OGSA

Newsletter

Orissa Geological Service Association

September 2011
Volume-XXIV

Inside this Issue

EDITORIAL

Mineral Prospecting has been a different kind of challenge to mankind ever since its existence. Man has been trying to search and utilise the minerals for livelihood since time immemorial. This makes Geology a coveted branch of science where skill, imagination and commitment play a vital role for success. Usage of minerals has been multiplied over the years. This has invited a need for expeditious discovery of new deposits to cater to the booming demand and a secure future. Judicious consumption, value addition, conservation are the call of the time. But the most effective way to face the rising need of minerals is through intensive exploration of mineral deposits.

Orissa fortunately provides conducive geological setup to host an array of minerals. The existing resources in the state match some of the continents in quality and volume. But unfortunately, the level of exploration being undertaken in the State is not at par with other strong mineral economies of the World. Lack of awareness is a key factor. Lessees sitting pretty with huge concession areas for decades are yet to carry out systematic exploration inside their leasehold areas. Thus a few blunders may certainly take place. They may dump over the mineralised patches. They may also exhaust the high grade material ahead of the low grade stuff to follow, with which they could otherwise blend the material before selling.

Directorate must play the lead role in showing light to these entrepreneurs. In fact a dedicated **Exploration Counseling Cell** should operate in the Directorate of Geology to provide with vital exploration related information to the aspiring miner. This may come handy in guiding the mining community for proper and systematic exploration methods according to their situations.

Mineral Prospecting in the recent times has seen a sea change in technology and equipment. Dozens of tools have arrived to assist the conventional geological mapping through a compass and hammer. Remote sensing brought about the first major breakthrough in exploration methods by providing speedy coverage, synoptic understanding of regional structures and many other advantages. Then came the airborne surveys. Interpretation of magnetic, radiometric, gravity, electro-magnetic and other geophysical information acquired from aircrafts now boast to provide continuous coverage of geology irrespective of water, soil and vegetal cover. Aeromagnetic data help in understanding some of the deep structures and litho packaging that no other tool can provide. The use of the data is unanimous in advanced mineral economies like Australia and Europe.

Directorate is blessed with a comprehensive dataset of high resolution airborne magnetic, radiometric and elevation data over 3,30,000 line km in its database. Data is available of sale. But not many indigenous companies are coming up to buy and use the data for their exploration activities. Barring the low awareness factor, the other issues creating hindrance in use of the data is the price tag. Data at present is priced at US$ 3.00 per line km, which is exorbitant by all standards. Similar data in some other countries are given away by the respective Governments free of cost to the aspiring explorer. In some other countries there is a token price of a few cents per line kilometer. The idea is to invite more and more people to use the data and make new mineral discoveries. Multiples of the acquisition cost in turn can be recovered through the royalty of the newly found mineral resources. The Orissa database has cost the State exchequer a sum of about Rs 58 crores. This can be considered as a small investment to boost up the mineral exploration scenario in the region. There should be rush to step up data sales through publicity and awareness campaigns. But not in order to hastily recover the investment. This should be achieved by educating people to make use of the data. A Counseling Cell may be giant leap towards this.

Exploration counseling cell

GEOMORPHOLOGICAL STUDIES ALONG ORISSA COAST

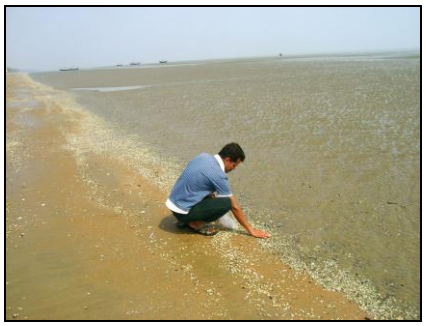
J P Behera, Geologist
S A Jena, Geologist

Landuse/ land cover and geo-morphology are intricately inter-woven with each other. Hence, for any landuse planning and development, study of geo-morphology is quite essential. The geomorphological study with special reference to coast is very important as the coastal areas are resourceful (such as coastal forests, mangroves, surface water/ground water, agriculture, fertile soil, marine/brackish water fisheries etc.) and are thickly populated, which need planned utilization of land resources. Further, coastal areas are highly dynamic in nature, hence the landforms developed by different natural agencies do not require much time to change rather it can change within hours or minutes. Therefore, all these features of coastal environment warrant continued attention for conservation and sustainable development of natural resources and a scientific management in long term basis.

Under these backdrop geo-morphological studies, along 480 km long Orissa coast, using remote sensing technique (IRS-ID PAN and LANDSAT ETM+ data were used for the purpose) was taken up by Directorate of Geology under the sponsorship of Ministry of Environment of Forests (MoEF), Govt. of India. The work was initiated in F.S.-2002-03 and continued intermittently in field seasons -2007-08 and 2010-11 and the entire coast of Orissa was covered under the process. The study area (covering 480 km long Orissa coast, with a width of 10 km inland from the present shore line) is bounded by latitude 19° 00' 00" to 21° 45' 00" N and longitude 84° 37' 30" to 87° 29' 4.37" E and encompasses 78 Toposheets in 1:25,000 scale. An area of 9460 sq. km. was covered under geomorphological mapping.

Utility of the Project

- The sand dune complexes/ beach ridges identified in the area will be helpful in heavy mineral and ground water exploration
- The degraded coastal forests identified on the sand dune complexes can be subjected to forest plantations
- The tidal flats in the area can be developed for aquaculture/ prawn culture/ pearl culture
- Beach/ river erosion and water logged/ drainage congested areas have been identified for remedial measures
- Areas affected by saline water intrusion have been identified for remedial measures
- Wetlands have been identified for development of aquaculture and water sports
- Areas have been identified for raising shelter belt plantations adjacent to coast line
- Identification of water sports areas
- Close relationship between geomorphology and land use has been highlighted
- The maps can be used for Coastal Zone Management Plan (CZMP) for sustainable development
- New beaches have been identified for development of tourism and recreation as well as for safe nesting of Olive ridley turtle. The lime shell deposits along Balasore coast can earn sizeable revenue



Lime shell deposits at Kusumali beach, Balasore

Lime shell collected by locals for poultry feed

- Degraded mangrove areas have been identified for restoration

Mangrove Plantations at Balasore coast

The rich data base and maps produced under the project can be utilized by different end users, NGOs, planners and researchers for proper planning and development of coastal zone of Orissa.

LINGAPADER BAUXITE DEPOSIT, KALAHANDI DISTRICT

M K Oram, Geologist

The investigations for locating bauxite bearing plateaus around Lingapader were carried out during the field season- 2010-11. The bauxite bearing plateau of Lingapader is continuously exposed from north of Karlapat to south of Betkote. Physiographically the plateau can be divided into two blocks namely north of Lingapader and east of Lingapader. Both blocks are linked through a narrow ridge of hard laterite having the width of 20 meters.

North of Lingapader block is the largest plateau in the study area and is located 1 km. north of Lingapader village in Thuamul Rampur block of Kalahandi district. The north of Lingapader plateau is features in T.S. No. 65M/2 and is bounded by longitude 83^0 08' 20"N to 83^0 09' 40" N and latitude 19^0 42' 25" E to 19^0 43' 50" E. It is extending in NW-SE direction having a length of 2km and maximum width of 0.9km with an area of 1.5sq km. The plateau rises to a height of 1040m above mean sea level (MSL). Scarp sections are well developed on periphery of the plateau and thickness of the scarps vary from 4m to 8.6m. At places caves and saucer depressions are also developed in scarps and surface of the plateau respectively. Perennial first order

streams are well developed in slope and flow in all directions of the plateau. Plateau is partly covered by grasses and Sal forests.

Channel sampling on the scarp section of Bauxite plateau

During study it was observed that the plateau consists of khondalite striking $N15^0W$-$S15^0E$ dipping 80^0 towards east. Khondalite is the major source of aluminous content. Both laterite and bauxite are formed from highly migmatised khondalite by the process of *in situ* weathering of khondalite. Due to chemical enrichment more alumina is leached downward during the period of lateralization. The bauxite deposits occur in shape of blankets overlain by lateritic capping. The bauxite is gibbsitic in nature, porous and soft to moderately hard having buff, brownish yellow and reddish brown in colour. In total 367 bauxite samples (including 151 channel samples) have been collected from the plateau. The average grade of the bauxite is Al_2O_3 -37%, reactive SiO_2 - 0.20%, non reactive SiO_2 - 6.57%, TiO_2 - 2.68% and Fe_2O_3 - 31.14%, which is analyzed from 40 channel samples.

KANIGUMA BAUXITE DEPOSIT, KALHANDI DISTRICT

T B Munda, Geologist

Bauxite was named after the village Les Baux in southern France, where it was first recognized as containing aluminium and named by the French geologist Pierre Berthier in 1821. Bauxite deposits around Kaniguma are associated with khondalites and charnockites of Eastern Ghats Super Group of rocks. It occurs at an altitude of more than 900m above mean sea level and forms a gently undulating blanket over the parent rock with a slope of 10^0 to 12^0. It may be exposed to surface as well as covered by thin soil on the top of the plateau covered by sparse vegetation, where as the slope of the plateau is covered by dense forest. Bauxite plateaus are the main source of perennial streams of the area.

The Bauxite is reddish brown in colour, highly porous with low specific gravity and gibbsitic in nature. Under microscope, gibbsites appear as tiny crystals in bizarre orientations. Few tabular crystals of gibbsites show lamellar twinning. Recrystallised gibbsite microllites are forming colloform bands. Some microcrystalline gibbsites are lining the cavities in the rock. Some veins of iron solutions are following the cracks of relict garnets.

Differences between the Bauxite deposits of khondalite and charnockite origin in this area are as follows.

- Areas of Bauxite plateaus of charnockite origin are smaller than plateaus of khondalite origin.
- Vertical scarp faces are well developed in bauxite plateaus of khondalite origin and absent in plateaus of charnockite origin.
- Caves are noticed in khondalite bauxite plateaus and absent in charnockite bauxite plateaus.
- Thickness of the bauxitised zone is more in the khondalite origin than charnockite origin.
- Al_2O_3 content is more and SiO_2 content is less in bauxite of charnockite origin than bauxite of khondalite origin.

PETROGRAPHIC SIGNATURE OF GIBBSITISATION IN KANIGUMA PLATEAUS

S Sahoo, Petrologist

Incidence of bauxitization has been reported in Khondalite and charnockite group of rocks in and around Kaniguma in Thuamula Rampur block of Kalahandi district that comes under Survey of India T.S. No.65M/2. Massive variety of aluminous laterite has been encountered in the upper parts of the plateaus. The fabric of the rock is drastically changed in this zone of bauxitization. The major aluminous mineral gibbsite is megascopically identified as tiny creamy white shining crystals.

Microscopic study reveals appearance of numerous tiny crystallites of gibbsite and some coarse grained subhedral to euhedral crystals in the rocks. Under the microscope it appears as pale brownish to colourless crystal with low birefringence, oblique extinction and polysynthetic twinning. These aluminous laterites mostly exhibit vesicle filled, mesh and spongy textures. Vesicles appear in different shapes such as oblong, circular, elliptical and irregular which might have formed by removal of some minerals through solution action and are often filled with aluminous materials. Sometimes concentric layers of gibbsite crystals internally rim the vesicles. Occasionally the gibbsite is found in large size lining the pores. Secondary precipitation of hydrous aluminous material has taken place within porous substrate often result in network texture, which contains gibbsite of crisscross nature. Some veins of iron solution are following the cracks of relict garnets.

The bauxite deposits of Kaniguma are associated with Khondalite and charnockite group of rocks of Eastern Ghat Super Group. Alumina is very mobile in solution. Due to downward migration it might have precipitated as gibbsite in cavities.

PALAEO-PLACERS: THE FUTURE TARGET OF HEAVY MINERALS

P C Mishra, Geologist

In view of growing demand of Titanium ore worldwide and liberalized industrial policy, entrepreneurs have rushed to our state to try their fortune. They are also rampantly applying for grant of lease along the southern and central

coastal tract of Orissa, where Titanium bearing minerals do occur along with other heavies within the sandy formations. It is worth to mention that State Directorate and AMED have been engaged in detailed exploration of these strategic minerals since 1972 and almost covered the entire southern and part of central Orissa coast in detail. Preliminary investigations in this regard have also been carried out in parts of central and northern coast of Orissa. Such investigations are mostly confined to the recent younger coastal alluvium of sand dune/ beach ridge complexes containing loose un-consolidated sediments. Mining of heavies in these loose sediments are easy and economically viable.

With reference to eustatic sea level in time and space the entire coastline has witnessed several phases of marine transgression and regression in geological history and thereby kept the imprints in form of geomorphic features/ landforms. Now time has come to venture for those palaeo-geomorphic forms formed by the action of earlier strand lines, which might serve as the potential loci for accumulation of heavies.

A recent case study over these palaeo coastal sediments occurring to the southern Ganjam coast, where four strandlines have already been proved, revealed that these palaeo horizons are potential target areas for future exploration/ exploitation of heavies. Preliminary results indicate that out of 57km^2 area covered about 22km^2 area appeared to be promising having average THM % more than 6%. The analytical data indicates that Ilmenite predominates all other heavy minerals contributing about 57% of the bulk heavies, where garnet is only 6.6%. While, these two are almost near equal in percentage in recent coastal sand. These are also found to be rich in zircon, which is 0.107%. A preliminary estimate shows 17.38 million tonnes of heavies in the area, which warrants detailed studies.
Therefore, it is suggested to focus on the inland placers horizons may it be marine or fluvial, which will be potential targets for the future in addition to the already proved coastal margin.

FIELD CRITERIA FOR LOCATING RHODOLITE AND ALMANDINE GEM GARNETS IN EASTERNGHAT TERRAIN

A K Mohanty, JDG

The litho-assemblages of EGMB depicts khondalite and charnockite suite of rocks. A gem garnet belt is reported by the author and associates towards the south of Ong river of Balangir district. This belt stretches over a strike length of 22 km and 0.5 km width having 22 pockety occurrences of almandine and rhodolite gem garnet. The continuity of the gem tract was noticed upto Matiapali village in the east to the Chhelia R.F. in the west (T.S. No.64 P/5 & 64 P/9). It is noteworthy to mention that, the famous rhodolite gem garnet earlier mined by O.M.C. falls on the northern part of the study area. The gem tract is undoubtedly of structurally & lithologically controlled aligned to E-W trend following the Ong shear.

These primary source of gem garnet occurrences were examined in detail and the following criteria have been taken into account to explain the mineralization of rhodolite and almandine gem garnets.

The rhodolite pocket occurrences usually develop in association with silica rich suite in granulite facies i.e. quartzite- khondalite gradational facies in contact with basic granulites (amphibolite). The almandine gems develop only in contact of amphibolite and khondalites. The quartzo-feldspathic permeations in course of granitisation is responsible for the refinement of the gem garnets.

PROSPECT OF CHROMITE RESOURCES IN DHENKANAL DISTRICT

N K Mishra, Geologist

India's hope for chromite is confined to Sukinda Valley. Rapid industrialization scenario and commissioning of mega steel plants has increased the demand of chromite manifold. Hence, Directorate of Geology, Orissa has taken adequate steps for augmenting the resource figure of chrome ore.

The chrome bearing ultramafic rocks occur close to the trijunction of Jajpur, Dhenkanal and Keonjhar districts featuring in parts of T.S.No. 73 G/16, G/12, H/13 & H/9. The ultramafic field lying NW of Sukinda occupying 70km^2 area is under active exploitation. However, the western extension of this ultramafic complex which occupies about 540km^2 (strike extension 27 km and width 20km) in Dhenkanal district has not been covered in detail. The chromiferrous ultramafic complex of Jajpur district occupies a narrow, westerly sloping valley which broadens out westward. This valley is a gently sloping plain land dotted with small knolls rising 10m to 20m above the surrounding level. The elevation of the valley region ranges from 166 to 208m above mean sea level.

Towards the western extension of Sukinda Valley the chrome bearing ultramaphics were reported around Samal, Patharakata, Khajuria, Tangarapada. There is ample prospect of Cr, Ni, PGE & HMI rocks in these areas which are to be taken up during the 12th plan period by DG (O).

STUDY OF HEAVY MINERAL RESOURCES ALONG JAGATSINGHPUR COAST

S K Dalai, Geologist

In the era of industrialisation, the utilization of heavy minerals are increasing due to its various strategic applications. Keeping this in view, the beach sand investigation was taken up in the coastal tracts over 27km stretching from Nuamuhan to Jatadhari confluence in Jagatsinghpur district. (T.S.No. 74 I/5, 73 L/8, 73 L/12). The coastal province of Jagatsinghpur coast comprises of deltaic alluvium of Mahanadi river system and marked by geomorphic such as beach and windblown sand dunes. The area of exploration is occupied by beach, berm, valleys,

sand flats, mud flats etc. of Quaternary era.

Pilot sampling on beach sand has been done at an interval of 500m X100m grid to assess the potentiality of heavy minerals. 659 sand samples were generated where the HM concentration appears to be moderate. The bulk density of the sand samples varies from 1.395 gm./cc. to 1.895 gm/cc. The sand samples represents heavy minerals mainly ilmenite, rutile, leucoxene, zircon, monazite, garnet and sillimanite.

IRON ORE IS VITAL FOR STEEL'S FUTURE

S N Parida, JDG

Iron Ore floats

From time immemorial steel is the basic constituent of a civilization. Consumption of steel is considered as a yardstick to measure prosperity of a nation. Iron ore (haematite) is the principal raw material for manufacture of steel. As a consequence of increase in consumption as well as export, iron ore reserves are depleting fast. Haematite iron ore resources in India have been estimated at 14,630Mt and magnetite ore resources at 10,619Mt (As on 01.04.2005). Orissa shares 34% of country's iron ore resource. India's per capita iron ore reserve is 21 kg against 333kg for Brazil & 2000 Kg for Australia. It may be mentioned here that the iron ore rich countries like USA & China are not exporting iron ore. At the current rate of growth of 20% of production, India's hematite resource will last for 25-30 years.

Orissa is likely to face shortage of iron ore to meet demand of upcoming 49 MoUs signed for steel plants in the state with projected production capacity of 76Mt of steel per annum.

In view of the present scenario it is felt necessary for absolute consumption of iron ore and to prepare action plan for future exploration and augmentation of iron ore reserves in the state.

- Systematic & effective exploration for proving of iron ore resources as per UNFC guidelines.
- Prospecting of virgin areas using geophysical method & putting scout boreholes. Emphasis should be given on search for small & scattered iron ore bodies.
- To have additional boreholes in the inadequately explored iron ore blocks like Baliapahar, Mankarnacha Pahar & Khandadhar for assessment of proved reserve as per UNFC norm.
- Puncturing of BHQ/BHJ horizons to discover new iron ore bands underneath, if any.
- Reassessment of iron ore resources in leasehold as well as freehold areas is badly necessary. We have estimated that there is a reserve of 2805Mt of iron ore in the existing leasehold areas in the state. But this estimation has been done on the basis of information made available by the lessee at the time of grant. It is felt necessary to obtain detailed prospecting reports of entire lease hold areas for correct assessment of reserve.
- Fines constitute about 40% of iron ore resource which are being exported. Export of iron ore is required to be minimized and steps may be taken to make use of fines for extraction of metal through pelletisation and sintering.
- Optimal use of low grade iron ore taking cut off as 45% Fe.
- Extraction of iron ore from BHQ/ BHJ is the need of the hour. It can be achieved by applying modern R&D techniques.

Folded Iron Ore with BHQ/ BHJ

DIAMOND POTENTIAL OF KALMIDADAR OLIVINE LAMPROITE BODY

Bikash Ch Sahoo, Geologist

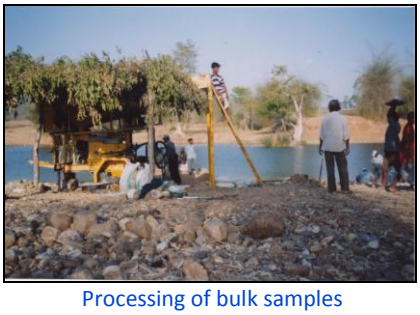
Exploration for primary source of Diamond has been a challenging and tough job for geologists worldwide. The diamond exploration is a fully integrated exercise to become successful. This aspect is well observed while taking up the exploration in the Directorate of Geology. With the aid of UNDP, the gem and diamond exploration started in Orissa, by the Directorate of Geology in 1992. The diamond exploration in Orissa started in two localities such as Dharambandha and Nangalbod areas of Nuapada district. Sincere and painstaking efforts of the geo scientists and other team members resulted in discovering three olivine Lamproite bodies at Kalmidadar, Pokhanpadar and Bharuamunda villages near Dharambandha area. But during the field season 2001-02 the geo scientists of this Directorate could establish the olivine lamproite rocks of Kalmidadar area to be diamondiferous for the first time in the history of Orissa.

Sampling site

Bulk samples were collected from this body and processed by the mobile Processing Plant (MPP) in the field and three different size fractions (-12mm,+5mm), (-5mm, +3mm) and (-3mm) are obtained for scanning. The diamond grains are recovered from these sample concentrates after careful processing and scanning. From the exploration data it is established that the recovery factor of diamond is 9.95 carats/ 100 tonnes which is an encouraging factor in respect of diamond exploration.

Most of the diamond grains are recovered from (-5mm to +1mm) size fraction samples in the diamond Laboratory of this department after processing and scanning. Though the diamond grains recovered from the Kalmidadar area are of small in size but most of them are gem to near gem quality. The maximum weight of the recovered grains is 2.11carat and the minimum weight is 0.01carat. The diamond grains occur in Rhombohedral, Octohedral and dodecahedron form. But the crystal faces are resorbed and most of them are broken crystals. The grains might have resorbed while coming to the surface travelling through a long distance of about more than 150Km. Some grains occur as platy and irregular shape. The presence of machles(twinned diamond crystals) is also marked amongst the recovered diamond grains.

The diamond grains of this deposit show various colours ranging from off white, yellowish brown, brown and grey to different shades of yellow. Commonly the specific gravity of diamond varies from 3.42 to 3.52. The adamantine luster and the internal fire of this precious stone play a key role to distinguish it from others in naked eye. In this case the luster varies from adamantine, resinous to greasy. The diamonds show positive thermal conductivity. The diamond grains show strong, moderate, weak and bluish glow under ultraviolet light. The grains are transparent, semi transparent and translucent (brown coloured industrial diamonds) in nature. Some gains are not free from flaws. Within few diamond grains internal cracks are filled up with the host rock materials and in some others black minerals are present as inclusions.



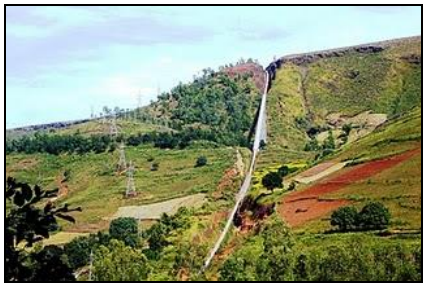
Processing of bulk samples

Diamond crystals of kalmidadar area show triangular pits, pitted and grooved surface markings on the crystal faces. Growth lines and striations are also seen in case of few grains. The trigons, the most diagnostic surface feature, with their apex pointing opposite to the vertex of a crystal are well marked in some of the crystal faces. The qualitative and quantitative aspects of this precious stone speak of its gemstone potentiality.

CONVEYOR TRANSPORTATION

S Mishra, Geologist

Transporting ores and minerals through conveyors drastically reduces most chances of pollution that would otherwise happen due to road transport. Transportation of ores and minerals by dumpers and haulage trucks generates a lot of dust, smoke and adds to the traffic congestion. Bad roads multiply the impact. In fact in mining belts, more pollution occurs due to transport of mineral rather than mining activity. Conveyor is a covered moving belt which continuously transfers material from one point to another.



Nalco's Conveyor at the Panchpatmali Bauxite Mines

NALCO uses a single flight gravity supported conveyor for the transport of bauxite from its Panchpatmali hill top to the Alumina plant in Damanjodi. The conveyor is the longest of its kind in the Asian Continent. It is needless to mention that the mines today is an ecofriendly tourist spot. One has to visit there to believe this. Serene environment surrounds the Panchpatmali mines round the year. Single flight ensures the absence of transfer points, where there would otherwise be some amount of leakage of dust.

Following the model, Vedanta is planning to use similar system for transport of material from Niyamgiri mines to the Lanjigarh Plant in Orissa. But delay in availability of captive lease has resulted in sourcing of bauxite from other places by the company. (Obviously the company cannot shut down its gigantic plant set up at astronomical investments. Shut down may also result in a number of adverse impacts including retrenchment of personnel. Hence the road transport has been the only option, which has brought in a number of inconveniences as stated earlier. Continuation of the practice is bound to take a heavy toll on the environment of the area. As such, due to the non-completion of the railway alignment up to Lanjigarh, all the alumina is being transported by road to Vedanta's smelter at Jharsuguda and the impact is clearly visible.

OGSA NEWS

Promotion and Posting

- A K mohanty, DDG was promoted to the post of JDG (L-II) and joined at Dhenkanal on 02.12.10.
- A T Dash, DDG was promoted to the post of JDG (L-II) and joined at Koraput on 14.12.10.
- T Mohanta, DDG was promoted to the post of JDG (L-II) and joined at Bhubaneswar on 23.11.10
- S N Parida, DDG was promoted to the post of JDG (L-II) and joined at Keonjhar on 28.02.10
- D N Pani, DDG was promoted to the post of JDG (L-II) and posted at Bolangir on 25.11.10

Retirement

- S N Moharana, Geologist retired on 31.05.2011 on super-annuation.
- U K Mohanty, Geologist retired on 31.06.2011 on super-annuation
- B K Bhagat, Geologist retired on 31.08.2011 on superannuation.

Views expressed in various articles belong exclusively to the respective authors and are not essentially that of OGSA –J.P.Behera, Editor