

# Geology

## 1) MINERALOGY, PETROLOGY AND GEOCHEMISTRY

Concept of point group, space group, reciprocal lattice. Electrical, magnetic and optical properties of minerals. Bonding and crystal structures of common oxides, sulphides, and silicates. Transformation of minerals – polymorphism and isomorphism. Solid solution and exsolution.

Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma-mixing, -mingling and -immiscibility.

Metamorphic structures and textures; isograds and facies. Metamorphism of pelites, mafic-ultra mafic rocks and siliceous dolomites. Material transport during metamorphism.

Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, khondalites, gondites, granite-greenstone and granulite belts.

Structure and atomic properties of elements, the Periodic Table; ionic substitution in minerals; Phase rule and its applications in petrology, thermodynamics of reactions involving pure phases, ideal and non-ideal solutions; equilibrium and distribution coefficients. Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes. Evolution of lithosphere and hydrosphere. Geological, geochemical and geobotanical methods of surface and sub-surface exploration. Sampling, assaying and evaluation of mineral deposits.

## 2) SEDIMENTOLOGY

Clastic sediments- gravel, sand and mud; biogenic and chemical sediments. Size classification, textural parameters, Classification of conglomerates, sandstones and carbonate rocks. Flow regimes and processes of sediment transport. Sedimentary textures and structures. Sedimentary facies. Aeolian, fluvial, lacustrine and glacial environments, reconstruction of paleoenvironments. Formation and evolution of sedimentary basins. Heavy minerals and their significance. Paleocurrent analysis. Sediment maturity, Provenance analysis, XRD and DTA analysis, Lithification and diagenesis. Evaporites. Application of sedimentary petrology to science, industry and technology.

### **3) STRUCTURAL GEOLOGY AND GEOTECTONICS:**

Theory of stress and strain. Behaviour of rocks under stress. Mohr circle. Various states of stress and strain. Different types of failure. Geometry and mechanics of fracturing. Paleostress analyses. Techniques of strain analysis. Deformation mechanisms. Geometry and mechanics of development of folds, boudins, foliations and lineations.

Internal structure of the Earth. Earthquakes – their causes and measurement. Interplate and intraplate seismicity. Paleomagnetism, sea floor spreading and plate tectonics.

Major tectonic features and associated structures in extensional-, compressional-, and strike-slip-terraces. Geological characteristics of plate boundaries. Geodynamic evolution of Himalaya.

### **4) PALEONTOLOGY AND STRATIGRAPHY**

Theories on origin of life. Organic evolution, – Speciation, phyletic evolution and quantum evolution. Mass extinctions and their causes. Application of fossils in age determination and correlation. Paleoecology, Life habitats and various ecosystems, Modes of preservation of fossils and taphonomic considerations. Types of microfossils. Environmental significance of fossils and trace fossils. Application of micropaleontology in hydrocarbon exploration. Important invertebrate fossils, plant fossils and microfossils in Indian stratigraphy.

Geological time scale, recent developments in stratigraphic classification. Code of stratigraphic nomenclature – Stratotypes, Boundary Stratotype Sections in Indian stratigraphy. Lithostratigraphic, chronostratigraphic and biostratigraphic subdivisions. Methods of stratigraphic correlation. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther's law. Methods for paleogeographic reconstruction. Earth's Climatic History. Stratigraphy of Indian cratons. Life in Precambrian. Precambrian – Cambrian boundary with special reference to India. Phanerozoic stratigraphy of India with reference to the type areas – their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy. Biostratigraphy, magnetostratigraphy and Quaternary climate.

## 5) MARINE GEOLOGY AND PALEOCEANOGRAPHY:

Morphologic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Hydrothermal vents- chemical and biological significance of hydrothermal vents systems. Ocean Circulation, Coriolis effect and El Nino. Thermohaline circulation and oceanic conveyor belt.

Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; Mineral resources. Sea level changes.

## 6) ECONOMIC GEOLOGY:

Magmatic, hydrothermal and surface processes of ore formation. Metallogeny and its relation to crustal evolution; Distribution of ore deposits in India; Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Coal bed methane. Nuclear energy resources.

7) **Geomorphology:** Historical and process Geomorphology. Landforms in relation to climate, rock type, structure and tectonics. Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition. Geomorphic processes and landforms – fluvial, glacial, eolian, coastal and karst. River forms. Tectonic geomorphology, neotectonics, seismites, active tectonics and their applications to natural hazard assessment.

8) **Remote Sensing and GIS:** Electromagnetic spectrum, Types of aerial photographs, Photo elements, terrain elements, elements of photo-interpretation, emission range, film and imagery, sensors, geological interpretations of air photos and imageries. Applications of remote sensing in engineering geology and disaster management. Global positioning systems. GIS, Raster and vector data structure, attribute data and thematic layers. TIN and its utility.

9) **Engineering Geology:** Engineering properties of rocks and physical characteristics of building stones, concretes and other aggregates. Geological investigations for construction of dams, bridges, highways and tunnels. Remedial measures. Mass movements with special emphasis on landslides and causes of hillslope instability.

10) **Hydrogeology and Environmental Geology:** Groundwater, Darcy's law, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-bearing formations. Groundwater exploration and water pollution. Anthropogenic impact on environment, environmental pollution and remedial measures.