# Thesis Abstracts

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***Kartika Goswami***

## Luminescence chronology of the fluvial archives from the Kaveri Basin, India: Implications to late Quaternary climate change

*February 2021*

Indian Institute of Science Education and Research Kolkata, Kolkata, India

*Degree: Ph.D.*

*Supervisor: Dr. Manoj Kumar Jaiswal*

The study uses optically stimulated luminescence (OSL) dating to reveal the chronology of the flood and deltaic sediments from the Kaveri basin, south India, and investigates the relationship of the sediment depositional history with the late-Quaternary climate changes. This objective is addressed by collecting flood deposit samples from the upper Kaveri basin, and the coastal/deltaic sediments from the coastal part of Kaveri delta, southeast India. The OSL ages are correlated with independent age controls such as radiocarbon ($^{14}$C) dating and young ages with the river gauge records, whenever possible. The quartz grains from southern India generally have bright OSL signal. This was advantageous in the dating of extremely young sediments. However, the river Kaveri flows mostly through rocky terrain in its upper reaches and is also joined by various tributaries. It therefore carries locally weathered sediments. Hence, it was interesting to explore the extent of bleaching, and thus the feasibility of OSL dating young flood sediments (~ few tens of hundreds of years only).

Heterogeneous bleaching was observed in the flood sediments from the upper parts of Kaveri. Age estimates were made using existing age models, like the minimum age model (MAM) and the central age model (CAM). Additionally, grain size analysis, micropaleontological studies (of deltaic sediments), and palaeodischarge analysis using the slope-area method (from flood deposits) are applied to further reach our research goals.

The study of the flood deposits, provided insights into the monsoon flood-climate relationship. The study revealed that high-magnitude flooding events have occurred during major climatic shifts, from fluvial dormancy to sudden outburst of monsoons (~ 2 ka), from warmer to colder periods (onset of 'Little Ice Age' (LIA) ~ 14th century), from colder to warmer periods (end of LIA ~ 19th century) and ~ 20th century. This also indicates that not all wet phases are associated with large floods and not all dry phases with low floods or droughts. The study also demonstrated that the occurrence of the 20th century floods in the upper reaches of Kaveri is a result of high-intensity, short-duration storms. Brief precipitation analysis of the recent 2018 Kerala/Karnataka floods suggests that it is not only the increased amount of rainfall but also the temporal variability in the downpour that affects the occurrence of floods in the study area. Additionally, the paleodischarge analysis points out that the floods in recent times (post 1950) are occurring at a higher magnitude than the paleofloods.

The OSL ages, and the micropaleontological results obtained from the four deltaic subsurface sediment cores of 25 m depth each, revealed a close correlation of the sedimentary dynamics of the Kaveri river with the late-Quaternary sea-level and accompanied warmer conditions. The river has attempted to re-establish its equilibrium profile with the rise in the sea-level during ~ 140 – 143 ka, ~ 121 ka, ~ 95 – 100 ka, ~ 81 – 89 ka, ~ 73 – 78 ka, ~ 57 – 60 ka, ~ 40 – 45 ka, 6 – 9 ka, ~ 5 ka, and ~ 3 ka. This is majorly achieved by the river's vertical aggradational deposition as a result of a balanced influx of fluvial sediment with sea-level rise. However, a gradual progradation of the coastline towards the sea since ~ 30 – 15 ka is also observed, suggesting the effect of gradually falling sea-level in the coastal stratigraphy during this period. At ~ 6 – 9 ka, ~ 45 ka, ~ 75 ka, and ~ 121 ka, the presence of foraminifers is also observed in these coastal shores, suggesting marine influence. However, ~ 6 – 9 ka transgression is seen as the most pronounced and long-lived in the study area out of them all. Luminescence chronology of the cores also hints towards a fault movement post ~ 70 ka, indicating the role of Pleistocene tectonics, sea-level changes, climate, river dynamics in the late-Quaternary evolution of the Kaveri delta.

Therefore, the findings of present work contribute to the understanding of the regional palaeo-climate and its implications to the fluvial responses from the Kaveri basin, southeast India.

***Dirk Mittelstraß***

## Decomposition of weak optically stimulated luminescence signals and its application in retrospective dosimetry of quartz

*December 2019*

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*Degree: M.Sc.*

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The accuracy of quartz CW-OSL dating results relies strongly on the dominance of the thermally stable and easy-to-bleach 'fast' signal component. If this component does not dominate the initial signal, systematic errors are likely. These are caused by signal components from insufficiently bleached or thermally unstable traps. A signal component separation procedure would solve this issue, but has to meet the following requirements to be applicable in daily lab routine:

1. Allow automated component and dose evaluation, without inherent need for user interaction.
2. Identify the number of components and their decay constants on a sample-to-sample basis.
3. Allow component-resolved dose calculation, even for samples with low-SNR measurements.
4. Be applicable for a large variety of instrumental and measurement conditions.

To fulfill these requirements, a new mathematical approach is presented. The signal component separation is divided into two major steps. In the first step, the number of signal components and their decay rates are identified. This is done by creating one global average CW-OSL curve from all measurements in a given data set. On this representative CW-OSL curve, the multi-component exponential decay fitting algorithm described by Bluszcz and Adamiec in 2006 is applied. In the second step, the signal component intensities for each single CW-OSL measurement are obtained by an algebraic decomposition algorithm, novel in the field of luminescence dating. The algorithm is purely analytical and based on linear algebra methods. This ensures mathematical robustness and allows the propagation of uncertainty. All algorithms were realized in R and bundled in an R package. Multiple simulations as well as some application tests are realized as Rmarkdown scripts and are therefore easy to reproduce.

Method parameters as well as the accuracy, precision and robustness of the procedures were tested at 10368 (step 1) respectively 15.5 million (step 2) simulated CW-OSL curves with varying detection- and component parameters. The step 1 simulation demonstrated a high reliability in identifying the fast component. In 97.4% of the 5184 relevant OSL curves, the estimated fast component decay rate is within $\pm$ 10% of the true value. The correct number of components was found in 73% of the OSL curves. Under-fitting (missing components) occurred in 21% of the simulated cases but found to be unproblematic for the decay rate estimation of the remaining components. Over-fitting (imaginary components) occurred in 6% of the cases and lead to shifted decay rates and therefore to systematic errors. As over-fitting is correlated to long measurement durations, it is recommended to limit them to 40 s. Typical background signal levels were found to have no significant impact on the decay rate accuracy. The step 2 simulation demonstrated high precision and 100% reliability in estimating the fast and medium component intensities. This reliability accounts also for the statistical error values. Slow component intensities, however, are systematically shifted in the presence of detection background signals. The introduction of a background component was tested. It removed these systematic errors but lead to highly imprecise slow component estimations in some cases due to the similar appearance of slow components and background signals.

As application test, five CW-OSL SAR quartz sample data sets were analysed. All samples were from different locations and had independent age control available. For two samples, for which the default late background subtraction analysis lead to under-estimated ages, the new approach found ages in accordance with the independent age control. For two other samples with also under-estimated ages, this was not the case. But for these samples the under-estimation could be related to other sample-specific issues. For the fifth sample, the already as correct classified CW-OSL age was confirmed.

As second application test, the no-heating SAR protocol proposed by Roberts et al. in 2018 was tested by dose recovery tests at two samples. For the coarse grain reference quartz 'Las Sables', the recovered dose was accurately estimated while for the dim fine grain quartz BT1713 the recovered dose was highly over-estimated. Both samples have similar OSL characteristics at room temperature with the 'fast' component becoming the medium component of five components.

The thesis shows, that the presented component separation method fulfills the defined requirements although the range of applicable measurement conditions remain to be further specified. Nonetheless, the usefulness of the method as reliable and rapid data analysis tool in quartz OSL dating is demonstrated.

The thesis is available for download at https://iktp.tu-dresden.de/IKTP/pub/19/Dirk_Mittelstrass_Master.pdf. A further improved version of the **R** package `'OSLdecomposition'` and a tutorial are available at https://luminescence.de/.

***Mahadev Rawat***

## Late Holocene Evolution of Fluvial System in Tamilnadu, India: Implications to Climate and Tectonics

*March 2021*

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*Degree: Ph.D.*
*Supervisor: Dr. Manoj Kumar Jaiswal*

Paleo-flood is one of the extreme events, also an essential fluvial archive preserving signatures of intense precipitation linked with climate changes. However, it remains a puzzle to be taken as a proxy for intense humid phases. Usually, humid periods are associated with high discharge, high-frequency flooding, whereas dry climate is associated with low discharge and low frequency of such extreme events. However, even dry periods are related to extreme events making it complicated. The study of paleo-flood requires a robust paleoflood record and precise geochronology beyond historical or instrumental records. The current work proposes exploring these events and thus constructing past flooding history by analysing the various fluvial deposits. The Palar, Gingee, Then-Pennai, Vellar and Lower and Kaveri River and its tributary as Amravati River in Southern India, Tamilnadu was chosen for the study. These rivers receive winter monsoon as a significant source of precipitation. Being as a low discharge river in rocky terrain, these are sensitive to high precipitation events.

Luminescence dating is a widely accepted and popular method for estimating the age of sediment burial. However, sediments' partial or heterogeneous bleaching poses a problem in dating the young sediments (< 2 ka). Except for the Kaveri River, all others are ephemeral river systems, flowing for a few hundred kilometres through the rocky terrain and having a high chance of mixing unbleached weathered sand grains. Bleaching and mixing can be further enhanced by short transportation distance. Application of various luminescence age models is required to get the best age estimate for such extreme events. This study aims to test luminescence dating feasibility in a system consisting of high energy fluvial deposits, where partial bleaching could be high.

All the samples were processed for OSL dating; the quartz grains are showing relatively low sensitivity in Gingee, Vellar and Amaravati rivers and high sensitivity in the lower Kaveri River, equivalent to the calibration quartz. However, most of them suffer from partial bleaching. With the application of various luminescence age models, three sets of OSL ages were obtained. The first set (100 to 200 years BP) indicates a drastic change in climatic conditions associated with the recurring tropical cyclonic systems, which have resulted in high-frequency flooding events in recent time. The second set of OSL ages suggests a large scale flooding event between 700 – 800 years BP coinciding with the change of Medieval Warm Period (MWP) to the Little Ice Age (LIA). The third set of OSL age (2 ka to 3.5 ka) shows a shift in the Inter-Tropical Convergence Zone (ITCZ). The study suggests increased flooding in a transition zone and not in a prolonged phase of either dry or humid periods.

Earlier the southern part of the Indian Peninsula has been thought to be a tectonically stable shield area. However, the research carried out during the past three decades indicates possible unstable tectonism, at least since the Jurassic. The fluvial system in continental records response swiftly to tectonics or climate changes. The tectonic and geomorphic processes are related to each other, and the effect of change in tectonic or climate can be easily seen in the drainage systems. The current study focuses on reconstructing the Holocene evolutionary history of the Gingee and the Vellar River basin. Physiography, drainage patterns, geomorphic features, and structural controls of the Gingee and the Vellar rivers were evaluated to reconstruct the drainage basin's evolutionary history.

The morphometric approach was applied to get the tectonic signal from the Gingee and Vellar River basins. The study helped in understanding the role of tectonic elements in the evolution of the basins. The literature survey and the morphometric analysis results have been applied to obtain information about the tectonic elements and the possible reconstruction of their activity in recent times. The analysis indicates the southward tilting of the Gingee drainage systems and northward tilting of the Vellar drainage systems, strong asymmetry in some reaches, pronounced elongation of certain tributaries. All these analyses and the previous studies point towards active tectonism in the area. Because of the tilting, the Gingee River is migrating towards the south and the Vellar River towards the north, leaving their paleochannels towards the north and south, respectively. The Gingee River migrated clockwise to its current position during the mid-Holocene period ~ 3.5 ka. The Vellar River got shifted in an anticlockwise direction during 1.28 ka BP. Luminescence ages of the paleochannels also suggest that both the rivers are migrating with the same rate of ~ 4.5 km/ka.

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***Svenja Riedesel***

## Exploring variability in the luminescence properties of feldspars

*January 2021*

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*Degree: Ph.D.*
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Feldspars are the most abundant minerals in the Earth's crust and they have the ability to store charge within defects in their crystal lattice over geological time scales. This allows their use as natural dosimeters in luminescence dating studies, which enables chronologies of past geomorphological, geological and archaeological events to be established.

Despite the routine use of feldspars in luminescence dating studies over the past decades, many key questions regarding the physical processes leading to luminescence of feldspars remain unanswered. For example, the crystal defects functioning as electron trapping centres in feldspars are still unknown, and the causes of variability seen in anomalous fading rates of the blue emission (~ 410 nm) in feldspars have not been fully identified. Since feldspars are complex framework silicates with a variety of chemical compositions and mineralogical properties, linking properties inherent to the feldspar to particular luminescence characteristics is challenging. This thesis aims at establishing a better understanding of potential relationships between feldspar chemical composition, structural state and the number of phases present within a crystal and the luminescence properties of selected feldspar samples. To achieve this goal, this thesis investigates the luminescence properties of a selection of single crystal feldspars and feldspars of grain mixtures extracted from sediment and bedrock, by using a combination of excitation and emission spectroscopy, photo- radio-, thermo- and infrared stimulated luminescence and anomalous fading measurements.

Electron trap depths ranging from 2 eV to 2.4 eV were found in chemically and structurally different feldspars. The IR resonance peak, likely reflecting the first excited state of IR-sensitive electron trapping centres, is located 1.45 eV above the ground state of the trap. Similarities in energies measured for the ground and excited state energies across the sample suite indicate that defects functioning as electron trapping centres are likely located on the Si,Al-framework. Site-selective infrared photoluminescence (IRPL) excitation-emission spectroscopy revealed up to three different lattice environments in which the investigated electron trapping centres might be located. A comparison of chemically and structurally different alkali feldspars indicated the presence of $K^+$ ions on M sites as one likely influence of the lattice environment of electron trapping centres in feldspars. Disorder of the tetrahedral site occupancy of $Al^{3+}$ ions has only little effect on electron trapping centres and related IRPL emissions, and no correlation was found between the number of phases present in a single crystal feldspar (i.e. whether it is single phase or perthitic) and electron trapping centres. Thus, observed differences in electron trap depths and IRPL emissions are influenced by additional factors, not explored in this thesis.

The width of the sub-conduction band-tail states range from 0.2 to 0.8 eV in the samples investigated. This suggests different impacts on charge mobility, and stability of trapped electrons in these samples. The intensity and stability of the blue luminescence emission (~ 410 nm), the emission most commonly used in luminescence dating studies, is suggested to be influenced by the degree of order of $Al^{3+}$ ions on the framework. It is proposed that crystal defects giving rise to the blue luminescence emission are not only related to feldspars from geological environments where the high structural state (disorder of $Al^{3+}$ ions on the framework) is retained during rapid cooling of the magma (e.g. volcanic origin), but is also related to perthites. In perthites the interfaces between K- and Na-feldspar lamellae are likely to host a high density of defects, resulting not only in intense blue emission, but also in high anomalous fading rates, making fading correction of luminescence ages inevitable.

Research in this thesis shows the complexity of factors influencing luminescence properties in feldspars, which has to be kept in mind, when trying to further improve the use of feldspars as natural luminescence dosimeters.

***Maria Schaarschmidt***

## Luminescence dating of archaeological and geomorphological sites in central Myanmar and northern Vietnam, Southeast Asia

*March 2021*

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*Degree: Ph.D.*
*Supervisors: Prof. Richard Roberts, Prof. Bo Li*

Southeast Asia plays a key role in understanding the dispersal of early modern humans through South Asia into Australasia. The routes they took are still debated, as is the timing of initial modern human dispersal out of Africa. Multiple scenarios are possible, mainly focussed on Marine Isotope Stages 5 (130 – 70 ka) through 3 (57 – 30 ka). During these periods, environmental conditions in Myanmar and Vietnam would have allowed for diverse nutrition strategies and options for shelter. Caves and rock shelters in Myanmar and Vietnam commonly contain evidence of human activity, including stone artefacts and fossil remains. Establishing reliable chronologies for such sites can therefore provide insights into the timing of human occupation and possible routes of hominin dispersal through mainland Southeast Asia.

Archaeological and geomorphological sites may be dated using a variety of geochronological methods. Luminescence dating is potentially applicable to sediments deposited in the last few hundreds of thousands of years, which is the reliable age range for two ubiquitous minerals, quartz and K-feldspar, found in many depositional settings. However, only a few sites in Southeast Asia have been dated using luminescence methods. In this study, four archaeological and geomorphological sites in Myanmar and Vietnam were investigated: Badahlin Cave, Gu Myaung Cave and the Chauk river terraces in central Myanmar, and Nguom rock shelter in northern Vietnam.

Twenty-seven samples were prepared for luminescence dating, using a range of grain-size fractions of quartz and K-feldspar. The optically stimulated luminescence (OSL) signal from individual grains of quartz was measured using a standard single-aliquot regenerative-dose procedure. Single grains of K-feldspar were measured using a two-step post-infrared infrared (pIRIR) procedure, together with a regional standardised growth curve constructed for these samples. The $L_nT_n$ method was used to estimate the equivalent doses for the K-feldspar samples, some of which were

also measured using the infrared radiofluorescence (IR-RF) signal. Environmental dose rates were estimated using beta counting and in situ gamma-ray spectrometry.

The deposits in Badahlin Cave were dated to between ~ 54 and ~ 3 ka, with consistent ages obtained from quartz and K-feldspar for most of the samples. The OSL ages range from ~ 54 ka at the base of the excavation to ~ 5 ka at the top, while the pIRIR ages range from ~ 47 to ~ 3 ka. Systematically and significantly older ages were obtained using the IR-RF signal for dating (~ 87 – 51 ka), likely due to an undetected and substantial residual dose. At the nearby site of Gu Myaung Cave, the ages range from ~ 19 to ~ 3 ka (OSL) and from ~ 17 to ~ 1 ka (pIRIR). As at Badahlin Cave, the IR-RF ages are significantly older (~ 100 – 39 ka). The Chauk terraces flanking the Irrawaddy River were dated using OSL and pIRIR methods to between ~ 167 ka, for the uppermost terrace, and ~ 5 ka, for the terrace bordering the river. Samples from the middle terrace produced widely dispersed distributions of equivalent dose comprised of discrete components, with an age of ~ 75 – 8 ka considered most likely for terrace formation.

The deposits at Nguom rock shelter were dated to between ~ 41 and ~ 11 ka based on the OSL signal, whereas significantly older, maximum age estimates were obtained using the pIRIR signal (~ 187 – 26 ka). Archaeologically sterile layers in the middle part of the deposit indicate that the cave roof may have collapsed ~ 25 ka, based on the OSL and radiocarbon chronologies.

This study has found that human occupation of Badahlin Cave, Gu Myaung Cave and Nguom rock shelter commenced between ~ 40 and ~ 20 ka, during the late stages of the Pleistocene, and continued through into the Holocene. These findings add to our knowledge of modern human settlement and dispersal through Southeast Asia. The OSL and pIRIR ages obtained for Badahlin and Gu Myaung Caves are the first luminescence ages reported for any site in Myanmar, and excavations at these sites have also yielded the first evidence for bifacial stone artefacts discovered in this part of Southeast Asia. Human occupation of the Chauk terraces seems unlikely at the locations investigated, as no archaeological remains were recovered.

The OSL signal appears to be suitable for dating of Myanmar and Vietnam quartz grains and the pIRIR signal similarly for Myanmar K-feldspars, which presents the opportunity to apply these methods to other sites in the region. IR-RF dating may provide an alternative to OSL and pIRIR methods in the future, but the extent of residual signal and variability in bleaching behaviour require further investigation before reliable IR-RF ages can be obtained.

***Atul Kumar Singh***

## Luminescence Chronology of Late Quaternary Terraces in Darjeeling-Sikkim Himalaya: Implications to Climate and Tectonics

*July 2020*

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*Degree: Ph.D.*
*Supervisor: Dr Manoj Kumar Jaiswal*

The Himalaya formed due to collision of the Indian and Eurasian plate ~ 50 Ma. Since then it has not been only tectonically active but also has modulated the regional monsoonal precipitation. The Himalaya hold many secrets of past tectonic activities and climate change. This study uses two of geomorphic proxies viz. alluvial fans and fluvial terraces which act as archives preserving information about the past. This study aims at unveiling the past climate changes and tectonic activities during Late Quaternary in Darjeeling-Sikkim Himalaya (DSH).

Alluvial fans are important geomorphic archives because of its strategic location at mountain front. It forms when the sediment supply overwhelms the water discharge and such condition could only be achieved in certain tectonic or climatic setting. We provide a detailed luminescence chronology of Matiali alluvial fan in north West Bengal, India. The regional fan surface (T4) has been dissected by E-W trending Himalayan thrusts known as Matiali and Chalsa thrusts and have various terraces named as T3, T2 and youngest one as T1. Luminescence ages suggest that the formation of the alluvial fan (regional surface) started before 171 ka and continued till 72 ka covering a time span of nearly 100 ky; suggestive of weaker monsoon at 72 ka. Matiali fault activated after 171 ky. Chalsa fault is suggested to be active during 48 – 41 ka. The last aggradational phase was around 6 ka which led to the formation of T1a terrace. The study suggests that climatic fluctuation during this period were shaping the morphology of the alluvial fan, along with tectonic activities on the two faults.

Further investigation to the south of the Matiali fan reveal the existence of an active fault known as the Baradighi fault. The activity on the Baradighi fault started around 25 ka and it was active in recent past also. The drainage system in the Matiali fan as well as in the Baradighi surface has been highly modified by the tectonics. The Asymmetry factor and Basin elongation ratios also indicated that the river basins in the region are influence by tectonics whereas the Hypsometric Curves and Integral (HI and HC) indicate otherwise. The HI and HC give an idea about the dominance of erosion or tectonics, although the region is tectonically active but is mostly composed of non-lithified Quaternary sediment. Thus, it is easier for the rivers to erode into softer sediments.

Fluvial terraces in the Himalaya are also important geomorphic archives which preserve the signature of tectonics and past environment. Terraces in the DSH fold and thrust

belt have not received much attention of the geologists. An attempt to understand the evolution of paired and deformed terraces between major thrust boundaries of the eastern Himalaya, on the either banks of the Tista River in Darjeeling-Sikkim-Tibet wedge has been made. These terraces are located at the confluence of Tum Thang khola and the Tista River (near Rangpo). Three levels of terraces are present in general and also in the study area. The terrace T3 was formed during last interglacial period and the T2 terrace during last glacial maximum (LGM) and in the humid phases after LGM. The top section of T2 terrace (~ 2.5 m thick) was formed in the transition phase (arid to humid) after Younger Dryas event. The region has experienced several deformational events, (i) one after 45 ka which raised the T3 terrace to its present level, (ii) another one after 11.9 ka which raised the T2 to its present level and this event is also associated with the shifting of the Tum Thang khola, and (iii) the region is still tectonically active as shown by the warping of the T1 and T0 surfaces, which are of recent origin. These terraces have complex input of sediments from Higher Himalayan Crystalline (HHC) rocks and from locally present Lingtse granites. This study was further extended to other sections, viz. Manglay, Sintam and Sevoke for better understanding of the past climatic conditions and neo-tectonics. The study gave similar kind of results and also shows that there was a large-scale change in the gradient of the Tista River after 34 ka.

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***Giulia Tamburini***

**Thermally Transferred Optically Stimulated Luminescence (TT-OSL): a dating technique for quartz**

*March 2021*

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*Degree: M. Sc.*

*Supervisors: Marco Martini, Laura Panzeri*

Optically Stimulated Luminescence (OSL) is a very powerful technique that can date samples as old as hundred thousand years or more and its applications cover many areas of Earth sciences for the determination of the age of sediments by measuring how long ago they were last exposed to daylight. In the last few years, the use of a new signal from quartz extracted from sediments has been suggested as a new tool for optical dating. This signal, termed TT-OSL (Thermally Transferred Optically Stimulated Luminescence), originates when the sample is optically bleached and subsequently heated. Two types of transfer contribute to the appearance of this signal: recuperation (Re-OSL) and basic transfer (BT-OSL). The former is due to the presence of electrons in light-insensitive ("hard-to-bleach") traps prior to the zeroing event and remaining in these traps until the sample is heated; the latter is due to electrons in the OSL traps which, during the bleaching event, are transferred to light-sensitive traps ("refuge traps"); during preheating, some of these electrons may be transferred back to the OSL traps. TT-OSL signal appears to have the potential to extend by almost an order of magnitude the age range over which OSL luminescence dating can be applied.

This thesis work is devoted to the study of the OSL and TT-OSL signals detected in quartz, both from sediment and as a mineral with different characteristics and provenances. In particular we focused our attention on the factors that may influence its behaviour and on the identification of the traps responsible for this signal studying the TL glow curves. The possibility of effectively using the TT-OSL signal to determine the equivalent dose, in order to apply it to the field of dating will be also discussed.

Firstly the dependence of the TT-OSL signal on the preheating temperature used to induce thermal transfer was studied. It was noticed for all the sample analysed that this signal increases with the temperature until it reaches a peak between 280 and 300 °C, implying that the TT-OSL source trap should correspond to an electron trap with a TL peak at temperatures above 280 °C. Mineral quartz aliquots, specifically rose quartz, show some differences from sedimentary quartz, since the intensities of their OSL and TT-OSL signals are lower by two orders of magnitude. It can be concluded that this behaviour may arise either from sensitisation processes due to repeated cycles of trapping and de-trapping, or from the different nature of the sample, as it has not been subjected to the same heat and light exposures as a sediment. For this purpose, a solar simulator was used in order to increase the intensity of OSL and TT-OSL signals in rose quartz aliquots through the repetition of light exposure and subsequent bleaching cycles of optically-active centres. It was observed that, despite this treatment, the shape of OSL and TT-OSL decay curves remain unchanged, and therefore the different origin of the sample may affect the intensity and behaviour of this signals.

Finally, in order to identify the source traps that contribute to OSL and TT-OSL signals in quartz, variations in Thermoluminescence (TL) glow curves caused by OSL and TT-OSL measurements were studied. By performing comparisons and subtractions between different glow curves, clear optical bleaching effects can be observed. In particular, it is possible to identify the presence of a TT-OSL trap associated with a TL peak at ~ 270 °C, at lower temperatures than that of OSL trap at ~ 280 °C, demonstrating that the two mechanisms have different origins, in agreement with results previously obtained. A PDF of this thesis can be acquired by contacting the author (g.tamburini@campus.unimib.it).