Orissa Geological Service Association

August 2001
Volume-XV

OGSA Newsletter

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Message

I am glad to learn that Orissa Geological Service Association is publishing regularly its biannual geotechnical bulletin 'NEWSLETTER' incorporating very useful write ups on advanced disciplines of geoscience, ongoing technical activities of the Directorate and new findings thereof. I am sure the bulletin possesses the potential of providing crucial information to the academicians, professionals and entrepreneurs of the State.

I understand that the Association is bringing out its 15th issue of Newsletter during the 11th AGB Meeting. I sincerely record my compliments to the organisers and wish all success for such a noble act.

H S Chahar, IAS
Commissioner-cum-Secretary to Steel & Mines Department
Government of Orissa

EDITORIAL

First came the supercyclone. Then draught. Now it is flood. The nature that always showered full bounties upon the state is now demonstrating its fury. To make it all worse, the state is reeling under acute financial crunch. We all have to bear it, fight it and overcome. Together. Everybody has to make his own contribution, in his very own manner. All through the history the geoscientists have played their role to the fullest in gifting the state with new mineral deposits. This has always strengthened the economy and helped in the development of the people. The time has come, when we have to do that at a greater pace. Let's do the maximum that is possible on our part. Let's expedite exploration and contribute in our own exclusive way by bringing new mineral deposits to light. Let's help the state in recovering from its present state of crisis. Let's make Orissa a better place for living and set an example for others. Sincerity in attitude must be our motto. We all have the right potential. Let's unleash the capabilities, believe in ourselves and prosper. Together.

HORNBLENDE SYENITE-

THE MAJOR CONTRIBUTOR OF FLUORINE TO THE GROUNDWATER OF KARLAKOT

M Pattnaik, DDG; S Mishra, Geologist

In a major breakthrough, during the petrochemical study of fluorosis affected area in Nuapada District, it was found that the major geochemical source of fluoride found in the groundwater of Karlakot area lies in the host rock of hornblende syenite.

The preliminary analysis of some rock samples revealed that the hornblende syenite of Karlakot area contains much higher quantity of fluorine in comparison to the other rock types of the area.

In a bid to ascertain the geochemical reasons of the occurrence of higher amounts of fluoride in the groundwater of the region, samples of four types of rocks were analysed. It was found that hornblende syenite contains upto 4240 ppm fluoride whereas the range in other rocks like granite gneiss, nepheline syenite, amphibolite etc. varies from 460 ppm to 1568 ppm only.

The finding also solves the mystery of Karlakot being worst hit by fluorosis although many other villages are also situated in the same type of geological set up and environment. The exception is due to a patch of hornblende syenite on which Karlakot is situated.

Water samples from all possible sources in Karlakot and nine nearby villages were analysed in four lots in a time spanning two years. Water samples from four tubewells, 2 dugwells and a pond in Karlakot were analysed for the presence of fluoride and other contaminants. The results show that the fluoride content in the surface and groundwater of Karlakot varies from 2.50 to 6.90 mg/ltr whereas in other areas it varies from 0.40 to 4.1mg/ltr.

The unusually high fluoride content of the groundwater of the area has brought about a devastating outbreak of severe dental and skeletal fluorosis among the people using it for drinking purposes. Although nine other villages are also under the deadly grip of this disease, Karlakot is certainly and clearly the worst affected.

Hornblende syenite is exposed in an outcrop (250m x 50m) elongated in the direction of N-S, which is also roughly the trend of foliation. The rock is mesocratic, gneissose and foliated. The major mineral constituents of the rock are plagioclase, orthoclase, hornblende, and biotite. During the breakdown of hornblende syenite and other granitoids due to weathering, fluorine is released into the circulating groundwater, the movement of which is facilitated by the presence of foliation and joints in the rocks.

Tube wells (70m to 90m deep) on the western edge of the hornblende syenite exposure yield water with a maximum fluoride content of 3.9mg/ltr while even dugwells of 20' to 40' depth situated on the east of the outcrop contain water with as much fluoride as 6.9 mg/ltr. The fact

is obviously supported by the easterly dip of rocks.

Although the research is yet to go a long way, it has already confirmed the fact that the source of fluoride in the groundwater of this region is geochemical in nature. This induces a great amount of involvement and responsibility on the geoscientists of the state in the consideration of environmental hazards like fluorosis.

X-RAY DIFFRACTION STUDY OF UMUNDIRA ULTRAMAFITES

S K Mohanty, Geologist

The effects of X-ray diffraction by mineral structures constitute the basis of a generally applicable method for identifying minerals and other crystalline substances. X-radiation in the form of a line spectrum is produced when an emitted high speed electron strikes on atom of the target and dislodges an electron from one or more of the inner shells; consequently, the atom is in an excited state. When so excited, outer shell electrons – which have higher characteristic energies than inner shell electrons – shift to the vacancies in the inner shells with the resulting loss of energy taking the form of emitted X-radiation. The X-radiation is, of course, of a characteristic energy (and, therefore, wavelength) for any shift within a given element.

XRD study in respect of three ultramafite samples of Umundira valley has been undertaken in RRL, Bhubaneswar. The analysis has been done at chart speed of 2^0 2θ/minute, CuKα_1 target and scan of 6^0 to 7^0 2θ. The XRD analysis is represented in graph by the intensity in counts per second in Y-direction and the 2θ value (at an interval of 2^0) ranging from 6^0 to 70^0 in X-direction. Peaks (in shape of higher intensity values) have been picked up from the graph and the respective 'd' value of each peak has been found out from the XRD study results. Keeping in consideration the 'd' value, the mineral has been identified.

The study has revealed that antigorite constitutes the essential mineral of all three ultramafite samples of Umundira valley.

USE OF GEMSTONES IN MODERN TECHNOLOGY

M K Senapati, Geologist

Gemstones are not used for ornamental or astrological purposes only. The gemstones in modern technologies find place in glass polishing to missile technology. Mostly corrundum, ruby and sapphire are used in advanced technical equipments. Due to their scarcity in nature, the laboratories in U.S.A. and Europe produce artificial or synthetic crystals. For example, U.S.A. produces around ten metric tones of boules (artificially produced gemstone). In comparison to U.S.A., the state of Orissa has got enough potential of producing clear boules. Some of the uses are:

1. Giant crystals of synthetic sapphires are cut into their radiation-resistant wafers, many of which are used as substrates for microcircuits in satellite systems.
2. Almost every watch that costs more than Rs 10,000/- has its face covered with sapphire. No acids or other chemicals affect sapphire and is virtually scratch proof.
3. Corrundum is harder than steel, which will not wear out if anchored with spinning steel shafts. Corrundum and ruby bearings are used in quartz watches, compasses, electric meters and as thread guides in textile machines. Fine mechanical watches still have 17 or 21 jewels, usually rubies.
4. Capitalising on three superior qualities of corrundum that is hardness, high melting point and ability to allow free passage of all waves from ultraviolet through visible to infrared, the ruby or sapphire hemispheres are used as tips of the missiles to resist abrasion and allows the passage of optical wavelengths to the GPS sensors behind it.

There are many more uses of rubies and sapphires. Researchers are only beginning to tap the potential of sapphires and rubies. Their future value to technology? Priceless. Thank God, Orissa has got enough deposits of corrundum to add to the future technology.

THE RICH & WEALTHY MOORS OF MURIBAHAL AREA OF BOLANGIR DISTRICT

J P Panda, Geologist

Muribahal area in Bolangir district is located at a distance of 100 Kms from Bolangir. The area represents an undulating topography with occasional mounds & knolls. Most of the area is covered with bushy forests & fallow lands. In the moors & valley of this area, rich colluvial deposits of gemstones like blue topaz, colourless topaz, aquamarine, chrysoberyl, colourless beryl (goshenite), apatite, garnet & rock crystal are found.

The area constitutes a part of Easternghat Super Group of rocks, such as khondalite, charnockite, leptynite, garnetiferous granite gneiss, calc-granulite, pegmatite & vein quartz.

The lithounits of the area under mention are highly affected by folding & faulting. The calc-granulite exposed in the area are intensively folded both laterally & vertically as observed from the disposition of ptygmatic folding, chevron folding & disharmonic bands of calc-granulite. It also exhibits a blackish blue colour & grooved weathering with ridges & furrows.

The pegmatite bodies, which are found in the valley & moors of Muribahal are extensively weathered, unzoned, simple & segregated type & occur at shallow depth. These are confined to the contact of granitic suite of rocks & the calc-granulite. The pegmatite contains quartz, K-feldspar, tourmaline, muscovite & precious/ semiprecious stones. It appears to be metasomatic in origin. The floats of pegmatitic material on the surface indicate the presence of colluvial zone beneath.

These colluvial zones are rich with gemstones like topaz, chrysoberyl, colourless beryl, aquamarine, garnets & rock crystals.

The chrysoberyl crystals are yellow & greenish yellow in colour, transparent to translucent. Apatite crystals from this area are of chatoyant variety.

Though the moors & valley of Muribahal are rich, they have not been able to bring prosperity to the valley dwellers.

APPLICATIONS OF SEISMIC METHODS OF PROSPECTING

S Mishra, Geophysicist

Seismic method is one of the most useful methods in geophysical survey. Though the method finds prime application in the field of hydrocarbon exploration, its importance in other areas of exploration cannot be ignored. Seismic method, which makes use of the theory of acoustic/ seismic wave propagation and the resistance, it suffers in passing through different sub-surface layers, is very useful in delineating the fault locations and the depth-to-bedrock profiles. Its utility in groundwater and mineral potential investigations is enormous. The method also has academic and research applications in the study of the earth's interior.

Except for exploration of hydrocarbons, the method is not very capital intensive. The method can be conducted in the field by means of a user-friendly, low-cost and portable seismograph. The instrument requires a simple hammer as a source to generate the required seismic energy. Interpretation of the seismic data can be done by means of a simple PC.

ROLE OF GEOLOGIST IN DAM SAFETY ORGANISATION

N M Hasan, DDG; A K Raut, Geologist

Geology of an area plays a vital role not only during the selection of dam site, but even during the construction as well as post-construction stage of the dam. The Geologist's role starts with locating the most ideal sites for dam, spillway, spill channel & reservoir and continues with monitoring the foundation condition of all these components of dam project during

the construction stage. He is also entrusted with the responsibility to ascertain any possible submergence of valuable mineral occurrence in the reservoir area, and his Mineral Clearance Report is a must for the dam project to commence.

Realising the importance of safety and stability of dams, specially large dams, and impending danger and disaster in case of their failure, the World Bank has started funding the Dam Safety Organisation (DSO) under Water Resources Department of Government 0f Orissa since 1992 for constant surveillance and monitoring of dams. The Directorate of Dam Safety has been entrusted with the responsibility of making periodical inspection of all dams - Major, Medium and Minor Projects in the state to ascertain their stability. During the last 9 years, the Directorate of Dam Safety has been able to inspect about 200 nos. of such dams (both during the Phase-I first cycle and Phase-I second cycle inspection) in great detail throughout the State and submitted the inspection report as per the guidelines issued by DSRP (Dam Safety Review Panel) under Central Water Commission (CWC) of Government of India. During such inspection of dams, some geological/geo-technical problems in various components of dams have been identified, their corrective/ remedial measures suggested and in some cases, compliance achieved too. The World Bank guidelines insist upon inclusion of Geologist's Report in the combined inspection reports of all dams.

After proper scrutiny of all the Phase-I inspection reports of dams thus prepared, about 34 nos. of dams have been identified and selected (on the basis of their level of distress condition) to undergo Phase-II inspection by team of experts for rehabilitation and upgradation, under World Bank Assistance Programme. Of these, about 19 nos. of dams have already been rehabilitated, and the rest are under process of upgradation.

Besides such periodical inspection of dams from time to time, the services of Geologists are also requisitioned by various project authorities of Water Resources Department for consideration of specific geological/ geo-technical problems that arise in their respective field area. Such problems are examined and their remedial/ corrective measures are suggested.

ENVIRONMENTAL PROBLEMS- ROLE OF A GEOLOGIST

P K Ojha, Deputy Director Geology

The fantastic strides made by man have not only made him all powerful, but has attributed him the role of a geological agent capable of bringing in modifications in natural situations and inducing palpable changes in the environment. This one track journey by man, into a river of no return of industrialization and mechanisation has not been all too desirable. It has created an overall crisis by the depletion of non-renewable resources and inequitable distribution of the benefits derived from their utilisation in the world. The excessive industrialisation, nuclear activities and modification of nature through engineering measures have led to a serious ecological imbalance through pollution of air, water and land, resulting in disruption of ecosystems. Consequently, the wonderful in-built security system that nature had provided for us has become ineffective; forcing us to adopt the "Preservation of the environment" as a global battle cry. In this altered situation, the geologists hitherto designated as "Plunderers" of the earth, should also take upon themselves, the moral & social responsibility and redefine their role in the present perspective to help in conservation, maintenance and rectification of the environmental equilibrium. In this context, particularly during the recent period, the geologist has an important role in an in-depth study of the natural Land-Water-Resources system and to suggest ways and means of alleviating the situation.

The sphere of the activity should include

- Long term planning for exploitation of natural resources such as minerals, construction materials, fuels and ground water.
- Water management, pollution control, proper disposal of dangerous materials like atomic wastes, organic wastes etc.
- Land use including changes related to human activities, engineering constructions, hazards and problems of deltaic and coastal areas.
- Human health as related to the role of major and minor elements and geological cycle. (Extensive biogenic contamination all around the rural and urban settlement and lack of basin sanitation, drainage have exposed all to endemic diseases.)

The entire gamut of environmental studies calls for systematic and urgent inter-disciplinary programmes for rural and urban development. Geologists should form the core group for the purpose. Some of the basic information required to be collected during environmental appraisals are:-

- Basic geological map indicating formational characteristics (of the lithotypes, soils etc.) such as strength, erodability, stability, degree of consolidation, weathering, seismicity, neotectonism etc.
- Delineation & analysis of geomorphic units.
- Drainage characteristics
- Land capability:- factors for determining suitability for different uses.
- Water bodies and ground water studies:- discharge level, relationship with ground water, phreatic/ piezometric surface, delineation of zones of influence and effluence.
- Climate:- temperature variation, wind and rainfall characteristics since these influence geodynamism.
- Establishing the three dimensional geometry of the geological setting in mining zone and its surroundings for determining subsurface dissemination of pollutants, the absorption/retaintion capacity of the area in respect of pollutants.

GEO-ENVIRONMENTAL STATUS OF BHUBANESWAR CITY- AN OVERVIEW

G K Bhuyan, S Jena, Geologists

Bhubaneswar, the capital city of Orissa occupies an important position in the religio-cultural scenario of the State. Presence of many historical monuments juxtaposed with modern high-rise buildings reflects a fine blend of ancient and modern culture in the city. Once regarded as green city, of late seems to have tasted the bitter effects of pollution, which primarily owes its origin to human activities. Unplanned growth of the city due to exponential rise in population from 16,512 in 1951 to 6,50,000 in 2001 has been responsible for many environmental problems associated with urbanisation.

The post supercyclone environmental scenario resulting in extensive depletion of vegetal cover and record rise in temperature during past few years have made it imperative to carry out geoenvironmental appraisal studies which in turn will dictate the limiting levels of developmental activities that can be taken up with minimum damage to environment.

LANDUSE: Unplanned urban sprawl, depletion of green cover, congestion/ blockage of natural drainage, reduction in surface area of water bodies and anthropogenic activities around archaeological sites are some of the major geo-environmental problems which adversely affect the eco-friendly status of the city.

WATER QUALITY: The ground water quality analysis reveals that various constituents like Cl^-, PO_4^{-2}, SO_4^{-2} etc. are well within the permissible limit (as per BIS-1991) except the lower pH recorded

at Baramunda, Khandagiri, Nayapalli, Suryanagar, Damana area and high iron content in almost all the tubewells which may be due to the leaching of iron from laterite.

Bhubaneswar city gets its water supply from Mahanadi, Kuakhai and Daya rivers. The water quality is fairly good at many places except at few locations where local contamination might have occurred.

There is no conventional wastewater treatment facility in the city. So the untreated sewage are being discharged into principal valleys all leading to Gangua Nala that serves as trunk sewer and ultimately joins river Daya.

AMBIENT AIR QUALITY: The ambient air quality monitoring in the city indicates that the concentration of suspended particulate matter (SPM) has already exceeded the permissible limit in some of the residential and sensitive area around Vanivihar, Capital Hospital, Bhimtangi, and Baramunda. But the city is still free from major gaseous pollutants like SO_2 & NO_x though the concentration of NO_x in air is little higher in some areas. The pollution in urban atmosphere of the city can mainly be attributed to the exhaust gases of the automobiles.

Increasing urbanization, haphazard development with simultaneous depletion of vegetal cover, improper discharge of untreated sewage and blatant violation of vehicular emission norms are detected as major factors for the deteriorating environmental status of the city which if not monitored and controlled right now, may cause serious problems in days to come.

CHROMITE MAGNETITE REPLACEMENT IN SERPENTINITE - UMUNDIRA VALLEY

P K Chand, Petrologist

Geological exploration in the Umundira valley, the northwestern extension of Sukinda chromite field has indicated the presence of a serpentinite body containing black minerals (??) in the form of veins and stringers. When the samples were studied in the petrology laboratory both under refracted and reflected light (thin/ polished sections) it was observed that cumulous chromite occurs in serpentinite basically composed of fibrous antigorite and little altered clinopyroxene as discrete disseminated grains of about 0.2mm in size. These disseminated chromite grains occur in clusters in definite bands giving rise to thin veins and stringers of black minerals traversing the rock (noticeable in hand specimen). The chromite grains are usually enclosed by rims of ferrit chromit and magnetite, which may be an alteration product formed during the serpentinisation. The boundary between chromite and ferrit chromit is sharp and can be distinguished easily, as chromite gives dull grey colour and ferrit chromit exhibits little higher reflectance. Again the ferrit chromit is bounded by rim of magnetite, which indicates the gradual replacement of chromite to magnetite. In few grains the chromite is completely altered to magnetite inheriting its original shape. The detailed chemical variation (from chromite to magnetite) can be established by grain-to-grain electron probe analysis within a single sample.

DEVELOPMENT OF NATURAL RESOURCE INFORMATION SYSTEM IN PARTS OF GONDIA BLOCK

M R Mishra, Geologist

Now a days Central & State Governments are earmarking huge funds for rural development in various schemes. But hardly any survey has been taken up to assess the potentials existing in villages for proper planning. With this background Directorate of Geology has taken up investigation for development of NRIS in parts of Gondia Block of Dhenkanal district during 2000-2001 field season. Gondia Block comprises of twenty-four *grampanchayats* situated at a distance of 29 kms to the NE of Dhenkanal town. To start with, four *grampanchayats* of Gondia Block i.e. Deogan, Bidharpur, Kabera & Joranda were considered as target areas. All the *panchayats* are well connected by all weather roads with block headquarters as well as district headquarters.

Topographically this area represents a flat terrain with few outcrops of residual hills. General slope of the terrain is found to be towards north. The maximum & minimum elevations of the area are 181 m & 50 m from msl respectively. Daunri nala a tributary of Brahmani forms the major drainage system of the area. The area is coming under catchment areas of Brahmani River. 35 nos of villages in four panchayats of Gondia block was explored with a view to gather the NRIS data keeping the village as the unit of socioeconomic development. An area over 100 Km^2 in 1:25,000 scale have been covered by geological, geomorphological, landuse, groundwater & soil mapping. Environmental & mining activities are also taken into observation. Such tedious data collection and thematic georesources mapping in the aforesaid four *panchayat*s have provided substantial results as mentioned below:

1. Illegal excavations of huge laterite bodies in the wasteland and party cultivated land have been demarcated.
2. The laterite stone quarries cause substantial land degradation and hardly any step has been taken for reclamation & rehabilitation of mined out areas.
3. Wasteland like barren rocky areas, gullied land, old abandoned laterite quarries qualify for forestry and pasture development.
4. Protection of greenbelt should be made as deforestation is in progress.
5. Twelve perennial water sources have been identified which can be developed for irrigation purposes.
6. Huge laterite areas are located which can produce building stones.
7. Deposits of garnetiferous granite gneiss & charnockite can be exploited for decorative stones.

The area is free from environmental pollution and industrial development.

OGSA NEWS

Trainings and Courses

- S K Das, DDG; J P Behera, Geologist and P K Chand, Petrologist attended the training course on "Electronic Spread Sheets (MS-EXCEL) at NIC, Bhubaneswar from 22.02.2001 to 24.02.2001.
- M D Behera, Geologist attended a course on "Chemical Analysis of Environmental Samples by Modern Techniques" at IBM, Nagpur from 16.07.2001 to 20.07.2001.

Transfers

- Mrs S Das, JDG, Berhampur joined at Headquarters Bhubaneswar.
- B C Patnaik, DDG, Sambalpur joined at Headquarters Bhubaneswar.
- G D Panigrahi, DDG, Sambalpur joined at Bolangir.
- G P Ludam, DDG, Bolangir joined at Sambalpur.
- M K Senapati, Geologist, Bolangir joined at Headquarters Bhubaneswar.
- P K Panigrahi, Geologist, Koraput joined at Bolangir.
- S K Rath, Geologist, Bolangir joined at Berhampur.
- K Nayak, Geologist, Bolangir joined at Dhenkanal.
- K Pattanaik, Geologist, Dhenkanal joined at Berhampur.
- K D Nath, Geologist, Dhenkanal joined at Koraput
- A K Mohanty, Geologist, Dhenkanal joined at Bolangir.
- R K Kar, Geologist, Sambalpur joined at Headquarters Bhubaneswar.