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Program & Abstracts



Estuary Research Center, Shimane University



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EEIW 2024 Program

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| P-7 | Recent ostracod assemblage (minute Crustacea) and environment in Lake Nakaumi, southwestern Japan, and their spatiotemporal changes over the past 60 year | Aki ISHIGAKI, Toshiaki IRIZUKI, Koji SETO, Mika SHIMAIKE and Akira TSUJIMOTO |
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Oral Presentations

Reconstruction of Late Pleistocene glaciation at Turgen and Kharkhiraa mountain system in NW Mongolia

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Introduction. We recognize a new research demand on mapping and 3D modeling of Late Pleistocene glaciers on the mountain systems. The climatically driven glaciation extracted huge amounts of water from ocean and considerably changed land-sea interactions. Additional ice loading on mountain systems led to their glacio-isostatic subsidence, and unloading on the contrary caused lifting, which could interfere with tectonic movements. Quantitative assessments (area, thickness, volume and weight) of the paleo-glaciers can improve regional and global models of the Earth's geodynamic, environmental and climatic histories.

The geological community has greatly expanded its knowledge of the history of glaciation in mountainous areas in recent decades, especially using modern dating techniques and ELA modeling. It is clear that the glacial relief, which is visible in the mountains, was the result of the last, Late Pleistocene, glaciation. Scientific articles provide 2D reconstructions (maps) of paleo-glaciers for some mountain systems. We develop a technology of 3D mapping and reconstruction of ancient glaciers for regional studies at different scales: local centers of glaciation, mountain systems, continents, and world. The technology was created using Turgen and Kharkhiraa mountain system in NW Mongolia as a test area.

Methodology. The Late Pleistocene glacial landforms are well-preserved in the regions of mountain glaciation and can be identified by means of remote sensing coupled with GIS-based technologies of mapping and spatial analysis. The methodology includes: 1) Analysis of mountain systems to identify local glaciation centers; 2) Allocation of separate glacial valleys at each glacial center as basic units for their GIS analysis; 3) Outlining individual paleo-glaciers using their bounding geomorphs: glacial cirques, trough valleys, and side and end moraines; 4) 3D modeling of paleo-glaciers; 5) Integration of the data into database; 6) Linkage to geological data on the topography and age of mapped objects. Standard GIS and image processing software (QGIS and ENVI) is used for 2D and 3D mapping, and spatial analysis of the data. ASTER satellite images (NASA-METI), which have stereo-channels allowing the creation of anaglyph 3D views, is used to map paleoglaciers. Digital elevation model FABDEM (Forest And Buildings removed Copernicus DEM) of 30-m spatial resolution is used to identify local glaciation centers and for 3D modelling. The Randolph Glacier Inventory database is used to identify modern centers of glaciation, as well as to identify those of modern glaciers, who are the heirs of ancient glaciers. Topographic maps of different scales (up to 1:100,000) are used to allocate modern catchments of glacial valleys and for their geographic naming.

Locality. It is rather small, about 75x75 km (about 3.800 km²), a high-altitude massif located on the north-eastern edge of the Mongolian Altai to the west of Lake Uvs-Nuur. It includes smaller ranges Turgen (highest point 3965 m asl.) and Kharkhiraa (4037 m asl. according to Russian topographic map) separated by a valley. Since the valley in the late Pleistocene contained a glacier fed by ice streams from both ranges, we recognize this massif as a single center of glaciation.

Modern glaciation. The Randolph Glacier Inventory database reports 108 modern glaciers in the massif (see Figure). They form on the walls of ancient glacier cirques and some glaciers fill these cirques and flow down the valley; the glaciers are mostly single and some of them are dendritic. The largest glaciers are about 2.2 km long. Lowest altitude at which the glaciers end is 2823 m (according to COPDEM30). The largest glacier is 4.9 km² and there are 17 glaciers smaller than 1 km². The total area of the modern glaciers is 66.7 km².

Late Pleistocene glaciation. The late Pleistocene glaciers that we reconstructed in the Turgen and Kharkhiraa mountain system were much larger. There were seven large dendritic glaciers, stretching from 19 to 31.5 kilometers (see Figure). They occupied the main valleys and ended on the foothills at

elevations of 2000 - 2400 m. In addition, there were 29 lesser dendritic and single glaciers. The area of the seven largest glaciers is between 135 and 31 km² and the area of all 36 glaciers is 541 km². Therefore, during the late Pleistocene, the glaciers covered 8 times more land than modern glaciers.

The 3D modelling used to generate volumetric data on glaciers is time-consuming, and we continue to improve technology for faster processing. The two largest late Pleistocene glaciers in the region under discussion had the following parameters shown in Table.

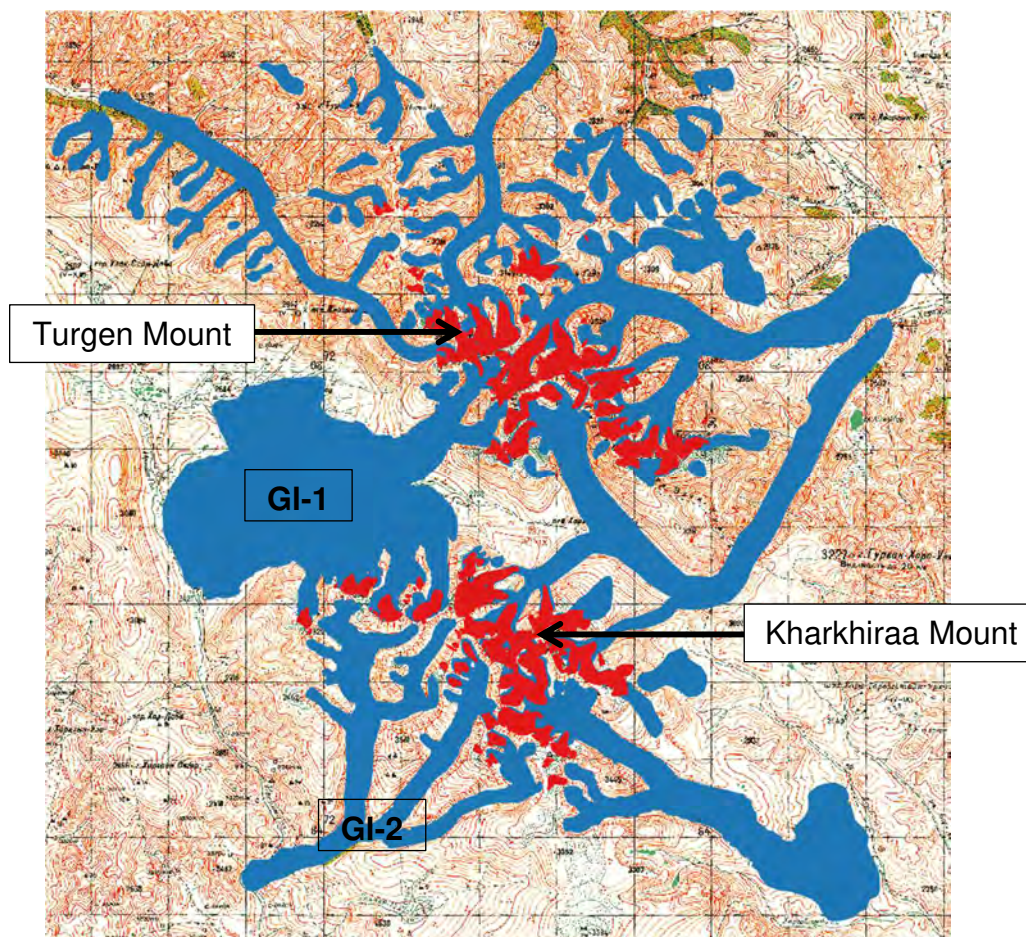


Figure. Extent of modern (red) and late Pleistocene (blue) glaciers in the Turgen and Kharkhiraa mountain system. Background is Russian topographic map.

Table. Main parameters of two largest glaciers of the Turgen and Kharkhiraa mountain system

Name	Length, km	Thickness max., m	Thickness med., m	Area, km ²	Volume, km ²
GI-1	21.798	357.53	91.18	134.666	12.629
GI-2	18.973	245.16	119.5	58.923	6.358

Key words: Late Pleistocene, paleoglaciers, geomorphology, remote sensing, GIS

Last transgression of Issyk-Kul Lake, Kyrgyzstan

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Issyk-Kul is a terminal lake in the Kyrgyz Republic in Central Asia. The lake has a length of 182 km and a width of up to 60 km, an area of 6236 km² and a volume of 1736 km³. It is the second-largest mountain lake in the world, the third-largest brackish-water lake (salinity 6g/L), the seventh-deepest lake (maximum depth 668 m), and the tenth-largest lake by volume (Podrezov et al., 2020).

The lake is located in a tectonic basin between the Terskey- Alatau and Kungey-Alatau Ranges of the Tien-Shan Mountains. The oldest Mesozoic sediments in the basin were uplifted during the Cenozoic collision of the Indo-Australian and Eurasian tectonic plates, which activated its fault tectonics; the region is now very seismically active. The sediment accumulation in the lake probably began in the Miocene, and the lake has its current appearance since mid-Pleistocene (Trofimov, 1990).

The current water level of Lake Issyk-Kul is referenced to 1606 m a.s.l. on the topographic maps. The lake level change history (Sevastianov, 1991; Romanovsky, 2002) is known from the late Pleistocene, when the highest lake level was at 1640 m a.s.l. The lake dropped to 110 m from the modern level at the end of the late Pleistocene. The lake became high in the Holocene with the highest stands 8.3-6.9 and 1.4-1.2 ka BP (Ricketts et al., 2001), while the level could not be higher than 1620 m a.s.l. – the Chu River outflow from the basin. The most recent rise occurred around the XVIII century AD according to historical maps (Narama et al. 2010), and the lake level has been steadily declining since then (e.g. Romanovsky et al., 2013; Zhang et al., 2022).

Our study contributes to a better understanding of the latest transgression of the Issyk-Kul, whose traces are represented by a wave-erosion scarp at an altitude of 1619 m a.s.l. and 10-13 accumulative coastal bars on the beach. Two sites were studied in detail on the south-eastern and south-western shores of the lake in 2021 (see Figure). Site 1 gave us opportunity to date the mollusk shells collected from the oldest (10), middle (5), and pre-modern (2) shorelines. The calibrated ages (median values) were 1337, 1420, and 1772 AD, respectively.

The effect of old carbon (freshwater reservoir effect) of Issyk-Kul has been estimated by dating shells of dead mollusks from modern shoreline and carbonates precipitated on modern water plants; their ¹⁴C ages are 94 ± 38 and 83 ± 40 BP, respectively. These dates are outside the IntCal20 (95 yrs BP) and MARINE20 (603 yrs BP) calibration curves. So we used 95-year value and the IntCal20 curve, which returned the calibrated age of 1835 AD. The value of 186 years (the difference between 2021 and 1835) was subtracted from the above dates to correct this effect.

Thus, the adjusted ages are 1523 AD for the maximum of the last transgression, 1606 AD for the middle level of the transgression, and 1958 AD for the pre-modern shoreline.

Archaeological data is useful for determining the initial stage of the last transgression and identifying the environment before it. The region was densely populated in early historical times. A 1375 AD Catalan atlas shows the “Ysicol” Lake and the Christian monastery on its shore. Later legends indicate that the monastery was flooded by lake water, which, however, is not confirmed by modern researchers. Instead, there are many archaeological finds under water of the lake: pottery, goods, weapons, graves

and ruins of buildings and settlements that span the interval of the VIII century BC - XV century AD (Mokrynin, Ploskikh, 1988). The finds were found in different places of the lake at depths up to 20 meters; however, there was no their systematic examination meeting modern standards of archaeology, has not been conducted. This work was recently started in the framework of International Diving Expeditions 2023 and 2024. Their preliminary results clearly show the wide spread of Medieval archaeological sites at a depth up to four meters below the modern level of the lake.

Conclusion. Our new geochronological and archaeological results paint the following picture of the latest transgression of Lake Issyk-Kul. The lake was lower than today in the Middle Ages and earlier times. We cannot reconstruct the rise of the level with certainty and assume that it was lower than 1600 m a.s.l. in the late XV century AD. The rapid, over 30-40 years, transgression to 1619 m a.s.l. led to flooding of populated shores and strong wave erosion formed the 10-m high above the coastal zone. The peak of the transgression was in the early XVI century AD and then the lake went into a regressive phase. The lake became eight meters lower during the next one hundred years and reached 1611 m a.s.l. in the early XVII century AD. The rate of the subsequent lowering was slower, and the lake reached 1608 m a.s.l. in the middle of the XX century AD. That is three meters of decrease took about 350 years. The rate of decrease by two meters in the last 65 years looks about the same as in the first stage of the regression.

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Key words: Holocene, lake level changes, geomorphology, geochronology, archaeology

Statistics and comparison of ancient and modern glaciers in Gongga Mountain area, Hengduan Mountains, Sichuan, China

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This study is a part of a project aimed to reconstruct late Pleistocene glaciation in mountain systems of Central Asia. We investigate local centers of glaciation in test regions in order to justify our elaborated GIS technology (see abstract of S. Krivonogov in this volume).

The Gongga Mountain represents a center of glaciation in the Hengduan Mountains – a structure separating the eastern side of the Tibet and Himalaya high-mountain region and the Sichuan Basin. The Hengduan Mountains consist of many mountain ranges stretching from north to south. Their formation was the result of a collision between India-Australia and Eurasia tectonic plates during the Cenozoic Era. The continuous tectonic stress has led to significant topographical differentiation of the mountains. Their deep valleys are the pathways of the largest rivers in South-East Asia: Yangtze, Mekong, and Salween, and their summits are covered by glaciers that have been important river feeders since the Ice Age. Modern glaciers occupy tops of the ranges at 5000 m a.s.l. and higher. Several centers of modern glaciation exist in the Hengduan Mountains, and Gongga is the largest among them.

Mount Gongga, 7,556 m a.s.l., is the highest peak in the Hengduan Mountains and this center of glaciation extends for 60 km from north to south. The Gongga Massif is asymmetric: its western slope are steeper than eastern. The Randolph Glacier Inventory database counts 76 modern glaciers in it. They form on the walls of ancient glacier cirques and some glaciers fill these cirques and flow down the valley; the glaciers are mostly single and some of them are dendritic. The largest glacier is 12 km long. Lowest altitude at which the glaciers end is 3007 m a.s.l. (according to COPDEM30). The largest glacier is 27.6 km² and there are 43 glaciers smaller than 1 km². The total area of the modern glaciers is 189.54 km².

In our study of the maximum extent of the late Pleistocene glaciation, we found traces of 75 ancient glaciers in the Gongga Massif. There were 10 large dendritic glaciers, stretching from 7 to 17.5 kilometers (see Figure). They occupied the main valleys and most of them ended in the middle of the valleys at altitudes between 2700 and 3300 m a.s.l.; only a few glaciers descended to the valleys bounding the massif in the west. In addition, there were 65 lesser dendritic and single glaciers. The areas of the 10 largest glaciers are between 78 and 12 km² and the area of all 75 glaciers is 503 km².

Conclusively, during the late Pleistocene, the glaciers covered 2.7 times more land than modern glaciers. This value is not high. We explain this phenomenon by the high altitude of the Gongga Massif, which allows for relatively large modern glaciers, on the one hand. The position of the massif in the relatively warm low-latitude area of the Earth limited, on the other hand, the formation of the late Pleistocene glaciers.

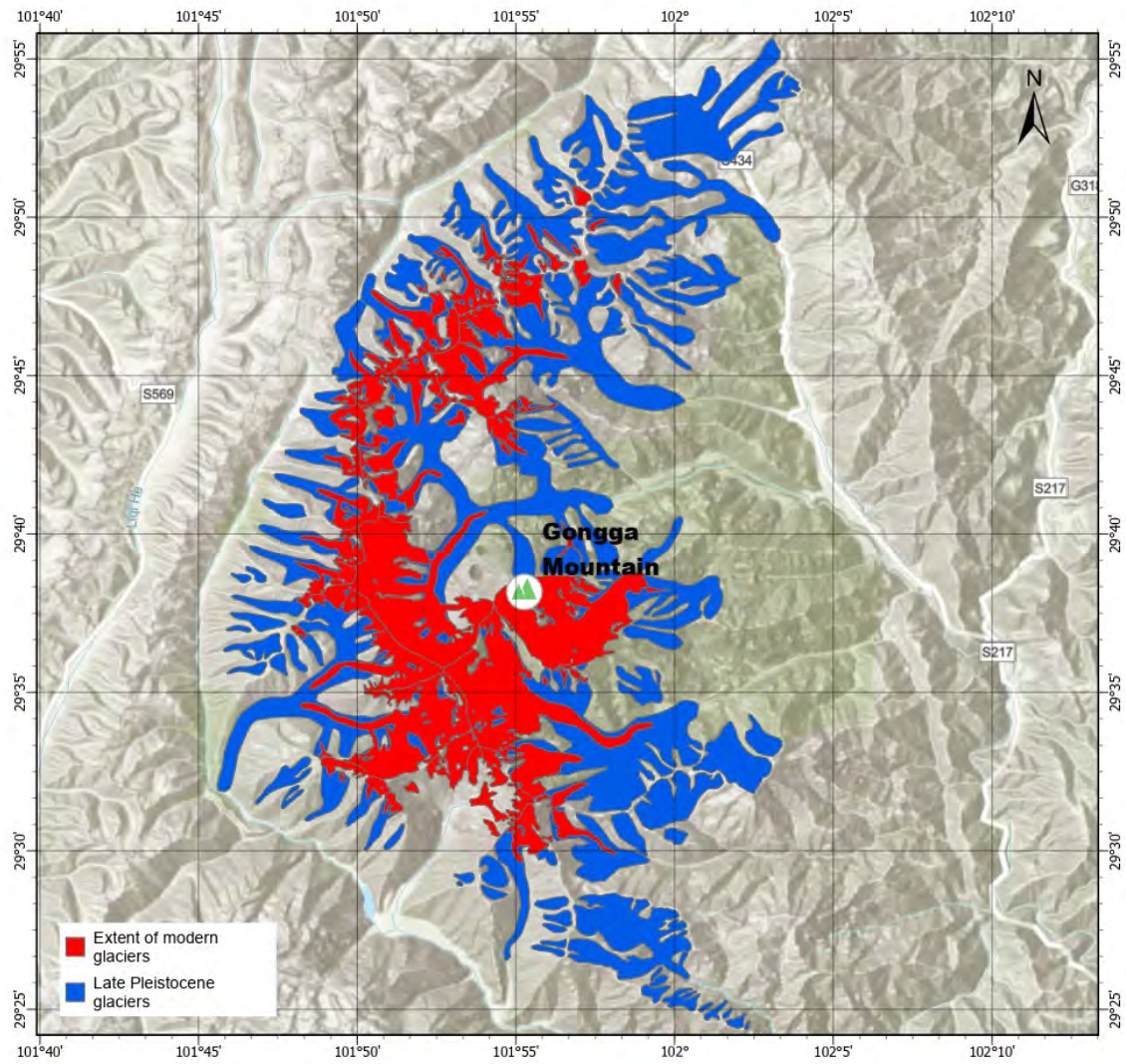


Figure. Extent of modern (red) and late Pleistocene (blue) glaciers in the Gongga Massif. Background is ESRI shadow relief map.

Key words: modern glaciers, paleoglaciers, Late Pleistocene, geomorphology, remote sensing, GIS

The appearance of early humans in Jeongok-ri, Korea

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The Palaeolithic site of Jeongok-ri is one of the best-known archaeological sites on the Korean Peninsula and is notable for the first discovery of Acheulean-like handaxes in East Asia. These Acheulean-type handaxes, previously found only in Africa and Europe, were first recovered from an excavation in East Asia at this site in 1978. The discovery of these bifacial handaxe assemblages has sparked prolonged debate regarding their relationship to tool typologies from Africa and Europe. This finding provided clear evidence against Movius' theory, which proposed that handaxes were absent in the Palaeolithic of East Asia (Movius, 1948). Despite the site's archaeological significance and over 40 years of research, the chronological framework of the Jeongok-ri site remains debated due to a lack of suitable material for dating and the limitations of conventional dating methods.

This study aims to understand the geological distribution and formation of the Hantan-Imjin River basin, identify the timing of human emergence, and examine the climate and ecological environment at that time to interpret interconnections. Direct dating of the artefact-bearing layers was attempted using Optically Stimulated Luminescence (OSL) techniques, which showed great potential for accurately determining the timing of deposition. To extend the age range of OSL dating, the study also explored the thermally transferred OSL (TT-OSL) signal and single-grain K-feldspars using post-Infrared Infrared Stimulated Luminescence (pIR-IRSL). The Jeongok Basalts were directly analyzed using the Ar-Ar dating method. Additionally, the burial age of unconsolidated gravel and sand layers underlying the Jeongok Basalt was dated using ¹⁰Be dating.

The results of these multiple absolute dating methods contribute to developing chronologies for the Jeongok-ri archaeological sites and help constrain the timing of the earliest hominin occupation in South Korea. The study of ancient human movements and settlements on the Korean Peninsula offers significant archaeological value. We believe that tracing the emergence of humans on the Korean Peninsula can provide key insights into the global debate on the origins and movements of ancient humans.

Application study of environmental magnetism on a paleosol-bearing sequence of Paleolithic site in the central Korean Peninsula

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Magnetic enhancement, such as magnetic susceptibility (k) enhancement (kE), plays a key role in reconstructing terrestrial paleohydroclimates and their teleconnection to the oceanic signals. Using these kEs is expected as useful for discriminating impacts by human activities from those by natural driving factors on Holocene hydroclimate changes. However, this application in the Korean Peninsula (KP) is challenging due to the lack of investigations addressing the kE and its driving process(es) linking to the local/regional hydroclimate variability. Here, we present a novel example investigating two kEs of similar magnitudes, dated the Marine Isotope Stage (MIS) 1 (Holocene) and late MIS 3 (~29–36 ka), from a ~2.7 m-thick paleosol sequence developed on upland of paleo-fluvial terrace in the central KP. In the studied site, rich lithic industries (particularly of Paleolithic) were unearthed. We yielded detailed mineral magnetic properties allowing characterizations of type, concentration, and particle-size of magnetic minerals, in addition to k , and X-ray diffraction quantification (in wt%) of major constituent minerals, with available soil total organic carbon and carbon isotope data, and numerical age–depth relationship, across the two kE intervals. The results show enhanced occurrence of ferri- and antiferro-magnetic mineral components including ultra-fine particles, and stronger chlorite (silicate) weathering for the two kEs , suggesting the pedogenic components predominance. The kEs by pedogenesis are interpreted to be driven by the Fe-bearing (phyllo)silicate weathering mechanism that were proposed in Chinese Loess Plateau sequences, more prominent in the southern part with higher rainfall. Detailed magnetic results also indicate the superparamagnetic to pseudo-single domain-sized particles of pedogenic magnetite as the major contributor to the kEs . Correlation of unmixed magnetic features of the kEs features to local/regional variabilities of East Asian summer monsoon (EASM) (rainfall) intensity, aridity, air temperature, and organic matter content proxies suggests that multiple factors, rather than solely EASM intensity, dominate the concentration and particle-size of pedogenic ferri- (and antiferro-)magnetic minerals. We infer that one of additional dominant factors could be organic matter content (\approx vegetation cover). This study therefore provides a baseline for deepening understanding of the magnetic mineral pedogenesis and responses linked to surrounding hydroclimate and environment variabilities.

Keywords: environmental magnetism, paleosol, paleohydroclimate, Holocene, late Marine Isotope Stage (MIS) 3, Korean Peninsula

High-Resolution Late Quaternary Manganese Chemostratigraphy Using XRF (X-ray fluorescence) Scanning Data of Shallow Marine Sediments in the Southwestern Taiwan

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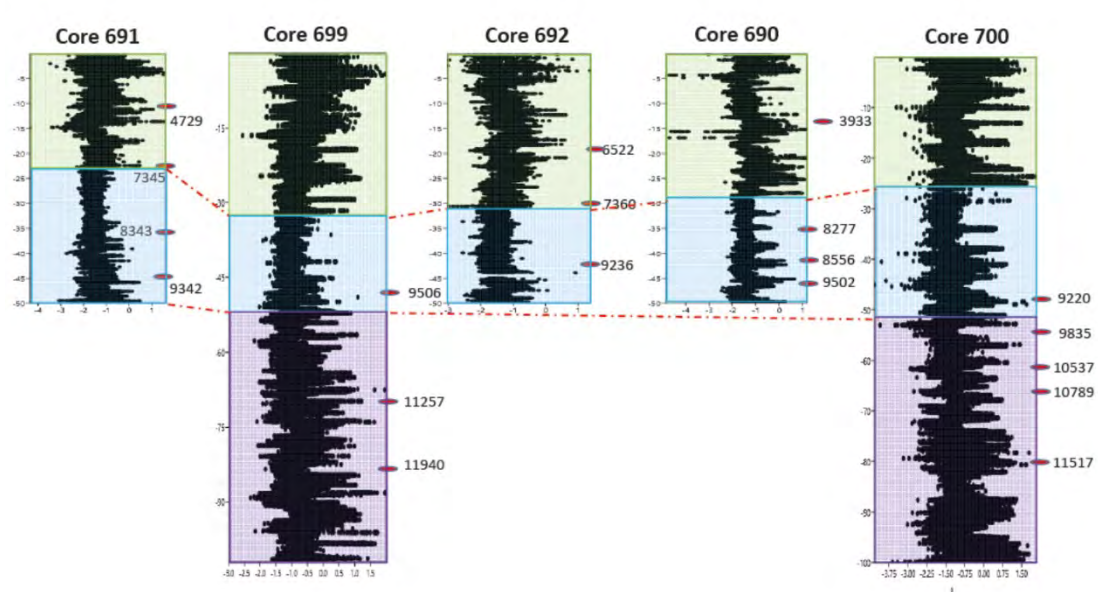
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A suite of thick shallow marine depositional sequences of continental shelf to lagoon, estuary and deltaic facies were deposited in the paleo-inner sea in the southwestern Taiwan during the latest Quaternary (13,000 to 3,000 years ago) in Tainan area. A total of five long sedimentary cores (50 and 100 meters long, respectively) were retrieved from the Tainan Science and Technology Park for archeological and paleo-environment studies. These sediment cores were scanned using XRF scanners at very fine scale (1mm/point) for non-destructive, high-resolution chemostratigraphic analyses. Since the elementary intensity (counts per second, CPS) measured from semi-wet sediments using the XRF core scanner were heavily influenced by the sediment properties (e.g., grain size, water content and surface roughness, surface elevation) of the core, outlier detection and data cleaning are a necessary prerequisite before conducting multivariate analyses of the scanned data. After prudential data hygiene, about 96% of the data points per core and 11 elements of the scanned were retained. To mitigate the constant sum problem inherited in the CPS data and make the data distribution more close to multivariate normality, all data were firstly log-ratio transformed, and then principal component analyses (PCA) were applied to data set of each core to recognize the most determining elements that explain most of the data variance. Element Mn, Ca, Zr and Cu, in descending order, were identified to account for the first three principal components for various cores. In most cases, intensities of Mn, Ca and the geometric mean of the retained elements co-vary together and therein form a solid basis for Mn-dominated variation in vertical stratigraphic columns. These strata enriched with Mn (marked by relatively high Mn CPS) are tend to associate with high contents of silt (4 – 63 μ m). As a result, based on Mn and Ca content (represented mainly by Mn), the shallow marine sediments of the latest Quaternary in the Tainan Science and Technology Park of ~13000 – 3000 years ago can be subdivided into three sections (Figure 1): Section I, strata of 13,000 – 9,600 years ago in age (preserved only in 100m-long Core 699 and Core 700); Section II: strata of 9,600 – 7,350 years ago where Mn-Ca diagenesis were weaker, and Section III: strata of 7,350 – 3,000 years ago, where Mn-Ca diagenesis were strong. The diagenesis might have governed by the redox conditions of the depositional environment, sub-ground water circulation and lithology (silt content). The formation of Mn-Ca veins and micro-nodules in the sediments might have enhanced permanent carbon sequestration.

Keywords: chemostratigraphy, XRF, Mn stratigraphy, late Quaternary



Mn Stratigraphy of the studied five cores, Tainan Science and Technology Park, Southwest Taiwan. The numbers are calendar calibrated ^{14}C ages.

Holocene sea-level changes in Japan coastal areas recovered from the brackish lake sediment cores based on physical properties and geochemical analysis

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After the termination of the Last Glacial Maximum (LGM; 30-17 ka; Yokoyama et al., 2018), the global average temperature rose by approximately 6 degrees Celsius until the present (Tierney et al., 2020). This global temperature increase led to the melting of expanded ice sheets that extended as far as the Scandinavian Peninsula, Greenland, and the North American continent, which in turn resulted in a rise in the eustatic sea level from 130 meters to the present sea level (Yokoyama and Purcell 2021 and references therein). In East Asia, the relative sea level (RSL) reached its maximum in the middle Holocene and then regressed due to glacio- and hydro-isostatic effects (GIA, Clark and Lingle, 1979; Nakada and Lambeck, 1987). Since Japan is an island surrounded by the sea (the Pacific Ocean and the Japan Sea), robust geographical evidences have been utilized to reveal the past sea-level changes in Japan's coastal areas during the Holocene (e.g., Tanabe, 2022). However, the exact timing remains ambiguous due to a lack of sequential sampling points.

The coast of Japan has numerous brackish lakes, many of which were formed due to the past sea-level transgression and regression during the Holocene (Kunii et al., 1993; Saito 2011). It is a significant advantage that brackish lake sediment cores allow us to recover undisturbed past environmental changes since it has sequential and high time resolution records. Nara et al (2022) found out the sea-level regression period in the late Holocene through the brackish lake (Lake Ogawara, Tohoku town, Aomori prefecture) sedimentary records of halogen (bromine: Br and iodine: I) and trace element (uranium: U) along with the precise age model established by radiocarbon dating of plant residues and the tephra layer (B-Tm; Changbaishan eruption at AD 946). Therefore, it is certain that brackish lake sediment cores along the Japan's coastal area can provide additional evidences that enhance our understanding of past sea-level changes during the Holocene.

In our current research, we are focusing on using the brackish lake sediments from Lake Kibagata (Komatsu city, Ishikawa prefecture) on the Japan Sea coast to gain information about the past sea-level changes. Contrary to the Pacific side, the study of the past sea level changes on the Japan Sea side is still limited. To clarify the past sea level response to climate-induced water mass changes, either eustatic or due to GIA, understanding the past sea-level changes in relatively enclosed environments, such as the Japan Sea, is essential. Lake Kibagata is located about 5 km inland from the coastline of the Japan Sea and has not undergone large-scale artificial modifications such as land reclamation. We obtained the approximately 4-m long Lake Kibagata sediment core (KB2023) in the center of the lake (N36°22'07.60", E136°26'53.29") from a water depth of 1.7 m in 2023 using a

piston core sampler. Radiocarbon dating of plant residues showed that the core KB2023 spans from approximately 11,100 cal BP to around 4,300 cal BP (Kida et al., 2024), which covered the period of the Jomon Transgression. Additionally, a drastic change of the water content (WC) of KB2023 at around 7,300 cal BP was reported (Kida et al., 2024), which corresponding to rapid sea-level rise events called as the Jomon Transgression. These results suggest that the core KB2023 could provide us valuable information for understanding the past-sea level changes at the middle and late Holocene.

The physical properties (CT image, porosity and magnetic susceptibility, which measured by the multi sensor core logger at Kochi Core Center under Kochi Core Center Open Facility System) and the geochemical (Br, I, and trace elements measured by XRF) analysis were conducted on the core KB2023. Based on these data, we will present a report on the past sea level changes at the late Holocene that took place along the Japan Sea coast.

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Keywords: Sea-level change, Brackish lake, The Holocene, CT image, Multi sensor core logger (MSCL), XRF

Determination of sedimentary characteristics of Holocene estuarine fills using micro-XRF data: A case study from the Izumo Plain, Shimane Prefecture, Japan

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Estuaries form with the onset of transgression, accumulate sediment until maximum flooding when the shoreline is furthest inland, and continue to fill during the subsequent highstand of sea level (Dalrymple et al., 1992). As such, they are sensitive to both fluvial and marine processes, including past relative sea level changes. The Izumo Plain is part of Paleo-Shinji Bay, a narrow east-west oriented drowned incised valley connected to the Japan Sea to the west; its valley incision was formed during the Last Glacial Maximum. The filling of this incised valley began with the onset of post-glacial sea-level rise and is characterized as a partially unfilled, narrow, wave-dominated estuary. In this study, we analyzed HK19 and HK22 cores taken from the eastern margin of the Izumo Plain. We used mainly micro-XRF data in combination with CNS (carbon, nitrogen, sulfur) and grain size data with the thirty-four AMS radiocarbon dates and three age-known tephra to establish the chronological framework.

The sedimentary facies shows thin fluvial-dominated gravelly sediments at the base overlain by transgressive muddy coastal sediments in the valleys, which began at about 9.3 cal. kyBP as sea level rose rapidly. Thick muddy sediments were deposited under brackish to marine conditions until about 0.7 cal. kyBP. After this period, coarser sediments began to be deposited and the area of the core site was rapidly filled by delta progradation of the Hii River. The dominant distribution of detrital elements (Ti, K, Rb, Si, and Zr) in the muddy sediments was intense until 7.4 cal. kyBP with a relatively high accumulation rate, coinciding with rapid sea-level rise, and sediments were mainly transported from the coasts outward into the bay by coastal erosion. This facies is overlain by a regressive central basin, which is characterized by thinly laminated muddy sediments, resulting from the shallowing of the bay mouth and the anoxic environment in the bay bottom, induced by the decelerated sea-level rise. The anoxic conditions produced distinct geochemical characteristics with an abundance of Fe and S. The northward progradation of the bay-side delta of the Hii and Kando Rivers had divided the central basin into two basins (west and east) at about 3.7 cal. kyBP, then further decreased the water circulation and accumulation rate in the eastern inner basin. This inner basin became a more closed environment, triggering the dominant concentration of diagenetic elements (Fe, S, Mn) at least until about 0.7 cal. kyBP. Our record provides a case study of how the muddy central basin sediments in the incised valleys can receive different sediment sources in response to changes in relative sea level and bay morphology.

Dalrymple, R. W. et al., 1992. Estuarine facies models: conceptual basis and stratigraphic implications. *Journal of Sedimentary Petrology*, 62(6), 1130–1146.

Keywords: Paleo-Shinji Bay, Izumo Plain, Holocene, estuarine deposit, central basin, μ XRF

Holocene millennial-scale variations of *Neogloboquadrina pachyderma* (planktonic foraminifera) in the southeast coastal areas of Korea and its implication to paleoclimatic changes in the East Asian margin

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We investigated fossil planktonic foraminifera from a drilled long core ND-02 (Nakdong River delta) and a piston core PC-11 (inner shelf off southeast Korea; 39.6 m water depth) since ~9 ka, in order to study the millennial-scale variation in the Tsushima Warm Current and its impact to the coastal areas of the southeast Korea. Planktonic foraminifera occurred continuously during ~8–4 ka in core ND-02 and from ~4 ka to the present in core PC-11. *Neogloboquadrina pachyderma* (dex.) (equivalent to *N. incompta*) shows that millennial-scale near-cyclic fluctuation occurs five times (~1, ~3, ~5, ~7 and ~8 ka) in the two cores.

This fluctuation may be strongly different from that of hemi-pelagic sediments off the western margin of Japan showing that dominant species usually shifted from *N. pachyderma* (sin.) to *N. pachyderma* (dex.) across ~7 ka at once through the intensification of the Tsushima Warm Current (Domitsu and Oda, 2008). In contrast, the stratigraphic variation of *N. pachyderma* (dex.) (regarded as a temperate species) in our cores is similar to that of *Fragilariopsis doliolus*, a warm-water diatom, in Oki Ridge (Koizumi, 2008). Koizumi and Sakamoto (2010) noted that ~1.6 kyrs cyclicity is present in the fluctuation of warm-water diatom during the Holocene which may follow the Bond Event in the North Atlantic Ocean (Bond et al., 2001).

In contrast, the near-cyclic variations in our planktonic foraminiferal record were not fully consistent with the intensity variations of the Tsushima Warm Current and Kuroshio. This implies that our record seems to reflect more regional oceanographic variations in the marginal seas along the East Asia. We propose that the coastal upwelling of the subsurface water along the southeast coast of Korea in summer plays an important role in generating near-cyclic variations of planktonic foraminifera, suggesting possible teleconnection mechanism to the Bond Event in the North Atlantic Ocean.

Keywords: Tsushima Warm Current, upwelling of subsurface water, coiling ratio, warm-water biota, Bond Event

Hydroclimatic Changes on Jeju Island, South Korea during the Holocene: Focusing on the 4.2 ka Event

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Understanding the East Asian monsoon is crucial in the context of climate change because of its extensive impacts on society, culture, and the environment. Previous studies have typically characterized the 4.2 ka event as a sudden and widespread cooling period in the Northern Hemisphere, but its effects on hydroclimate have varied by region. In particular, wet conditions during the 4.2 ka event have been documented in the Yangtze region of central China. We have conducted monthly monitoring since 2022 to assess water quality and collect samples. Our data shows that tycho planktonic species appear in July, while cold species are present during winter. Using diatom assemblage data from Sara-oreum and Muljangori wetlands, volcanic cones on Jeju Island in South Korea, our research indicates a high prevalence of tycho planktonic species around 4.2 ka. These findings suggest a humid climate during this period, supported by current monitoring data. The prevalence of tycho planktonic species aligns with the westerly effect index throughout the Holocene. Although precipitation patterns between Sara-oreum and Muljangori wetlands are similar, Sara-oreum results show greater influence from the westerly jet due to its higher elevation. We suggest that a stronger westerly jet could have caused the rain belt to remain longer in the southern regions, increasing rainfall in southern China and extending its impact to Jeju Island.

Keywords: Diatom variation, Climate change, 4.2 ka, Crater lake, Jeju Island

Decoupling warming and monsoon precipitation over the last 3110 years in northwestern Yunnan Province, southwestern China

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Abstract

Understanding the variability and related dynamic mechanisms of the Indian summer monsoon (ISM) evolution over the past millenniums is crucial for disaster prevention and mitigation in the context of strengthening global warming. Here, we present a high-resolution hydroclimate reconstruction over the past 3110 years in northwestern Yunnan Province, southwestern China, based on grain size analysis using the End-member modeling algorithm (EMMA) and other environmental proxies. The results indicate that the temperature in northwestern Yunnan Province generally decreased since 3110 cal. yr BP, aligning with other temperature records on regional and global scales. Precipitation in the study area remained relatively stable before 1000 cal. yr BP, but exhibited an obvious out-phase change compared with the temperature records over multidecadal to centennial timescale. While after 1000 cal. yr BP, the precipitation steadily increased, revealing the hydroclimate pattern of notably dry Medieval Warm Period (MWP) and relatively wet Little Ice Age (LIA) in the study area. The decoupling combination of temperature and precipitation spanning the MWP and LIA in southwestern China contrasts with that in the East Asian summer monsoon area and the Indian subcontinent which is also controlled by the ISM, indicating the spatial heterogeneity of precipitation in the Asian summer monsoon region. The discussion about dynamic mechanisms points out that solar activity emerges as a significant factor influencing regional temperature changes, and El Niño-Southern Oscillation (ENSO) and Intertropical Convergence Zone (ITCZ) migration jointly impact the precipitation change in the study area and the hydroclimate discrepancy in the ASM region.

Keywords

Hydroclimate reconstruction; Late Holocene; End-member modeling algorithm; Grain size analysis; Alpine lake

Sea surface temperature reconstruction at Shushi Bay, Tsushima Island during the last 3ka

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To reconstruct the changes in sea surface temperature (SST) along the northeastern Part of the Tsushima Island over the past 3,000 years, radiocarbon dating and Alkenone analysis were conducted on the SS1C core sediment obtained from Shushi Bay in Tsushima, Japan. The average SST value for the southern coast over the past 3,500 years, reconstructed using the Uk'37 (Prah1 et al., 1988) ratio of 103 measured alkenones, is 22°C, which is similar to the current 30-year average spring to autumn (March to October) SST of 21.5°C in the Tsushima area. This confirms, as in previous studies, that the reconstructed past SST values from the core sediments of the study area accurately reflect the SST values from spring to autumn at that time. Currently, the SST shows significant seasonal variations, which are known to be largely related to changes in the Kuroshio Current and its extension. Therefore, to evaluate the relationship between the past SST in the study area and the Kuroshio Current, the reconstructed SST values from the MD-81 core sediment in the western Pacific, located at the starting point of the Kuroshio Current, were compared (Stott et al., 2004). The results showed that the overall trend, including decadal to centennial variations over the past 1,000 years, is similar, indicating that the SST changes from spring to autumn in the study area over the past 3,500 years are closely related to the temperature changes of the Kuroshio Current. Moreover, the decadal to centennial variation trends during the same period align with the changes in Total Solar Irradiance (Steinhilber et al., 2009), suggesting that the SST in the Shushi bay was likely directly influenced by solar activity. Therefore, through ongoing research, we aim to evaluate the factors affecting SST variations over the Korea Strait and their association with climate change in the Korean Peninsula.

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Keywords: Late Holocene, Sea surface temperature, Alkenone, Kuroshio current

Hydroclimate changes in Tsushima Island, Japan during the past 3000 years

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Past hydroclimate information is very important to predict and prepare future potential negative influences. In this study, past hydroclimate variability in Tsushima Island where freshwater input has been constrained by limited catchment area has been traced based on the radiocarbon dating and geochemical analyses (carbon isotope, C/N ratios). The time series of C/N ratios in the coastal area clearly indicate decreasing trend during the last 3000 years, suggesting decrease in the influence of terrestrial plant. And this can be supported by increasing trend in the time series of the $\delta^{13}\text{C}_{\text{TOC}}$ values. This long-term trend is superimposed by low-amplitude fluctuations at multi-decadal to millennial variability. To test more high-frequency variability in the past hydroclimate based on the C/N ratios, we subtracted its long-term trend described by three-order polynomial and their detrended values were achieved. Using this detrended C/N ratios, spectral analysis was performed. The result reveals prominent three periodicities (1300, 645, and 134 years). Compared to recently reconstructed past freshwater input record (e.g., Ti/Al) from the southern coast of Korea, the behavior of the C/N ratios in the Tsushima Island seems to be similar to the variability of the detrended Ti/Al ratios. For example, decreased C/N ratios during the LIA (600~200 cal yr BP) are compatible with decreased Ti/Al ratios. During the MWP and 1500 cal yr BP, increased C/N ratios are correlated with increased Ti/Al ratios. Furthermore the 700 year-cycle found in the detrended Ti/Al ratios is quite similar to 670-year cycle in the C/N ratios in Tsushima Island, suggesting common variability in the two areas as a common response to controlling factors, needing further testing on possible influences of ENSO activity and sea surface temperature changes.

Keywords: precipitation, C/N ratios, carbon isotope, global warming, Tsushima Island

High Aeolian Particle Fluxes but Low Rainfall in Taiwan Related to Drastic Population Declines in China over the Past 2,600 yrs

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Distinctive white laminations appear in the generally black sediments of the anoxic, subalpine Great Ghost Lake in southern Taiwan. These white laminations have lower porosity, organic matter content and C/N ratio, but higher C/S, N/S ratios and magnetic susceptibility, and contain organic matter most probably derived from phytoplankton. This and the collision marks on the quartz particles suggest that they have an aeolian component and have been deposited in cooler and drier periods. The organic matter of the black sediments is mainly from land plants and the quartz particles bear no collision marks wet-dry, suggesting local deposition under warmer and wetter climates. These high resolution data, the first not only in Taiwan but also for Southeast Asia, are in good agreement with the local climatological records deduced from documentary sources since 1681 and direct instrumental measurements at stations nearby since 1900. Rainfall over the past 2600 years has been reconstructed. Major droughts appear in 240 BC, 80 BC, 90 AD, 420-520 AD, 620-700 AD, 850-930 AD, 1350-1430 AD, 1570 AD, 1730-1800 AD and 1960 AD, and correspond to not only the periods of cold/dry and frequent dust storms but also major population declines based on the historical and natural records of China. These seem to reflect large scale climatic changes.

Keywords: population in China, paleolimnology, aeolian particles, Great Ghost Lake, Taiwan, climate.

Reconstruction of environmental and flooding histories since AD1250 at three annually laminated lakes in the Central Finland presumed by diatom assemblages

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Keywords:

In Finland, there are plenty freshwater lakes where seasonal lake environmental changes were recorded as annually laminated deposits. We surveys diatom fossil assemblages at the following three lakes in the central Finland to reconstruct high resolution environmental histories using annually laminate time setting of the deposits. Our target was about these 750 years since AD1250 until present to presume anthropogenic impacts and global climatic impacts during the Medieval Warm Period, the Little Ice Age and the Global Warming. The survey lakes, the number of samples we observed were as follows;

Lake Korttajarvi (80 samples; about 9 years' interval)

Lake Kalio-Kourjarvi (78 samples; about 9 years' interval)

Lake Lehmilampi (165 samples; about 4.5 years' interval)



Fig.1 lon.com/maps/europe/finland-physical-maps.html

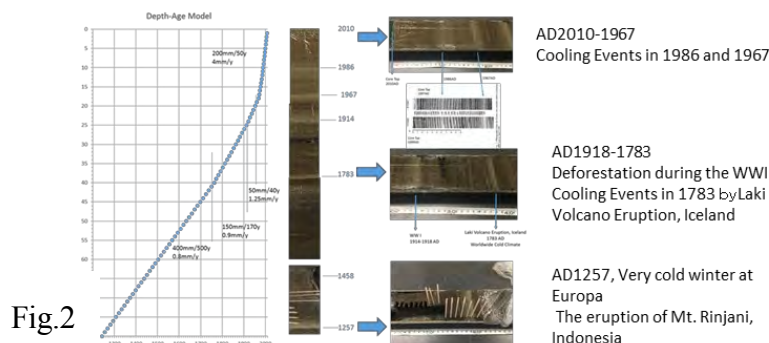


Fig.2

Fig.1: Location of Annually laminated lakes, Central Finland
Fig.2: Age-Depth Model, and coarse lamina at Lake Korttajarvi. Base of the core was dated at Very cold winter at Europa (AD1257), due to the eruption of Mt. Rinjani, Indonesia

The processes of laminated sedimentations in Finland were strongly related into the snow melting flooding during early spring season. The flooding layers were composed of whitish gray sands and were contrast to dark gray clay at other seasons. Among the laminated layers of Lake Korttajarvi, we recognized the several thick whitish flooding layers, dated AD1260, AD1460, AD1780, AD1914-1918, AD1967 and AD1986 respectively. AD1260, AD1460 and AD1780 were presumed to be cold winter in North Europa by historic records, and AD1967 and AD1986 were recorded as lowering of winter temperatures by Meteorological observation in Finland. AD1914-1918 was the period of WWI, and the huge deforestation occurred.

Diatom assemblages were dominated by freshwater planktonic diatoms as *Aulacoseira ambigua*, *A. valida*, *Stauroneis* spp., those presumed the freshwater lake environment has continued since AD1250 to the present. In addition to those lake living diatoms, *Eunotia* spp., *Pinnuralia* spp., peat living diatoms, were observed abundantly. They presumed to be entered into the lake from the surrounding peat lands during the flooding Early Spring season. Benthic diatoms and resting spores increased at cold climatic years as AD1260, AD1460, AD1780, and AD1986. In addition to them, the ratio of them increased during the Little Ice Age, about AD1780-1900. Diatoms made resting cists when lake water conditions became unsuitable for growing, and the ratio of resting cists was presumed to be related to the climatic and flooding histories at the lake.



Fig.3



Fig.3: Subsampling at Lehmilampiäarvi , and annually laminated deposits. We took samples at 4mm each (about 4.5 years interval).

Fig.4: Thickness of each lamina at Kalio-Kourjarvi and Lehmilampiäarvi. Average thickness of the laminae are 0.45mm (Kalio-Kourjarvi) and 0.81mm (Lehmilampiäarvi). The peaks of thickness of lamina are well matched between the two lakes within 10 years gaps.

The sedimentary processes for coarse lamina might be controlled by climatic events of cold winter temperatures.

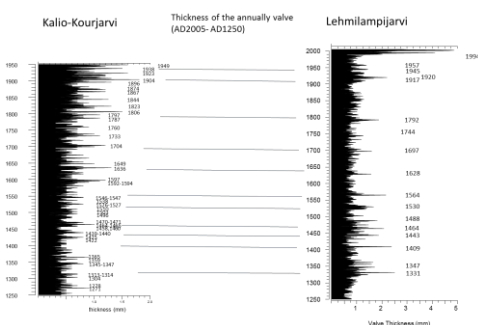


Fig.4

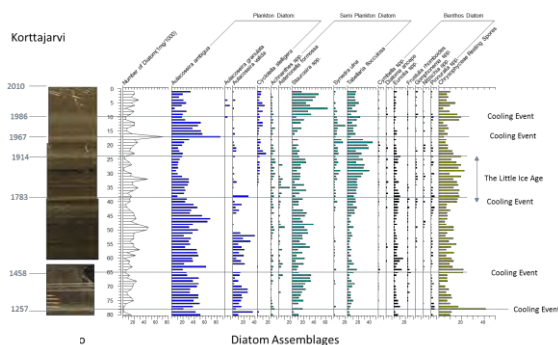


Fig.5

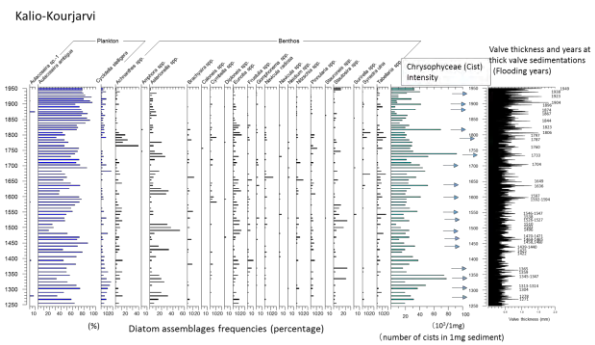


Fig.6

Fig.5: Diatom assemblages at Korttajärvi (Vertical Axis is depth (cm))

At cooling events and The Little Ice Age, benthic diatoms and Crysophyceae resting cists were increased.

Fig.6: Diatom assemblages at Kalio-Kourjarvi

Fig.7: Diatom assemblages at Lehmilampiäarvi. (Vertical Axis are years by counting lamina structures in the cores.)

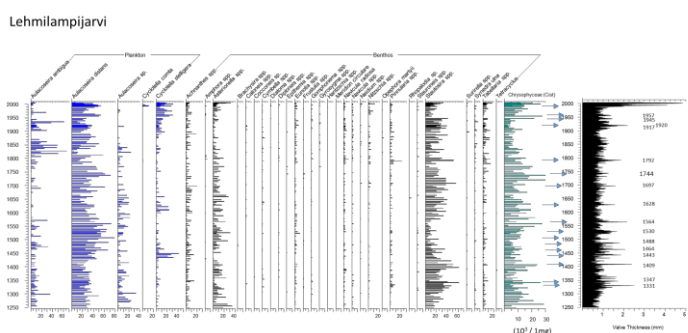


Fig.7

A 200-year hydrological and environmental record from sediment biomarkers of Lake Balkhash, arid Central Asia

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Abstract Lake Balkhash (73–80°N, 44–47°E; 342 m above sea level) is situated in southeast Kazakhstan and is now the largest water body in arid Central Asia. The lake is closed and slightly saline with 17,000 km² water surface area. Lake Balkhash has a 501,000 km² catchment area characterized by an arid to semiarid climate. In the study, lipid biomarkers in a ²¹⁰Pb- and ¹³⁷Cs-dated sediment core from Lake Balkhash were measured to identify their environmental significance and infer environmental change history over the last ~200 years. The terrestrial origin of long-chain *n*-alkanes and the aquatic origin of both *n*-fatty acids and mid-/short-chain *n*-alkanes were inferred from molecular distributions and diagnostic ratios. Based on stratigraphic shifts in biomarker indicators, three major environmental phases were identified over the past two centuries. During 1800–1860 AD, the lake exhibited a high water level with abundant macrophytes and limited phytoplankton, marked with high proportions of aquatic macrophytes (Paq) and long-chain *n*-fatty acids (L-FAs). Overall minor terrestrial inputs were revealed by low concentrations of long-chain *n*-alkanes (L-ALKs), suggesting a dense vegetation cover in the catchment. In the subsequent phase 1860–1930 AD, lake environment experienced a pronounced change, during which macrophytes gradually degraded, as revealed by the decreasing trend of the aquatic proxies, e.g., L-FAs, Paq. On the contrary, emergent plants and terrestrial inputs increased as suggested by declined Paq values. In this period, a great variation in water levels is likely resulting in a decrease of macrophytes. During 1930–2017 AD, human impacts began to emerge on the sediment profile. The highest terrestrial inputs as revealed by maximum L-ALKs abundance on record highlight intensive exploitation of the catchment during 1935–1959 AD. The lowest L-FAs and Paq suggest that macrophytes were at the lowest levels during this phase, possibly in response to the declined water levels and increasing salinity. Increased human-induced nutrient loading coupled with elevated regional temperature prompt the lake to become an increasingly productive lake system, especially in more recent decades as indicated by the highest levels of short-chain lipids. The result highlights the important role of hydrological variation and human activity in the environmental evolution process in the Ili-Balkhash Basin.

Keywords Sediment lipid biomarker; Hydrological change; Human impact; Lake balkhash

Modern vegetation-climate relationships for pollen assemblages across the mountainous regions of southwestern China: Implications for palaeoenvironmental reconstruction

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Abstract

A comprehensive understanding of modern pollen transport processes is a prerequisite for utilizing fossil pollen to elucidate the evolution of palaeoclimates and palaeoenvironments, especially in areas such as southwestern China where complex mountainous topography results in vegetation heterogeneity. In this study, we selected four vertical profiles in mountainous regions of southwestern China, each with distinct plant communities, to investigate the relationship between modern pollen rain, vegetation types and vegetation cover, and to quantify the influence of environmental factors.

We collected 79 surface moss pollen samples and analyzed their relationships with environmental variables. Key findings include:

(1) Pollen assemblages accurately reflect changes in dominant plant communities despite inter-taxa variations in pollen production and dispersal capabilities, and potential long-distance transport by valley winds.

(2) Random forest analysis determined a 500-meter radius as the optimal spatial range for pollen samples to reflect vegetation cover, highlighting the importance of scale in pollen-vegetation relationships.

(3) Calibrated arboreal pollen percentage (AP) and the ratio of arboreal to non-arboreal pollen (AP/NAP) serve as reliable quantitative proxies for vegetation cover, emphasizing the necessity of appropriate calibration in fossil pollen interpretation.

(4) Multivariate analyses (DCA, RDA, VPA) quantified the relative influences of climate, soil nutrients, and vegetation cover on pollen distribution. The mean temperature of the coldest month (MTCM) most significantly influences the merged pollen assemblages. Climate factors primarily regulate pollen distribution below the tree line, while arboreal cover (AC) and total soil nitrogen (TN) exert greater influence above the tree line.

This study enhances the accuracy of pollen-based palaeoenvironmental reconstructions in southwestern China's mountainous regions, providing a robust foundation for inferring past climate dynamics from pollen records and improving our understanding of long-term vegetation responses to climate change

Key words: Modern pollen-vegetation-climate relationships; Vegetation cover; Soil nutrition; Different mountains; Southwestern China

Environment and distribution of archaeological sites in the Red River Delta in Holocene

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Introduction: The Red River Delta is one of the two largest deltas of Vietnam, it was formed by the Red River and Thai Binh River, has an area of about 12,650 km² (Phung et al., 2019). The main factors determining the development of delta are rivers, waves and tides (Mathers et al., 1996). The Delta and its tributaries have provided the necessary resources for long-term economic sustainability such as: water supply, transportation, riverine wetlands are places with rich natural plant and animal resources. Therefore, it plays a very important role in the development of Vietnamese history so call "The birth place of the Red River civilization" where high concentration of prehistorically archaeological sites.

Data we use: This paper uses the archaeological and paleo-environmental data in the Red River Delta during the Holocene aim to understand the natural environmental conditions and human adaptation to the environment during prehistoric time.

Results: Pollen analysis data from archaeological sites argued that the vegetation reflects both natural and cultural influences on the environment, possibly as a mosaic of grassland species, shrub trees and native forest. The analysis of pollen combined with archaeological data may give a clearer picture of the cultural and environmental landscape of this area in prehistoric periods; -The Early Neolithic period was an important period in enhancing landscape management, with livelihood activities mainly based on natural exploitation by hunting and gathering such as nuts, shells, fish, crab,.. bones of small animals like pigs, deer,... in very thick cultural layers. Among the pollen assemblages identified, it is important to note that there is the recurrent presence of the ubiquity of Leguminosae, Chenopodiaceae, Compositae, and most important is Poaceae in virtually almost samples, some of which having a diameter larger than 30µm are possibly related to the domestic cereals (Nguyen, 2013); - During the Late Neolithic to Early Bronze Age (~5–3.5 ka), sea levels have dropped, and the coastline has been pushed farther seaward (Tanabe et al., 2003, 2006; Boyd et al., 2004), which has created the extremely favorable conditions for the ancient inhabitants, who resided in the mountains and hillsides to move down to occupy and reside in the lower plains where there were abundant food sources and more favorable living conditions. Population growth and intensification of agricultural production expanded the human footprint across the Red River Delta, associated with more houses, more investment in ceramics and produced other tools, as well as a larger number of cemetery burials. The direct evidence of vegetational changes through the results derived from the palynological and macrofossil analyzes show that Neolithic people were more or less familiar with several cereal food crops and domestication. Although the scale of these transformations is small but taken together, the footprint of human activity is traceable, marking the beginning of a new type of human relationship and environment; - In the mid- late Bronze Age to Early Metal (~3.6–2.2ka), larger populations were better equipped with tools and the number of archaeological sites sudden increase, especially in the Viet Tri junction area. Some big residential clusters were formed in the Delta (15000m² - >80,000m²), along the rivers and natural levees (Lâm, ed. 2015, Funabiki et al. 2012). In such large residential areas, the number of residents must be quite crowded, and the increased demand for food promotes the development of agricultural activities. At this stage, the appearance of rice growing cultural areas

appeared widely in the Delta. Many charred rice grains and rice husk prints on ceramics were found (Nguyễn, 2017). Metallurgy developed, agricultural production tools became popular they are hoes, shovels, penknives, sickles, in particular, the presence of copper plowshares (Chữ, 1979) along with the development of ceramics reflects the harvest and post-harvest activities at the time.

Discussion and Conclusion: Although archaeological and environmental data are still not really complete, pollen analysis results also show that the flora of the area is mainly tropical plants, preferring hot and humid climates. At most archaeological sites, the amount of pollen from herb pollen increased while the percentage of arboreal pollen decreased, possibly due to humans in clearing and felling of trees to create space for farming and settlement activities. The high amount of Poaceae pollen with large in size ($>30\mu\text{m}$) in almost archaeological sites may be related to rice cultivation (Nguyen, 2013). Research on settlement patterns in the Red River Delta shows that the shift from highlands along hills and mountains to plains, on the natural levees and low-lying areas was most evident in the late Holocene (4–2 ka). The evidence is the formation of archaeological cultures, which through the number of archaeological sites shows that the population density is increasingly dense. During the same time, the way of life also changed from hunting and gathering to farming. Although there is early evidence of domestication of animals such as pigs and dogs and the presence of rice, subsistence methods based on gathering and hunting still coexist to varying degrees.

Keywords: Environment, Palynology, Archaeology, Red River Delta, Holocene

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Boosting riverine sediment by artificial flood in the Yellow River and the implication for delta restoration

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Due to accelerated river-derived sediment deficits, global deltas are presently under an increasing risk of being submerged. To address the fundamental need to save Earth's deltas, boosting riverine sediment supply can be considered a reasonable option, but only if the new supply of sediment is prolonged and greater than the opposing forces: sea level rise, delta subsidence and compaction, and ocean energy. In July 2018, an artificial flood with a peak discharge of 3780 m³/s was released from the Xiaolangdi Reservoir, the last reservoir located on the mainstream of the Yellow River, China. From July 03 to July 29, 412 million tons (Mt) of sediment was discharged out of the dam, including 240 Mt that was previously sequestered within the reservoir. During this event, 140 Mt of the escaped sediment directly reached the estuary.

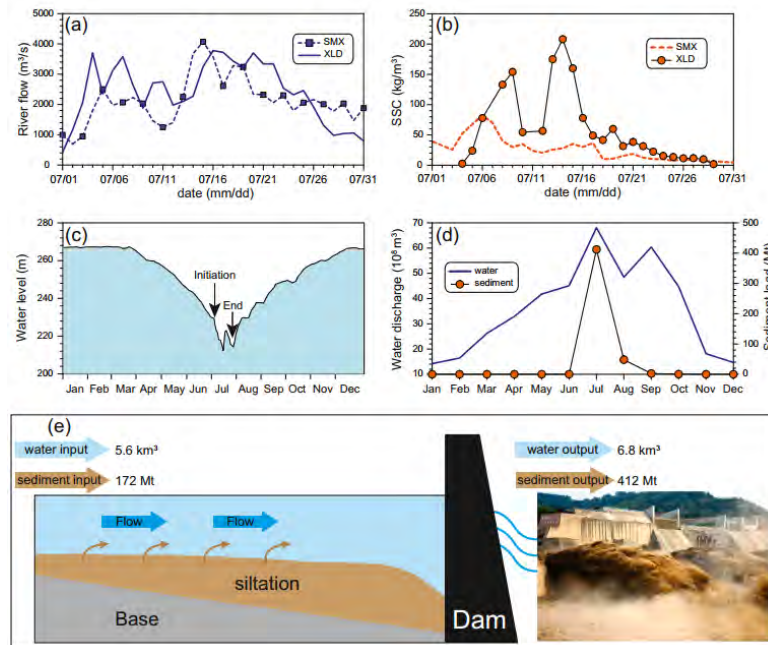


Figure 1. Daily river flow (a) and SSC (b) at Sanmenxia and Xiaolangdi dams in July, 2018; (c) Daily water level in the Xiaolangdi reservoir in 2018; (d) Monthly water and sediment delivery from the Xiaolangdi dam to the lower Yellow River in 2018; (e) Water and sediment budgets within the Xiaolangdi reservoir during the dam-released flood in July, 2018.

Totally 245 Mt of sediment was deposited along the lower river channel bed, of which 83.6 Mt was eroded once again and transported to the sea in the subsequent five months. This dam-released pulse, coupled with channel diversion and tidal shear fronts, nourished the deltaic area. New land was built, with the submarine offshore gaining up to 2.6 m in seafloor shoaling. Sediment impounded behind the dam, if properly released, could thus become a potential savior for sediment-starved deltas.

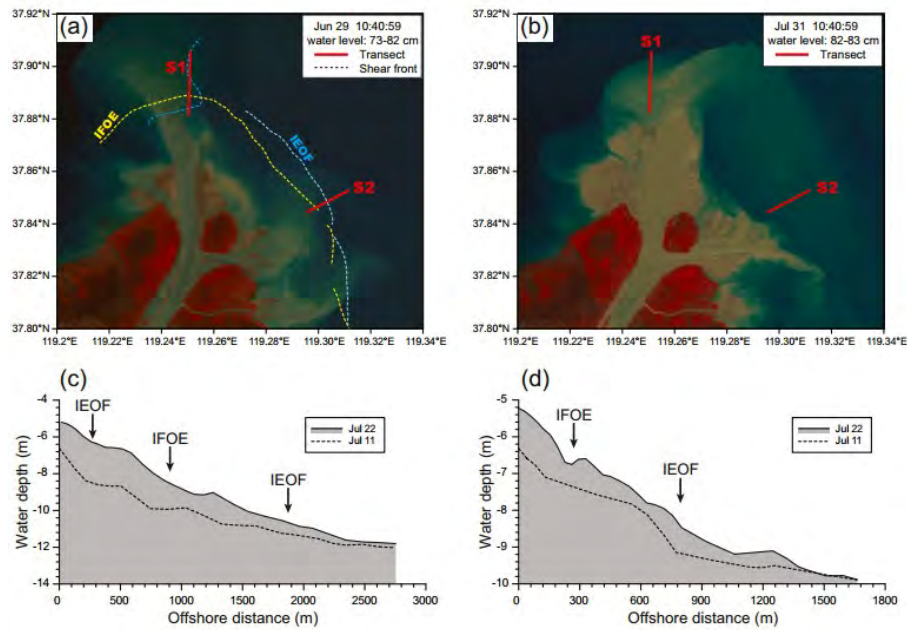


Figure 2. Landsat images (a) June 29, 2018 and (b) July 31, 2018, before and after the artificial flood event, respectively. The yellow dashed lines (IFOE) and blue dashed lines (IEOF) identify the two types of tidal shear: inner-ebb-outer-flood and inner-flood-outer-ebb. Locations of shear fronts. The red lines indicate the bathymetric transects shown in panels (c) transect S1 and (d) transect S2. The vertical variation of the subaqueous delta is shown as S1 and S2 in panels (c) and (d).

Keywords: dam-released flood; sediment replenishment; delta sustainability; Yellow River

Chronology constraints on the late Quaternary complex sedimentary history of the Pear River delta

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Abstract: The delta deposition serves as archives of past environmental changes, providing insights into global climate and sea-level fluctuations, transgression-regression depositional history, and anthropogenic impacts on different time scales. Accurate dating of deltaic sediments is key for better understanding of the sedimentary history of coastal deltas in response to environmental changes. Luminescence and radiocarbon dating techniques play a key role in constraining the formation timing of the late Quaternary Pearl River Delta (PRD) and its evolution. However, the late Quaternary sedimentary evolution of the PRD from the subaerial to subaqueous continuum remains unclear due to insufficient dating efforts, despite a few studies having established chronostratigraphy of the subaerial delta using luminescence dating and radiocarbon techniques. Here, we utilized multiple luminescence dating techniques, including quartz optically stimulated luminescence (OSL) and K-feldspar single aliquot (SA)- and single grain (SG)-based post-infrared (IR) IR stimulated luminescence (pIRIR) dating methods, associated with radiocarbon dating methods to establish a spanning 120-ka-long chronology sequence of the studying core from the PRD estuary. Based on sedimentological analysis of core sediments, we explored the dynamic successions of the studying record from fluvial and coastal to deltaic depositional systems. The results show that two transgressions were constrained in this study in response to global sea level changes. Our findings would contribute to a better understanding of the late Quaternary sedimentary evolution of the PRD and provide valuable insights into the region's environmental history and geomorphological developments.

Keywords: The Pear River Delta, Late Quaternary deposition, Luminescence dating, Marine transgression, Sedimentary history

Past flood events inferred from atmospheric radionuclides and physical properties of West Nanao Bay sediments

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The recent increase in extreme heavy rainfall may greatly impact sediment discharge in river catchments. To prevent future flood and sediment disasters in river watersheds, the historical record of the flood event induced by heavy rainfall events and its frequency is important. This study aimed to reconstruct the decadal and centennial flood record based on the atmospheric radionuclide Pb-210 and magnetic properties of sediment cores from the Nanao Bay in Japan. Sediment cores were collected off the Kumaki River, which is a major inflow river to the West Nanao Bay, in November 2017 and May 2019. The vertical changes in Pb-210 concentration, magnetic susceptibility, and grain size were analyzed along the cores. The excess (atmospheric) Pb-210 concentration in these cores exponentially decreased downward with some anomaly layers of Pb-210 concentration. Based on this vertical profile, the age of the core bottom was estimated at 40 years, and four event layers indicated rapid sedimentation. These event layers corresponded to the depths with coarse grain size and high magnetic susceptibility reflecting intense sediment inflow. The periods of these event layers were estimated around 2019 and the 2013, 2003, and 1986 based on the excess Pb-210 concentration. Comparison between these estimated events and the observed water level change and the past flood record of the Kumaki River suggested that these events corresponded to the observed flood in 2018 (or 2017), 2011 (or 2009), 2002, and 1985, respectively. This result indicates that the detection method of event layers using Pb-210 and magnetic susceptibility is useful for reconstructing the historical record of flood and related sediment discharge events in this area.

Keywords: sediment, atmospheric radionuclides, magnetic properties, flood event

Effects of global warming on an ice-covered mountainous lake, Akaga-Onuma, in Japan

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Global warming has a major impact on our society, including the strength of typhoons, the occurrence of linear rain bands, and an increase in the frequency of heavy rains. It also has a significant impact on the water environment. Research into the impact of global warming on lake environments is also being conducted in Japan. In Lake Biwa in Shiga Prefecture, the surface water temperature has risen by 1.5°C at the last 40 years. Total vertical mixing was not observed in the winters of 2019 and 2020, so that the hypoxic water mass in the bottom water has not been renewed, raising concerns about the impact on the ecosystem. In Lake Ikeda in Kagoshima Prefecture, total circulation is not occurring due to the rise in surface water temperature in winter. Furthermore, ice fishing for smelt has not been held in Lake Haruna, Gunma Prefecture, for the last six years due to weak freezing.

Reports on the impact of global warming on lake environments in summer and winter are increasing. However, there are few reports in Japan on the impact of global warming on frozen lake environments, and on chemical components such as organic matter decomposition, nitrogen and phosphorus regeneration associated with stratification during freezing. Therefore, our research group began winter observations in February 2021 at Lake Akagi-Onuma in Gunma Prefecture, which is located at an altitude of 1,350 m near the southern limit of the frozen lake boundary. It has an area of 0.87 km², an average water depth of 9.1 m, a maximum water depth of 17.5 m, and a catchment area of 4.82 km². It is a mountain lake that fully circulates in spring and autumn and has semi-closed characteristics. In this study, we report the results of winter observations from 2021 to 2024 winter.

Figure 1 shows the observation results from January to March in 2023 to 2024 winter. The dissolved oxygen (DO) concentration was almost 0 mg/L in the bottom layer in 2023, but was high at 5.3 mg/L on February 29, 2024, and maintained a high concentration of 6.1 mg/L on March 12. NH₄-N generated by the decomposition of organic matter showed high concentrations in the bottom layer of 85.5 µmol/L in March 2023, but was about one-third that at about 30 µmol/L in February and March 2024. In addition, dissolved Fe²⁺ concentration had a maximum value of 56.9

$\mu\text{mol/L}$ in 2023, but was low at $0.11 \mu\text{mol/L}$ in February 2024. In the winter of 2024, the amount of precipitation in autumn was low, causing the water level of Lake Akagi-Onuma to drop by about 2 m, and because the lake did not freeze over completely, ice fishing for smelt was partially lifted on January 31 (usually around January 10).

The above results suggest that the lake did not freeze over completely in the winter of 2024 due to an increase in the heat capacity of the lake caused by the drop in water level and rising temperatures caused by global warming. The present situation is linked with the water mass weakened the thermal stratification and suppressed the hypoxia of the bottom water. The another possibility was caused that the amount of organic matter decomposition decreased due to a decrease in the amount of organic matter supplied during the entire cycle in autumn.

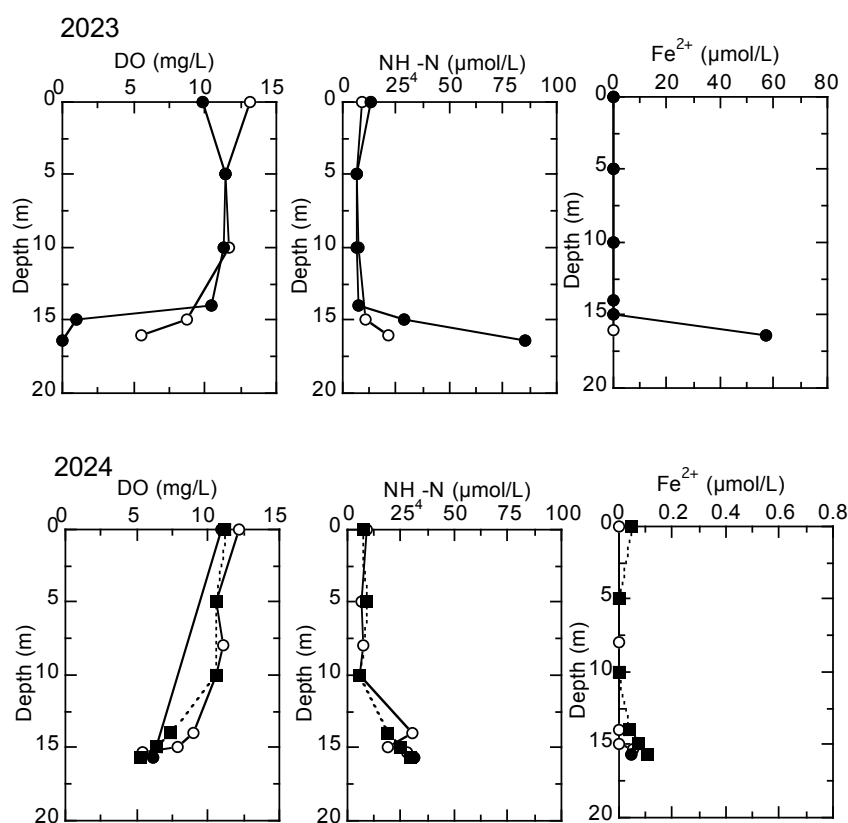


Fig. 1 Vertical profiles of redox-sensitive parameters at Lake Akagi-Onuma in 2023 winter (upper panel: ○ 2023/1/12, ● 2023/3/14) and 2024 winter (lower panels: ○ 2024/2/8, ■ 2024/2/29, ● 2024/3/12).

Keywords: Mountainous lakes, stratification, redox changes, bottom layer

Lacustrine sediment information and estimation of erosional force**Kenji KASHIWAYA**

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Studies on landform changes and processes in lake-catchment systems may be called limno-geomorphology, which is a branch of geomorphology. Estimation of erosional force in the systems is of great importance for understanding landform changes in the systems. Information on the earth-surface processes and changes in the systems are generally printed in lacustrine sediments. Both present and past information are continuously included in the sediments, which is advantageous for considering past information with present observational one. Three time-intervals are introduced for two systems to estimate the forces; one is the short interval for nearly 10 years (instrumental observation period) for a small system (in the Rokko Mountains, Kobe), and the other is the long one for one, and some 100 thousand years for large systems (Lake Biwa). For the short interval sedimentation rate in the lake was instrumentally observed in the two points on the lake bottom with sediment traps. The sedimentation rate in these lake-catchment systems may be proportional to erosional force. The erosional force is mainly controlled by rainfall. A model on sedimentation rate with weathering and erosional force (seasonal rainfall) shows good agreement with observation data; the erosional force can be expressed as mathematical equations using surface erodible parts and dominant periods in rainfall intensity (seasonal rainfall). Two different cores obtained in the other points (northern basin and central basin) are used to estimate in comparatively large two intervals of the large lake-catchment system. The sedimentation rate for the 1000 years (in the northern basin) is calculated based on the age model estimated with C-14 and the fluctuation in CRII (Cosmic Ray Induced Ionization). It seems that the sedimentation rate here slightly decreased. The sedimentation rate in the central basin is estimated based on insolation-fluctuation age. The sedimentation rate seems to decrease in the long interval gradually. The recent sedimentation rate is roughly the same for the two cores. The erosional force may be roughly established using the sedimentation rate.

Keywords: lake-catchment system, sediment information, erosional force, limnogeomorphology

Impacts of Mt. Fuji eruption on the diatom assemblages of Lake Kawaguchi

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Besides human impacts on mountain lake water systems, it is necessary to assess the relative importance of natural processes including volcanic eruption which can also induce changes in water quality and primary production. In particular, understanding the magnitude and duration of volcanic eruptions on water quality is important for comprehending the water environment of Japan, which is a volcanic island nation. Mt. Fuji is the highest and most famous volcano in Japan, and the Lake Kawaguchi is a dammed lake on the northern mid-slope of the mountain. Core KG22-01 was obtained from the western basin of Lake Kawaguchi in June 2022. KG22-01 consists of approximately 340 cm of sediment, with a distinct coarse scoria layer found at 327–319 cm depth. This scoria layer was deposited around 1,780 cal. yr BP. Additionally, CT images revealed a high-density layer, presumed to be volcanic ash, located about 30 cm above this scoria layer. Therefore, we analyzed the diatom assemblages in the depth of 240–340 cm of core KG22-01 to discuss the impact and duration of the volcanic eruption on the ecosystem of Lake Kawaguchi. The most dominant diatom taxon in core KG22-01 was *Cyclotella dubius*, which comprises over 30% of the total assemblage. This taxon shows little variation in its relative abundance before and after the volcanic eruption. On the other hand, significant changes were observed in some diatom taxa. An alkaliphilic planktonic taxon, *Lindavia radiosa* was abundant below the scoria layer however almost disappeared after the scoria deposition. Similarly, an alkaliphilic mesotrophic taxon, *Fragilaria crotonensis* was abundant before the scoria deposition. However, this taxon showed a gradual decline in relative abundance post-deposition of scoria in step by step, becoming extremely rare after the deposition of a volcanic ash layer. On the other hand, an alkaliphilic eutrophic taxon, *Aulacoseira granulata* temporarily increased in relative abundance following the scoria layer deposition, however decreased about half a century later. In contrast, the relative abundance of a neutral taxon, *Aulacoseira subarctica* var. *longispinosa* gradually increased after the decreasing of *A. granulata*. These assemblage shifts probably suggest that while the eutrophication of Lake Kawaguchi caused by the Mt. Fuji eruption was temporary approximately half a century, the lake water neutralization continued for at least 450 years. According to Yoshizawa and Yamamoto (2017), *L. radiosa* and *F. crotonensis* have been the primary and secondary dominant taxa of Lake Kawaguchi over the past hundred years, indicating that the effects of lake neutralization have already been finished. It should also be added that the number of diatom valves showed low values when the eutrophic taxon, *A. granulata* increased. Despite the nutrient-rich conditions after the volcanic eruption, the diatom production was likely limited by changes in water quality or another reason as light limitation.

Keywords: Mt. Fuji, volcanic eruption, diatom, Lake Kawaguchi, Late Holocene

Slope stability on the northern coast of Taiwan: cases around Keelung and Hoping islands

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Coastal retreat is a big issue for the safety of transportation. Because of the sub-tropical environment, typhoons and monsoons continuously cause coastal retreats around the island. Ten landslides occurred at Hoping Island Geopark in the last 3 years, and there was a huge landslide on 4 June 2023. All of these landslides caused many problems for coastal management. The mechanism of landslides is caused by seawater processes, weathering from the joint system, and detached from the wedge of dis-continuously rock mass. Keelung landslide occurred on the slope which was reshaped for the highway construction, it caused landslides because of weathering and vibration of earthquake waves.

The Hualien Earthquake occurred on 3 April 2024 and does not influence the stability of the slope. The momentum of earthquake sounds decreased after a long distance. It is also an interesting topic on the diminished energy of earthquakes.

This study would like to discuss the different dynamic situations and explain the mechanism and impact of coastal retreat.

Recognizing landfills as geological strata

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In Korea, there are approximately 1,170 closed unsanitary landfills (Ministry of Environment, 2002), but unofficial estimates suggest there are over 3,000. The issues with anthropogenic strata (landfills) are numerous. From a biochemical perspective, the increase in landfills leads to more sources of methane, which has a serious impact on global warming. From a geotechnical perspective, the physical characteristics of landfills respond differently to heavy rain, earthquakes, and landslides compared to natural strata, affecting both physical safety and psychological reassurance. When developing land and encountering former landfills, additional costs are incurred whether the waste is removed, compaction methods are used, or grouting is applied. The first step in recognizing and addressing these issues is to more clearly define anthropogenic strata (landfills) from a geological standpoint and incorporate them into geological epistemology.

Keywords: landfill anthropogenic strata

Numerical experiments of turbidity currents generated by 2011 Tohoku-oki Earthquake and tsunami

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Keywords: earthquake, Japan Trench, subduction zone, turbidite

The ocean bottom pressuremetry and borehole core samples off the coast of Tohoku revealed that the 2011 earthquake and tsunami generated a large-scale turbidity current, covering an area over 100 km wide and 200 km long, depositing turbidite in the Japan Trench. This study aims to replicate this turbidity current using a numerical model and to understand its generation mechanism to reconstruct the scale of past tsunamis and earthquakes from turbidites.

The model, based on a horizontal two-dimensional shallow-water equation, uses topographic data from GEBCO's 425 m grid seafloor DEM. Unique features of this model include accounting for the turbulent kinetic energy's influence on sediment transport and considering water entrainment and detrainment at the flow's upper interface. The numerical scheme is based on the CIP-CUP method with third-order accuracy.

Key findings from the numerical experiments include: (1) The gully on the Japan Trench slope splits the flow from a single source, creating multiple surges. (2) The gentle slope gradient off Sendai requires a large suspended sediment cloud for turbidity currents to inflow the Japan Trench. (3) A ridge in the central region of the Japan Trench hinders a single flow from crossing, suggesting that turbidite deposition across the trench likely results from the merging of flows from northern Sanriku and Sendai-oki. These results will be compared with the actual characteristics of turbidites in Japan Trench obtained by IODP Expedition 386.

This study provides a fundamental understanding of reconstructing seismic history from geological records in the Japan Trench. Future plans include developing an inverse analysis model using neural networks to estimate the history of past large earthquakes from turbidites.

**Tsunami behavior inferred from widespread tsunami deposits
in Noto Town by the 2024 Noto Peninsula earthquake**

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The 2024 Noto Peninsula earthquake (Mw 7.5; Japan Meteorological Agency, 2024) occurred on January 1 in the northern part of the Noto Peninsula, central Japan. We conducted three field surveys between January and April 2024. The first field survey was conducted on January 27–29, approximately one month after the earthquake. The field surveys focused on the tsunami inundation area, inundation depth, current direction, and tsunami deposits at a lowland in Noto Town, where the tsunami inundated widely. The inundation depth was measured using watermarks preserved on structures and trees, and the direction of rice-plant bents was recorded to reconstruct the current direction of the tsunami inundation. Tsunami deposits were investigated by using a shovel and sampled for laboratory analyses (e.g., grain size, CT scanning, geochemistry, and microfossils).

The study area, Uchiura of Noto Town, faces a small cove with an area of 600 m × 1000 m and a depth of <10 m, and it is divided into two regions: the Nunoura and Kurikawashiri areas. The Nunoura area is on the left riverbank and northeast of the Kurikawashiri River, and it is mostly used for large facilities such as the baseball and track-and-field grounds. Meanwhile, the Kurikawashiri area is on the right riverbank and southwest of the river, and it includes private houses and paddy fields. A lowland area with a width of up to 550 m and elevation mostly less than 2 m was estimated to have been inundated up to 750 m inland (The 2024 Noto Peninsula Earthquake Tectonic Landform Research Group (The Association of Japanese Geographers), 2024). The distribution of floating debris that was transported furthest inland by the tsunami was generally consistent with the inundation limit estimated from aerial photographs; however, the floating debris were observed beyond the estimated limit in some places. Thus, while aerial photographs are useful for estimating the overall extent of tsunami inundation, a field survey immediately after the tsunami is indispensable for obtain the complete extent of the inundation.

The measured inundation depth reached a maximum of more than 320 cm near the shore in the Nunoura area but was less than 70 cm in the Kurikawashiri area. The seawardmost bridge of the Kurikawashiri River was 4.44 m a.s.l. in elevation, but it was destroyed by the tsunami and covered by floating debris such as seaweed. This fact indicates that the tsunami inundation height reached at least ca. 4.5 m in Uchiura. In addition, since the bridge was more than 2 m higher than the right riverbank, the wave

height likely exceeded the riverbank, and the tsunami overflowed into the lowland area in the Kurikawashiri area. Indeed, the measured current direction was in the inland direction near the shore in the Nunoura area but extended from the river to the lowland in the Kurikawashiri area. The traces of overflow from the river were conspicuous at the topographic low section of the riverbank near the inundation limit in the Kurikawashiri area. The measured elevation on the topographic low section was 1.65 m a.s.l., whereas it was 2.53 m a.s.l. on the bank of the river. The obvious current direction marks were found spreading from the topographic low section to the lowland.

Most of the inundation area was covered by tsunami deposits. The tsunami deposits were gray in color, and they mainly comprised very fine to medium sand and exhibited a normal grading structure throughout the lowland area (Note: Grain size analysis is currently underway. Detailed data will be reported at the presentation). They were covered by a mud cap with a thickness of 0.5–1.0 cm except in some areas near the shore. In some places in the Nunoura area, the sand layer was divided into two layers with a layer of plants at the boundary between them. The sandy tsunami deposits in the Kurikawashiri area were also exhibited sublayer structure divided by < 0.5 cm thick mud drape especially near the river. These sedimentary structures probably reflect two tsunami inundation flows as reported in previous modern case studies.

The tsunami deposits exhibited a considerable variation in thickness. In the Nunoura area, the maximum and the average thickness of the tsunami deposits were 8.0 cm and 3.8 cm, respectively. A landward decrease in the thickness of the deposits was not clear along the transects perpendicular to the shore. In the Kurikawashiri area, the tsunami deposits reached a thickness of 16.0 cm behind the main overflowed point at the topographic low section near the inundation limit, which was the thickest observed in Uchiura. The complexity of the thickness distribution of tsunami deposits was greatly influenced by the local topography.

In conclusion, the field survey immediately after the tsunami revealed the distribution of tsunami deposits and tsunami behavior in the most inundated area by this tsunami. Our data will be helpful for future tsunami inundation and sediment transport calculations. These are expected to contribute to the elucidation of the source area of this earthquake and tsunami.

Keywords: Post-tsunami survey, Inundation limit, Inundation depth, Current direction, Tsunami deposit

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Poster Presentations

Accurate restoration of marine primary productivity using maleimide analysis for highly aged T-OAE sediments

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Keywords: Toarcian oceanic anoxic event; Sakuraguchi-dani; Primary productivity; Carbon cycle; Chlorophyll

Environmental perturbations across the Early Jurassic Toarcian Oceanic Anoxic Event (T-OAE) are represented by -3 to -8‰ negative shift in both carbonate and organic carbon isotopic excursion (CIE), reflecting a significant disturbance of carbon cycle at that time^{1,2,3}.

The recovery processes of the CIE and the regional environmental changes during the T-OAE remain largely unknown. Variations in marine primary productivity may reflect carbon cycling and environmental changes during the T-OAE, making it crucial to resolve these uncertainties. Therefore, many studies examine the relationship between T-OAE and marine primary productivity^{4,5,6,7,8}. An increase in nutrient supply due to the intensification of the hydrologic cycle during the T-OAE is generally thought to stimulate primary productivity. These estimates of primary productivity for the T-OAE are made using the abundances of fossil phytoplankton (e.g., nannoplankton), total organic carbon (TOC), and nutrient proxies such as phosphorus (P). However, there are still challenges in accurately reconstructing primary productivity. For instance, it is difficult to separate signals of enhanced primary productivity from enhanced organic matter preservation⁹. Additionally, the significant increase in terrestrial organic matter in the marine environment during the T-OAE complicates this issue further, as it masks the contribution of terrestrial organic matter from marine primary production¹⁰. Moreover, ocean acidification caused the dissolution of carbonate microfossils during the T-OAE, which hampers microfossil-based reconstruction of primary productivity¹¹.

Firstly, this study focuses on porphyrins incorporated in kerogen within geological formations. Pigments such as chlorophyll and carotenoids in sediments are commonly used as proxies for marine primary producers¹² due to the labile nature of these compounds. Chlorophyll fossils in surface sediments correlate with satellite-based chlorophyll abundances in sea-surface regions with moderate to high productivity, such as coastal and upwelling regions¹³. Extracting chlorophyll fossils from kerogen using chromic acid oxidation allows the analysis of porphyrins as their fragmented molecules, such as maleimide and phthalimide, both biomarkers for photosynthetic organisms¹⁴. To clarify accurate marine primary productivity during the T-OAE, we analyzed marine chlorophyll-derived fossils (geoporphyrins) and maleimides in black mudstone from the continental shelf of the northwest Panthalassic Ocean, currently located in the Toyora area of Yamaguchi, Japan. It has been reported that this black shale has been subjected to high temperatures of approximately 300°C¹⁰.

We observed an increase in maleimide concentrations during the positive CIE, which does not correlate well with oceanic redox conditions inferred from the ichnofabric index of the same sample and redox-sensitive trace metal data from previous studies¹⁵. This finding suggests that high concentrations of maleimides likely reflect an increase in marine primary productivity during the positive CIE, rather than an increase in preservation potential.

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Magnetostratigraphy, rock magnetic signatures and eolian dusts of reef limestones from Miyako-jima Island

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Reefal limestones are composed of corals and other organisms' fossils with significant heterogeneity in the samples and their magnetizations are weak in general. Previous studies on the reefal limestones in Miyakojima Island (e.g. Anai et al., 2018) suggest that magnetite seems to be the main carrier of their weak magnetism, whose origin is fossil magnetotactic bacteria and/or detrital. In the reefal limestones, other magnetic minerals such as hematite or goethite are also present preventing extraction of primary magnetizations carried by magnetite. Thus, standard magnetization measurement using superconducting magnetometer, and AF or thermal demagnetization or thermal is not easy for paleomagnetic studies including magnetostratigraphy. Anai et al. (2018) was successful in minimizing the influence of secondary magnetizations carried by hematite and/or goethite using reductive chemical demagnetization (RCD). With this new technique, magnetostratigraphy of reefal limestone provides reliable age constraints. In addition, reefal limestone is known to be an excellent recorder of paleoenvironment, such as sea-level change and/or climate change. Here, we present preliminary results of magnetostratigraphic and rock magnetic studies as well as investigations on eolian dusts including grain size analyses using specimens from the outcrops around the southern coastal area of Miyako-jima Island.

We have taken samples from seven (MK3~MK9) and eight (MK11~MK18) sites along the western and eastern consecutive road sections, respectively. We conducted NRM measurements on all paleomagnetic specimens and stepwise AF demagnetization experiments on pilot specimens. The preliminary results suggest that the paleomagnetic polarity boundaries corresponding to Matuyama-Brunhes transition is between MK4 (normal) and MK5 (reversed) for the western section, which has the approximate altitude of 35 m. Rock magnetic measurements were conducted on a selected specimen for each site using Lake Shore VSM 8604; i.e. hysteresis, back field DC demagnetization, IRM acquisition and first order reversal curve (FORC). FORC analysis suggest that there are varying proportions of single domain (SD), multidomain (MD) and vortex state grains, which is considered as mainly magnetite. Specimens with corals and coral fragments are generally unstable, whereas specimens with rhodolith are stable with prominent central ridge suggesting fossil magnetotactic bacteria origin. IRM unmixing suggests the presence of higher coercivity minerals, which is considered as hematite and/or goethite. We also re-examined the effectiveness of RCDs. The specimens show increase in S-ratios and reduction of higher coercivity minerals in IRM unmixing curves after RCD indicating that secondary magnetic minerals such as hematites and/or goethites are removed by RCD. A grain size analysis with Horiba LA-960 on the specimen from MK1 shows that there are two populations centered around 0.2 μm and 7 μm . Details on the eolian dust particles and grain sizes will be presented.

Keywords: Miyako-jima Island, Environmental Magnetism, Eolian Dust, Magnetostratigraphy

Quantitative pollen-based paleoclimate reconstructions for the past 18.5 ka in southwestern Yunnan Province, China

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Quantitative reconstruction of past climate plays an important role in understanding global and regional climate changes and validating climate models. Although some important progress has been made in quantitative paleoclimate reconstructions based on terrestrial records in the Indian summer monsoon region, high-resolution quantitative studies spanning the last ~20 ka are still relatively sparse with differing results. This study presents high-resolution quantitative variations in mean temperature of the coldest month (MTCM, the first controlling factor of the regional vegetation), mean annual temperature (MAT, the second controlling factor), and mean annual precipitation (MAP) from Lake Tengchongqinghai in southwestern China, based on an updated modern pollen dataset and the fossil pollen record spanning the last 18.5 ka. The results show that temperature and precipitation increased gradually from 18.5 ka, and peaked from 7.2-4.5 ka when MAT was on average 1.0 °C higher than the modern observational value (14.5 °C), corresponding to the mid-Holocene climatic optimum, and then decreased gradually. The total reconstructed ranges are between -2.2 and 9.2 °C for MTCM, 7.7 and 17.2 °C for MAT, and 840 and 1300 mm for MAP. On top of this overall climate trend, seven abrupt cold and dry events were detected during the periods of 16.2-14.8 ka, 12.8-11.5 ka, ~11.1 ka, 9.1-8.4 ka, ~7.7 ka, 4.3-3.7 ka, and 0.68-0.009 ka (1270-1950 CE). The results of this quantitative reconstruction were validated by both statistical and ecological evaluations. We conclude that the trend of climatic change since 18.5 ka in this study area was primarily driven by June, July, August, and September solar insolation and changes in radiative forcing and greenhouse gas concentrations. The abrupt changes may be caused by changes in the Atlantic meridional overturning circulation, solar activity, the position of the Intertropical Convergence Zone, and volcanic activity.

Keywords: Pollen; Quantitative reconstruction; Temperature and precipitation; Abrupt events; Indian summer monsoon; Southwestern China

Paleoenvironment and paleobiogeography based on fossil bay ostracods (minute Crustacea) from the Upper Pleistocene and Holocene sequences in Ise Bay, central Japan

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Two sedimentary cores (GS-IB18-1 and GS-IB18-2) were extracted from the western region of Ise Bay, approximately 10 km from Tsu City, Mie Prefecture, central Japan, by the National Institute of Advanced Industrial Science and Technology (AIST), Japan. Cores GS-IB18-1 (core length: 36 m) and GS-IB18-2 (core length: 65 m) were obtained from depths of 21.66 and 22.91 m, respectively. Amano et al. (2020) used lithology, fossil diatom assemblages, and ¹⁴C and optically stimulated luminescence dating to reconstruct the depositional environment. Both cores revealed two intervals of marine clayey sediment. The upper interval is associated with the Holocene (MIS 1), and the lower interval corresponds to the Late Pleistocene (MIS 5) based on age data. Both intervals contained abundant well-preserved fossil ostracods.

This study aims to reconstruct paleoenvironments by analyzing fossil ostracod assemblages (minute Crustacea) in the study area and compiling paleobiogeography data since the Middle Pleistocene in central Japan.

The ostracod assemblages from the MIS 5 interval of the study cores exhibited minimal temporal variation and low species diversity. The dominant species were *Spinileberis quadriaculeata*, *Cytheromorpha acupunctata*, *Bicornucythere* sp. U, and *Neomonoceratina delicata*, which are typical of inner shallow muddy bay species (e.g., Ikeya and Shiozaki, 1993; Irizuki and Seto, 2004). Offshore species are rarely found. However, the ostracod assemblages in the MIS 1 interval exhibited different assemblages. Enclosed inner bays and brackish ostracods dominate the horizon at approximately 10000 cal yr BP. *Nipponocythere bicarinata* and *Krithe japonica*, which live abundantly in offshore muddy bays at water depths greater than 15 m, were found from a horizon of approximately 8000 cal yr BP. Subsequently, the ostracod abundance and diversity increased upward, peaking at their maximum at a horizon of approximately 7000 cal yr BP, indicating a rapid increase in sea-level change. The inferred paleowater depth at this time was 20–30 m based on offshore bay species such as *Amphileberis nipponica* (Irizuki et al., 2018). This paleoenvironment has persisted since then.

Fossil ostracod assemblages from the MIS 1 and MIS 5 intervals exhibited markedly different compositions. This difference can be attributed to several factors. First, differences in paleowater depth, influenced by relative sea-level changes, played a significant role. The paleowater depth during the MIS 1 interval was estimated to be deeper than that during the MIS 5 interval, which contained more offshore ostracod species. Second, variations in paleowater temperature contributed to these differences. Subtropical to tropical species such as *Bicornucythere* sp. U and *N. delicata* were found only in the MIS

5 interval. Therefore, the warm Kuroshio Current more strongly influenced the study area during MIS 5, resulting in higher water temperatures during the MIS 5. Third, paleobiogeographical factors also played a role. *Bicornucythere* sp. U from the MIS 5 interval had lived in the inner muddy bays of the Pacific coast from eastern to southwestern Japan during the Middle to Late Pleistocene but now lives in southwestern Japan to the west of the Kii Peninsula on the west of Ise Bay and does not live in the study area (Irizuki et al., 2011). Similarly, another dominant species, *N. delicata*, lived in the same areas as *Bicornucythere* sp. U during the Middle to Late Pleistocene but now lives in tropical areas to the west of the Ryukyu Islands, the East China Sea, and the South China Sea (Irizuki et al., 2009). Due to the lack of planktonic larval stages, benthic ostracods have limited dispersal abilities compared with other benthic animals (e.g., Boomer, 2002). Consequently, these two species disappeared from the study area during the Last Glacial Maximum (LGM) due to low water temperatures and could not migrate to the study area even after sea-level and water temperature increases since the LGM because of some barriers that hinder their dispersal.

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Keywords: Ise Bay, ostracod, Holocene, MIS1, MIS5, paleogeography

Holocene Environmental Change in Lake Shinji Basin Inferred from Variations in Magnetic Properties of the Sediment Cores on the West Shore

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Environmental change in Lake Shinji and the surrounding areas has been investigated by lithological, geochemical, and biological analysis of core sediments recovered from the lake bottom and onshore. These studies revealed that Lake Shinji originated as a bay on the Japan Sea coast by the post-glacial sea-level rise around 10,000 years BP and that subsequent transition from an enclosed brackish-water lagoon to a fresh-water lake occurred in association with the deposition of fluvial sediments in the bay-mouth area in the west. In this presentation, we report the results of magnetic measurements of sediment cores collected near the mouth of Hii River on the western shore of Lake Shinji in 2019 (HK19 core) and core samples collected at the same site in 2022 (HK22 core), demonstrating that the remanent magnetization and other magnetic properties provide profound insights into the reconstruction of the paleoenvironment of coastal lakes.

Magnetic measurements of U-channel samples from the HK19 and HK22 cores revealed the existence of stable remanent magnetization components in the sediments deposited in the inner bay environment (24.0–33.0 m depth). The inclination variation at this interval is correlative to the paleomagnetic secular variation (PSV) record of 7.5–9.5 ka reported from Lake Biwa. However, the upper sediments (11.4–23.9 m depth) deposited in the enclosed brackish-water environment have relatively low remanent magnetization intensities, and a clear record of the PSV was not preserved. At this interval, the initial magnetic susceptibility and the anhysteretic susceptibility (ARM susceptibility) also significantly decreased, suggesting that due to early diagenesis, the magnetic minerals have dissolved or altered, affecting the paleomagnetic record. Magnetic hysteresis data such as saturation magnetization, saturation remanent magnetization, coercive force, and residual coercive force show variations consistent with the initial and ARM susceptibilities, indicating that the diagenesis has strongly affected the content and particle size of ferromagnetic minerals, especially in the brackish-water deposits.

Above 11.4 m depth, the lacustrine or fluvial sediments are suggested to have been deposited near the mouth of the Hii River after the “Hii River East Rerouting Event”, which is dated in the 1200s CE based on radiocarbon calendar year calibration ages. Since stable remanent magnetization was observed particularly in the fine-grained part (7.2–11.4 m depth), it is likely that the influence of reductive diagenesis disappeared with the change from a brackish to a freshwater environment and that the amount of magnetic mineral inflow from the river increased at this interval. Regarding the change in magnetic mineral content here, the ARM susceptibility increases rapidly at a depth of 11.4 m. In contrast, the value of the initial magnetic susceptibility rises progressively to a depth of about 9 m. Compared to the initial magnetic susceptibility, which indicates the total amount of magnetic minerals, the ARM susceptibility is considered to reflect the content of very fine-grained ferrimagnetic particles. It is suggested therefore that the input of suspended sediments including fine-grained magnetite first increased, followed by a gradual increase in the inflow of coarse-grained clastic material originating from granitic rocks of the San'in Belt.

Keywords: environmental magnetism, paleomagnetic secular variation, early diagenesis, Lake Shinji, Hii River

Diatom-based lacustrine paleoenvironment reconstruction affected by tsunamis about the last 900 years in Lake Harutori, Hokkaido

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Large earthquakes of magnitude 8-9 and tsunamis occur periodically along the Kuril-Kamchatka trench, which lies along the southeast coast of Hokkaido, the south coast of the Kuril Islands, and the south coast of Kamchatka. The coastal areas are often damaged by these earthquakes and tsunamis. There are many marshes and lagoons in the southeast area of Hokkaido, which formed after the Holocene glacial retreat. These areas have been affected by artificial modifications like dredging, however majority of the original lacustrine sediments still remain undisturbed. Although it is important to understand the changing of lacustrine environment and primary ecosystem after tsunamis for coastal land use, little attention has been given to there. In this study, we investigated the diatom assemblages in the sediment cores of Lake Harutori, where is a coastal lake located along the Pacific coast of Kushiro, southeast Hokkaido, to make clear how the environment in and around the coastal lake was affected and changed by tsunamis since the mediaeval age. In August 2022, four sediment cores (cores R4H1, R4H2, R4H3, R4H4) were collected in the southwest area of Lake Harutori by using a Mackereth piston corer. The sediments were mainly composed of laminated and massive silts. Three sediment cores included the sandy beds that were inferred tsunami sediments. According to the previous researches as Nanayama (2001) and Nanayama et al. (2021), the sand beds are inferred to form by twice magnitude 9 earthquakes, which occurred in 12th or 13th and 17th centuries (GTS2 and 1), and once magnitude 8 earthquake, which occurred at AD1843 (1843 Tokachi-oki earthquake). In case of the Kuril trench earthquakes, the magnitude 9 earthquakes generally cause geomorphic changes of the coastal area, while the magnitude 8 earthquake does not. The diatom assemblages of R4H3 core shows that the relative abundance of marine diatoms taxa gradually decreased after the deposition of GTS2 event layer. This suggests that a part of Chiyonoura sand barrier, which separates Lake Harutori from Pacific Ocean, was broken by the tsunami and following it formed gradually. On the other hand, the diatom indicated that desalination of Lake Harutori occurred after GTS1 event, meaning that the tsunami did not break the barrier at that time. These results suggested that the induced environmental changes by tsunami were not stable, even the magnitude of earthquakes were same as 9. Furthermore, there was significant lacustrine changes around GTS1. However, no change was observed around the geological horizon estimated to 1843 Tokachi-oki earthquake. This suggests that no geomorphic change occurred in and around Lake Harutori by magnitude 8 earthquake of Kuril Trench. The relative abundances of diatom taxa, which prefers eutrophic condition with severe organic pollution, increased near the core top. The term seems to coincide with the period when drainage flowed into the lake from Taiheiyo Coal Mine.

Keywords: Earthquake, Tsunami, Kuril Trench, Diatom, Lake Harutori, Hokkaido

Recent ostracod assemblage (minute Crustacea) and environment in Lake Nakaumi, southwestern Japan, and their spatiotemporal changes over the past 60 year

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Lake Nakaumi extends across the border of Shimane and Tottori prefectures in southwestern Japan, and is located at the estuary of the Hii River flowing from the Chugoku Mountains. This extremely closed, high-salinity brackish-water lake is connected to Lake Shinji on the west side via the Ohashi River and to the Sea of Japan (Miho Bay) on the east side via the Sakai Channel. National land reclamation and freshening projects in Lake Nakaumi began in 1963, and full-scale construction began in 1968. The construction projects include the Nakaura gate installed at the mouth of the lake, the construction of artificial dikes such as the Moriyama dike around the Honjo area in the northwestern part of the lake, and reclamation works along the coast. The construction markedly changed the path of seawater entering the lake from the Sea of Japan. Before construction, seawater flowed counterclockwise from Sakai Channel to Daikonjima Island (DI). After construction, seawater flowed southward from the Nakaura gate and then clockwise to the lake. Meanwhile, the Honjo area was completely closed to seawater. The reclamation and freshening projects ceased in December 2002, and after removing the Nakaura gate, removing the western drainage channel dike in the Honjo area, and partially opening the Moriyama dike (completed in 2009), seawater again flowed into the Honjo area. The present study focuses on Ostracoda (a microcrustacean with two calcareous valves, considered as a useful “microfossil”), which has been investigated before and after reclamation and freshening projects (Ishizaki, 1969; Takayasu et al., 1990; Tanaka et al., 1998; Irizuki et al., 2003).

The present study clarifies the relationship between recent ostracod assemblages (minute Crustacea) and environments in 2021, compares the results of previous studies with those obtained in 2021, and examines how anthropogenic modification has altered the ostracod assemblages and environments over the past 60 years.

Water collected by a small ship belonging to the Estuary Research Center of Shimane University was subjected to a water quality survey, and lake-bottom samples (1 cm of the surface layer of the bottom sediments) were collected by an Ekman–Birge grab sampler in August 2021. The sediments were washed on a sieve with an opening diameter of 63 µm, stained with rose bengal to distinguish the living specimens from the ostracod remains, and washed and dried. The dried samples were sorted through a sieve with an opening diameter of 75 µm to separate the coarse-grained sediments. The whole ostracods (both living specimens and remains) were examined under a binocular stereomicroscope.

The water quality at the time of the survey was characterized by the presence of a halocline at an approximate water depth of 4 m. The bottom salinity ranged from 29 to 31 psu at deeper sites and by less than 10 psu at shallower sites. The collected samples (living specimens and remains) yielded at least 123 species of ostracods. The dominant species was *Bicornucythere bisanensis*, which has remained unchanged for about 60 years. This species is abundant in the mud bottoms of enclosed inner to middle bays throughout Japan (Ikeya and Shiozaki, 1993) and can tolerate organic pollution (Irizuki et al., 2003). The species also abundantly occupies the southeast coast of DI, south of the former Nakaura gate, and from the central part of the lake, dominating at some sites with salinities of 30 psu and high total organic contents. *Bicornucythere bisanensis* was also found near the Moriyama-dike excavation site in the Honjo area and in the coastal areas north of DI. The abundance of these species increased from 1986 to 2021, the post-construction period. Coastal phytal and sand-bottom species, such as *Xestoleberis hanaii* and *Hemicythere miii* were abundant around the DI and along the Moriyama dike in 2021, suggesting that seaweed and seagrasses have thrived along the coast, increasing the species diversity. *Spinileberis furuyaensis*, *Cytherura miii*, and *Dolerocypria mukaishimensis*, which inhabit areas of low or fluctuating salinity, occurred sporadically around the mouth of the Ohashi River. The species diversity was highest in the Sakai Channel, where the coastal sand-bottom species *Pontocythere subjaponica* and the open-marine species *Loxoconcha optima*, and the bay species *Trachyleberis niitsumai* were found; however, most of the specimens were relict valves. Ostracods were scarce in the central part of the Honjo area and the southern part of Lake Nakaumi, where the lake-bottom water becomes anoxic in summer. Species diversity was high around DI but decreased toward the center of the lake, which is inhabited by only one species (*B. bisanensis*).

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Keywords: Lake Nakaumi, ostracod, reclamation and freshening projects, anthropogenic modification

Estimating carbon storage in eutrophic lakes in subarctic regions using Anthropocene varved sediments

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In the coastal area of the Sea of Okhotsk in the east part of Hokkaido located to subarctic zone, many brackish-water lakes are distributed. Lake Mokoto is a small coastal lagoon with an area of 1.1 km². This Lake has two-layer structure of polyhaline surface waters and mixoeuhaline bottom water. The bottom water shows the anoxic conditions in summer season. This lake is considered a eutrophic lake because the lake water has a very high concentration of chlorophyll a (> 20 ppb). The surface sediments consist of organic mud with very high TOC concentrations (4 to 6%), suggesting that the lake may play a role in modern carbon storage. In this study, we will perform CNS elemental analysis on 2m-level cores obtained from Lake Mokoto, and estimates the changes of carbon accumulation rate.

We collected 09Mk-1C core (length: 178 cm) from the northwest part of Lake Mokoto (water depth 3.8 m), and 18Mk-8C core (length: 176 cm) and 24Mk-9C core (length: 168 cm) from the central part (water depth 4.5 m). These cores consist of muddy varve sediments and can be correlated at the lamina level. As a result, the varve age of the core bottom of the 09Mk-1C core was determined to be 1854CE. In this core, the varve age of the peak of Cs¹³⁷ indicates 1963CE, which coincides with the peak age of Cs¹³⁷ fallout in Japan. The varve ages of the core bottom of the 18Mk-8C and 24Mk-9C cores were determined to be 1926CE. Therefore, the average sedimentation rates of the 09Mk-1C core and 18Mk-8C core are estimated to be 11.4mm/y and 19.1mm/y, respectively.

In CNS elemental analysis, the total organic carbon (TOC) content of the 09Mk-1C core was high, ranging from 3 to 8%. The TOC content was highest between 1850CE and 1920CE, at around 8%. After decreasing to the lowest value in 1990CE, it increases again to 5%. The TOC content of the 18Mk-8C core showed similar values despite the different sedimentation rates. On the other hand, the carbon accumulation rate of the 09Mk-1C core is 10 to 20 mg/cm²/y during the period from 1850CE to 1920CE. After that, the carbon accumulation rate tends to increase from 20 to 30 mg/cm²/y. The 18Mk-8C core shows a carbon accumulation rate 1.6 times faster than that of the 09Mk-1C core. From these values, the carbon storage over 100 years is estimated to be approximately 20 kt in Lake Mokoto.

Keywords: clastic varves, total organic carbon (TOC) contents, total sulfur (TS) contents, carbon accumulation rate

Expansion of tropical larger foraminifera *Amphistegina* in the Japan Sea owing to the recent warming trend of SST

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The sea surface temperature (SST) in the southern part of the Japan Sea is warming twice as fast as the global average. Such warming has severely affected on the fishery activity in this region. However, the warming influence on the basic small organisms has been still unveiled. A tropical larger foraminiferal genus *Amphistegina* is widely distributed in tropical to subtropical shallow sea. In the eastern Eurasia region, it shows abundant occurrence along the coastal region of the Ryukyu Islands. In recent years, however, the genus has been detected along the coast of the southwestern part of the Japan Sea. It should be noted that the genus has demonstrated a significant expansion in the Mediterranean Sea invaded from the Red Sea through the Suez Canal. Then, the genus has been regarded as the most successful invasive taxa in the Mediterranean Sea. We should note such “cryptic” turnover of meiobenthic community potentially followed by a turnover on higher community.

The present author and his coworkers have investigated the distribution of living *Amphistegina* along the coastal region of the western part of Japan. At the San'in and Hokuriku districts, he conducted monthly/bimonthly survey to obtain the population dynamics of the Japan Sea's community. The depth interval of the present survey is about 0 to 20 m. Bottom samples, mainly composed of calcareous algae and sediments, were collected in the 5 cm squared area (25 cm²) on the rocky reef. Each sample was colored by Rosebengal, washed up to remove extra color and dried up. Then, foraminiferal individuals were picked up from the dried residues by using a binocular microscope.

According to the results, the northern limit of living *Amphistegina* is located at the Oki Dogo Island and the eastern limit is in Hokuriku district. The population dynamics implies a unique seasonal pattern in which the number of small individuals increase rapidly in the summer. The seasonal pattern suggests that the occurrence of the genus in the Japan Sea should not be abortive migration because living individuals of both juvenile and adult has been observed even in snowing winter. The present distribution data clearly shows that the tropical larger foraminifera has already get a position of successful invasive taxa in the Japan Sea.

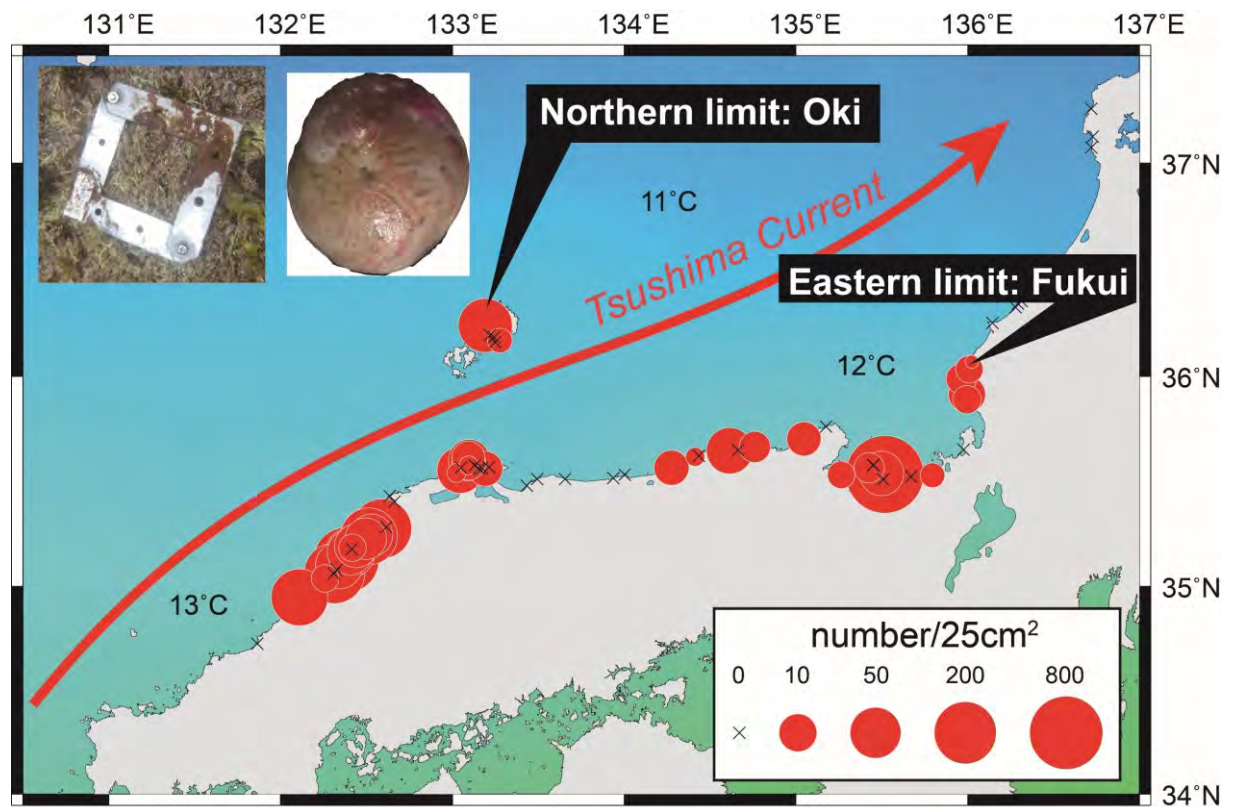


Fig. 1 Density of living *Amphistegina lobifera* at shallow rocky reef (Hayashi 2023, partly modified after new data). The base map is SST in February generated from the database of Japan Oceanographic Data Center.

Keywords: Japan Sea, shallow sea, tropical larger foraminifera

The erosion rate in Gobi Altai Mountain, the catchment of Boon Tsagaan Lake, Mongolia

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Endorheic lake basins preserve great records of changes in regional hydrology and environmental conditions. In this study, we investigated sedimentation dynamics for the saline Boontsagaan Lake in the arid region of Mongolia. The lake currently has one inflow river (Baidrag river) from the northeastern corner of the lake. Sediment cores, sediment traps samples from the lake and inflowing Baidrag river, and rocks from the southern catchment mountain range were collected. A catchment rock sample were analysed by the apatite fission track method, the low temperature thermochronological technique, to estimate the average erosion rate in the catchment. A rock was crushed, served, then magnetic minerals were removed. By the heavy liquid separation, apatite was separated and dated. Sample ages show correlation against sample elevation. The erosion rates were estimated from the elevation-age relationship and thermal history modeling with HeFTy program (Ketcham, 2005). The erosion was basically very slow (a few mm /100 yrs) and even slower recently without any influence by the India-Eurasia collision.

Keywords: 4–6 words: Erosion, Fission track dating

Fundamental Research on Foraminifera as Dosimeters in Thermoluminescence dating.

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Foraminifera are crucial environmental indicators in Quaternary research, playing a significant role in paleoenvironmental reconstructions. Their ages are important for understanding past climate and environmental conditions. Typically, the absolute age of foraminifera is determined using ¹⁴C dating for relatively young samples up to tens of thousands of years old. For older samples, relative ages are often assigned based on the fluctuation of oxygen isotope ratios (Oba 2006). While thermoluminescence (TL) dating is commonly applied to minerals such as quartz and feldspar, there are a few studies of its application to carbonates. Since some foraminifera contain carbonate in their shells, applying TL dating to these organisms could potentially provide absolute ages, thus significantly advancing Quaternary research. This study aims to assess the performance of foraminifera as TL dosimeters through a series of fundamental experiments.

Sedimentary deposits containing foraminifera, referred to as ooze, were collected from the western tropical Pacific region during IODP Expedition 363. These samples were treated with hydrogen peroxide to remove organic matter, thoroughly washed with distilled water, and then dried in an oven. The mineral composition of the samples was identified as calcite using powder X-ray diffraction (XRD: Rigaku Ultima IV). The concentrations of trace elements known to act as luminescence quenchers or activators (Mn, Fe, Co, Ni, Pb) in calcite (Medlin, 1958) were measured using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS, Agilent 7500s). The samples were irradiated with α , β , γ , and X-rays at specific doses. Then the samples were stored in a dark room, and red TL (RTL) and blue TL (BTL) were measured. The shapes of the resulting glow curves were compared between RTL and BTL to see the differences depending on the emitting light wavelength. Fading of the luminescence signal over time was investigated with RTL,

Keywords: TL dating, Quaternary, Foraminifera, Carbonate

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Subsidence potential of Izumo clay as a result of sediment consolidation

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Introduction: Izumo Plain is an alluvial plain formed by the filling of Paleo-Shinji Bay with deposits supplied by the Hii as well as Kandogawa Rivers. Due to the presence of thick Holocene mud, the subsidence due to sediment consolidation is a crucial issue in the area. The present study aims to estimate the subsidence potential of the Holocene sediment in the Izumo Plain through sediment consolidation analyses.

Methods: This study targets core sediment obtained from the shore of Lake Shinji (SJ-1: 20.7 m long) at the easternmost part of Izumo Plain. A conventional facies description was carried out and the representative undisturbed sections of each core were selected for consolidation tests and index property tests such as water content, Atterberg limit, specific gravity, bulk density and grain size analysis.

Results: The succession between 1 and 4 m below ground level (b. g. l.) consists of the reclaimed sediments associated with the bank construction. The Holocene sediment comprises delta front facies (4 - 10 m b. g. l.) and prodelta facies (10 - 20.7 m b. g. l.). The delta front facies are represented by sand-dominated alternations of medium to fine sand and silt beds showing the upward coarsening trend. Some sand beds show inverse-grading and parallel, and ripple cross-lamination, typical of hyperpycnal flow deposits originated from the Hii River. The prodelta facies consists of thick, muddy sediment with less frequent sand beds. Physical properties such as water content ' w ', liquid limit ' w_L ', plasticity index ' I_p ' and clay content are significantly higher in the prodelta sediments (Fig. 1). The compression index ' C_c ' of clayey sediments of both facies are greater than 0.4 representing high compressibility (Fig. 2). As the delta front facies are dominated by the sand beds, the rate of consolidation and preconsolidation stress is higher, and therefore the settlement potential is negligible. The prodelta facies is a thick succession of muddy sediment with high compressibility, low rate of consolidation ' C_v ' and low preconsolidation stress ' P_c ' indicating a high potential for subsidence. A significant amount of settlement can happen in the prodelta facies of 10.7 m thickness and is estimated around 62.90 cm with addition of 50 kPa stress at present condition by using conventional compression curve method. The final settlement time taken for 90 % of primary consolidation settlement is approximately 3,510 days i.e. 9.62 years (Fig. 3).

Conclusion: The geotechnical analysis of this research with high sample frequency at each meter depth, indicates that the Holocene succession of the eastern Izumo Plain is highly prone to subsidence through sediment consolidation. For example, if we apply 50 kPa of load to the eastern Izumo Plain, the ground will settle around 62 cm and the 90 % of this settlement will take approximately 9.62 years for consolidating.

Keywords: Holocene sediment; Izumo clay; Consolidation test; Subsidence; Compression Index

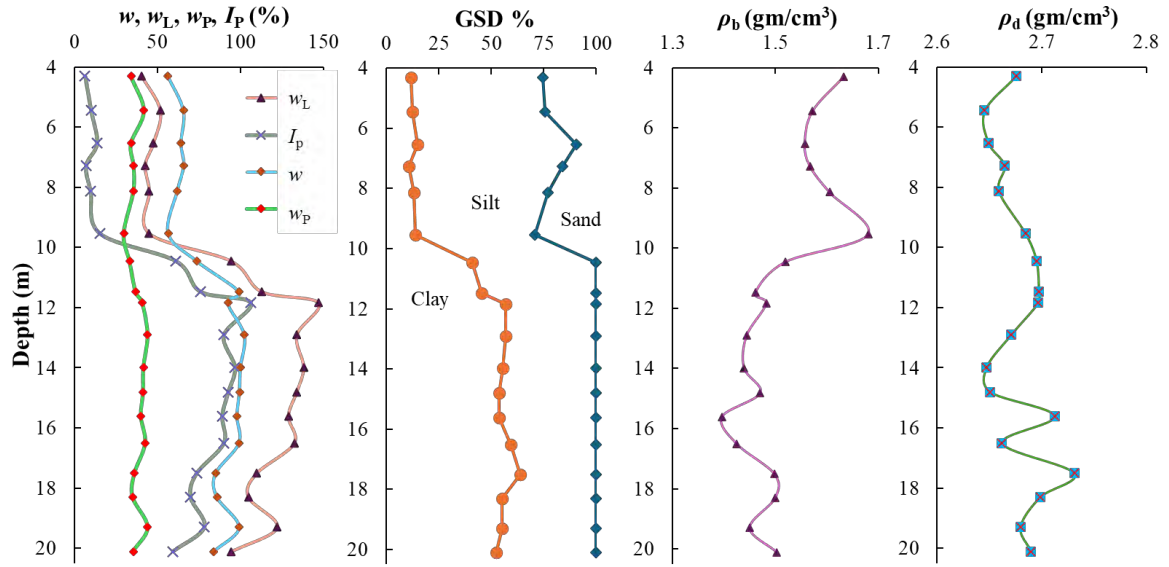


Fig. 1 Depth wise distribution of index properties

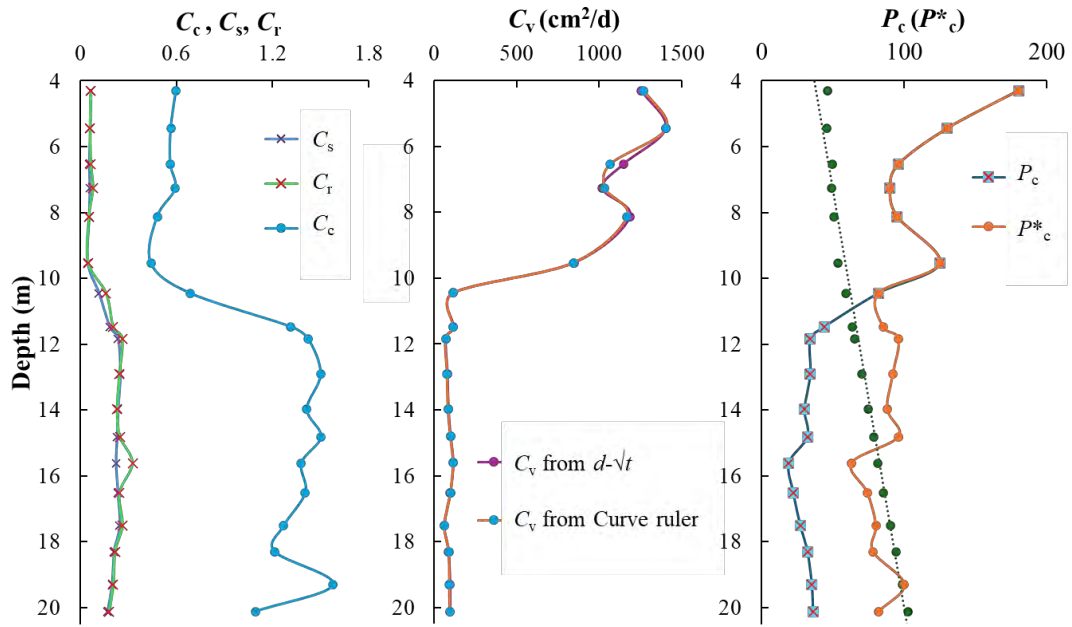


Fig. 2 Depth wise distribution of consolidation properties

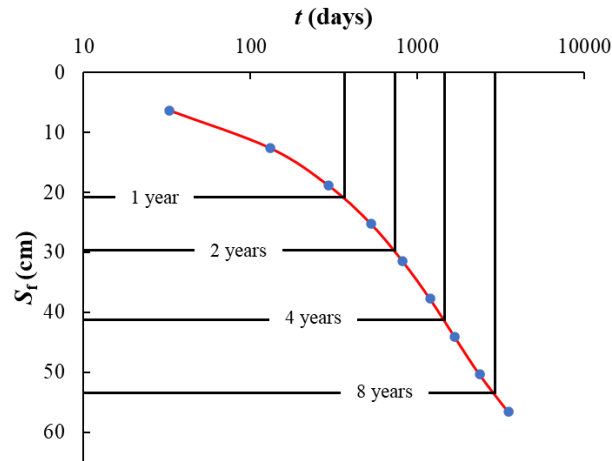


Fig. 3 Elapsed time required for the settlement

Sedimentary facies and successions at the delta margin of the Kiso River delta

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Delta progradation results in the deposition of delta front sandy sediments overlying prodelta mud. Typically, sediments at the delta front exhibit a coarsening-upward trend, with sand content exceeding 50%. Previous studies predominantly sampled borehole core sediments near former, major river mouths, leading to frequent reporting such successions. However, the ubiquity of these successions across deltaic environments remains uncertain. This study examines the characteristics of delta deposits through the analysis of borehole core sediments collected at a distance from the major channel and through the evaluation of existing borehole logs.

Our research focuses on the Kiso River delta, formed at the mouths of the Kiso, Nagara, and Ibi rivers in central Japan. The delta's western margin is bordered by the Yoro Mountains, with the Yoro Fault, a major reverse fault, running north-south along its boundary. Alluvial fans, formed by tributaries, commonly occur at the foot of the mountain. A borehole core sediment sample was taken from the floodplain near the terminus of an alluvial fan formed by the Oguradani River (site OR: elevation 1.07 m, penetration depth 32 m). Existing borehole logs from the vicinity of the OR site were collected and analyzed to assess the extent of the deposits observed in the OR core.

The borehole sediments were divided into six sediment facies (braided channel, floodplain, estuary, prodelta, delta front, and delta plain) in ascending order, based on lithology, grain size, color, sedimentary structures, fossil components, and succession character. Mud deposits dominate, except in the braided channel and certain portions of the delta plain facies. Similar characteristics were observed in the borehole logs from the floodplain surrounding the OR site. The mud content is almost 100% from estuary to prodelta facies in the OR core. On the delta front, the mud content is over about 80%, i.e., sand content is only less than about 20%, except for specific horizons rich in shells. Mud content falls below 50% in some horizons at depths shallower than 4 m within the delta plain. Radiocarbon dating indicates that delta deposits accumulated over the past ~8 ka, with accumulation rates for delta front sediments surpassing those of prodelta sediments.

The predominance of mud throughout the core, except for the braided channel at its base, and the low sand content, particularly in the upper delta front, suggest that the OR site is located away from the major river mouths (e.g., Kiso, Nagara, Ibi rivers). Furthermore, it indicates that coarse-grained sediments did not reach the site from tributaries such as the Oguradani River, where debris flows occur. The observed increase in sand content over the past 1000 years implies the expansion of the alluvial fan formed by the Oguradani River.

Keywords: accumulation rate, delta front, delta margin, radiocarbon age, sediment facies

Interpretation of sedimentary facies from late Quaternary to present: a multi-proxy analysis of sediment in the western coastal plain of Bohai Bay, China

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The west coastal plain of Bohai Bay has undergone several coastal processes of transgression and regression events since the Last Glacial Maximum (Wang et al., 2015). Delta lobes formed along the coastal zone, caused by river channel shifting over the last 7000 years (Xue, 1993). Each time the channel changed, cheniers subsequently developed in front of these delta lobes according to radiocarbon dating evidence (Saito et al., 2000). The barrier island-lagoon system dominated by marine processes also contributed to the chenier formation (Wang et al., 2022). This area was influenced by the alternating hydrodynamic forces of marine and terrestrial environments, resulting in complex sedimentary facies.

Five cores along W–E transect from the modern shoreline to inland were collected using a rotary drilling corer (Figure 1) to interpret the sedimentary facies and reconstruct the paleoenvironment. Organic sediment samples were collected from drilling cores, and the peat obtained were selected for AMS radiocarbon analysis. Color parameter, grain size, and electric conductivity analyses were conducted.

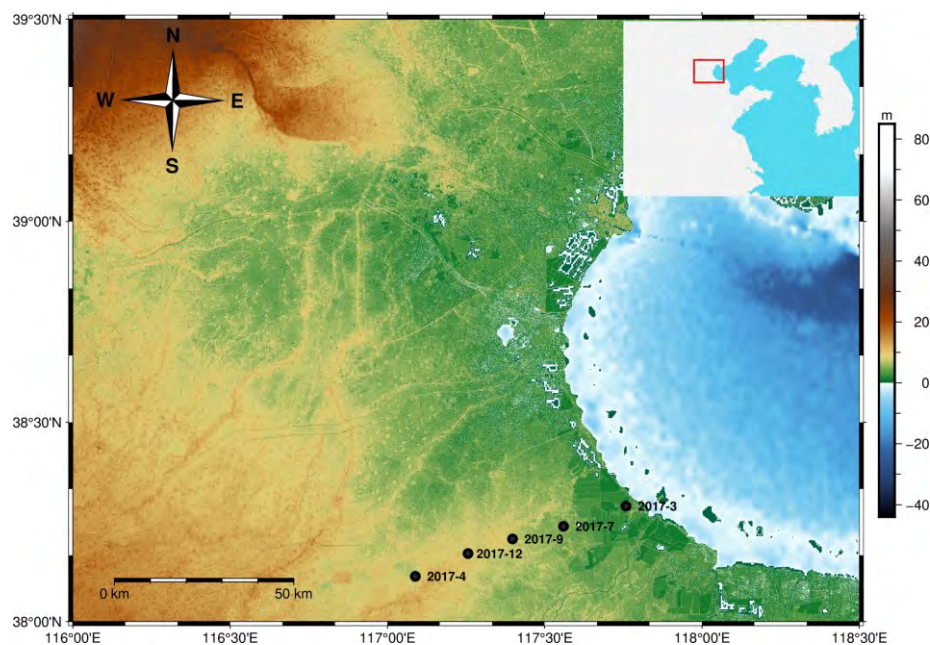


Figure 1. Study area and the position of borehole cores

The interpretation of sediment facies suggests that core 2017-4 was not influenced by marine processes. In core 2017-12, a 1.1m thick layer of tidal flat deposits with relatively high electric conductivity values was identified, and the base of this layer dates to 7676–7587 cal BP. It indicates that the boundary of the Holocene

transgression likely lies between the locations of core 2017-4 and core 2017-12. (Figure 2). The Holocene marine unit in core 2017-9 is composed of gray clayey silt, interbedded with thin silt layers, suggesting a tidal flat to shallow marine depositional environment. In core 2017-7, tidal flat deposits are observed at the bottom, overlain by a coarsening- upward delta front succession from sandy silt to silty sand, and followed by a fining-upward succession from very fine sand to clayey silt. These sedimentary sequences reveal the process of delta progradation during the regressive phase. The bottom of the Holocene marine unit in core 2017-3 is composed of shallow marine deposits and followed by a well-sorted, fining-upward sequence from fine sand to very fine sand, indicating a transition from an offshore bar to foreshore depositional environment.

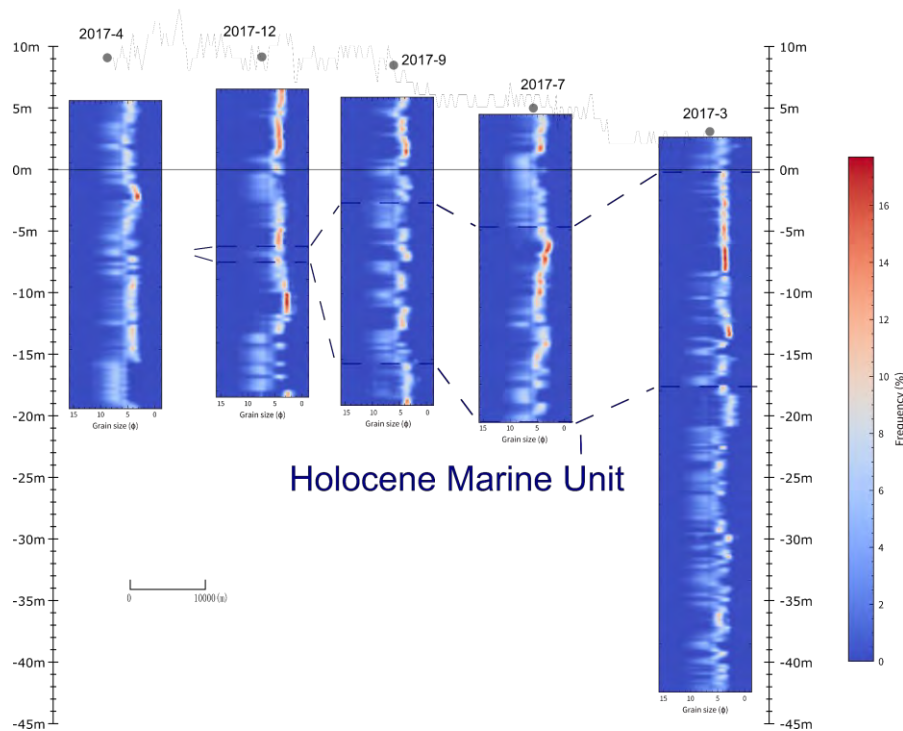


Figure 2. Transect of borehole cores and grain size frequency heatmap

Keywords: Bohai bay; Grain size; Paleoenvironment; Transgression

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Characteristics of grain size distribution of river flooding sediments in midstream area of the Nakdong River

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This study analyzed the characteristics of the grain size distribution of the sediments obtained from the flooding in the Ibang-myeon, Changnyeong-gun (located in the central part of the Korean Peninsula), which was caused by the collapse of the embarkment on the Nakdong River on August 9th, 2020. As a result, it was found that the mean grain size decreases and the sorting becomes poorer as the distance from the embarkment collapse point increases. This is attributed to the fact that the transport energy of the river decreases when flooding occurs, ensuring that coarse-grained sediments are deposited first. Further, as the transport energy further reduces and becomes dispersed, the sorting for the fine-grained sediments becomes poor. Considering the characteristics of spatial distribution, sediments along the farm road showed the properties of floodplain deposits that transport to natural levee and back swamp due to river flooding. On the other hand, sediments along the irrigation ditch exhibited the properties of the deposits that are carried by the flow backward of ditch from the river after the collapse of the embarkment. The results of this study are significant because characteristics of flooding sediments were elucidated for major rivers where flooding rarely occurs due to the recently built artificial structures. In addition, by applying the grain size distribution characteristics of present river flooding sediments, it will be able to contribute to clarifying the sedimentary environments of the paleo river flooding deposits.

Keywords: Flooding, Grain size distribution, Grain size analysis, Nakdong River

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Tidal controls on migration of intertidal sand ridges? An example from Hamhae Bay tidal flat, southwestern Korea

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Irrespective of their sizes and orientation, numerous intertidal sand bodies are found from lower sand flat to upper mud flat in Hamhae Bay, Korea. They represent narrow, linear or curvilinear shoals or bars, forming topographic high on the flat surface. The sand bodies consist mainly of sand and shelly material accumulated by waves and other physical coastal processes. Cheniers or shelly beach ridges resting on mud flats are a type of sand bodies that have migrated landward by storm waves. Interesting feature is the linear sand ridge aligned perpendicular to the shoreline. In this context, the intertidal sand ridge located on the muddy flat was examined to elucidate its origin and driving mechanism of sand ridge migration.

About 460 m long, shore-normal linear ridge is located at 550 m distance to the sea cliffs. It is topographically situated at near the mean sea level. Maximum tidal currents by an ADV velocimeter were recorded up to 80 cm/s with slightly ebb-dominance. Mean grain sizes of ridge sands range from 0 to 1 phi, similar to beach sands at the shoreline. Ridge sands are mineralogically immature and moderately well-sorted. The source materials of sands are likely derived from coastal erosion of highly-weathered granite sea-cliffs. Small tidal creeks may play a vital role in transporting materials when drained. Sediment transport direction inferred from bedform asymmetry analysis shows the ridge migrated landward in a sideways. The time-series overlay of aerial photograph shows that, over the past 50 years, the sand ridge has migrated about 200 m to the east. It is thus evident that the ridge itself is actually tide-controlled, rather than waves. The study signifies tide effects on ridge migration underrated, while winter waves overestimated.

Keywords: Intertidal sand ridge, Macrotidal mudflat, Tidal creek, Migration, Hamhae Bay



Figure 1. Intertidal sand ridge in the Hamhae Bay tidal flat, aligned perpendicular to the shoreline.

Holocene paleoclimate changes and agricultural activities based on the phytolith records in Lake Gyeongpo, South Korea

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Phytoliths consist of amorphous silicon dioxide ($\text{SiO}_2 \cdot n\text{H}_2\text{O}$). They are parts of plant tissues and can retain their own morphological characteristics in soils even after separating from the plants. In particular, since phytoliths can resist physical and chemical weathering, they remain well in the soil. Moreover, phytoliths are semi-permanently preserved in wetland soils, lake sediments, agricultural lands, and dry land soils where pollen preservation is difficult. In addition, unlike pollen, phytoliths have the advantage that they can be analyzed under different conditions. There are different forms of phytoliths exist in the Gramineae family, and some morphotypes of phytoliths reflect the climatic environment at the time of formation. Therefore, phytolith analysis is a useful method for reconstructing the Quaternary climate environment and identifying the possibility of agricultural activities at that time.

In South Korea, phytolith studies have mainly focused on the morphology and taxonomy of phytoliths produced by the plants. Recently, phytolith studies with pollen and diatom analysis have been used as potentials for archaeological and palaeoecological studies. However, phytolith studies of environmental change in the coastal region have not been sufficient. Furthermore, paleoclimatic and paleoenvironmental analysis using phytoliths in South Korea is insufficient as the application of phytolith research in Korea has been predominantly directed to archaeological studies, especially to the beginning or history of agriculture.

Within the past extent of Lake Gyeongpo, sediments transported by the Gyeongpo Stream since the mid-Holocene have gradually led to terrestrialization in the shallow inland bay environment. In addition, there are records of topographic and vegetation changes in the study area, including the geomorphological evolution of Lake Gyeongpo. This study examines the characteristics of agricultural activities, focusing on climatic and environmental changes since the mid-Holocene and the appearance of *Oryza sativa* in the Gangneung area.

In the lake sediments of Lake Gyeongpo, scientific evidence indicating vegetation and climate changes after the mid-Holocene period was well preserved. Phytolith analysis was conducted on a 660 cm core from Lake Gyeongpo in South Korea to clarify environmental changes, including climate and agricultural activities during the Holocene. From the results of phytolith analysis, six phytoliths assemblage zones (PAZ) were recognized. PAZ I (~5000 yr BP) suggests the transition from warm and dry to cool and wet climatic conditions. The climate of PAZ II (ca. 4000-2000 yr BP) was kept on warm, but alternated between dry and wet conditions. PAZ III (2000-1000 yr BP) suggests the expansion of agricultural activities under the warm and humid climatic conditions, evidenced by significant phytolith production of Paniceae and *Oryza sativa*. While PAZ IV (1000-500 yr BP) indicates very cool and dry

conditions, PAZ V and IV suggest the warm-dry and cool-humid climatic conditions, respectively. Similar to the results of the pollen analysis in the lake, agricultural activities were recognized by PAZ III around 2000 yr BP from the results of phytolith analysis, and the rice cultivation, such as *Oryza sativa*, has expanded since 2000 yr BP or later. The results of phytolith analysis showed that Paniceae cultivation activities were carried out from about 2000 yr BP, and the cultivation of *O. sativa* has been ongoing since then.

Keywords: Phytolith, Lake Gyeongpo, Holocene, Climate changes, beginning of rice cultivation

Late Quaternary Vegetation and Paleoenvironmental Changes based Pollen records in the Korean Peninsula

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This study aimed to reconstruct the anthropogenic vegetation interference based on vegetation, climate change and human activities on the Korean Peninsula, late Quaternary High-resolution palynological analysis was conducted on a total of 15 sites in the mid-west(Gimpo, Boryeong, Yesan, Asan, Younghwa-dong, Jangjeri, Cheonan Seongjeong-dong, Chungsu-dong, Cheongju Pyeng-dong, Sorori and Sangju), southern(Gochang, Daegu, Changwon and Ulsan) and eastern coastal(Goseong Hwajinpo) regions. Based on the findings of this study and prior research, an Isopollen map was generated. Furthermore, the study investigated the impact of anthropogenic vegetation interference through vegetation and climate change during the late Quaternary using by CI(Climate Index) and HII(Human Influence index).

The results of the Isopollen map revealed changes in specific species, such as the *Alnus*, *Pinus*, *Quercus* and NAP/AP ratio when analyzed over a time series. ca. 8,000 years BP, *Quercus* exhibited high occurrence along both the eastern and western coasts. However, ca. 6,000 years BP, it showed even higher occurrence rates along the eastern coast. This trend can be attributed to the relatively denser forests on the eastern coast and the contrasting ecological characteristics between *Quercus* and *Pinus*, as well as localized geographical differences. Around 5,000 years BP, the maximum marine transgression in the middle Holocene, salty water invading inland valleys led to bay environments in the alluvial plains downstream of major rivers. This Phenomenon occurred farther inland on the west coast, due to its gentle slopes and high tidal range, than on the east coast. These changes led to the dominance of *Alnus* thriving in moist conditions, and this pattern was maintained until ca. 3,000 years BP. From 3,000 years BP, the NAP/AP ratio exceeded 1.0, indicating a dominance of NAP in the central western coastal lowlands and the southeastern alluvial plains. This trend gradually expanded nationwide by approximately 2,000 years BP. These changes were attributed to human-induced disruptions of vegetation, including deforestation and cultivation activities carried out for agricultural and residential purposes. The occurrence rates of *Alnus* and *Pinus*, which previously showed marked differences between eastern and western regions, disappeared around 2,000 years BP. The rapid decline in *Alnus* and the nationwide increase in *Pinus* can be attributed to selective removal by human activities and secondary afforestation on deforested land, rather than climate change. Time series changes can be examined and analyzed using Isopollen maps, which allow for the observation and analysis of spatial distribution patterns.

The climate conditions of cold/warm and wet/dry were reconstructed using CI(Climate Index) such as the AP ratio, the ratio of *Artemisia* and Chenopodiaceae, and the (A-C)/(A+C) index. These indicators reflected the climate condition from 23,000 to 20,000 years BP, the climate on the Korean Peninsula was characterized as Cold and Dry. During ca. 20,000 years BP, the Last

Glacial Maximum(LGM), the climate became extremely Cold and Dry. This led to an expansion of open meadow and the distribution of sparse forests in the surrounding hills. Between 16,000 and 14,000 years BP, the temperature slightly increased, transitioning from Very Cold to Cold climate. 12,900 to 11,500 years BP, a short-term cold period known as the Younger Dryas occurred, characterized by extremely Cold and Dry conditions. About 10,000 years BP, there was a transition from Cool to Warm and Dry climate. 8,200 years BP, there was a temporary temperature decrease, resulting in Cool and Dry climate from 9,000 to 8,000 years BP. From 8,000 to 6,000 years BP, the temperature recovered, and during the Climatic Hypsithermal period, the climate became Warm and Wet. From 6,000 to 3,000 years BP, a Warm and Dry condition persisted. However, around 4,200 to 4,000 years BP, there was a temporary temperature decrease, resulting in Cool and Dry climate. From 3,000 to 1,000 years BP, the climate became Cool and Dry again. After 1,000 years BP, there have been regional variations, with some areas experiencing a Warm and Dry climate, while others have Cool and Dry climate. This variation can be attributed to the influences of the Medieval Warm Period and the Little Ice Age, as well as vegetation disruptions caused by human activities. The changes in the NAP/AP ratio, which can be used as indicators of HI(Human Influence Index), along with the increase in Gramineae, particularly including particles larger than 35 μm , the occurrence of *Fagopyrum*, and the concurrent increase of indicator species associated with human activity, as well as the rapid increase of *Pinus* and decrease of *Alnus*, revealed the intensification of agricultural activities and provided insights into the spread route of agriculture during this period. Based on these indicators, it has been determined that extensive agricultural activities, including the cultivation of Gramineae, began ca. 4,000 to 3,200 years BP in the Gyeonggi Bay area on the western coast. Subsequently, in the southwestern coastal areas, agricultural activities started slightly later, from 3,100 to 3,000 years BP. ca. 3,000 years BP, agricultural activities appeared in the alluvial plains of the downstream areas of large rivers. Additionally, around 2,500 years BP, there was a shift towards inland areas in the central and western regions. In the southeastern coastal areas, the spread of agricultural activities occurred along the surrounding coastline. Around 2,200 years BP, agricultural activities began to expand inland along major rivers in the southeastern region of the Korean Peninsula. By ca. 2,000 years BP, agriculture had experienced significant growth and had spread throughout the entire Korean Peninsula. From 1,800 to 1,100 years BP, agricultural activities expanded deeper into the inland areas along major rivers such as the Han River and Nakdong River. In the coastal regions, agriculture also extended into island areas. The eastern coastal region exhibited a distinct pattern of south-to-north spread of agriculture. Furthermore, even the remote alpine wetlands in the inland areas, where human activities were less active, started to show signs of agricultural influence after 680 years BP.

Keywords: Pollen analysis, Late Quaternary, Isopollen map, Climate Index, Human influence Index,

Reconstructing paleoenvironmental changes in Southeastern Mongolia from the Late Pleistocene to Holocene using the paleo-lake sediments

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This study explores the paleoenvironmental changes in the southeastern part of the Gobi Desert, Mongolia, located near the limit of the East Asian Summer Monsoon (EASM). Along the EASM boundary, the study area is susceptible to climatic shifts. The presence of depressions with paleo-lacustrine sediments and lacustrine terraces in this region indicates past variations in precipitation. Moreover, the area is free from the influences of glaciation and seismic activity, making it an ideal site for reconstructing paleoenvironmental changes in East Asia. However, despite its significance, only some studies have focused on the paleoclimate of this region.

To address this gap, we conducted fieldwork to collect paleolake sediment samples, ensuring the precision and relevance of our data. During the fieldwork, we also employed Unmanned Aerial Vehicles (UAVs) to obtain high-resolution Digital Elevation Models (DEM), which are not easily captured by conventional satellite imagery. This data facilitated a more detailed topographic analysis and enhanced the accuracy of Geographic Information System (GIS) mapping in the study area.

Our research employed a multi-proxy approach, combining geochemical analyses, age dating, particle size analysis, and diatom analysis to reconstruct the paleoenvironmental changes in the region. The results identified the combined values of Biogenic Silica (BSi) and organic content as an essential proxy for the paleoenvironment. When these proxy data values increased, they indicated the presence of a freshwater environment supported by particle size and diatom analyses during periods of strong monsoonal influence characterized by warm and humid conditions. Conversely, declining proxy data correspond to drier periods with reduced monsoonal impact, indicating lower precipitation.

Analysis reveals that during a wet and warm period in the mid-Holocene, the paleolake in the study area reached its highest water level, forming a prominent terrace at approximately 1,070 meters above sea level (m.a.s.l.). AMS results of organic matter extracted from these highest terrace sediments indicate that the lake's maximum extent occurred around 4,000 years BP under humid climatic conditions. However, as the East Asian Summer Monsoon (EASM) limit moved northward, its influence over the study area decreased, and the climate shifted towards aridity. This resulted in significantly lower precipitation and the subsequent recession of lake levels. The study area's diminished exposure to monsoonal rainfall during these dry periods aligns with broader patterns of mid-Holocene aridification observed in the region.

Furthermore, our study suggests that the paleoenvironmental conditions in southeastern Mongolia during the Holocene Thermal Maximum (6,500 to 5,000 BP) were likely similar to those in the warm

and humid climate in both regions, as indicated by our proxy data, would have supported the expansion of habitable and agriculturally productive land. Previous studies on paleoenvironments in northeastern China have similarly identified increased precipitation and higher temperatures during this period, which fostered the growth of early agrarian societies, including the Hongshan culture. These favorable conditions likely facilitated cultural exchanges and parallel developments between southeastern Mongolia, northeastern China, and the Korean peninsula.

As the climate shifted towards aridity in the mid-Holocene, the resulting paleoenvironmental changes may have disrupted these early societies, affecting cultural dynamics and exchanges across both regions. This period of aridification, reflected in our study, aligns with broader archaeological and paleoenvironmental evidence from northeastern China, highlighting the interconnectedness of these regions. The similarity in environmental shifts underscores the importance of understanding southeastern Mongolia's paleoenvironment when reconstructing the cultural and environmental history of East Asia during this crucial period, emphasizing the broader implications of our research.

Keywords: Lake sediments, Southeastern Mongolia, Paleoenvironmental changes, Proxy data

**Late Holocene hydroclimate variability
recorded in Yongho paleolake in central South Korea**

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Recently extreme climates have been increasing due to global warming, accordingly the importance of research on the such climate event is increasing and is considered very urgent to understand their natural variability for future climate prediction. To trace past extreme climate variability, paleo-hydrological fluctuations were reconstructed using 10 m-long sedimentary cores (20CR-02) from Yongho paleo-lake located in Changnyeong area, southern Korean peninsula. Radiocarbon dating was performed using plant fragments found in the lake sediments. Grain size analysis and XRF core scanning were performed to determine the physical and chemical characteristics of the sediment layers. Radiocarbon dating results indicate modern age at about 1.5 m and 4500 cal yr BP at about 8.5 m in depth, suggesting that the paleolake sediments were deposited over the past 5000 years. The time series of the median grain size and elemental ratios (e.g., Zr/Ti and Zr/Rb ratios) showed similar variability. For example, the Zr/Ti ratios significantly increased at 800, 1200, 2000, 2400, 4400, 5000 cal yr BP, suggesting increased heavy rainfall events. Dry periods based on the Zr/Ti and Zr/Rb ratios were found at 1000, 1600, 3000-3800 cal yr BP. These multi-centennial hydroclimate fluctuations in the study area seem to have been influenced by regional summer monsoon changes coupled to global intertropical convergence zone (ITCZ) shifts.

Keywords: paleolake, extreme hydroclimate event, summer monsoon, intertropical convergence zone (ITCZ)