15 Development of North Eastern Region

NORTH EASTERN REGION

15.1 The North-Eastern Region (NER) of India comprise a unique agglomeration, with a diversified geological set-up. The spectacular physiographic set up includes the stunning Himalayan mountain belt in the North, the Indo-Myanmar Range in the east and the mighty Brahmaputra, forming the extensive Assam plains. The diverse lithologic and tectonic ensemble calls for integrated geoscientific studies to identify and outline target areas pertaining to mineral resource evaluation, mitigation of natural hazards, environmental issues and water resources development projects.

15.2 The North Eastern Region represents varied, geomorphological and geological setup which is ranging from Precambrian to Recent age. It is manifested by spectacular Himalayan Mountain Belt in the north; Shillong Massif Plateau in the south and mighty Brahmaputra forming the extensive Assam plain in between and Indo-Myanmar Range in the east.

Weathered and oxidized chromite band, Ophiolite belt, Manipur

Work done by Geological Survey of India (GSI) in North Eastern Region

15.3 A total of 31 (excluding items of Regional Training Institute) investigations were carried out in NER (including Sikkim) during annual programme of 2009-2010. A brief summary of the highlights pertaining to that period is given below.

MISSION: I Baseline Geoscience Data Generation

SURVEY & MAPPING

Regional Survey

Systematic Geological Mapping (scale: 1:50,000)

15.4 In the item systematic geological Mapping in parts of Mokokchung, Longleng & Tuensang district, Nagaland the area was mapped on 1:50,000 scale. The study area exposes Disang and Barail Group of rocks. The Barail Group exposes Laisong Formation represented by thick and well bedded sandstone (80%) and thin band of shale (20%) with coal seam (1-2m thick). The contact between the Barail Group and Disang Group is gradational. Based on the petrographic studies the Laisong are classified as quartz arenite, sub-arkosic arenite, sub-lithic arenite and micaceous. The general strike of these formations trending NE to SW with moderate to steep dips on either side.

Specialised Thematic Studies (scale: 1:25,000)

15.5 In North Eastern Region three items of Specialized Thematic Mapping were taken up in the states of Assam, Arunachal Pradesh, Meghalaya and Mizoram.

- The item on "Specialized Thematic Mapping on

1;25,000 scale along Assam - Arunachal foothills in parts of T.S. No. 83B/9 & 13 in Sonitpur district, Assam and West Kameng dstrict, Arunachal Pradesh has been taken up to build up the litho-chrono-stratigraphy- of the area and to delineate the Neogene - Quarternary boundary with the aid of micropalaeontological studies.

- Specialized Thematic Mapping and tectono metamorphic studies of the gneiss-quartzite / schist contact and their stratigraphic relation along the eastern margin of Shillong Basin in parts of East Khasi Hills and Jaintia Hills districts, Meghalaya is taken up for elucidation of the gneiss-quartzite contact and their stratigraphic relation along with related structural and tectonomagmatic / metamorphic studies and search for mineralization, if any.

- The item on Specialized Thematic Mapping in the selected areas of (i) west of Ngopa 84E/1 (ii) Around Khawzawl 84E/2 (iii) South west of Cherhlun 84F/1 Champhaiand Serchhip districts of Mizoram on 1:25,000 scale is carried out with the objective of establishing the detailed lithostratigraphy, to ascertain the thickness of sedimentary sequence, occurrence of unconformity between Barail and Surma Group of rocks and mineral deposits, if any.

Geochemical Mapping (GCM)

15.6 The following three programmes were taken up during the period:

- Regional geochemical mapping in Toposheet No. 78J/,8 & 11 in Goalpara and Bongaigaon districts, Assam.

- Regional geochemical mapping in Toposheet No. 78O/11 in parts of East Khasi Hills district, Meghalaya.

- Geochemical mapping in Toposheet No. 78A/3 & 4 covering parts of West and South districts, Sikkim and Darjeeling district of West Bengal.

Geophysical Mapping (GPM)

15.7 A gravity-magnetic survey was carried out in parts of East and West Khasi Hills districts, Meghalaya (GPM/NER/RHQ/2009/002) in toposheet 78 O/11. In the magnetic (TF) anomaly map magnetic variations have been observed over different geologic domain mostly in the western part, eastern and southeastern part and southern and southwestern part of the toposheet. These zones possibly represent Porphyritic Granite body, Shillong group of rock and Sylhlet Trap and Tertiary respectively. In addition to that, clustering of magnetic anomalies has been observed in central part of the study area.

Mission II: Natural Resource Assessment (MINERAL EXPLORATION)

Iron Ore

15.8 In Meghalaya, reconnaissance (G-4) stage investigation has been carried out for assessment of iron ore potentiality in the northern part of East Garo Hills district. Large scale mapping (1:10,000) along with pitting/trenching and collection of bedrock samples are accomplished in Athiabari area in toposheet no: 73K/13. The BMQ bands trending NE-SW is usually exposed as discontinuous bands over a strike length of about 2 km with width ranging from 10 to 85 meters. These bands continue further towards north. Two trenches and six pits were excavated in the unexposed portions of the area to establish the strike continuity of the potential BMQ bands and also to study the contact relationship between the gneissic rocks and the BMQ. The depth persistence of the iron ore bands may be limited. In many portions of the area the iron ore also occur as floats.

Platinum Group of Elements (PGE)

15.9 In Manipur, reconnaissance (G-4) stage

investigation for PGE in ophiolite belt was carried out. The ophiolite suit comprises serpentinised peridotite, peridotite, pyroxenite with minor plagiogranite which has a general trend of N-S to NNE-SSW and shows varying degree of tectonic alteration and serpentinization. Three discontinuous lenses (3m x 1m) of massive chromite have been observed within serpentinised ultramafic. The ophiolite suits are emplaced into the pelagic sediments of Tertiary age. The contact between sediments and ophiolite is sharp, sheared and shows intense brecciation (1-3m). Cr203 content of chromite is 44-59%.

Basemetal

15.10 In Meghalaya, reconnaissance (G-4) stage investigation for base metal and REE mineralization in parts of Umphyrnai area, East Khasi Hills district was taken up. The channel samples from the adjoining area i.e. east of Pomlakrai reveals that there is a segment with high value of copper i.e. 310 ppm to 950 ppm. Occurrence of secondary uranium- lead and high value of REE and thorium has also been reported. In the present area the lithounits of quartzite & acid volcanics are trending NE-SW and two shear zones have been traced, one trending along E-W and the other along N450W. Specks of primary oxidized sulphides were noticed along thinly banded acid metavolcanics.

10.11 In Sikkim, reconnaissance (G-4) stage investigation for basemetal and gold was taken up in Chakung-Jugdum area, West district during the FS 2009-10. The item was taken up on the request of DMMG, Sikkim with a geoscientific partnership. The copper mineralization is mainly confined to the quartz veins occurring in fractures and shears in chloritic phyllite of Gorubathan Formation of Daling Group. During FS 2005-06 some anomalous spot values for gold has also been reported from the adjoining areas. Presently systematic sampling is being carried out for a strike length of more than 1 km in Jugdum block covering all the three old workings, reported earlier.

Industrial Minerals

10.12 In Assam, a reconnaissance (G-4) stage investigation for glass sand was taken up in Jiyajuri-Chapanala areas, Nagaon district in FS 2009-10. The mapped area is essentially occupied by quartzite of Shillong Group ((Palaeo-Mesoproterozoic).The quartzite occurs within Pulibagan to the west and Parkup to the east can be described as friable quartzite and appears to be suitable for glass sand industry. However, the block between Jiyajuri and Champawati is of immediate interest. The width of the quartzite varies between 0.5km and 1.5km.

Misssion: III Geoinformatics (Dissemination of Information)

- A total of 335 maps on 1: 50K scale have been uploaded in the portal till September 2010.
- The metadata of about 1254 nos. of reports of GSI have been uploaded.
- 56 nos. of full reports published pre and post 2004 have been accommodated in the GSIPORTAL for consultation and downloading as per the new dissemination policy of the Govt.

Mission:IV Fundamental & Multidisciplinary Geosciences and Special studies (SPECIALIZED INVESTIGATIONS)

Geotechnical Investigations

10.13 Following is the list of investigations taken up:

Geotechnical evaluation of water resource development projects in Arunachal Pradesh

(a) Bichom Dam Complex (Kameng H.E. Project, Package-I) Construction Stage, W.Kameng district, Arunachal Pradesh, T.S. No. 83A/11

(b) Kameng H.E. Project, (Construction Stage) West Kameng district, Arunachal Pradesh (T.S. No. 83A/11)

(c) Kameng (Kimi) H.E. Project, West Kameng district, Arunachal Pradesh.

(d) Pare H.E.Project, Papumpare District, Arunachal Pradesh, Sponsor: NEEPCO

(e) Bana H.E.Project: East Kameng District, Arunachal Pradesh, Sponsor: KSK Dibbin Hydro Power private Ltd.)

(f) Construction stage Geotechnical Investigation for Kameng H.E. Project, Package-II, Tenga Dam Site, West Kameng district, Arunachal Pradesh. Sponsor: NEEPCO

Geotechnical evaluation of water resource development & other projects in Assam

(a) Lower Kopili H.E. Project, North Cachar Hills district, Assam.

(b) Kulsi H.E. Project, Kamrup district, Assam, Sponsor: Brahmaputra Board

(c) Killing H.E. Project, Karbi Anglong district, Assam, Sponsor: Brahmaputra Board

(d) Geotechnical Investigation for Food grain Godown, FCI complex, Tura, West Garo Hills district, Meghalaya. Sponsor : FCI

Geotechnical evaluation of water resource development projects in Meghalaya

(a) Jadukata (Kynshi) M.P. Project (Stage-II), West Khasi Hills district, Meghalaya.

(b) New Umtru H.E .Project, R-Bhoi district, Meghalaya, Sponsor: MeECL

(c) Umngot H.E.P., East Khasi & Jaintia Hills districts, Meghalaya (Sponsor - MeSEB)

Geotechnical evaluation of water resource development projects in Mizoram

(a) Tuichang H.E. Project, Lunglei District, Mizoram, (Sponsor: CWC)

Exposures of ophiolite in Manipur

(b) Tuipui H.E Project, Champhai District, Mizoram. Sponsor:CWC

Landslide Hazard Studies

Arunachal Pradesh : Landslide Hazard Zonation Mapping in the Catchments Area for Dibang Multipurpose Project, Lower Dibang Valley District was taken up as a sponsored project of NHPC Ltd. The area falls in the moderate to High Landslide Hazard Zone.

Meghalaya : Meso Scale Landslide Hazard Zonation of Shillong Town, East Khasi Hills District: A total area of 30 sq. km out of the 170 sq km (approx.) of Greater Shillong Planning Area (GSPA), was selected for preparation of landslide hazard zonation map on meso scale (1:10,000) to asses the vulnerability of area to landslide. On the basis of slope characteristics, the entire area has been categorized into 1434 numbers of facets. Most part of the area studied falls under thickly to moderately populated slope category. A few probable landslide prone zones were identified within Shillong town. Two nos. of old debris landslides have been reported in the study area.

Nagaland: Site Specific Studies of Zubja Landslide, Kohima District: The Zubja landslide located on NH-39 (the only life line for the states of Manipur and Nagaland) near Zubja village, Kohima district, is an active rock cum debris slide and subsidence zone. The

landslide is mainly due to a combination of the factors like presence of old landslide zone, construction of NH above the crown of a huge landslide, heavy traffic in small hilly road, improper training of drainage and anyhropogenic interference.

Sikkim: Detailed geotechnical investigation of Andherijhora Landslide, East District was taken up. Besides , Kyongnosala Land Slide across Gangtok - Nathula Highway (NH31A) and Integration of expert know-how for instrument aided monitoring of the 9th Mile Slide Zone in Sikkim were also carried out.

Preparation of Landslide Inventory of North Eastern Region And Updation of Inventory: The first volume of the landslide inventory documents incorporates data on landslide occurrences up to F.S. 2001-02 and a total of 314 nos. of landslide incidences were studied and incorporated encompassing seven states of North Eastern Region. The second volume, incorporating data on landslide occurrences w.e.f. F. S. 2002 - 2003 has been taken up. A total of 144 landslide incidences have been recorded from FS 2002-03 to FS 2008-09 as per the available database/ reports from the states of NER viz. Assam (5), Arunachal Pradesh (14), Meghalaya (61), Manipur (21), Mizoram (26), Nagaland (16) & Tripura (1).

Seismic Studies (Earthquake Geology)

Study of Ultapani-Saralbhanga-Lalbhita-Singimajli-Ripu-Penkhua (USLSRP) was continued in Kokrajhar District (BTAD), Assam. During the period field investigation has been carried out which includes (i) geological and morphotectonic mapping on 1:50,000 scale in the Penkhua Block constituting part of the western segment of 30 Km long USLSRP active fault (established previously) (ii) Study of scarp morphology through measurement of profile sections with cumulative length of 1 LKm across northerly facing scarps of Balukhola river and its E-W trending tributary (iii) the GPS monitoring in campaign mode involving the data acquisition for the third consecutive epoch on the 6 existing pillars.

Active Fault Studies around foothills of Mishmi Block of Arunachal Himalaya was taken up. The work done includes Photogeology and Remote Sensing (PGRS) study for an area of 1000 Sq.Km using ETM+ (Landsat 7), TM (Landsat 5) and MSS (Landsat 3) satellite imageries and SRTM (90 m resolution) elevation data with the help of ILWIS 3.1 (Academic) Image Processing Software, geological mapping on 1:50000 scale for an area of 70 Sq.Km and profile section measurement/ terrace mapping for 0.5 LKm on the S.O.I. toposheets 82 P/11, 12 &16.

The item taken up in and around Arya Patty area and Govindapur village (ward no. 2) on the bank of Barak river, Silchar, Cachar district, Assam for preliminary geological investigation of ground deformation. The preliminary geological investigation revealed that the fissures and subsidence along the bank of Barak river is mainly due to fluctuation of water level and neotectonic activities prevailing in the Barak river basin. The suggested strategies for controlling bank erosion and degradation of land include the measures that will protect the area from the actions of running water, such as, the plantation of quick growing plant species and appropriate trees as well as designing project parameters.

Geohazard (Environmental Studies)

Geoenvironmental appraisal in areas around industrial growth centre, Bodhjungnagar, West Tripura, Tripura, has been carried out. Micro relief and landform mapping on 1:10,000 scale have carried out in an area of 2.8 sqkm. The environmental hazards, identified in the area are due to anthropogenic as well as geogenic processes. The anthropogenic effluent waste along with foul/toxic odour of H2S gas from the Rubber Industry is released in the lungas and flows down and affects/ degrades soil fertility. The effluent rich nalas pollute the surface and subsurface water and indirectly affects the human and animal health. Though

the Industrial authorities have laid embankments across the lunga to stop the flow but during the monsoon season, it overflows the embankment affecting the down stream areas. The geogenic hazard includes iron contamination of ground water. The iron content in the water ranges from 2.52 to 8.93 ppm, which exceeds the permissible limit of 1 ppm (BIS 1991). The lithological peculiarity of the undulating tilla surface comprising of unconsolidated/ unlithified loose sediments of clayey silt, silty clay to silty sand give rise to base level undercutting and erosion by the running water of the stream and nalas which remove the loose material during the monsoon period and cause landslides along the channel. Due to this, a considerable amount of sediment is generated which settles on the nala course.

Climate Changes

Glaciology

15.14 On demarcation of glaciated regime in catchment and identification of potential source of water to Tamze Lake for providing water to Gangtok town, Sikkim, a reconnoitery survey of adjoining area around Tsong (Changu) Lake was undertaken during April, 2010 for evaluating alternate water source for Gangtok township. The existing water supply system of Gangtok township, which has an installed capacity of 36 MLD, was also visited. Updating the inventory of glaciers in Sikkim Himalaya was being continued.

Fundamental Geoscience

Petrogenetic studies on Kyllang granite pluton was carried out with the help of petrography, mineral chemistry and fluid inclusion studies. Kyllang pluton is syn-tectonically emplaced into the gneissic country rock of Meghalaya. It is very coarse-grained, porphyritic (megacrystic) granite with varied proportion of mafic minerals, and microgranular enclaves (MME). In the vicinity of Kyllang pluton one more granite body is recorded. It is grey coloured, leucocratic, and porphyritic granite. This is relatively finer than the Kyllang granite. The late intrusive phase in Kyllang pluton is alkali feldspar granite, which exhibits hypidiomorphic texture. The major and accessory mineralogical assemblages, An content of feldspar and biotite composition suggest the granite is I -type and ACG (Amphibole-bearing Calc-alkaline Granitoids (Low K-High Ca). MME in granite possibly suggest an evidence of magma mixing (?)/ assimilation.

Petrogenesis of the mafic - ultramafic and dioritic rocks within gneisses in Umling - Lailad - Jirang - Nongkhlaw areas, Meghalaya with special reference to its mineral potential were carried out with the help of detail petrographic studies supported with field observations. Field study reveals that these rocks are mica rich, melanocratic, coarse to very coarse grained, massive exposed haphazardly within the basement gneiss. At Nongkhlaw, a small gneissic enclave found within the

Table 15.1

Budget and expenditure of GSI for the Northeast Region for the Financial Year 2010-11

₹ in crore

		NER Approved BE	Exp. Till Oct. 10	% against B.E
1.	Survey & Mapping	5.02	4.14	82.47
2.	Mineral Exploration	1.67	1.27	76.05
3.	Special Investigation & other Exploration (Investigation)	0.72	3.54	491.67
4.	R&D	3.56	0.82	23.03
5.	Information Dissemination	1.83	0.55	30.05
6.	Human Resource Development	0	0.02	–
7.	Modernisation & Replacement	3.40	0.09	2.65
	Total	**16.20**	**10.43**	**64.38**

very coarse grained; mica rich melanocratic rock indicates intrusive relationship with basement gneiss. Sulfide mineralization is found very often within these bodies. The central portion of the rock is relatively coarse grained compared to the marginal part and has more or less same mineral composition but modally it is higher in plagioclase feldspar, biotite and less in pyroxene.

Systematics, diversity and biogeography of some major group of macro invertebrates from the Upper Cretaceous sediments of Meghalaya Basin with a special emphasis on brachiopods has been carried out with the aim to systemaically study some invertebrate taxa from the Upper Cretaceous of Meghalaya involving statistical methods wherever applicable, interpret the palaeoenvironment and the palaeobiogeography. A diverse assemblage of invertebrate taxa represented by echinoids, gastropods and bivalves has been recorded in the Mahadek Formation and Langpar Formation. The two dominant echinoid genera Conulus and Stygmatopygus show wide biogeographic distribution. Conulus has been recorded in the entire North European Province and also the Tethyan Province Bivariate plot of size of the Conulus population from Meghalaya with other biogeographic regions shows that the Meghalaya form attained a larger size and is younger than the European species.

Search for Micro Mammals, Micro vertebrate and Invertebrate fossils in the intertrappeans of Sylhet traps in areas around Thalan, Dewsaw and Shella, East Khasi Hills of Meghalaya: The project aimed at better correlation of the Mesozoic sediments of India based upon reported occurrence of micromammals, microvertebrates and microinvertebrates in Mesozoic rocks of Meghalaya. A thorough search was carried out to locate any intertrappean rocks, with in the Sylhet trap of the area but no intertrappean sediments are observed; a reported thin impersistent band of intertrappean sediments observed at Thalan area appears to be a joint filling by percolating water. An acme zone of Echinoids was marked within sandstone of Mahadek Formation, near Phlang- Mawsyrpat area where the Echinoids were observed to be exposed both randomly and in groups. The item will be continued.

Work Done by Indian Bureau of Mines in North Eastern Region

15.15 The Sub-regional office of IBM at Guwahati continued to undertake inspection of mines and studies on development of resources of the North-Eastern region. During the year 2010-11 (upto December 2010) 04 mines / areas were inspected for enforcement of provisions of MCDR 1988 and for processing & disposal of mining plan / scheme of mining.

15.16 Forty-two chromite samples for 882 radicals were analyzed for the Directorate of Commerce and Industry, Manipur.

15.17 Two training programmes viz (i) Workshop-cum-Meeting on North Eastern Special Assistance Programme at Kohima and (ii) Training Programme on Preparation of Mining Plan / Scheme of Mining / Final Mine Closure Plan at Udaipur were conducted, in which a total 25 personnel from North-Eastern region participated.

Work Done by MECL in North Eastern Region

15.18 MECL has been associated with mineral exploration activities and geo-technical studies for the development of mineral industry in the North Eastern Region in last 29 years. It has completed exploration for caol in 15 blocks in the states of Assam, Arunachal Pradesh, Nagaland and Meghalaya on behalf of Ministry of Coal, North Eastern Council and CMPDIL. Under its promotional programme funded by Ministry of Mines, it has completed mine schemes which include copper, sillimanite, glass sand, shell limestone and Ferro-Silicon grade quartzite in the states of Assam, Meghalaya, Mizoram, Sikkim and Arunachal Pradesh. In addition, it has carried out geo-technical studies on behalf of Brahmputra Flood Control Board in the state of Assam and Arunachal Pradesh and consultancy work

for remote sensing studies at Tripura on behalf of Ministry of Mines. Exploration services were also rendered to Atomic Mineral division involving survey, drilling & mining in Umarangaon/Domiaset block, West Kasi Hill district.

15.19 During 2010-11, detailed exploration for limestone in Western part of Tongnub Sourth East Sub Block, Litang River Valley in Jaintia hills distt. of Meghalaya and exploration for dolomite in Rupa dolomite prospect in West Kameng district Arunachal Pradesh, were taken up and physical activities, i.e., geological mapping and exploratory drilling in both the projects are under progress.

15.20 In addition to above, detailed exploration of limestone at Nimi-Pyakatsu block, district Kiphire, Nagaland at an estimated cost of ₹113.57 lakhs will also be taken up in which field work shall be carried out by DGM, Nagaland and laboratory & report writing work will be taken up by MECL.

15.21 Further to above, on behalf of Directorate General of Hydrocarbon, Govt. of India, MECL with BRGM France has completed studies for resource estimation in respect of oil shale deposit in an area of 254 sq.km. of Assam & Arunachal Pradesh. this will help in revealing the oil potential in the shales of North Eastern Region of the country. The physical work includes input of 2818 m of drilling in 8 borehole along with associated geological activities. The detailed project report has been submitted as scheduled.