

Inaugural Issue #1

CONGLOMERATE

December 2014

D for Diamonds

Journey into the world of most beautiful and attractive gem

The Telltale Fossil Wood of Sattanur

Story of the plants from Cretaceous

Lonar- Lake of Heritage

Explore one of the few meteor craters in India

Causative Factors of Malin Landslide

Insight into the disaster of the year



Deccan Education Society's
Fergusson College, Pune
Department of Geology



**GEOLOGY
ASSOCIATION**

CONTENT

FEATURE STORY



15

Lonar lake of Heritage

Explore one of the few meteor craters in India



51

The Telltale Fossil Wood of Sattanur

Story of the plants from Cretaceous.



55

D for Diamonds

Journey into the world of most beautiful and attractive gem



60

Causative Factors of Malin Landslide

Insight into the disaster of the year

OTHER

Piezoelectricity	11
Geology Science of Earth	18
Crystal Caves at Naica	21
Geological Timescale	23
Geology around Sangamner and Aane ghat area	26
Introducing and Classifying Dinosaurs	29
Batu caves Malaysia	35
Rare Polymorphs of Olivine and Quartz	38
Fluorescence of minerals	44
The Gabbro Intrusions	47
The most expensive coconut of my life	49
Rolling Stones	64
Where giants walked	66
Rocky Times	70
Flash Stones	73

REGULARS

Preface	4
Foreword	5
Our Department	7

Mentors

Dr. R.G.Pardeshi
Principal Fergusson College, Pune

Dr.R.N. Mache
Head, Department of Geology
Fergusson College, Pune

Dr. Tanuuja Marathe
Dr. P.K.Sarkar
Prof. S.D.Raut
Dr. S.N.Mude
Prof. Devdutt Upasani
Prof. Madhuri Ukey
Prof. Aneesh Soman
Mr. Chinmay Thite
Mr. Amey Dashputre
Miss Aditi Bharadwaj

Editorial Committee

Prof. Devdutt Upasani
Mr. Chinmay Thite
Mr. Amey Dashputre
T.Y.B.Sc. Geology Students 2014-15

Cover Page and Back Cover : Columns of basalts from Isle of Staffa, (Fingal's Cave)
Scotland, United Kingdom

Photography : Chinmay Thite

Magazine cover and Design : Chinmayi Dumbre

Published by : Department of Geology
Fergusson College, Pune

Contact : egeomag@gmail.com

For academic and educational purposes only

PREFACE

Student and Staff
Department of Geology
Fergusson College

Geology is an earth science comprising the study of solid Earth, the rocks of which it is composed, and the processes by which they change. Geology gives insight into the history of the Earth by providing the primary evidence for plate tectonics, the evolutionary history of life, and past climates. In modern times, geology is commercially important for mineral and hydrocarbon exploration / exploitation as well as for evaluating water resources. It is also important for the prediction and understanding of natural hazards, the remediation of environmental problems and for providing insights into past climate changes. Geology also plays a role in geotechnical engineering and is a major academic discipline. Geology is a subject that is considered by many Indian students. The career opportunities available for students who finish their studies in this field are also high.

In spite of the subject being so important, in India the common-man is aloof of the subject and also the advances happening in it. The

E-Geo Magazine aims at taking the subject to the masses, especially the school students, so that the subject can be nurtured in their minds since the beginning.

We, the students and staff of Department of Geology, Fergusson College, take great pride in presenting to you this inaugural issue of our magazine. Sincere efforts have been taken by all, to present articles and data of utmost importance and interest and that too in a lucid manner so that even non-geologist reader friends can benefit from it.

Care has been taken so that no copyright laws are broken in the magazine. References of the original writers and researchers have been included wherever required. In spite of this if any copyright has been flouted we would offer our sincere apologies for the same.

We would also like to urge all the readers to recommend the magazine to all their friends and family, so that our subject gets the much deserved attention and importance.

The Deccan Education Society, Pune was established in 1884 and registered on 13th August 1885 by patriotic visionaries like Vishnu Shastri Chiplunkar, Bal Gangadhar Tilak, Gopal Ganesh Agarkar, Mahadeo Ballal Namjoshi and Vaman Shivram Apte-who were already recognized as the pioneers of new education in India with the Launch of New English School in Pune in the year 1880. Deccan Education Society's, Fergusson College, was established in the year 1885 and since its inception has been imparting quality education of the highest level, such that today, it is recognised as one of India's premier institutes. Fergusson College has been re-accredited by the National Assessment & Accreditation

FOREWORD

Dr. Ravindrasinh G. Pardeshi
Principal,
Fergusson College

Council, Bangalore and awarded an "A" Grade with CGPA of 3.26.

The Geology department is one of the well established departments of Fergusson College. The subject of geology was introduced in Fergusson College in 1908 as one of the optional subjects at the inter science examination. In 1951, the University of Pune introduced the B.Sc. (General) course at the college. Teaching of M.Sc. degree by research to the students was offered by the authorities

of the Fergusson College till the year 1955 after which M.Sc. course was also started at the department. The centenary year of the Geology Department was celebrated on grand scale in December 2008 and centennial seminar was organized during this celebration.

Today, the Geology department offers undergraduate and postgraduate courses and it also has a Research Centre for Ph.D. programmes. The Department has produced many famous geologists - in the field, industry and in academics.

As part of our outreach to the general public, our goal is to inform the interested public of the nature and scope of geology and geologic research. The launch of E-Geo Magazine of Fergusson College is a celebration of the work our Geology Department and Geoscientists, who have struggled to understand and reconstruct our rich geological past. As a part of that celebration, we are dedicating this very first issue of the Magazine to a retrospective display of articles published in the recent and not so recent past, field trip evaluations, and work submissions by our students and faculty.

We endeavour to incorporate various papers on the subject, review articles and discuss all aspects of geology covering mineralogy, petrology, palaeontology, stratigraphy, structural geology, geophysics, geochemistry and geomorphology. Let's work towards making this E-Geo Magazine a success, with a mine of information, for generations to come.



Geology is that branch of Science, with which everybody is not familiar. Yet it helps in finding practical solutions to the everyday problems as well as those that have long term consequences. It is a challenge for government and industry to develop infrastructure without disturbing the natural harmony, for which geological data obtained by geologists is very useful. Yet, there are still very few undergraduate colleges where Geology is taught even today. This situation speaks of the sagacity of Fergusson College, when it decided to launch the Geology teaching department for their undergraduate classes, way back in 1908. Having been established then, the Geology

Our Department

One of the Oldest Department of Geology

Dr. Ram Mache
Head,
Department of Geology,
Fergusson College

Department of Fergusson College is one of the oldest departments in India.

Initially, Prof. T.G. Yeolekar, who was Head of Zoology Department, looked after the duties of the Head of Geology Department also. Those days Prof G.G. Narke used to teach Geology in the Engineering College of Pune. Having developed an interest for Geology, he accepted with enthusiasm to teach Geology in Fergusson College as an honorary teacher.



Prof. K.V. Kelkar joined this college in 1924 as a Junior Lecturer, to assist Prof. Yeolekar.

A milestone was set in 1926, when students were allowed to offer Geology as the principal Subject for graduation level. Eventually, Prof. Kelkar was appointed as Head of the Geology Department in 1932. Over the years that followed, some past students viz. R.D. Godbole, Y.T. Apte, R.V. Sathe, L.V. Agashe, R.B. Gupte and S.Y. Date had short stints here as lecturers and had their contributions in the development of this department. For a short period, after the Pune University was established in 1949, there were certain practical difficulties for the University to start post-graduate teaching in Geology. During those years (1949-1955), the College was conducting classes for M. Sc. in Geology by research.

In 1946, the Government of India appointed the Geology Education Committee, its members being stalwarts like Dr. W.D. West, Dr. D.N. Wadia and Dr. S.P. Parija. The Committee was highly impressed by the progress made by the department. As a result, it recommended a handsome grant for a separate building for the department. Due to various reasons, the construction work could not be completed till 1959. The new building was inaugurated in September 1959 at the hands of Prof. D.G. Karve, the then Vice-chancellor of the Pune University.

Meanwhile, the Pune University had established their postgraduate Geology Department. However it was located in the Fergusson College premises. Therefore, in 1959, both the undergraduate geology department of Fergusson College and postgraduate geology department of the Pune University were shifted to the new building. In the year 1971, the University shifted their postgraduate teaching department to the University campus. But this Department started postgraduate teaching on non-grant basis, leading to the M. Sc. degree of University of Pune, from July 2007.

The Geology Department of Fergusson College has an excellent and unique Museum known as Prof. K.V.Kelkar Museum. This Museum was set up in 1962 when Prof. K.V. Kelkar retired as the Head of the Geology Department. The museum was established by the students in honour of their teacher, who was a pioneer in graduate and post-graduate studies in Geology in the western part of Maharashtra. The Museum is a vast treasure of specimens of rocks, minerals and fossils, donated by the students of the department as well as those collected by the teachers and students during their field trips. Some typical specimens have also been purchased from dealers within the country and outside. Notable contributors have been Mr. R.V. Mandhare, who has donated a wide range of specimens in the form of minerals and gemstones. Some of the specimens donated by him are priceless, especially the giant quartz crystals collected from the Himalaya. Prof. A.V.Phadake, Geology Department, University of Pune, has also donated excellent specimens of zeolites collected from around Pune and many other fine mineral specimens from different parts of the world. The Museum is a great asset to the department and is a landmark of Fergusson College, Pune.

Another specialty of the department is the Library facility. The departmental library has more than 1000 books on various topics such as Palaeontology, Mineralogy, Crystallography, Petrology, Applied Geology, Stratigraphy, Structural Geology, General Geology, Geomorphology and general books on Earth Science.

The Department celebrated its centenary on 19th and 20th December, 2008. The main function of the event was the Centennial Seminar, when past students working on key posts of certain organizations spoke on the status of the art pertaining to their own fields.

A gala get together of past students was arranged, which was attended by over 250 alumni of the department, of batches ranging from 1944 to 2008. The past students collected a fund of Rs. 75,000/- on the occasion, for the development of the Department. The response received was overwhelming. Large crowds thronged the Museum. Notable among them were the school children accompanied by their parents. The event received a wide coverage by print and electronic media.

During the Academic year 2012-13, the Department was recognized as a 'Research Centre in Geology'. Simultaneously, five teachers have been granted recognition as research guides for M. Phil. and Ph. D. degrees of the Savitribai Phule Pune University. Presently the Department has three research laboratories viz. Remote Sensing-GIS, Petrology and Palaeontology-Sedimentology. The laboratories are equipped with high resolution Petrological microscopes, Gemological microscope and Ore microscopes; and also various software for GIS studies

The department is always keen to organize seminars, workshops and lecture series for the benefit of the postgraduate and undergraduate students. It must be specially mentioned here that the Department had organised 'The International Conference on Recent Developments in Stratigraphy' (ICRDS-2013) during 14th December 2013 to 16th December 2013, which was inaugurated by Padmashree Prof. K. S. Valdiya, former Vice Chancellor, Kumaon University, Nainital. 'National Conference on Emerging Trends in Stratigraphy' was also organized prior to this International Conference. The geology association activity called as 'FLINTS' is being organized every year for about three days. This activity includes Prof. K. V. Kelkar Memorial Lecture and exhibition of geological specimens

All the class-rooms and laboratories in the department have DLP Projector facility. The internet facilities are extended to the

rooms of the staff members, computer and research laboratories. The students also have access to the internet in the computer laboratory.

Presently the department is having eleven highly qualified teaching faculty for undergraduate and post graduate classes assisted by one Lab assistant and six Lab attendants. There are more than 500 students admitted to UG and PG classes who have opted for Geology subject. The department is also extending all kind of help for placements and is always keen in arranging field study tours for all UG and PG classes.

to the students was offered by the authorities of the Fergusson College till the year 1955 after which M.Sc. course was also started at the department. The centenary year of the Geology Department was celebrated on grand scale in December 2008 and centennial seminar was organized during this celebration.

Today, the Geology department offers undergraduate and postgraduate courses and it also has a Research Centre for Ph.D.

programmes. The Department has produced many famous geologists - in the field, industry and in academics.

As part of our outreach to the general public, our goal is to inform the interested public of the nature and scope of geology and geologic research. The launch of E-Geo Magazine of Fergusson College is a celebration of the work our Geology Department and Geoscientists, who have struggled to understand and reconstruct our rich geological past. As a part of that celebration, we are dedicating this very first issue of the Magazine to a retrospective display of articles published in the recent and not so recent past, field trip evaluations, and work submissions by our students and faculty.

We endeavour to incorporate various papers on the subject, review articles and discuss all aspects of geology covering mineralogy, petrology, palaeontology, stratigraphy, structural geology, geophysics, geochemistry and geomorphology. Let's work towards making this E-Geo Magazine a success, with a mine of information, for generations to come.

Piezoelectricity

Nikita Zankar

T.Y. B.Sc

For the annual function of the Geo Association i.e. ‘Flints’ in the year 2013-14, we had to make a project based on our geological knowledge. After a lot of study and search, we struck upon this very interesting topic of Piezoelectricity. As we read more about it, we found it more and more interesting and we decided to make a model showing this phenomenon. As it was a new concept for us, we had to think a lot about what would the project exactly be, or which model would best describe our concept. Upon loads of discussions and meetings we came up with the idea of showing piezoelectric roads that help in lighting the street lamps. A glimpse of what Piezoelectricity is and what our project was about is presented in this article.

WHAT IS PIEZOELECTRICITY?

It is the ability of certain minerals to generate an AC voltage when subjected to mechanical pressure. This is also called as the Piezoelectric effect.

Piezoelectric materials are used to obtain energy from exerted forces or vibrations. The deformation of the material produces an internal dipole moment, which in turn, produces an electrical charge across its surfaces. This process is reversible – when an electric current is run through the material, its shape also changes. The polarity of charge results in alternating current (AC) which is then converted into direct current (DC). The converted current is then used to charge a

capacitor or a battery, which can store the energy for later use.

The concept of Piezoelectricity has been around since the 1880s’ and was discovered by Jacques and Pierre Currie. The theories behind piezoelectricity, or the conversion of movements and vibrations into electricity, have existed for many years. However, very few applications of piezoelectricity exist in this modern age.

Even if the planet with doubled the amount of solar and wind power available, there would still be a shortage of clean electricity in the coming years. We need to grab energy from wherever we can find it, which is

why piezoelectricity – the charge that gathers in solid materials like crystal and ceramic in response to strain – has recently begun to pique the interest of entrepreneurs and scientists alike.

A number of materials are piezoelectric, including topaz, quartz, cane sugar, and tourmaline. Other minerals used are Rochelle salts and various solids. That means a charge begins accumulating inside these materials when pressure is applied. Piezoelectrics are already commonly used in a number of applications. Quartz clocks, for example, rely on piezoelectricity for power, as do many sensors, lighters, and actuators. But these are the old uses for piezoelectricity. Scientists today have much more interesting piezoelectric plans in mind.

PIEZOELECTRIC MATERIALS

Piezoelectric materials are materials that produce an electric current when they are placed under mechanical stress. There are several materials that we have known for some time that possess piezoelectric property, including bones, proteins, crystals (e.g. Quartz) and ceramics (e.g. Lead Zirconate Titanate)

In May 2012, some scientists from University of California Berkeley lab have found a mechanism of harnessing piezoelectricity from viruses also. This is the first time a biological material has been used to make piezoelectricity.

The piezoelectric effect is exhibited by 20 out of 32 crystal classes and is always associated with non centrosymmetric crystals. Naturally occurring materials, such as Quartz, exhibit this effect as a result of their crystalline structure. Engineered materials like PZT for instance, are subjected to a process called poling to impart the piezoelectric behavior.

Some naturally occurring piezoelectric materials include Berlinite (structurally identical to quartz), cane sugar, quartz, Rochelle salt, topaz, tourmaline and bone (dry bone exhibits some piezoelectric properties due to the apatite crystals, and the piezoelectric effect

is generally thought to act as a biological force sensor)

HOW CAN IT BE USED?

Man made piezoelectric material includes barium titanate and lead zirconate titanate.

Piezoelectric plates are placed under the cross-walk so that vibrations and pressure fluctuations caused by cars and pedestrians can be converted into electricity.

The electricity can be piped to power street lamps, traffic signals, cameras and other electronic devices located in the vicinity.

So, the concept is to use mechanical energy or external force to create electricity by the use of specific crystals.

It can be used at various public places like,

1. Railway stations, Bus stations
2. Roads, Highways
3. Walking tracks, Footpaths
4. Discos, Pubs etc.

Imagine, walking down the street and charging your phone as you walk, or charging your laptop by typing, or powering a night-club by dancing on a piezoelectric floor!!! This is possible if piezoelectricity is used.

APPLICATION OF PIEZOELECTRICITY IN DAILY LIFE

1. The first and the most recent use of piezoelectricity was seen in 2008 at Club Watt, a dance spot in the Netherlands, dubbed the world's first sustainable dance club. The club installed piezoelectric materials in its dance floor to turn patrons' moves into electricity that is used to change the color of the floor's surface.

2. Tokyo railway station installed a piezoelectric floor that uses kinetic energy to generate 1,400 kW of energy per day – enough to power ticket gates and displays.

3. Toulouse, France, recently became the first city to put pressure-sensitive piezoelectric

modules on the sidewalk, generating enough energy to power streetlamps.

4. The United Kingdom plans to install power-generating tiles on London streets to light up bus stops and pedestrian crossings.

5. In 2009, a British supermarket installed kinetic road plates that collect energy from customers driving over road bumps in the store parking lot. The road plates are pushed down by vehicle weight, which creates a rocking motion that turns generators.

6. In Israel, a company called 'Innowat-tech' is installing strips of asphalt embedded with piezoelectric materials. According to the company, the generators could produce 1 MWh of electricity from a four lane highway, enough to power 2,500 homes.

Piezoelectric sidewalks, roads, and clothing items haven't taken off in a big way quite yet, but they probably will soon.

ABOUT OUR PROJECT

When we understood the basic concept of Piezoelectricity, we decided on applying it on a very simple level, like it has been happening in many other countries. We designed a road with streetlamps and tried to show the electricity generation to light the lamps by the help of mechanical pressure in form of vibrations applied by cars on the road. Here, we assumed that the piezoelectric crystals were

Rough Sketch of the model

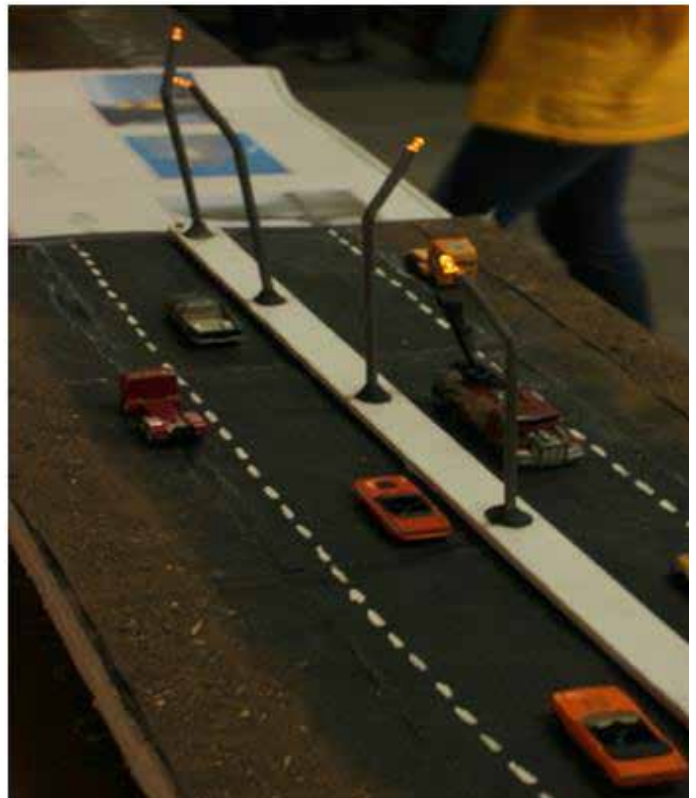


put under the road and were connected to the battery where the electricity was stored.

This model was well thought and we made it as simple as possible, where the small LED's were attached by wires which stood as streetlights in the middle of our road made by using the base as thermacol. These un-insulated copper wires were connected in parallel and a resistor was used to control the flow of current. This was further given a connection with the 6V battery and attached to a button to switch on and off the lights.

There was also another small model to show the use of quartz as a piezoelectric crystal. A Cigarette lighter was used and the

Actual Model



demonstration of how, when the pressure is given on the lighter knob, the quartz crystal present inside it shows piezoelectric effect and with the help of liquid present, ignites the flame

There are three issues that we are currently faced with when trying to tap piezoelectricity as a viable electricity production method.

LIMITATIONS OF PIEZOELECTRICITY:

The major issue is that the quantity of electricity produced is so small, so unless vast installations are set up, it simply would have not enough strength to power our latest gadgets.

The current is only produced when there is mechanical stress being applied, so as soon as you stop compressing the material, there is no charge produced.

Another issue is that up till now, many of the starting products needed to produce the piezoelectric materials are toxic and difficult to work with.

CONCLUSIONS OF OUR PROJECT:

The use of piezoelectricity for sensors is widely accepted; however, doubt still remains concerning its efficiency as a direct source of energy. Because of the sheer amount of force it takes to generate a very small amount of electricity, many believe that piezoelectricity will never have large scale applications. However, in examples like the train stations in Japan, the individually insignificant footsteps of people add up to significant electricity to power the lightning systems and gates. It would seem this potential is too great to ignore – and that future research into piezoelectricity as a prospective power source is well worth the effort.

REFERENCES

Brenda Ou, Dec '11, Submitted as a coursework for PH240, Stanford University, Fall 2011

Rex garland, April '13, Submitted as a coursework for PH240, Stanford University, Fall 2012

J. Fraden, *Handbook of Modern Sensors: Physics, Designs and Applications* (Springer, 2004)

I. Amato, "Piezo: Tough Plastic With a Sensitive Side," *Los Angeles Times*, Dec '89

J. Ryall, "Japan Harnesses Energy from Footsteps" *The Telegraph*, Dec '08

Wikipedia

science.howstuffworks.com

www.piezomaterials.com

www.thegreenage.co.uk – piezoelectric materials

www.nanomotion.com/piezoelectric-motor-technology/piezoelectric-effect/

LONAR

A lake of heritage

Neeraja S. Chinchalkar

T.Y.B.Sc.

The Lonar Crater, located near the Lonar village in Buldhana district of Maharashtra, is one of the most unique meteorite impact craters on the Earth, formed nearly 5, 70,000 years ago (F. Jourdan et al, 2011). The crater itself with its raised rim is about 1.8 km in diameter, while the saline lake that it harbors is about 1.2 km in diameter. Impact craters on the earth are not uncommon; in fact, as many as 170 terrestrial impact craters have been identified [2] (Grieve et al., 2005). Even though it cannot be asserted with complete certainty, Lonar crater is probably the largest and most preserved impact crater on earth formed entirely in a basaltic terrain.

The Earth, in its orbit around the Sun, passes through a lot of debris left behind by comets and asteroids. This debris, in the form of meteors, enters the earth's atmosphere at velocities greater than 10km/sec. The friction with the atmosphere causes the meteors to either burn away

completely, or to slow down and eventually have a free fall. A meteor on hitting the surface of the earth is known as a 'meteorite'. If the meteor is sufficiently large enough to withstand the resistance from the atmosphere, it may continue to travel with a hypervelocity and collide with the surface of the earth, giving rise to a depression known as an 'impact crater'. Some of the well known examples of impact craters are Barringer Crater (Meteor Crater) in Arizona and Chixulub Crater in Mexico.

Impact craters may be classified as Simple or Complex, depending on their structure. The basic difference between the two lies in that the Simple Crater has a flat floor while the Complex Crater has an uplifted centre within the flat floor. Lonar Crater has been classified as a Simple Crater as it shows no central uplift, among other factors.

The theories about the formation of the Lonar crater have been of a controversial

nature. Being located in the Deccan Traps, one of the largest igneous provinces in the world, Lonar crater was originally considered to be of a volcanic origin. On the contrary, recent studies have led scientist to attribute the formation of this crater to a meteorite impact.

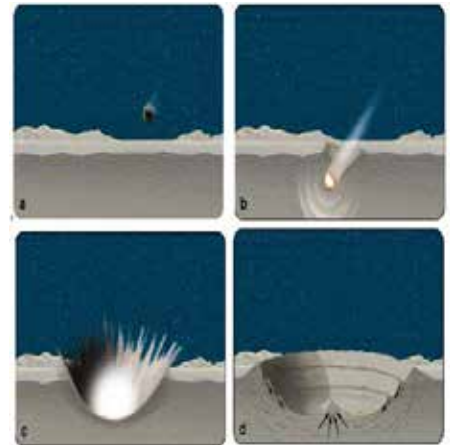
Geoscientists from across the world have provided evidences through their research to corroborate this theory. The bowl-shaped structure of the crater along with a raised rim is typical of an impact crater. The impact has given rise to many fractures appearing in radial, conical as well as concentric systems in the crater. These fracture systems form an essential component while describing the impact.

The matter excavated by the impactor surrounds the Lonar crater up to about 1350m and is known as 'ejecta matter' or 'ejecta blanket' (P. Senthil Kumar, 2005). Basalts from the ejecta have undergone shock metamorphism due to the tremendous heat and high pressure

generated during the impact. The most important effect of shock metamorphism in these basalts is the conversion of Plagioclase to Maskelynite. Maskelynite is a diaplectic glass which is formed only by the processes involving temperatures and pressures as high as those generated during impact processes. Occurrence of Planar Deformation Features or PDFs in the Feldspars of these basalts has served as an unambiguous evidence for recognizing Lonar as an impact crater. PDFs are a result of shock metamorphism and cannot be formed due to volcanic activities. Dark coloured glassy rocks showing vitreous lustre have been found at various locations

inside and outside the crater. These are known as 'Impact Glass' and cannot be clearly distinguished from volcanic glass without sophisticated laboratory techniques. No fragments of the impactor have been recovered from the crater. The large diameter of the crater suggests that the impactor was probably completely vaporized, thus making it difficult to find any fragments.

A comprehensive study of the crater would allow for a wider understanding of the effects of meteorite impact on basalts. Such studies will also help better understand the impact structures on moon and terrestrial planets, as the surfaces of these bodies which are riddled with numerous



(Image courtesy www.2astro.psu.edu)

Formation of an Impact Crater.

impact structures, are almost completely made up of basaltic strata.

Lonar is not only important from a geological perspective but it also has a lot more to offer. Lonar Crater

A view of Lonar Lake in November 2013





Daitya Sudan Temple at Lonar

is home to many biological species ranging from nitrogen fixing micro organisms to migratory birdlike flamingos, and countless other species of plants and animals. Temples of historical and archaeological significance built thousands of years back are still preserved and prized by the villagers. The 'Daitya Sudan Temple' of Lord Vishnu at Lonar is a classic example of the 'Hemadpanthi' style and features exquisite carvings throughout. 'Kamalja Devi Temple' and 'Gomukh Temple' are also very well known among pilgrims.

However, a lot of ignorance still exists about the Lonar Crater. The stories of how the crater came into being revolve around myths and beliefs of the local people of Lonar village. One such myth states that a Goddess, offended by treacherous acts

of humans, created the lake to bury and protect her treasures which the villagers of Lonar still believe to be hidden under the lake. Religious festivals, deforestation and construction around the crater are responsible for the pollution and exploitation of the lake. If such activities are not checked, the crater will lose its beauty in no time.

Even though the Lonar Crater has been a subject of research and speculations for a long time, many of its mysteries are yet to be explored. We must not forget that nature has created this enigmatic wonder and it is in our hands to preserve and cherish it before it disappears forever.

References:

- F. Jourdan, F. Moynier, C. Koeber3, and S. Eroglu, *$^{40}\text{Ar}/^{39}\text{Ar}$ Age of the Lonar crater and consequence for the geochronology of planetary impacts*
 Grieve, R.A.F.; Cintala, M.J.; Tagle, R. (2007). *Planetary Impacts in Encyclopedia of the Solar System*, 2nd ed., L-A. McFadden et al. Eds, p. 826
 P. Senthil Kumar, *Structural effects of meteorite impact on Basalt: evidence from Lonar Crater, India* (2005).
 Wikipedia: Lonar Crater Lake
 Lonar Crater, India: Analog for Mars in the field and laboratory – S.P. Wright, Auburn (Eight International Conference on Mars – 2014)
 No evidence of impact induced volatile loss from Maskelynite of Lonar Crater, India – S. Misra et al (2007).
 Geology of Lonar Crater – Maloof et al (2010).

GEOLOGY

Science of the Earth

Navnath Ghodake, T.Y.B.Sc

Geology is the science of the earth, which deals with its physical and chemical characters, as also its structure, origin, age and history. It also deals with the materials (rocks, minerals, ores, coal and petroleum deposits etc.) that constitute it and the processes, both external and internal that operate on and within it.

The name geology is coined from the Greek word 'gea' or 'gaia', meaning the earth and 'logy' meaning science. Richard de Bury was the first to use the word geology. In the year 1473, he applied it to the 'law' or earthly science as opposed to 'theology' or heavenly science. There are 3 unique features in the subject of geology:

Firstly, it covers an immense period of time, about 4.6 billion years i.e. from the origin of the earth, its differentiation and evolution, till the present day.

Secondly, geology is basically a field science. The field work and field observations are most essential in answering most of the questions, regarding natural events.

Thirdly, geology is an interdisciplinary science i.e. it requires direct or indirect assistance from other sciences. For e.g.: To know the chemical composition of a rock, knowledge of chemistry is essential.

It would not be an exaggeration if one said 'geology serves and prospers the nation'. Natural resources and their proper exploitation plays a vital role in nation building. Knowledge of geology is essential for effective generation of power and energy. All natural resources except solar energy are directly linked with the earth. The earth

holds metallic, non-metallic and atomic mineral deposits. It has generated and preserved huge hydrocarbon (petroleum) reserves and coal deposits. Its mineral constituents from diamonds to kaolin (a type of clay) are useful to mankind in everyday life.

The basic need of humans i.e. food and shelter, are directly linked with geology. In the agricultural sector, groundwater, soil and use of fertiliser, are the prime factors and can be tackled with the help of geology. Shelter in the form of single or multi-storeyed buildings, cannot be built without bricks, rocks and cement. Therefore, knowledge of geology is essential for their search and analysis, both quantitative and qualitative.

Planning of huge hydroelectric projects, big water reservoirs, railways, tunnels requires proper geological information and advice. The search of economically important minerals, ore, coal, petroleum and atomic minerals, becomes much easier with the help of geological studies.

Geology is further extended, to include

study of earthquake, volcanoes, mountains, movement of continents, oceans, rivers, wind, glaciers etc. It can be summarised that, whatever is happening today, on and within the earth has happened in the geological past. Thus, a geologist thinks in a reverse manner as compared to a normal person.

A bright future awaits the geologist in the years to come. Nevertheless, a vastly diversified and developing country like India, offers many opportunities to the geologist in both private and public sectors. Those who do not wish to pursue higher studies and want to do something on their own, can start their own consultancy in the field of ground water, engineering geology, soil analysis, gemmology, cutting and polishing of semiprecious stones, trading of building material, small scale mining, procurement of mining lease etc. Private and government enterprises always require geologists. For the past decade, many multinational oil companies are recruiting qualified petroleum geologists.

Some important organisations where geological services are required are:

1. G.S.I : Geological Survey of India
2. S.A.I.L : Steel Authority of India Ltd.
3. A.M.D : Atomic Mineral Division
4. B.G.M.L. : Bharat Gold Miners Ltd.
5. C.G.W.B : Central Ground Water Board
6. C.I.L : Coal India Ltd.
7. H.C.L. : Hindustan Copper Ltd.
8. H.Z.L. : Hindustan Zinc Ltd.
9. I.B.M : Indian Bureau of Mines
10. I.S.R.O : Indian Space Research Organisation
11. I.I.G : Indian Institute of Geomagnetism
12. N.G.R.I : National Geophysical Research Institute
13. N.I.O : National Institute of Oceanography
14. I.R.E.L : Indian Rare Earth Ltd.
15. M.G.M.I. : Mining Geological and Metallurgical Institute of India
16. M.T.Co. : Mica Trading Company
17. M.O.I.L. : Manganese Ore India Ltd
18. N.L.C. : Neyveli Lignite Corporation
19. U.C.I.L : Uranium Corporation India Ltd
20. N.M.D.C. : National Mining Development Corporation
21. N.M.L. : National Metallurgical Laboratory
22. S.C.C.L. : Singareni Collieries Company Ltd
23. T.I.S.C.O. : Tata Iron and Steel Company
24. K.I.O.C.L : Kundermukh Iron Ore Company Ltd
25. A.C.C. : Associated Cement Company
26. M.M.L : Mysore Mineral Ltd
27. G.M.D.C. : Gujarat Mine Development Corporation
28. I.B.M. : Indian of Bureau of Mines

29. G.S.D.A. : Ground Water Survey and Development Agency
30. N.R.S.C. : National Remote Sensing Centre

Oil Companies:

1. O.N.G.C. : Oil and Natural Gas Corporation
2. I.O.C. : Indian Oil Corporation
3. C.P.C. : Chennai Petroleum Corporation
4. G.A.I.L. : Gas Authority of India Ltd
5. G.S.P.C. : Gujarat State Petroleum Corporation
6. Reliance Petroleum



Multinational Oil Companies:

1. ExxonMobil
2. Aramco
3. Shell Oil
4. Petronas
5. British Petroleum
6. Chevron Corporation



CRYSTAL CAVES

AT NAICA

Sakshi Maheshwari, F.Y.B.Sc

Before we study about crystal caves we need to know what are caves actually.

Cave: A natural underground chamber in a hillside or cliff

Naica Caves

Cave of the Crystals also called as the Giant Crystal Cave is a cave connected to the Naica mine 300 metres below the surface in Naica, Mihiuahua, Mexico. The main chamber contains giant selenite crystals (gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), some of the largest natural crystals ever found. The cave's largest crystal found to date is 12 m (39 ft) in length, 4 m (13 ft) in diameter and 55 tons in weight. The cave is extremely hot with air temperatures reaching up to 58°C with 90 to 99 percent humidity. The cave is relatively unexplored due to these factors. Without proper protection people can only endure approximately ten minutes of exposure at a time.

A group of scientists on the Naica Project have been heavily involved in researching these caverns.

Crystal in Naica cave
(image courtesy- news.nationalgeographic.com)



(image courtesy- www.picture-newsletter.com)

The History Of Crystal Caves

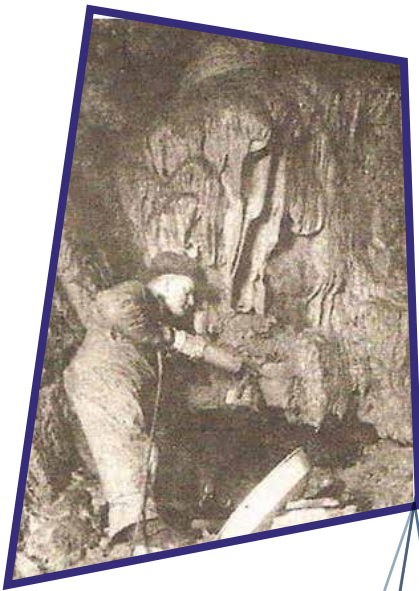
The discovery of crystal caves is credited to a local sixteen year old farm boy, William R. Vanasse. In 1881 William was chasing a squirrel and when the squirrel disappeared down a sink hole, William went home and told his brother George about his discovery (Green, 2004). The next day, armed with rope and a lantern, the two boys explored the hole and found themselves in the main room on the second floor. Over the years, explorers visited the Sander's Corner Cave, and it went largely under-explored until



1941 (Green 2004).

Formation of the crystals

Naica lies on an ancient fault and there is an underground magma chamber below the cave. The magma heated the ground water and it became saturated with minerals, including large quantities of gypsum. The hollow space of the cave was filled with this mineral-rich hot water and remained filled for about 500,000 years. During this time, the temperature of the water remained very stable at over 50 °C (122 °F). This allowed crystals to form and grow to immense sizes.



Explorer exploring inside the Naica cave (image courtesy-<http://crystalcavepa.com>)

Giant Crystal Cave's Mystery Solved

A geologist announced that he and a team of researchers had unlocked the mystery of just how the minerals in Mexico Cueva de los Cristales (Cave of Crystals) achieved their monumental forms. Buried a thousand feet (300 meters) below Naica mountain in the Chihuahuan Desert, the cave was discovered by two miners excavating a new tunnel for the Industrias Peñoles company in 2000. The cave contains some of the largest natural crystals ever found: translucent gypsum beams measuring up to 36 feet (11 meters) long and weighing up to 55 tons.

"It's a natural marvel," said García-Ruiz, of the University of Granada in Spain.

Crystal Cave in Wisconsin is longest



Diagram showing formations of crystals

known cave; located in Wisconsin's Peirce country, less than a mile west of Spring Valley on State Highway 29. Discovered by accident in 1881 by William Vanasse, Crystal Cave is a multi-level solutional cave formed in dolomite bedrock located in the Prairie du Chien group. The Dolomite was formed approximately 485 million years ago in the lower Ordovician period when a warm shallow ocean covered much of Wisconsin and Minnesota.

Crystal Cave (Wisconsin)

Inside the crystal cave in Wisconsin

(image courtesy-www.whereisbermuda.com)



REFERENCES

www.wikipedia.com
www.sequoiahistory.org
www.nationalgeographic.com
www.wisconsinincaves.org
www.crystallinks.com

THE GEOLOGICAL TIME SCALE

Rucha Kulkarni
M.Sc 1

The Geological Time Scale is a unique classification of the past 4.6 billion years of Earth's history preserved in the rocks. The Time Scale is classified into various subdivisions based on age of the minerals in the rocks, the formation of the rock itself and the identifiable fossil record preserved in the sediments.

The stratigraphers and palaeontologists made an account of developing a Time Scale for approximately last

half a billion years about a century ago. In the recent years there have been a lot of drilling activities for the exploration of the ocean floor. Geology of the remote areas, exploration of petroleum reservoirs etc. also gave new ideas and information to refine the aspect of the Time Scale established before.

A Danish scientist Nicholas Steno made the first approach to modern stratigraphy in the year 1686. The sequence was arranged on the basis of order of superposition and faunal succession along with the interpreting of physical evidences as well as volcanic activities. The Time Scale is divided into 6 major Eras namely Hadean (formation of the Earth), Archaeozoic (time of the initial life), Proterozoic (time of earliest life), Palaeozoic (time of old life),

Mesozoic (time of middle life) and Cenozoic (time of recent life or modern life). These divisions are based on the evidences of life or its absence. The beginning of the Eras and the Periods are not well marked but they fall in the range of some (+/-) 2, 5 or 10 million years. These boundaries are identified by observing some sudden change in the lithological character or the change in the fossil content or by a period of non-deposition/erosion.

The Hadean Era is placed at the bottom of the Time Scale and starts from 4600 million years up to 4000 million years. It includes the formation of the Earth in the Solar System and the formation of the Moon. It is the time when the Earth was in a molten state and was slowly getting condensed forming a thin crust. This process continued for about 1000 million years. Unfortunately, there is scanty record of the Hadean Era preserved for us. The oldest rocks on the earth's crust are of about 3700 to 4000 million years in age which form the first ever geological record available. The atmosphere was still developing along with the formation of primordial crust of the Earth and therefore, it was of a highly mixed composition.

The next is the Archaean Era which began at about 4000 million years and ended at about 2500 million years. The atmosphere during the Early Archaean time was similar to the Hadean time, though there was gradual increase in the oxygen levels along

with the minor evolution of initial life forms. As the time passed through the Archean, the atmosphere started changing by the end of the era. The deposition of the sedimentary – volcanic sequence is supposed to be the first geological record which is approximately of the age of the Hadean – Archaean Boundary. The hydrosphere present was extremely acidic and there was extensive volcanism. During the Late Archaean, the first anaerobic bacteria called as phytolites were formed. A very pronounced unconformity, that is, the Eparchaean Unconformity, separates the Archean Era from the overlying Proterozoic Era.

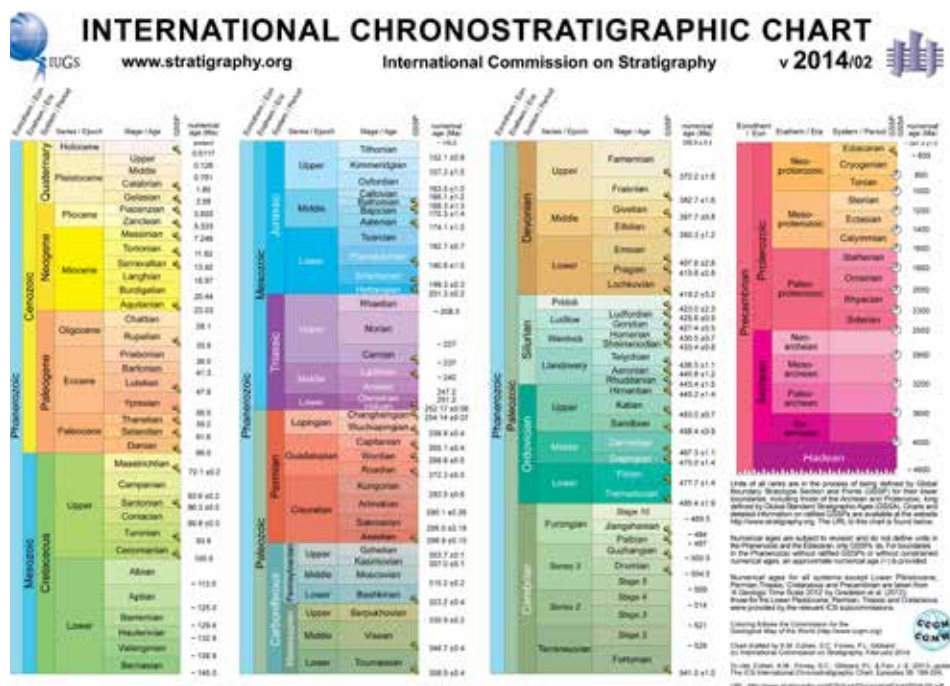
The Proterozoic Era was first established from the Canadian Craton. The era began at about 2500 million years and lasted till about 570 million years. During the Early Proterozoic time, there was a shallow marine environment prevailing on the Earth. There was an improvement in the atmosphere and the hydrosphere by the removal of toxic substances, which supported the growth of life in water. Thus, small simple life forms such as algae started growing in the marine waters. These life forms were so simple that they were devoid of hard parts and hence are not preserved in the sediments. Some of these algae have been observed to leave their traces in the form of stromatolites on the limestones and dolomites. By the Late Proterozoic, the changes in the hydrosphere permitted the birth of some complex life

forms in the water.

The Phanerozoic Eon is full of life forms which suddenly appeared at the beginning of the Eon. This Eon begins with the Palaeozoic Era which began at approximately 570 million years and lasted up to 245 million years. The Era is sub-divided into 6 Periods: Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian. There was a sudden diversification and abundance in the life forms, both simple and complex in the marine waters. The life started evolving in the waters of the Cambrian to Devonian time. Meanwhile, there was an ice age at the end of the Ordovician Period. Until the Carboniferous Period all the life was present in the water, but in the Early Carboniferous time, slowly some of the aquatic animals started migrating to the land. This was in response to the orogenic activities during these times which increased the land area, providing abundant space for the animals to flourish. The atmosphere had abundant oxygen content and comparatively less carbon-di-oxide levels which supported the life to settle on land. There was also a huge growth in the marine fauna as well as in the terrestrial fauna during the late Palaeozoic Era. There were dense forest covers near the equator and gradually became scarce towards the poles. During the Palaeozoic Era there was only one supercontinent i.e. a single land mass on the Earth named as Pangaea and the rest was the water body known as Panthalassa. There

were abundant marine invertebrates in the Cambrian and the Period is characterized by the index fossil Trilobite. The Ordovician Period had the first appearance of the vertebrates. The European orogeny and the first ever terrestrial plants were reported in the Silurian Period. The Devonian is also known as the age of fishes and there was the first appearance of insects and amphibians, also the growth of the forests began in this period. In the Carboniferous the forest growth of the Era reached its peak. The Carboniferous Period also has the first appearance of reptiles, the amphibian-like reptile forms and the abundance of amphibians. During the Permian period there was a glaciation in the Southern Hemisphere and the reptiles spread all over the globe and diversified. Even though there was such a great development of life on Earth, it was suddenly destroyed by the Permian – Triassic Mass Extinction which took place at the end of the Permian and became the boundary between the Palaeozoic and Mesozoic Eras. The extinction is also known as 'Great Dying' as more than 90% of the species and life forms went extinct. The ones who survived the destruction continued to diversify and evolve in the later time.

The Mesozoic Era began at about 230 million years and ended with yet another mass extinction at about 65 million years. The Era is sub-divided into 3 Periods: Triassic, Jurassic and Cretaceous. The Mesozoic is also known as the



Geological Timescale 2014

‘Golden age of Reptiles’. The Triassic Period is characterized in the geological history by the first appearance of the fossil dinosaurs. The Jurassic Period had the first ever appearance of mammals on Earth and also the tremendous evolution and diversification of dinosaurs. Also there was a great orogeny in the North American area of the supercontinent. The breaking of Pangaea started around this time and the plates started drifting towards the directions in which the present continents are situated with respect to the supercontinent. There were also some birds which started appearing in the Jurassic time. During the Cretaceous the dinosaurs and other reptiles were well adapted to the environment and were grown to the maximum size they can attain. There was sudden appearance of the flowering plants and they also diversified themselves rapidly. The climate during the Cretaceous was warmer than the present and the sea levels were also

very high. The end of the Era was by the abrupt disappearance of the dinosaurs and other plants. Though the dinosaurs got extinct from Earth, the destruction caused was less as compared to the previous Permian – Triassic Mass Extinction. This event is known as the Cretaceous – Tertiary Mass Extinction.

The Coenozoic Era Started at approximately 65 million years and is the ongoing Era. The Coenozoic is divided into two Periods: Tertiary and Quaternary and further divided into Epochs. Each Epoch is characterized by some adaptations in life forms and distributed in the Tertiary and Quaternary Periods. The Tertiary Period consists of Paleocene, Eocene, Oligocene, Miocene and Pliocene. During the Paleocene there were orogenies that were occurring in Europe and Asia. In the Eocene there was the first appearance in fossil records of monkeys, horses and whales, whereas, the Oligocene has the first fossil record of apes and elephants. The Miocene

had the hominids and Pliocene had the first human-like animals on Earth. Animals like mammoths, saber tooth, etc. belonged to the Tertiary Period and few of the species even continued in the Quaternary. The Quaternary Period consists of Pleistocene and Holocene. The Pleistocene Epoch had the modern ice age and the evolution of humans had a successful beginning. The Holocene began with the most recent glaciation and the existence of the present day Earth.

The Geological Time Scale is refined continuously by the Geological Society of America with a time interval of few years. There is a huge increase in the availability of the data due to the modern technology. The present Time Scale is refined in the year 2013. The Geological Society of America has been providing the time scales since last 30 years since 1983. The first time scale was published in the year 1913, in the book by Aurther Holmes.

GEOLOGY AROUND **SANGAMNER AND AANE GHAT AREA**

Ankita Katkar
T.Y.Bsc

The following is a brief write up of a one day field work conducted by the Geo-association of Department of Geology, Fergusson College on 9th of September 2014. The route is admirable and is very comforting; even non geologists are likely to find it entertaining for its scenic beauty and lush green appearance during the monsoons.

Location 1: Village- Gabhanwadi ,Panchayat-Chandanapuri (near Sangamner)

At this location a section a seven metre thick quaternary sedimentary deposits is observed. The section shows different layers of coarse, medium and fine grained rock. Along the section, sedimentary structures like cross bedding, lensoid deposits, laminations, pinching and swelling of sediments etc. is also observed. These

structures are useful in deciphering the palaeocurrent direction of the deposits.

SEDIMENTARY DEPOSITS -

Laminations observed in the clay-rich sediments (Left) and Rhizoliths(Right)

A little further of spot A, at spot B trough cross-bedding and laminated bedding are seen. Deposits of calcretes (calcium carbonate) are seen across the bedding planes as cylindrical, bifurcating tube-like objects. These when broken show remnants of plant roots. These cylinders can thus also be referred to as 'rhizoliths'. These rhizoliths are formed due to capillary action which occurs usually during the drier part of the year.

These thick deposits found around 'Chandanapuri Ghat' are a wonder to study as the energy required for such thick deposits to form is

not observed the present day Pravara River which flows through the area.

How such thick deposits can form with well preserved



**Primary Sedimentary Deposits –
Pravara Gravel Formation**



Sedimentary Deposits With Cross Bedding(Left) and with pinching and swelling structure(Right)

Outcrop of GPB



Natural Bridge at Ane Ghat

sedimentary structures is still a mystery!

LOCATION 2: GULANCH-WADI, ANE GHAT

A. Natural arch/Natural bridge

At this location a huge natural arch/natural bridge is seen. There are many theories for the formation of this feature. Researchers have attributed its formation to weathering and erosion, neotectonism and uplift, jointing in the basalts etc. Nevertheless it is a fascinating feature to observe

in the field.

B: GPB (Giant Plagioclase basalts)

At this location mega porphyritic basalt/Giant Plagioclase Basalt (GPB) with large plagioclase laths is observed. The plagioclase laths in the GPB show horizontal arrangement at a few places.

This GPB horizon is intruded by a mafic discordant body. This body is a vertical dyke which cuts through the horizontal basalts in the region. The dyke shows well developed horizontal jointing. The GPB is a marker flow in the region and is known as M3 horizon in the lithostratigraphy of the region.

flow lobe starts with chilled margin, followed by pipe amygdalites. The pipe amygdalites at places are bent in a particular direction indicating the flow direction of the lava. Above the pipe amygdalites a compact basaltic part is seen followed by vesicular and amygdaloidal basalts at the top. Features like squeeze-ups are also seen at places. The downstream of Mandhol dam shows a structurally controlled stream.

LOCATION 3:- MANDHOL DAM

At this location compound lava flows are observed. This type of flow externally shows many subordinate flow units called as flow units/flow lobes. A Red bole horizon demarcating the different flows in the area is also seen. The base of a typical



A dyke intruded into GPB (Left) and contact between dyke and host rock (Right)



Units of compound flow



Flow Squeeze-up feature seen at the location.

INTRODUCING AND CLASSIFYING DINOSAURS

Vikram Vakil
T.Y.B.Sc.

What were they?

Nearly everyone knows what dinosaurs looked like, such as Tyrannosaurus, Triceratops and Stegosaurus. But they may be much vaguer about the lesser known ones, and may have difficulty in distinguishing between dinosaurs and other types of prehistoric creatures.

It's not at all unusual to overhear an adult, taking a group of children around a museum display, being reprimanded sharply by the youngsters for failing to realize that a woolly mammoth wasn't a dinosaur, or- more forgivably- that a giant flying reptile such as Pteranodon, wasn't a dinosaur either, but simply a reptile that lived at the same time as the dinosaurs, having descended from the same, common ancestor too- the archosaurs.

So what exactly is a dinosaur? And how do palaeontologists decide on the groups they belong to?

There are four features that determine what counts as a dinosaur

Dinosaurs lived only in the Mesozoic Era: Dinosaur remains have been discovered in rocks which range from the latest part of the Triassic Period (about 220 mya) throughout Jurassic Period and up to the end of the Cretaceous Period (65 mya)- spanning approximately 155 million years



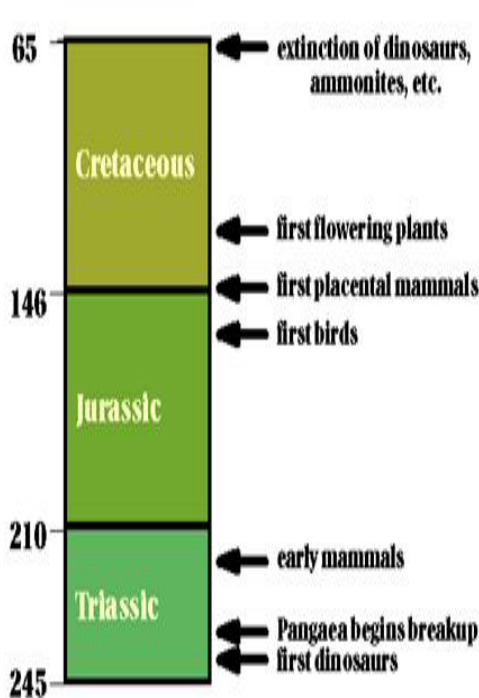


Image courtesy- google images

of Earth's history.

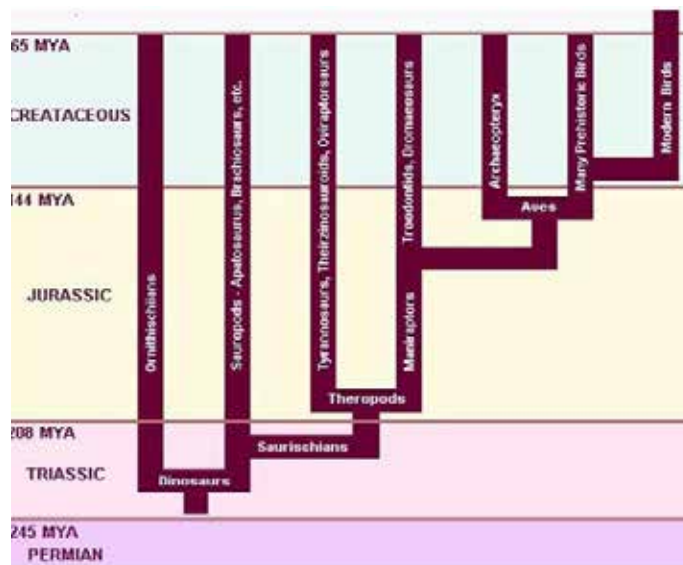


Image courtesy- dinosaur world.com

Therefore, any prehistoric creature which comes from rocks which can be dated at older than 220 million years or younger than 66 million years is highly unlikely to be a dinosaur.

This immediately excludes an enormous number of types of fossils, and of course rules out the woolly mammoth, whose remains may be a mere 100,000 years old.

2) Dinosaurs were reptiles: Living reptiles are very easy to identify because of their peculiar scaly skin, and the fact that they lay eggs with shells. These are rather difficult characteristics to identify in practice, because only a few dinosaurs have been preserved with skin impressions or with fossilised egg shells.

Nevertheless, it does help us to eliminate fishes, amphibians (which lay eggs without shells), birds (with feathers), and mammals (with hairs and live-born young).

All dinosaurs lived only on land

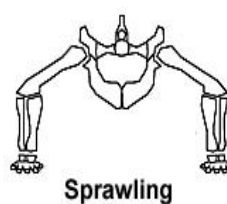
This is a particularly useful characteristic because it helps us to eliminate a wide range of giant and other bizarre fossils, which are very frequently confused with dinosaurs.

Among these are the giant seagoing reptiles of the Mesozoic Era, the plesiosaurs, ichthyosaurs and mosasaurus; as well as the varied flying reptiles, the pterosaurs, which ranged in size from the size of sparrows, like Pterodactylus, to that of small aircrafts like Quetzalcoatlus.

All dinosaurs walked on upright, pillar-like legs

That's the final and most distinctive characteristic of all. Among the reptiles, only dinosaurs have managed to arrange their legs in such a way that they are held directly beneath their body.

All other reptiles have their legs sprawled outward at an angle from the sides



(dinosaurs, mammals)



(rauisuchians)

Image courtesy- google images

of the body, so that their feet remain wide apart.

This particular feature was first noticed by Richard Owen in 1842. For the dinosaurs, it was doubly advantageous: it allowed them to swing their legs most efficiently beneath their body, so that they could have long- striding legs and could run fast: and it also meant that the legs were able to support the great body weight of the largest dinosaurs, because they could act literally like supporting pillars.

Classifying Dinosaurs

Since 1842, when Richard Owen took the vital step of recognising dinosaurs as a distinct group, several hundred species have been recognised, varying greatly in size and shape.

However, a great step in understanding dinosaur relationships came in 1887. By this time, a number of reasonable skeletons of dinosaurs had been described, and Professor Harry Govier Seely of King's College, London, noticed that they could be separated into two distinct groups on the basis of differences in the structure of their hip bones.

Seely called these two groups the Saurischia (meaning "lizard/reptile-hipped") and Ornithischia (meaning "bird -hipped").

The Saurischians

As the name suggests, the hip bones are arranged in much the same way as they are in other reptiles. The large, blade-like upper bone, called the ilium, is connected to the

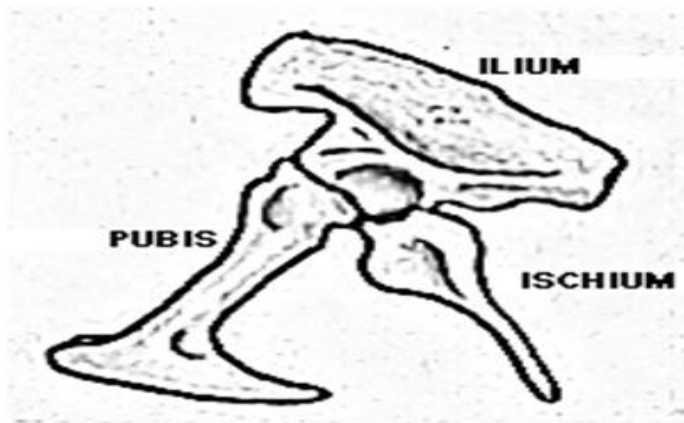


Image courtesy-forbes paleo club.weebly.com



backbone by a row of strong ribs, and its lower edge forms the upper part of the hip socket. Beneath it is a large bone that points downward and forward- the pubis- and behind it there's a bone extending backwards- the ischium. All three bones meet at the hip socket, which forms a deep, round opening in the side of the pelvis.

The dinosaurs which have this type of hip structure fall into two distinct types

Theropods : These include all carnivores(meat-eating) types; the name itself means "beast-foot" on account of the very sharply clawed three-toed feet of these dinosaurs.

This group includes notable dinosaurs such as the giant Tyrannosaurus, the small and very agile Deinonychus, the very early form Coelophysis and so on.

Sauropodomorphs : These were all herbivores – that is, plant-eaters. They range in size from the early prosauropods, which appear in the Late Triassic and Early Jurassic, up to the gigantic sauropods of the Jurassic and

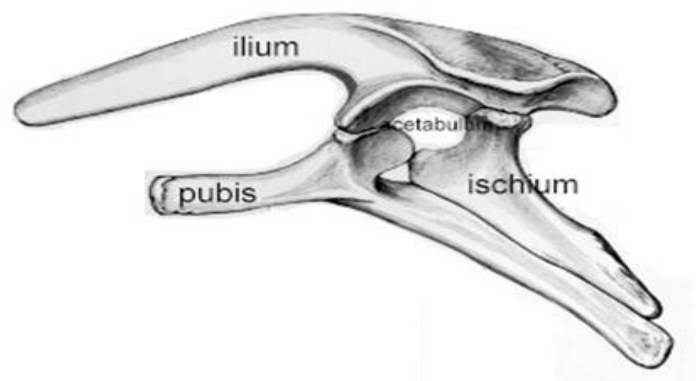


Image courtesy-users.tamuk.edu

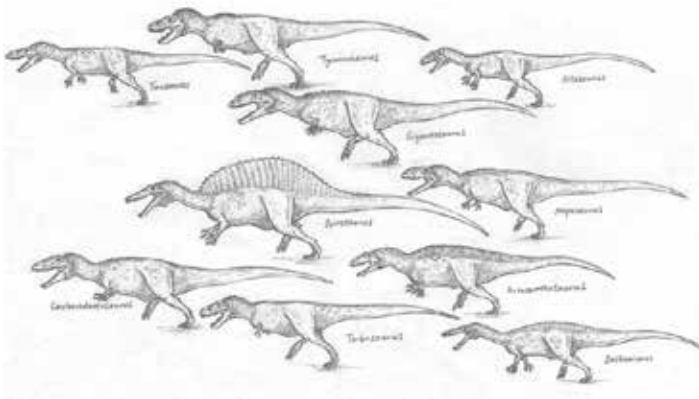


Image courtesy- tmac1kobe8vc15

Cretaceous Periods. The common sauropods are Diplodocus, Apatosaurus (formerly known as Brontosaurus or "thunder lizard") etc.

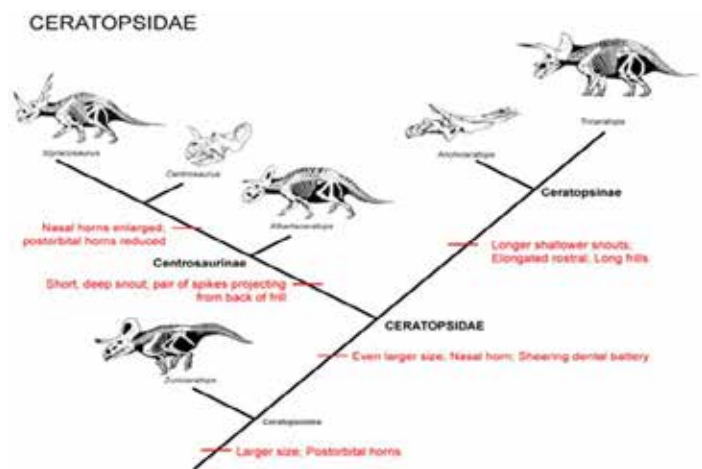
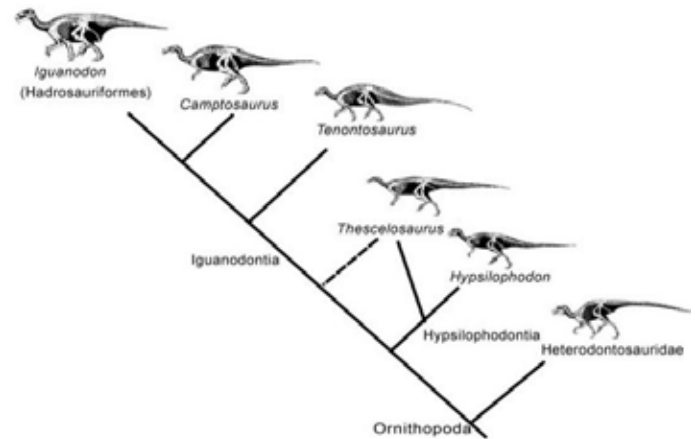
The Ornithischians

The arrangement of bones in the hips of these dinosaurs is, as the name suggests, very similar to that seen in living birds- though, confusingly, there's no family link with birds as far as this group is concerned.

The pubis, here, is a narrow, rod-shaped bone lying alongside the ischium. Also, all ornithischians seem to possess a small, horn-covered beak perched on the tip of the lower jaw (a very distinctive feature of dinosaur illustrations).

There are five major divisions of this group

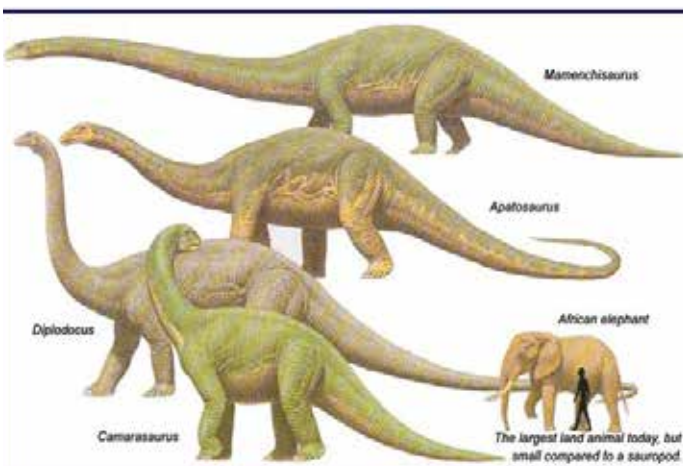
Ornithopods: These include many small to medium sized dinosaurs which ran on



their hind legs for most of the time. Examples include Lesothosaurus, Heterodontosaurus, Hypsilophodon, Dryosaurus, Iguanodon, Tenontosaurus, Camptosaurus, and also the hadrosaurs (meaning "duck-billed dinosaur").

Ceratopsians: These were the distinctively horned and frilled dinosaurs, with curiously narrow, parrot-like beaks and appeared very late in dinosaur history, only during the second half of the Cretaceous Period. Examples include Psittacosaurus, Protoceratops (whose eggs were first found in Mongolia in the 1920s), Leptoceratops, Triceratops, Anchiceratops, Torosaurus, Styracosaurus, Pachyrhinosaurus, Chasmosaurus etc.

Pachycephalosaurs: They had a very distinctive, curiously domed and massively reinforced heads. These forms appear to have arisen during the middle part of the Cretaceous and persisted to the close of that period, but they were never particularly abundant as a



group.

Examples include Pachycephalosaurus, Homalocephale, Dracorex, Stegoceras etc.

Stegosaurus : These were the plated dinosaurs of which Stegosaurus is the most common example which seems to have lived from the early part of Jurassic right till the early Cretaceous. The structure of the spines and plates of these dinosaurs has proved to be extremely important and interesting, and provides evidence in the debate as to whether dinosaurs were “warm-blooded” or “cold-blooded”.

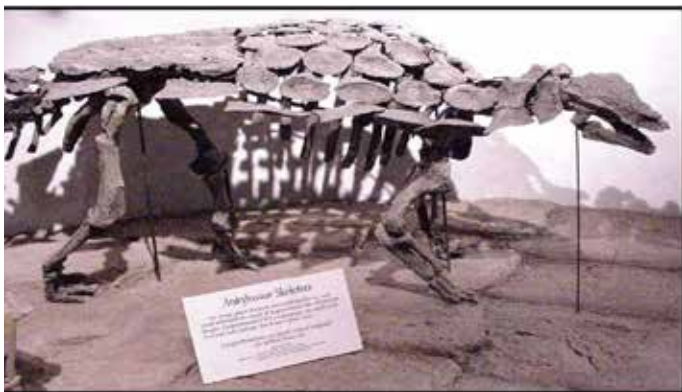
Ankylosaurs : They were the armoured tanks of the dinosaur world. These dinosaurs were fully covered in thick bony plates in order to ward off the attentions of the larger theropods. They appeared in the early Jurassic but became abundant only in the Late Cretaceous of Asia and North America. Examples include Ankylosaurus, Edmontonia, Gastonia, Euplocephalus etc.

This brings us to the end of my topic strictly pertaining to the introduction and classification of dinosaurs. The subject Dinosaurs is vast and probably beyond one’s imagination when it comes to talking about their evolution from Archosaurs and the continuation of their lineage into modern day birds.

Also, their extinction, which took place 65 million years ago, is a mystery in itself as there are no solid evidences till date to entirely support one definite theory.



T-rex skeleton





T-rex (Left) and its family member Albertosaurus(Right)



T-rex skeleton Model of juvenile T-rex



Skulls of Tarbosaurus and Daspletosaurus

PICTURES AND BOOKS REFERRED TO-
 Cambridge University press- *Dinosaurs* – Fastovsky & Weishampel
 Google images
 Illustrator Jan Sovak's masterpieces for Scholastic
Dinosaurs A- Z.
Dinosaur!- David Norman
Dinosaurs – Christopher Maynard

BATU CAVES

MALAYSIA

Ankita Katkar
T.Y.BSc

This year in June on a tour to Malaysia I visited Batu Caves. The following article talks about Limestone caves and features found in it. Batu Caves is a limestone hill that has a series of caves and cave temples in the Gombak district, 13 kilometres (8 mi) north of Kuala Lumpur, Malaysia. The Caves are a series of several hundred limestone caverns in a large limestone outcrop overlooking the city of Kuala Lumpur. Locals say that the caves take their name from the Sungai Batu or Batu River, which flows past the hill. The cave is one of the most popular Hindu shrines outside India, dedicated to Lord Murugan. It is the focal point of Hindu festival of Thaipusam in Malaysia.

When our guide informed us that these are limestone caves. I was the most eager person to climb a steep flight of 272 steps! I was eager to see the Karst topography or at least some part of it like Stalactites /Stalagmites. The limestone forming Batu Caves is said to be around 400 million years old! Rising almost 100 m above the ground, the cave complex consists of three main caves and a few smaller ones. The biggest i.e. the Temple Cave has a very high ceiling and features ornate Hindu

shrines. We visited the temple cave for which we had to climb 272 steps. As we can see in the picture a beautiful 42.7-metre (140 feet) high statue of Lord Murugan is at the foot of the caves. It is the tallest Lord Murugan statue in the world.

Limestone, a sedimentary rock composed largely of the mineral calcite (calcium carbonate: CaCO_3) forms these caves. The high solubility of Limestone in water and weak acid solutions creates caves and cave features. In fact, most natural cave systems are through Limestone bedrocks.

Far off view of the caves





Tallest Lord Murugan statue in the world at the foot of the caves.

In some of the Batu Caves the limestone has been completely washed away from the top to create natural sky-lights.

These Limestone caves are located so close to the equator that it gives the cave system an unusual tropical environment inside and out unlike many limestone cave systems in colder climes.

Frequent Rainstorms in the area provide plenty of water to carve the caves; this perhaps forms faster and larger caves than in drier areas.

As we were walking we saw stalactites everywhere on the walls of the caves.

Formation of 'Caverns'

Rainwater, already slightly acidic mixes with carbon dioxide in the atmosphere and soil layer to form carbonic acid (H_2CO_3), this acidic water flows through the crevices, cracks and cavities which act to dissolve away limestone.



(Water) + (Carbon dioxide) = (Carbonic acid)

Most caverns are created at or near the zone of water table. Due to further dissolving of limestone the water table may drop, the area of active cave formation will go lower into the bed rock. The continuation of this process will leave the upper opening in the zone of aeration (i.e. open to air). Now if this area comes in contact with rain water, the dripping water through these dry passages may deposit CaCO_3 in various forms collectively known as 'Speleothems'

The above all processes if act together in

sequence will lead to the formation of Sink-holes, Stalactites, Stalagmites etc. These all are the components of a 'Cavern'.



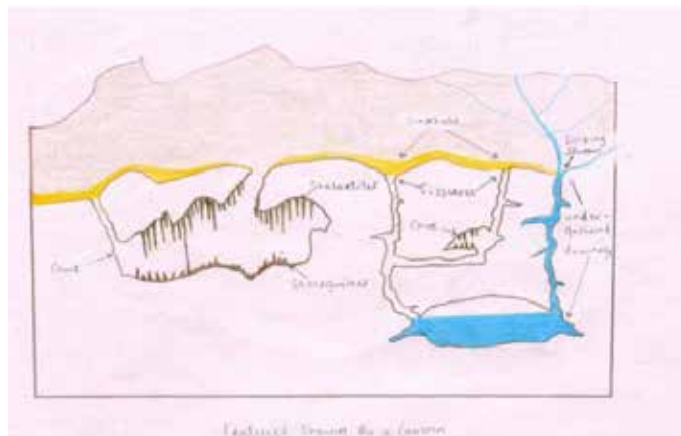
Entrance to the caves



Path to the entrance of the caves



Stalactites hanging from the walls of the cave(Left)
and some have touched the ground (Bottom left)
Natural skylights.(Above)



Features shown by a cavern

REFERENCES-

<http://www.esi.utexas.edu/outreach/caves/karst.php>
http://www.geocaching.com/geocache/GC1NAJH_batu-caves-kl-earthcache?guid=13cd927c-5ea7-41fo-91ad-df42f9c8aebf

FOR MORE INFO. -

<http://www.karst.edu.cn/igcp/igcp448/2002/3-2-7.pdf>
http://www.iaeg.info/iaeg2006/PAPERS/IAEG_024.PDF
<http://www.ejge.com/2009/Ppro9127/Ppro9127.pdf>

Rare Polymorphs of Olivine and Quartz

Sushant Sudhakar Navarat.
T.Y.B.Sc.

Olivine is most abundantly found in ultrabasic & basic igneous rocks. Due to close oxygen packing in the atomic structure, olivine exhibits neso-silicate structure i.e. it appears in individual tetrahedra. Generally, it requires high temperature & high pressure conditions during formation. Although, the change may occur in the crystal structure by the change in surrounding pressure, temperature conditions. These minerals which show similarity in the chemical composition to olivine, But differ in the crystallisation system

are termed as polymorphs of olivine.

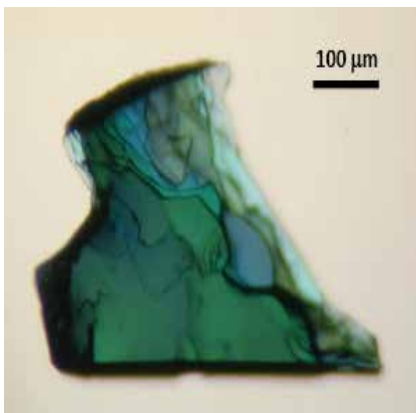
On the basis of occurrence, they are very rare minerals. Here are the major polymorphs of olivine - Wadsleyite & Ringwoodite. Wadsleyite was named after mineralogist, Arthur David Wadsley (1918-1969). And Ringwoodite was named after the Australian Earth Scientist, Ted Ringwood (1930-1993), who studied polymorphic phase transitions in the common mantle minerals olivine and pyroxene at pressures equivalent to depths as great as about 600 km.

These minerals are found in the upper mantle of the earth. Of which wadsleyite is a polymorph of forsterite Mg_2SiO_4 . In the phase transformations of forsterite to fayalite, Mg-rich forsterite ($\alpha\text{-Mg}_2\text{SiO}_4$) changes to wadsleyite ($\beta\text{-Mg}_2\text{SiO}_4$) under pressure of 130 to 180 kbar between depths of 410 to 525 km & under 1000 to 1500 °C temperature, Then with increasing pressure, it transforms to ringwoodite ($\gamma\text{-Mg}_2\text{SiO}_4$). This series of

transformations is thought to occur during an extra-terrestrial shock event i.e. a meteoritic impact on Earth.

Wadsleyite

Wadsleyite is a high-pressure polymorph of olivine, and is an orthorhombic mineral found in the Peace River meteorite in Alberta, Canada. It resembles the crystal structure of spinel and it is based on a distorted cubic-closest packing of oxygen atoms. It is polymorphous with ringwoodite and is found to be stable in the transition zone of the Earth's upper mantle. These regions are from 400-525 km in depth. Because of oxygens not bound to silicon in the Si_2O_7 groups of wadsleyite, it leaves some oxygen atoms underbonded, and as a result, these oxygens are hydrated easily. As a result, there can be high concentrations of hydrogen atoms in the mineral. Hydrous wadsleyite is considered a potential site for water storage in the Earth's mantle due to the low electrostatic potential of the underbonded oxygen



Wadsleyite
(image courtesy- www.mindat.org)

No.	Mineral	Silicate Strucure	Crystal System	Hardness	Specific gravity	Depth of formation
1	Olivine	Neso silicate	Orthorhombic	6.5-7	3.27-3.37	250-410 km
2	Wadsleyite	Soro Silicate	Orthorhombic Sometimes Monoclinic	5.8-6.2	3.82-3.86	410-525 km
3	Ringwoodite	Neso Silicate	Isometric (Cubic)	6.6-6.9	3.56-4.85	525-660 km

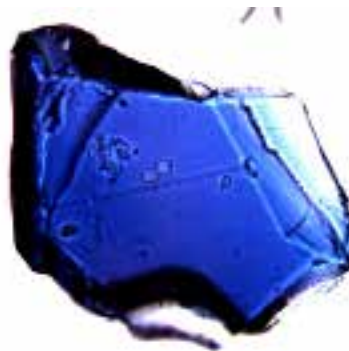
atoms. The water solubility and density of wadsleyite are ultimately affected by the temperature and pressure inside of the Earth. Wadsleyite was first identified by Ringwood and Major in 1966 and was confirmed to be a stable phase by Akimoto and Sato in 1968. The phase was originally known as " β -Mg₂SiO₄" or "Beta-phase".

Wadsleyite in Peace River meteorite occurs as microcrystalline rock fragments, of size about 0.5 mm in diameter. The meteor or asteroid that impacted the earth generated the mineral phase transformations of olivine to transform into significant amounts of high-density wadsleyite. It also contains sulfide-rich veins of olivine.

Ringwoodite

Ringwoodite is an important polymorph of olivine that is formed at high temperatures and pressures of the Earth's mantle between 525 and 660 km depth. Ringwoodite is notable for being able to contain hydroxide ions (-OH) within its structure. This mineral was first identified in the

'Tenham' meteorite in 1969, and it is inferred to be present in large quantity in the Earth's mantle. Ringwoodite is one of the polymorphs of Olivine, and is an isometric mineral abundantly found in meteorites. It occurs in the veinlets of quenched shock-melt, cutting the matrix and replacing olivine produced during shock metamorphism. In the lower half of the transition zone, it has crucial importance in mantle dynamics and the plastic properties of ringwoodite are thought to be critical in determining rheology i.e. flow of material in this part of the mantle. In regions of subduction zones, the ringwoodite stability field hosts high levels of seismicity.



Ringwoodite(image courtesy-
www.wikipedia.com)

An ultra-deep diamond found in Juína, Brazil, contained inclusions of ringwoodite, the only known sample of natural terrestrial origin, thus providing evidence of significant amounts of water as hydroxide in the Earth's mantle.

Quartz

Quartz is the most abundant constituent of acidic & intermediate igneous rocks, which account for 59.12 % in the form of silica. As well as found in sedimentary & metamorphic rocks as an important constituent. Due to framework structure arrangement of SiO₂ tetrahedra, it exhibits common tectosilicate structure & belongs to hexagonal system. But sometimes because of change in pressure & temperature conditions, change in crystal structure may occur without any change in chemical composition. This minerals with the same chemical composition (SiO₂), but different crystal structure are known as polymorphs of quartz. There are several polymorphous minerals of quartz namely,

Cristobalite, Tridymite, Coesite, Stishovite, Moganite, Seifertite, Keatite.

No.	Minerals	Crystal System	Hardness	Specific Gravity
1	Cristobalite	Tetragonal (Pseudoisometric)	6.0-7.0	2.3
2	Tridymite	Monoclinic (Pseudo-hexagonal)	7-7.2	2.2
3	Coesite	Monoclinic (Pseudo-hexagonal)	7.0-8.0	2.9
4	Stishovite	Tetragonal	8	4.3

Cristobalite is a high-temperature polymorph of quartz. Cristobalite occurs as white octahedra or spherulites in acidic volcanic rocks such as Obsidian and sometimes in converted diatomaceous deposits. Cristobalite is stable only above 1470 °C, but can crystallize and persist metastably at lower temperatures. The persistence of cristobalite outside of its thermodynamic stability range occurs because the transition from cristobalite to quartz or tridymite is “reconstructive”. There is more than one form of the cristobalite framework. At high temperatures, the structure is cubic. But, a tetragonal form of cristobalite occurs on cooling below 250 °C at ambient pressure, and is related to the cubic form by a static tilting of the silica tetrahedra in the framework. This transition is variously called the low or high transition.

Tridymite

Tridymite is a high-temperature polymorph of quartz and usually occurs as minute tabular white or colourless pseudo-hexagonal crystals,

or scales, in cavities in felsic volcanic rocks. Tridymite was first described in 1868 and the type location is in Hidalgo, Mexico. The name is from the Greek tridymos for triplet as tridymite commonly occurs as twinned crystal trillings.

Tridymite can occur in seven crystalline forms. Two of the most common at standard pressure are known as α and β . The α -tridymite phase is favored at elevated temperatures more than 870 °C and it converts to β -cristobalite at 1470 °C.

Coesite

Coesite is a tectosilicate with each silicon atom surrounded by four oxygen atoms in a tetrahedron. It is inherently monoclinic and cannot be hexagonal. The crystal structure of coesite is similar to that of feldspar and consists of four silicon dioxi-de-tetrahedra arranged in Si₄O₈ and Si₈O₁₆ rings & these rings are further arranged into chains. Coesite was first synthesized by Loring Coes, Jr. , a chemist at the Norton Company, in 1953. This structure is metastable

within the stability field of quartz, coesite will eventually decay back into quartz with a consequent volume increase, although the metamorphic reaction is very slow at the low temperatures of the Earth’s surface. Coesite is a polymorph quartz, that is formed when very high pressure 20–30 kbar, and moderately high temperature 700 °C , are applied to quartz.

In 1960, a natural occurrence of coesite was reported from Barringer Crater, in Arizona, USA which was evidence that the crater must have been formed by an impact. After this report, the presence of coesite in unmetamorphosed rocks was taken as evidence of a meteorite impact. It was not expected that coesite would survive in high pressure metamorphic rocks. In metamorphic rocks, coesite was initially described in eclogite xenoliths from the mantle of the Earth that were carried up by ascending magmas. Kimberlite is the most common host of such xenolithic coesite.

In metamorphic rocks, coesite is now recognized as one of the best mineral

indicators of metamorphism at very high pressures (UHP, Ultrahigh-Pressure Metamorphism). Such UHP metamorphic rocks record subduction or continental collisions in which crustal rocks are carried to depths of 70 km or more. Coesite is formed at pressures above about 25 kbar and temperature above about 25 kbar and temperature above 700 °C. This corresponds to a depth of about 70 km in the Earth. It can be preserved as mineral inclusions in other phases because as it partially alters to quartz, the quartz rim exerts pressure on the core of the grain, preserving the metastable grain as tectonic



Cristobalite (image courtesy-
www.mindat.org)



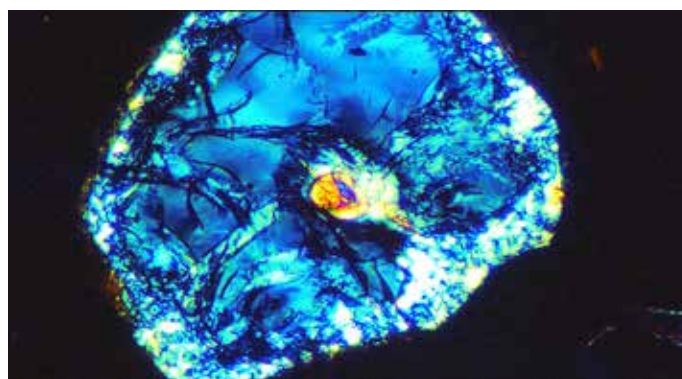
Tridymite (image courtesy-
www.wikimedia.org)

Cristobalite

Cristobalite is a high-temperature polymorph of quartz. Cristobalite occurs as white octahedra or spherulites in acidic volcanic rocks such as Obsidian and sometimes in converted diatomaceous deposits. Cristobalite is stable only above 1470 °C, but can crystallize and persist metastably at lower temperatures. The persistence of cristobalite outside of its thermodynamic stability range occurs because the transition from cristobalite to quartz or tridymite is “reconstructive”. There is more than one form of the cristobalite framework. At high temperatures, the structure is cubic. But, a tetragonal form of cristobalite occurs on cooling below 250 °C at ambient pressure, and is related to the cubic form by a static tilting of the silica tetrahedra in the framework. This transition is variously called the low or high transition.

Tridymite

Tridymite is a high-temperature polymorph of quartz



Coesite (image courtesy- www.wikimedia.org)



Stivshovite(image courtesy-www.junpeisato.blogspot.com)

and usually occurs as minute tabular white or colourless pseudo-hexagonal crystals, or scales, in cavities in felsic volcanic rocks. Tridymite was first described in 1868 and the type location is in Hidalgo, Mexico. The name is from the Greek tridymos for triplet as tridymite commonly occurs as twinned crystal trillings.

Tridymite can occur in seven crystalline forms. Two of the most common at standard pressure are known as α and β . The α -tridymite phase is favored at elevated temperatures more than 870 °C and it converts to β -cristobalite at 1470 °C.

Coesite

Coesite is a tectosilicate with each silicon atom surrounded by four oxygen atoms in a tetrahedron. It is inherently monoclinic and cannot be hexagonal. The crystal structure of coesite is similar to that of feldspar and consists



**Mogonite (image courtesy-
www.mindat.org)**

of four silicon dioxi-de-tetrahedra arranged in Si_4O_8 and Si_8O_{16} rings & these rings are further arranged into chains. Coesite was first synthesized by Loring Coes, Jr. , a chemist at the Norton Company, in 1953. This structure is metastable within the stability field of quartz, coesite will eventually decay back into quartz with a consequent volume increase, although the metamorphic reaction is very slow at the low temperatures of the Earth's surface. Coesite is a polymorph quartz, that is formed when very high pressure 20–30 kbar, and moderately high temperature 700 °C , are applied to quartz.

In 1960, a natural occurrence of coesite was reported from Barringer Crater, in Arizona, USA which was evidence that the crater must have been formed by an impact. After this report, the presence of coesite in unmetamorphosed rocks was taken as evidence of a meteorite impact. It was not expected that coesite would survive in high pressure metamorphic rocks. In metamorphic rocks, coesite was initially described in eclogite xenoliths from the mantle of the Earth that were carried up by ascending

magmas. Kimberlite is the most common host of such xenolithic coesite.

In metamorphic rocks, coesite is now recognized as one of the best mineral indicators of metamorphism at very high pressures (UHP, Ultrahigh-Pressure Metamorphism). Such UHP metamorphic rocks record subduction or continental collisions in which crustal rocks are carried to depths of 70 km or more. Coesite is formed at pressures above about 25 kbar and temperature above 700 °C. This corresponds to a depth of about 70 km in the Earth. It can be preserved as mineral inclusions in other phases because as it partially alters to quartz, the quartz rim exerts pressure on the core of the grain, preserving the metastable grain as tectonic forces uplift and expose these rock at the surface. As a result the grains have a characteristic texture of "A Polycrystalline Quartz Rim".

Coesite has been identified in UHP metamorphic rocks around the world, including the western Alps of Italy at Dora Maira, the Lanterman Range of Antarctica, in the Western Gneiss region of Norway and the Himalayas of Eastern Pakistan.

Stishovite

Stishovite is an extremely hard, dense tetragonal form of silicon dioxide. Which is one of the polymorphs of Quartz. It is very rare on the earth's surface. It may however be a predominant form of silicon dioxide in the earth, especially

in the lower mantle. Stishovite was named after Sergey M. Stishov , a Russian high-pressure physicist who first synthesized the mineral in 1961. It was discovered in Meteor Crater in 1962 by Edward C. T. Chao.

Unlike other silica polymorphs, the crystal structure of stishovite resembles that of rutile (TiO_2). The silicon in stishovite adopts an octahedral coordination geometry, being bound to six oxides. Similarly, the oxides are three-connected, unlike low pressure forms of SiO_2 . It was long considered the hardest known oxide. However, boron suboxide has been discovered in 2002 to be much harder. At normal temperature and pressure, stishovite is metastable. Stishovite can be separated from quartz by applying hydrogen fluoride (HF); and unlike quartz, stishovite will not react.

Until recently, the only known occurrences of stishovite in nature formed at the very high shock pressures more than 100 Kbar and temperatures more than 1200 °C present during hypervelocity meteorite impact into quartz-bearing rock. Minute amounts of stishovite has been found within diamonds, and post-stishovite phases were identified within ultra-high pressure mantle rocks. It is second densest polymorph of silica, after Seifertite.

Other Important Polymorphs of Quartz

Seifertite

Seifertite is a silicate mineral with the formula SiO_2 and is one of the densest polymorphs of quartz. It has only been found in Martian and lunar meteorites. Where, it is eventually formed from either tridymite or cristobalite. It is named after Friedrich Seifert (born 1941), the founder of the Bayerisches Geoinstitut at University of Bayreuth, Germany, and is officially recognized by the International Mineralogical Association. As a result of heating during the atmospheric re-entry and impact to the Earth, at an estimated minimum pressure of 350 kbar. Seifertite forms micrometre-sized crystalline lamellae embedded into a glassy SiO_2 matrix. The lamellae are rather difficult to analyze as they vitrify

within seconds under laser or electron beams used for standard Raman spectroscopy or electron beam microanalysis, respectively, even at much reduced beam intensities.

Moganite

Moganite is one of the polymorphs of quartz that was discovered in 1984. It crystallises in the monoclinic crystal system. This mineral is “Virtually indistinguishable” from chalcedony which is made up of both moganite and quartz. Physically, it has a hardness of about 6, a dull luster and appears gray in color but transparent. It was named after the municipality of Mogán on Gran Canaria. In 1994, the International Mineralogical Association (IMA) had disapproved it as being a separate species because it was not clearly distinguishable from quartz. It has only recently been approved as a

valid species by the CNMNC, [The Commission on New Minerals, Nomenclature and Classification] (part of the IMA). It has been mainly found in dry locales such as Gran Canaria and Lake Magadi. It has been reported from a variety of locations in Europe, India and the United States.

Keatite

Keatite is a silicate mineral with the chemical formula SiO_2 that first was discovered in 2013. It is a tetragonal polymorph of silica first known as a synthetic phase. It was reported as minute inclusions within clinopyroxene (diopside) crystals in an ultra high pressure garnet pyroxenite body. The host rock is part of the Kokchetav Massif in Kazakhstan.

References –
Wikipedia, *Earth Materials* (Kevin Heffern, John O'Brian)

FLUORESCENCE

of minerals

**Vinoy D'souza,
Shivaraj Patil
TYBSc.**

What is a Fluorescent Mineral?

Fluorescence is a phenomenon which causes the minerals to glow when they are subjected to ultra-violet Light radiation. This phenomenon is exhibited only by some minerals and a mineral which possesses this property is called a fluorescent mineral. These minerals have the ability to temporarily absorb a small amount of light(ultra-violet) and an instant later release a small amount of light of a different wavelength (Visible spectrum wavelength).

Fluorescence

Fluorescence in minerals occurs when a specimen is illuminated with specific wavelengths of light. Ultraviolet light x-rays and cathode rays are the typical types of light that trigger fluorescence. These types of light have the ability to excite susceptible electrons within the atomic structure of the mineral. These excited electrons temporarily jump up to a higher orbital within the mineral's atomic structure. When those electrons fall back down to their original orbital a small amount of

energy is released in the form of light. This release of light is known as fluorescence.

The wavelength of light released from a fluorescent mineral is often distinctly different from the wavelength of the incident light. This produces a visible change in the colour of the mineral. This "glow" continues as long as the mineral is illuminated with light of the proper wavelength.

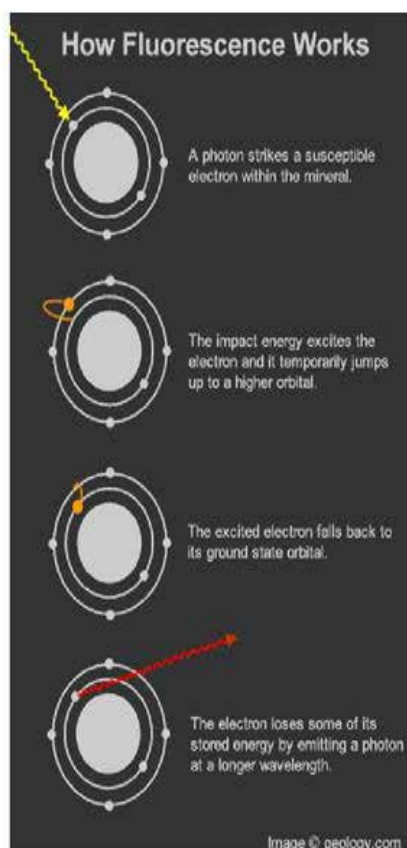
How Many Minerals Fluoresce in UV Light?

Most minerals do not fluoresce. Only about 15% of minerals have this ability and

every specimen of those minerals



Fluorescence of minerals
(Image courtesy: www.geology.com)



Diagrammatic representation of interaction between photons and electrons which produce the fluorescence phenomena (Image courtesy: [www. geology.com](http://www.geology.com))

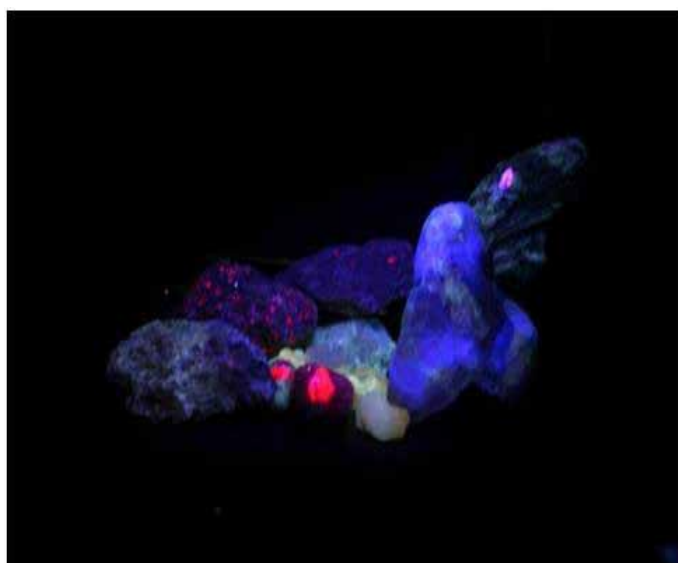
does not fluoresce. Fluorescence usually occurs when specific impurities known as “activators” are present within the mineral. These activators are typically cations of metals such as: tungsten, molybdenum, lead, boron, titanium, manganese, uranium and chromium. Rare earth elements such as europium, terbium, dysprosium, and yttrium are also known to contribute to the fluorescence phenomenon. Fluorescence can also be caused by crystal structural

defects or organic impurities.

Lamps for Viewing Fluorescent Minerals

The lamps used to locate and study fluorescent minerals are very different from the ultraviolet lamps (called “black lights”) sold in novelty stores. The novelty store lamps are not suitable for mineral studies for two reasons:

1. They emit long-wave ultraviolet light (most fluorescent minerals respond to short-wave ultraviolet).
2. They emit a significant amount of visible light which interferes with accurate observation, but is not a problem for novelty use. The scientific-grade lamps used for mineral studies have a filter that blocks most of the visible light that will interfere with observation. These filters are very expensive and are partly



responsible for the significantly higher price of scientific lamps.

Scientific-grade lamps are produced in a variety of different wavelengths. The table at left lists the wavelength ranges that are most often used for fluorescent mineral studies and their common abbreviations.

Practical Uses of Fluorescence in Minerals:

Fluorescence has some practical uses in mining, gemmology, petrology and mineralogy.

The mineral scheelite, an ore of tungsten, typically has a bright blue fluorescence. Geologists prospecting for scheelite sometimes go



Fluorescent Mineral Viewing cabinet

out at night with fluorescent lamps to look for deposits. They also use fluorescent lamps to examine core specimens and well cuttings. These exploration procedures have also been used for other minerals. Fluorescent lamps can be used in underground mines to identify and trace ore-bearing rocks. They have also been used on picking lines to quickly spot valuable pieces of ore and separate them from waste.

Many gemstones are sometimes fluorescent including: ruby, kunzite, diamond and opal. This property can sometimes be used to spot small stones in sediment or crushed ore. It can also be a way to associate stones with a mining locality.

Crude oil (petroleum) fluoresces in a

range of colours, from dull-brown for heavy oils and tars through to bright-yellowish and bluish-white for very light oils and condensates. This phenomenon is used in oil exploration drilling to identify very small amounts of oil in drill cuttings and core samples.

Fluorescence shown by the minerals in
Project done in Flints 2013

Fluorescence of Minerals shown by Using
a Blacklight (Long UV light):

Green Fluorescence Shown by Calcite
[Colour in ordinary light: Colourless]

Bright Red Fluorescence shown by Ruby
in Fuchsite [Colour in ordinary light: Red]

Blue fluorescence Shown by Fluorite
[Colour in ordinary light: Colourless]

The Gabbro Intrusions

Khopoli, Maharashtra

Mugdha Chimote
Dipal Jain
Supriya Bahirat
T.Y.BSc.

The gabbroic intrusions occur as a medium grey toned low lying ridge extending in ENE-WSW direction about 3 km west of Khopoli. The country rock wherever exposed shows a slightly lighter tone than the ridge.

Field works reveal that the ridge is due to a coarse grained melanocratic rock which has a discordant relationship with the associated Deccan Trap Basalt Flows. The intrusive body has lenticular outcrops which extend for about 3-4 km in length with maximum width of about half a km. In the SW direction along the gabbroic body, the country rock has been fractured with individual master joints trending in ENE-WSE direction. Further down it is observed that the tributary of Patalganga

River is also controlled by this fracture. This clearly indicates that, the magmatic material has followed the fracture zone.

The occurrence of dyke near Dheku village, having the same ENE-WSW trend, supports the view that the trend of the fracture pattern is ENW-WSW, and it existed in this area prior to the intrusion of magmatic material.

The gabbro body exhibits typical topography and probably because of its nature, the intrusive body has been indicated as Stony Waste on Survey of India Toposheet



Gabbroic intrusions at location 1



Gabbroic body exhibiting topography



Country rock consisting laths of plagioclase (Left)
Country rock exhibiting porphyritic texture (Right)

No. 47F/5.

The country rock in this area is amygdaloidal basalt and has become reddish along the boundary of intrusive body due to contact effect. In thin sections under microscope, plagioclase plate encloses pyroxene and olivine giving rise to poikilitic texture. Analysis have shown that olivine is 45%, pyroxene is 25%, plagioclase is 28% and glass, iron ore etc constitute 12%. Olivine commonly alters to iddingsite (Mulay and Peshwa, 1980).

Samples of the rock specimens were collected only from the top of this gabbro body. Exposure of intrusive body represents the top of it, is evident from the fact that outcrop is concealed at one place below a ridge and at another by a hammock of basalt flows into which it has intruded. Presence of glass can therefore be attributed to fast cooling near the top of intrusive body.

Hence we can draw conclusion that there have been intense intrusive activities of olivine gabbro in the Dheku village. Besides the peripheral areas show clear evidences of gabbro basalt contacts and the gabbros show a perfect Tor topography.



Google image of the area

Location 1 - Olivine Gabbroic ridge (18.788552N, 73.304405E)

Location 2 – Contact between the country rock and the intrusive body (18.790370N, 73.309388E)

Location 3 – Exposed country rock exhibiting porphyritic texture (18.799830N, 73.316287E)

REFERENCES:

Mulay J. G. and Peshva V.V. , “Remote Sensing of dykes in Deccan trap area around Khandala and Khopoli (Maharashtra)”, National Space Science Symposium, Varanasi, 1980.

Oka M. S., “On the occurrence of some gabbroic rocks at Vajrat, District Ratnagiri, Maharashtra” Jour. Inst. Of Geol. Vikram Univ., 1969, 2, 39.

THE MOST EXPENSIVE COCONUTS OF MY LIFE

The lighter side of geological fieldwork (a real incidence)

Dr. P. K. Sarkar
Associate Prof. Department of Geology,
Fergusson College, Pune

This is a true story which happened during one of my Ph.D. fieldworks around Malvan in Sindhudurg district of Maharashtra, India.

I registered for my Ph.D. in Geology at the Department of Geology, University of Pune in 1983. My research was to work on the sedimentological aspects of the Kaladgi Supergroup of rocks, which are also known as the Konkan Kaladgis. After everything was finalized, the first field reconnaissance survey was undertaken along with my guide to delineate and formulate the traverses for the fieldwork. Everything went on well and I could learn many new concepts and the importance of geological mapping. It took us five to six days to formulate

What has to be done in the field and

How different type of data has to be collected and analyzed.

I happily returned with my guide back to Pune.

After a few days my guide advised me to go to my research area and proceed with my research work as suggested, somewhere in the month of March, 1983. I said "Yes Sir", however, a fear started developing within myself that, will it be possible for me to carry out this fieldwork alone! Climbing hills, mountains, moving through dense vegetation, valleys and what animals or reptiles I would face that would come my way. I was lucky as one of my classmates Mr. Ram Kiturkar a.k.a. Ramya, agreed to

accompany me to the field.

We went to the field in the second week of March, 1983. The fieldwork was proceeding well as accordance to the plan. On the fifth day we had to take the longest traverse along a thickly vegetated area. We started moving through the dense vegetation collecting data and information. It was very hot and humid on that day and all our energy was getting drained by intense sweating. We ultimately came to a spot near a small stream, lined with native vegetation and several coconut trees. We were exhausted, thirsty, and hungry. We thought of taking some rest for a while under a tree and proceed ahead later for the fieldwork. There was absolutely no sign of any

human settlement in the area. As we were resting, suddenly an idea struck me and I said to Ramya, whether he would like to have some coconuts as I knew how to climb a coconut tree. I could read my friends face which expressed that, what I had said is not possible. Anyways, I had to do what I had committed to my friend. I rolled-up my trousers till my knees and started climbing up slowly and steadily. Somehow, I reached the top of a tall coconut tree unharmed. I started plucking and throwing the coconuts one by one. Suddenly, I could see a small village girl collecting wood in the nearby area. I was scared and I came down immediately.

Now, the problem we faced was to cut four large coconuts and drink its sweet water without a knife. In such a situation one can use the multipurpose Geological hammer. Hence, the chisel end of the hammer became our

knife for making a hole in the coconut. We both drank the sweet water from the first two coconuts.

As I was about to cut the remaining two coconuts, we got shocked and scared by the noise of people shouting and running towards us. In the panic, we left the remaining coconuts behind and started running towards the stream. Unfortunately, there was lots of water flowing in the stream. Ramya was even more terrified as he could not swim. I asked him not to worry as I would take him across. In the panic we entered the stream and tried crossing in the flow. It was about seven feet deep. Somehow we crossed to the other side and started running without any orientation.

We ran for our life for about two to three kilometers and ultimately we saw some houses. Exhausted and tired we reached one of those houses. We saw an old lady sitting in the sun. I

asked her if she could give us some water to drink. The lady refused to even look at us or hear out what we were saying. After a while a young boy came towards us from nowhere and started shouting towards the direction from where we came. We later realized that he was shouting to the people who were hunting for us, telling them that the persons they are looking for are in their house. In a short time all those who were looking for us surrounded us. We got terrified to see them and felt that we would be trashed and beaten up. It took lots of time to convince and explain them. Ultimately the matter was settled by paying Rs. Two hundred for the four coconuts.

There is a saying in Hindi "Aasman se gire aur khajur me atke". It means that someone already in problem gets more problems from somewhere.

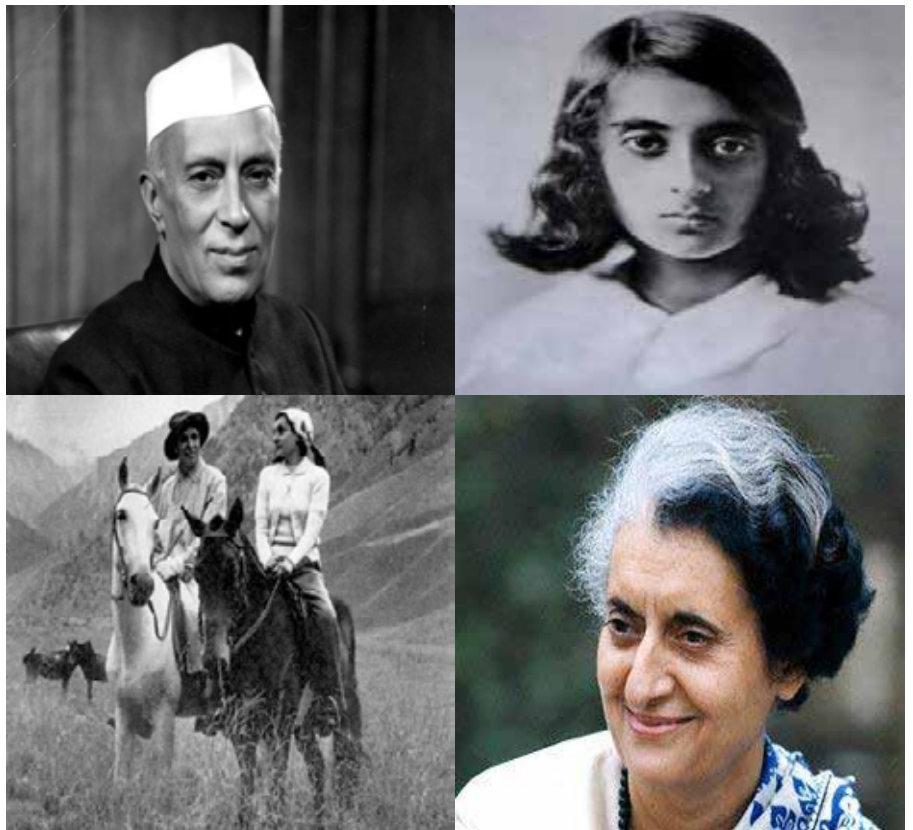


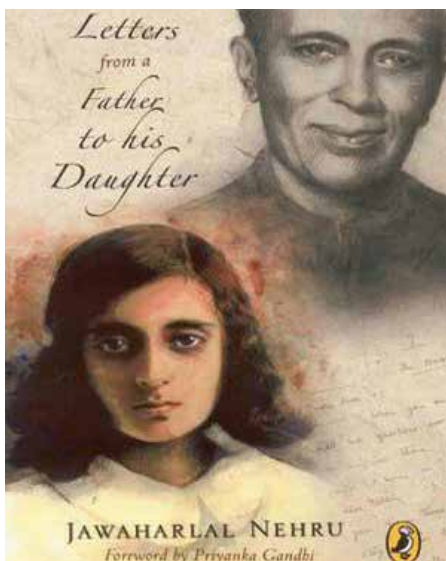
The Telltale Fossil Wood of Sattanur, District Perambalur, Tamil Nadu

Vidyadhar D. Borkar
Visiting Faculty Member,
Department Geology,
Fergusson College, Pune

Pandit Jawahar Lal Nehru, the first Prime Minister of independent India, was educated in England. He was a science student. Very few are aware of the fact today that the subjects he had opted for his graduation included Geology, Botany and Chemistry. In 1928, when his daughter, Indira, was just a ten year old school student, went to Mussoorie during the summer holidays. At that juncture he wrote letters to her narrating interesting information from Natural History, Archaeology and Prehistory

His friends and relatives suggested that these letters should be published in the form of a booklet. And so they were published. Name of that booklet is 'Letters from a





Father to his daughter'. I do not know if the student readers of this e-journal have read it. But I hope that they have at least heard of this lovely and lively booklet. As Nehru had learnt Geology during his graduation, no wonder that he writes in his very first letter:

"There was a time when no kind of life existed on the earth. It is difficult to imagine this world of ours, which is so full today of all kinds of animals and men, to be without them.. You read history in books. But in old times when men did not exist, surely no books could have been written. But fortunately we have some things which tell us as well almost as a book would. We have rocks and mountains and seas and stars and rivers and fossils of old animals. These and other like things are our books for the earth's early story.

Imagine how fascinating it is. The real way to understand this story is not merely to read about it in other people's book but to go to the great Book of Nature itself. You will, I hope, soon begin to learn how to read this story from the rocks and mountains."

And then Nehru narrates how a pebble lying at some remote place can reveal its journey from a hillside slope through a small streamlet and then through a river. How erosion wore away its edges and corners while it was being transported. How this erosion gave it a rounded shape, ultimately polishing it.

In the same manner, I have attempted to decipher the speechless narrative a huge fossil wood is trying to convey. Length of this fossil wood is more than 18.0 m, while its girth is to the tune of 1.0 m. It occurs near Sattanur, a remote village in the Perambalur District of Tamil Nadu, and is preserved in the rocks deposited some hundred million years ago. It is a rare, rewarding and fascinating marvel of nature, worth conserving for posterity. Therefore, the Geological Survey of India has established a small national park at Sattanur

All of us are well versed with the hypothesis of continental drift, since we learn it right from our school days. Hence we know that the distribution of oceans and continents has been changing. Millions of years ago there were only two megacontinents, one in the northern hemisphere and the other in the southern. Name of continent in the northern hemisphere is Laurasia, while that in the southern is Gondwanaland. Of course, there was no human being at that time, who would designate names to those megacontinents. These names were suggested by scientists, after their

existence was discerned in the early years of the last century. There was an ocean in between these two continents. Scientists called it the Tethys. Remaining surface of the earth was covered by a vast ocean. It occupied more than 50% of the earth's surface. This was the original expanse of what we know today as the Pacific Ocean.

In due course of time, both the megacontinents were split into the constituent segments. A chunk of the Laurasia separated apart; and drifted much to the west. We call it North America today. The remaining segment is known today by the name Eurasia. The mega-continent Gondwanaland was split into five segments viz., Australia, Antarctica, South America, Africa and Indian Peninsula. Each of these severed segments drifted variously to occupy their present positions. The Indian Peninsula very gradually drifted to the north. Finally it got attached to the southern edge of Asiatic part of Eurasia. And now it is considered an integral part of Asia.

The Tethys Ocean was receiving sediments from both these continents for ages. As





segments of both the mega-continents separated and drifted towards their destinations, Tethys gradually started narrowing down. The layers of sediments which had been accumulating for millions of years were lifted up, thrown into gigantic folds and transformed into a lofty mountain chain. We call it today Alpine-Himalayan Mountain chain.

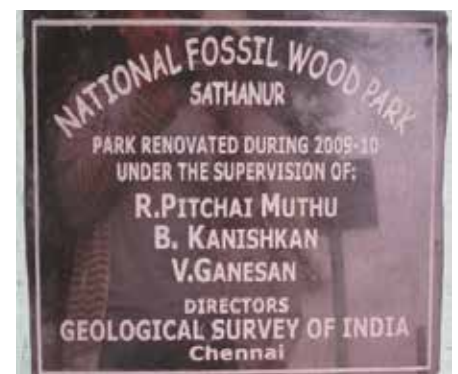
Obviously, this mountain chain was not created overnight. It was sometime in the Cretaceous Period (120 million years to 55 million years) that the first phase of Himalayan uplifting took place. When Indian Peninsula severed off from the adjacent segments, Arabian Sea and Bay of Bengal started taking shape.

All these geological activities must have caused reduction in the capacity of oceans for quite some time. It is a proven fact that when capacity of oceans reduces, there are temporary and local

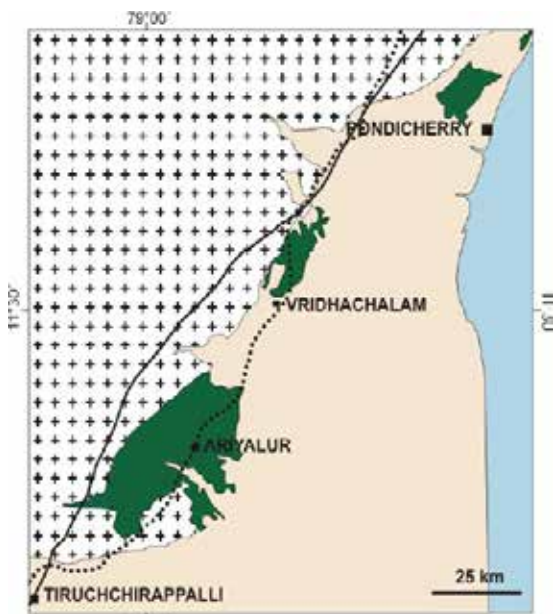
encroachments of sea on the neighbouring low lying land. This phenomenon is called a marine transgression, which lasts for some million years.

The shallow marine seas formed due to such marine transgressions provide a site for accumulation of sediments. It also constitutes an environment extremely suitable for marine organisms. But such seas cease to exist one day due to some geological reason or the other. The region covered by marine waters once again becomes a land, leaving behind sedimentary rocks and fossils of marine organisms.

During the Cretaceous Period marine transgressions occurred in different parts of all the continents. One of the transgressions took place in parts of Tamil Nadu and Pondicherry. Marine rocks deposited during this geological episode are today exposed in four major patches, the



largest of them being that occurring in the Perambalur and Ariyalur Districts of Tamil Nadu



Green coloured patches are exposures of marine Cretaceous rocks of Tamil Nadu and Pondicherry. One near Thanjavur is to the south of this map and hence not included here

Very close to the exposures of these marine Cretaceous rocks, to their west, occur steep hill slopes. Though these hill slopes are an eroded version of what they must have been during the Cretaceous, anybody can guess that those hills were not under marine waters then. Their height from the mean sea level during Cretaceous must have prevented farther inward encroachment of the invading marine waters.

.During the Cretaceous period, when marine transgression was rampant, the hill slopes by the seashore supported flora which existed then. Those days gymnosperms (Cycadales and Coniferales) dominated

the floral assemblage. There were, of course certain other non-flow-ering plants like ferns and bryophytes. In some of the sedimentary rocks, we do get excellently preserved fossils of these plants.

The several plant species that flourished on the hill slopes included huge cycadean trees. After the trees lived for many years, we can imagine, were attacked by fungi and insect pests. There must have been certain worms and arthropods which were parasites on roots of the cycads. Cycadean trees then were getting uprooted.

A number of trees therefore must have collapsed on the slopes. Presumably, numerous trees rolled down the slopes and were buried in the marine sediments, and were thus deposited in the temporary Cretaceous seas. Many wood logs are found in a particular layer. It can be deduced that when this particular layer was being deposited, there was luxuriant

growth of these huge cycads. One very huge cycadean tree trunk had its destination near Sattanur, which was eventually fossilized there.

The Cretaceous Sea receded in due course of time. The sediments deposited there were exposed and became part of land. All exposed lands are subjected to the process of erosion. Erosion helped in exposing the huge fossil log to be finally noticed by geologists.

Every outcrop, every rock, every mineral and every fossil has a story to tell. Would you like to develop the skill of deciphering their language? Believe me. It is indeed very fascinating.

Acknowledgements: Ms Amrita Paranjape, a Research Student in the Geology and Palaeontology Department of the Agharkar Research Institute, has assisted in preparing illustrations accompanying this article,



Steep slopes, very close to the exposures of Cretaceous rocks in Perambalur District, to their west. They were just by the side of seashore 100 million years ago, supporting entirely different flora, which existed during Cretaceous.

Hello my student friends of Geology.... Many of you must be aware of the glamour associated with the mesmerizing diamond jewellery displayed in majestic show-rooms of major cities of India; their impressive and haunting advertisements in leading magazines, newspapers, television channels, at prime-locations on high ways and in

of physical, optical, electrical and thermal properties making it indispensable for its various industrial uses and applications in the anthropological world. Whenever you see diamond jewellery worn by anybody, just appreciate the age of diamond in that ornament. It will be anywhere between 1.0 to 3.33 billion years! All such jewellery pieces should be priceless for their antiquity..... You are in possession of that time of this beautiful planet's- MOTHER EARTH's life preserved in that tiny faceted crystal of diamond.

These diamonds formed beneath the old, cold and stable cratons at depths of 120-150 km are brought up on the earth's surface via fast and forceful kimberlite or lamproite eruptions taking place along the deep-seated, mantle reaching, long-lived fractures which develop on or near cratons. The stable interior portions of continents, characteristically composed of ancient crystalline basement rocks that have been stable for over a billion years are termed as cratons. Kimberlites are a group of volatile rich, dominantly CO₂ rich, potassic, ultrabasic rocks exhibiting a distinctive inequigranular texture. Kimberlitic magmas formed at even greater depths than those required for the formation of diamonds. During their upward journey while erupting, if kimberlitic magma passed through overlying diamondiferous regions, then resulting kimberlitic pipes became diamond bearing, else they remained

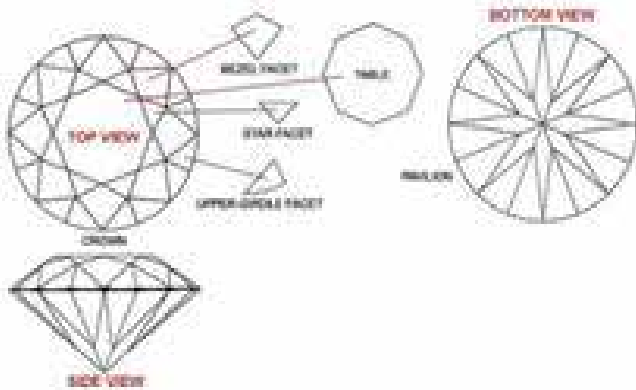
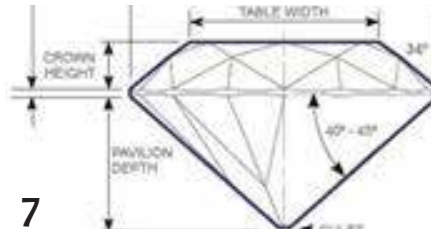
D FOR DIAMONDS

Dr. Tanuuja Marathe
Associate Professor,
Department of Geology,
Fergusson College, Pune



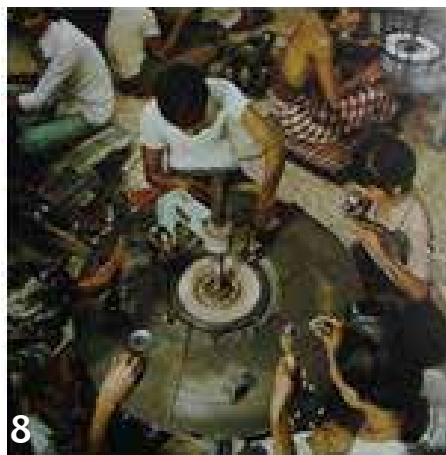
hotspot areas of main cities; must have seen the photographs of cine artists, models, elite women from business world and society wearing beautifully crafted, enchanting and hypnotic diamond jewellery. That is the dazzling side of diamonds- a gemmy or gem quality diamond!

Diamond is a mineral made up only of carbon, it is a mineral found in the native element form. It is formed under high temperature (9000C to 12000C) and high pressure (60-80 kbar) conditions existing at great depths below the earth's surface, slowly crystallized into a covalently bonded, transparent cubic crystal of carbon having a unique combination



1. Kimberlite eruption and mining stages
2. Rough diamonds
3. Gem quality rough diamonds
4. Primary diamond deposit
Weathering of kimberlite
5. Sieving of gravel in Tertiary diamond deposits
6. Names of facets in brilliant cut of diamond
7. Profile view of brilliant cut of diamonds
8. Cutting and polishing

6



non-diamondiferous. They are named after town Kimberley in South Africa where first occurrence of kimberlite was detected. Lamproites are mantle derived ultrapotassic, mafic volcanic and hypabyssal

igneous rocks which are rich in incompatible elements. The eruptions of kimberlites and lamproites have taken place in the various cratonic parts of the world during different geologic time since Palaeoproterozoic till Recent. Only 15% of such eruptions are diamondiferous i.e. diamond bearing. Moreover, not all diamondiferous kimberlites or lamproites are economically viable for undertaking diamond mining activities. Also, for obtaining one carat gem quality diamond nearly 250 tons of kimberlite or lamproite needs to be unearthed. Rough diamonds further need to be cut and polished before being set in jewellery. One carat

is only 0.2gm. I think, this should explain the cause of high price of diamonds.

There are many diamond producing countries on the world map today such as South Africa, Botswana, Angola, Namibia, Congo, Ghana, Lesotho, Sierra Leone, Russia, Australia, Canada, China and others. Several global mining giants such as De Beers, Rio Tinto, Alrosa, BHP Billiton, Petra Diamonds, Gem

Diamonds, Debswana etc are busy mining the precious treasure of the earth either via open cast mining or via underground mining. Prior to modern methods of mining, age-old alluvial mining



1. Kohinoor



2. Hope Diamond



3. Regent Diamond



4. Darya-i-Noor



5. Dresden green Diamond



6. Shah Diamond

methods (which involves digging, sieving and sifting for collection of gemstones from mud, sand and gravel in the stream/river deposits) were applied in the palaeo and present river channels draining the diamondiferous areas and also along the beaches. Diamonds mined from Kimberlite or lamproite pipes by open cast or underground mining method is known as primary diamond deposit. Those mined from conglomerates, where in they are eroded from source rocks and deposited in conglomerates are termed as secondary deposits and those mined from river channels, from

loose gravels, from beaches are termed as tertiary diamond deposits.

At mines, rough diamonds after separation are sorted as per their crystal forms, clarity, colour and weight. Then they are auctioned to the site holders who are mainly in the business of diamond manufacturing (cutting and polishing of diamonds).

Diamond mines which are operated by De Beers have a subsidiary known as Diamond Trading Company, which looks after the sales of their produce i.e. rough diamonds.

After the rough

diamonds are cut and polished they are ready to be set in various metals such as gold, silver, gold of different colours such as white, pink, red, green, violet, blue, grey etc and in platinum with mind alluring designs. This is a mine to market journey of diamonds.

Since times immemorial, India has been the only diamond producing country in the world till the discovery of diamonds in Brazil (1725) and South Africa (1867). Many famous legendary diamonds, that too differently coloured with remarkable sizes have been produced from old mines of south India falling in

region then known as Rayalseema. During British rule, these mines were under British company- Golkonda Diamond Mining Co. Hence the two terms -Indian diamonds and Golkonda remained inseparable for a long period. The famous legendary diamonds are Kohinoor (colourless, 105.6 carats, oval brilliant cut, at present in Tower of London), Hope (blue, 45.52 carats, cushion shaped brilliant cut, now in Smithsonian Institution, Washington D.C.), Regent diamond (140.50 carats, blue tint, cushion shaped brilliant cut, currently in Louvre Museum, Paris), Darya-i-noor(approx. 185 carats, pale pink, table cut, now in National Jewels Museum, Tehran), Dresden Green (40.70 carats, apple green, pear shaped brilliant cut, at present in Albertinum Museum, Dresden, Germany), Shah (88.70 carats, pale yellow, uncut, nowadays in

Kremlin, Moscow) and many others such as Nassak, Orlov, Sancy, Agra, Great Mughal etc. Diamond, considered as symbol of power, courage and virility, till fifteenth century was worn mostly by Rulers and military men. Possession of such invaluable gems was always a matter of pride and prestige and many a wars were fought for them; frauds, murders and treacheries were not uncommon. These stones exchanged several hands, travelled many continents for many centuries. Today, we find them silently resting at their terminuses. There are fascinating stories associated with many of them..... stories next time....

Today, India is seen prominently on Diamond Map of the world, but for manufacturing of diamonds, closely chased by Israel and China; and not as prominent diamond producing country.

The only working mine of diamonds is at Majhgawan, Panna, Madhya Pradesh. However, there are three distinct diamond producing regions in India where diamonds have been found. Roughly they are known as southern region, eastern region and northern region. Southern region includes parts of Krishna, Anantpur, Cuddapah, Kurnool, Mehboobnagar, West Godavari and Guntur districts. Earlier this area formed state of Golkonda. It includes the region drained by Godavari, Krishna and Pennar rivers. Eastern region comprises of area spread from Chhotanagpur plateau in Ranchi district, Jharkhand; parts of Kalahandi, Boudh and Sambalpur districts in Odisha, parts between Mahanadi and Godavari rivers and Mainpur Kimberlite Field of Raipur district, Chhattisgarh. Northern region mainly comprises of ENE-WSW stretching belt in Madhya Pradesh near Panna.



**Majhgawan Diamond Mine, Panna, Madhya Pradesh,
An open cast mine**

Diamond mines here are laid across on an area of 80 km belt, starting from the Paharikhera in North-East to Majhgawan to South-West with breadth of around 30 kms. At Majhgawan, lamproite is hosting diamonds which are mined by NMDC(National Mineral Development Corporation). It is an open cast mine. Diamonds are also mined from conglomerates of Vindhyan Supregroup and from loose gravels in the neighbouring areas. T.Y.B.Sc. Geology students of the year 2004-05 batch were fortunate enough to visit Majhgawan Diamond mine in December, 2004 and observe all the stages of mining right from ore extraction, processing plants for crushing and milling to various rough diamond separation techniques such as washing, screening, heavy media separator, Grease belt and X-ray separator to tailends disposal.

Recently, new diamond deposit has been found in northern region i.e. in Bundelkhand region, to south-west of Majhgawan mine. It was discovered in 2004 by Rio Tinto and is known as Bunder Project. It is a seven times richer deposit than Majhgawan and is proposed to be operational in 2016. That definitely will bring India on world map once again as an important diamond producing country as well.....



Satellite picture of Majhgawan diamond mine, Panna



Satellite picture of Bunder Project. M indicates location of Majhgawan.

REFERENCES:

- Maillard Robert (1980) : *Diamonds- Myth, Magic and Reality*,. Editor-in-Chief, Crown Publishers, Inc., New York, 287p.
- Marathe Tanuuja (2005) : *Global Occurrences of Primary Host Rocks of Diamonds*, *Indian Gemmologist*, Vol.XIII, No. 1-2, pp 50-53.
- Marathe Tanuja Santosh (2004): *Geological Studies of Diamond and other Gemstones of Raipur District of Chhattisgarh by integrated Classical and Remote Sensing Methods*, Unpublished Ph.D. Thesis, Barkatullah University, Bhopal.

Internet

Google Earth

Causative Factors of Malin Landslide

Pune District, Maharashtra

Prof.S.S.Thigale
Symbiosis International University

Introduction

The landslide event at Malin village in Pune district on the morning of 30th July, 2014 was the most disastrous one, in the landslide history of western mountain chain (popularly known as Sahyadri) of Maharashtra. This is so not only because it has killed 151 people but also because an entire village vanished from the map of India.

A literature review indicates that fairly comprehensive literature is available on the landslide episodes and events that occurred in the western mountain chain of Maharashtra. It is in the form of reports, publications and Ph.D. thesis, and mainly includes work carried out in the Department of Geology, University of Pune (now Savitribai Phule Pune University) since 1983. It covers

information on physical set up of the mountains chain, causative factors, symptoms and mechanism of landslides drawn after studying Konkan landslide episode of 1983 (Thigale, 1989), Maval landslide episode of 1989 (Thigale, 1989), Satara and Thane landslide episode of 1993 (Thigale, 1995; Thigale et al, 1996; Thigale and Khandge, 2000, 2004), Mahad episode of 2005 (Thigale and Umrikar, 2007, Thigale, 2009) and Patan-Mahabaleshwar episode of 2006 (G. S. D. A., 2006).

Background Information:

Evidences collected during episodes and events mentioned above indicate that problem of land sliding was not so intense in the western mountain chain, which is constituted of horizontally

disposed basaltic flows, till 1967. A belief that the entire Deccan plateau is safe from seismicity was shattered after Koyna earthquake of December, 1967. Since then the area is experiencing tremors of varying magnitudes, their epicentres being mostly shallow and confined mainly around Koyna, Bhatsa and Chandoli.

A perusal of data of Konkan landslide episode of 1983 (Thigale, 1989) revealed that huge cracks were developed on slopes at many places during Koyna earthquake. A number of ephemeral springs were developed at the base of these cracks during monsoon. The data also revealed slow creeping along the cracks. It is interesting to note that majority of landslides occurred precisely along these cracks during incessant rains. Landslide episodes and events

which occurred in 1993, 2005 and 2006 indicate that the process of developing and widening cracks, gradual creeping and ultimate triggering during incessant rains is still on all along the mountain chain (Thigale and Umrikar, 2007; Thigale, 2009).

The data also suggests that the areal extent of landslide-prone zones and severity are on the rise. It is mainly because of metamorphosis of slopes due to anthropogenic activities all along and across the western mountain chain. These activities are housing, terracing, trenching, deforestation, transportation routes, quarrying and change in agricultural practices. Such human induced changes are responsible for shifting slopes from equilibrium to in-equilibrium state.

Malin Event:

Physical Setup: The observations made during field investigations and evidences collected through structured interviews of stakeholders including affected inhabitants, school teachers, local NGO and Chief of National Disaster Reduction Force involved in Malin rescue operation on 22nd and 23rd September, 2014 about Malin landslide (Toposheet No.47E/12) are outlined below:

Malin village was located on the spur portion, at an elevation approximately between 730 m and 780 m, between two south-easterly flowing lower

order streams which meet the south-westerly main stream. This stream is mapped as fractured controlled on the satellite-based groundwater potential map prepared by MRSAC, Nagpur. The village was located on moderate slope backed by steep one as evident from the toposheet.

Geological map of Malin prepared by MRSAC using data of Geological Survey of India shows five horizontally disposed basaltic flows of vesicular, mixed and massive type. These flows are covered by moderate to thick soil layer (0.5 to 2.5 m) which grades downward into weathered to moderately jointed basalt and then hard basalt. Outcrops of fresh rock are intermittently seen on the surface of the spurs. The banks of fracture-controlled streams are constituted of valley fill material.

The area receives heavy rainfall of the order of over 3700 mm annually. It is commonly observed that upper soil and weathered portion, being porous and permeable, permit rainwater to infiltrate and percolate up to the interface of pervious and impervious bed rock. The base flow so developed travels laterally down slope and emerges out in the form of springs where water table intersects with land surface. These springs are essentially ephemeral



Wide view of main scarp and crown

which continue to yield water up to January/February every year. Water table and land intersection points naturally should lie along the banks of the streams. But in mountainous terrain they even lie up slope due to human induced modifications such as construction of transportation routes or levelling of slopes. It was noted two such springs were aligned along the road passing through the Malin village.

There is no seismic history for Dimbhe reservoir. Structured interviews of inhabitants, however, revealed that the region experienced the shaking of ground after Koyna and Latur earthquakes in the year 1967 and 1993 respectively.

Human-induced changes: Google Earth image of Malin (19.61°, 73.69°) of February, 2014 (<http://blog.agu.org/landslide-blog/2014/07/31/malin-landslide>) shows the clustering of houses on hill slope and other man-made changes, terracing for paddy cultivation being dominant along the streams and upland slope of the village. It is worth mentioning

here that terracing for paddy cultivation has been a traditional practice all along the streams in western mountain chain. Apart from terracing and housing other changes made on the slope include i) cutting the trench close to the row of houses located in the upper reach for diverting water in the paddy fields, ii) levelling of slope for bringing more land under paddy cultivation upland, and iii) cutting of trees during levelling.

Inhabitants were experiencing oozing of water in a few houses particularly those close to the southern part of the scar. The yield of water during excessive rains used to be so high that pipes were laid to remove it.

Toe of the slide is located along the road which was washed out in the landslide. The springs at lower reaches are mostly ephemeral in nature which yield water up to February/March.

Discussion:

The area under investigation falls in Zone III of seismic map (moderate intensity) prepared by Geological

Survey of India. Dimbhe dam is constructed on river Ghod which is considered to be fractured controlled and shows evidences of uplifting (Powar, 1993; Radhakrishna, 1993; Valdiya, 2001; Peshwa and Kale, 1997; Kale and Shejwalkar, 2008). Higher order streams contributing to the river are also fractured controlled. The village Malin is located on one such stream flowing in southerly direction and meeting the main stream flowing in south-east direction and ultimately emptying its water in Ghod river. Thigale and Umrikar (2007) while investigating the Mahad landslide episode observed that seismicity of the region appears to be responsible for developing fissures parallel to N-W to NNW-SSE trending streams on the slopes along which majority of landslides occurred. Although there is no convincing evidence of development of cracks on slopes during the Koyna and Latur earthquakes, the tectonic setting is conducive to develop them.

From all the evidences collected through previous literature, maps, field evidences

and structured interviews, it can be inferred that steep to moderate slope, adverse geological and tectonic settings, and excessive rainfall are natural, and metamorphosis of slope due to housing, terracing, trenching, were human induced causes responsible for bringing slope under geologic threshold. Signatures of instability of slope such as cracks to the walls of houses and ground, and oozing of groundwater in houses at least a decade before the calamity were adequate to support this fact. Incessant rains during the event ensured percolation of large quantity of rainwater in already shattered pervious surfaces which helped increasing weight of the slope by displacing air and increasing pore-water pressure. The condition conducive for ultimate triggering was developed during incessant rains from 28th to 30th July as a consequence huge mass of debris collapsed making rumbling noise.

Crown Cracks



Crown





Debris of earlier landslides from the area



View of the Malin Landslide Sight

References:

- Groundwater Survey and Development Agency (2006). Expert Committee's Report on Landslide Episode of July 2006 in Satara District, p.32.
- Kale Vishwas and Shejwalkar Nikhil (2008), Uplift along the western margin of the Deccan Basalt Province: Is there any geomorphometric evidence?, *Jour. Earth Syst. Sci.* 117 (6), December 2008, pp. 959-971, retrieved from, <http://www.ias.ac.in/jess/dec2008/jess57.pdf>
- Peshwa, V. V. and Kale, V. S. 1997. Neotectonics of the Deccan Trap Province: focus on the Kurduwadi lineament. *Jour. of Geophysics*, 18(1): 77-86
- Powar, K.B. (1993) Geomorphic Evolution of Konkan Coastal Belt and adjoining Sahyadri Uplands with reference to quaternary uplift, *Current Science*, Vol. 64, pp 793-796.
- Radhakrishna B.P. (1993) Neogene uplift and geomorphic rejuvenation of the Indian Peninsula. *Current Science*, Vol. 64, pp 787-793.
- Thigale, S S (1989) Processes conducive for slope failure in Western Ghats of Maharashtra, India, *Abst. Internat. Geo. Congress, Washington*, 3:232-233.
- Thigale, S.S. (1989) Preliminary Geotechnical report on Landslide Episode of Maval Taluka, Pune District, Maharashtra, report submitted to Government of Maharashtra, p 12.
- Thigale, S S (1995) A review of landslides along the Western Ghats of Maharashtra, In: *Proc. National Seminar on Landslides in Western Ghats*, CESS, Trivandrum, pp 248-251.
- Thigale, S S and Khandge, AS (1996) Generation of database for preparation of Landslide Hazard Zonation map of the Western Ghats of Maharashtra, India, *Geoinformatics*, 7 (1-2): 61-68.
- Thigale S.S., Khandge A.S., Thigale M., Bhokare M. Afor Landslides and Sawarkar A. (1998). Causative Factors as Applicable to GIS: A Case study of western mountain chain of Maharashtra. In: *Proceedings International Symposium on Application of RS-GIS to Disaster Reduction*, Geol. Survey Japan, Tsukuba, pp 197-213.
- Thigale, S S and Khandge, AS (2000) Landslides in the Western Ghats of Maharashtra, In: Pathan, A.M. and Thigale, S.S. (Eds) *Contributions To Environmental Geoscience*, Arvalli Books International, New Delhi, pp 161-174.
- Thigale S.S. and Khandge A.S. (2004). Coping with landslide disasters in western ghats. In: *Coping with Natural Hazards* (Eds Valdiya K.S. and Kale V.S.), Orient Longman, Hyderabad, pp 269-315.
- Thigale S.S. and Umrikar Bhavana (2007) Disastrous Landslide episode of July, 2005 in the Konkan Plain of Maharashtra, India with special reference to tectonic control and hydrothermal Anomaly, *Current science*, Vol. 92 (3), pp 383-386.
- Thigale, S S (2009) Report on Geological Investigations in the Landslide Affected Villages in Mahad Taluka, Raigad District, Maharashtra
- Dr. Dave (2014) retrieved from <http://blog.agu.org/landslideblog/2014/07/31/malin-landslide>

ROLLING STONES



History of the Universe Part 3- Formation of the earth

Earth's formation was turbulent and spectacular. Beginning in the Hadean Era, early Earth had lots of frightening scenes with Mars sized collisions, humongous meteors and a surface completely filled with boiling magma.



Inside the Earth

The Earth's interior is composed of four layers, three solid and one liquid – not magma but molten metal, nearly as hot as the surface of the sun. The deepest layer is a solid iron ball, about 1,500 miles (2,400 kilometers) in diameter. Although this inner core is white hot, the pressure is so high the iron cannot melt. The iron isn't pure – scientists believe it contains sulfur and nickel, plus smaller amounts of other elements. Estimates of its temperature vary, but it is probably somewhere between 9,000 and 13,000 degrees Fahrenheit (5,000 and 7,000 degrees Celsius).

Above the inner core is the outer core, a shell of liquid iron. This layer is cooler but still very hot, perhaps 7,200 to 9,000 degrees Fahrenheit (4,000 to 5,000 degrees Celsius). It too is composed mostly of iron, plus substantial amounts of sulfur and nickel. It creates the Earth's magnetic field and is about 1,400 miles (2,300 kilometers) thick.



Planet That Smashed Into The Earth - Moon Formation -
 TITLED- FEMALE VOICE OF SPACE
 revueciov - Carol Meier

The Planet that smashed into the Earth

That old theory that the Moon was formed out of fragments of Earth blasted into space after a massive planetary collision 4.5 billion years ago has gained support from two new studies.

Boffins have tried to figure out exactly how a giant impact in our solar system made the Moon. Previous theories have suggested that the celestial body could have been made from pieces of the mysterious planet that crashed into Earth, but recent studies showing that Earth and the Moon have the same isotopic composition pour water on that idea.



Earth's interior and plate tectonics
 Peace

Earth's Interior and Plate Tectonics

Animated Earth and its interior layers. Description of plate tectonics and tectonic boundaries.



View of Fingal's cave from outside

Where giants walked....

Chinmay Thite
Department of Geology

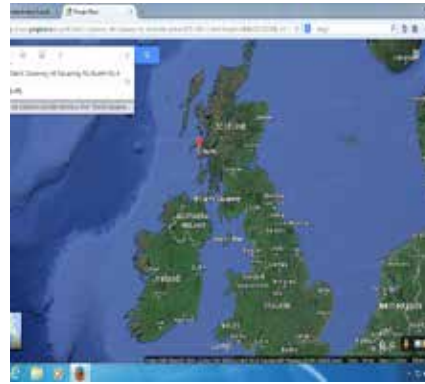
Geomythology is very interesting and new branch of geology which is lesser known. It is the study of alleged references to geological events in mythology. The term was coined in 1968 by Dorothy Vitaliano, a geologist at Indiana University.

"Geomythology indicates every case in which the origin of myths and legends can be shown to contain references to geological phenomena and aspects, in a broad sense including astronomical ones (comets, eclipses, meteor impacts, etc.).'Primarily, there are two kinds of geologic folklore, that in which some geologic feature or the occurrence of some geologic phenomenon has inspired a folklore

explanation, and that which is the garbled explanation of some actual geologic event, usually a natural catastrophe'."

Vitaliano (1973)

Oral traditions about nature are often expressed in mythological language and may contain genuine and perceptive natural knowledge based on careful observation of physical evidence about the geological events that have taken place in the past. Before the birth of the modern science in last 400 or so years the events or other scientific things commonly known to us now were given explanations with the help of myths and stories, which may have been about the gods and demons and



View of Giants Causeway and Google map of Giant's causeway and Isle of Staffa

giants etc. Geomythology alleges to provide valuable information about past from these myths about the past events like earthquakes, tsunamis, floods, impact events, fossil discoveries, and other events, which are otherwise scientifically unknown or difficult to trace.

In August 2004, the 32nd International Geological Congress held a session on "Myth and Geology", which resulted in the first peer-reviewed collection of papers on the subject.

Here I have attempted to discuss one of the popular examples related to it.

Recently I had an opportunity to visit one of the most popular tourist destination associated with geology – The Giant's Causeway in Northern Ireland UK and its lesser famous counterpart from Scotland called as Fingal's Cave belonging to a very small island called as Isle of Staffa. It is a strange rock formation that has a spellbinding effect on the multitude of tourists that arrive by the busload. The striking and at times, like the day of our visit when the mist hung low over the shore, eerie perfection of the precise geometric columns has led many a traveler to believe that it must have been created by human or supernatural forces. There are many myths and legends surrounding the origin of such a mysterious feature, the most prominent of them being the Legend of Finn.

The Legend of Finn McCool.

"Finn McCool (Fionn mac Cumhail) an Irish Giant lived on an Antrim headland and one day when going about his daily business a Scottish Giant named Benandonnar began to

shout insults and hurl abuse from across the channel. In anger Finn lifted a clod of earth and threw it at Benandonnar as a challenge, the earth landed in the sea.

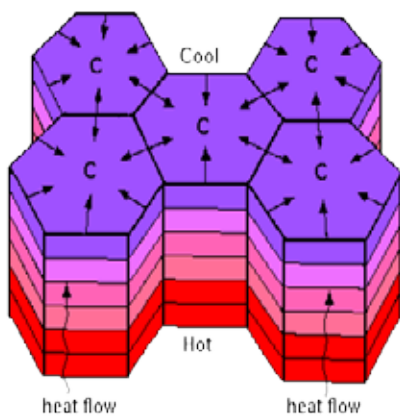
Benandonnar retaliated with a rock thrown back at Finn and shouted that Finn was lucky that he wasn't a strong swimmer or he would have made sure he could never fight again.

Finn was enraged and began lifting huge clumps of earth from the shore, throwing them so as to make a pathway for the Benandonnar, Scottish giant to come and face him. However by the time he finished making the crossing he had not slept for a week and so instead devised a cunning plan to fool the Scot.

Finn disguised himself as a baby in a cot and when Benandonnar came to face him Finn's wife Una told the Giant Benandonnar, that Finn was away but showed him his son sleeping in the cradle. The Scottish giant became apprehensive, for if the son was so huge, what size would the father be?

In his haste to escape Benandonnar sped back along the causeway Finn had built, tearing it up as he went. He is said to have fled to a cave on Staffa which is to this day named 'Fingal's Cave'.

Other versions of the legend include Finn throwing a huge piece of earth which then became the Isle Of Man and the hole which it



Columns at Giant Causeway

left behind became Lough Neagh.

It is told that Finn was building a Causeway pathway to Scotland using the hexagonal rocks, much to the upset of Benandonnar. A battle ensued. To this day, there remain hexagonal rocks for all to see at the Isle of Staffa, however, the main breathtaking formations are situated at the Giant's Causeway, World Heritage Site, with over 38,000 basalt columns on display.- "The National Trust U.K."

Was The Giant's Causeway actually formed by a giant trying to cross the Irish Sea? Unfortunately, (or maybe fortunately because just imagine a world with angry giant's running amuck) no. The Giant's Causeway is actually a volcanic feature known as columnar basalt.

The columns at the Causeway are a type of rock called basalt, a mafic igneous rock that is made up of the minerals clinopyroxene and plagioclase. The term mafic describes its chemical composition and means that it is rich in iron and magnesium. Igneous simply means that it was formed from molten rock: magma. It is extrusive – it cools at the surface unlike granite, an intrusive igneous rock, which cools in the crust below the surface of the earth– and forms when magma rises from the mantle, erupts onto the surface, cools and becomes solid rock.

Magma can be formed by three main processes: decreasing pressure, increasing temperature, or changing chemical composition. Decompression melting is a geologic

phenomenon that occurs when the pressure of overlying material is reduced. Buried mantle rocks, under less pressure, will melt and rise to the surface where they either erupt or cool within the crust. In the case of the Giant's Causeway basalts, the magma was formed by decompression melting of the mantle beneath the Rathlin trough, a sedimentary basin that extends from the Antrim to Islay, an island off the south coast of Scotland (McCann).

The physical properties of columns are due to the manner in which cooling occurred. After magma erupts to the surface it is known as lava. As lava cools, it expels dissolved gases, contracts, and solidifies, all of which decrease its overall volume. In order to accommodate the volume loss, the rock begins to crack and form what are known as joints. Under ideal conditions, joints will form at 120 degrees to one another in basalt, creating the hexagonal pattern you can see from the top of the columns. However, when walking along the top of the columns you may notice that some can be five, seven, eight, or even nine sided. This is just an example of the imperfections in nature. As further cooling ensues, the cracks will propagate downward creating vertical columns known as columnar jointing. When this pattern forms in basalt, it is known as columnar basalt.

Tomkeieff was the first to describe the Giant's Causeway basalts as tholeiitic, a term used to describe the composition of the magma. A tholeiitic magma is enriched in iron and depleted of magnesium which preferentially

crystallizes out of the cooling magma. Geochemical and petrographic analysis of the basalts led researches to conclude that they were formed by sheet flows contained within the margins of a fault basin (Lyle and Preston).

Staffa - A Geological Marvel

Staffa is one of the smallest islands in the Southern Hebrides, located south-west off the isle of Ulva and halfway between the Ross of Mull and the Treshnish Isles. The Vikings gave it this name as its columnar basalt reminded them of their houses, which were built from vertically placed tree-logs. Island is very small with only 33 hectares, was once inhabited in the 1700s by as much as 16 people but nowadays seabirds and tourists have taken over their place. The 1700s were also the time that Staffa was part of the Ulva Estate but it was sold in 1777 and via several owners it was donated to the National Trust of Scotland by Jock Elliott from New York in 1986. Staffa is now a Site of Special Scientific Interest.



View of Fingal's cave from inside

Staffa, an entirely volcanic island, is probably best known for its unique geological features such as the many caves and the unique shape of the basalt columns which are also found in the Giant's Causeway and Rathlin island in Northern Ireland and closer by on the island of Ulva. It consists of a basement of tuff, underneath colonnades of a black fine-grained Tertiary basalt, overlying which is a third layer of basaltic lava lacking a crystalline structure. By contrast, slow cooling of the second layer of basalt resulted in an extraordinary pattern of predominantly hexagonal columns which form the faces and walls of the principal caves. The lava contracted towards each of a series of equally spaced centres as it cooled and solidified into prismatic columns. The columns typically have three to eight sides, six being most common.

The island is not historically important but is a wonderful geological marvel and is often visited by the tourists who are looking for the new experience and geology enthusiasts.

References-

www.wikipedia.org
<http://www.southernhebrides.com/staffa.html>
geomythology.wordpress.com

Largest dino fossil found in Argentina



A technician next to the femur of a dinosaur – likely to be the largest ever to roam the earth – in Rawson, Chubut, some 1,300km south of Buenos Aires; Bottom: A picture of the site in Argentina's remote Patagonia region, near the locality of Las Plumas

Paleontologists in Argentina's remote Patagonia region have discovered fossils of what may be the largest dinosaur ever, amid a vast cache of fossils that could shed light on prehistoric life. The creature is believed to be a new species of Titanosaur, a long-necked, long-tailed sauropod that walked on four legs and lived some 90 million years ago in the Cretaceous Period.

Researchers say the plant-eating dinosaur weighed the equivalent of more than 14 African elephants, or about 100 tonnes, and stretched up to 130 feet in length.

The previous record holder, also in Argentina, the Argentinosaurus, was estimated to measure 36.5 metres long.

A fossilised femur of the Titanosaur was larger than a paleontologist who lay next to it. And the find didn't stop there. Bones from at least seven individual dinosaurs, including some believed to be younger, were found at the site.

This is "the most complete discovery of this type of giant dinosaur in the world," a modest discovery for scientists, "showed how Luis Carballido, one of eight scientists who participated in the research.

The fossils were accidentally



time and Spanish researchers, said the searches rebuild the ecosystem at the



Aftermath of Moin Fresh complaints of sinister cracks from distts inundate GSI

Retraying panic, villagers and administrators have become hypersensitive to sudden changes in their terrain, showing unusual alacrity in reporting them

The Geological Survey of India (GSI) experts have been sent in to survey the Ambegaon taluk to: Study the likelihood of more landslides. Identify cracks in hills and houses, tilting of trees and electric poles. Whenever such signs are seen, villagers would be relocated.

Levelling of hill slopes for farming to blame: Experts



THE SCHEME
It is a government scheme in which the hill slope is levelled off and cultivable plots are created. Fertiliser is an essential requirement for the scheme. Barren land in hilly and hill slope areas has to be converted to cultivable paddy land under the Employment Guarantee Scheme. For this, a group of people have to come together and develop their own local bodies. Records are taken with the nearest village officer to the place, central to the scheme.

When Mishra had visited Ambegaon, 29 such camps had been conducted in Ambegaon taluka. Staff and orders



Are you sure you parked it there? LANDSLIDE SWALLOWS CAR PARK IN JAPAN

A bus containing terrified passengers stood trapped halfway down a mountain side after heavy rain caused this gigantic landslide in Takashima, Japan. But none of the passengers were killed after half a car park was swallowed up. Two cars were left standing over the cliff's edge. Half a million people were advised to evacuate over the weekend in torrential rains from Typhoon Maeri lashed western Japan.

IT COULD HAPPEN AGAIN
Geological Survey of India (GSI) experts have been sent in to survey the Ambegaon taluk to: Study the likelihood of more landslides. Identify cracks in hills and houses, tilting of trees and electric poles. Whenever such signs are seen, villagers would be relocated.



WHAT EXPERTS SAY
1. Sanku Thigale, who has studied the landslide at Main appears to be levelling of land for cultivation.
2. Sumaira Abdullah, an environment activist. Parts of the Himalayas are rocky and have nothing to hold the soil. These areas are prone to landslides. Here, we are creating the condition by cutting trees.
3. A K Saha, deputy director general, Geological Survey of India. Preliminary reports indicated the landslide occurred due to two days of non-stop rain.

LONG CRACK IN THE GROUND

Fortage has emerged showing an 8m-deep crack stretching over a kilometre in the farmland of Madras. The crack, which appeared last week, has disconnected Highway 20 between Heri-the coast, Sky News reported. In some parts the crack is 5m wide. The civil protection will be assured may have been caused by an earthquake which hit last Sunday. But another investigation by the University of Soconia found that a looking levee stream to contain rainwater may sed the earth above it until it collapsed.

THE INDEPENDENT

A fresh study of fossil records have found that the dinosaurs might have survived the asteroid strike that wiped them out if it had taken place slightly earlier or later in history.

A large Tyrannosaurus Rex is the central figure, standing on a dirt path and looking towards the right. It has a brown and orange striped pattern on its body. In the background, there are other dinosaurs, including a Triceratops and a Stegosaurus, and a bright, glowing light source in the sky, possibly a comet or a bright sun, casting a long beam of light across the scene. The landscape is prehistoric with green grass, trees, and hills in the distance.

An international team of paleontologists led by the University of Edinburgh studied an updated catalogue of

Paddy farming is main culprit: GSI

Family Xplore
www.familyxplore.com
 With CT's DailyConnective

Levelling of hill slopes for farming to blame: Experts

Levelling of hill slopes for farming to blame: Experts

Shirley M. Shadoff



THE SCHEME

- It is a government scheme in which the hill slope is levelled off and cultivable plots are created
- Fertilizer is an essential requirement for the scheme
- Scarce land in hilly and hill slope tribal areas

Could antibacterial clay fight superbugs?

Researchers have discovered natural clay deposits with antibacterial properties and they could take on drug-resistant bacteria responsible for difficult-to-treat infections in humans

Superbugs, disease-causing microorganisms that are resistant to multiple antibiotics are now a major public health concern. This virus threat is no longer a prediction for the future," states a 2011 World Health Organization report. "It's happening right now in every region of the world and has the potential to affect anyone, at any age, in any country."

But could the answer to defeating this threat be hidden as far from home as the Earth?

BOOMING BENEFITS OF BIOCHEMISTRY
 "As antibiotic resistance (bacterial strains) emerges and new infectious health risks," says Lynda Williams, a biogeochemist at Arizona State University (ASU), "new antimicrobial agents are needed."

In their answers, Williams and colleagues found that most seem to use a variety of naturally occurring soil and water layers like clay, silt and sandstone, sandstone and siltstone. They also pointed to a volcanic deposit near Crater Lake, Oregon in the United States. They then mentioned the pathogenic bacteria *Clostridium botulinum* and *Clostridium sporobes*, which are found in the soil, with clay. It is different from the *Clostridium* deposit and found that the clay could uptake of some unspored bacterial metabolism. Cells were flooded with nutrients, which could be used as a source of energy and affect the bacteria.

"Although there have been a number of studies, the ability of antiacid therapy to buffer gastric acid appears key to their healing potential and visibility as alternatives to conventional antacids," states the scientist in the journal *International Journal of Gastroenterology and Hepatology*.

"Although there have been a number of traditional medicines," says Tripathi Kariya, a program director at the National Science Foundation (NSF), which funded the research. "But there is often no scientific basis of the reaction."



Wastels of linings than they with antiseptic properties that could be disregarded another

1004750

The deposit was formed near volcanoes active over tens to hundreds of thousands of years. The Copper Lake region is characterized with volcanoes from the last 100,000 years.

OMT clays may be 20 to 30 million years old. They were "bent" once before deposits from volcanoes such as Mt. St. Helens, which erupted 200,000 years ago, covered the coast.

RESEARCH DESIGN

The OAT also was shown to be sufficiently bactericidal against *E. coli* and *S. typhimurium*. The *E. coli* white sample reduced the population of *E. coli* and *S. typhimurium* by 56 per cent and 29 per cent, respectively, but the red sample did not show an antibacterial effect. "We can use this information to propose the most rational application of certain natural clays, especially in animal husbandry," says Hoffmann.

Chronic, over-healing wounds, ulcers, etc., are usually more alkaline (or acidic) the healing skin. The pH of normal skin is slightly acidic, which helps maintain the acid mantle.



FROZEN IN TIME

Marine's teacher Professor Miles Lister (5) and master of the Steamship Museum Gaila Rasmussen will happily accept your contribution to be the next captain master of the species now based at the National Maritime Museum in London. Marine, 12 yrs, again taken from the Eastern coast for her, was discovered in this and her sister's final postcard of 1907 and is believed to have died around 42,000 years when she was a month old. It is not yet 100 on her, and is now from the National Maritime Museum in London is the smallest "Marine" in her "Marine" at the National Maritime Museum.

Panchale Khurd unsafe for villagers:

Survey finds indications similar to Malin before the landslide struck, experts urge residents to be moved to safer place as so

Sandip Dighe
@timesgroup.com

TWEET @ThePuneMirror

A team of experts from the Geological Survey of India (GSI) conducted a fresh survey of the Panchale Khurd village near Malin in Ambegaon, where they found that some of the houses are not safe to live in, and immediate precautions need to be taken.

Experts claimed they have come across indications of possible landslides in one part of the village in their survey. Two GSI experts had visited the village last week and



FILE PHOTO

denly emerged in the fields in 2003.

A senior GSI official who did not wish to be identified, told *Mirror*, "Experts have found that water is seeping out of the hill and entering some of the houses. Two hours before the Malin landslide, a similar indication was noticed in Panchale Khurd

GSI superintendent told *Mirror*, "After cation from the tion, our expert survey of the vil will be complex to the administr will take a decis Singh added

Fresh complaints of sinister cracks from distts inundate GSI

Japan volcanic isle may collapse, create tsunami

TOKYO: An erupting volcanic island that is expanding off Japan could trigger a tsunami if its freshly formed lava slopes collapse into the sea, scientists said on Tuesday.

The small, but growing, island appeared last year and quickly engulfed the already-existing island of Nishinoshima, around 1,000 km south of Tokyo. It now covers 1.26 square kilometers.

The island's craters are currently spewing out 200,000 cubic metres of lava every day — enough to fill 80 Olympic swimming pools — which is accumulating in its east, scientists said.

"If lava continues to mount on the eastern area, part of the island's slopes could collapse and cause a tsunami," warned Fukashi Muro, as-

stant professor of the Earthquake Research Institute at the University of Tokyo. He said a rockfall of 12 million cubic metres of lava would generate a one-metre tsunami that could

ICELAND RAISES ALERT

Iceland has warned of the risk of an eruption at one of its largest volcanoes, four years after millions of air travellers were grounded by a huge ash cloud from another volcano.

The meteorological office raised the alert at the Barðarbunga volcano to orange, its second most serious, signalling increased activity and a heightened risk of eruption. Eyjafjallajökull volcano in 2010 stranded more than eight million travellers.

travel faster than a bullet train, hitting the island of Chichijima — 130 kilometres away — in around 18 minutes, he said. Chichijima, home to some 2,000 people, is the largest island in the Ogasawara archipelago, a wild and remote chain that is administratively part of Tokyo.

"The ideal way to monitor and avoid a natural disaster is to set up a new tsunami and earthquake detection system near the island, but it's impossible for anyone to land on the island in the current situation," Muro added.

An official from the Japan Meteorological Agency, which monitors earthquakes and tsunamis, said the agency is watching for any signs of anything untoward.



AFP Lava spews out of the volcano off Tokyo



THE WARNING SIGNS

- Sudden springs appearing, seepage or subsided ground in areas not typically wet before
- New cracks or unusual bulges in the ground, street, pavements
- Soil moving away from foundation of buildings
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Sinking roads
- Rapid increases in creek water levels, possibly accompanied by increased turbidity

ing to open the premises. The official committed to the district administration, which includes advice on precautions to be taken," Pawar explained.

An official from Raigad district administration, who did not wish to reveal his identity, told *Mirror*, "Landslides are common in our district. But, people have become more sensitive after the Malin landslide. They are saying that it is a big lesson for them too, to not ignore the cracks in the field." Another expert from GSI, who also shied away from identification, added, "Recently, we received a complaint from a Marol taluka village reporting big cracks that appeared in the village. When we arrived there, we found nothing to cause worry."

But this does not mean that any complaint can be taken lightly, after what happened to Malin. There have been over a dozen landslides around Srinagar Fort in the wake of monsoons. In the last couple of months, GSI experts who visited the area to take stock of the situation

found that a road-widening project over a 9 km approach to the fort could be the genesis. "It has become imperative to conduct an elaborate awareness programme on the indicators of landslides for villagers living on hilly terrains. This can avert another Malin from happening," observed M Venkataswamy, deputy director general, GSI, Nagpur.

Flash Stones

Field photographs of Kaldagi Supergroup around the Bagalkot- Badami Area of Karnataka

Aishwarya Chandekar
T.Y.B.Sc.



Folded BHQ of Dharwar Supergroup at Bagalkot Anticline



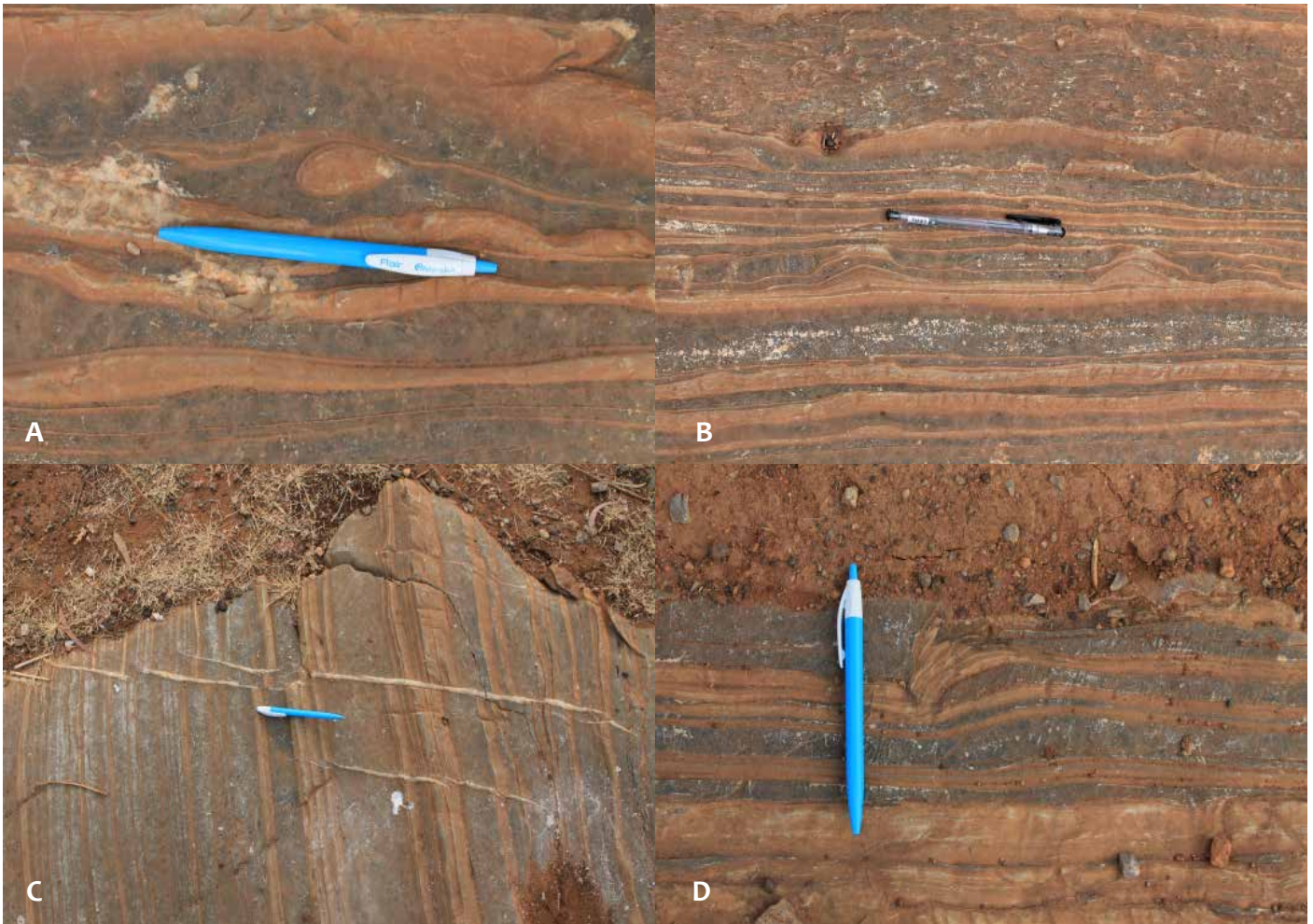
Closepet Granite with MME at Bilgi



Basal Conglomerate of Kaladgi Supergroup (Salgundi conglomerate)



Saundatti Quartzite at Bilgi



A) Ball and Pillow structure B) Load cast
C) Calcite filling in fault planes D) Flame Structure in Chikshelikeri Limestone at Gaddankeri Cross



Parasitic folding in Chikshelikeri limestones near Lokapur



Jallikatti Phyllites at
Gaddankeri Cross



Stromatolitic Limestone at Petlur



Petlur Limestone at Petlur



Bevinmatti Conglomerate Gaddankeri Cross



Muchkundi Quartzite Gaddankeri Cross



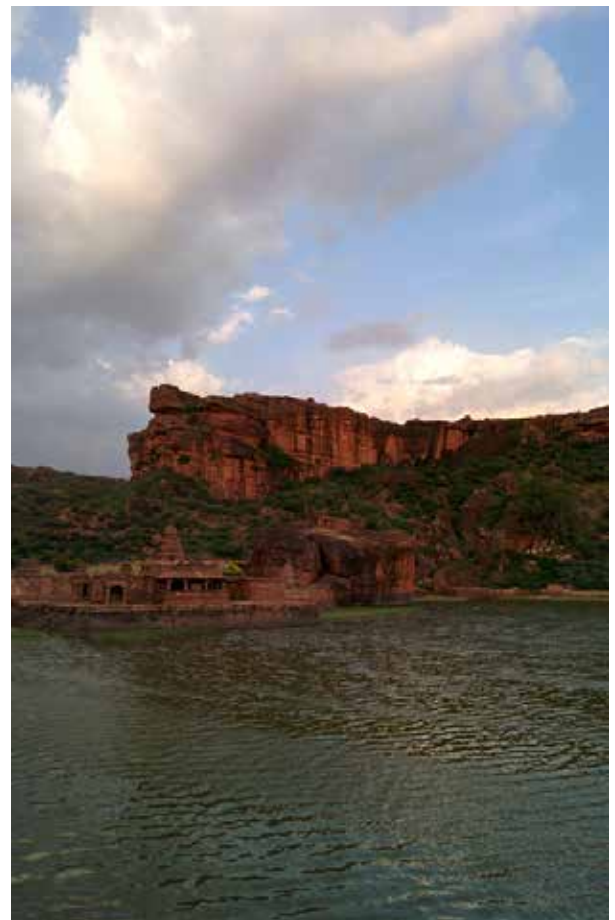
Govindkoppa Argillite at Gaddankeri Cross



Niralkeri chert Breccia at Gaddankeri Cross

GROUP	SUBGROUP	FORMATION	MEMBER	TH
K A L A D G I	B	Kalageri	⇒ Korkankoppa Limestone (27)	85
	A		⇒ Halkurki Shale (26)	87
	D	Kerur	⇒ Bulbikundi Arenite (25)	39
	A		⇒ Halgeri Shale (24)	3
	M		⇒ Cave-temple Arenite (23)	89
	I		⇒ Kerdur Conglomerate (22)	3
	<i>Angular Unconformity</i>			
	S	Hoskatti	⇒ Molapur intrusive (21)	7
	i		⇒ Dedanhatti Argillite (20)	685
	S U P E R G R O U P	m	Arlikatti	⇒ Lakshanhatti Dolomite (19)
i		⇒ Kankalmatti Haomarite Schist (18)		42
k		Kundargi	⇒ Nirkatti Chert-breccia (17)	39
e			⇒ Govindkoppa Argillite (16)	80
r			⇒ Muchundi Quartzite (15)	182
i		⇒ Bavimatti Conglomerate (14)	15	
<i>Discontinuity</i>				
B		Yadhali	⇒ Argillite (13)	58
A			⇒ Bamanbudhi Dolomite (12)	402
O T T O R O U P		L	Muddapur	⇒ Puttur Limestone (11)
	K	⇒ Jalikatti Argillite (10)		43
	O	Yendigere	⇒ Naganur Dolomite (9)	93
	T		⇒ Chikkashellikere Limestone (8)	883
	a	Hobbal Argillite (7)	⇒ Hobbal Argillite (7)	186
	p		⇒ Chitreshanurkot Dolomite (6)	218
	u	Yargatti	⇒ Muttageri Argillite (5)	502
	r		⇒ Mahakut Chert-breccia (4)	133
	Ramdurg		⇒ Menoli Argillite (3)	61
			⇒ Saundatti Quartzite (2)	353
⇒ Saigundi Conglomerate (1)			31	
<i>Non-conformity</i>				
Granitoids, gneisses and metasediments				

Cave temple arenite at Badami Caves



Lithostratigraphic Classification of Kaladgi Supergroup by Jayprakash et al. (1987)

