of data generated and accessible to GSI make its very well placed to do so. On the other hand, the fast pace of geoscientific activity makes it necessary for GSI to develop and sharpen its research capabilities in order to retain its relevance in the geoscientific community. This is one area where the GSI academia linkage should be fostered, scientific excellence recognized and rewarded and opportunities provided to allow easy access to international scientific fora for keeping abreast with the latest developments in the science.

6.4.14. **Training and capacity building**

The task of creating a close-knit geoscientific Community has many implications. In the context of the aspiration to develop into World class institution, there is a clear underlying thought that GSI needs to ensure that the human resources under its control need to be the best, and that they need to be continuously be exposed through training and interaction to the latest technologies and practices. But GSI, in its leadership and partnering role has also to be able to help in the same way other stakeholders of the sector, including Central Institutions, State Governments and the Private Sector.

6.4.15. Accordingly, training as a Mission for GSI means an expansion in policy and scope, and GSI has to radically enhance its training infrastructure and range of services to rise to the challenge of the Vision and the Charter.

6.4.16. The existing training infrastructure of Training Institute and five field training centres will need to be expanded, with comprehensive and modern training facilities, with lab and computer support, at least at the Regional level. GSI will also need to plan out the curriculum and ensure development of resource persons and training material accordingly. Clearly this will require a management mechanism that can envision the training needs for the sector as a whole, not merely one from GSI with the overall objective of sectoral capacity building.

6.5.0. Geoscience Partnerships

6.5.1. Though not actually a Mission, the concept of partnership has now to pervade all of GSI's mission in tune with the vision. Partnerships in geoscientific areas is not only desirable for its own sake, in the Indian context, given the federal structure, it is necessary for GSI to partner with State level geoscientific organizations, particularly to enable the best use of natural resource assessments, ensure that multidisciplinary applied geoscience and special studies address local needs effectively, and geoscientific information is available for a variety of developmental purposes. Such partnerships would prima-facie seem to be highly favourable to State level institutions, since it will include capacity building, knowledge transfer, sharing of GSI's resources etc. However, in the long run it will improve GSI's ability to focus on new and emerging areas by transferring many responsibilities to State levels, as was done in the case of USGS. It will also increase GSI's outreach through project-specific partnerships.

6.5.2. Partnerships with Central institutions engaged in geosciences will also create synergy, and by avoiding wasteful effort, help GSI grow in the directions it really needs to grow. At a broad level, the basic partnership would be for information sharing and data pooling. However, it would be advisable if GSI could identify agency-specific projects for such partnerships leveraging its own strengths, particularly in geospatial information management and field presence.

6.5.3. Partnership with international institutions would be useful to GSI firstly in areas like climate change or plate tectonics where issues of a truly global nature need to be addressed. In such cases GSI

needs to be in the forefront, leveraging its position within the country and profiting from the sharing of knowledge and the developing of its expertise at the international level.

6.5.4. There are also many areas where GSI will benefit by MOUs with geoscientific agencies in other countries, particularly in terms of knowledge. Here too it is essential that GSI take a proactive role in developing such relationships in order to improve its own capability.

6.5.5. Finally GSI needs to develop partnerships with geoscientific institutions of nations well endowed with natural resources, in furtherance of the national interest even if such nations do not yet have a vast geoscientific knowledge base and in such cases GSI would have to be able to provide useful services like training and capacity building and even be able to bring to bear its core competence in survey and mapping.

6.6.0. CGPB as Trustee for the Charter:

6.6.1. The Central Geological Programming Board will be the Trustee of GSI's Charter. As has been mentioned in para 2.4.3, in keeping with the mandate of para 5.5 of the National Mineral Policy, the CGPB has been revamped and 12 Committees have been constituted so that sectoral projects and programmes are prioritized in line with national policy goals and are chalked out after taking into account the exploration work undertaking by the Private Sector.

These 12 Committees are as follows:

I. Ferrous Minerals

II. Precious Metals and Minerals

III. Non-ferrous and Strategic Minerals

IV. Industrial and Fertilizer Minerals

V. Energy Minerals and Resources (Coal, Lignite and Geothermal)

VI. Marine Geology & Exploration and Coastal Geoscience

VII. Airborne Survey and Remote Sensing

VIII. Geology & Mineral Resources of North-Eastern Region

IX. Geoscientific Investigations (Geotechnical investigation, Natural hazards, Climate Change, Environmental Geology, Shallow Sub-Surface Geology & Sub-Surface Hydrology)

X. Fundamental and Multi-disciplinary Geoscience

XI. Geo-informatics and data management

XII. Geoscience for sustainable development

6.6.2. The terms of reference of the Committees are given in *Annexure VI.I*. The Committees will function to ensure partnerships between GSI, Central and State Institutions, Academia and the Private Sector, and formulate annual plans, coordinate activities and generally functions as mechanisms to implement GSI's Visions and Charter under the overarching structure of the Central Geological Programming Board (CGPB).

Annexure VI.I

I. TERMS OF REFERENCE FOR COMMITTEES OF THE CGPB FOR MINERALS (COMMITTEE- I to COMMITTEE -V) VIDE RESOLUTION NO. 4[2]97-M.I DATED 12th MARCH, 2009

Committee I: Ferrous Minerals, Committee II: Precious Metals & Minerals, Committee III: Non Ferrous and Strategic Minerals; Committee IV: Industrial & Fertilizer Minerals and Committee V: Energy Minerals and Resources Committees of the CGPB were reconstituted with the following terms of reference:-

1. To formulate annual and five year plans for regional, detailed and promotional exploration on a national scale.

2. To review the work done so far relating to the activity domain of the Committee including the ongoing programs along with utilization of budget of promotional exploration schemes sponsored by different Ministries of Government of India .

3. To coordinate the exploration work by Government, Public and Private Agencies as per the defined plan objectives and priorities.

4. To facilitate and promote partnership between Central and State organizations and Public Private partnership in exploration.

5. To prepare status papers, long/short term perspective plans, updating manual of end-users specifications keeping in view progressive advancement of knowledge and technology.

6. To prepare and update the database (including status map) of all regional and detailed exploration involving Central, State and private agencies.

7. To formulate methodology and act as nodal agency for data sharing and dissemination.

8. To advise government on conservation and optimum utilization of minerals taking into consideration the future needs of the country through adoption of scientific mining, ore dressing and beneficiation technology in tune with global standards.

9. To ensure data filing by the concession holders engaged in regional exploration as per rule, and monitor its availability in public domain after lock-in period through an identified system.

10. To prioritize Research & Development work in the mineral sector related to exploration techniques, modernization of field/sampling equipments and beneficiation.

11. To advise Government on human resource development and training of personnel in order to strengthen the manpower of Central and State organisations.

II. TERMS OF REFERENCE FOR COMMITTEE-VI (MARINE) OF THE CGPB

1. To formulate annual and five year plans on a national scale.

2. To review the work done so far relating to the activity domain of the committee including ongoing projects;

3. To make concrete suggestions on the various on-going programmes of GSI and other organizations with reference to Plan objectives;

4. To recommend changes, if necessary, in priorities assigned to various items of work. The priorities and sharing of responsibilities between MoM and MoES have to be defined with respect to (a) systematic seabed mapping & regional offshore mineral exploration in Exclusive Economic Zone (EEZ) and also allocated deep sea areas as per mineralisation and (b) systematic seabed mapping of the Extended EEZ in future.

5. To update the classification of the coastal geomorphology and digitization of the data with a view to use these data for planning remedial measures for coastal disasters.

6. To propose reclassification of offshore data generated by various organizations for data dissemination to various user agencies keeping in view the strategic and classified nature of the offshore data and to work out the modalities of exchanging the same amongst member organizations as well as in the public domain.

7. To prepare status papers, long/short term perspective plans and creating end users specifications in view of new developments in NMP 2008.

8. To suggest collaborative programme between GSI and other member organizations and specialized institutions in India and abroad for development of knowledge in marine geosciences.

9. To advise on any other matter of special significant relating to the particular activity domain viz., coastal geoscience, geotechnical parameters, environmental assessment etc. as considered necessary by the Committee.

III. TERMS OF REFERENCE FOR COMMITTEE VII (Airborne survey & remote sensing) OF THE CGPB

1. To formulate annual and five year plans on a national scale.

2. To review the work done by various organisations so far relating to the activity domain of the Committee.

3. To make concrete suggestions on the various on going-programmes of GSI and other organizations with reference to Plan objectives.

4. To develop mutual interaction and collaboration amongst the different organizations with a view to share databases and developing applications for making least use of the information for geoscientific purposes.

5. To promote dissemination of basic aerogeophysical data and maps in the public domain and find out ways to remove restrictions in sharing aerogeophysical data or suggest suitable remedial measures necessary from time to time.

6. To review and monitor technological developments in airborne and heliborne remote sensing and suggest new and cutting edge technology for adoption for survey and mapping, including hyperspectral and gravity mapping.

7. To review the prevalent rules/restrictions of acquisition, processing, utilization, archiving and publication of data accrued through RP/LAPL.

8. To advise the Government on any related matter as the Committee consider necessary.

IV. TERMS OF REFERENCE FOR COMMITTEE VIII (North-Eastern region) OF THE CGPB

1. To formulate annual and five year plans on a regional scale.

2. The Committee to act as a common platform for all participants (Govt., public, private, universities, R&D institutions etc.) in the field of Geoscience activity.

3. To monitor and co-ordinate all Earth science related activity in NER by the different stake holders, both public and private, for mapping, exploration & exploitation of mineral resources.

4. To address all issues related to the fragile ecosystem of the Region in terms of both natural and anthropogenic hazards.

5. NER being the hydropower store house of the country with both public and private organizations engaged for its development, the Committee will act as a common platform to deliberate/ resolve all issues particularly directed towards geological surprises and engineering solutions on water resource development.

6. To recommend changes, if necessary, in priorities assigned to various items of work.

7. To prepare status papers on various emergent issues, long/short term perspective plans.

V. TERMS OF REFERENCE FOR COMMITTEE IX (Geoscientific investigations) OF THE CGPB

1. To formulate annual and five year plans on a national scale.

2. To advise the Government from time to time on societal issues arising out of natural hazards and to suggest probable preventive / mitigation measures including rehabilitation.

3. To monitor and collect data systematically (where possible on a spatial basis) on a large number of parameters relating not only to landslides and Earthquakes, but also other public-health and public good issues having a geospatial dimension like Arsenic, Fluorine pollution, etc.

4. To review the work done by different organizations including NNRMS, PM Committee on Climate Change, etc. and to assess their proposals for future work and to identify the gap areas for future course of action in the geoscientific domains under the purview of the Committee.

5. Promoting use of the state-of-the-art and research in the geo-environmental and natural hazard domains for effective management of the Earth system and its resources.

6. To enable integration of relevant data sets including spatial data in order to help develop a GIS application for planning, management, prevention, etc. in respect of various geoscientific related events including natural hazards.

7. To advise CGPB on any other urgent matter relating to the particular activity domain, as considered necessary by the Committee.

8. The Committee is empowered to convene meetings on smaller groups on specialized subject matter with specific agenda.

VI. TERMS OF REFERENCE FOR COMMITTEE-X (Fundamental and Multi-disciplinary Geoscience) OF THE CGPB

1. To promote and prioritize research in the field of fundamental and applied Geoscience (Geology, Geophysics, Geochemistry, Geomatics).

2. To encourage better understanding of geological process in the crust and lithosphere, evolution of Earth, localization of minerals, etc.

3. To review the state of education in Geosciences and make recommendations to improve the quality of geoscientific education particularly at higher levels in order to improve the pool of geoscience talent

4. To review policy relating to Geoscientific research and make recommendations for improving research infrastructure, funding etc; and ensure better mutual coordination between field practices and fundamental research.

5. To continuously review global technological advancements in instrumentation (analytical and scientific) and methodologies and recommend state-of-the-art techniques to be adopted, in order to modernize the laboratories, to bring these at par with international standards.

6. To facilitate and coordinate sharing of laboratory facilities available with different organizations for optimum use.

7. To promote R&D work for evolving new and efficient techniques in the mineral exploration and mining, for locating new mineral resources, value addition, maximizing utilization and conservation of existing natural resources.

8. Participation of different organizations in preparation of Standard Reference Material.

9. To help improve the geoscientific knowledge within the States and Central institutions by training or other knowledge acquisition measures for the existing personnel both in field and laboratory techniques and to suggest knowledge sets of personnel for the future.

10. To focus the long term and short-term activity domains and working plans of different organizations.

11. Collection, maintenance, preservation and documentation of Earth science samples for curatorial, geological and chemical studies and for exhibition and display purposes

VII. TERMS OF REFERENCE FOR COMMITTEE XI (GEOINFORMATICS) OF THE CGPB

1. To promote use of information technology in geoscientific activity, develop Geoinformatics with a strong spatial and attribute database.

2. To facilitate coordination among geoscientific agencies to develop common standards and sharable databases under the NSDI architecture; and encourage wide and easy dissemination of geoscientific information through Internet based technologies.

3. GSI and other Central Agencies including NNRMS, and state DGMs to work together to create a distributed national geological information system.

4. To review and adopt standards and protocols for developing the system (including metadata).

5. To coordinate with Mining Tenement & Registry System being developed by IBM.

6. To formulate policy and advice CGPB for providing access to quality and unique geospatial and non-spatial data.

7. To develop new methodologies for sophisticated management of data through the use of domain enriched software to produce 3D and modelling out puts.

8. To review the work done so far relating to the activity domain of the Committee, with reference to GSI Portal.

VIII. TERMS OF REFERENCE FOR COMMITTEE–XII (GEOSCIENCE FOR SUSTAINABLE DEVELOPMENT) OF THE CGPB

1. To facilitate integration of geoscience into policy making for environmental issues and to transmit the concepts to potential interest groups including policy makers, non-governmental environmental agencies and general public

2. Help develop a framework and methodology for promoting sustainable development strategies (including optimum land use) through best use of geoscientific data gathered in the course of survey and exploration by GSI and other geoscientific organizations in the country.

3. Assist nodal agencies concerned by developing new areas for geoscientific data collection, particularly spatial data such as geomorphology to help them analyze ecosystem functions and make informed planning decisions.

4. The Committee may co-opt other institutions as invitees.