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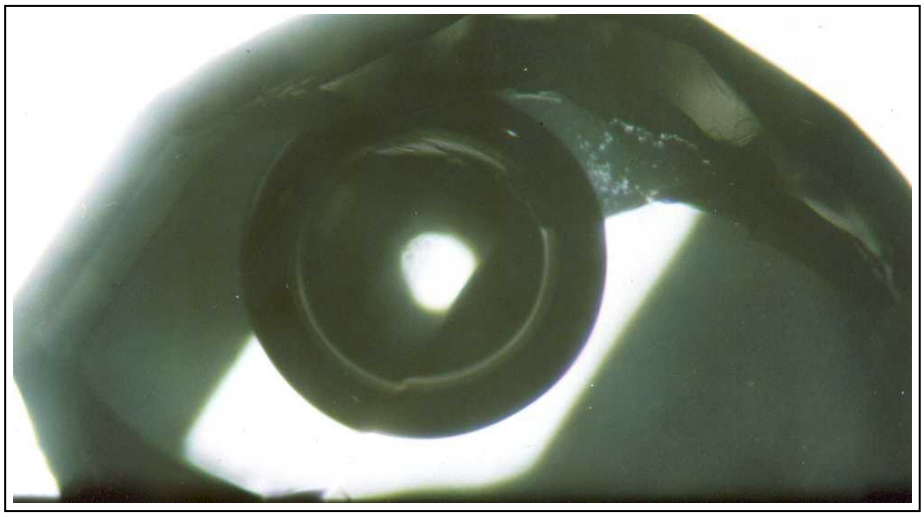


A MOBILE THREE PHASE INCLUSION IN GOSHENITE (Details on Page-3)

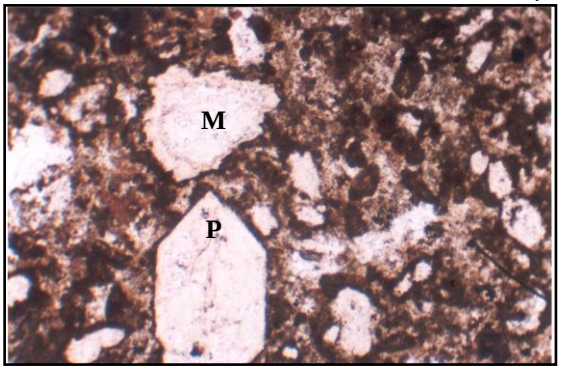
REJUVENATING EARTH SCIENCE

FROM THE EDITOR'S DESK

Earth Sciences now face a global recession after it failed to capitalise on the initial gains of the oil boom era. Except for small changes like the introduction of GIS, it has failed to emerge as an important subject, though large-scale exploitation of the Earth's resources and its effects should have elevated this science to new heights. The discipline does not hold much charm for the student community any more and the research in Earth Science has lost its cutting edge. After glorious work by the British and Indian geologists for a century, which has seen much more than high quality fieldwork and high fidelity map-making, the geological work culture in India has started sliding slowly and steadily.

On the contrary, realising that the field-based geology is at the core of our science, the United States Geological survey has initiated a National Cooperative Programme for preparation of geological maps which invites graduate students and qualified undergraduates in universities and colleges to apply for funds for geological mapping. British Geological Survey also farms out mapping projects to Universities.

What Earth Science needs now is a total shift from the age-old practices to public-beneficial approach. Common man should realise the benefits of this subject in his everyday life. University curricula, research fields and Government programmes should be oriented towards this end for giving a new lease of life to this discipline. It always pays to know how best it is to manage our geo-environment than to go into the intricate details of topics of no immediate concern. Prime areas like urban geoscience, groundwater management and disaster mitigation etc. call for prompt activation in order to rejuvenate Earth Science. Urban geoscience is still in its infancy and needs to be prioritised by the



TWO GENERATIONS OF OLIVINE REPORTED FROM OLIVINE-LAMPROITE OF SUPULI VALLEY (Details Page 4)

FLUOROSIS MENACE IN KHURDA DISTRICT- Page 7

universities, research centres and governments. A comprehensive land-water management is what is needed in our major cities to tackle problems like water crisis, water logging, land subsidence and soil erosion. Water scarcity poses to be the biggest ever problem of the 21st century that will be powerful enough to create social tensions and even topple governments. Artificial recharge, rain water harvesting and groundwater management need to be addressed immediately. Major disasters like earthquakes and volcanic eruptions seldom occur in India when compared to countries like the United States and Japan. But in those countries, people are well educated about these calamities and there are task forces to deal with them. The Latur earthquake has shattered the popular notion and proved that stable regions are also vulnerable. Disaster management should be given due importance at the academic as well as administrative levels and setting up of state-wise cells involving experts should be given priority.

Greater co-operation between universities, research laboratories and government departments in sharing expertise as well as equipment for the betterment of Earth Science community as a whole, conducting mass awareness programmes for the benefit of the public by Departments and organisations related to Earth Science and a conscious attempt by the academicians, policy-makers and scientists to resurrect the waning subject are some of the potential solutions in sight for revival of Earth Science.

On the top of everything, unless a day comes when both the visible and invisible boundaries between the allied branches vanish and all of them work as if their life is in peril, one can not expect a better future for Earth Sciences.

DIAMOND... AT LAST!!

B C Patnaik, DDG

Centuries old records of alluvial diamond (secondary) occurrence in the river Mahanadi and its tributaries like Ib, Bheden, Mand in Orissa has offered geo-scientists the challenge to locate the primary sources of the alluvial diamonds in the cratonic blocks. Several exploration agencies like GSI, DMG etc. have undertaken exploration activities in the past intermittently to locate the primary source but with a little success; although the favourable factors like secondary diamond incidence, stable cratonic blocks and sets of lineament were always there.

Six years of systematic exploration activities initiated by UNDP through the Directorate of Geology in one of the cratonic target blocks i.e. the Nuapada proterozoic basin in Nuapada district had indicated the presence of pipe rock in the northern as well as southern part of the basin. This success came through a systematic regional gravel sampling at a density of 1 sample per 3.0 sq km.

Having the above indication and the less travelled large Kimberlitic Chromite grains in the sample points, the Kalmidadar-Supuli valley area was put under intensive exploration. Close spaced scanning and further follow-up sampling in the valley area could lead to the discovery of the pipe rock during the year 1999. Further work could prove the pipe rock to be a diamondiferous Olivine-Lamproite. This discovery made a significant breakthrough in the mineral exploration programme of the State, which is first of its kind in the mineral development profile of Orissa.

Geology:

Kalmidadar-Supuli valley of Dharambandha *grampanchayat* is occupied by Archaean gneissic basement complex comprising quartzo-felspathic gneiss, biotite gneiss, hornblende gneiss, dolerite and younger granites. The area is quite brittle having no major tectonic events after 2200 ma (Friend and Nutman, 1991) and is characterised by the presence of NW-SE & NE-SW trending lineaments, which are often referred to as wrench faults.

Discovery of Olivine-Lamproite (Pipe rock):

Basing on positive D.I.M. results, follow-up sampling and geological mapping in the valley could lead to identify highly weathered, light green coloured ultrabasic rock with phlogopite mica with calcrete development within the mass. Close mapping and trial excavations demarcated the altered ultrabasic rock (250m long and 75m wide), which is found to intrude along a NNW-SSE trending lineament developed in the host granite gneiss. The XRF geochemistry of the rock designated the ultrabasic rock as Olivine – Lamproite (OL) and results indicated more than two episodes of OL intrusion. The subsequent bulk sampling has yielded more than 40 pieces of diamond of various weights and shapes. The maximum and minimum weight of gem quality diamonds are 110 and 7 cents respectively. The quantity of diamonds may increase as the scanning is going on with hand picking. As a norm of kimberlitic province, one more such body has been discovered to the south of the present Kalmidadar OL and expectation of discovering many more in this area is bright because more positive sampling locations are yet to be probed.

The present discovery of OL and finding diamonds in the very 1st meter of the body has established Orissa as the 3rd state to possess diamondiferous pipe rock. The discovery has attracted many MNCs to put their effort in exploring the vast pre-cambrian terrain to strike pipe rocks.

MYLONITES OF BURBURHA, BOUDH DISTRICT

P C Mishra, Geologist

The East to ESE trending Ranipathar shear zone, which forms the northern margin of Phulbani domain, has shear criteria in steeply dipping mylonites containing shallow to moderate east pitching mineral lineations. One such mylonite band flanked by migmatised khondalite in the north and leucogneiss in the south has been traced for a cumulative length of about 2 km with variable narrow width extending in E-W direction around Burburha & Dimirikhol. This happens to be localised along the intersection of E-W and ESE-WNW set of lineaments which are also indicated in the

POSSIBILITY OF PGE LOOMS LARGE

S K Mohanty & D N Pani, Geologists

Economically most important concentration of Platinum Group Metals (PGM) occur in layered igneous complexes as largely "stratabound" reefs (J M reef of Stillwater complex and Merensky reef of Bushveld complex). The recognition of widespread associations of sulphides with chlorine – bearing hydrosilicates in both the reefs and the presence of chlorine – bearing graphite in Merensky reef pegmatoids have led to the conclusion that the C-O-H-S-Cl system acts as a dominant factor in the evolution of PGM deposits.

In Orissa, the easternmost chromite seam of the Baula-Nausahi mafic-ultramatic complex is represented by a breccia zone, comprising chromite / serpentinite fragments set in a ferrit-chrome matrix and the whole is injected by pyroxenite and pegmatitic gabbro. The matrix of the breccia zone comprises ferrit-chromit, magnetite, chalcopyrite, pyrrhotite, pyrite, pentlandite, millerite etc. This igneous breccia zone seems to be potential for Platinum Group Elements (PGE) concentration.

Keeping the above back-ground in view, while pursuing the investigation work in Umundira-Kateni valley under Chromite Investigation Project during FS 2001-2002, contact zones of gabbro-pyroxenite with marked association of sulphides were encountered in Bandhuni Huli, Padhani Sahi Huli as well as adjoining valley tracts in TS-73 G/12. These zones, suspected to contain PGE, were delineated. Systematic bed rock sampling as well as stream sediment sampling were undertaken along these zones. Petrological, ore microscopic, geochemical, trace element as well as PGE analysis are currently being taken up by departmental as well as outside laboratories with an aim to establish the occurrence of PGE concentration. Lab findings would help shaping the Directorate's PGE exploration strategy in future.

geological interpretations of High Resolution Aeromagnetic Survey Project. It is a dark coloured, fine grained, streaky laminated rock with ovoid shaped porphyroclasts of quartz and plogioclase. Microscopically, intense stress condition is reflected by extreme grinding and milling of mineral constituents. Almost all mineral grains inclusive of quartz, feldspar & biotite are highly crushed and granulated forming thin veins. Few grains of quartz, orthoclase & plagioclase which survived granulation are found as oval or elongated eyes that are aligned parallel to the trend of lamination i.e. E-W. The porphyroclasts exhibit clear sign of internal strain as evident from marginal granulation & undulatory extinction. Thin flakes of biotite with fine quartz & feldspar traverse around the ovoids like a train. This mylonite suggests strong E-W shear criteria in this region.

A MOBILE THREE - PHASE INCLUSION IN GOSHENITE

Mrs A B Mishra, Geologist

A unique three-phase inclusion displayed by goshenite, a colourless beryl of Bolangir district has been observed in the Gem Testing Laboratory of the Directorate.

It contained a large euhedral negative crystal with free moving gas bubble. Also seen moving within the liquid phase were numerous tiny white solid particles, which make this a three-phase inclusion. The mobility and size of the gas and the solid phases are note worthy. Such negative crystal is primary and may be formed when a globule of immiscible liquid or gas adheres to the growing face of a crystal and is trapped while the host exerts a minimal surface energy on the void. (Photo on cover page)

'BAUXITE' - NATURE'S BOON TO RAYAGADA

M K Senapati, J P Panda Geologists

Consequent upon a major technological breakthrough in aluminium production, there have been worldwide search for new grounds for bauxite, which induced Government of Orissa to launch a massive bauxite exploration programme in the undivided Koraput & Bolangir districts during which most of the fairly large bauxite bearing plateaus were explored in detail & large resources of bauxite were brought to light during mid-seventies. The discovery of enormous quantity of good quality bauxite in undivided Koraput district led to the establishment of NALCO in Orissa. Besides the bigger plateaux, there were a number of small plateaux, which were ignored at that time, considering their smaller dimension. But recently multinational companies, small entrepreneurs and metallurgists are looking for smaller bauxite resources to cater to their own need of small industrial units. This necessity has urged the geo-scientists to scan & explore the smaller plateaux. In the process, Rayagada district, being rich in bauxite resources, has become their destination.

The Easternghat Super Group of rocks occupying Rayagada district host the major component of East-coast Bauxite deposits. The deposits are lateritic in origin and have been formed by the *in-situ* chemical weathering of khondalites and charnokites. The major bauxite deposits of Orissa as well as Rayagada occur as a very gently undulating blanket overlying the parent rocks (Khondalite) below a laterite capping of about 3 to 4m. They are found in this unique bauxite province at elevations of 900m to 1400m above MSL. The uplifted peneplains/ table-lands having a undulating landscape were well dissected later on to give rise to the present status of some major & minor plateaus.

Hence all the small plateaux are dissected plateaux of the proven big bauxite deposits like Kodingamali, Chanamali, Sasubohumali etc. The plateaux form a mesa, Most of the plateaux have a surface which is undulating with saucer shaped depressions (30 to 100m long and 10 to 20m wide). 50cm to 1.5m of thick sandy grayish

black soil supports vegetation. The slope of the top of the plateaux varies from 5^0 to 10^0. The first order streams originating from the plateau surface are parallel to each other. At places these first order streams have scooped the surface humus and soil layer to expose the yellowish red multicoloured cavernous laterite. Numerous perennial springs are found to be flowing around the plateaux. The drainage system in the plateaux helps in the formation of escarpments.

Plateau Profile:-

The plateaux are capped with almost 3m to 4m thick yellowish purple looking cavernous & ferruginous laterite chert & jasper add colour to this cavernous laterite. The ferruginous laterite as marked on all the plateaux continue to a depth of 3 to 4m in an average. Below this lateritic zone, the horizon of aluminous laterite is found having a uniform thickness of 2m to 3m as marked on all the plateaux. Bauxite horizon begins at a depth of about 8m below the plateau surface. In this horizon, caves have been developed, which provide shelter to the wild fauna like beer, rabbits, porcupine, jackal & fox etc. The presence of gibbsite changes the grade of aluminous laterite to bauxite.

The bauxite samples are derived from the Khondalites, which can be very clearly observed in the field megascopically. The bauxites are gibbsitic in nature, cavernous or porous like sponge & low in specific gravity. The scarp face & plateau surface predict that the bauxitic horizon extends like a blanket with perforation pockets in form of saucer shaped depressions. These indicate the location & presence of lithomerge clay pockets, which have been exposed to the plateau surface after continuous weathering & erosion of the overlying bauxitic material in due course of time.

Scarp section study of the plateaux has revealed the presence of bauxitic ore satisfying the metallurgical norms as observed in these plateaux. These bauxites can cater to the need of the metallurgists & small to medium scale entrepreneurs.

Infrastructural Facility:

So far as infrastructural facility is concerned, the area is well connected with important towns & the state capital by rail & road. Tikiri railway station falling on Howrah-Rayagada- Tikiri- Koraput-Vizag rail link is the nearest rail head of the area. The bauxite bearing area is also well connected to Rayagada, Bhabanipatna & Koraput & other parts of the state by all weather roads. From Tikiri all the remote parts of the bauxite bearing area can be approached by fair weather/ all weather roads to the foot-hill region & then by means of foot track only.

Presence of a number of perennial springs flowing from these plateaux ensures the availability of sufficient ground water necessary for human & industrial use. The area has also been provided with power supply necessary for modern industrial civilization.

The area also enjoys a very pleasant climate even in the month of May & June. The temperature hardly exceeds 36^0C in these summer months. During winter the temperature falls to 7^0C. The human resources of the area compise innocent tribal folks, who are very simple in their nature.

Considering the available infrastructure, some multinational companies have already established their office at Tikiri. In the near future the rich bauxite resources is going to play a major role in shaping the fortune of the local people tremendously.

Restoration of the depleted environment:

It is observed that all the plateau tops are covered with hard aluminous laterite/ ferruginous laterite except the saucer shaped depressions. The plateau tops are generally devoid of healthy vegetation. These are either barren or have small bushy shrubs on them. The slopes on all the sides of almost all the plateaux are covered with thick fertile scree, which had once supported thick luxuriant vegetation in the past. The expanding modern civilization, population explosion in general, and the growth of population among tribals in particular compelled the natives of the locality to produce more food grains by converting the plateau slopes into cultivable land. During the last 40 years there has been massive deforestation & degeneration of the natural eco-system all around the area. The need & demand of hour is to restore the environment. The major solution to this problem is “Bauxite mining”. Bauxite is restricted to upper 50m slice of the plateau. Bauxite can be mined out & the quarries can be filled up by waste materials. Necessary processing can be taken up to use the plateau tops as agricultural land and massive afforestation along the hill slopes with help to regain the lost vegetation which will help a lot to restore the depleted environment to some extent & ecological balance can be maintained.

TWO GENERATIONS OF OLIVINE REPORTED FROM OLIVINE LAMPROITE OF SUPULI VALLEY

P.K. Chand, Petrologist

Petrographic study reveals the occurrence of two generations of olivine having different morphology in the olivine lamproite sample collected from Supuli valley of Dharambandha area, Nuapada district. These consist of an earlier generation of anhedral macrocrystal (M) olivine (xenocryst) and a later suit of euhedral to subhedral phenocrystal (P) olivine (Photomicrograph on cover). The macrocryst exhibit undulose extinction and are partially resorbed at their margins. Some grains have serrate margin, which gives a “dog tooth” appearance. The deformation feature (undulose extinction & anhedral habit) suggests that this fraction of olivine population is of *xenocrystal* origin. Phenocrysts or microphenocryst (groundmass) olivines are typically euhedral single crystals of simple habit. Coexistence of mantle-derived olivines with microphenocrystal euhedral olivine is a typical feature of olivine lamproites. Alteration of euhedral olivines to red-orange iddingsite at their margin is noticed. Both variety of olivines constitute about 35% (modal) of rock mass and are highly altered to serpentine and talc preserving its skeletal structure.

From the above observation it is concluded that the xenocrysts may have been derived from upper mantle and most likely from xenoliths of peridotite-pyroxinite suite. It is assumed that fragmentation of these mantle-derived xenoliths during transportation may have been resulted in the additon of xenocrysts to the magma. The phenocryst or microphenocryst of subhedral to euhedral habit are derived from primary liquid phase and are crystallised *in-situ* to form the groundmass.

REMOTE SENSING FOR NATURAL RESOURCES SURVEY AND ENVIRONMENT

P K Ojha, DDG

Remote sensing is one of the excellent tools for the natural resources survey. It possesses capability of vividly displaying the natural resources occurring on the earth's surface. Its synoptivity and multi-spectral nature provides contrast between various natural resources and its temporal resolution provides information on the changes that are taking place over the natural resources and their environment. Hence the art of remote sensing has made eye catching strides in the last two decades, in the inventory and mapping of earth resources,, geomorphology, environment, surface water resources (& its quality variation in time & space), ground water, soil, forest, agriculture and ocean resources etc.

Way back, during 1972 with the launching of ERTS-1 satellite by NASA became a major event in this field, and the geoscientist's mind started working for utilisation of remotely sensed pictures for natural resource survey.

Different minerals and rocks have got varying responses to different bands of electromagnetic spectrum. The same rock type shows different spectral reflectance under visible, near infrared and thermal infrared ranges of EM spectrum. The studies conducted proved that the colour, crystal system, hardness, specific gravity, cleavage, fracture etc. greatly alter the spectral reflectance (Ramaswamy *et al*, 1993). In the same way the percentage of quartz, ferromagnesian minerals, feldspar, etc. also influence the spectral reflectance of minerals and the mineral aggregates present in a rock. Thus catalogues have been evolved correlating bands of the electromagnetic spectrum & the reflectances for discrimination of rock types. For example, igneous, sedimentary and metamorphic rocks can be mapped precisely using bands 1 to 7 of TM data, bands 1 to 4 of IRS and bands 1 to 3 of SPOT data. For better discrimination, bands can be combined and false colour composite images can be generated.

Remote sensing provides excellent possibilities for mapping pervious and impervious rock types by application of filtering technique to raw satellite data. For this purpose, combination of TM 1+5/1-5 subjected to filtering provides excellent information. This information can be used for identifying clay deposits, ground water perspecting and delination of recharge area.

The rock types have got predominating control over the erosional process. Variation in texture can be detected easily from satellite data and mapped. Such maps will be of immense use in engineering geology projects, especially for reservoir siltation studies.

As the remotely sensed photographs provide a panoramic view, once again serve as a very good tool for mapping the pattern and orientation of hill ranges and folded structures. These fold patterns can be mapped on the basis of linearities and curvilinearities observed in soil, vegetation, cultivation pattern, alignment of tanks etc, which are of immense use from mineral exploration point of view. The remote sensing data give best idea about features like fracture system and the lineaments, through which magnetic and metalliferous fluids are brought to the surface and ground water movement takes place. They act as neo-tectonic windows through which earthquakes and seismicity takes place. The lineaments also act as master conduits through which aggressive migration of pollutants takes place, hence lineaments mapping is warranted for locating factories, which may discharge harmful effluents.

Depiction of geo-morphology is greatly helped by remote sensing studies. Each and every landform has got its own resources and environment potential. For example weathered mineral deposits, the moderately weathered pediments can have poor ground water potential. The flood plains form favourable areas for ground water development and riverine forestry schemes. The levees are potential hunting grounds for heavy metals and minerals, where as regions of cut off meanders are dangerous areas for siting dams as the river may rejuvinate. The regions of palaeo channels must be avoided for setting up effluent discharging factories as these may act as conduits for faster transmission of pollutants.

The satellite images provide spectacular information in the size, shape, pattern, spatial distribution of water bodies, hence on the basis of such data the surface water budgeting can be done regularly. The near IR ranges (0.8 to 1.1 μm) provide best information for such purpose owing to the light absorption in that particular spectral domain. Water quality study can be taken up by this, as the impurities are better picturised in visible band (0.4-0.5 μm). Different soil types can be mapped precisely due to varying spectral responses under different bands of EM spectrum. The forest canopy gives best reflectance in 0.6 to 0.7μm and 0.8 to 1.1μm ranges due to chlorophyll content. Mapping of forest diseases and fire can be done based on chlorophyll emission. Healthy forest shall show bright red colour where as diseased or fired one will show either black or blue colour.

Thus remote sensing is an excellent tool which provides answer for earth resources and its environment.

DISASTER MITIGATION THROUGH DISASTER PREPAREDNESS

Mrs Subhashree Jena, Geologist

Disaster is defined as a catastrophic situation in which the normal pattern of

life (or eco-systems) is disrupted and extraordinary emergency interventions are required to save and preserve human lives and/or the environment.

The UN General Assembly Resolution 236 of 1989 launched the International Decade for Natural Disaster Reduction (IDNDR, 1999-2000) that effectively set the trend in shifting the focus of attention from 'rescue and relief' to 'preparedness and mitigation'.

It is not possible to eradicate natural hazards completely. However, experience has shown that the damage from natural hazards can be minimised by way of a comprehensive preparedness plan. Now it is becoming increasingly evident that a relatively smaller investment in disaster preparedness can save thousands of lives and vital economic assets as well as reduce the cost of overall relief assistance. While preventive measures will not halt earthquakes or cyclones, they will certainly minimise the impact of such disasters on human life, public/ private properties and the environment.

Pre-disaster Management- A Geologist's View Point:

Orissa, a state rich in mineral wealth, is prone to natural hazards like floods, cyclones, earthquakes and drought etc. Application of geological methods in minimising the damage caused by the above disasters can be a part of pre-disaster management.

Floods in Mahanadi delta region causing untold miseries in rainy season can be controlled by constructing a number of dams in the catchment areas. The only major dam which has reduced the severity of floods to some extent is Hirakud Dam. Dams, which have been stalled due to political or environmental grounds have to be constructed on the tributaries of river Mahanadi. Heavy siltation due to deforestation in the catchment area has over the years raised the level of river-beds. This has reduced the water carrying capacity of the rivers, which can be managed by dredging and constructing drainage cuts to release some of the flood-water directly into the sea through these cuts. The embankments which have weakened at different points due to hydraulic action and other artificial reasons have to be critically examined and maintained properly. The map based information through GIS regarding possible subemergence are to be made available to the District Collectors during flood period.

Cyclones associated with storm surges have inundated the vast areas of Orissa coast in past. The recent super cyclone was most damaging. The suggested preventive measures include preparation of a terrain evaluation map to depict costal landforms, closing of sluice ways by sand, establishing vegetation corridors in the barren coastal strips to reduce wind velocity, strengthening of embankments, clearing of sand and silt from choked drainage channels, tidal creeks and protection of mangrove forests etc.

Even though historical records don't speak of major earthquakes in Orissa, the state is designated as moderate risk zone from earthquake point of view. Integrated geological and geophysical investigations indicate the existence of Mahanadi graben zone which passes through the two coal fields (Ib valley & Talcher), reservoirs (Hirakud & Rengali) and cities like Cuttack & Bhubaneswar. There are also evidences of features like block faulting parallel to the coast and other fault zones such as NOBF, WOFZ, VNFZ and Brahmani fault. Any possible reactivation in these fault zones and lineaments may lead to earth movements. The human, material or environmental losses can be reduced by some pre-disaster planning like hazard zone mapping, implementation of laws for construction of earthquake resistant structures and installation of seismic observatories in sensitive areas.

Considering the vulnerability of the state to the above mentioned disasters and many more natural and man made hazards like sea erosion, land slides, mine fire, dam failure etc, awareness has been created among policy makers, environmental scientists and public to minimise the losses by implementing pre-disaster measures. The earth scientists shall have to assist the decision makers in identifying the causes of hazards, providing earth science information to mitigate and monitor disasters using remote sensing, GIS & GPS as effective tools.

ELECTRICAL LOGGING HELPS TO IDENTIFY FRESH AND SALINE AQUIFERS

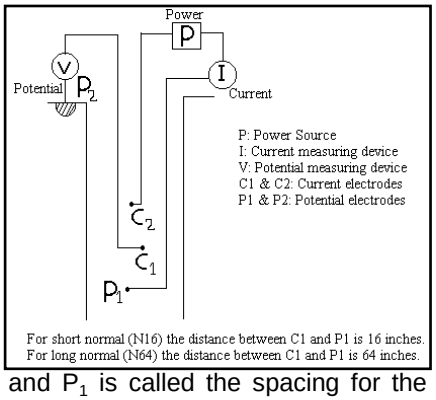
K C Mohapatra, S Mishra
Geophysicists

Geophysical borehole logging is a technique to identify different physical properties of formations encountered in a borehole and quality of formation fluid. There are a number of logging systems. Some logs can be taken in cased boreholes whereas some are to be taken in uncased boreholes. Electrical logging has to be taken in uncased borehole to read single point resistance (SPR), short normal (N-16), Long normal (N-64), Lateral (L-6') and Self Potential (SP). SPR, N-16 and SP help in lithological correlation and bed thickness determination. N-64 and L-6' help to get formation resistivity. N-16 helps to get invaded zone resistivity.

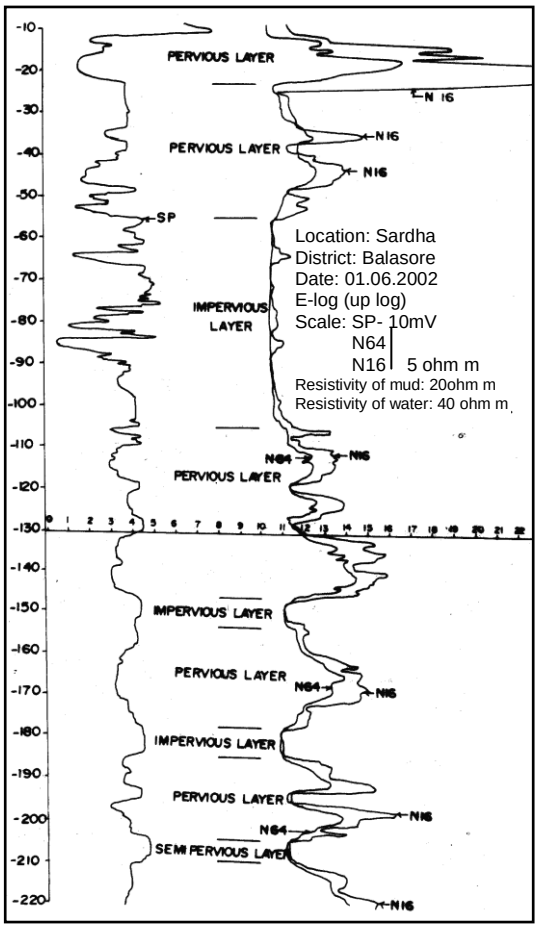
SP log is a graphic plot of the small differences in voltage, measured in milli volts, that develops at the contacts between the bore fluid, the shale or clay-sandstone boudary and the water in the aquifer.

Normal log curves (N-16 and N-64)

Shlumberger brothers introduced the short normal (N16) and long normal (N64) logging. Normal curves are earth resistivity measurements for which four electrodes are always required: two current electrodes C_1 and C_2 and two potential electrodes P_1 and P_2. The distance between the electrodes C_1 and P_1 is called the spacing for the normal logs i.e. 16 and 64 inch.



$V=RI/4\pi\ (C_1\ P_1)$



Where R is the resistivity of a homogenous medium, I is the constant current intensity from C_1, and C_1 P_1 is the electrode spacing.

It is evident that C_1 and P_1 are closely spaced, whereas C_2 and P_2 are far apart then the potential transmitted from C_1 to P_1 is the only one that will matter. This potential is measured at the reference level O, halfway between C_1 and P_1.

Case History:

The above curves are E-log of a borehole drilled at Sardha in Balasore district. The logging was done for groundwater to identify pervious, semi-pervious and impervious zones. It is also necessary to locate saline and freshwater aquifer (Refer the log). Left side curve is SP and right side two curves are N16 and N64. All the layers are identified basing on resistivity and SP logs. The layer from 55m to 105m is showing very low resistivity (3Ωm approximately). But it developed a SSP (Static Self Potential) maximum upto 42mv. From SP it is interpreted to be pervious layer and low resistivity of normal curves may be due to high salinity.

SSP (Static Self Potential) = -70.7 $\log_{10}$ Rm/Rw

Where Rm = mud resistivity
Rw = Formation fluid (water) resistivity
From std curve Rm/Rw = 4
Rm = 20Ωm (measured at the site)
Rw = 5Ωm
TDS (Total dissoved solid) (% of NaCl)
= (10,000/Rw)X 0.67 ppm
=(10,000/5) X 0.67 ppm
= 1340 ppm
If TDS ≤700
the water quality is fresh
If TDS =700 – 1500 it is brakish
TDS > 1500 – it is saline

So the zone upto 105m depth contains brakish water. Below that level, the TDS is < 700 ppm. So fresh water aquifers are observed in ervious zones below 105 m. At this place pervious zones contain loose sand, semipervious zone contains mixed sand and clay. Impervious zone contains clay.

So SP, N16 and N64 loop help in finding different layers and freshwater aquifers.

ROCK QUALITY DESIGNATION

B C Sahoo, Geologist

Deer (1963) contributed a new concept Rock Quality Designation (RQD) to classify rocks into five classes (excellent, good, fair, poor and very poor) based on core recovery characteristics. It brought in the role of joints and fractures that destroy the massiveness of the rocks. It makes the rock blocky and the rockmass strength is reduced. The rockmass behaviour changes with the destruction of massiveness.

RQD is a measure of the uniaxial compressive strength of the rock.

In view of the widespread use of RQD in various rock mass classification methods, it is of value to present an approximate correlation between Jv (volumetric Joint count) and RQD.

RQD = 115 – 3.3 Jv (approx.)
(RQD = 100 for Jv < 4.5)

The relationship can be used for estimating the order of magnitude of RQD when borecore is unavailable. This can also be used to calculate RQD from rock exposures.

Rock Quality Designation (RQD) is a modified core recovery percentage in which all the pieces of sound core over 10 cm length are counted as recovery and are expressed as a percentage of the length drilled. The smaller pieces resulting from closer jointing, faulting, or weathering are discounted. International society for Rock Mechanics (ISRM) suggests that if the core is broken by handling or by the drilling process (i.e., if the fractures are fresh breaks rather than natural surfaces) the fresh broken pieces should be fitted together and counted as one piece, provided they form the requisite length of 10cm.

Material that is obviously weaker than the surrounding rock such as over-consolidated gouge is discounted even if appears as intact pieces that are 10cm or more in length. (This type of material will normally be recovered when using the most advanced drilling equipment and experienced or carefully supervised drilling crew.)

The length of individual core pieces should be assessed along the centre line of the core, so that discontinuities that happen to parallel the drill hole will not unduly penalize the RQD values of an otherwise massive rock mass.

FLUOROSIS MENACE IN KHURDA DISTRICT

G K Bhuyan, Geologist

Occurrence of fluorosis has been reported in Balasingi and Singhpur villages in Sagarguan *grampanchayat* of Khurda district. Directorate's investigation in the area has revealed that 92-98 % of the children are affected by dental fluorosis (cover photo) and 6-8% of the older persons are affected by skeletal fluorosis. Investigation has established that the local as well as the regional geological setting and hydrogeological conditions have contributed to the incidence of high fluoride content in the groundwater of the area. The Directorate of Geology, in the past, had taken up the environmental study of the fluorosis affected area around Karlakot GP of Nuapada district and revealed the geological factors responsible for the outbreak of the disease.

NEWS CONGLOMERATE

STATE MINERAL POLICY IN THE PIPELINE

State Mineral Policy is being drafted and will be finalised soon. The policy would formulate guidelines keeping in view the achievement in optimum mineral development in the state of Orissa. A committee has been constituted to finalise the document with Principal Secretary to Government Steel and Mines Department as Chairman and MD, OMC; MD, IPICOL; Regional control of Mines, IBM; Director of Geology, Orissa and President and General Secy., as members. Director of Mines, Orissa is the member convenor for the meeting.

O.I.L. ALL SET TO STRIKE OIL IN MAHANADI DELTA

Venture to harness the rich oil reserves in the Mahanadi delta has gained momentum with Oil India Limited (OIL) making big preparation for exploration by the end of this year. An area of about 7,989 sqkm in Cuttack district and some parts of Kendrapara and Jagatsinghpur have been mapped for having the potential to harbour rich hydrocarbon reserves. It is learnt that the seismic survey could detect the exact location of the hydrocarbon concentrations.

This mission would be executed under the banner of 'Bay Exploration Project', a joint venture between OIL, Oil and Natural Gas Corporation, Gas Authority of India Limited and Indian Oil Corporation.

RUTHENIUM – THE RARE METAL TO CLEAN UP CAR EMISSIONS

Chemically, ruthenium belong to the Platinum Group Elements (PGEs). These metals, platinum, palldium, rhodium, iridium, osmium and ruthenium, tend to be found together, and exhibit similar properties, sometimes allowing the substitution of one metal for another in applications. All are valuable as catalysts of various kids, exhibit remarkable electrical and have potential uses as superallys.

Ruthenium has been used for a long time as a catalyst in the production of ammonia and petrochemicals. In recent years it has been used increasingly in automobile catalytic converters, in superalloys and in the electronics industry, particularly in IT and mobile phone applications.

So, how much ruthenium does the world need ? It governments and people continue to demand cleaner cars and faster, smarter computers then it seems there will be a sustained demand for ruthenium. Given its amazing qualities, it is unlikely that ruthenium will continue to be seen as a Cinderella to its proud sister metals.

UNITED NATIONS FRAMEWORK CLASSIFICATION

In 1997, United Nations Economic Commission for Europe (UNECE), Geneva circulated a draft on UNFC for mineral resource. The field guidelines for implementation of UNFC are based on a three dimensional grid with the following axes.

a. Geological Assessment
b. Feasibility Assessment
c. Economic viability

In the geological assessment axis a typical consecutive stages of geological investigations are-

i. Reconnaissance G4
ii. Prospecting G3
iii. General Exploration G2
iv. Detailed Exploration Gl

Each of these stages produce resource data with a clearly defined degree of geological assurance.

The feasibility assessment axis has typical consecutive stages such as

1. Geological Study F3
2. Prefeasibility Study F2
3. Feasibility Study/ Mining Plan/ Report Fl

The economic viability axis has been divided into three stages namely

1. Intrinsically Economic E3
2. Potentially Economic E2
3. Economic El

The mineral deposits are classified into the following types on the field guide lines are formulated for each type.

1. stratiform, stratabound and tabular deposits of regular habit
2. stratiform, stratabound and tabular deposits of irregular habit
3. Lenticular bodies of all dimensions occurring enechelon silicified linear zones of composite veins.
4. Lenses, veins and pockets, stock works, irregular shapes, modest to small size bodies.
5. Gemstone and rare metal pegmatites, reefs and veins
6. Placers and residual refractory mineral deposits of hill and valley wash.
7. Dimension stones.

COAL ROYALTY HIKE

Coal royalty has been revised after a lapse of eight years. The state would benefit by Rs 60 to 70 crores per year from this.

The Mines and Minerals (Development and Regulation) Act, 1957 provides for revision of royalty every three years. The Sarkaria Commission had recommended that it should be revised every two years. The eleventh Finance Commission had suggested that the revision should take place every three years and in case it did not take place, the state should be compensated.

The difference in royalty of highest and lowest grade coal was only 10.5% in 1971 while it went upto 74% in 1991. It however, came down to 71% in 1994.

OGSA NEWS

Trainings and Seminars

- M R Mohapatra, P C Mishra and Subhashree Jena attended a training programme on "Role of Panchayats and NGOs in Natural Calamity Management" organised by Regional Institute of Planning, Applied Economics and Statistics" during the period 07.01.2002 to 19.01.2002.
- P K Ojha attended the "First Course on Application of Remote Sensing and GIS for Mineral Exploration" at GSI Training Institute, Hyderabad from 17.01.2002 to 30.03.2002.
- Smt S Das and Smt Subhashree Jena attended a training programme on "Working with Spreadsheet" at NIC, Bhubaneswar from 19.02.2002 to 21.02.2002.
- B P Mishra attended a training on "Working with MS Access" at NIC, Bhubaneswar from 23.04.2002 to 25.04.2002.
- D N Pani attended a "Regional Workshop on Satellite Remote Sensing Data Products-Services and Applications" held at Vishakhapatnam on 28.09.2001.
- S K Mishra attended an orientation Programme on "Disaster Management at GAA, BBSR from 15.02.2002 to 16.02.2002.
- B P Mishra, B C Patnaik and A Sahoo attended the "International Conference on Diamond and Gemstones held at Raipur from 09.02.2002 to 12.02.2002.
- B P Mishra, A Dash, P Subuddhi, M D Behera and G K Bhuyan attended the SGAT Seminar on "Utilisation of Mines Waste and Marginal Grade Ores/Minerals" on 15.09.2001 at Bhubaneswar.
- S K Das presented a paper titled "Description of Various Gemstones as Available in the State of Orissa and Role of Directorate of Geology" at SISI, Cuttack on 25.09.2001.