Curriculum Vitae

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I have submitted PhD thesis entitled "**Optically Stimulated Luminescence (OSL) dating of fluvial sediments: Applications and Implications to Paleoseismology and Paleoclimatology**" on 19th October, 2005 to M.S. University of Baroda, Vadodara, Gujarat, India. The thesis work was carried out in the Planetary and Geosciences Division, Physical Research Laboratory (PRL), Ahmedabad, India under the supervision of Prof. Ashok K. Singhvi.

Research Interests: Luminescence Dating, Study of Earth-surface processes, Sedimentology and Stratigraphic correlations, Quaternary Geochronology, Archaeology, Paleoseismicity and past climate reconstruction in Himalaya.

Thesis outline

The work focuses on feasibility of Optically Stimulated Luminescence (OSL) dating on Himalayan sediments with respect to bleaching, a basic assumption that reset the luminescence clock. To do so, sediments from various depositional regime, (i) flash flood; (ii) slack water; (iii) alluvial fan deposit and (iv) tectonically uplifted fluvial terraces, were selected. Single Aliquot Regeneration (SAR) method of luminescence dating was applied and results thus obtained were interpreted for paleoclimate and paleoseismic implications. The results are encouraging and accords well with the process and paleo-climatic conditions.

In this process, methodological aspects to improve upon the current SAR protocol were examined too. We have analyzed sensitivity changes during natural OSL measurement using 110°C TL peak as a surrogate for sensitivity in Himalayan sediments. The samples from Himalayan rocks have shown considerable changes in sensitivity (up to 30%). A possible solution was suggested towards that with interesting and encouraging results. At the same, applicability of recently developed standard growth curve was examined on the Himalayan sediments. The results have shown that under some conditions only, this will be applicable. (Please see the thesis summary at the end of the CV for detail)

Currently the applicant is involved in luminescence chronology of neo-tectonic activity in Himalayan frontal fault and its sympathetic thrusts in the western Himalaya. The applicant is also analyzing paleo-flood deposits in Lesser Himalaya to reconstruct past climate. The work involves the OSL dating for geochronology and geochemistry (major and trace elements) for provenance studies.

Personal details: Male, Indian citizen, born on 22nd July, 1975.

Academic Qualifications:

1. Submitted Ph.D. Thesis on 19/10/2005 in M.S. University of Baroda, India in Geology. The work was carried out in Physical Research Laboratory, Ahmedabad, India under the supervision of Prof. Ashok. K. Singhvi.
2. Master of Science in 1999 in Applied Geology from University of Allahabad, India.
3. Bachelor of Science in 1997 in Mathematics, Chemistry and Physics from University of Allahabad, India

Fellowships and Grants:

1. **Graduate Aptitude Test for Engineering (GATE)** conducted by Indian Institiute of Technology, Bombay, India, qualified in year 1999 with 35th rank in geology and geophysics stream.

2. **National Eligibility test for research and lecturership (NET)** qualified for Lectureship and Junior Research Fellowship in June, 2001 in earth sciences stream.
3. Foreign Travel Grant to attend "**UK Luminescence and ESR Meeting, 2004**" from Department of Science and Technology **(DST)** and Council of Scientific and Industrial Research **(CSIR)** New Delhi, India.

Workshop/ Contact course/ Conferences attended:

1. "Contact course on Contemporary Concepts and Tools in Fold and Thrust belt Deformation" organized by Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Bangalore, India from Nov. 26 to Dec. 01, 2001.
2. DST short course on "Palaeoseismology and Earthquake Geology", organized by the Department of Geology, Punjab University, Chandigarh, India from Oct. 08 to Oct. 11, 2002.
3. "Shear Zone: Mapping and Analysis" organized by Department of Earth Sciences, University of Sambalpur, Sambalpur, India from Dec. 20 to Dec. 29, 2002.
4. "National Seminar on Himalayan Orogen- Foreland Interaction", January 29-30, 2003, University of Lucknow, Lucknow, India.
5. "International Conference on Luminescence and its Application", February 9-12, 2004, Bhabha Atomic Research Centre, Mumbai, India.
6. "Brain storming work-shop on Tectonic Geomorphology", May 3-7, 2004, Indian Institute of Technology, Kanpur, India.
7. "Indian Association of Sedimentologist", 21-23 Dec., 2005, Wadia Institute of Himalayan Geology, Dehradun, India.
8. "UK Luminescence and ESR Meeting, 2004" in September 2004, held at St. Andrews University, Scotland, UK. Attended and presented a paper.

Lab Visit:

10 days visit in National Geophysical Research Institute, Hyderabad, India to teach and set up experimental protocols in newly developed TL/OSL lab.

Referees:

1. Prof. Ashok K. Singhvi,
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Publications:

Published/Accepted

1. I. B. Singh, **Manoj K. Jaiswal**, A. K. Singhvi and B. K. Singh, 2003. Rapid subsidence of western Ganga plain during late Pleistocene: Evidence from optical dating of subsurface samples. *Current Science*, 84, 451–454.
2. Mark D. Bateman, Charles D. Frederick, **Manoj K. Jaiswal** and Ashok K. Singhvi, 2003. Investigation into the potential effects of pedoturbation on luminescence dating. *Quaternary Science Reviews*, 22, 1169–1176.
3. Mark D. Bateman, Peter J. Holmes, Andrew S. Carr, Benjamin P. Horton and **Manoj K. Jaiswal**, 2004. Aeolianite and barrier dune construction spanning the last two glacial-interglacial cycles from the southern cape coast, South Africa. *Quaternary Science Reviews*, 23, 1681-1698.
4. J.N. Pal, M.A.J. Williams, **Manoj K. Jaiswal** and A.K. Singhvi, 2006. Infrared stimulated luminescence ages for prehistoric cultures in the Son and Belan valleys, north central India. *Journal of Interdisciplinary studies in history and archaeology*, 1, 51-62.

5. M.A.J. Williams, J.N. Pal, **Manoj K. Jaiswal** and A.K. Singhvi. River responses to Quaternary climatic fluctuation: evidence from the Son and Belan valley, north central India. (in Press, *Quaternary Science Reviews*)

Submitted

1. **Manoj K. Jaiswal**, V. Jain, P. Morthekai and A.K.Singhvi. Limits of Applicability of Standard Growth Curve in Single Aliquot Regeneration method of Luminescence dating. (Under review in Radiation Measurement)
2. **Manoj K. Jaiswal,** Srivastava P., Juyal, N. and Singhvi A.K. Residual luminescence signal in flash flood sediment from Himalaya: Aspects of optical dating (submitted to Ancient TL).
3. R.J. Wasson, N. Juyal, **M.K. Jaiswal**, M.McCulloch, M.M. Sarin, V, Jain, P. Srivastava, A.K. Singhvi. The Mountain-Lowland Debate: Deforestation and Sediment Transport in the Upper Ganges Catchment (submitted to Science)
4. Malay Mukul, **Manoj K. Jaiswal**, A. K. Singhvi. Out-of-Sequence active deformation in Lesser Himalaya (submitted to Science).
5. Lewis A. Owen, Robert C. Finkel, Darrel Kuffman, **Manoj K Jaiswal,** Shannon Mahan, Joan S. Schneider, Warren Sharp, Ashok Singhvi, Claude N. Warren. A Late Quaternary spit-shoreline complex at the northern end of Silver Lake, Mojave Desert, California: a comparison of different numerical dating techniques (submitted to Quaternary International).

Under Preparation

1. **Manoj K. Jaiswal,** Srivastava P., Wasson, R.J. and Singhvi A.K. Optically Stimulated Luminescence Chronology of Paleo-flood Deposits at Raiwala, Haridwar, India.
2. **Manoj K. Jaiswal**, P. Srivastava, N. Juyal, I.B. Singh and A.K. Singhvi Luminescence Chronology of mega and piedmont alluvial fan aggradation in Ganga Plain during the Late Quaternary.
3. **Manoj K. Jaiswal,** Singhvi, A.K. and Stokes, S. Changes in natural OSL sensitivity of quartz: Implication to Single aliquot regeneration dating of Himalayan sediments.

Abstracts

1. Malay Mukul, **Manoj K. Jaiswal** and A. K. Singhvi, 2003, Neotectonic activity in Darjeeling-Sikkim-Tibet wedge, National Seminar on Himalayan Orogen- Foreland Interaction, January 29-30, 2003, University of Lucknow.
2. A.K. Singhvi, **Manoj K. Jaiswal**, N. Juyal and V. Jain , Luminescence dating studies at the Physical Research Laboratory, International Conference in Luminescence and its Applications, February 9-12, 2004, BARC, Mumbai.
3. Wasson, R. J, Jain, V, **Jaiswal, M**., Juyal, N., Mcculloch, M, Sarin, M.M. Srivastava, P., Singhvi, A. K.The Contribution to the Sediment Budget of Landslides in the Upper Ganga Basin. International Association of Geomorphologists, Regional Conference, Feb. 27-29, 2004, Calcutta.
4. **M.K**. **Jaiswal,** Jain V., Wasson, R.J. Juyal N., and Singhvi A.K. Luminescence characteristics of fluvial sediments from complex lithologies in Himalaya: Implications for SAR and provenance. UK Luminescence and ESR meeting, 2004, St. Andrews University, UK.
5. Martine Simões, Jean Philippe Avouac, Yue-Gau Chen, Ashok K. Singhvi, Yu-Chang Chan, **Manoj Jaiswal**, Sylvain Bernard. Investigating the kinematics of shortening across the Pakuashan anticline, West Central Taiwan. American Geophysical Union, 2004.
6. **M.K. Jaiswal**, Pradeep Srivastava, A.K. Singhvi. Luminescence Chronology of mega and piedmont alluvial fan sequences in Ganga Plain. Indian Association of Sedimentologist, 2005, 21-23 Dec. 2005 at Wadia Institute of Himalayan Geology, Dehradun, India.

Thesis Abstract

Optically Stimulated Luminescence Dating of Fluvial Sediments: Applications and Implications to Paleoseismology and Paleoclimatology

The dynamic Himalaya is the result of collision of the Indian and the Asian plate. The signatures of climatic and tectonic events during its evolution are preserved in the form of various geomorphic features. This thesis deals with the methodological aspects of luminescence dating of fluvial sediments in the Himalaya. The results are then used to understand some aspects of the past climate and seismic events in Himalaya.

Optically Stimulated Luminescence (OSL) dating relies on the premise that daylight exposure of the constituent minerals during their pre-depositional transport photo-bleaches the geological signal to a zero or near zero level. In case of fluvial sediments, the daylight is attenuated due to variety of factors such as depth of water column and turbidity. This implies that the fluvial sediments are in general partially and heterogeneously bleached at the time of their deposition. Luminescence dating methods such as the Single Aliquot Regeneration (SAR) method now enable an understanding of the bleaching history of a sample and help in the isolation of the most bleached grains for age estimation.

The present study examined the feasibility of using OSL dating for a variety of fluvial environments from Himalayan terrain. The basic effort was towards examining the validity of the basic assumptions of luminescence dating technique using samples with age constraints. In this process new protocols were developed, tested and applied. The aim and scope of the thesis can be summarized in two broad categories–

1. Methodological aspects

Sensitivity changes during the measurement of natural OSL are not accounted for, in conventional SAR protocol. Such a change could imply systematic offsets in SAR ages. This aspect was examined for a large variety of sediments using 110^{o}C TL peak as a surrogate for OSL sensitivity. Results indicated that sensitivity changes could range from 20-50% and therefore corresponding offsets in ages could occur. The possible way of corrections was applied, which gave encouraging results.

A practical handicap in applying SAR protocol is that it consumes considerable measurement time. This implies a low data throughput. Recently, a practical solution towards increasing the data throughput was suggested. This involved construction of a Standard Growth Curve (SGC) from a small set of growth curves, on which sensitivity corrected natural luminescences from large number of aliquots are read to estimate the paleodose. This process minimizes time by eliminating the need of carrying out a full SAR cycle that comprises the construction of a growth curve for each aliquot. A detailed investigation suggested that reliable SGC-SAR based ages can be obtained for cases where regression coefficient of SGC is greater than 0.9.

2. Feasibility of sediment dating from Himalayan terrain, chronology and its Implications

Breaching of a landslide induced natural lake is quite common in Himalayas and results in flash floods. This provides high velocity, high bed load and high suspension load flows. A feasibility study for the dating of sediments transported under these conditions was examined using samples of a known catastrophic flood event in Himalaya. This was the 1970 flood in the Alaknanda basin. A suite of samples at various distances downstream from the origin of flood over a distance of ~250 km were collected. No systematic change in bleaching was found although mean grain size of the sample decreased as the distance of travel of the sediment. However samples deposited during receding phase of flood has indicated significant bleaching up to 90% and gave a notional luminescence age of ~ 400 a, indicating the magnitude of ‘zero error’ in luminescence dating of such sediments.

The extent of daylight bleaching for the slack water deposit in Raiwala near Haridwar was also examined. The difference between mean and least 10% of paleodoses suggested that samples were partially bleached and the SAR protocol could still provide realistic ages. Almost 1.5 meter of sediment was deposited in a time period of ~2.3ka to ~800 years having 14 flood couplets in total. The results accorded well with paleoclimate records.

Fan sediments comprise gravel and coarse-grained sands. Typical transport distance in the case of Himalaya fans sediments is of the order of few km and the bleaching in such sediments is expected to be partial. It has been suggested that mega fan aggradation in Ganga plain occurred during the time of the initiation of humid climate that was preceded by a long arid phase when huge amount of sediment from the Himalaya were transported into the Ganga plain. The data suggested that the mega fan sediments are relatively better bleached as compared to piedmont fan sediments. Our results concluded that the studied section of the mega fan sedimentation postdate the Last Glacial Maximum and occurred in three episodes during ~14 – 8 ka. This accorded well with the paleoclimate records. The possible cause of well-bleached mega-fan sediment is explained by the prolonged daylight exposure during weathering in arid period. Chronology of the younger piedmont fan suggests its formation during ~2 – 1 ka.

During tectonic uplift of the riverbed, the river incises into the bedrock and leaves a thin veneer (~1-2 meter) of sediments on incised bedrock. Samples from such strath terraces in Tista valley were taken for feasibility of luminescence dating with respect to bleaching. A poor bleaching indicated by wide dose distribution. However, minimum 10% SAR ages provided a stratigraphically consist inverted age sequences. The luminescence ages suggest that the Darjeeling-Sikkim-Tibet wedge is going through a cycle of various phases of mountain building processes. There were two deformation fronts active between 20–5 ka; one near the Main Boundary Thrust and the other on south of the mountain front. The results suggested that the region close to the Main boundary thrust in Tista valley is neo-tectonically active and out of sequence thrusting occurred due to various phases of mountain building processes. Luminescence SAR ages have indicated a varying incision rates of 3–10 mm/year by river Tista in the studied section.

Overall the present thesis established that reliable ages using Luminescence Dating could be estimated for sediments from wide range of depositional environment. Radiocarbon dating has limited applicability in the region on account of non availability of suitable dating material and contamination and hence reliable chronology of these sediments was not possible till this work. The present thesis examined the bleaching aspects of luminescence dating and the implication of SAR analysis in sediments from the Himalaya. This study therefore provides a basis for the application of Luminescence Dating and concludes that it can play a significant role in studies related to paleoclimate and tectonic in the Himalayan region.

Conclusions

Present study enabled the following inferences

(i) Fluvial samples suffered from heterogeneous bleaching as indicated by wide and positively skewed paleodose distribution histograms.

(ii) It was demonstrated that natural correction factor (ncf) plays important role in palaeodose estimation, if not taken into account, the ages may offset by up to 30%.

(iii) Variability in the Standard Growth Curve (SGC) technique suggests that it can be applied successfully to such samples where SGC have regression coefficient >0.9. This implies that SGC is sensitive to the heterogeneous origin of Quartz.

(iv) Luminescence study of flash flood sediments from the Alaknanda basin suggests that to some extent bleaching is independent of the distance of transport but show a grain size dependency.

(v) Chronology of monsoon dominated slack water deposit shows evidence of 14 major floods during the last 2.6 ka and 0.8 ka suggesting enhanced southwest monsoon. This is the first record of post Holocene humid climate obtained from the fluvial record in the region.

(vi) Chronology of mega fan sediment suggests that fan sedimentation occurred in pulses during the transition climatic regime. Three major events of mega fan aggradations were identified between 14 ka, 9 ka and 8 ka. The piedmont fan sedimentation post date mega fan aggradations episode and were dated to 2 ka to 1 ka.

(vii) Luminescence dating of incised terraces in the Tista River suggests that incision was favored by the temporal changes in the sub-critical condition of Andherijhora (AJT) and its sympathetic thrust during 7 ka to 1 ka. These are the first evidence that indicate AJT was active during the Holocene.