CHAPTER 22

GEOLOGY

Doctoral Theses

01. DEVSAMRIDHI

Neoproterozoic Orogenic Imprints From India and Antarctica: Implications For Supercontinent Reconstructions.

Supervisor : Prof. Naresh Chandra Pant

Th 24506

Abstract
(Verified)

The Neoproterozoic Era registered rapid continental-scale movements and archived at least two major grouping of continents known as Rodinia and Gondwana. Present work attempts to characterize the time frame 1000 – 500 Ma in two widely spaced domains of India and Antarctica.Domain 1 comprises of NW-SE trending outcrops of Sirohi Group and Erinpura granite present towards western end of South Delhi Fold Belt. Orogenic characteristics and three component mixing model are ascertained for Erinpura granites by strontium-neodymium isotopic analyses. Ages estimated for the Revdar metapelite of Sirohi Group and the Erinpura granite are 831±13 Ma and 892±10 Ma respectively. An attempt is made to decipher relationship of Erinpura granite emplacement to the older Delhi orogeny as well as the younger Sirohi orogeny Domain 2 comprises of coastal outcrops of Princess Elizabeth Land (PEL) of East Antarctica. Pelitic granulites indicate 800-950°C and 2-5 kbar as conditions of metamorphism and a relict high pressure (~10 kbar) metamorphic event is also inferred. Extensive development of cordierite coronas around restite phases and pseudosection analyses suggests a strong component of decompression of ~5kbar. Two set of ages are estimated (~700-800 Ma and ~500 Ma). An attempt is made to mark out paleo-orogenic belts, in PEL and its conjugate Indian sector, supported by field as well as aero-magnetic signatures in interior PEL. Presence of a thinned lithosphere along the system of subglacial lakes-canyons confirmed by ICECAP/PEL consortium, in sub-ice PEL is interpreted. Analog modelling is used to demonstrate influence of pervasive mechanical anisotropy of the basement in defining its orientation and its connection to the Lambert Graben.This work substantiates evidence of swift configurational changes from Rodinia to Gondwana in Indo-Arabian as well as Indo-Antarctic terrains. It specifically highlights the geodynamic importance of a hitherto poorly recognized ~800 Ma orogeny in both the domains.

Contents

1. Introduction 2. Geological setting and geophysical Data of NW Indian shield 3. Petrochemistry of revdar metapelite and erinpura granites 4. Geochronology of revdar metapelite and erinpura granites 5. Summary of Domain 6. Geological setting and geophysical data of princess Elizabeth land, East Antarctica 7. Petrochemistry and metamorphic evolution of PEL granulites 8. Geochronology of PEL granulites 9. Rift hypothesis and analog modelling 10. Summary of domain 2 11. Conclusion. References and Appendix .

02. MISHRA (Brijendra Kumar)
Neotectonics of Kullu Valley(Larji-Kullu Tectonic Domain) and its Implications For Landslide Hazards in the Higher Himalayas: A Remote Sensing and GIS Approach.
Supervisor: Prof. Anupam Chattopadhyay
Th 24504

Abstract
(Verified)

The present study focuses on the Upper Beas Basin of the Larji-Kullu Tectonic Window (LKTW) in the Kullu Valley within the Higher Himalayas of Himachal Pradesh, India. This area has experienced high rate of tectonic activity from early Miocene to Quaternary. It is a 'window' structure formed in the Lesser Himalayan Series (LHS) rocks, circumscribed by the Vaikrita Thrust and the Kullu Thrust, along which the Greater Himalayan rocks are emplaced over the LHS. The area is drained by Beas River and its tributaries viz. Parvati, Hurla, Sainj and Teirthan rivers. The present study attempts to analyze the tectono-geomorphic characters, major landslide events and landslide susceptibility factor in the LKTW, to establish the tectonic and lithologic control on landslides. Mapping of the river profiles, slope-length index, river valley width-to-height ratio, knick zones, paired/unpaired river terraces etc. can be related to a differential uplift due to Quaternary tectonic activity. Topographic/Bedding plane Intersection Angle (TOBIA) index, Surface Roughness index and Lithological Competency analyses show that landslides are mostly associated with southern and southwestern-facing slopes, and with 'Orthoclinal' slope calss with gradient of 37°-48°. Rock-fall and Rock-slides are most common. A geomorphic lineament parallel to the Sainj River has been identified using satellite Imagery and verifed in field, which records a significant number of landslides. A prominent clustering of landslides is observed in the northern side of the Sainj River, which also shows high Hypsometric Integral (HI) values, indicating enhanced tectonics-induced erosion. Major sites of landslides are found to be located in the intensely fractured Manikaran Quartzite within the core of the LKTW. Geomorphic and field studies indecate that the Sainj lineament is an active fault with an oblique-normal sense of fault movement. The active fault, hitherto unrecognized, is named 'Sainj Fault (SF)', and its tectonic characters are discussed here.

Contents

1. Introduction 2. Geological and tectonics set up of the study area 3. Methodology for morphotectonic and landslide analysis 4. Result of geomorphic and morphotectonic analysis in the Larji Kullu tectonic window (LKTW) 5. Landscape characterization and susceptibility mapping using remote sensing and GIS tools 6. Transect study along sainj fault (SF): some new observations 7. Discussion conclusion and References.

03. KUMAR (Om)
A Multi Proxy Study of Holocene Monsoon Climate Variability and Atmospheric Circulation Changes from the Chandratal Lake Sediments, Western Himalayas, India.
Supervisors : Prof. J.P. Shrivastava and A.L. Ramanathan
Th 24503

Abstract
(Not Verified)

The thesis investigates the climate, glacier, and atmospheric circulation changes variability of late Quaternary (50 Ka BP to present day) using proxy data and CMIP5 Model. The thesis consists of four chapters (as manuscript format) addressing following major research questions: 1) Is the ice mass stored in the glaciers in the Western Himalaya formed by precipitation brought out by mid-latitude Westerlies or the Indian Summer Monsoon (ISM), 2) Could pore water stable isotope records be trusted as a proxy to disentangle different Holocene climatic phases, including the 8.2 ka BP event?, 3) How to derive information of past humidity source (ISM or mid-latitude westerlies precipitation) from pore water and the triple water isotopes and chemical composition variation ?, 4) How to reconstruct the past atmospheric circulation changes using dust proxy ?, 5) Does some similar pattern of climatic variability exist in the Himalayas in the past, and 6) Is Paleoclimate modelling inter-comparison project (CMIP5) performance can agree with paleo-archive records. In order to address the aforesaid scientific/research questions, measurements of d18O, d17O, d D, AMS C14, d-excess, O17-excess, Cl-, Br-, NO3-, TOC, Grain size, BSi, and Amino acids were performed with the help of Piccaro Cavity Ringdown spectrometer (L2140-i), Accelerator Mass Spectrometry (IUAC, Delhi) and Ion Chromatograph at JNU, New Delhi. In this manuscript, I have presented a new Holocene paleorecord disentangling the presence of the ISM and mid-latitude westerlies and their effect on glacier fluctuations during the Holocene. The results indicate that the ISM dominated precipitation ~21% of the time, whereas the mid-latitude westerlies dominated precipitation ~79% of the time during the last 11 Ka BP. This is probably the first study of this kind that portrays the moisture sources referring to the above proxies from the Himalayan region as an alternative to the ice core records.

Contents

1. Introduction 2. Disentangling source of moisture driving glacier dynamics and identification of 8.2 ka event: evidence from pore water isotopes, Western Himalaya 3. Holocene climate and atmospheric history from Western Himalayan lake sediments using triple water isotopes and other proxies: alternate archives for ice records 4. Testing the reliable proxies to understand the mid Holocene climate variability records from Chandra Tal Lake, Western Himalayas 5. Revisiting the contribution of Indian summer monsoon and westerlies on past glacier and climate variability in Himalayas during the Late Quaternary 6. Conclusion

04. YOUSUF (Ibrahim)
Geochemistry, Geochronology, Pathogenesis and Tectonic Setting of Proterozoic Bimodal Volcanism of Betul Chhindwara Belt, Central Indian Tectonic Zone.
Supervisor : Prof. Devesh K. Sinha
Th 24505

Abstract
(Not Verified)

Betul-Chhindwara belt is part of Central Indian Tectonic Zone (CITZ) that includes Proterozoic bimodal volcanism, quartzite, mafic-ultramafic rocks, volcano sediments and banded iron formation. The mafics of Betul belt have been subjected to upper greenschist to lower amphibolite grade of metamorphism and have well preserved remnant of pillow structure.The major element geochemistry of the samples clearly discriminatesinto sub alkali basalts and rhyolites. The metabasalt is represented by high Ti and low Ti Groups, these variation in terms of Ti indicate different degree of partial melting of mantle source. Fe and Ca decreases with decreasing Ti indicating clinopyroxene and iron-titanium oxide

fractionation.These metabasalts are generally enriched in incompatible elements such as Rb, Ba and depleted in Nb, Ti and P, which collectively are good indicators of continental crust/lithosphere involvement in their genesis. The rhyolites show very strong negative Eu anomaly, which indicates fractionation of feldspar, whereas metabasalt do not show any Eu anomaly. Positive anomalies of U-Th-Zr for the felsic rocks indicates crustal involvement. Whole rock Sm-Nd isochron for the mafic volcanic rocks indicate an age of crystallization for these volcanic rocks at about 1232±37 Ma (initial 143Nd/144Nd = 0.510752±0.000035, mean square weighted deviate [MSWD] = 1.20) which is much younger to the basement rocks. The εNdt(t=1232 Ma) vary from -5.93 to -3.1 for the mafic volcanic rocks and between -5.81to +0.14 for felsic volcanic rocks. DM model ages of metabasalts vary from 2204 to 3040 Ma and for rhyolites vary from 2174 to 2863 Ma, respectively. Mafic magma while ascending interacted with the continental crust at different levels, supplying heat and fluids reducing the melting points of the source regions, producing felsic melt of varying compositions. Tectonic discriminant diagrams and geochemical data indicate subduction zone tectonic environment for the genesis of the Betul-Chhindwara belt bimodal volcanism.

Contents

1. Introduction 2. Analytical techniques and methodology 3. Lithology, field relationship and petrography 4. Classification and major element geochemistry 5. Trace elemental geochemistry 6. Sm-Nd and Rb-Sr systematic 7. Petrogenesis and conclusion 8. References 9. List of publication.

M. Phil Dissertations

05. KASANA (Parv)
Analysing the Impact of the Himalayan Orogeny and Son –Narmada Lineament on the Ganga-Narmada Basin Drainage Divide Using CHI(x) Analysis.
Supervisor: Dr. Vimal Singh

06. NEGI(Priyanka)
Petrochemical Characterization of Anorthosites of Barabar Hills of Northern Part of Chotanagar Granite Gneiss Complex Of Eastern India.
Supervisor: Dr. Ashima Saikia

07. VICKY SHANKAR
Investigation or the Piedmont of Fault Between The Ghaghara and The Sharda Rivers, South of The Central Himalaya.
Supervisor: Dr. Vimal Singh