

CHAPTER 22

GEOLOGY

Doctoral Theses

01. ADITYA SARKAR
Groundwater Quality Variation in Parts of Upper Yamuna Basin in Perspective of Groundwater Dynamics, Anthropogenic Influences and Sediment Nature.
Supervisor : Dr. Shashank Shekhar
Th 23383

Abstract
(Not Verified)

The study in this PhD thesis entitled, "Groundwater quality variation in parts of Upper Yamuna basin in perspective of groundwater dynamics, anthropogenic influences and sediment nature", establishes the linkage between the groundwater quality variations in alluvial plains of Upper Yamuna basin with different geogenic and anthropogenic factors. It is the geology which has primary control on the groundwater quality. However of late the changes in groundwater dynamics together with anthropogenic influences are showing their distinct footprints. This has been further confirmed by assessments of spatial and temporal hydrochemical facies, stable isotopic studies and spatial distribution of trace elements. The spatial distribution of trace elements could successfully identify vulnerable aquifers which needs to be managed properly. Besides at a local scale in Palla well field it is the dewatering and induced recharge from floodwater which influenced the hydrochemistry of groundwater. The study in active flood (younger alluvial) plains incorporated grain size distribution, XRD analysis of bulk and clay sediments and SEM-EDS studies of sediments from younger alluvial plains. The observations from this study clearly indicated the limited role of sediment groundwater interaction on groundwater quality in active flood plains. The study enriches the current understanding of hydrological processes in the sand dominant younger alluvium of Yamuna river system. It proposes that though apparently the hydrochemical facies variation in younger alluvium follows classical Chebotarev series, but the hydrological processes are different in the dynamic groundwater zone. Here the facies variation seems to be controlled by mixing of the meteoric recharge water with static reserve and recharge through meteoric water mixed with drain or any other water of higher salinity. These new insights in to the hydrological processes and factors controlling groundwater quality would provide a new direction for integrated and holistic aquifer management. It will ensure source sustainability of portable groundwater resources.

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7. Spatio-temporal variation in groundwater quality of palla well field aquifer
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- 02 BHATTACHARJEE (Joyeeta)
Geochemistry and Petrogenesis of Granites from South-Western Bundelkhand Craton: Elemental and Isotopic Constraints.
Supervisors : Prof. Devesh K. Sinha and Prof. Talat Ahmad
Th 23386

Abstract
(Not verified)

Indian is categorized into four cratonic blocks, namely (1) the north-western and central region of Aravalli-Bundelkhand craton; (2) South-central region of Bastar Craton; (3) Eastern region of Singhbhum Craton and (4) Indian peninsular region of Dharwar Craton, which. The Archaean terrains of Bundelkhand are categorized by these lithological associations, named as TTG, Greenstone Belts, Komatiites, Late Archaean Calc-Alkaline Granites, Sanukitoids and Mafic Dykes swarms and Quartz reefs. Heterogeneity in granites from South-western Bundelkhand Craton can be observed in term of their textural feature, colour and the availability of mafics. They vary from pink (PG) to Intermediate (IG) to grey granites (GG). Petrographically grouped into Grey Granites, Rapakivi Granites (RG) and Pink Granites. These granites have typical granitic mineralogy comprising of quartz, K-Feldspar, plagioclase, biotite & hornblende. From mineral chemistry, the 'GG' are contain plagioclase feldspar of low (An) and high (An) Ca content. In PG & RG, kfeldspars are i.e., perthitic and non-perthitic feldspars. Major elemental analysis classifies these geochemically diverse Bundelkhand Granites into three broad categories; Closepet type Granites, Rapakivi Granites and Monzogranites (LSHM and HSLM). The U-Pb zircon ages ranges in between 2.57 – 2.53 Ga and coincides with the late-Archaean alkaline magmatism. Sm-Nd isotopic studies of granites and diorites show longer crustal residence time and similar protolith. The present study shows that crustal evolution of Bundelkhand Craton began around the Palaeoarchaeon and got reworked by Neoarchaeon. Crust-mantle interactions resulted in Closepet type granites whereas the Rapakivi and Monzogranites resulted from pure crustal melting. Comparative analysis demonstrates similarities with Closepet from Dharwar Craton, Archaean Carajas Province, Brazil, High-K granitoids from Archaean southern greenstone belts High-K granitoids from Musoma-Mara region from Tanzania and the Dharwar biotite granites. Contemporaneous Palaeoarchaeon evolution patterns have been seen between Bundelkhand, Bastar and Singhbhum Cratons suggesting them to be a part of Ur supercontinent

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03. JAIN (Mansi)

Geometry and Kinematics of Thrusts in a Brittle Tectonic Wedge: An Experimental Approach.

Supervisors : Prof. Anupam Chattopadhyay

Th 23733

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04. GROVER (Pooja)
Microbiota from the Intertrappean Beds of Lower Narmada Valley and Kelapur (Maharashtra) with an Analysis on Biodiversity, Biotic Affinities and Palaeobiogeography of Deccan Volcanic Province
 Supervisor : Prof. G.V.R. Prasad
Th 23384

Abstract
(Not verified)

Microbiota from the intertrappean beds of lower Narmada valley and Kelapur (Maharashtra) with an analysis on biodiversity, biotic affinities and Palaeobiogeography of Deccan Volcanic Province At the end of the Cretaceous Period, the Indian landmass was moving rapidly towards the north at a rate of about 15-20 cm/year (Powell, 1988). This was also the time when India witnessed a large volcanic eruption which led to the formation of the Deccan volcanic province (Rao, 1999). The bulk (around 80%) of the volcanic eruptions took place during the middle Phase 2, which lasted for half a million years. Today Deccan volcanic rocks cover an area of about (>10.km.) which equals to two thirds of the peninsular India's area .However, the initial area covered by Deccan basalts is estimated to be 2 X 10⁶, and approximately half of the volcanic rocks have been eroded or weathered during the last 60 million years (Madhavaraju and Lee, 2010). If Deccan volcanism could cause extinctions at global level, what were its effects on the biota at the actual site of eruption? Besides these questions, we do not know which palaeobiogeographic pattern, vicariant, dispersal or geodispersal was prevalent during the Cretaceous/Paleogene transition. To address some of these intricate questions, one must examine the Late Cretaceous fossiliferous deposits of the Indian subcontinent. The main objectives of the present study are: To document fossils from the select Deccan intertrappean sections of lower Narmada Valley and Kelapur (Maharashtra). To reconstruct palaeoenvironments of the investigated intertrappean sections .To know the diversity, biotic similarities and taxonomic affinities at global level of the Deccan infra- and inter-trappean biota. To reconstruct the palaeobiogeography of peninsular India during the Late Cretaceous.

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1. Introduction 2. Previous work 3. Geological setting of localities 4. Systematics palaeontology 5. Age of the investigated fossiliferous sections 6. Paleocology and depositional environment 7. Distribution, diversity and taxonomic similarities of the deccan infra-inter-trappean biota 8. Late cretaceous paleobiogeography of India-A new perspective 9. Summary and conclusions 10. References

05. KANDWAL (Kula Nand)
Geological Controls on Ground Water Dynamics in Parts of Yamuna Basin Around Faridabad, Haryana, India.
 Supervisor : Prof. C.S. Dubey
Th 23385

Abstract
(Not verified)

The present study deals with geological controls on groundwater dynamics in parts of the Yamuna basin around Faridabad region. Attempt has been made to classify the study area based on hydrogeomorphic characters, satellite image characters and neotectonics. Water table contour mapping of areas allowed interpretation of recharge – discharge boundaries as well as areas of deficit. On the basis of image interpretation, four hydrgeomorphic units are established viz. rocky tract, aeolian plain, alluvial plain and flood plain. The alluvial terrain in the Faridabad region shows signatures of uplift and subsidence, reflected in anomalous meandering pattern of the River. The subsidence has resulted into a deposition of productive aquifers in thick sand bodies. The water table change maps plotted with a difference of 6 years (2005-2011) indicate depletion of

water table from -5m to -10m., in general, whereas the gain of 10m has been found in close vicinity of canal. Electrical resistivity soundings carried out roughly in East-West direction in areas of buried channels, which helped in delineation of aquifer disposition and water quality. Transverse resistance values were calculated and found to be analogous with transmissivity. Most resistivity sites have been identified as promising aquifers because of high value of transverse resistance except for few localities. Polygons plotted on the basis of variations in apparent resistivity for the same half current Schlumberger spacing (L) in radial directions revealed the anisotropy in subsurface geologic material around pediment zone and the orientation of fractures in bedrock. The fresh water (HCO₃ type, class I) pockets are found close to hard rock areas where flow gradient is high and in areas where subsurface lithology is dominated by sand bodies. The thesis thus delivers an overall picture of groundwater dynamics in the Faridabad region.

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1. Introduction 2. Hydrogenomorphic classification and aquifer disposition 3 Tectonic implications for aquifer disposition 4. Vertical electrical resistivity sounding (VES) for delineation of aquifer disposition 5. Ground water quality 6. Hydrochemical evolution of groundwater 7. Summary and conclusion. References

06. NINGREICHON (A.S.)
Orographic and Tectono-Geomorphologic Controls of Extreme Events in Alaknanda and Bhagirathi River of Garhwal Himalaya.
 Supervisors : Prof. C. S. Dubey
Th 23730

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1. Introduction 2. Geology and structure 3. Tectono-geomorphologic studies in Garhwal Himalaya 4. Spatial and temporal variation in discharge and sediment load 5. Climatic and orographic control on extreme events in Alaknanda and Bhagirathi river of Garhwal Himalaya 6. conclusion

07. RAJKUMARI PRIYADARSHINI DEVI
Comparative Study of Palaeogene Ichthyofauna of Western India: Diversity and Intercontinental Affinities.
 Supervisors : Prof. G. V. R. Prasad
Th 23731

Abstract
(Not verified)

During the Palaeocene-Eocene interval, India had reached tropical low latitudes and the width of Tethys Seaway was shrinking due to convergence of Africa and Europe in the west and India and Asia in the east. To understand the evolution of vertebrate fauna during phase of India's northward flight, the Palaeogene sequences of western India have been investigated from vertebrate palaeontological point of view. Four ossiferous horizons were found, two each in Kapurdi Lignite Mine and Padma Rao Quarry and Harudi and Khadi Nadi Formations. The fauna from the Kapurdi Lignite Mine indicates a Ypresian age while that of the Padma Rao Quarry favours a Ypresian-Lutetian. The faunas from the Harudi Formation and Khadi Nadi formations indicates Middle Eocene and Lower Miocene age respectively. The Kapurdi Formation fauna consisting of marine, brackish and freshwater elements indicates a lagoonal environment. Taxa recovered from the Padma Rao Quarry favours shallow marine nearshore environment. Coastal shallow marine nearshore environment in the inner shelf region has been interpreted for the deposition of Harudi Formation. The fauna from the Khadi Nadi Formation also supports a coastal shallow marine environment. The Palaeogene fauna of the studied sections is similar to fauna of Palaeocene-Eocene

faunas of Africa, southern Europe and southeastern USA. These fossil localities lie along a corridor bordered by Africa on the south and Europe and Asia on the north, formerly occupied by the Tethys Sea. This tropical seaway which was considered as the cradle of selachians radiation in the Eocene may have facilitated the dispersal of fauna between Tethyan bioprovince to Indo-Madagascan bioprovince. Presence of *G. mayumbensis* in the Early Miocene of India, known from the Atlantic and the southern and northern coasts of Tethys Sea and Madagascar indicates that free faunal exchanges were possible between the Western Tethys and Indo-Pacific region even in the Early Miocene.

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1. Introduction 2. Previous work 3. Geological setting and investigated sections 4. Systematic palaeontology 5. Age of the studied fossiliferous units 6. Palaeoecology and depositional environment 7. Palaeobiogeography 8. Summary and conclusions. References

08. SUMAN KUMAR

The Response of Non Indurated Aquifer to a set of Stresses Using Numerical and Analytical Modelling Approach

Supervisor : Dr. Shashank Shekhar

Th 23381

Abstract (Not Verified)

The groundwater loss has been most noticeable in North Western part of the country. In this context two discrete windows in North West India was chosen for the present study. The first window was in the active flood plain of River Yamuna in Palla region of Delhi. While the second window was Sangrur district of Punjab, which has one of the highest exploitation of groundwater resources in India. The Palla window of Delhi was chosen as there is a preexisting battery of about 100 tubewells. The Palla window was studied by onsite experimental investigations. In the process of data analysis and interpretation, a new approach for estimation of specific yield was also proposed. Together with a realistic estimate of aquifer parameters; the recovery data suggested that during normal condition pumping should be generally for eight hours with a rest of eight hours for recovery to take place. The Sangrur window of Punjab was chosen for simulation of groundwater system with numerical modeling approach and to examine the aquifer response to possible changes in agricultural practices and climatic condition. A regional transient model was calibrated and validated using 2004 to 2013 water level data from Central Ground Water Board. The study area, that is Sangrur district was separated out from validated model adopting telescopic mesh refinement methodology. It emerged out that with prudent demand side management groundwater source sustainability can be achieved. The system responds positively to a twenty percent increase in agricultural water use efficiency. While testing for different scenarios it also emerged out that the some part of the district are sensitive to changes in stress while others are not. It may be that some aquifers have been exploited beyond their resilience capacity under normal circumstances.

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09. TUSHIPOKLA

Crustal Evolution in the Western Dharwar Craton (Gorur-Holenarsipur Region) Southern India

Supervisors : Prof. M. Jayananda

Th 23382

Abstract
(Not verified)

The study on Holenarsipur greenstone belt and surrounding TTG basement presents detailed petrography, whole-rock geochemistry and Nd isotope study of ultramafic-mafic volcanic rocks and U-Pb zircon dating of surrounding TTG basement. Based on lithological associations and tectonic framework, the greenstone belt is divided into three blocks viz. southern-block, central-block and eastern-block. Similarly the TTG basement is divided into Hassan-Gorur section, east of Holenarsipur and the trondhjemite plutons. SHRIMP U-Pb zircon ages of gneisses shows 3342 ± 6 Ma and 3326 ± 6 to 3302 ± 5 Ma for Gorur -Hassan region. 3276 ± 4 Ma for north eastern-part Holenarsipur belt and 3103 ± 15 Ma for southeastern side of Holenarsipur belt, 3231 ± 8 Ma and 3221 ± 27 Ma for Trondhjemites. The major element characteristics indicate Low-Al and high-Al gneisses. The highly fractionated REE patterns of high-Al TTG together high content of Sr and Ba indicate their derivation from deeper mafic source with significant garnet in residue. On the other hand poorly fractionated REE patterns with low Sr and Ba of low-Al gneisses suggest their derivation from shallow mafic source. Elemental and Nd isotope data suggest that magmatic protoliths of gneisses derived by melting of arc crust or oceanic plateau crust at different depths. Majority of the Holenarsipur greenstone volcanics show Al-depleted nature with few samples showing Al-undepleted character similar to Munro-type. Elemental ratios of greenstone belt reveal their derivation of the southern oceanic plateau derived by plume source, whilst central oceanic island arc derived from melting of subducted slab and eastern block corresponds to fragment of oceanic crust derived from MORB source. The SHRIMP U-Pb zircon ages, Nd isotope and published data from the Western Dharwar craton reveals two major episodes of crustal growth through TTG accretion sub-contemporaneous with greenstone volcanism at 3350–3280 Ma and 3230–3200 Ma. This greenstone volcanism and surrounding sub-contemporaneous TTG accretion of the Holenarsipur belt is explained by combined plume-arc model.

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10. YADAV (Bhupendra S)
U-Pb Geochronology, Geochemistry and Nd-Isotopic Constraints on the Petrogenesis and Tectonic Settings of Paleo-Proterozoic Granitoids from Mahakoshal Supracrustal Belt (MSB), Central Indian Tectonic Zone (CITZ).

Supervisors : Prof. Talat Ahmad

Th 23732

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1. Introduction 2. Geological background 3. Field study and sample collection 4. Petrography 5. Major and trace element geochemistry 6. U-Pb zircon geochronology and radiogenic isotopes 7. Discussion and conclusion. References and appendices