

The fascinating world of rocks



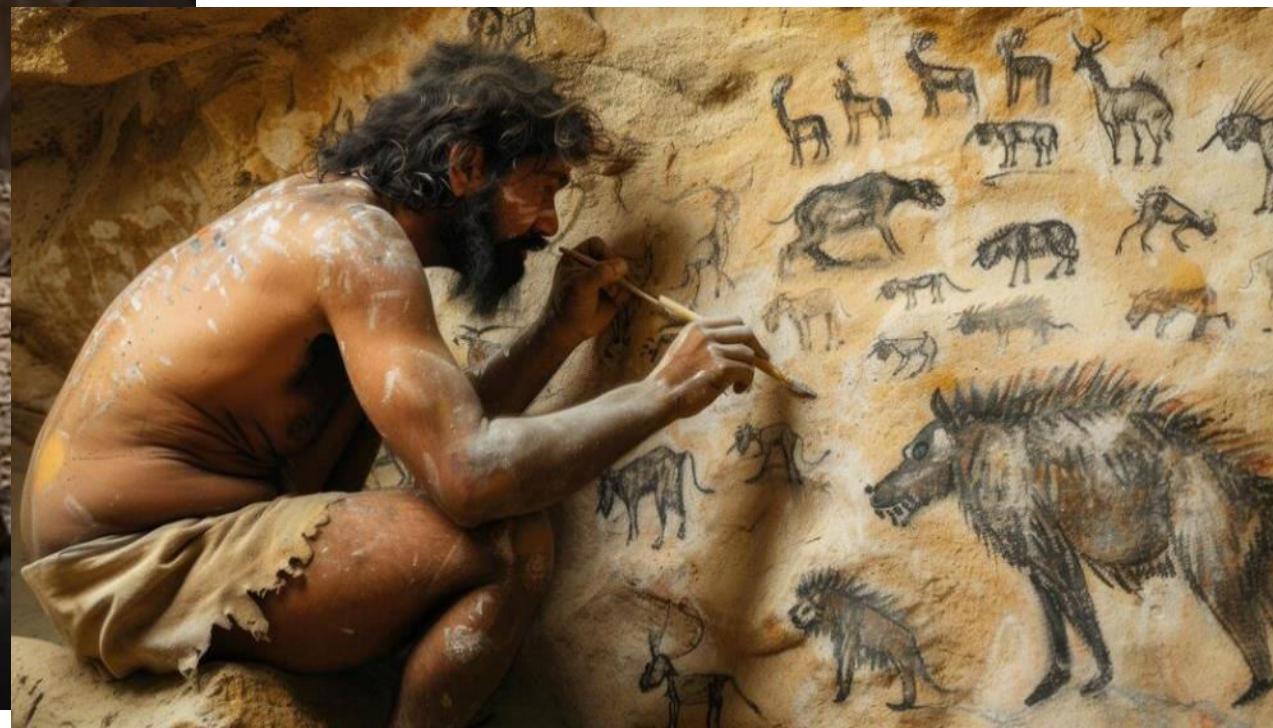
Rocks have always been a matter of fascination for human beings.

Stones were among the first tools and weapons used by humans.





The rock caves provided shelter to the prehistoric man

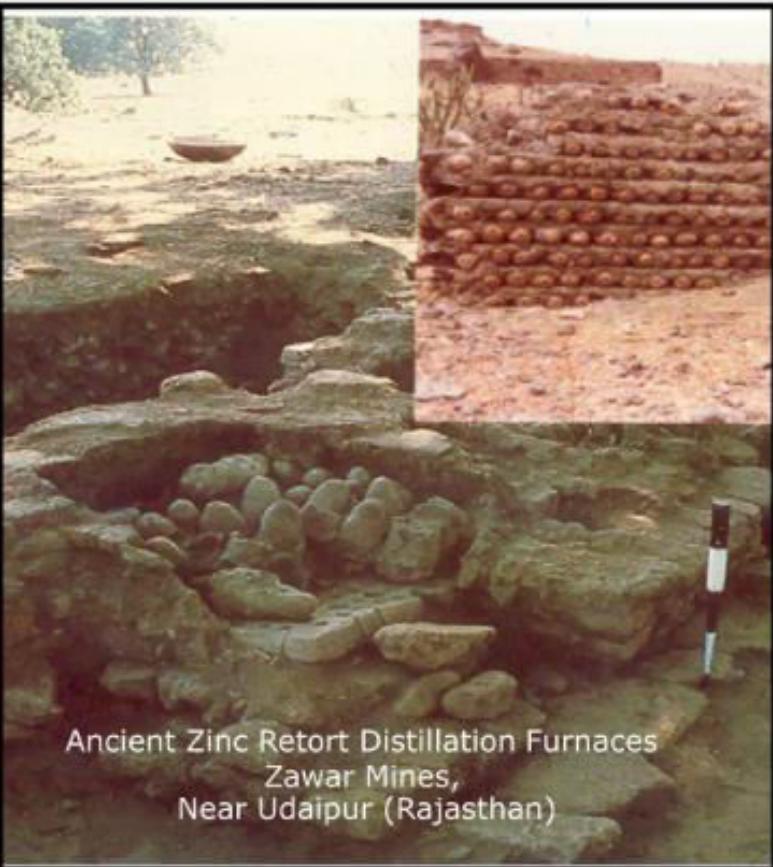


He could ignite fire by rubbing pieces of rocks



Rocks have been being explored by human beings for extraction of valuable minerals and metals. Later, metals became the basis of wealth and the foundation of empires.

Ancient Indian Zinc Metallurgy



Ancient Zinc Retort Distillation Furnaces
Zawar Mines,
Near Udaipur (Rajasthan)

Zinc in India has a rich history and heritage. Lead & Zinc metals have been known in India during Vedic times.

- ❖ The excavations work carried out by British Museum, MS University and HZL at Zawar and extensive slag heaps at various ancient mining sites in Rajasthan provide conclusive proof of highly developed extractive metallurgical technology for zinc metal in India.
- ❖ American Society of Metals (ASM) recognised these sites at Zawar Mines as one of the **International Historical Landmarks**.

MALANJKHAND COPPER MINE

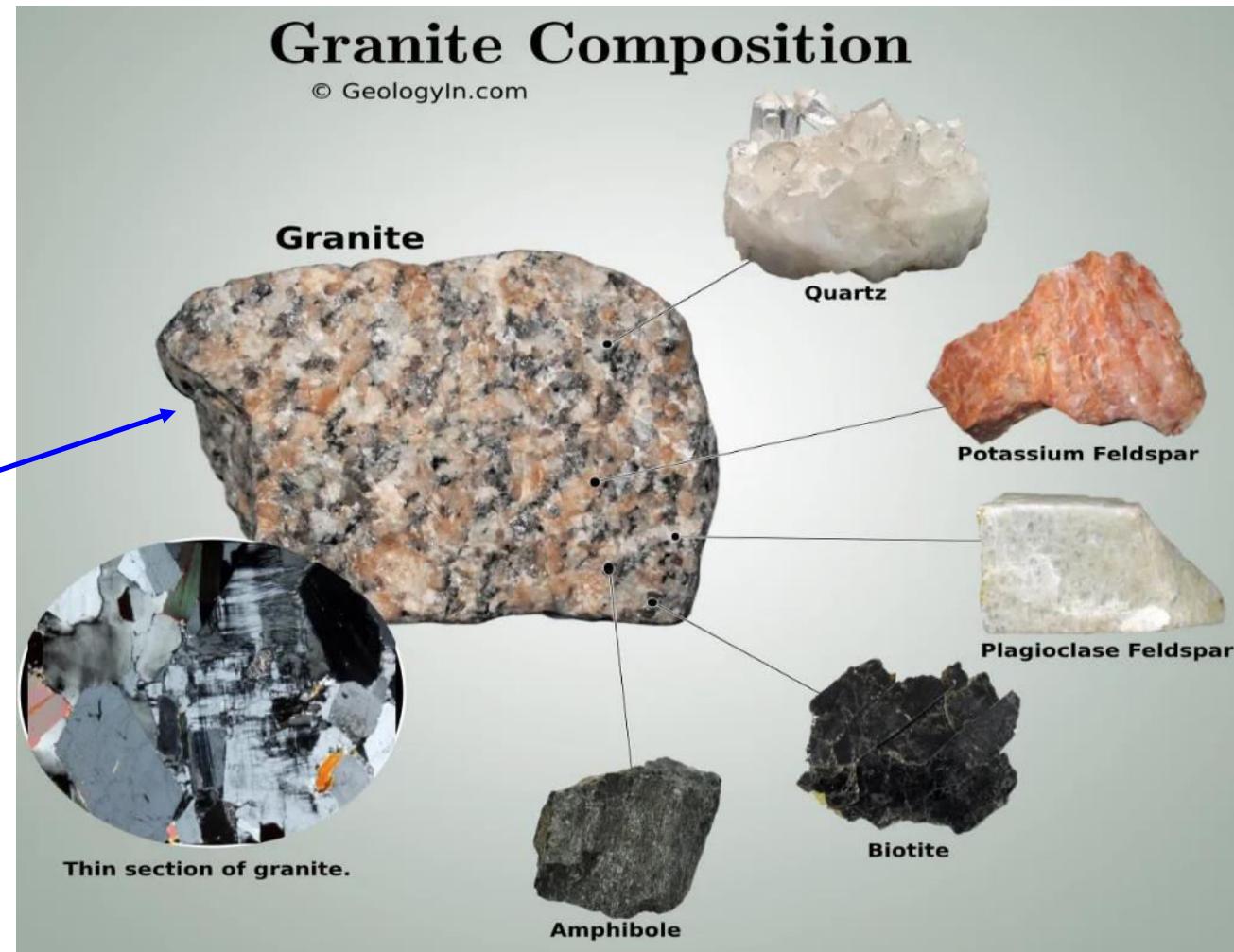
Malanjkhand Copper Project was established in 1982. The initial project has been set up by Hindustan Copper Ltd to exploit the copper ore through an open-pit mine.

Malanjkhand copper deposit is the single largest copper deposit of India with nearly 70% of the country's reserve.



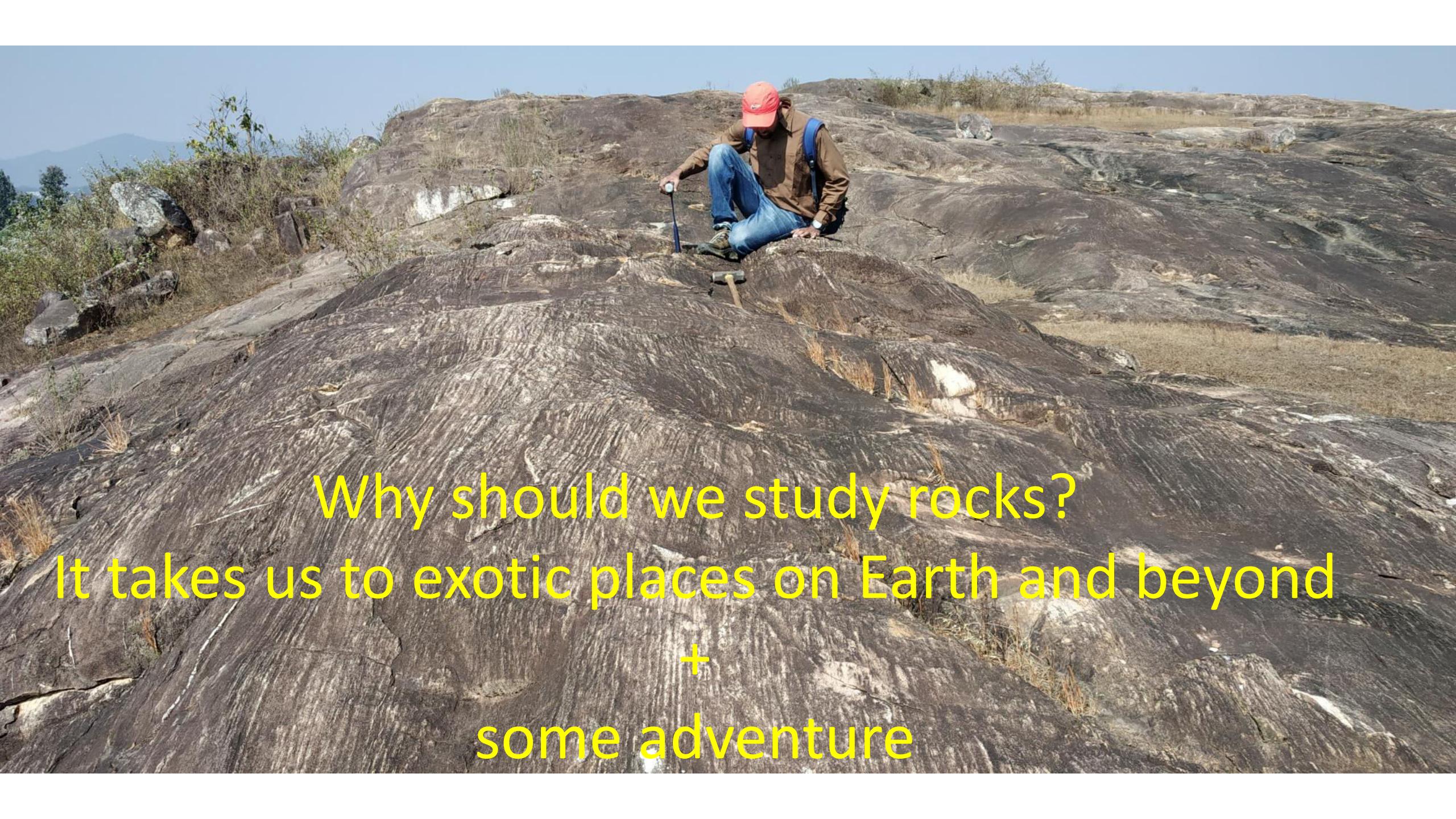
Rock

A rock is an natural aggregate of one or more minerals.



Petrology

Petrology is the branch of geology that deals with the compositions, structures, and origins of rocks-igneous, metamorphic, and sedimentary.



Why should we study rocks?
It takes us to exotic places on Earth and beyond
+
some adventure

Geological fieldwork with BSMS students Dec 2018



Geological fieldwork with BSMS students Dec 2019





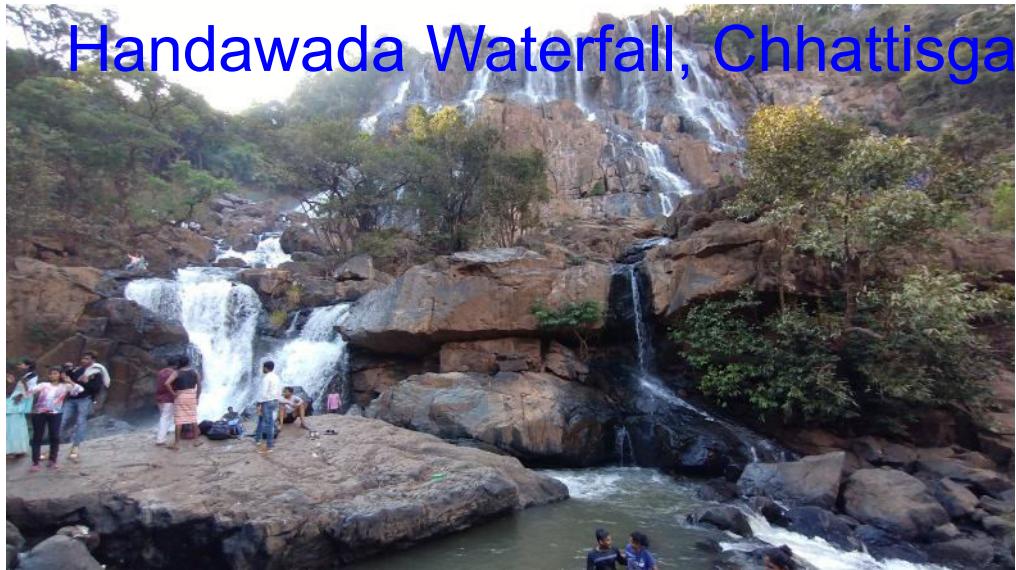
Khandadhar Waterfall, Orissa



Chitrakote Waterfall, Chhattisgarh



Handawada Waterfall, Chhattisgarh



Abujhmar forest, Chhattisgarh



Rocks are the only archive of what happened on Earth in geological past



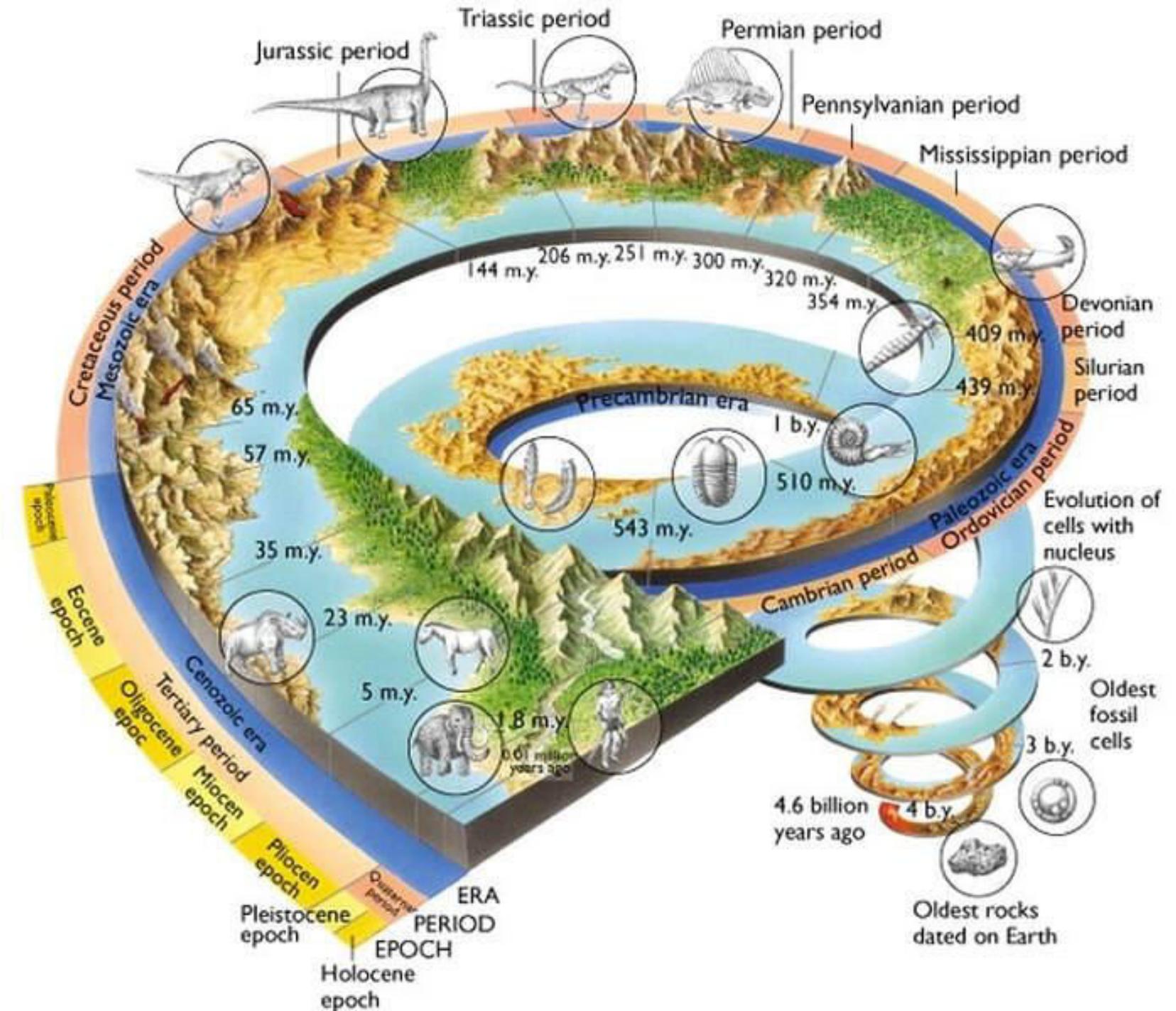
Evolution of life

Footprint of 15
dinosaur species,
Bolivia including
Sauropods &



mighty Tyrannosaurus Rex.

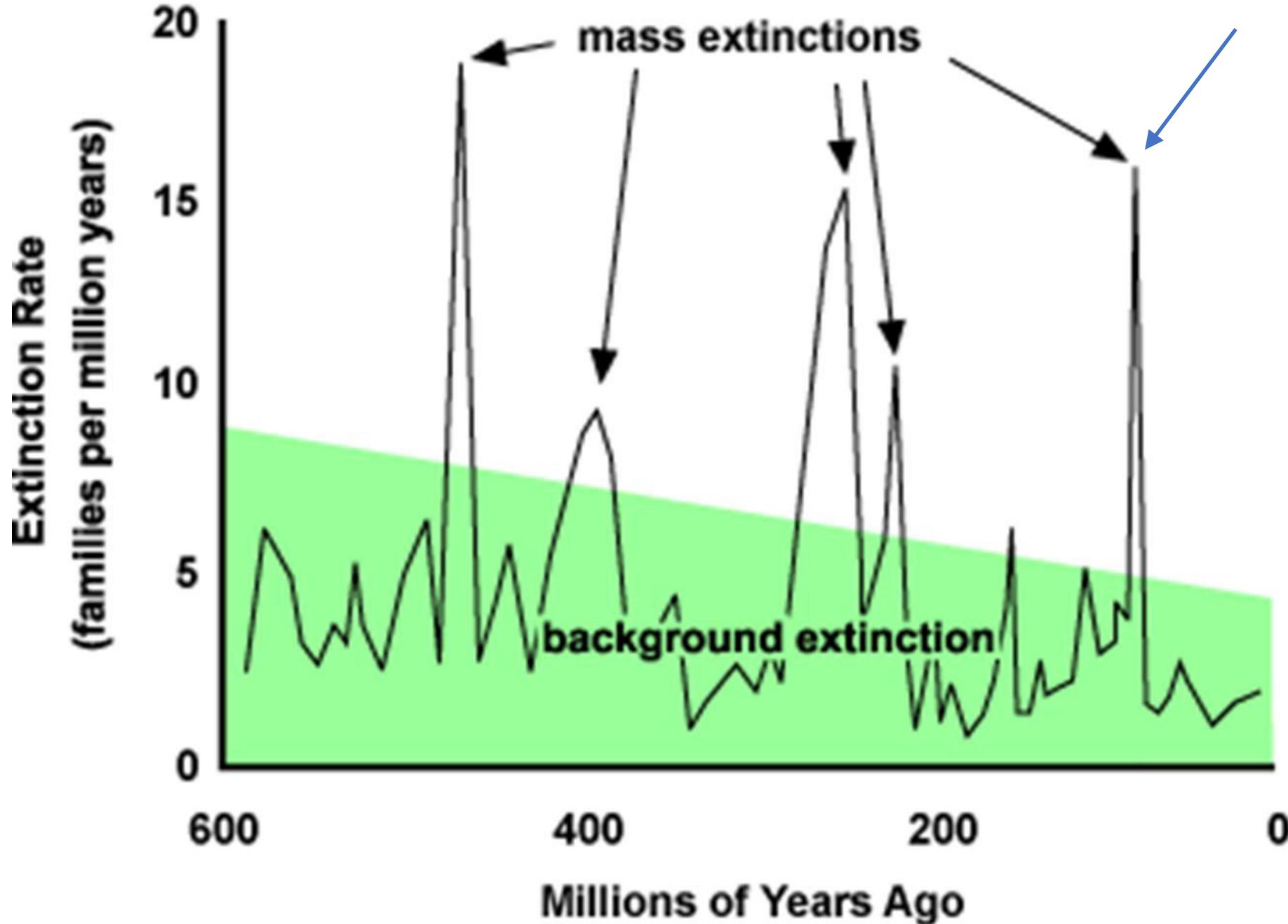




MYA	Era	Period	Major events
0 - 65	Cenozoic	Tertiary:	Mammals diversify
65 - 145	Mesozoic	Cretaceous:	Extinction of dinosaurs, First primates, First flowering plants
145 - 251	Mesozoic	Jurassic:	First birds, Dinosaurs diversify
251 - 359	Mesozoic	Triassic:	First mammals, First dinosaurs
359 - 416	Paleozoic	Permian:	Major extinction, Reptiles diversify
416 - 488	Paleozoic	Carboniferous:	First reptiles, Trees, seed ferns
488 - 542	Paleozoic	Devonian:	First amphibians, Fish diversity
542 - 65	Paleozoic	Silurian:	First vascular plants
65 - 145	Mesozoic	Ordovician:	Major diversification of animal life
145 - 251	Mesozoic	Cambrian:	First fish, First chordates (animal with backbone)

Mass extinction

Dinosaur extinction

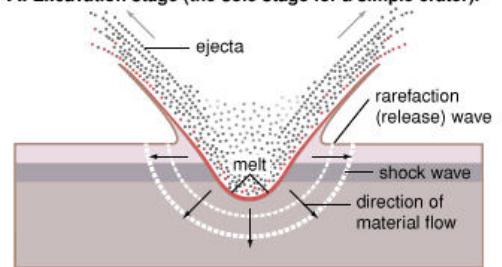




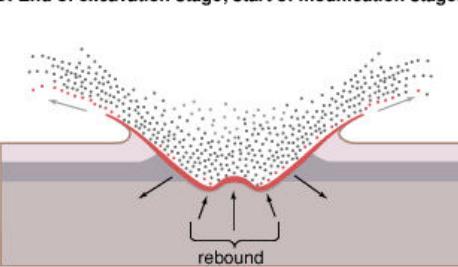
Meteorite impact 65 Ma before

Formation of a complex impact crater

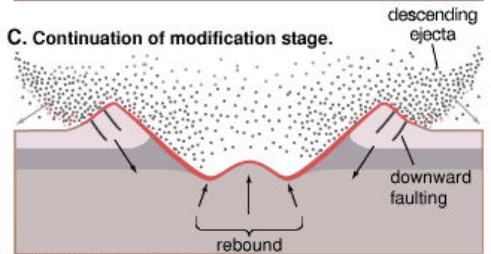
A. Excavation stage (the sole stage for a simple crater).



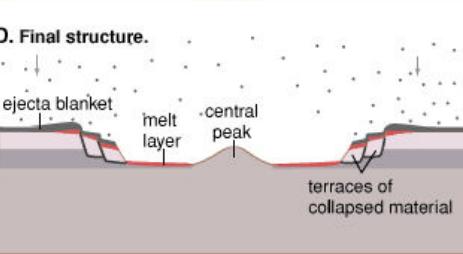
B. End of excavation stage; start of modification stage.



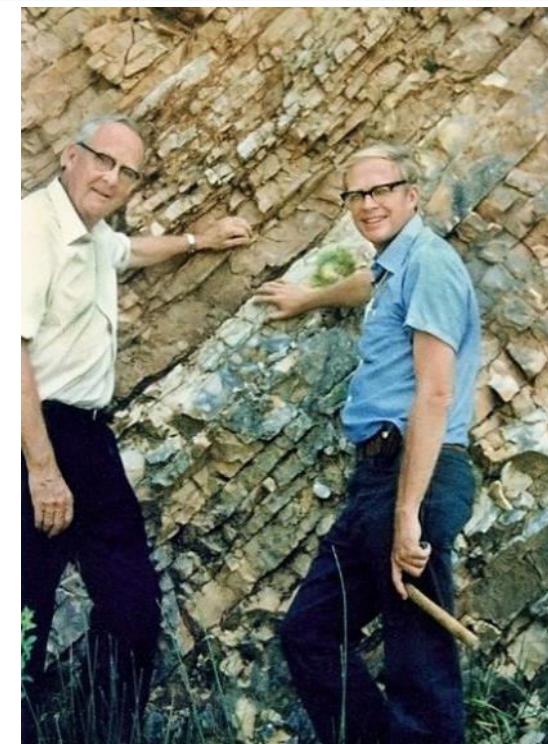
C. Continuation of modification stage.



D. Final structure.

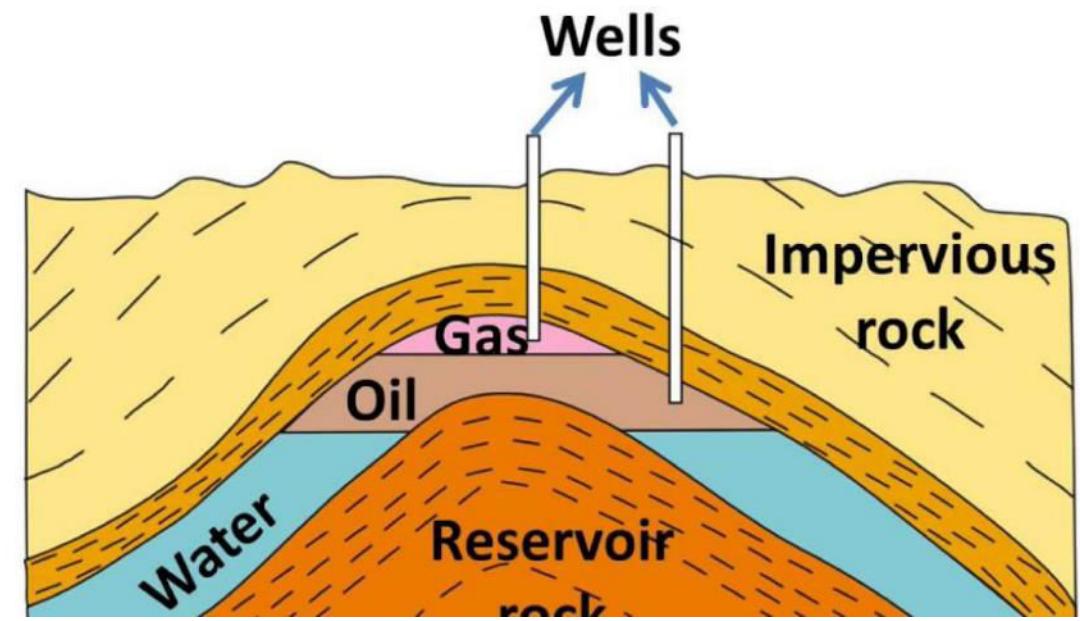


© 2007 Encyclopædia Britannica, Inc.



Iridium enrichment
Luis and Walter Alvarez
at 65 Ma
Claystone, Italy, 1981

Petroleum deposit



Sagar Samrat, Bombay

Rocks are the sources of valuable minerals, metals, petroleum

There is a bit of rock in everybody's life



Panna Diamond Mine



Iron Ore Mine, Bolani, Orissa



The Koh-i-noor diamond on the front of Queen Mother's Crown, rested on the coffin of Elizabeth,



Pb-Zn mine, Rajasthan

5.11.08

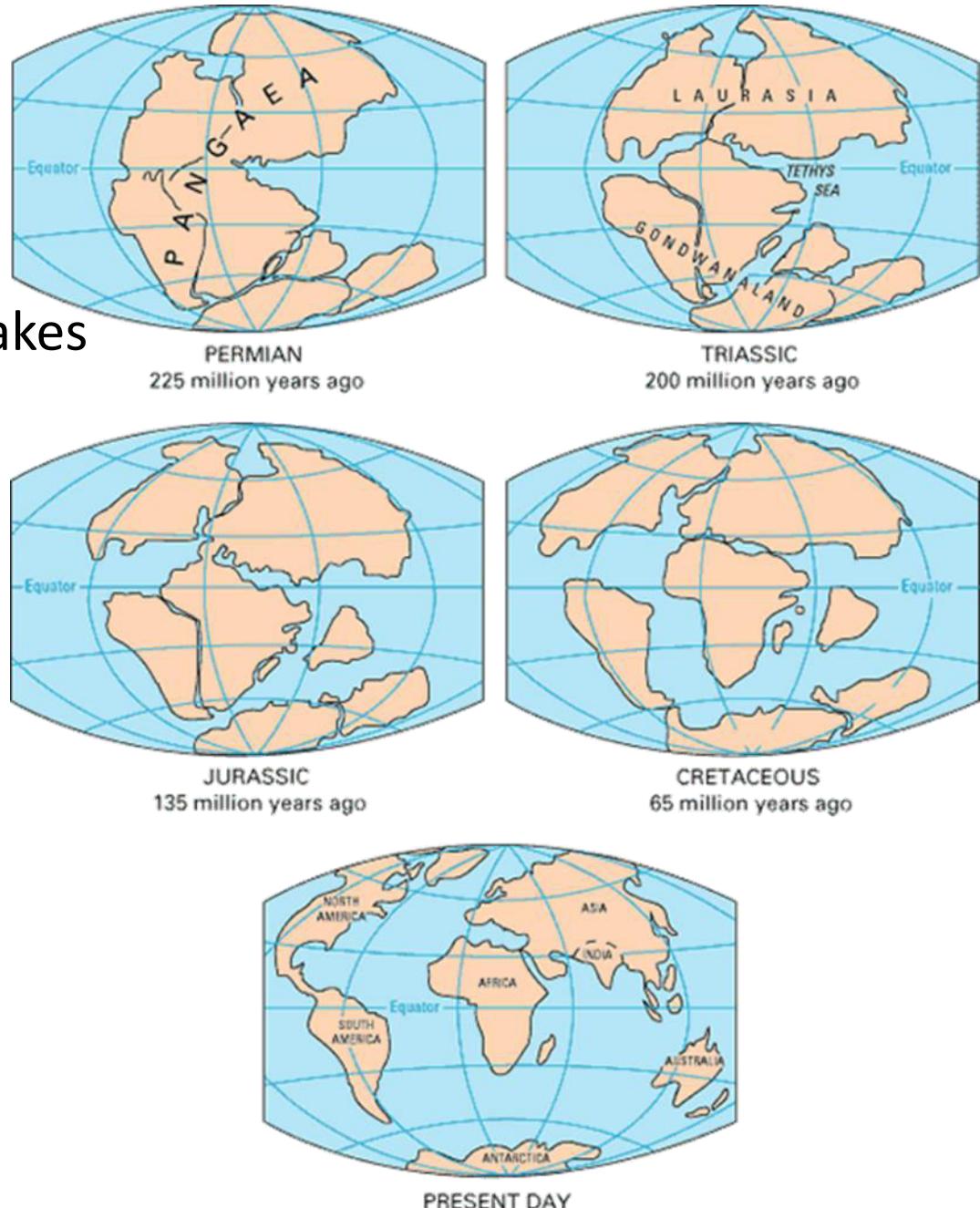
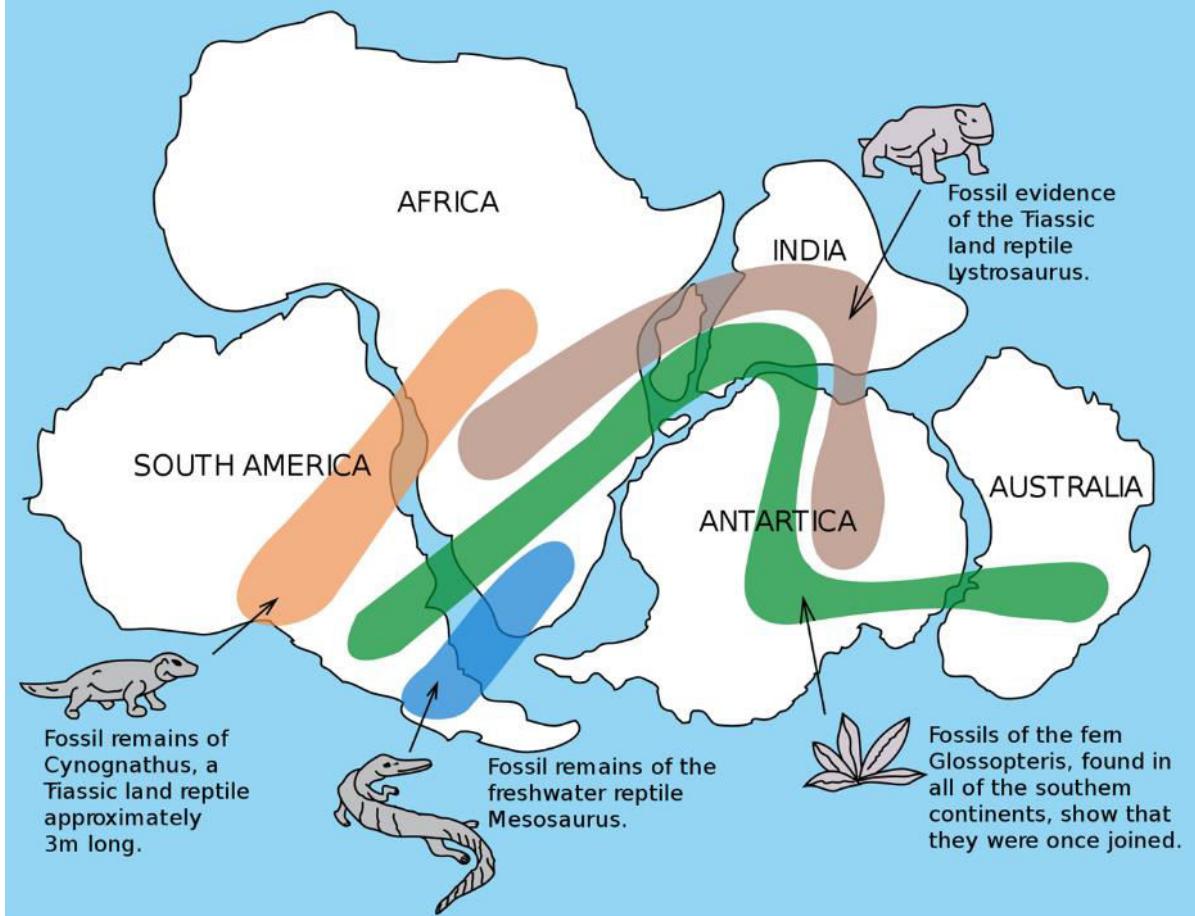
Supercontinent formation & breakup

Controls almost everything – climate change,

Evolution of ocean, atmosphere, life

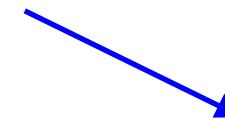
Mineral & petroleum deposit formation

Mountain building, tectonics, magmatism, earthquakes

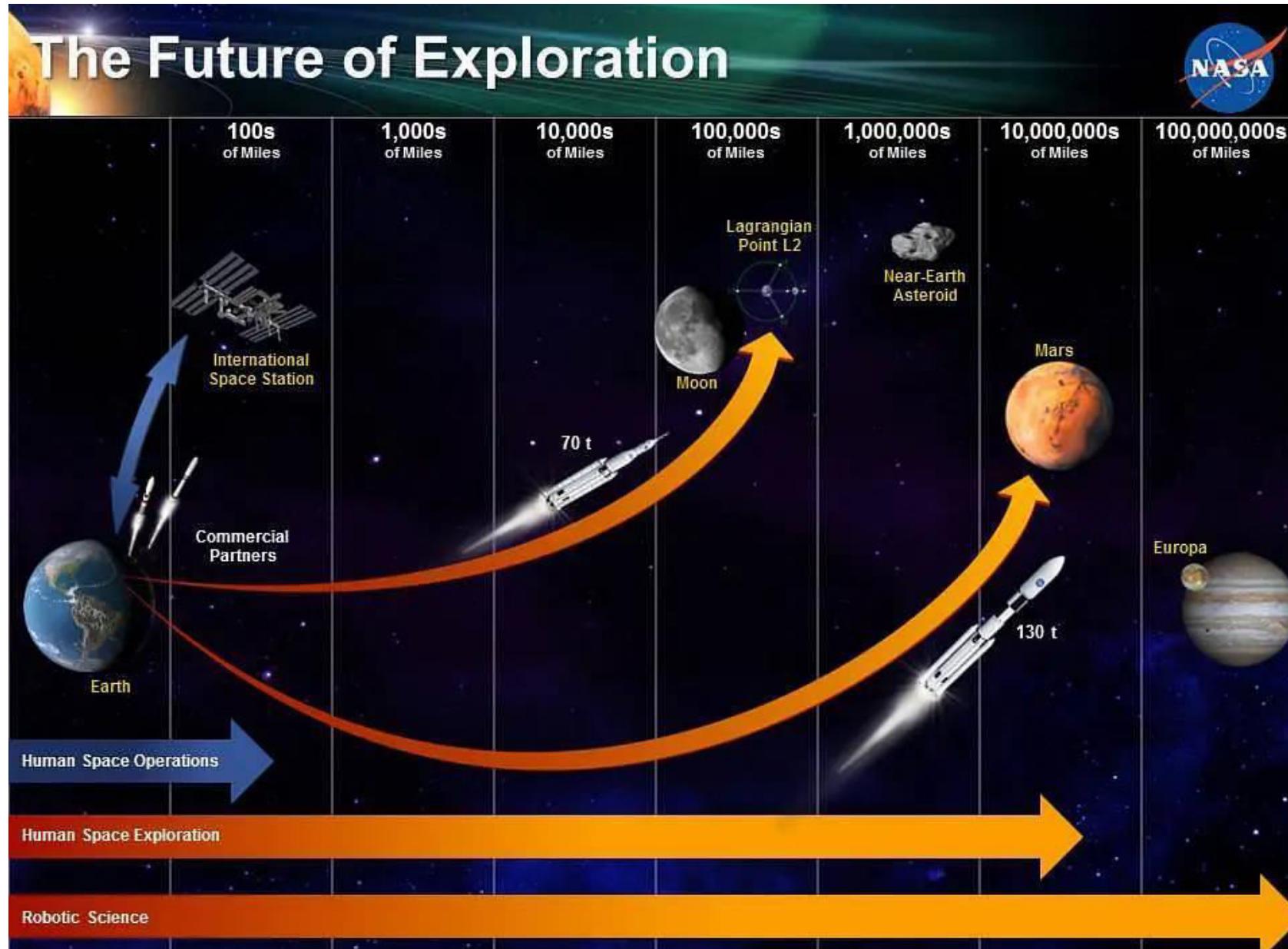


Nature is our laboratory – now bounded by walls

The amazing journey of a hostile planet to a habitable green earth



Future planetary exploration



The role of geology

Study of rocks

From NASA



Chandrayaan-3's lander Vikram
on the Moon as seen by the
Pragyan rover.

Types of rocks (depending on how they are formed)

- 1. Igneous**
- 2. Sedimentary**
- 3. Metamorphic**

Igneous rocks

Formed by the cooling & solidification of very hot, molten material called magma or lava, which originates deep inside the Earth.

The word ‘igneous’ comes from the Latin word ‘ignis,’ which means ‘of fire.’



Modern lava flows,
Hawaii





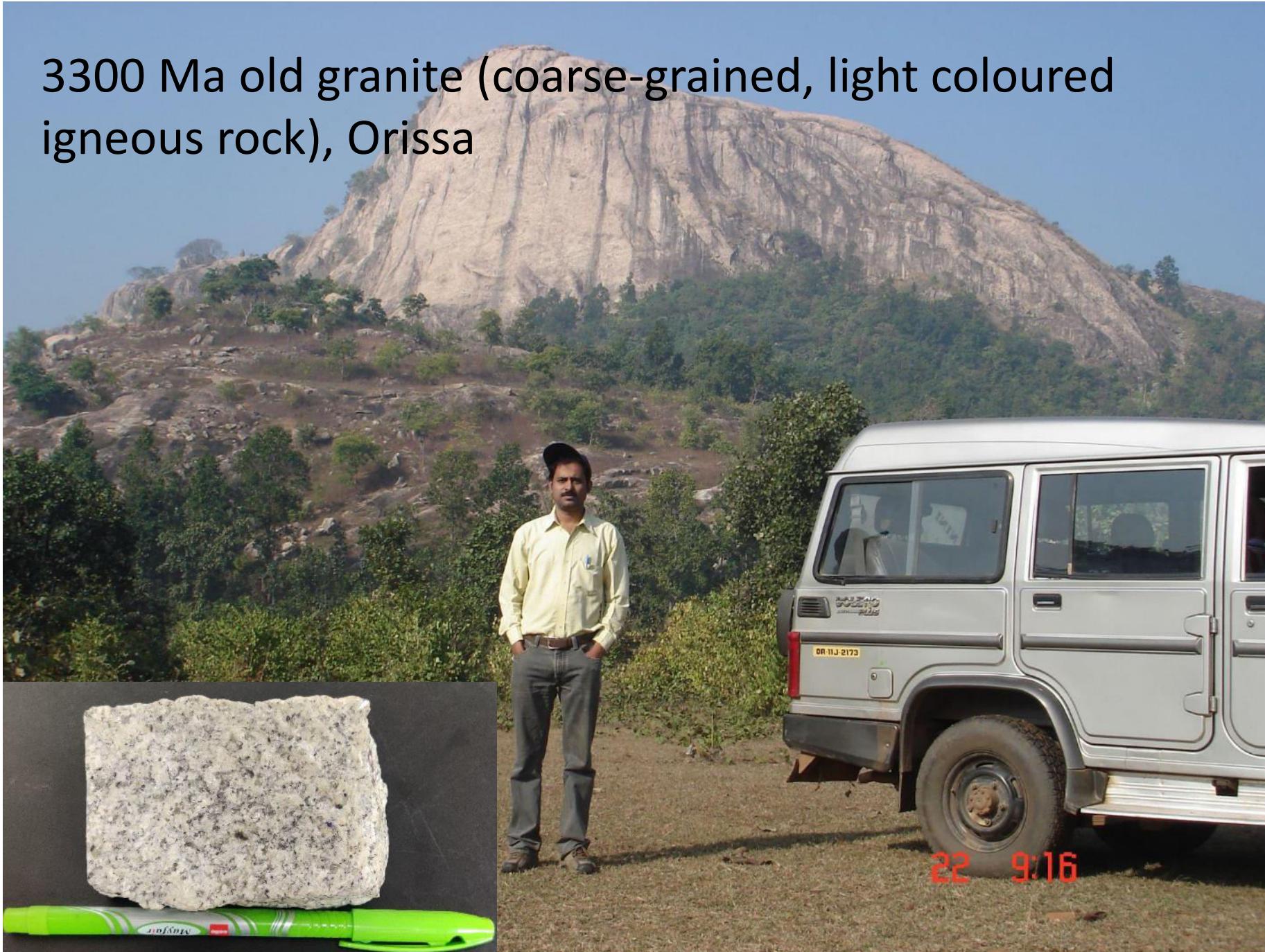
Barren Island

India's only active volcano



Ancient lava flows, Deccan Trap, Maharashtra, 65 Ma

3300 Ma old granite (coarse-grained, light coloured igneous rock), Orissa



Cabinet approves funds for four space missions, including Chandrayaan-4, Venus orbiter mission

By HT Correspondent, New Delhi

Sep 19, 2024 05:39 PM IST



The Union Cabinet on Wednesday green-lit four important space endeavours for launches by the Indian Space Research Organisation (Isro) in the near future.



SS]

tion:
now venue
years ago

ibic'
similar
nned
>

belief as
gladesh's

30

standout mission among all of Isro's achievements on the global stage.

Chandrayaan-4 will be a remote mission seeking to retrieve samples of the lunar surface. The mission, which will aim to bring rock samples from the lunar surface back to Earth after a soft landing, is slated for launch in 2027 and will expand on the technology developed in Chandrayaan-3 by adding elements like lunar docking, precision landing, sample collection and a safe journey back to Earth.

Story continues below advertisement

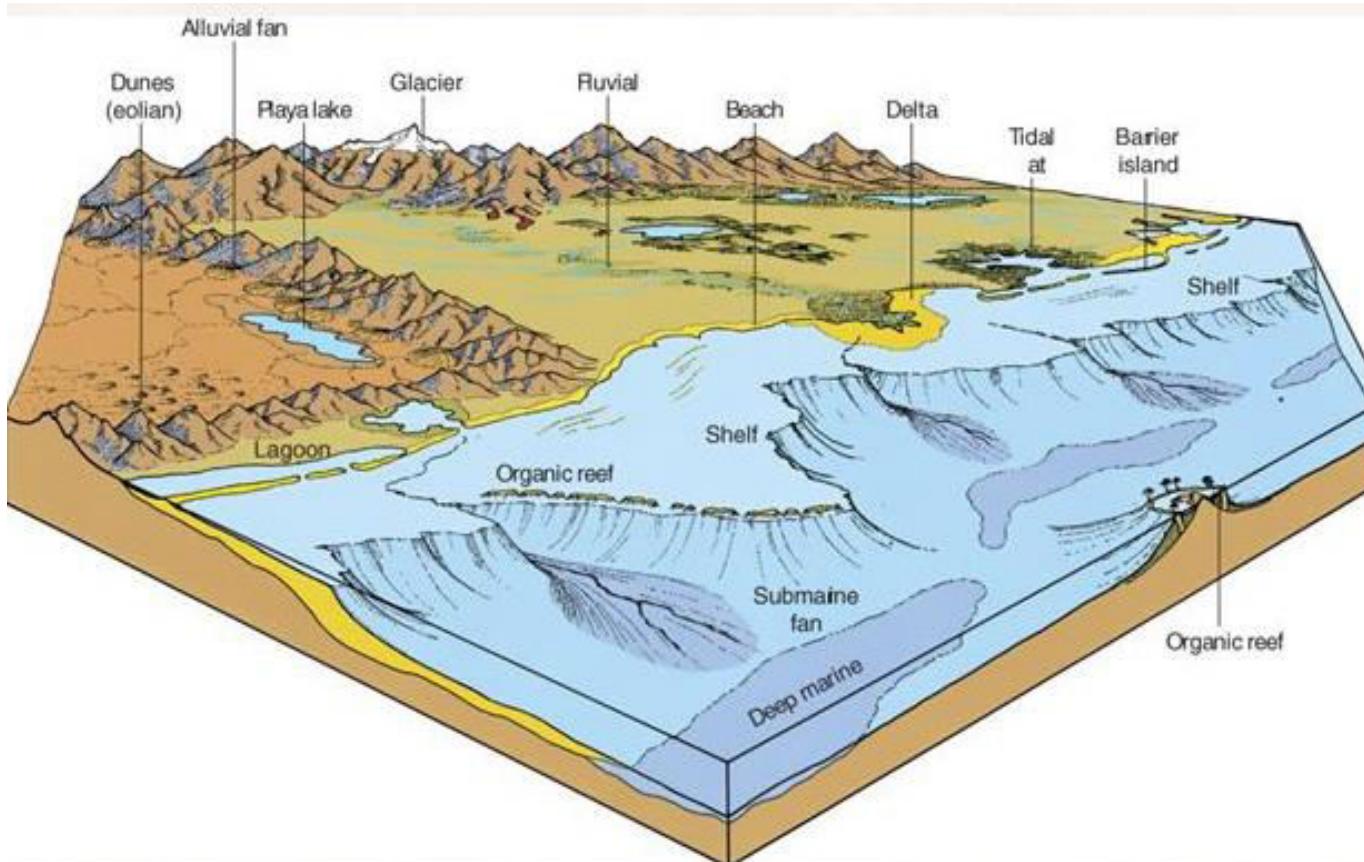


A model of Chandrayaan-4 displayed at Bharat Mandapam. (Photo: Isro)

Chandrayan-4 2027.
Venus Orbiter Mission (VOM) 2028.
Indian Space Station (Bharatiya Antariksh Station) by 2035.
Crewed lunar landing by 2040.

Sedimentary rocks

- Formed by the deposition of fragments (sediment) that have been eroded and weathered from earlier rocks.
- Consist of sand, pebbles & mud carried mechanically by water, wind or ice.
- Deposits in rivers, lakes, beaches, deserts, oceans.



Major steps in the formation of sedimentary rocks

- Weathering of preexisting rock
- Transportation
- Deposition
- Compaction and cementation



Sand &
sandstone

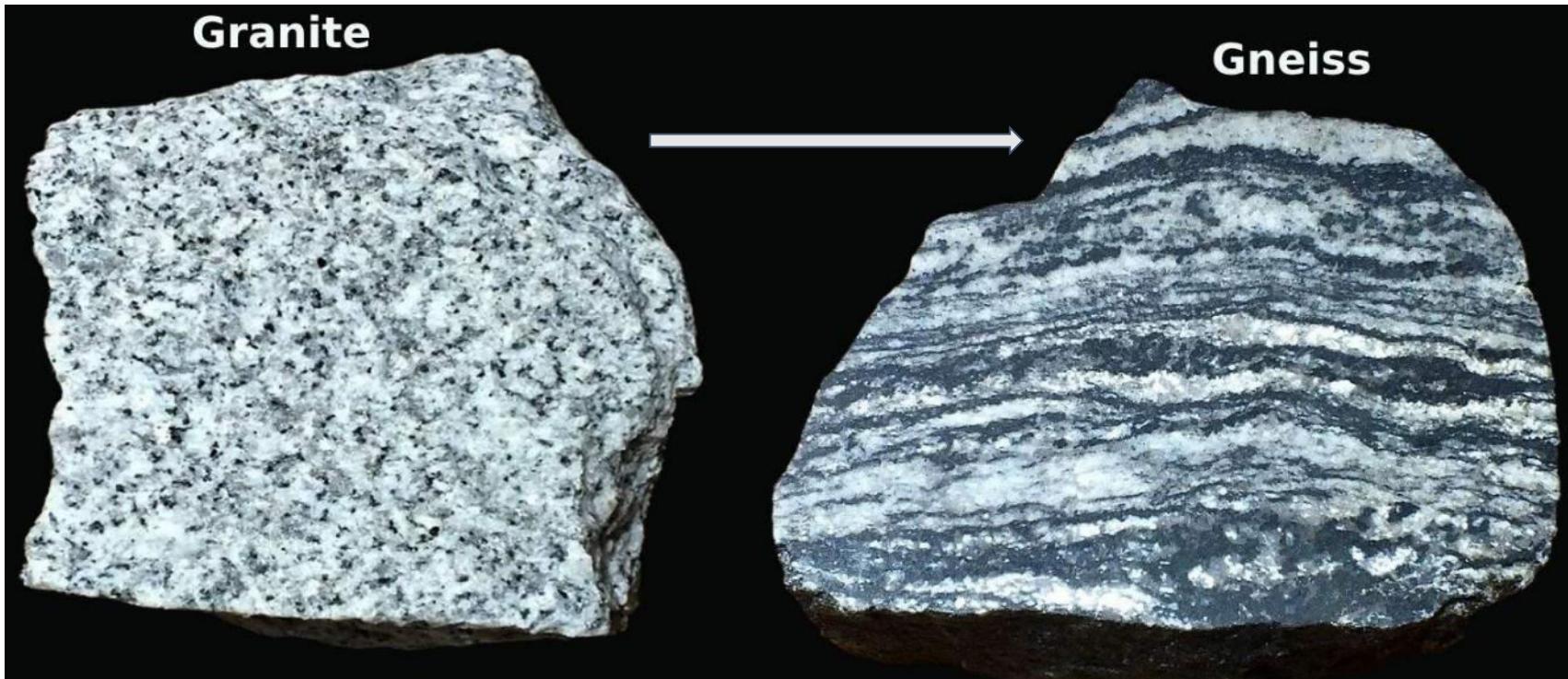


Metamorphic rocks

Formed by the effect of high pressure, temperature or fluids on an earlier rock (igneous, sedimentary or even earlier metamorphic rock) - no melting.

Brings changes in mineralogy, structure and texture of earlier rocks.

Happens due to deep burial, tectonic deformation, igneous intrusion, fluid flow through rocks.





Limestone



Recrystallization

(caused by heat)

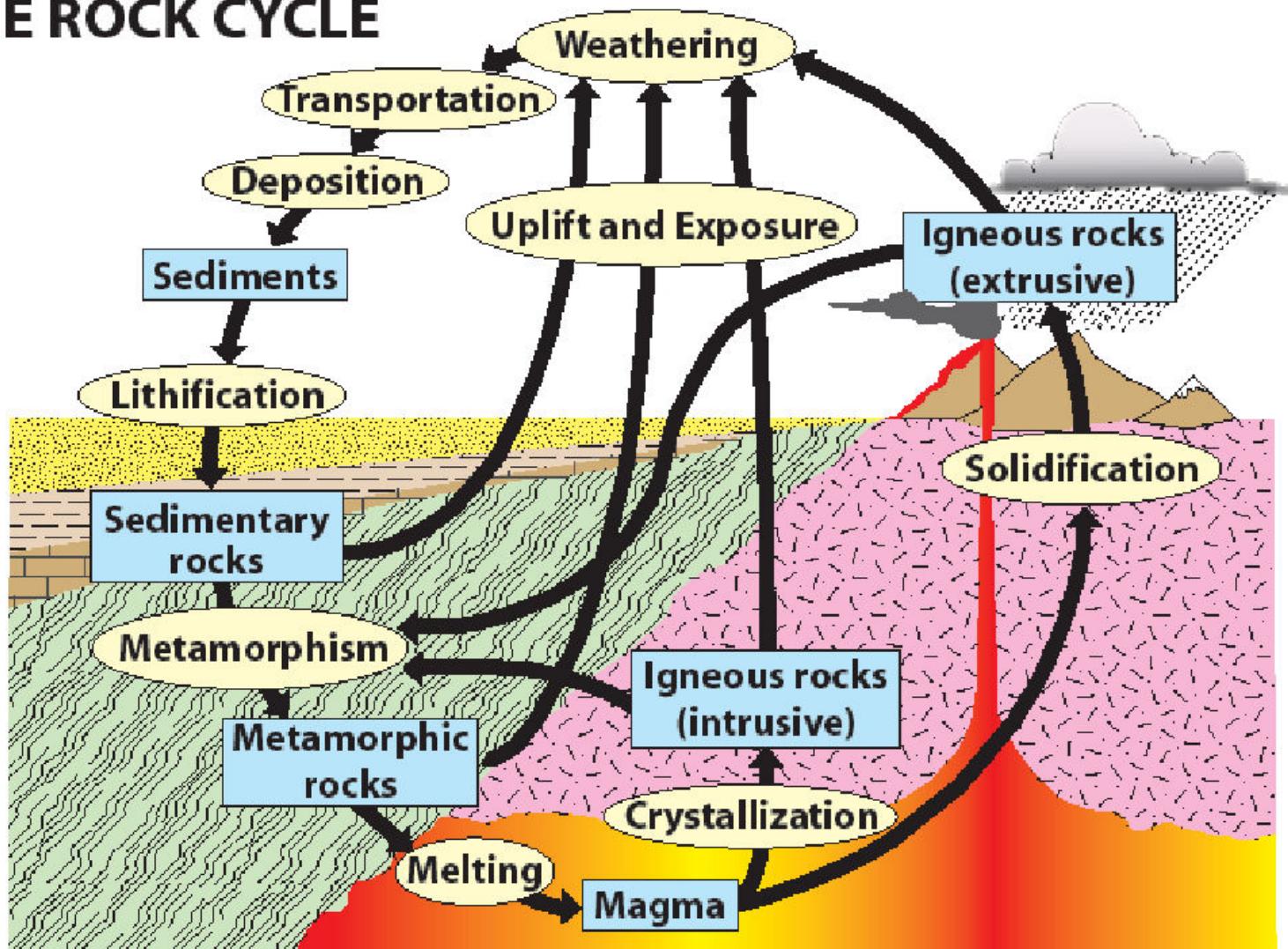


Marble



Makrana marble quarry, Rajasthan

THE ROCK CYCLE



Igneous Rocks -

Rocks that form from the cooling of molten rock (magma), Example: granite and basalt

Sedimentary Rocks -

Rocks that are formed from pieces of other rocks, Example: sandstone, or that are deposited from the ocean by chemical processes, Example: limestone

Metamorphic Rocks -

Rocks that are changed by heat and pressure without melting, Example: gneiss

Igneous rocks formed from Magma and Lava

Magma

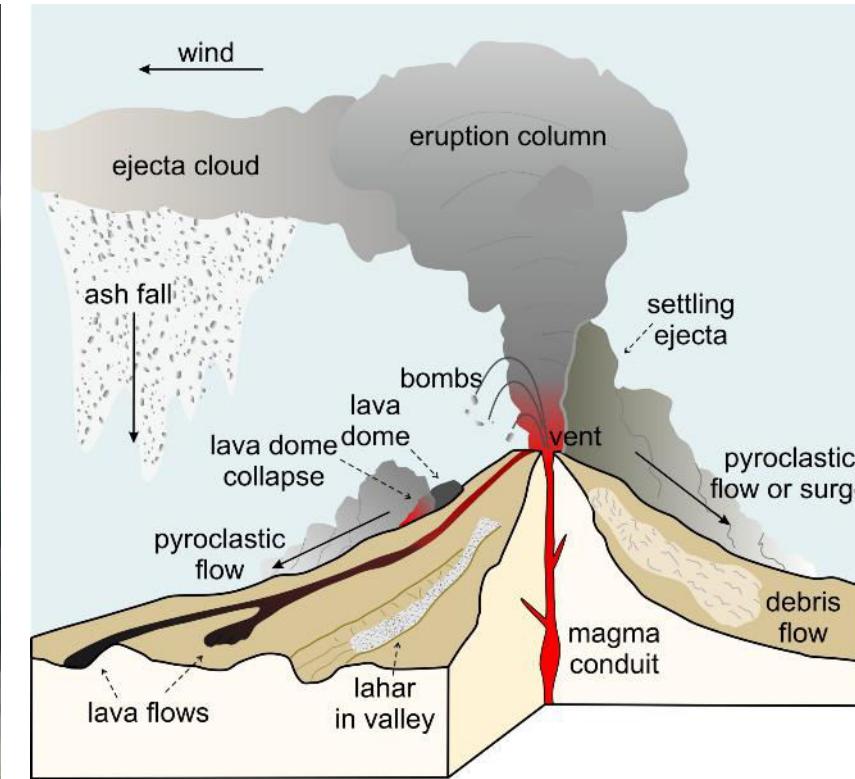
- molten rock below Earth's surface.

Lava

- magma on the Earth's surface.

Pyroclastic material

- (*pyro* = fire, *clastic* = debris/fragments)
- Airborne lava
 - cools as it falls



The Eruption of Mount Vesuvius and the destruction of the city Pompeii in 79 AD



The Beginning of the Eruption



The Aftermath



Mount Vesuvius now



Magma is a mixture of molten material (mostly silicates), crystals, and gas.

Produced by melting of crust or mantle by a variety of processes.

Magmas are less dense than surrounding rocks, and will therefore move upward.

Temperature of Magmas

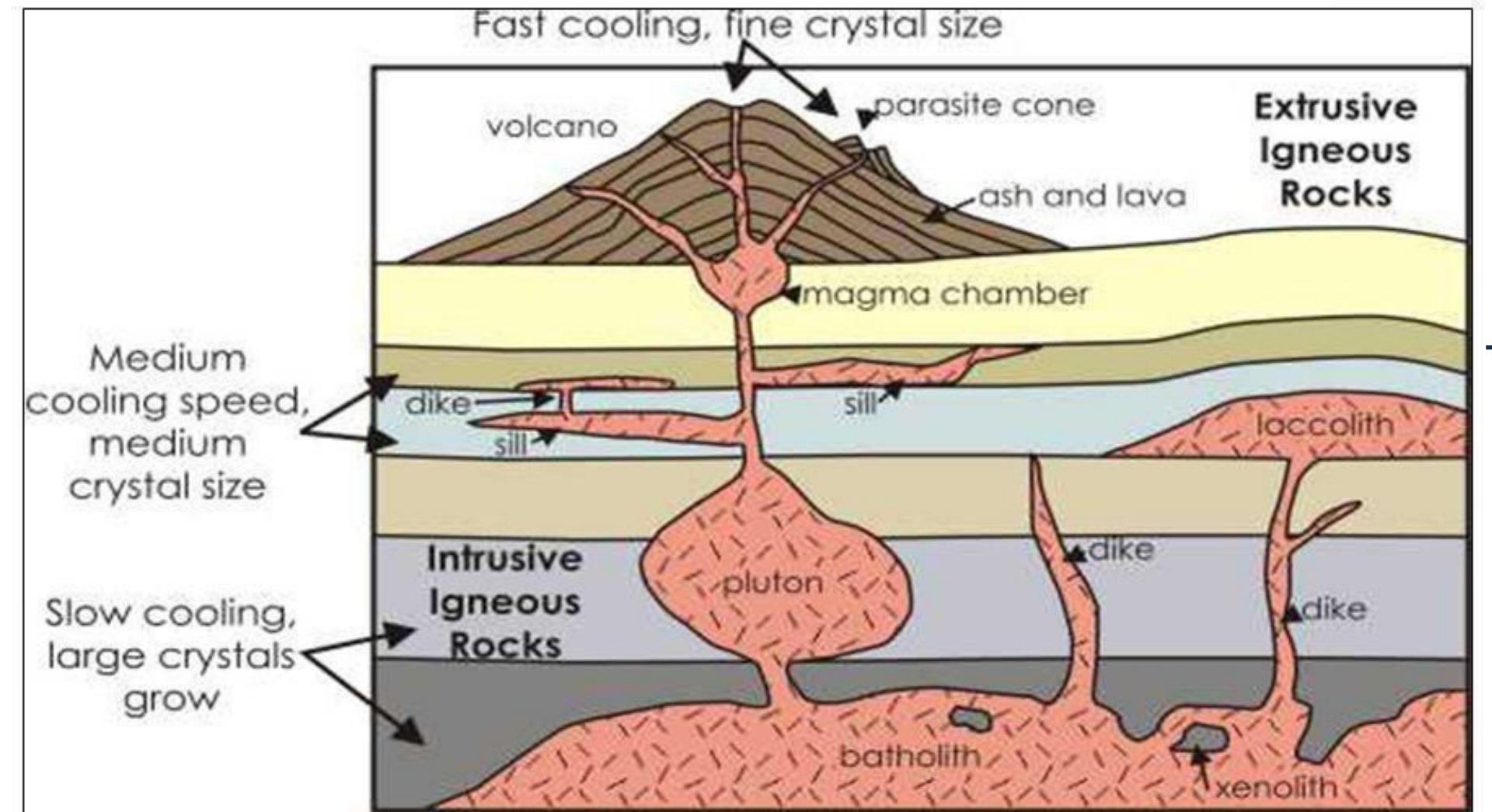
Mafic/Basaltic - 1000-1200°C

Intermediate/Andesitic - 800-1000 °C

Felsic/Rhyolitic - 650-800 °C

Obviously, we do not expect fossils in igneous rocks.

Intrusive and Extrusive Igneous Features



Intrusive
igneous
rocks

Batholith

A batholith is a large (> 100 sq km across) body of igneous rock formed deep (at >10 Km depth) within the Earth's crust.

Magma cools slowly - coarse grained.

Extends to an unknown depth.

Formed from the crystallization of large volumes of magma.

The exposed Sierra Nevada Batholith, USA.
650 x 100 km



Pluton

A relatively small intrusive body (a few to 10's of km across).

A batholith may be composite and consists of many plutons.



Sholay
shooting
spot

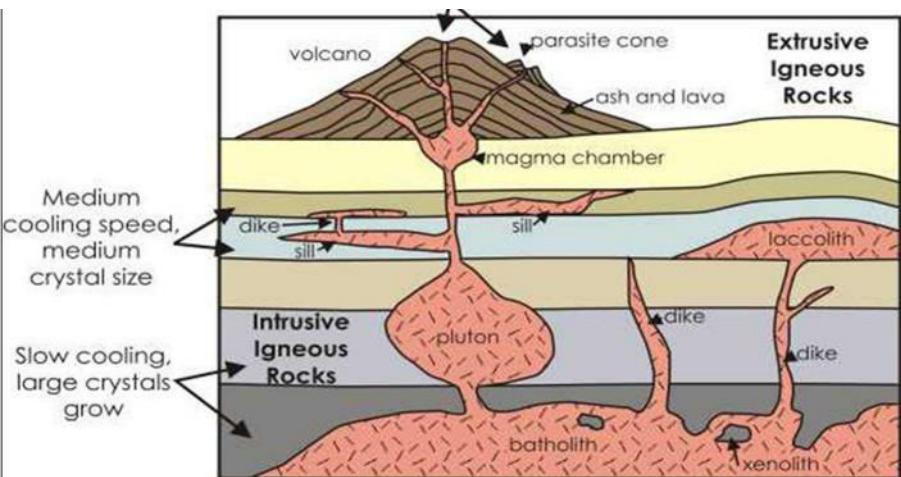
Granite plutons from Ramadevarabetta Vulture Sanctuary near Bangalore



Dike or Dyke

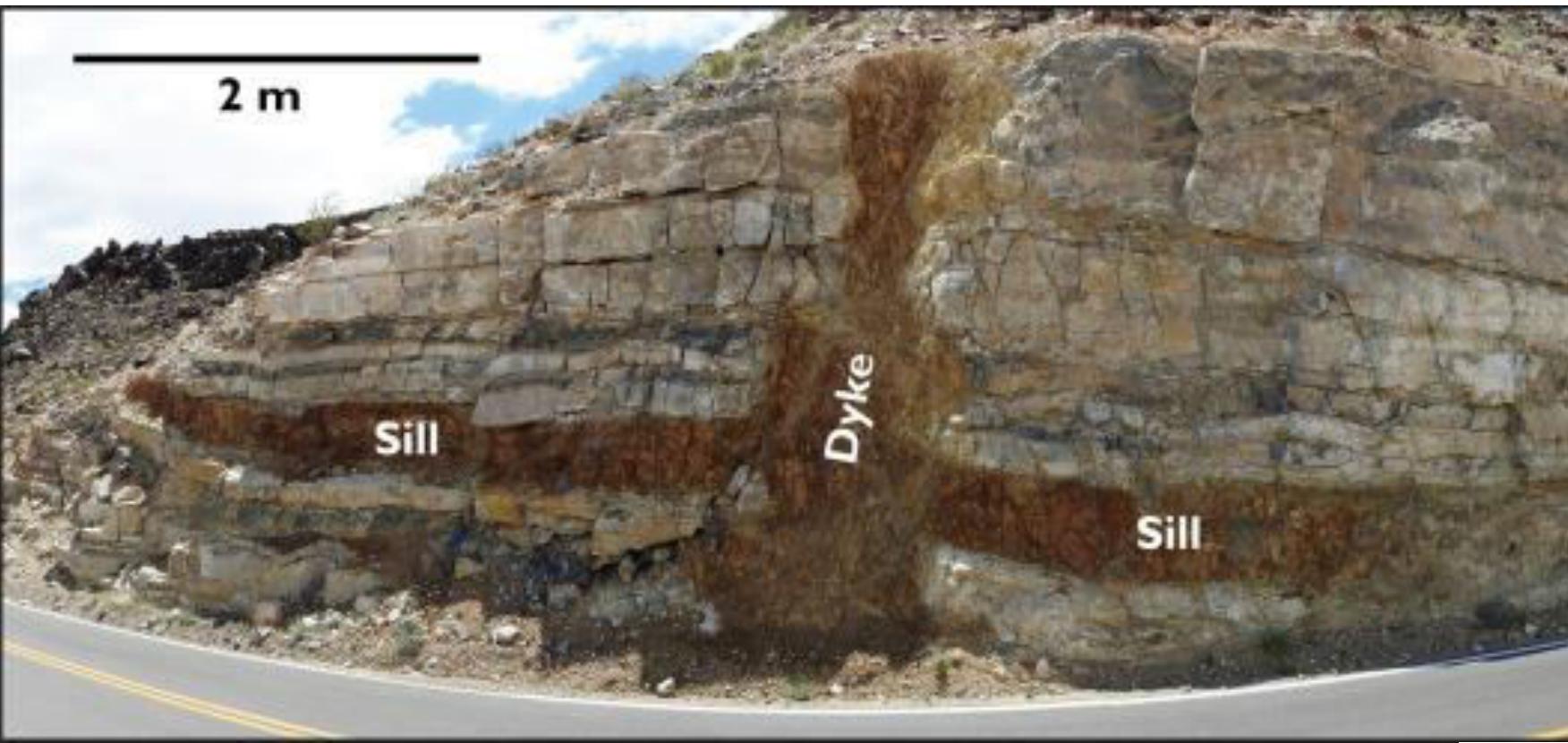
A tabular or sheet-like body of igneous rock that cut through layering of country rocks.

Magma intrudes into cracks in the country rock.



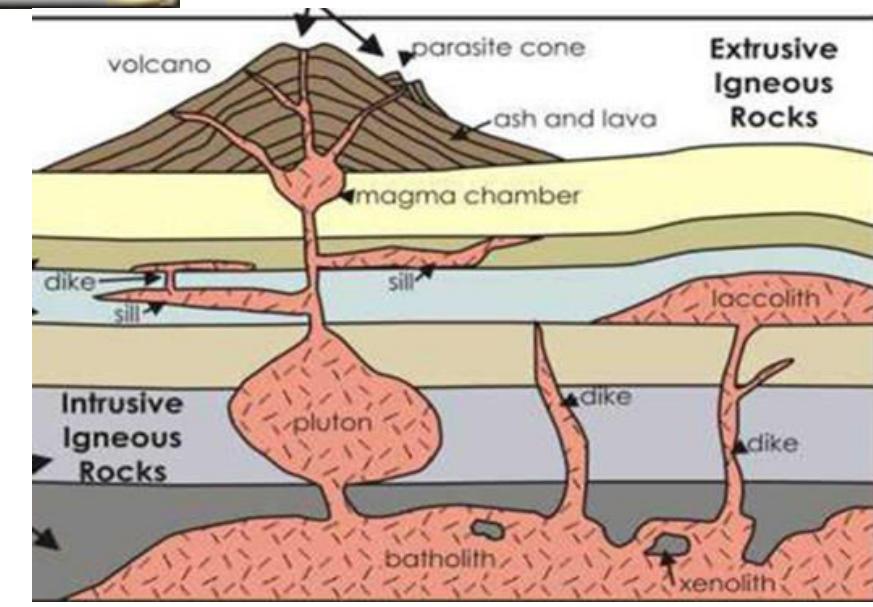


Dykes



A sill is a concordant intrusion that runs parallel to the layers or structure in the country rock.

Magma followed the path of weakness between the layers.



Sill



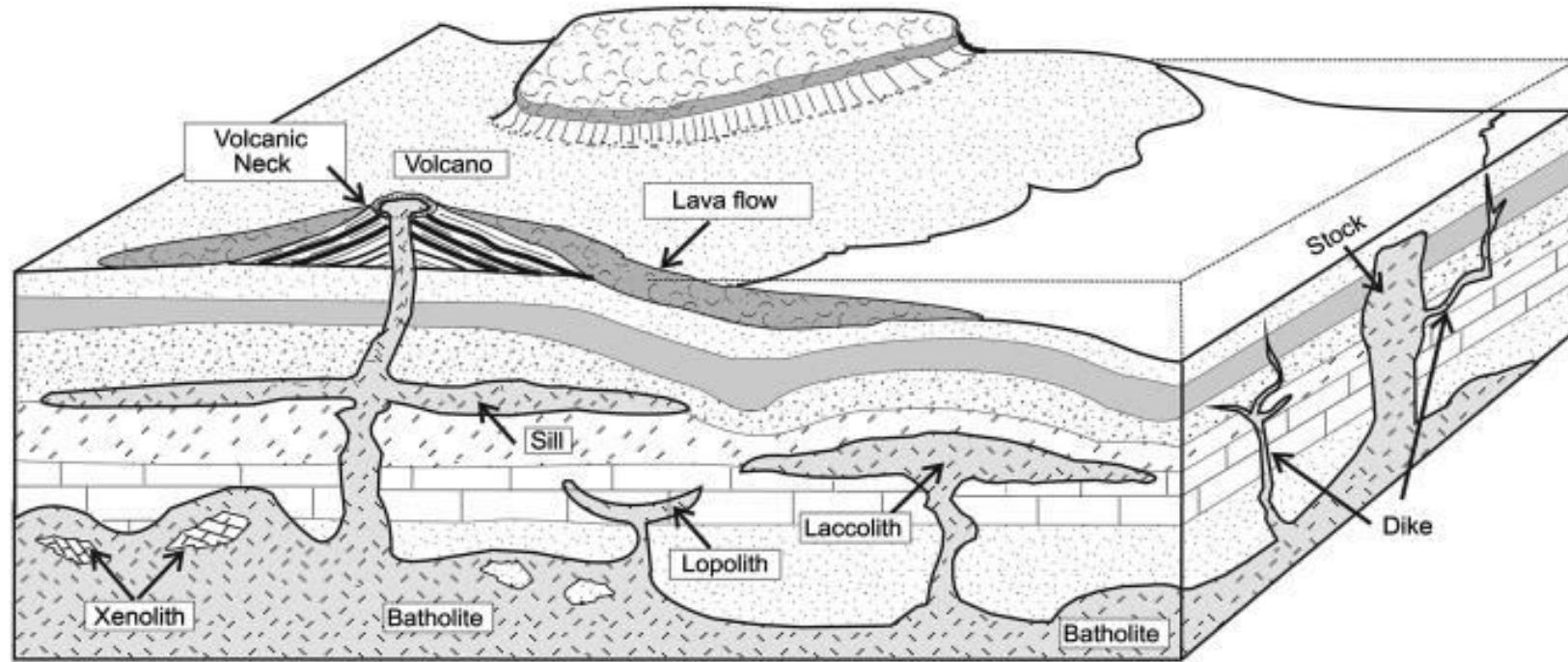
Laccolith

A dome shaped igneous intrusion, convex upper roof, flat base.

Concordant with the layering or banding in the country rock.

Circular in plan.

Magma pushed upward and also spreads laterally.





An exposed laccolith

Lopolith

A concordant igneous intrusion of lenticular shape that is sunken in its central part because of sagging of the underlying country rock.

