ORAL SESSION

Day 1 (09.22.^{MON})

Keynote Lecture

Rethinking quartz ESR dating of sediments: Addressing key challenges and potential solutions

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Electron spin resonance (ESR) dating of quartz has the significant potential for dating early to middle Pleistocene sediments and rocks. The last decades, ESR dating method has demonstrated its reliability to constrain the chronology of Quaternary deposits in Europe, Asia, and Africa, often yielding results in good agreement with independent age controls. However, the method still faces several unresolved challenges. In this presentation, we review the key unanswered questions on quartz ESR dating of sediments and discuss possible solutions to address them. 1) What is the true limit of quartz ESR dating? The laboratory dose response curves often display peculiar shapes (exponential plus linear for the Al centre or the signal decreasing at high doses for the Ti centre), which are not expected in nature, and therefore the upper limit of the quartz ESR signals is difficult to evaluate from the laboratory dose response. 2) Is a preheat necessary for ESR dating? One argument against preheating is that the ESR signal originates from a single, thermally stable trap. However, experimental results suggest that preheating may still be required. Additionally, no systematic comparison was made between the two common protocols used in ESR dating (multiple aliquot additive dose and single aliquot regenerative dose protocols) in the equivalent dose determination. 3) What is the unbleachable Al centre, and why cannot the signal be regenerated by laboratory irradiation? 4) How bleachable is the Ti centre? The bleachability of the Ti centre appears to be comparable or better than the feldspar post-IR IRSL signal. However, some sediments show significant residual doses for the Ti centre, sometimes exceeding several hundred grays, when the ages are compared with independent ages. 5) Can the relative bleachability of ESR signals vary depending on the sample, and can agreement between different centres truly be taken as evidence of complete bleaching? A better understanding of these challenges will refine ESR dating protocols and enhance robustness in age estimates for Quaternary sediments.

Keywords (max. 5): ESR dating, Quartz, dating protocol, residual, thermal stability

ESR dating of sea-floor hydrothermal barite: principles, technical advances and issues

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Since a monumental publication by Ikeya[1], various minerals have been found useful for electron spin resonance (ESR) dating, such as calcite, aragonite, hydroxyapatite, quartz, and gypsum[2]. While it was pointed out that barite ($BaSO_4$) is potentially a mineral to be utilized for ESR dating[3], practical application of ESR dating of barite was firstly reported in 2010[4] where barite is the newest mineral that was found to be useful for ESR dating. In the present paper, features of dating of sea-floor hydrothermal barite will be reviewed and issues will be summarized.

The ages of seafloor hydrothermal activities provide crucial data for discussing the potential of seafloor mineral resources and the evolution of biological communities sustained by hydrothermal activities. Barite precipitates with sea-floor hydrothermal activities when hydrothermal fluid containing Ba is mixed with sea water containing SO_4^{2-} ions. Therefore, the ages of barite will reveal the history of the sea-floor hydrothermal activities. After the first paper, there are several papers reporting technical advances as in the following and systematic dating results on hydrothermal sites around Japan[5]. The following are the technical specific features found in dating of sea-floor hydrothermal barite.

(1) SO_3^- radical is produced by radiation and is used to obtain the equivalent dose.
(2) The additive dose method is usually applied to obtain the equivalent dose. Regeneration method is not successful so far due to sensitivity change on heating, which seems to be pre-dose dependent.
(3) Ra replacing Ba sites in barite is the source of radiation. Ra concentration can be quite large (several Gy per year) and minimum detection limit of the age can be very young as several years.
(4) Maximum age detection limit would be serval thousand years due to the half life of ^{226}Ra (1600 y).
(5) The contribution of internal dose is significant; therefore, alpha effectiveness is an important factor[6].
(6) Decay of parent nuclei (^{226}Ra and ^{228}Ra) and temporal change of the daughters have to be considered. When the age is calculated from the equivalent dose, the dose rate has to integrated according to a complex formula.
(7) The water content just depends on the porosity of the sample.
(8) Dose rates from sea water and from cosmic ray can be neglected.
(9) As the barite contains ^{226}Ra and ^{228}Ra, ages are also obtained with radioactive disequilibrium of these nuclei. When compared, its was found that these ages tend to be consistent with ESR ages in young samples but the differences are larger in older samples, which is interpreted by multiple formation of barite crystals, i.e., they were not formed by a single event but by several events of different age[5].

Keywords (max. 5): barite, ESR, hydrothermal, radium, sea-floor

[1] Ikeya, M., 1975. Nature, 255, 48-50.
[2] Ikeya, M., 1993. New Applications of Electron Spin Resonance, Dating, Dosimetry and Microscopy, World Scientific.
[3] Kasuya et al., 1991. In Essay in Geology, Prof. Nakagawa Commemorative Volume, 95-98.
[4] Okumura et al., 2010. Geochronometria. 37, 57-61.
[5] Fujiwara et al., 2015. In Ishibashi J, Okino K, Sunamura M eds., Subseafloor Biosphere Linked to Global Hydrothermal Systems; TAIGA Concept. Springer, Tokyo, Chap. 29, pp. 369-386.
[6] Fujiwara et al., 2016. Geochronometria. 43, 174-178.

Zero-dose-residual correction of ESR Al-centre signals

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Electron spin resonance (ESR) thermochronometry of quartz minerals presents a promising tool for reconstructing rock cooling histories throughout the Quaternary, a timescale poorly resolved by existing geochronological methods. Recent advances include the implementation of a single aliquot regenerative dose (SAR) protocol, incorporating an annealing step (typically 400 °C for 2–4 minutes or 300 °C for 2 hours) to reset the ESR signal prior to dose response measurements. However, analyses of quartz from the same lithology with varying natural equivalent dose values reveal that this annealing treatment is not universally effective; some samples retain more than 10% of the natural Al-centre signal, corresponding to a significant fraction of the maximum saturation signal.

This study focuses on quartz extracted from different bedrock samples to evaluate the effects of prolonged thermal treatment on signal sensitivity and to assess three correction strategies for addressing the zero-dose-residual. Results demonstrate that extended heating at 400 °C can cause sensitivity changes in some samples, while shorter heating durations have negligible effects. To address residual signals that remain post-annealing, we recommend an extrapolation-based correction approach, in which the zero-dose-residual equivalent dose is added to the SAR regenerative doses before curve fitting. For this, the SAR data need to be fitted using a single-aliquot-additive-dose (SAAD) method, treating the zero-dose-residual signal as the natural dose and extrapolating back to determine its equivalent dose.

Our findings underscore the need for caution when interpreting ESR signals from thermally treated quartz and highlight the importance of accounting for zero-dose-residuals to ensure accurate apparent age and thermal history estimations. The proposed correction method enhances the reliability of ESR thermochronometry in low-temperature geochronological studies.

Keywords: ESR thermochronometry, Al-centre, quartz, residual correction, sensitivity change

Towards Electron Spin Resonance dating of anthropogenic carbonates: ESR signals of historical lime mortars

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Anthropogenic carbonates such as lime mortars and plasters have been receiving growing attention as they are an invaluable source of information for archaeologists, conservators, and restorers of cultural heritage. Taking into account the production process, the age of mortars reflects the age of the building. Two physical dating methods currently enable us to date mortars: radiocarbon (^{14}C) dating and optically stimulated luminescence (OSL), however both are not yet considered routine, due to a number of limitations.

In this study we present the ESR analysis of historical lime mortars, as a first part of the ongoing project focused on establishing ESR as a method of dating anthropogenic carbonates in a form of lime binders. Since carbonate crystals are formed during the mortar production, this moment can be regarded as the zero point for the accumulation of trapped charges, and their concentration in a measured sample should reflect the age of the mortar.

We investigated ESR signals in natural and laboratory-irradiated lime binders from several different archaeological sites, with ages ranging from about 2800 to 500 years old. The samples have been previously dated by radiocarbon method, which means they had undergone extensive characterisation and preparation, ensuring the selection of binder, which reflects the true age of the mortar. Since the samples were originally collected for radiocarbon dating no data on the annual doses was available, hence the goal of this work is a qualitative analysis of the signals found in a variety of mortars, assessing their potential suitability for dating. Despite the relatively young age of the investigated samples for ESR dating, measurable signals were detected in natural materials. With the aid of ESR simulations, signals commonly found in carbonates, such as CO_2^- isotropic and orthorhombic, CO_3^- orthorhombic, NO_3^{2-} and NO_2^{2-}, SO_2^- isotropic, SO_3^- axial and isotropic, surface defect caused by crushing, organic radical, as well as a signal caused by pyrolysis of organic matter, were identified in the laboratory irradiated samples. As there are almost no examples of ESR dating of Holocene carbonates, lime binders present an exciting opportunity to push forward the boundaries of ESR dating, which has great implications for Quaternary geology, and historical archaeology.

Keynote Lecture

Rock optically stimulated luminescence (OSL)-depth profiles (DPs) and its applications

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When the rock or cobble surface is exposed to sunlight, due to processes such as faulting, river transport, or surface erosion, the luminescence signals of feldspars at their surface can be reset. Over time, a significant amount of photons will penetrate beneath the surface, though their number attenuates exponentially with depth. If exposed surfaces are later buried, the luminescence signal builds up again. In this study, we show how rock optically stimulated luminescence (OSL)-depth profiles (DPs) provide a novel means of reconstructing and quantifying fault slip, and how to establish OSL-DPs of upper and lower sides of fluvial cobbles and obtain the burial ages of cobbles from terrace. Age-Temperature plateau and Age-Depth plateau are encouraged to use jointly to evaluate the reliability of cobble OSL dating from the view of fading and bleaching. The bleaching pattern of OSL-DPs between upper and lower sides may reflect the transportation and deposition history of cobbles, providing a new perspective for fluvial dynamics.

Keywords: Rock OSL- depth profiles, Age-temperature (A-T) plateau, bedrock fault scarps, fluvial dynamics

Pattern identification of spatially resolved luminescence images – gradient based analysis

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The development of portable luminescence imager and in-lab EMCCD instruments has promoted the spatially resolved luminescence measurements over the last ten years. The spatial patterns of luminescence signals of the materials, e.g., rocks, gravels or archaeological remains, shown by the in-situ luminescence images, could be inverted to unravel the combined bleaching (light or heat) and dosing history, resulted from cracking, mass removal, transport and burial events. The luminescence intensity vs. depth profiles across the sample are commonly utilized to model these events. 2D data from in-situ luminescence images allow detailed patterns, e.g., the bleached plateau and bleaching front, to be identified in the field. In this study, we will develop and show gradient based analysis to identify the pattern and higher order signature of spatially resolved luminescence and to invert the heating, bleaching and burial histories. The interferences due to inhomogeneously distributed luminescent grains and measurement noises will also be investigated and procedures to circumvent these interferences will be proposed.

Keywords: bleaching, dosing, gradient, rock, noise

Sediment source shifts in the Yangtze River induced by the Three Gorges Dam: insights from single-grain luminescence sensitivity

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The Yangtze River, the longest river in Asia, plays a vital role in sustaining ecological processes and human livelihoods through the transport and deposition of sediments. However, the construction of large-scale hydraulic structures, such as the Three Gorges Dam (TGD), has profoundly disrupted the river's natural sediment regime. Since its operation, the TGD has markedly altered the hydrodynamics of the Yangtze River, resulting in a 74% reduction in sediment flux during the period 2006–2017 compared to the pre-dam baseline from 1950–1985. In this study, we investigated how this anthropogenic intervention has changed downstream sediment transport, using single-grain quartz luminescence sensitivity as a provenance tracer. Measurements were performed using an EMCCD attachment, allowing for the measurement of both thermoluminescence (TL) and optically stimulated luminescence (OSL) sensitivities in the same quartz grain. A total of 46 quartz sand samples were collected and analyzed, including 32 from riverbeds and confluence zones of Dongting Lake, Han River and Poyang Lake, and 14 from mid-channel bars. Coarse-grained quartz (180–250 μm) was used in all measurements. The results reveal a significant change in the distribution of luminescence sensitivities along the river: for roughly the first 400 km downstream of the dam, sediments contain a higher proportion of highly sensitive quartz grains, but this proportion declines farther downstream. Meanwhile, samples from confluence zones display significantly lower luminescence sensitivities and narrower distributions compared to both upstream and downstream samples. This suggests that tributary inputs contribute minimally to the coarse-grained sediment load downstream. The spatial pattern of luminescence sensitivity in riverbed sediments is consistent with enhanced bank and channel erosion, as documented in channel profile surveys reported in the Changjiang Sediment Bulletin. These findings indicate that the dam has increased the riverbed and bank erosion, transforming the middle and lower reaches of the Yangtze from sediment transport pathways into significant sediment sources. This study highlights the potential of single-grain luminescence sensitivity as a powerful tool for investigating such sediment dynamics, and underscores the role of dam operations in shaping sediment dynamics, provides essential insights for managing sediment budgets and ensuring ecological sustainability in large river systems.

Keywords: Luminescence sensitivity, Yangtze River, Sediments provenance, Anthropogenic impact, EMCCD

On the failure of dose recovery test in K-feldspar pIRIR dating: a case study using desert sediment samples from northern China

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Abstract:
Luminescence dating, as a broadly-used technique for dating Quaternary sediments, plays a pivotal role in reconstructing paleoenvironments and studying landform evolution in arid regions. Quartz and feldspar are the two most commonly used minerals for luminescence dating. However, in the deserts of northern China, quartz often exhibits aberrant luminescence characteristics such as dim optically stimulated luminescence (OSL) signal and/or low saturation dose, compromising their reliability for dating sediment samples. In contrast, potassium-rich feldspar (K-feldspar) demonstrates significant advantages in dating applications due to brighter signals and higher saturation doses of its infrared stimulated luminescence (IRSL) and post-infrared infrared stimulated luminescence (pIRIR) signals. Nevertheless, many studies have found that for some K-feldspar samples, the IRSL and pIRIR signals fail to accurately recover the given laboratory dose in dose recovery tests, raising questions about the reliability of their dating results. Understanding the reasons for the failure of the dose recovery test is essential for establishing robust dating procedures for K-feldspar dating.

This study aims to investigate the factors influencing K-feldspar dose recovery test results conducted using the multi-elevated-temperature pIRIR (MET-pIRIR) dating procedure. Nine K-feldspar samples extracted from desert sediments at the southern edge of the Gurbantunggut Desert in Xinjiang Province, China were investigated. For all of these samples, dose recovery tests conducted on aliquots bleached for 8 hours under a solar simulator yielded underestimated dose recovery ratios for both IRSL and pIRIR signals, with the degree of underestimation varying among samples. To understand the causes of the systematic dose underestimation for these samples, a series of experiments were performed to assess the effects of various factors, including preheat temperature, the size of test dose, the number and temperature of pIRIR measurement steps, bleaching light source, and initial sensitivity change.

The results indicate that measurement temperature, the size of test dose, bleaching light source, and initial sensitivity change induced by preheating can all impact the outcomes of dose recovery test for the investigated samples. However, the dominant factor contributing to the underestimated dose recovery ratio differed among samples. Consequently, for a specific sample, the selection of a suitable dating procedure should be guided by the key factor that most significantly affect the accuracy of its D_e determination. This study underscores the importance of systematic dose recovery investigations in K-feldspar luminescence dating, and highlights the necessity of considering between-sample variability when designing dating procedure for samples from the same region.

Keywords： K-feldspar; MET-pIRIR; Dose recovery test; D_e underestimation

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Keynote Lecture

Statistic considerations in single-grain optical dating of quartz

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In single-grain optical dating, a sample's equivalent dose (D_e) is estimated from statistical analysis of the distribution of D_e values of individual grains. Various statistic models have been proposed to analyse the single-grain D_e values. Conventionally, such analysis has been based on frequentist approaches, including the most commonly used models such like central age model (CAM) for dealing with well bleached samples, minimum age model (MAM) for poorly bleached samples and finite mixture model (FMM) for disturbed or mixed samples [1]. Recent development of Bayesian models has allowed the incorporation of the key parameters involved in age estimation, such as the dispersion of single-grain dose rates, natural variability among grains, as well as their associated measurement uncertainties. In this study, key sources of variability causing the spread in observed D_e values are investigated based on computer simulations. The influence of various parameters on the dating results using various statistic models, such as CAM, average dose model (AMD) [2], Bayesian hierarchical age model (BHAM) [3], is assessed based on simulated data sets. The results suggest that the performance of statistic models relies on the understanding of the sources of variability in the observed data. The advantages and drawbacks of various models are discussed.

Keywords: single grain, quartz, statistical model, simulation

References:

1. Galbraith, R.F. and R.G. Roberts, Statistical aspects of equivalent dose and error calculation and display in OSL dating: An overview and some recommendations. Quaternary Geochronology, 2012. 11: p. 1-27.
2. Guérin, G., et al., Absorbed dose, equivalent dose, measured dose rates, and implications for OSL age estimates: Introducing the Average Dose Model. Quaternary Geochronology, 2017. 41: p. 163-173.
3. Li, B., Z. Jacobs, and R.G. Roberts, A Bayesian hierarchical age model for optical dating of single grains of quartz. Quaternary Geochronology, 2023. 77: p. 101455.

Sensitization of OSL and TL signals of quartz from bedrock and se diments: coupling and decoupling

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The 110°C thermoluminescence (TL), 325°C TL, and optically stimulated luminescence (OSL) signals of quartz are interconnected in terms of their electron trapping or recombination, and the sensitivities of these three signals to radiation dose are expected to co-vary. Although paired sensitivities of these luminescence signals and co-variation of them have been employed to trace the quartz provenance and determine the equivalent doses, the ambiguity of our understanding on related processes sometimes lead to the failure of such applications. In this study, dosing-bleaching cycles and dosing-annealing cycles are employed to sensitize the 110°C TL, 325°C TL, and OSL signals of quartz extracted from eight rock and sediment samples, which the pristine luminescence sensitivities vary a lot. Our results show that the sensitization of all three signals depend on their initial sensitivities, and their sensitization processes display complex coupling and decoupling behaviors, with a slight dependence on the lithology. The mechanisms and implications of these results for dating and provenance characterization will also be discussed.

Keywords (max. 5): quartz, sensitization, luminescence, dating, provenance

Thermoluminescence paleothermometry – A new method for terestrial surface air temperature reconstruction and its application to key sites in the northern hemisphere

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Quantifying the magnitude of past climate variations is essential for improving our understanding of the climate system in general and for constraining climate sensitivity. While various proxies allow for surface air temperature reconstructions, methodological challenges and preservation issues limit their spatial coverage and the timeframes for which they can be effectively applied. Consequently, for major climate system shifts – such as the Pleistocene-Holocene transition, marked by rapid warming and environmental adaptations following the Last Glacial Maximum (LGM) – the scarcity of terrestrial records increases uncertainty in continental temperature reconstructions, especially in the tropics.

Recently, low-temperature thermoluminescence (TL) signals of feldspar (200–280 °C) have been demonstrated to be sensitive to terrestrial temperature fluctuations over geological timescales, making them a valuable tool for reconstructing past surface temperatures in terrestrial environments. Using physical principles derived from trapped charge dating, the trapped charge population can be used to infer paleotemperatures in the form of the most likely time-temperature paths through inverse modeling. This process incorporates time-resolved relative temperature records – such as Greenland ice sheet $\delta^{18}O$ data, speleothem records, or pollen records – as additional model constraints.

This contribution first discusses the method's basic principles and persisting challenges. We then present methodological improvements and results from validation samples with known thermal history. Finally, we show preliminary results of surface air temperature reconstructions since the LGM at several study sites, with the ultimate goal of integrating these data with other Euro-African records to better constrain the evolution of altitudinal and latitudinal surface air temperature gradients since the LGM.

Keywords (max. 5): K-feldspar, Temperature reconstruction, Paleoclimate, Thermochronometry, Validation

Progress Towards Reproducible Luminescence Data Analysis: The REPLAY Project

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Accessible and transparent software tools for luminescence data analysis are undoubtedly beneficial to the reproducibility and reliability of dating results. In a century where discipline boundaries are pushed through the mining of increasingly larger datasets, and the implementation of machine learning-driven approaches, access to user-friendly discipline-specific software tools becomes paramount.

Within the luminescence dating community, several applications and scripts have evolved predominantly within the ecosystem of the statistical programming environment R. One such application is the R package 'Luminescence' [1]. Established 13 years ago, and with now 24 developers, it has demonstrated some success in fostering a community-driven, reproducible, and open research software framework through a bottom-up approach. However, open-access R code does not guarantee transparency and reproducibility. Additionally, R scripts can be challenging especially for, and even large language models can only generate code with meaningful context if training data is high-quality and complete.. Within the software project REPLAY, we have made a new push towards usability and considerably intensified our efforts to enhance the user-friendliness and robustness of luminescence data analysis with R. As a first step, throughout the past year, we have fully implemented the FAIR principles (Findability, Accessibility, Interoperability, and Reusability) for research software, improved the stability and code quality of 'Luminescence', and initiated the refactoring of 'RLumShiny' [2] as its graphical user interface.

Our presentation will spotlight key milestones and implemented quality measures (e.g., automated testing, snapshots, usability measures). While the underlying technical aspects are indeed intriguing, the primary focus will be on reproducibility aspects, user-visible modifications, and practical benefits for everyday work in the trapped-charge dating community.

Keywords: data analysis, R, reproducibility, software, luminescence

[1] Kreutzer, S., Burow, C., Dietze, M., Fuchs, M.C., Schmidt, C., Fischer, M., Friedrich, J., Mercier, N., Philippe, A., Riedesel, S., Autzen, M., Mittelstrass, D., Gray, H.J., Galharret, J.-M., Colombo, M., Steinbuch, L., de Boer, A.-M., 2025. Luminescence: Comprehensive luminescence dating data analysis. v1.1.0 DOI: 10.32614/CRAN.package.Luminescence

[2] Burow, C., Wolpert, U.T., Kreutzer, S., Colombo, M., 2025. RLumShiny: "Shiny" applications for the R package "Luminescence." v0.2.4. DOI: 10.32614/CRAN.package.RLumShiny

ORAL SESSION

Day 2 (09.23.^{TUE})

Keynote Lecture

Reminiscing Five Decades of Cohabitation with Luminescence Dating

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This presentation will trace landmark contributions that were cardinal to luminescence dating gaining universal acceptability due to key methodological contributions by Martin Aitken's group in Oxford and by Vagn Mejdahl's group at Riso. Their contributions included, a) development of reliable instrumentation; b) understanding of the physics of mineral luminescence; c) methods to compute radiation dose in nature despite heterogeneous distribution of natural radiation dose and, d) isolation of luminescence arising from diverse mineralogizes. Demonstration of Optically Stimulated Luminescence by Dave Huntley's group at Vancouver, and infrared stimulated luminescence from feldspars by Galina Huett's group at Tallinn revolutionized luminescence dating. Lars Boetter-Jensen and his team at Riso developed automated TL-OSL readers and capabilities for single grain luminescence which enabled improved methodological rigor through the ease of reproducible measurements. Presently, luminescence dating occupies a centre stage in Quaternary Sciences with ~ 4000+ publications annually.

Luminescence dating is a good example of synergistic mutualism between Physics and Geology as many new phenomena in the solid state were discovered through unexpected results from applications, such as e.g. changes in the rates of linear energy transfer on the luminescence yield and efficiency of luminescence production; complexity in growth of luminescence with radiation dose due to competitions for charges between traps and trap saturation effects; quantum mechanical leakage of trapped charges in feldspars and heterogenous distribution of radiation dose in nature..

Complimenting this, have been the applications domain where luminescence dating made it possible to provide rates and timelines of varied geomorphic processes, where none was available. Some noteworthy applications include, the Dunes Atlas, paleo-flood chronologies, elucidation of complexities in land-sea correlations, chronologies of the past- temperatures/climates, paleo-seismology, soils, denudation rates, thermochronology, provenance and the like. Luminescence dating is now providing numerous socially useful products. This talk will present some examples of this mutualism and outline some interesting future possibilities [3].

1. A.K. Singhvi, R.K. Kaushal and S. Parida 2022. Luminescence dating and Quaternary Geology: The Indian Narrative, *J. Paleontological Society of India*. 67(1). 183-201.
2. A.S. Murray, L. Arnold, J-P. Buylaert, G. Guerin, J. Qin, A.K. Singhvi, R. Smedley and K.J. Thomason, Optically Stimulated dating using Quartz. *Nature Reviews Primers*. Doi.org/10.1038/s43586-021-00068.
3. A.K. Singhvi, 2023. INQUA in India: Some Reminiscences and Some Anticipations. *J. Paleosciences*, 72, 69-79.

Reconstruction of Long-Term Fault Activity Using OSL Dating of Paleo-Surface Deposits: A Case Study of the Pamir Frontal Thrust Zone

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Accurate dating of paleoseismic events is fundamental for quantifying fault activity patterns and assessing seismic hazards. Optically stimulated luminescence (OSL) dating has emerged as a primary chronological method for constraining paleoseismic ages, particularly in organic-poor depositional environments. However, coseismic deposits in paleoseismic trenches are typically characterized by rapid, proximal sedimentation, often resulting in insufficient sunlight exposure and incomplete OSL signals bleaching, leading to systematic age overestimation. While methodological improvements (e.g., single-grain OSL and minimum age models) have addressed some limitations, challenges persist due to quartz sensitivity issues and anomalous fading of K-feldspar. The Pamir Frontal Thrust Zone represents the northern deformation front of the western Himalayan syntaxis, exhibiting intense late Quaternary tectonic activity and frequent moderate-to-strong earthquakes. The 1985 Mw 6.9 Wuqia earthquake produced a surface rupture zone exceeding 22 km along this fault. A large paleoseismic trench clearly reveals 9 paleos eismic events, including the 1985 earthquake.

To address signal resetting issues, we employed an sampling strategy focusing on pre-earthquake paleo-surfaces deposits with prolonged sunlight exposure instead of traditional coseismic or post-seismic deposits. Based on this sampling strategy, we conducted a comprehensive study of the 9 paleoseismic events recorded in the trench. Using coarse grain quartz (9 mm aliquot) SAR, as well as coarse grain K-feldspar SG-pIRIR, we compared the ages of the pre-1985 paleo-surfaces with overlying silt deposits, and aeolian dune sands. The results precisely constrain the age sequence of the 9 paleoseismic events since 22 ka, revealing a mean recurrence interval of ~2.6 ka. This study presents the first long-term paleoseismic sequence documented in a single large thrust fault trench worldwide, providing critical scientific evidence for seismic hazard assessment in the region.

Keywords : Long-Term Fault Activity, OSL dating, Paleo-Surface Deposits, the Pamir Frontal Thrust Zone

A Novel Application of the Post-Isothermal Infrared Stimulated Luminescence (pIt-IR) Technique to Two IODP Cores from the Bay of Bengal, Northern Indian Ocean

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It was demonstrated over 45 years ago by Wintle & Huntley (*Nature*, 1979) that mineral grains of the deep-sea sediments can be used to estimate their depositional age. There have been limited attempts to expand such research into the paleoceanographic studies, with varying degrees of success. The main difficulties encountered include the incomplete bleaching and inaccurate estimation of the dose rate. In this study, we present results of a systematic optically stimulated luminescence dating investigation of purposely collected deep-sea sediments in two cores retrieved from the Bay of Bengal during the IODP Expedition 353 in the Northern Indian Ocean. While conventional SAR protocols for quartz and polyminerals of the fine-grained (4-11 um) fraction are used for luminescence measurements, the post-isothermal infrared stimulated luminescence (pIt-IR) proposed by Lamothe et al. (*Quaternary Geochronology*, 2020) was tested on the fine-grained polyminerals. Experiments include both single-aliquot and multiple-aliquot approaches and with a variety of low and high stimulation temperatures. The equivalent doses or paleodoses, up to 600 Gy, obtained are compared. The near core top samples are used to evaluate applicability of the methods. We measured U, Th and K which are ubiquitously present in the surroundings. However the complication in uranium-chain disequilibrium in the marine sedimentary environments makes the calculation of the dose rate very difficult. We estimate the potential uncertainties in the three parts of the dose rate calculation by combining the measured and modeled results of isotope contents and activities. The data obtained so far (including core top and down core samples) are shown to have the potential in circumventing the effects of signal instability and incomplete bleaching commonly encountered in luminescence dating of sedimentary feldspars.

Keynote Lecture

Accident dosimetry using TL/OSL techniques in South Korea: From development to practical application

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Retrospective dosimetry is a technique used to estimate the radiation dose received by individuals who were not wearing personal dosimeters at the time of a radiological emergency or unexpected exposure incident. It plays a critical role in emergency response, particularly for the initial triage of highly exposed individuals requiring urgent medical attention and for confirming exposure levels in the potentially exposed population to alleviate psychological distress among the so-called "worried well." For accurate dose assessment, the importance of a multi-assay approach, which integrates multiple techniques such as physical measurements (e.g., thermoluminescence/optically stimulated luminescence (TL/OSL), electro paramagnetic resonance (EPR) techniques), biological analyses (e.g., cytogenetic assays), and computational simulations, has been increasingly emphasized.

Among the various retrospective dosimetry methods, TL/OSL techniques have gained significant attention for their ability to utilize commonly carried personal items as fortuitous dosimeters. Key materials include display glass and surface-mounted components (SMDs) like resistors from smartphones, as well as smart chips embedded in credit cards or SIM cards. These items are widely available, easily retrievable after an incident, and offer short measurement times (typically under one hour per sample), making them highly effective for rapid screening in the early response phase. Recently, research has expanded beyond smartphones to include low-cost electronic devices such as wireless earbuds and headphones, which are more accessible and disposable.

This study presents the current development and application status of various TLOSL-based techniques in South Korea. Key topics include: exist protocols for measurement using display glass, resistors, and smart chip cards; emerging TA-OSL and PTTL methods designed to improve signal fading characteristics; development of on-site systems and miniaturized modules to reduce delays in sample collection and laboratory transport; field tests replicating virtual exposure accident in collaboration with domestic and international partners to validate the reliability of these techniques; calculation methods for dose conversion coefficients for estimating organ doses; and a discussion of the application of these techniques in actual small-scale exposure incidents and from a regulatory perspective.

Keywords (max. 5): Thermoluminescence, Optically stimulated luminescence, radiological accident, retrospective dosimetry

Optically stimulated luminescence dating of coastal sediments from southwestern Korea: some discontinuities with concentrated organic layer

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The fourteen sample were collected from three outcrops from the Ujeon Coast of the southwestern Korean Peninsula. A single-aliquot regenerative-dose(SAR) optically stimulated luminescence(OSL) and single-grain post-infrared infrared stimulated luminescence(pIR-IRSL) were applied to quartz grains of 4-11㎛ in diameter and K-feldspar grains of 180-212㎛ in diameter, respectively. As a result of fine-grai ned quartz OSL, the OSL ages range from 127±8.12 ka to 0.15±0.01 ka and are mostly in stratigraphic o rder. In contrast, the age reversal occurred in the lower part. In the case of the fine-grained quartz, equivalent dose(De) steadily increased throughout the sequence. And, most aliquots passed the acceptance criteria to check the SAR suitability. Also, the shape of the decay curve is dominated by the fast component. A pIR-IRSL using K-feldspar was applied to the same sample to determine whether the age underestimation was caused by saturation of equivalent dose in quartz and for extending the age range. Despite the ~20% increase in pIR-IRSL ages of K-feldspar single grain compared with fine-grained quartz ages, the age reversal still existed in the same section as fine-grained quartz OSL. The age reversal may have arisen mainly from a sudden increase of 150% dose rate to the lower part. On significant potential error in dose rate determination is the non-consideration of the attenuation of organic-rich sediments and intercalation of low dose layer. The dose attenuation caused by organic material is substantial and our correction may not be sufficient for this. In this study, an experiment was conducted on the dose rate measurement and the effect of the direct organic layer to overcome the limitations of dose rate measurement. Also, the reliability of OSL ages from the high-dose linear region of the dose-response curve was considered.

Keywords (max. 5): single grain K-feldspar, fine grain Quartz, pIR-IRSL, dose rate, Korean Peninsula

Thermoluminescence Signal Resetting of a Polymineral Sample in Laboratory-Produced Fault Gouge Layers

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Luminescence dating methods have been applied to a specific type of fault rock known as fault gouge to unravel the timing of the last seismic activity of a fault. However, the routine application of these methods has resulted in overestimated ages in various geological settings compared to other age controls derived from instrumental period seismicity or the dating of sedimentary features formed by past earthquakes.

This discrepancy is likely caused by the complexity and uncertainty involved in the development of frictional heat in fault gouges during co-seismic slip events. Frictional heat production is a highly localised process that, among others, depends on the host rock characteristics. If the friction-induced heating is insufficient during the fault slip, partial signal resetting occurs.

To gain a deeper understanding of the extent of signal resetting during a major earthquake, friction experiments employing a rotary shear apparatus have been conducted in several studies[1,2,3] to simulate fault gouge deformation in a laboratory setting. Those experiments were carried out only on prepared quartz. However, we hypothesise that the luminescence signal resetting depends upon the host rock and cannot be readily generalised.

Hence, for our contribution, we utilised chemically untreated volcaniclastic host rock material from an active fault located south of the Alborz Mountains (Iran). The sample was first reset by heating at 400˚C and then irradiated with a known gamma dose. To compensate for the low-slip velocity (5 cm s^{-1}) of our rotary shear apparatus, we increased the applied normal stress to 12 MPa. The temperature evolution of the gouge layer during the friction experiment was monitored using a high-speed infrared camera. We then measured the thermoluminescence (TL) and TL spectra signals from three subsamples and compared those results with those from the untreated material.

We observed that the spatial temperature evolution along the rotary shear apparatus was not uniformly distributed and that temperatures of ca. 300 °C were reached only in a localised high-friction zone. We will present the experimental setting and the results obtained, and discuss the implications for fault gouge dating.

References

(1) Yang, H. L.; Chen, J.; Yao, L.; Liu, C. R.; Shimamoto, T.; Thompson Jobe, J. A. Resetting of OSL/TL/ESR Signals by Frictional Heating in Experimentally Sheared Quartz Gouge at Seismic Slip Rates. *Quaternary Geochronology* **2019**, *49*, 52–56. https://doi.org/10.1016/j.quageo.2018.05.005.

(2) Kim, J.H., Ree, J.-H., Choi, J.-H., Chauhan, N., Hirose, T., Kitamura, M., 2019. Experimental investigations on dating the last earthquake event using OSL signals of quartz from fault gouges. Tectonophysics 769, 228191. https://doi.org/10.1016/j.tecto.2019.228191.

(3) Oohashi, K., Minomo, Y., Akasegawa, K., Hasebe, N., and Miura, K.: Optically Stimulated Luminescence Signal Resetting of Quartz Gouge During Subseismic to Seismic Frictional Sliding: A Case Study Using Granite-Derived Quartz, J. Geophys. Res. Solid Earth, 125, https://doi.org/10.1029/2020JB019900, 2020.

Revisiting the beach-ridge set hypothesis in Japan using K-feldspar luminescence dating

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Beach ridges are widespread coastal landforms formed when dunes or beaches are abandoned inland due to shoreline progradation driven by sediment supply. With accurate chronology, they offer valuable insights into past shoreline positions and long-term variations in coastal sediment dynamics. In Japan, beach-ridge plains have traditionally been interpreted as comprising three or four beach-ridge sets, with assumed inter-regional synchroneity. This view has been applied to strand plains in northeastern Japan—such as Sendai, Ishinomaki, and Akita—but has been supported only indirectly through radiocarbon dating of organic materials in muddy inter-ridge swales. This weak chronological framework has led to a speculative hypothesis that the 'synchronous' beach-ridge sets reflect episodic increases in fluvial sediment supply following millennial-scale large earthquakes along the Japan Trench and resultant landslides. To test this hypothesis, we conducted post-infrared infrared stimulated luminescence (pIRIR) dating on 15 K-feldspar samples from beach ridges in the Akita coastal plain. Three ridge sets (I to III), arranged landward to seaward, were identified. Ridge sets I and II are approximately +10 m in elevation, whereas Ridge set III reaches +15–20 m. These elevations exceed the swash limit, and the upper portions of the ridges are composed of thick aeolian sand layers. Ridge set III also displays features of parabolic dunes, indicating dominant landward aeolian transport. The samples exhibited bright pIRIR signals at 150 °C ($pIRIR_{150}$) and IRSL signals at 50 °C (IR_{50}). Fading-corrected $pIRIR_{150}$ and IR_{50} ages were broadly consistent, though IR_{50} ages appeared slightly overestimated. Therefore, these $pIRIR_{150}$ ages were used for further analysis. Seven $pIRIR_{150}$ ages from Ridge sets I and II range from 3700 to 6000 years, significantly older than corresponding ridges in the Sendai plain. This discrepancy challenges the assumption of synchroneity between the two regions. Instead, abrupt changes in wave diffraction, likely influenced by the geomorphic features of adjacent bedrock, may have caused shifts in ridge orientation and distinction of ridge sets in Akita. Eight $pIRIR_{150}$ ages from a parabolic dune in Ridge set III range from 420 to 820 years, suggesting rapid aeolian sand accumulation between 500 and 700 years ago. This period coincides with enhanced coastal dune formation in Wakayama, 800 km southwest of Akita, and may reflect intensified winter monsoon activity across the Japanese Archipelago.

Keywords (max. 5): coast, earthquake, winter monsoon, post-IR IRSL

Timing and Evolution of an Earthquake-triggered Landslide in the Unkursay Valley, Inner Tien Shan, Kyrgyzstan: Insight from Geomorphological and Geochronological Approaches

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The remarkable advances in Earth-surface dating techniques, such as luminescence dating, have grea tly enhanced our ability to determine the timing of landform development, particularly for Quaternary la ndforms, with high scientific precision. However, in cases where it is difficult to collect suitable samples that directly constrain the formation age of specific landforms–such as through burial dating or exposure dating–we often encounter significant challenges. Under such circumstances, it becomes necessary to inf er landform formation ages indirectly, relying on accumulated theories of landscape evolution and empir ical knowledge.

We applied a combined geomorphological and geochronological analysis to indirectly estimate the timing of the complex landslide topography in the Unkursay Valley, Kokomeren Basin, Kyrgyzstan. Field investigations and UAV-based high-resolution digital surface model (DSM) analysis were conducted for topographical mapping and kinematic interpretation of the landslide. Additionally, single-grain post-infrared infrared stimulated luminescence (pIR-IRSL) and radiocarbon dating (^{14}C) were used on geological and biological evidence indicating pre- and post-landslide topographic changes.

Key findings are summarized as follows. First, the geomorphological and kinematic characteristics of the Ak-Kiol landslide suggest that the slope failure was triggered by seismic waves. Second, evidence supporting an earthquake-triggered landslide includes geomorphological and kinematic features such as deep-seated slope failure with distinct bedrock stratigraphy, hummocks, debris ridges, and transverse ridges. Third, the Ak-Kiol landslide can be divided into four distinct geomorphological zones, each displaying unique kinematic characteristics. Fourth, the Lower Ak-Kiol paleo-lake disappeared as a result of an outburst flood following the failure of the Ak-Kiol landslide dam.

Based on key findings and chronological data, the Late Quaternary geomorphic evolution of the Unkursay Valley can be reconstructed as follows: ⅰ) During the Late Pleistocene (103–87 ka), clast-supported sediment with a thickness of over 80 m rapidly accumulated within the Unkursay Valley. ⅱ) Around 87 ka, sediment supply declined abruptly, initiating a phase of river incision that persisted for ~80,000 years until the onset of the Holocene, ultimately resulting in the formation of a canyon. ⅲ) In the early Holocene (8–7 ka), a seismic event triggered the Ak-Kiol landslide, which completely blocked the valley and led to the formation of the Ak-Kiol dammed lake. ⅳ) The dammed lake lasted from weeks to months but eventually breached after exceeding its water threshold, and the resulting outburst flood elim inated the paleo-lake at Lower Ak-Kiol.

This study identified the triggers and timing of the landslide and documented the post-failure geomorphic response in study area. Landscape reconstruction using geochronological methods highlights the potential for both direct and indirect estimates of large-scale landslide timing. Moreover, integrating geomorphological and geochronological approaches to constrain the timing of earthquake-triggered landslides offers a valuable tool for paleoseismological investigations in regions lacking instrumental seismic records.

Keywords: Earthquake-triggered Landslide, Luminescence dating, Radiocarbon dating, Paleoseismology, Kyrgyzs tan

Semi-quantitative provenance analysis via multi-proxy luminescence fingerprinting: a case study from an intermontane basin, Eastern Tibetan Plateau

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Luminescence characteristics, especially luminescence sensitivity (LS) are increasingly employed to trace pathways in coastal, fluvial, aeolian, and glacial environments. However, direct comparisons with independent provenance markers and quantitative determinations of source fractions remain limited. Here, we selected a unique catchment on the eastern Tibetan Plateau (Aba–Nianbaoyeze) with two distinct lithologies—Early-Jurassic granite exposed in glaciated headwaters (< 30 km upstream) and Triassic sandstone encircling the intermontane Aba Basin, and employed multiple luminescence fingerprints (relative sensitivity, LM-OSL components, decay curve characteristics) to explore the provenances of fluvial terrace sediments. Our results reveal distinctive LS signatures for the granite and sandstone end members and their differential responses to transport processes. By integrating 15 luminescence ages (quartz OSL and K-feldspar $pIR_{150}IR_{225}$), we reconstructed the Late Pleistocene aggradation-incision history of the Aba Basin and performed semi-quantitative unmixing of sediment source contributions through time. We document systematic, orbitally paced provenance shifts that align with independent provenance constraints based on detrital zircon U–Pb age spectra and εNd signatures. Together, these res ults highlight the potential of using multiple luminescence characteristics as a robust tool for sediment-routing studies.

Keywords (max. 5): provenance analysis, luminescence sensitivity, fluvial processes, Tibetan Plateau

Age and pedogenesis of alpine grassland soils on the northeastern Qinghai-Tibetan Plateau: Insights from optical dating

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Grassland soils in alpine regions of the Qinghai-Tibetan Plateau (QTP) constitute a crucial component of the QTP ecosystem. Understanding their formation requires accurate chronologies and insights into key pedogenic processes. This study applied multi-grain (MG) and single-grain (SG) post-infrared infrared stimulated luminescence (pIRIR) dating to alpine grassland soils around the Gonghe Basin in the northeastern (NE) QTP to gain new insights into their ages and pedogenic processes. In addition, ^{14}C dating was performed on soil organic matter, with the resulting ^{14}C ages compared with optical ages to evaluate their reliability for soil age determination. pIRIR dating showed that bioturbation-induced soil reworking is common in alpine grassland soils. SG pIRIR dating allows more accurate soil age estimation by effectively identifying grains associated with original deposition and pedoturbation, while ^{14}C dating yields underestimated ages due to younger carbon contamination. We proposed an SG pIRIR-based approach that can be applied to alpine grassland soils to constrain their ages and quantify bioturbation. Combined with a synthesis of regional alpine loess and palaeosol/soil chronologies and a comparison with regional climatic records, the influence of climate on alpine soil pedogenesis and bioturbation was explored. Our results showed that pedogenesis in the studied profiles started at ~11–5 ka, following an aeolian dust aggradation pedogenic mode. The intensity of soil mixing decreases with depth, with the most intensive mixing occurring in a near-surface zone of tens of centimetres depth. Integrating SG dating results with a new conceptual model, we for the first time estimated the recent and past downward soil mixing rates and the timing of intensified bioturbation for alpine soils on the QTP. Chronological synthesis revealed that alpine soil development on the NE-QTP was most pronounced since ~6 ka. Effective moisture is a key factor that affects both soil development and bioturbation intensity in alpine grassland soils.

Keywords: Alpine grassland soil, Single-grain pIRIR dating, Pedoturbation, Soil formation, Qinghai-Tibetan Plateau

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ORAL SESSION

Day 3 (09.24.^{WED})

Keynote Lecture

Advanced Luminescence Dating Applications on Anthropogenic Samples from Anatolian Prehistoric Settlements

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The peninsula of Anatolia, located within modern-day Türkiye, is recognized as a globally significant natural laboratory for both the Earth sciences and the study of human civilization. As a primary locus for the Neolithic transition, it archives the foundational developments of agriculture, sedentism, and complex society. Concurrently, its dynamic tectonic and volcanic setting forged a unique landscape that directly influenced these societal transformations. Accurately establishing the chronology of this period is therefore paramount, yet is often complicated by a scarcity of materials suitable for conventional methods in aceramic contexts. The advanced application of Optically Stimulated Luminescence (OSL) to complex anthropogenic deposits—such as mortars and earthen floors—provides a critical tool for building architectural chronologies in such settings.

Significant methodological challenges are presented by these materials. A critical issue is the accurate determination of the environmental dose rate (Dr) within heterogeneous archaeological contexts. Specifically, the dating of sediments situated between large, prehistoric stone-built walls necessitates specialized analysis beyond standard assumptions of a uniform radiation field. This challenge requires the application of specialized geometric dose rate modeling to calculate the gamma-ray flux from surrounding architectural elements, ensuring that the final age determination is not compromised by an oversimplified assessment. This rigorous modeling, combined with state-of-the-art Single-Aliquot Regenerative-Dose (SAR) protocols and thorough archaeometric characterization (e.g., XRF, optical microscopy), provides a robust framework for resolving these complex dating problems.

The successful establishment of high-resolution chronologies for distinct architectural phases is demonstrated through case studies from key Pre-Pottery Neolithic B (PPNB) settlements. This chronological resolution elucidates construction phases, habitation periods, and potential cultural transitions within the region. Ultimately, this work validates the necessity of integrated, advanced modeling for the reliable application of luminescence dating in complex archaeological settings.

Keywords (max. 5): Luminescence dating, OSL, dose rate modeling, Anatolian Prehistory, anthropogenic sediment

Exploring the lower limit of coupled ESR and U-series dating of fossil teeth

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The coupled electron spin resonance and uranium series dating (ESR/U-series) method has been increasingly applied to fossil teeth from prehistoric sites in non-volcanic regions, as it is among the few techniques capable of dating sites as old as the Early Pleistocene or even earlier. Although the thermal stability and saturation characteristics of the ESR signal in tooth enamel theoretically allow for dating very old fossils, the lower limit of the ESR/U-series method remains poorly defined. In this study, we present ESR/U-series dating results from two late Miocene hominoid sites in the Yuanmou Basin, Southwest China. The chronology of these sites has been constrained by faunal and paleomagnetic evidence, providing a rare opportunity to investigate the lower age limit of the ESR/U-series dating method. Equivalent dose (D_E) values of nine samples, determined using the additive dose method, range from approximately 5 kGy to 8 kGy. However, the fossil ages obtained using the US and AU models—currently the most widely used models in ESR/U-series dating—are younger than the reference age by approximately 32% and 85%, respectively. This underestimation cannot be solely attributed to high uranium content in dental tissues, as observed in some old sites previously dated using this method, since the uranium levels here are not exceptionally high. Interestingly, the CSUS model, which accounts for uranium uptake occurring at a relatively late stage, yields ages (7.03±0.41 Ma and 8.13±0.48 Ma) consistent with the reference age. The observed age underestimation may result from differences in the thermal stability of two distinct CO_2^- radicals, potentially leading to an underestimation of DE values. This study suggests that the lower limit of the ESR/U-series dating method likely extends into the Pliocene epoch.

Keywords: ESR/U-series dating, fossil teeth, lower limit, Equivalent dose

Absolute age dating of Quaternary archaeological site, Hantan River area, South Korea

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For decades, numerous Paleolithic artifacts have been excavated from fluvial sediments in the Jeongok area, located in the central part of the Korean peninsula (Yi, 1984). The timing of manufacture of these artifacts forms a critical key for understanding the prehistoric human evolution in the Korean Peninsula and East Asia, however, the chronological framework of these remains is still under debate because of the lack of suitable material for dating and the age limit of conventional dating methods such as radiocarbon dating. Therefore, in this study, we applied optically stimulated luminescence (OSL) dating to quartz grain samples collected from the Hantan River area to obtain the depositional ages of sediments containing these artifacts. In this study, direct dating of the artefact-bearing layers was attempted by applying OSL techniques, which showed great potential for use in the accurate determination of the timing of deposition. To extend the age range of OSL dating, a thermally transferred optically stimulated luminescence (TT-OSL) signal and single-grain K-feldspars using the post-Infrared Infrared stimulated luminescence (pIR IRSL) were also investigated. The Jeongok Basalts were directly analysed using the Ar-Ar method. ^{10}Be dating from the unconsolidated gravel and sand layers underlying the Jeongok Basalt were dated for burial age. These results of multiple absolute dating methods allow the development of chronologies of the Jeongokri archaeological sites and constrain the timing of the earliest hominin occupation in South Korea.

Keynote Lecture

Multi-scale luminescence-imaging instrumentation for dating a pplications

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Developments in imaging instruments for thermoluminescence (TL) and optically stimulated luminescence (OSL) offer the capability to obtain spatially resolved dose distributions for retrospective dosimetry and geochronology. Traditionally, this approach has been used for obtaining single-grain OSL dose distributions, where an imaging system, despite the presence of a crosstalk effect, can provide similar results compared with the standard laser-based single-grain system. Imaging has also been used on larger samples, such as a snail operculum for measuring TL dose distributions.

Following the introduction of infrared photoluminescence (IRPL) measurements for feldspar, the luminescence imaging system in Risø TL/OSL reader was quickly adapted to incorporate IRPL imaging, as IRPL provides a nearly non-destructive measurement at room temperature. Recent IRSL/IRPL imaging of several cm large rock slices on a new dedicated imaging system has unlocked new applications, including the reconstruction of transport histories of cobbles and boulders, as well as the study of post-depositional processes such as physical weathering and erosion. Latest studies demonstrate how luminescence imaging can uniquely reveal the timing and evolution of rock fracture systems. At smaller spatial scales (mm–cm), luminescence imaging enables the study of soil formation and sediment mixing, while at finer resolutions (nm–μm), it provides insights into the fundamental origins of luminescence signals and their sensitivity to environmental conditions.

This keynote will delve into these imaging techniques and showcase recent examples of luminescence imaging applied to unravel the complexities of Earth surface processes. By bridging scales and offering unprecedented detail, luminescence imaging has the potential to revolutionize our understanding of Earth surface processes.

Keywords (max. 5): luminescence, imaging, instrumentation

Variation in luminescence sensitivity of quartz across semi-arid Sabarmati River basin in Western India: Caveats and new possibilities for luminescence-based provenance studies

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The luminescence sensitivity (LS) of natural quartz is controlled by lattice defects, which are influenced by ambient pressure-temperature (PT) conditions and composition of matrix during crystallization, which is subsequently modified during transportation by exposure to radiation, heat, and daylight (Hashimoto et al., 1994,1997; Li & Wintle, 1992; Stokes, 1994; Zimmerman, 1971, Goswami et al. 2024, Panda et. al. (submitted)). Consequently, LS has been employed as a fingerprinting tool in provenance studies and for investigating surface processes over the past two decades (Gray et al., 2019; Sawakuchi et al., 2020). In addition, variation in LS have been variously used to assess from aspects of sediment budgets to delineation of past forest fire events (e.g., Fitzsimmons et al., 2009; Goswami et al., 2024; Pietsch et al., 2008; Zhang et al., 2022).

This study investigated the spatial variations of luminescence sensitivity (LS) of natural quartz grains from sediments in the upper reaches of the Sabarmati River basin in semi-arid Western India and its potential to study earth surface processes. Sources of sediments to this river are: a) denudation of bedrock, b) hillslope processes, c) soil formed on rock surfaces, d) Palaeodunes at the southern margin of the Thar Desert and e) coastal sands from shelf region during a low sea level stand.

The thermoluminescence sensitivity (TLS) of quartz of above sources ranged from 1.6 to ~400 Units (1 Unit = 100 photon counts/mg×Gy), with the lowest values in rock-derived quartz, the highest in quartz from proximal palaeodunes and TLS of river sediment had intermediate values. Random variation in TLS of river sediments along river's course suggested location-specific sediment mixing from multiple sources. To investigate this, various possibilities viz., a) TLS analysis is done on tributary wise source rocks and sediments, palaeodunes in the basin and coastal miliolites, b) laboratory sensitization experiments simulating natural processes of irradiation and daylight bleaching; c) analysis of single grain luminescence data from sediments and their sensitization, were explored.

This study provides evidence that river sediments comprise a mixture of low-TLS quartz from rocks and hillslopes and high-TLS quartz from palaeodunes. End-member mixing calculations suggest that a significant admixture (~50 ± 30%) of high-TLS palaeodune quartz can account for the observed TLS of river sediments.

Further, the number of laboratory sensitization experiments suggested that rock TLS would require several hundred cycles to reach the TLS of river sediment, and these provide an estimate for the residence time of sediment in the basin of at least several hundred ka. Single-grain luminescence measurements suggested that < 0.5% super-bright grains account for a significant fraction of the TLS of quartz from rocks while, ~ 97% of grains from the rocks and 60-80% in river sediments did not yield luminescence nor respond to the sensitisation cycle.

Current study implies caution in luminescence-based provenance studies in river basins with aeolian activity. We suggest the potential use of a fraction of non-luminescent grains as a proxy for provenance and the need to elucidate the physical mechanism of the TLS and its sensitisation process.

Keywords: Provenance, Quartz, Luminescence Sensitivity, Sabarmati River

References

Fitzsimmons, K. E., Rhodes, E. J., & Barrows, T. T. (2009). OSL dating of southeast Australian quartz: A preliminary assessment of luminescence characteristics and behaviour. Quaternary Geochronology, 5(2–3), 91–95. https://doi.org/10.1016/j.quageo.2009.02.009

Chawla, S., Rao, T. K. G., & Singhvi, A. K. (1998). Quartz thermoluminescence: dose and dose-rate effects and their implications. Radiation Measurements, 29(1), 53–63. https://doi.org/10.1016/s1350-4487(97)00200-x

Goswami, K., Panda, S. K., Alappat, L., & Chauhan, N. (2023). Luminescence for sedimentary provenance quantification in river basins: A methodological advancement. Quaternary Geochronology, 79, 101488. https://doi.org/10.1016/j.quageo.2023.101488

Gray, H. J., Jain, M., Sawakuchi, A. O., Mahan, S. A., & Tucker, G. E. (2019). Luminescence as a sediment tracer and provenance tool. Reviews of Geophysics, 57(3), 987–1017. https://doi.org/10.1029/2019rg000646

Pietsch, T. J., Olley, J. M., & Nanson, G. C. (2008). Fluvial transport as a natural luminescence sensitiser of quartz. Quaternary Geochronology, 3(4), 365–376. https://doi.org/10.1016/j.quageo.2007.12.005

Sawakuchi, A. O., Rodrigues, F. C. G., Mineli, T. D., Mendes, V. R., Melo, D. B., Chiessi, C. M., & Giannini, P. C. F. (2020). Optically stimulated luminescence sensitivity of quartz for provenance analysis. Methods and Protocols, 3(1), 6. https://doi.org/10.3390/mps3010006

Stokes, S. (1994). The timing of OSL sensitivity changes in a natural quartz. Radiation Measurements, 23(2–3), 601–605. https://doi.org/10.1016/1350-4487(94)90106-6

Zhang, J., Li, S.H., Sun, J., Tongyan, L., Zhou, X., Hao, Q. (2022). Quartz luminescence sensitivity variation in the Chinese loess deposits: the potential role of wildfires. Journal of Quaternary Science 38, 49–60. https://doi.org/10.1002/jqs.3462

Hashimoto, T., Sakaue, S., Aoki, H., & Ichino, M. (1994). Dependence of TL-property changes of natural quartzes on aluminium contents accompanied by thermal annealing treatment. Radiation Measurements, 23(2–3), 293–299. https://doi.org/10.1016/1350-4487(94)90055-8

Hashimoto, T., Katayama, H., Sakaue, H., Hase, H., Arimura, T., & Ojima, T. (1997). Dependence of some radiation-induced phenomena from natural quartz on hydroxyl-impurity contents. Radiation Measurements, 27(2), 243–250. https://doi.org/10.1016/s1350-4487(96)00115-1

Li, S.H., & Wintle, A.G. (1992). Luminescence sensitivity change due to bleaching of sediments. International Journal of Radiation Applications and Instrumentation Part D Nuclear Tracks and Radiation Measurements, 20(4), 567–573. https://doi.org/10.1016/1359-0189(92)90006-h

Zimmerman, J. (1971). The radiation-induced increase of the 100 °C thermoluminescence sensitivity of fired quartz. Journal of Physics C Solid State Physics, 4(18), 3265–3276. https://doi.org/10.1088/0022-3719/4/18/032

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Field testing of the correction models for athermal fading

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Correction for athermal fading relies on short term laboratory measurements and their extrapolation using prescriptions by Huntley and Lamothe (2001) or by Kars et al., (2008). Validity of such corrections based on short term measurement to geological time scales is yet to be established. Towards this, four loess samples from Titel and Ruma loess-paleosol sequence in southeastern Carpathian Basin northern Serbia, bounded by two marker tephras of well constrained Ar-Ar ages, L2; 160.6 ± 2.0 ka and L4; 367.5 ± 1.6 ka (Laag et al., 2021) were analyzed for their Infrared Stimulated Luminescence (IRSL) at 50 °C and post infrared IRSL (pIR-IRSL) at 225 °C. Although the pIR-IRSL signal is considered to be stable, it showed athermal fading (average g-value ~4 %/decade, and average ρ' $10^{-5.6}$). Use of measured g-value and fading correction using (Huntley and Lamothe, 2001) model provided underestimated ages whereas ρ' estimation and fading correction using (Kars et al., 2008) provided overestimated ages.

We then attempted an estimation of the ρ' in nature through inverse modelling of pIR-IRSL data using two loess samples, 20 cm above and below around the L2 marker tephra (161 ka). Inverse modeling estimated ρ' as $10^{-6.05}$ corresponding to a g-value of ~1.22 %/decade. This is lower than the laboratory estimated ρ' of ~$10^{-5.6}$ with a corresponding g-value of ~4 %/decade. Use of these values for the other samples provided ages in stratigraphic order and consistent with tephra ages.

These studies are being refined, and the results will be presented.

Keywords: athermal fading, pIR-IRSL dating, g-value, fading correction, Titel and Ruma loess-paleosol sequence.

References

Huntley, D.J. and Lamothe, M., 2001. Ubiquity of anomalous fading in K-feldspars and the measurement and correction for it in optical dating. Canadian Journal of Earth Sciences, 38(7): 1093-1106.

Kars, R., Wallinga, J. and Cohen, K., 2008. A new approach towards anomalous fading correction for feldspar IRSL dating—tests on samples in field saturation. Radiation Measurements, 43(2-6): 786-790.

Laag, C., Hambach, U., Zeeden, C., Lagroix, F., Guyodo, Y., Veres, D., Jovanović, M. and Marković, S.B., 2021. A detailed paleoclimate proxy record for the Middle Danube Basin over the last 430 kyr: a rock magnetic and colorimetric study of the Zemun loess-paleosol sequence. Frontiers in Earth Science, 9: 600086.

Effect of Metamorphism on the Point Defects in Quartz: Characterization using Different Spectroscopic Techniques

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The present study examines the effect of metamorphism on point defects in quartz. A granite sample with crystallization age of ~460 Ma (Albesti granite, Romania) and its metamorphic equivalent were used for the analysis. This sill-like granitoid occurs close to a ductile shear zone (locally named Bughea shear zone) of presumed Variscan age; the granitoid is exposed as relatively undeformed away from the shear zone as well as highly strained into a mylonitic fabric, when caught into the shear zone. Mineralogical differences were also observed, the metamorphic sample exhibiting lower quartz content and reduced grain strength. The point defects in quartz were characterized using thermoluminescence (TL), optically stimulated luminescence (OSL), electron spin resonance (ESR), scanning electron microscopy coupled with cathodoluminescence (SEM-CL) and Raman spectroscopy.

ESR data showed the presence of E' (an unpaired electron at an oxygen vacancy site (≡Si·), Al-related defects ($[AlO4]^0$) and peroxy (≡Si-O-O·) in both the samples with increase of these centres in the metamorphic sample, especially in the case of the latter. TL measurements showed four peaks (110, 160, 280, 380 °C) in both samples, though TL intensity was 40% lower in the metamorphic quartz. The OSL decay curves were dominated by fast component for un-deformed sample and the OSL intensity of the metamorphic quartz was approximately 60% lower than that of un-deformed granite. The OSL dose-response curve (DRC) is well represented by a sum of two saturating exponential functions. The DRC of metamorphic granite exhibited higher uncertainties, due to its low signal. The DRC shapes before and after heating were nearly identical for both samples. SEM-CL analysis showed emission in blue (~450 nm) and red region (~650 nm; attributed to NBOHC (≡Si–O·)). The CL emission of metamorphic quartz was 65% lower than that of un-deformed quartz. Raman spectroscopy showed narrowing of quartz bands in the region of 100 to 500 cm^{-1}, reflecting the shortening of the O-Si-O bond (463 cm^{-1}) and lattice compression (125 and 204 cm^{-1}) during metamorphism.

These findings provide new insights into mineralogy and quartz point defect dynamics under metamorphic conditions, with implications for geological processes. At the conference, detailed results and their implications will be presented.

Keywords (max. 5): Quartz point defects, Thermoluminescence (TL), Optically Stimulated Luminescence (OSL), Electron Spin Resonance (ESR), scanning electron microscopy coupled with cathodoluminescence (SEM-CL), Raman Spectroscopy

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POSTER SESSION

09.22.MON - 09.24.WED

Establishment of Dose-Response Curve Using Alanine Dosimeters in CyberKnife Radiotherapy

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This study aims to evaluate the dose–response characteristics and directional dependence of alanine dosimeters under CyberKnife irradiation. Alanine pellets (5 mm diameter × 3 mm height) composed of 80% L-α-alanine and 20% polyethylene were irradiated using 6 MV photons at SSD 80 cm, 1.5 cm depth in water, and a 6 cm circular field. The dose rate was 950 MU/min, measured with a PTW 23343 Markus chamber. Standard doses of 1, 5, 10, 15, and 20 Gy were delivered for calibration.

EPR signal intensities were measured post-irradiation, and dose–response curves were constructed for two orientations: perpendicular (vertical) and parallel (horizontal) to the beam axis. Linear regression analysis yielded $R^2 = 0.9993$ (perpendicular) and $R^2 = 1.0000$ (parallel), confirming excellent linearity in both configurations. The maximum signal deviation due to orientation was approximately 1.2%. Overall measurement uncertainty was within 3%, consistent with ISO/ASTM 51607 and IAEA TRS-398 protocols.

These results demonstrate that alanine dosimeters provide accurate and reliable dose measurements with minimal angular dependence under CyberKnife-specific conditions. This supports their use in absolute dosimetry and quality assurance for stereotactic radiosurgery.

Keywords (max. 5): Alanine dosimetry, CyberKnife, dose–response, angular dependence, EPR

Alanine-EPR Dosimetry Monthly Quality Control Using X-Band Standard

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The Dongnam Institute of Radiological & Medical Sciences (DIRAMS) operates as a KOLAS- and ISO/IEC 17025-accredited laboratory specializing in alanine-based Electron Paramagnetic Resonance (EPR) dosimetry. To ensure high accuracy, reliability, and traceability in radiation dose measurements, a comprehensive monthly quality control protocol has been established.

This protocol utilizes a fused quartz X-band reference standard irradiated to 261 Gy by NIST with ^{60}Co gamma rays. Signal intensities are measured across a microwave power range from 0.127 to 20.054 mW, and the results are statistically evaluated through Z-score analysis and $\bar{X}$-R control charts. All measurements have consistently fallen within ±3 standard deviations, confirming stable instrument performance without significant drift.

When stable instrument operation is confirmed but alanine dosimeter readings exhibit discrepancies, the linearity of the dose-response curve is assessed at standard dose points ranging from 0.5 to 100 Gy. The dosimeters consistently demonstrate excellent linearity, with coefficients of determination (R^2) exceeding 0.999, enabling differentiation between instrument and dosimeter-related issues.

By integrating rigorous instrument monitoring and dosimeter verification into its KOLAS-accredited standard operating procedures, DIRAMS ensures reliable, traceable, and reproducible radiation dose measurements suitable for both research and clinical applications.

Keywords (max. 5): Alanine dosimetry, Electron Paramagnetic Resonance (EPR), quality control, X-band reference standard

Retrospective dosimetry using optically stimulated luminescence of resistors in electronic personal dosimeters

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A study on retrospective dosimetry was conducted using electronic personal dosimeters (EPDs) to reconstruct doses received by radiographic testing workers. The dosimetric properties of the optically stimulated luminescence (OSL) signal accumulated over 1.5 seconds were investigated by measuring the OSL emitted from resistors extracted from the EPDs in a darkroom environment. The results showed that the OSL signal exhibited robust dosimetric properties, with a minimum detectable dose as low as 7 mGy. To estimate the absorbed dose using the resistors, a simplified single aliquot regenerative (SAR) dose method based on the OSL signal was employed. The zero dose of the commercial EPD model (CLOVER) was determined to be 12 ± 8 mGy, based on a random selection of three EPDs. A dose overestimation correction factor of 1.01 ± 0.04 was calculated to account for rapid sensitivity changes following OSL measurement of natural samples. Additionally, it was observed that the OSL signal faded exponentially to approximately 50% over a period of 12 weeks. For verification, retrospective dosimetry was performed by irradiating EPDs with a standard 1 Gy gamma-ray dose. The reconstructed dose from the OSL signal of the resistors closely matched the delivered dose. These findings demonstrate that retrospective dosimetry using EPDs can be effectively utilized to accurately estimate past radiation exposure doses.

Keywords (max. 5): Retrospective dosimetry, OSL, Resistor, EPD, Industrial radiography

Analysis of Physical Retrospective Dosimetry Methods and Ongoing Research

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Retrospective dosimetry refers to methods used to determine radiation doses received by individuals when conventional dosimeters were unavailable or insufficient at the time of exposure. Currently, retrospective dosimetry methods developed internationally can be classified into physical dosimetry (EPR, TL/OSL, Monte Carlo simulation) and biological dosimetry (DCA, CBMN, etc.). This study analyzes the current status and advances in physical dosimetry methods to develop and optimize the retrospective dosimetry techniques in Korea.

Internationally, EPR, TL/OSL, and Monte Carlo simulations are being conducted primarily in European countries (such as France, Austria, Germany) and the United States. EPR studies utilize biological samples (teeth, nails, hair) and alternative materials (smartphone glass, sugar, plastic, clothing), while TL/OSL research focuses on alternative samples (smartphone resistors, glass, credit cards, wireless earphones, ceramics, salt, medication). Monte Carlo simulations are mainly applied in reconstructing past radiation accidents and conducting cross-analysis.

In Korea, institutions such as the KIRAMS (Korea Institute of Radiological & Medical Sciences), DIRAMS (Dongnam Institute of Radiological & Medical Sciences), KAERI (Korea Atomic Energy Research Institute), and KINS (Korea Institute of Nuclear Safety) have established the KREDOS (Korea Retrospective Dosimetry network) to enhance the reliability of retrospective dosimetry technology. Research on EPR dosimetry primarily utilizes teeth and nails, with recent studies including personal belongings like smartphones. TL/OSL research is conducted using smartphone resistors, glass, and credit cards. Monte Carlo simulations are used for cross-validation in simulation environments and organ dose assessments.

Compared to international research, the analysis revealed that, in Korea, Monte Carlo simulation techniques are actively developed, while EPR and TL/OSL-based techniques remain limited to specific samples or foundational research levels. Therefore, continuous R&D, expansion of retrospective dosimetry infrastructure, systematic and standardized assessment procedures, development of national guidelines, and increased international cross-analysis participation are necessary to standardize retrospective dosimetry techniques, thereby enhancing their practical applicability in nuclear and radiation regulatory fields.

Keywords : retrospective dosimetry, physical dosimetry, EPR, TL/OSL, Monte Carlo simulation

OSL dating of Middle and Upper Paleolithic archaeological sites in southern Jordan: examination of quartz and K-feldspar

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The Middle and Upper Paleolithic periods in West Asia were marked by key paleoanthropological events, including the dispersal of *Homo sapiens* from Africa into Eurasia and their coexistence with Neanderthals. To clarify these processes, it is essential to establish an accurate and precise chronology for Middle and Upper Paleolithic sites. We have investigated several sites in southern Jordan that are associated with Late Middle Paleolithic, Initial Upper Paleolithic, and Early Upper Paleolithic cultural remains. However, samples suitable for radiocarbon dating in this region are poorly preserved due to the arid environment, and some archaeological sites are beyond the limit of the radiocarbon dating range. To overcome these challenges, we employed optically stimulated luminescence (OSL) dating.

Sediment samples for dating were collected from the stratigraphic sections of excavated trenches in some rock-shelter sites situated under the shadows of eroded sandstone. Quartz and K-feldspar grains, with diameters ranging from 62 to 90 μm, were extracted for analysis. Quartz OSL showed dependency of the equivalent dose (D_e) on preheat temperature and exhibited variability in the dose recovery ratio, leading to the conclusion that quartz is unsuitable for dating in this context. In contrast, K-feldspar post-infrared infrared stimulated luminescence (pIRIR) signals produced stable results in both preheat and dose recovery tests, making it suitable for dating. The dose rate was calculated based on ICP-MS analysis of the tube samples, and fading corrections were applied to the results.

The dating results indicated that the lower section of the Initial Upper Paleolithic site is approximately 50 ± 3 ka, and the upper section of the Middle Paleolithic site is around 53 ± 3 ka. However, a reversal of chronological order was observed in some layers near the upper section of the Middle Paleolithic site, where samples taken from closer to the bedrock yielded older ages than those from lower layers by several thousand years. This suggests the need for further discussion regarding potential errors in the dose rate calculation for more precise interpretation.

Keywords (max. 5): K-feldspar, Quartz, post-IR IRSL, Archaeological site, Jordan

Establishment of Standardized Growth Curves for Electron Spin Resonance (ESR) Dating of Old Fossil Teeth

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Additive dose method (ADM) is currently the most widely used approach for determining equivalent dose (D_E) in ESR dating. However, its application in ESR dating of old fossils is constrained by several factors, including limitations in irradiation facilities, calibration accuracy for high-dose irradiation, and the requirement for multiple aliquots analysis, which increases sample consumption. Establishing Standardized Growth Curves (SGCs) for fossil samples allows for a rapid estimation of D_E without the need for sample irradiation, and enables a preliminary assessment of fossil age based solely on the measurement of natural ESR signals. Nonetheless, it is important to note that the dose-response characteristics of enamel may undergo alterations during the diagenesis process. Our previous research has shown that young fossils (D_E < 2 kGy) fit the SGC better than old fossils (D_E > 2 kGy). To evaluate the feasibility of constructing a SGC specially for old fossil teeth, we analyzed 31 fossil enamel samples, including 23 with D_E > 2 kGy, using multiple methods to establish the SGC. Two samples from the Longgupo Early Pleistocene hominid site were tested, and the D_E values obtained using the SGC developed specially for old fossils showed better agreement with ADM results than those derived from a universal SGC applicable to all samples, with discrepancies ranging from 12% to 20%. The D_E values determined via SGC suggest that these fossil samples likely correspond to the Early Pleistocene rather than the Late Pleistocene age inferred from U-Th dating of speleothems collected from the same stratigraphic layer. This study demonstrates the potential of SGCs as a tool for rapidly estimating approximate D_E values for old fossils, while also providing a more reliable basis for selecting the optimal maximum dose in artificial irradiation protocols used in ADM.

Keywords: tooth enamel, electron spin resonance dating, equivalent dose, standardized growth curve, old fossil

New age constraints for the Singa hominin and the adjacent Abu Hugar fossil site

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The Singa calvaria, found on the western bank of the Blue Nile in 1924, shows a combination of modern and archaic features of *Homo sapiens*. A previous study applying U-Th dating of calcrete precipitates surrounding the calvaria and associated mammal teeth inferred a minimum age of 133 ± 2 ka. However, detailed age constraints on the Singa calvaria are still lacking. The Abu Hugar site, located just 35 km to the south of Singa, produced vertebrates and Middle Stone Age artifacts previously thought to be contemporaneous with the calvaria. Here, we applied optically stimulated luminescence (OSL) dating on the fluvial sediments and radiocarbon dating on soils and shells from Singa and Abu Hugar. Using an age-depth model, we estimate a considerably younger burial age of 39 ± 4 ka for the Singa calvaria. The new age indicates that the Singa hominin significantly postdates the origin of anatomically modern humans and the dispersal of *Homo sapiens* out of Africa. In contrast, the fluvial sediments from Abu Hugar have much older OSL ages of ~120–210 ka, with the oldest level estimated to be ~350 ka. This challenges the presumed temporal connection between the Singa calvaria and the faunal and lithic records of Abu Hugar, and indicates a more complex Pleistocene history of Blue Nile deposition.

Keywords: Singa calvaria, luminescence dating, human evolution, early modern human, Blue Nile

Late Quaternary lake level fluctuations in Khyargas Nuur, Western Mongolia: a comparative study of multi-grain and single-grain K-feldspar luminescence dating

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The Late Quaternary evolution of lake systems in Mongolia, along with their responses to climate changes and glacial meltwater input, remains poorly understood. In this study, we reconstruct lake-level changes of Khyargas Nuur in western Mongolia using optically stimulated luminescence (OSL) dating of palaeoshorelines, based on post-infrared infrared stimulated luminescence (pIRIR) signals from K-feldspar. Multi-grain pIRIR signals measured at 150°C ($pIRIR_{150}$) and 225°C ($pIRIR_{225}$) were used to date Holocene and older samples, respectively. Additionally, single-grain pIRIR dating, conducted for the first time in the region, was used to assess bleaching conditions. Several samples showed incomplete bleaching, for which the Minimum Age Model (MAM) was applied. Importantly, many multi-grain aliquots showed no clear signs of poor bleaching in their equivalent dose (D_e) distributions, which could have led to significant age overestimation if single-grain data had not been available. A robust chronological framework was established by combining multi-grain and single-grain pIRIR analyses. Without this approach, the chronology of lake level fluctuations could have been significantly misinterpreted.

Our results indicate that the highest dated lake level, at ~129 m above modern lake (a.m.l), occurred during Marine Isotope Stage (MIS) 5 (~89 ka), with a subsequent highstand (~118 m a.m.l) during the Late Glacial (~13.8–13.2 ka). Following this highstand, lake levels declined rapidly (~25 m/ka), reaching ~20 m a.m.l through the Late Glacial to early Holocene transition. During the late Holocene, the palaeolake exhibited small-scale fluctuations between ~15 and ~7 m a.m.l.

Keywords (max. 5): Multi-grain K-feldspar, Single-grain K-feldspar, Lake level changes, Western Mongolia

Sediment transport of the Kujukuri coast revealed by residual doses from IRSL and pIRIR of K-feldspar

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Infrared stimulated luminescence (IRSL) and post-IR IRSL (pIRIR) signals of K-feldspar are characterized by slow bleaching rates during exposure to the sunlight, resulting in residual doses due to incomplete bleaching. While residual doses make accurate dating difficult, those retained in modern sediments have been shown to be related to the distance and path of sediment transport and thus may serve as potential tracers or sources of information for transport. Furthermore, K-feldspar grains emit multiple luminescence signals with different bleaching rates, which can potentially be used for extracting more information than previous studies did.In this study, we characterized the residual doses in modern sediment samples in the Kujukuri coast based on measurements of multiple luminescence signals: IRSL at 50ºC (IR_{50}), pIRIR at 150ºC ($pIRIR_{150}$) after IR_{50}, and pIRIR at 290ºC ($pIRIR_{290}$) after IR_{50}. We examined ratios of residual doses from these signals—$IR_{50}/pIRIR_{50\text{-}150}$ and $pIRIR_{50\text{-}150}/pIRIR_{50\text{-}290}$—to investigate coastal sediment dynamics. Sand grains 120–180 μm or 180–250 μm in diameter with densities 2.53–2.58 g/cm^3 were extracted from the samples and taken as K-feldspar rich faction to be used for measurements.

Beach face samples collected along the Kujukuri coast showed a significant decrease in the residu al doses of each signal from the northern and southern sediment sources toward the central area. The $pIRIR_{150}/pIRIR_{290}$ ratio showed a similar trend, from about 0.2 near the sources to about 0.05 in the central area, which is considered the meeting point of longshore sediment transport. Residual doses of multiple signals in offshore surface samples are similar to those of beach face samples, regardless of water depth. Additionally, samples showing similar $pIRIR_{150}/pIRIR_{290}$ ratios to the central coast were found to occur up to water depths of 60–70 m. This finding suggests that the beach sand in the central coast was recently transported offshore 60–70 m deep. At water depths greater than 70 m, the $pIRIR_{150}/pIRIR_{290}$ ratio is slightly higher. This higher ratio is interpreted as indicating that the sediment has recently been retained in place, allowing the electron traps of both signals to be filled and thereby increasing the ratio.

Samples in sediment cores 60–75 cm long obtained at water depths of 10 m and 15 m showed the $pIRIR_{150}/pIRIR_{290}$ ratio consistently c. 0.05, similar to the beach face samples in the central coast. This s uggests that core sediments were discharged offshore from the central coast. Sediment cores at water depths of 20 m and 25 m are characterized by the upper 30–40-cm-thick layer and deeper layer. In the upper layer the $pIRIR_{150}/pIRIR_{290}$ ratio was approximately 0.05 and thus represents sediments transported from the central beach. In contrast, the deeper layer is characterized by a downward increase of the ratio, suggesting that the sediments have remained in place for several decades after deposition. By measuring multiple luminescence signals in coastal sediments, it is possible to gain insights into sediment dynamics that are otherwise difficult to detect.

Keywords : sediment tracer, coastal area, beach deposit, offshore

Multi-method (OSL, ESR, SEM, petrography) analysis of lime mortars from Benedictine Abbey in Tyniec, Poland.

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The Benedictine Abbey in Tyniec is the oldest existing monastery in Poland (11th cent. AD). Samples of mortars were collected from the oldest layers of historical relics located in the reserve under the presbytery of the Gothic church. In this study, we present the preliminary results of OSL measurements of quartz aggregate, and an ESR analysis of the carbonate binder conducted to assess the possibility of ESR dating.

Petrographic examination and SEM + EDS observations showed a predominantly carbonate composition, with localized carbonate-gypsum phases. The binder phase is primarily composed of $CaCO_3$, with minor admixtures of clay minerals. The aggregate fraction consists mostly of quartz sand, along with crushed fragments of unburned limestone and lime lumps.

The results of the analyses clearly indicate that the OSL signal of quartz grains was not sufficiently bleached during the production process. The multiple-aliquot regenerative-dose (MAR) protocol was used (Wang 2021), and the steps were added to monitor the effects of the so-called thermal transfer (TT). The MAR protocol results were compared with the thermally modulated OSL (TM-OSL) method, which determines the OSL age based on the fastest optically bleached signal (Chruścińska 2021). The OSL age obtained using this method should be close to the expected for quartz grains exposed to sunlight during mortar production. However, due to the lack of sufficient OSL extinction in quartz grains demonstrated by the MAR method, this TM-OSL age can only be considered as an upper-age estimate.

Samples of carbonate binder for ESR measurements were obtained through a sequential dissolution procedure (Michalska 2019) conducted in a darkroom, and dried at 50°C. The spectra were analysed with the aid of ESR simulations to identify the paramagnetic centres present in the samples, and compare them to the centres commonly found in carbonates and used for ESR dating, with the goal of assessing their suitability for ESR dating. Since carbonate crystals are formed during the mortar production, their concentration in a sample should reflect the age of the mortar.

Michalska D. 2019. Influence of different pretreatments on mortar dating results. Nucl. Instrum. Methods Phys. Res., B: Beam Interactions with Materials and Atoms (456), 236-246.

Wang X., Peng J., Adamiec G. 2021, Extending the age limit of quartz OSL dating of Chinese loess using a new multiple-aliquot regenerative-dose (MAR) protocol with carefully selected preheat conditions. Quaternary Geochronology, 62, 101144.

Chruścińska A., Palczewski P., Rerek T., Biernacka M., Lefrais Y. 2021, Measurement of the paleodose in luminescence dating using the TM-OSL of quartz. Measurement, 167, 108448.

Preliminary results of ESR dating for the Quaternary fault in the T oikanbetsu fault zone, Hokkaido, Japan

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The Toikanbetsu fault zone is an active fault zone composed of reverse faults in eastern part of the H oronobe area, northern Hokkaido, Japan[1]. Recently, a reverse fault outcrop of the fault zone was discov ered near the west side of the Pankerupeshupe River, which displaced unconsolidated peaty and sand lay ers[2]. Radiocarbon dating for several samples of the peat layer showed the most recent one was deposite d approximately 45 ka, indicating that the fault might have displaced after approximately 50 ka. Howeve r, the value was close to the detective limit of the dating method. A dating method using electron spin re sonance (ESR) measurement of a fault is a technique with the potential to estimate the ages of the lastest activity occurred during the Quaternary period. To obtain more reliable ages of the lastest fault activity u sing ESR dating, previous studies proposed the utilities of samples with multiple centers[3] or different gr ain sizes[4, 5]. Hence, we have tried to apply the ESR dating to the fault with the above approaches.

A suite of samples was collected from four fault gouges developed within the boundary zone betwee n the peat and sand layers. The collected samples were separated into fractions with grain sizes of < 51 μ m, 51-120 μm, and 120-250 μm by wet sieving. The magnetic minerals were removed from the fractions by a neodymium magnet. For the fractions, we conducted two series of ESR measurements: one at room temperature with microwave powers of 0.01 mW and 1 mW and the other at 77 K (liquid nitrogen) at wi th microwave powers of 4 mW and 10 mW. In ESR spectra of the fractions, we detected multiple ESR si gnals originating quartz (the E_1' center and Aluminum center) and peat (organic radical). In this presenta tion, we discuss the ESR signals detected from the fault gouges developed in the Toikanbetsu fault zone. Moreover, we will show preliminary results of the application of ESR dating with multiple aliquot additive dose protocol for the fault.

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References:
[1] Imaizumi et al., 2018, *Digital Active Fault Map of Japan*. The University of Tokyo Press, Japan.
[2] Tamura et al., 2025, A fault outcrop found in the Toikanbetsu fault zone, northern Hokkaido. SSS14-03, *A bstract of JpGU 2025* (In Japanese).
[3] Fukuchi, T., 1988. Applicability of ESR dating using multiple centres to fault movement—The case of the Itoigawa-Shizuoka tectonic line, a major fault in Japan. *Quat. Sci. Rev*., 7(3-4), 509–514.
[4] Lee, H.K., and Schwarcz, H.P., 1994, Criteria for complete zeroing of ESR signals during faulting of the San Gabriel fault zone, southern California. *Tectonophysics*, 235(4), 317–337.
[5] Lee, H.K., and Schwarcz, H.P., 1994, ESR plateau dating of fault gouge. *Quat. Sci. Rev*., 13(5-7), 629–634.

Keywords (max. 5): Electron spin resonance (ESR), quartz, peat, fault

Different fitting functions and its implications for equivalent dose determination in multiple centers ESR dating: A case study in middle Yangtze River basin

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To examine different fitting functions and their implication for equivalent dose determination in multiple centers ESR dating approach. In this study, we collected 18 fluvial sediment samples derived from the Zhoulao core, which is located in the depocenter of Jianghan Basin and is one of the most typical drilling cores in this region. Different fitting functions (SSE、EXP+LIN、Ti-2) were performed on the Al center and Ti-Li center to obtain a precise equivalent dose. The results showed that equivalent does fit by different functions were consistent within the error range with low irradiation (< 20000 Gy). Compared with the other functions, the SSE function yielded a higher adjusted r^2 and a lower error rate, which indicated that the SSE function may be superior to the EXP+LIN function for the Al center and could provide a goodness-of-fit equally for the Ti-Li center based on our data. SSE function could be an optimal fitting method for equivalent dose determination and reduce the maximum irritating dose significantly.

According to the equivalent dose, we suspect that the Ti-Li center may be more suitable for 600-1000 Gy sample dating. Both Al center and Ti-Li center deduce highly consistent equivalent dose for 1000-3000 Gy samples, While even older samples(> 3000 Gy), the Al center exhibit a great potential for ESR dating. Our results strengthen the understanding of fitting functions and dating range from different centers and provide a preferred scheme applied to sediments dating from boreholes.

Keywords: quartz; Al center; Ti-Li centers; different fitting functions; electron spin resonance (ESR) dating

Attempts to use the Ge center in quartz for ESR dating of fault gouge

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Fault gouge, as a direct product of fault activity, has long been a key material for studying fault movements and determining the age of fault activity. In 1982, Ikeya pioneered the use of the E' center in the quartz ESR signals of fault materials to date fault activity. Since then, numerous scholars have conducted in-depth research on this method, leading to the development of techniques utilizing various defect centers in quartz ESR signals, including E', Al, OHC, Ge, and others, for determining the ages of fault activity. Over the years, researchers have predominantly employed the Al and E' centers in fault gouge quartz ESR signals for dating fault movements, while studies utilizing the Ge center have remained relatively scarce (the Ge center has been more commonly applied in dating volcanic-related materials).

In recent studies, the author has identified frequent occurrences of the Ge center signals within quartz from fault gouges. The dating results derived from the Ge centers consistently yield younger ages compared to those obtained from other centers. The accuracy of ESR dating results with fault gouge fundamentally depends on whether ESR signals in quartz can be fully reset. Thermal experiments demonstrate that the Ge center exhibits lower thermal stability and is more readily reset than other centers in quartz. This study reveals that the Ge center in fault gouge quartz holds significant potential for dating applications targeting young active faults.

Keywords: ESR dating, fault gouge, fault activity, Ge center

A discussion on quartz Al center ESR signal for early Pleistocene sediment dating

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The ESR signals of quartz Al and Ti centers are often used for dating Quaternary sediments (e.g. Lin et al., 2006; Rink et al., 2007; Liu et al., 2010; Tissoux et al., 2015; Xu et al., 2024). D ue to the linear increase in quartz Al center ESR signal with artificial irradiation (usually over th an 5000 Gy) (Duval, 2012), the Al center signal can have a high equivalent dose (De) value. Th erefore, the Al center is the best signal for ESR dating of early Pleistocene sediments.

The Al center signal intensity was measured from the top of the first peak to the bottom of t he sixteen peak (Yokoyama et al., 1985; Buhay, 1987; Porat and Schwarz, 1991). The dose resp onse curves (DRCs) of the Al center from 5 quartz samples were selected. The sediment sample s were collected in the upstream terrace of the Yellow River. Compared with the dating results of cosmogenic nuclides, these data are not appropriately fitted with a function combining an ex ponential with a linear term (EXP+LIN).

Some samples have a very strong component from line 6 to 9, and this component may over lap a peroxy signal and effect the determination of ESR intensity and De (Lee and Schwarz, 199 3). The data show that the larger offset in baseline between the two sides of the Al center signal, the worse the fit of De. So, we speculate the very strong component may cause an offset in base line between the two sides of the Al center signal and affects the accuracy of dating results. The refore, it is suggested that it is better to obtain the Al center signal intensity by measured from t he top point of peak 1 to bottom point of peak 4 for the sample that has bigger offset in baseline between the two sides of the Al center signal.

Keywords: ESR dating, Al center, early Pleistocene, river terrace

Applying electron spin resonance dating to fluvial sediments in the central Korean Peninsula: Insights from estimating partial bleaching rate

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This study demonstrates the applicability of ESR dating using the Ti-Li signal in quartz for Quaternary fluvial sediments in the central Korean Peninsula. Although OSL dating is a well-established method for younger sediments, its upper age limit of approximately 150 ka restricts its utility for older deposits. The Ti-Li center has a higher saturation level compared to the OSL center, enabling the dating of older sediments beyond the range of OSL dating. One of the main challenges in ESR dating is the incomplete bleaching of quartz during sediment transport, whic h can lead to age overestimation. To address this, partial bleaching rates ranging from 55% to 6 0% were obtained from younger fluvial sediments, primarily composed of matrix-supported gravel layers or alternating gravel and sand layers, along the Yeongpyeong Stream, using OSL-derived equivalent doses as a reference. These estimated rates were then applied to ESR age cal culations for the older Baekuiri Formation. The Baekuiri Formation, composed primarily of gravel and sand layers from fluvial environments, is an unconsolidated sedimentary sequence sporadically observed along the paleo-channels of the Hantan River and its tributaries, such as the Yeongpyeong and Chatan Streams. The ESR ages for the Baekuiri Formation range from 36 4 to 279 ka along the Yeongpyeong Stream and from 589 to 505 ka along the Chatan Stream. T hese ages are in good agreement with independently obtained radiometric data from the overlyi ng Quaternary basalts, lending support to the accuracy of the ESR dating results in this region. Overall, this study advances of ESR dating as a valuable tool for extending sediment chronologi es. It underscores the need to correct for incomplete bleaching, particularly in fluvial environme nts. By establishing a methodological framework to account for partial bleaching, this research i mproves the reliability of ESR dating and broadens its applicability in Quaternary geochronology across similar geological settings.

Keywords: Quaternary sediment, Fluvial sediment, Baekuiri Formation, ESR dating, OSL dating

Elements incorporation in detrital quartz analyzed by Electron Spin Resonance method: insights for the modern source-to-sink system of Yangtze River basin

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Recently, the electron spin resonance (ESR) technique has been employed for the identification of distinctive elements incorporated within detrital quartz, thus serving as an innovative sediment provenance tracer. However, the applicability of quartz ESR signal intensity (ESR-SI) in modern "source-sink" processes within large river basins remains uncertain. In this study, the ESR-SI of quartz Al center and Ti-Li center in modern sediments collected from the Yangtze River basin was investigated. The analytical results revealed: (1) The spatial differentiation characteristics of quartz ESR-SI among different tributaries and the mainstream within the Yangtze River basin enable effective source tracing identification. (2) Upon exposure to varying gamma doses, the ratio of ESR-SI between Al center and Ti-Li center tends towards a stable value, particularly at high gamma doses (with a maximum radiation dose of 7561Gy), demonstrating features of provenance tracer stability. (3) The coarser sedimentary materials in the mainstream of the Yangtze River primarily originate from its upper reaches basin, while the material supply rate is significantly limited from its tributaries in the mid-lower basins, which aligns with numerous previous studies. In general, quartz ESR-SI as a newly developed fluvial sediment provenance tracer demonstrates effective and promising potential for application in large river modern source-to-sink system studies. However, further research is necessary to validate its efficacy in the quantitative tracing of sedimentary material sources in the large river basin.

Keywords: Yangtze River basin, modern "source-sink" system; quartz; electron spin resonance (ESR); provenance tracing

Applicability of Rock surface Luminescence Dating for Catastrophic Events: A Case Study of the 2000 AD Yigong Tsangpo Outburst Flood Cobbles

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Failure of large dams has caused some of the most destructive floods on the Tibetan Plateau, which have long been recognized as an important agent causing regional geomorphic change in this area. Acquiring a robust chronology of outburst flood events is vital for understanding disastrous mechanisms and it is challenging. Conventional luminescence dating via quartz or feldspar mineral grains is generally unsuitable because of the insufficient resetting or bleaching of the latent luminescence signal due to the short duration of sediment transport. In contrast, some larger clasts on the ground surface have the chance being exposed to sunlight for prolonged bleaching before entrained in outburst flood, and thus be potentially used for rock surface luminescence burial dating to determine the age of outburst flood events and unveil the transport and exposure-burial process of these extreme surface processes. While previous studies have successfully applied rock surface luminescence dating to Quaternary outburst flood deposits with promising results (e.g. Semikolennykh et al., 2022; Simth et al., 2023), concerns remained regarding the bleaching efficiency of clasts during short-duration, high-energy flood events. Cobbles deposited by modern catastrophic flood events provide critical benchmark materials to validate this methodology under known conditions. The well-documented 2000 AD Yigong outburst flood (YGOF), characterized by detailed records of dam breach timing, peak discharge, sedimentary features, and downstream impacts, provides a unique opportunity to evaluate signal resetting under extreme conditions and assess the feasibility of rock surface burial dating for catastrophic sediments. In this study, we investigate the daylight bleaching of IR_{50} and $pIRIR_{130}$ signals of 148 granite cobbles. Five of these cobbles show well-bleached luminescence-depth profiles were selected and the ages were determined. The $pIRIR_{130}$ signals were reset to depths of 2-7 mm beneath cobble surfaces, with ages of subsurface slices ranging from 0.58 to 0.02 ka. This work highlights both the potential and challenges of rock luminescence dating of catastrophic deposits.

Keywords: Rock surface luminescence burial dating, Outburst flood sediments, Modern samples, Bleaching, Yigong Tsangpo River

References:

Semikolennykh, D. V., Cunningham, A. C., Kurbanov, R. N., Panin, A. V., Zolnikov, I. D., Deev, E. V., & Murray, A. S. (2022). Dating of megaflood deposits in the Russian Altai using rock surface luminescence. Quaternary Geochronology, 73, 101373.

Smith, L. N., Sohbati, R., & Jain, M. (2023). Rock surface luminescence dating of gravel determines the age of a glacial outburst megaflood, Glacial Lake Missoula, Montana, USA. Geology, 51(4), 323-328.

Bleaching of blue light stimulation and X-ray irradiation response of Al_2O_3:C TL glow peaks separated by deconvolution

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Al_2O_3:C is a compound whose F and F+ centers, associated with luminescent emission, exhibit a very high intensity peak (dosimetric trap) close to 200°C in a typical TL glow curve. This property was introduced for the development of radiation dosimeters based on TL. This compound is highly sensitive to radiation, capable of detecting radiation of about 1 μGy, and has attracted attention for its potential use in environmental radiation measurements. However, the material is limited by its thermal quenching, which shows an unusual correlation between radiation and luminescence intensity at high temperatures. The recent interest in this phosphor is due to its excellent OSL properties and ability to avoid thermal quenching, which makes it a sensitive and practical material for OSL dosimetry [1, 2]. In this study, a POSL technique based on the Mott-Seitz model [3] was used to correct the TL signal for thermal quenching effect. The TL signals were then separated by the computerized glow curve deconvolution (CGCD) method. Finally, the bleaching to blue light and response to radiation dose of each separated TL glow curve were investigated. The results showed that in the temperature range from room temperature to 370°C after X-ray irradiation, the TL glow curves of Al_2O_3:C revealed at least three glow peaks, which were well described by the general order kinetic model. Bleaching with blue light stimulation showed two different exponential decays in bleaching rate for all the separated peaks, which can be explained by the competition of optical stimulation and phototransfer. In the dose response study, two peaks showed sublinear dose behaviour and one peak showed supralinear dose behaviour.

References

[1] Akselrod, M.S. *et al*., 1998. Journal of Applied Physics 84, 3364–3373.
[2] Botter-Jensen, L., *et al*., 2003. Elsevier Science, Amsterdam, Netherlands.
[3] Chithambo, M.L., 2007. Journal of Physics D: Applied Physics 40, 1880–1889.

Quantifying the longshore sediment transport using residual doses of K-feldspar pIRIR, southeastern Japan Sea

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Luminescence emitted from mineral grains is generally useful for sediment dating. It has also been considered a useful tracer of sediment transport, which is fundamental for understanding coastal systems. In this study, we attempted to quantify the longshore sediment transport through materials collected from the Teradomari coast along the Japan Sea. The Teradomari coast is located close to the mouth of the diversion channel from the Shinano River constructed in 1922, which has supplied a large amount of fluvial sand to the coast, resulting in beach progradation. The sand was further transported northeast beyond multiple headlands, forming pocket beaches. We collected modern beach sand samples at 19 sites along the coast and extracted K-feldspar grains 180–250 μm in diameter. Residual doses retained in the grains were determined from the multiple elevated temperature (MET) post-infrared infrared stimulated luminescence (pIRIR) protocol, which measures multiple signals with different bleaching rates. We measured infrared stimulated luminescence (IRSL) at 50 ºC and pIRIR at 150, 225, and 290 ºC. The residual dose of IRSL decreases immediately away from the channel mouth, making it difficult to estimate the decreasing rate accurately. We thus used residual doses of pIRIR for further analysis. Residual doses of three pIRIR signals show similar trends; the residual dose is the highest near the channel mouth and decreased toward the northeast. These trends suggest that beach sand is bleached by the sunlight with increasing time while it is transported toward the northeast, being consistent with trends of transport observed since the construction of the diversion channel. Residual doses decrease up to 15 km from the channel mouth, beyond which sand from other sources could be supplied. Next, we attempted to quantify the duration of the longshore transport in the 15-km interval based on bleaching experiments and several assumptions on solar irradiance and beach geomorphology. In bleaching experiments, a sample from the channel mouth, which implies initial conditions of longshore transport, was exposed to a solar simulator for different durations and its pIRIR signals were measured to quantify residual doses. We then fitted the relationships between exposure duration and residual dose retained with a regression curve, referred to here as a bleaching curve. An irradiance ratio of the solar simulator to the average natural sunlight in the Teradomari coast was calculated based on the solar irradiance database provided by the New Energy and Industrial Technology Development Organization (NEDO). The bleaching probability was also calculated according to the beach envelope model, in which beach sand transported longshore is assumed to be mixed down to a depth of 150 cm between the foreshore and surf zone. We finally integrated the bleaching curve, irradiance ratio, and bleaching probability to estimate the transport durations in the 15-km interval as 30, 26, and 21 years from 150, 225, and 290 ºC pIRIR signals, respectively. While these estimates from multiple pIRIR signals are similar to each other, the slight discrepancies may reflect variable impact of water on bleaching efficiency of the pIRIR signals.

Keywords (max. 5): bleaching experiment, coastal management, MET-pIRIR, sediment tracer

Influence of high-temperature on the luminescence signal of rock and its significance in dating

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The rock surface optically stimulated luminescence (OSL) dating method has emerged as a groundbreaking technique, filling a critical gap in quantitatively determining burial (exposure) ages, erosion rates, and transport histories of rocks within the 10^1–10^4 year timescale. It holds significant appli cation potential in Quaternary geology, geomorphological evolution, archaeology, and seismology geolo gy.

The scientific foundation of this method lies in investigating the bleaching depth of OSL signals from the rock surface inward, as well as the luminescence characteristics of dating minerals such as quartz and feldspar. Notably, rock samples from different burial environments exhibit distinct OSL signal bleaching mechanisms: for fluvial terraces, beach gravels, glacial moraines, landslide deposits, and flood sediments, sunlight exposure is the dominant factor controlling OSL signal resetting. In contrast, for rocks baked by volcanic activity or ancient human fires, as well as fault gouges, temperature serves as the primary factor in OSL signal resetting and significantly influences the luminescence properties of dating minerals.

However, the effects of temperature on OSL signal bleaching and luminescence characteristics remain insufficiently studied. In OSL dating, fully bleached and heat-reset samples hold significant scientific importance, particularly in establishing and validating the bleaching method and measurement procedures. This study takes volcanic baked granite as the object, focusing on exploring the comprehensive influence of baking temperature factors on the luminescence signals of rocks, establishing the relationship between baking temperature and the luminescence signals of rocks. The findings will provide a crucial theoretical basis for dating rock samples where thermal events act as the primary signal-resetting mechanism.

Keywords: volcanic baked granite, luminescence characteristic, rock dating

Analyzing complex MET-pIRIR equivalent dose distributions from Single-Grain K-feldspar in fluvial deposits

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Potassium feldspar (K-feldspar) luminescence signals are prone to anomalous fading and incomplet e bleaching, while micro dose heterogeneity is common in lithologically inhomogeneous fluvial sedimen ts. These factors often lead to highly dispersed single-grain equivalent dose (De) distributions, complicat ing age estimation. Notably, the very low De values observed in such distributions typically do not repre sent well-bleached grains but rather significantly underestimate the timing of the last depositional event. Misinterpreting these values as fully bleached components in statistical age models can result in substant ial age underestimation.

In this study, we applied single-grain MET-pIRIR (multiple-elevated-temperature post-infrared infr ared stimulation) and MET-SGC-pIRIR (standardised growth curve) protocols to heterogeneous sandy g ravel deposits and evaluate the suitability of different statistical age models. After plateau age screening and correction for fading and unbleached components, we found that the Minimum Age Model (MAM) still yielded underestimated burial ages. In contrast, models based on the mean or the Central Age Model (CAM) provided more reliable age estimates. Micro dose heterogeneity may result in a dispersed distribution of single-grain De values. Given that the environmental dose rate is calculated using the average value, the statistical analysis of sample De values is recommended to adopt the mean value or the Central Age Model (CAM).

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Keywords: Single grain, Potassium feldspar, MET-pIRIR, Micro dose, Statistical model

OSL dating of the most recent earthquake (MRE) at the Pamir-Tian Shan Collision Zone

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Precise dating of the most recent earthquake (MRE) is critical for seismic hazard assessment in active tectonic zones. Optically stimulated luminescence (OSL) dating proves indispensable for such studies in arid regions lacking organic materials. The Kashi region, situated at the Pamir-Tian Shan collision zone, has experienced a series of M≥7 earthquakes, including estimated M8-class events prior to instrumental records, ranking it among the most seismically active continental regions globally. This study investigates paleoseismic trenches across surfaces ruptures of three active fold-and-thrust belts. Chronological constraints were obtained by applying coarse-grained quartz (9 mm aliquot) OSL dating and single-grain K-feldspar post-IR IRSL techniques to the pre-earthquake paleo-surfaces deposits, coseismic deposits, and post-seismic sedimentary caps sampled from the trenches. The minimum age model (MAM) was employed to identify fully bleached K-feldspar grains within the potentially incompletely reset coseismic sediments. Results indicate that MRE ages cluster between 100-500 years, suggesting correlation with the 1902 Atushi M8$^{1}/_{4}$ earthquake. This work provides the first direct evidence of surface rupture associated with the 1902 event and demonstrates the efficacy of OSL/pIRIR dating in constraining century-scale seismic cycles in arid orogenic settings.

Keywords : Most recent earthquake, OSL dating, 1902 Atushi M8$^{1}/_{4}$ earthquake, the Pamir-Tian Shan Collision Zone

The potential of MET-post-IR IRSL method applied in buried rock surfaces luminescence dating

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Buried rock surfaces luminescence dating, a newly developed dating technique, which enables cobbles can be used as an alternative to the conventionally employed sand-sized mineral luminescence dating. In recent years, luminescence dating of buried cobbles has been applied to a variety of sedimentary environments such as glacial deposits, fluvial deposits, coastal deposits and archaeological sites. Measurement of the variation of the ages of rock slices with depth into the cobble surface is the crucial part of the experimental technique, because consistent ages of multiple rock slices at different depths (age-depth plateau) can be used to check the depth range within which optical resetting before burial had been sufficient. However, the lack of the conventional age-depth plateau may hamper its use for dating when the signal was only bleached to a depth in equivalence to first measurable slice of a sample.

Multi-elevated-temperature post-infrared infrared stimulated luminescence (MET-pIRIR) dating (Li and Li, 2011) provides an opportunity to measure several signals with different fading and bleaching rates in a single sample. Since a series of MET-pIRIR signals are bleached and faded at different rates, allowing us to interpret two MET-pIRIR signals with different temperature from the same slice displaying the same equivalent dose (age-temperature plateau) as an indication that both signals were most likely zeroed before burial and un-faded during burial. This interpretation is consistent with other forms of plateau method widely used in luminescence dating (e.g. Li and Li, 2011; Fu and Li, 2013) and was the basis of the adequate bleaching assessment of Rhodes and Leathard (2022), Rhodes et al. (2024) and Ivester et al. (2022). Thus, applied in rock surfaces luminescence dating, the age-temperature plateau could provide an internal-check to evaluate the degree of bleaching and fading of the luminescence signals just through a single rock slice, and there is an opportunity that a self-evidenced buried age could still be determined only using outmost first slice when lacking age-depth plateau.

In this study, MET-pIRIR procedure was employed to date fluvial cobbles from high terrace of the Manas River in northern Chinese Tian Shan. The age-temperature plateau of MET-pIRIR measurement was combined with the conventional age-depth plateau in luminescence-depth profile to evaluate the resetting and fading of MET-pIRIR signals. Our results showed that self-evidenced and reliable buried ages of fluvial cobbles could be determined by only using first sub-surface rock slice in the presence of age-temperature plateau. Therefore, it is recommended to applied MET-pIRIR method in buried rock surfaces luminescence dating, which could provide a dual diagnosis for evaluating both the bleaching extent and anomalous fading of the signals.

Keywords (max. 5): rock surfaces luminescence dating, MET-pIRIR, age-temperature plateau

New OSL-dated chronological constraints on the MIS 3 sea-level highstand from southwest coast of Korea

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Estimates of global mean sea-level (GMSL) during the last glacial phase, especially in Marine Isotope Stage 3 (MIS 3, 29-57kyrs BP), remain poorly constrained due to a low-resolution chronology resulting from lack of sea-level index points (SLIPs). Over the past decade, tidal deposits along the Korean penins ula have been documented displaying twofold regressive and transgressive sedimentation in response to changing local sea-levels during the last Interglacial to the Holocene. More recently, newly identified ma rine deposits between major interglacials (MIS 5e and 1) are considered to provide an important constraint during the glacial period. In order to reconstruct dynamic glacial sea-level history, here we focus on thes e multi-sequential order cycles from Baeksu tidal flat, the southwest coast of Korea (the eastern Yellow Sea) where have flat topography with tectonically stable condition that making it an ideal location for re constructing far-field records. Three borehole cores (up to 46 m long) were taken along a proximal-to-distal transect across the tidal flat. Facies analysis with well-constrained optically stimulated luminescence (OSL) dating has been conducted. Geochemical and micropaleontological analysis were implemented to evaluate past environmental conditions. The results show that two packages of retrograding spit/tidal dep osits corresponding to MIS 5a and 3 reflect the occurrence of two short-lived sea-level rise during glacia l phase of sea-level fall. In particular, heterotrophic dinoflagellate assemblage and high ratio of broadleaf and conifer highlight that the MIS 3 tidal mud deposits are tightly linked to high interstadial sea-level un der cold and arid conditions. Considering the indicative meaning of SLIPs and its vertical uncertainties associated with tidal range, we suggest higher relative sea-levels during MIS 3 in the range of -13 to -20 m during the interval 40-51 ka. This study thus shed light on the OSL-dated MIS 3 highstand records, he re documented for the first time in the Eastern Yellow Sea. Our estimates are compatible with previous s tudy by Pico et al (2018) in the Bohai and western Yellow Sea that record a peak mean sea-level of ca. -38 m based on GIA calculation and geophysical model. However, estimates that account for sediment co mpaction and GIA calculation will be necessary to define accurate far-field sea-level.

Keywords: Sedimentary sea-level proxy, OSL dating, Relative sea-level reconstruction, Marine Isotope Stage 3

Detection of Westerly wind path Variability in East Asia in Response to AMOC during MIS 11

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The westerly winds path over East Asia, which characterizes the seasonal progression of the East As ian summer monsoon, is known to shift southward changes variation in response to weakening of the Atlantic Meridional Overturning Circulation (AMOC), as repeatedly observed during the last glacial peri ods (Nagashima et al. 2011). In recent years, a weakening trend of the AMOC has been observed, raising concerns about further weakening and its impacts on the westerly winds path.

Recent paleoclimate studies have reported that large-scale AMOC weakening events occurred repeatedly during not only glacial but also past interglacial periods (Marine Isotope Stages MIS 1, 5e, 7e, 9e, and 11e) (Galaasen et al., 2020). However, it remains unclear whether AMOC weakening affects westerly wind paths during the interglacial periods in the same way as it does during the glacial periods. Here we aims to detect changes in the westerly winds path in response to AMOC weakening during the i nterglacial periods based on the dust provenances study following Nagashima et al. (2011).

We investigate the provenance of dust contained in the KR07-12 PC-5 core collected from the central part of the Japan Sea, since the relative contribution of Asian dust from the two typical East Asian des erts, the Taklimakan and Godi deserts, is sensitive to the westerly wind path (Nagashima et al. 2011). W e measure electron spin resonance (ESR) intensity of the E_1' center in quartz. The values reflects the number of oxygen vacancies in quartz which is proportional to its age, hence showing difference betwee n the two deserts (Sun et al., 2007, 2013).

In the presentation, we will report the variation in the oxygen vacancies in quartz during the past interglacial periods, then compared the results with the variations in the North Atlantic $\delta^{13}C$ records, indicating AMOC strength.

Keywords (max. 5): Quartz, AMOC, westerlies**,** ESR, provenance

Luminescence dating for identifying depositional sequences in the northeastern Kanto Plain, eastern Japan over the last 400,000 years

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The Kanto Plain is a relict Quaternary sedimentary basin filled with thick marine and terrigenous de posits in eastern Japan. In the Kanto Plain, extensive raised marine terraces are developed, indicating the dominance of uplift at least since the last interglacial period. We applied feldspar post-infrared infrared s timulated (pIRIR) luminescence dating to an 80-meter sediment core (GS-KUR-1) collected in the north eastern Kanto Plain and obtained 26 pIRIR ages. Eleven depositional facies units, A to K, were identified from the core in ascending order, representing the shallow marine, shelf, shoreface, foreshore, backshore, lagoon, fluvial channel, flood plain, and aeolian loess and soil. The sedimentary facies analysis was supported by the identification of shell fossils. Pretests of feldspar luminescence signals were carried out and pIRIR measured at 260°C, referred here to as $pIRIR_{260}$, was chosen as an optimal signal for determining luminescence ages. The fading rate of $pIRIR_{260}$ was determined from the fading test of 8 representative samples for correcting the age results. With the exception of the fluvial facies, of which ages appear to be overestimated owing to high residual doses, the resulting ages are younger than 420 ka, being consistent with the stratigraphy and an independent age control provided by a tephra layer Yb1.1. Five glacial-interglacial depositional sequences are defined with sequence boundaries. The sequences typically represent a succession characterized by a basal sequence boundary, fluvial facies, transgressive estuary facies, ravinement surface, and beach-shoreface facies or lagoon facies, in ascending order, but some of them are absent in the sequences. $pIRIR_{260}$ ages allowed the sequences to be compared with the existing stratigraphy in the Kanto Plain. The lower two sequences are correlated with the Jizodo Formation, suggesting a relative sea-level fall and subsequent rise during the Marine Isotope Stage 11, a period supposed to have only a single highstand. The third sequence is then correlated with the Yabu Formation deposited during the MIS 9 and 10. The fourth and fifth sequences represent two of three formations in MIS 7–8. The uppermost sequence is correlated with the Joso Formation that formed during MIS 5a–c. The Kioroshi Formation, correlated with MIS 5e and supposed to be extensively distributed in this region, is missing at the drill site. The beach facies dated as MIS 7 constrains the minimum uplift rate at 0.08 m/ky. In contrast, the MIS 10 fluvial facies limit the uplift rate as < 0.27 m/ky. This study exemplifies that pIRIR dating is useful for extracting paleoenvironmental information from the Middle and Late Pleistocene depositional sequences.

Keywords: Pleistocene, post-infrared infrared stimulated luminescence, sea-level changes, sedimentary facies, tectonics

Luminescence Dating of Offset Alluvial Fan Sequences Along the Northern Part of Ulsan Fault: Implications for Late Quaternary Fault Activity

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The Ulsan fault (UF), trending NNW–SSE to N–S, is one of the major active faults in SE Korea. It is characterized by predominantly reverse-slip kinematics and low to moderate dip angles in the shallow subsurface during the Quaternary. The study area is located in Galgok-ri, Gyeongju City, near the northern part of the UF. Previous studies have reported presence of the Galgok Fault (GF) in this region.

We performed detailed geomorphic and chronological analyses to investigate the spatiotemporal characteristics of the GF. High-resolution LiDAR (0.5 m) and historical aerial photographs (acquired in 1954) were utilized for GIS-based analysis. Optically stimulated luminescence (OSL) dating was applied to constrain the formation ages of alluvial fans along the GF. Quartz grains were primarily analyzed for OSL dating; however, where the upper dating limit of quartz-based OSL was exceeded, infrared stimulated luminescence (IRSL) dating of K-feldspar grains was employed as an alternative.

Three levels of alluvial fan surfaces were identified based on their relative heights above the streambed and classified as Qf_1, Qf_2, and Qf_3. The OSL and IRSL ages correspond well with the relative geomorphic heights: Qf_2 (OSL: 7.6 ± 0.6–34.0 ± 3.0 ka) and Qf_3 (IRSL: 175 ± 6 ka). Fault traces were mapped along fault scarps that align with previously reported positions of the GF. These scarps exhibit an east-side-up morphology, consistent with formation under the current stress regime. This geomorphic expression provides strong evidence for Quaternary reverse faulting. Notably, significant surface deformation features were observed only on Qf_2 and Qf_3, indicating that fault activity had ceased prior to the formation of Qf_1. Based on LiDAR-derived topographic profiles, the vertical offsets of Qf_2 were estimated at ~3 m. Based on these constraints, vertical slip-rate of the GF is estimated at 0.08-0.43 mm/yr. This broad range stands in noticeable contrast to the slip-rate of 0.06-0.11 mm/yr, which was derived from stratigraphic evidence. This discrepancy may stem from the characteristics of the sampling site, which is situated at a near surface of Qf_2. It is plausible that this site accumulated additional sediment from upstream sources after the formation of Qf_2, potentially resulting in an overestimation. Additionally, given that the sampling site is currently used for agricultural purpose, anthropogenic disturbance cannot be ruled out as a factor that may have altered the original stratigraphy. When the youngest age (7.6 ± 0.6 ka), which exhibits high uncertainty, is excluded and the slip-rate is recalculated, the revised slip-rate range narrows to 0.08-0.21 mm/yr. This more constrained estimate aligns more closely with the results of previous investigations and further supports the hypothesis that the upper part of Qf_2 alluvial deposit may have been affected by post-depositional reworking or disturbance.

Our findings demonstrate that an integrated geomorphic and geochronologic approach is an effective tool for characterizing the spatiotemporal behavior of a given fault, and it can also serve as a viable alternative in regions with low tectonic strains and/or where direct paleoseismological methods, such as trenching, are impractical.

Keywords: Ulsan Fault, OSL, IRSL, Alluvial fan, LiDAR

Combined ^{14}C, OSL, and ESR dating of Quaternary sediments from the Songnen Plain, northeast China: Implications for expansion of eastern Asian aridification

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The expansion of inland Asian aridification not only resulted in desert development in the middle–high latitudes of the Northern Hemisphere, but also became the main source of global aeolian dust, which today profoundly affect billions of people. Consequently, understanding the origins and expansion of these aeolian deposits is an important research topic, and might provide key information for assessing future regional and global climatic and environmental trends. However, previous studies have focused mainly on Central Asia, whereas northeast China, which is the easternmost boundary of aeolian dust transportation and expansion in Eurasia, has been rarely studied.

Loess–paleosol sequences are typical late Cenozoic aeolian deposits and are archives of the history of Asian aridification and past atmospheric circulation. In particular, loess–paleosol accumulation located downwind of sandy deserts records the evolution of Asian aridification. The Songnen Plain is located in the easternmost Eurasian arid–semi-arid zone, which is the farthest inland area of aeolian dust accumulation, and is sensitive to climatic fluctuations and eastward expansion of Asian aridification.

In this study, an extensive field survey of Quaternary sediments was carried out in northeast China, and the Huangshan profile that consists of lower lacustrine sediments, middle aeolian deposits, and upper black soil layers, was selected for detailed ^{14}C, OSL, and ESR dating. Based on these results and a previous magnetostratigraphic study, it is concluded that: (1) the Huangshan section was deposited in a paleo-lake during 1180–175 ka; (2) the paleo-lake disappeared at ca. 175 ka as a result of tectonism and thereafter aeolian sediments were deposited until 9.5 ka; and (3) after 9.5 ka the Huangshan section begin to develop black soil layers. The loess–paleosol sequence indicates that the climate of the eastern Songnen Plain in northeast China changed to arid or semi-arid conditions at ca. 175 ka, which also implies that inland Asian aridification expanded to northeast China by no later than 175 ka.

Keywords: Inland Asian aridification; Northeast China; Huangshan section; Aeolian deposit; Late middle Pleistocene

Quaternary Sedimentary Environment Reconstruction Using OSL and Detrital Zircon U–Pb Dating: A Case Study from the Samreung Area, Gyeongju, Korea

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This study aims to reconstruct the depositional age and sediment provenance of Quaternary deposits in the Samreung area of Gyeongju, southeastern Korea, through the combined application of optically stimulated luminescence (OSL) and detrital zircon U–Pb dating. Drill cores up to 12.5 meters in depth were obtained, and both OSL and U–Pb analyses were performed on stratigraphically constrained samples. Zircon is an ideal mineral for U–Pb dating due to its high resistance to physical and chemical alteration, high U and Th concentrations, and negligible initial Pb. The age spectra of detrital zircon grains can reflect the geochronological signature of their source rocks, functioning like a "barcode" of sediment provenance. In this study, we focused on a marsh unit located between 9 and 11 m depth. The OSL age of this unit was determined to be approximately 75 ka. U–Pb dating of detrital zircons revealed distinct provenance changes within the marsh deposit: the lower part was dominated by zircon populations sourced from the Hyeongsan River to the west, characterized by a broad range of age distributions; the middle part was dominated by high-U zircon grains derived from the Namsan granite (ca. 53.9 ± 0.4 Ma) to the east; and the upper part showed a mixed age spectrum representing both sources. These results indicate that the sedimentary environment was influenced by alternating provenance sources over time. In conclusion, this integrated approach of OSL and detrital zircon U–Pb dating allows for high-resolution reconstruction of both depositional timing and sediment provenance, offering a powerful tool for Quaternary stratigraphic and paleoenvironmental studies.

Keywords: OSL, detrital zircon U-Pb dating, provenance, Samreung, Korean

Preliminary study on luminescence dating of Saemangeum sediments to assess anthropogenic impacts

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The Saemangeum Seawall, the world's longest seawall, was constructed along the western coast of the Korean Peninsula as part of a large-scale reclamation project. Coastal wetlands such as Saemangeum provide valuable archives for reconstructing environmental changes, yet the extent to which human activities are recorded in sediments remains poorly understood. The infilling of tidal flats and adjacent waters has led to ecological degradation and changes in water quality, highlighting the need to determine whether these human activities are recorded in the sedimentary archives. This study aims to investigate whether the timing of seawall construction and subsequent anthropogenic impacts can be identified in the sedimentary record using luminescence dating.

Approximately 1 m-long sediment cores were collected from three sites in the Saemangeum coastal area, with samples taken at 5 cm intervals. Grain-size separation was performed using a 90 μm sieve. Polymineral fractions were analyzed using post-IR blue OSL and IRSL protocols. Selected samples were further separated into coarse-grained quartz and K-feldspar to apply quartz OSL and K-feldspar post-IR IRSL. Dose rates were calculated for two representative units per core, and four dating approaches had compared each other. Preliminary luminescence ages varied depending on the protocol. Quartz OSL generally yielded younger ages, whereas poly-mineral pIR-blue OSL tended to overestimate relative to IRSL. K-feldspar ages were relatively overestimated, likely reflecting incomplete bleaching rather than the effects of anomalous fading in young sediments. Some luminescence signals suggest possible links to reclamation activities before and after seawall construction.

Additionally, radiocarbon (^{14}C), ^{137}Cs, and ^{210}Pb dating will be conducted to improve chronological reliability. This study provides a basis for constraining depositional timing around seawall construction and for evaluating anthropogenic impacts within geological archives. Furthermore, dating young and polymineral samples require careful attention, and cross-validation with complementary age dating methods is essential for establishing robust chronologies.

Keywords: luminescence dating, Saemangeum, anthropogenic impact, poly-mineral, Quartz and K-feldspar

Reassessment of the dating of Jeju Island's Suwolbong Tuff

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Jeju Island, a Quaternary volcanic island in Korea, hosts numerous tuff cones (“oreum”) formed by hydrovolcanic eruptions. The Suwolbong Tuff, located on the island’s southwestern coast, is one such deposit and is composed primarily of pyroclastic materials. It was produced during a single hydrovolcanic event, and thus lacks a distinct stratigraphic sequence.

Previous studies have estimated the formation age of the Suwolbong Tuff at approximately 18 ka based on quartz Optically Stimulated Luminescence (OSL) dating (Cheong et al., 2007). Radiocarbon dating of the overlying Gosan Formation — an unconsolidated sedimentary unit beneath the Suwolbong Tuff — yielded an age of about 17 ka at its uppermost layer (Lim et al., 2015), implying that the Suwolbong Tuff should be younger than 17 ka.

In this study, the depositional age of the Suwolbong Tuff was re-evaluated using single-grain OSL dating, in which the luminescence signals of 100 individual quartz grains are measured and statistically analyzed. This approach, not applied in earlier research, provides a more robust age estimate and offers new insight into the timing of the last hydrovolcanic activity on Jeju Island.

Keywords (max. 5): Jeju Island, Single grain Quartz OSL, Quaternary, Suwolbong Tuff, Chronology

Interpretation of Depositional Environment Evolution through OSL Dating of Paleolithic Sites in Seoul, South Korea

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More than 100 Paleolithic sites have been excavated across the Korean Peninsula, among which Jeongok-ri, Suyanggae, and Seokjang-ri are internationally significant. While the Seoul area has seen relatively few reported sites due to urban development, recent discoveries suggest that Paleolithic culture was also present in this region. This study focuses on two newly identified sites in the Gayang-dong area of Seoul, located at ~10 m a.s.l., corresponding to the sedimentary environment in floodplain of the Han River.

Two sedimentary sections were investigated using stratigraphic logging, grain size analysis (2, 5 cm intervals), XRF core scanning (0.5 cm intervals), and isotope analysis for section 24GA-02. Both profiles show similar grain size trends, with mean grain sizes around 6–7 Φ, indicating medium to fine silt and suggesting a floodplain depositional environment. OSL dating of the uppermost part of section 24GA-01 yielded an age of ~110 ka, with deeper sediments likely exceeding dating limits. In section 24GA-02, OSL results suggest deposition occurred between ~30–80 ka at 2 m depth. $\delta^{13}C\_TOC$ values ranged from –31‰ to –25‰, implying dominance of C_3 vegetation and minimal C_4 plant contribution. These isotopic signals are consistent with contemporaneous data from other Korean Peninsula sites during MIS 3.

The findings suggest the archaeological site formed during a river terrace phase, followed by a non-depositional period marked by interglacial soil wedge formation. Today, the site lies within the Han River floodplain. This multidisciplinary approach highlights the significance of integrating geochronology and geochemistry in interpreting Pleistocene paleoenvironmental changes in urban regions.

Holocene Barrier and Coastal Evolution along the East Sea of Korea Using Optically Stimulated Luminescence Dating

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Optically stimulated luminescence (OSL) dating provides an effective alternative to radiocarbon methods for reconstructing coastal depositional histories where sufficient sunlight bleaching occurs. In this study, we applied single-aliquot regenerative-dose (SAR) and single-grain OSL techniques to quartz and feldspar fractions extracted from a 60-m-thick sediment core obtained from the modern shoreline of the East Sea of Korea. The succession records a coarsening-upward sequence from muddy to sandy facies, reflecting the development of beach–shoreface and barrier systems during the Holocene. Although poor luminescence sensitivity of quartz limited the number of reliable samples, multi-proxy comparisons with radiocarbon ages demonstrate that OSL and IRSL ages are stratigraphically consistent and generally robust. Furthermore, analyses of continuous-wave OSL (CW-OSL) decay components reveal systematic variations in fast, medium, and slow components linked to transport distance and depositional environment. These results indicate that luminescence signals were effectively bleached by coastal processes, and that OSL characteristics can serve as proxies for shoreline and environmental change. Our findings highlight the applicability of OSL dating for constraining Holocene barrier evolution in wave-dominated coastal settings of the Korean Peninsula.

Keywords (max. 5): OSL, sensitivity change, coastal evolution, barrier deposits, East Sea of Korea