(SS35) Environmental and cultural dynamics of the last 21,000 years, with emphasis on prehistorical agriculture in East Asia and other places of the world

Date: August 29
Place: Room 5333 (oral), Room 6317 (poster)
Organizers: Wei-Ming Wang, Hikaru Takahara & Sangheon Yi
Contact email address: wmwang@nigpas.ac.cn
Purpose: It is assumed that global Neolithic culture including original agriculture was generally formed some 12,000-10,000 years ago. The global climate of the last 21,000 years exhibits dramatic changes and abrupt events. It incepted with the end of the latest glaciations, and simultaneously with the transition between the Paleolithic and the Neolithic, when culture of a hunting-gathering mode tended to qualitatively change into an agricultural society. This session aims to present new developments to build an interdisciplinary synthesis for environmental and cultural dynamics, integrated cultural contexts, and high-resolution climatic and vegetation frameworks. This session will specially focus on some major climatic events, such as the Younger Dryas, the Holocene Megathermal, providing evidence for changes in environments, ecosystems and others that affected the regional development of agriculture.

Oral Presentation

Aug. 29 [AM1] Room: 5333

Chairs: Wei-Ming Wang, Hikaru Takahara

9:00-9:05 **[Introduction]** SS35-O01

9:05-9:40 **[Keynote] Vegetation and fire history in western Japan** SS35-O02 (508)

Hikaru Takahara

9:40-10:00 **Early agriculture and its impact on the landscape in NW China** SS35-O03 (281)

Xiaoqiang Li, John Dodson, Xinying Zhou, Keliang Zhao, Nan Sun

10:00-10:20 **Pollen-based Holocene vegetation and climate in southern Italy: the case of Lago di Trifoglietti** SS35-O04 (222)

Sébastien Joannin, Elisabetta Brugiapaglia, Jacques-Louis de Beaulieu, Liliana Bernardo, Michel Magny, Odile Peyron, Boris Vannière

Aug. 29 [AM2] Room: 5333

Chair: Hikaru Takahara

10:50-11:10 **The reconstruction of the historic landscape of the Moskva river valley based on palynological data, digital landscape models and climatic series** SS35-O05 (118)

Ekaterina Ershova, Alersandr Krenke, Nikolay Krenke, Natalia Berezina

11:10-11:30 **Environmental and cultural dynamics, recent development in study on natural background of prehistorical agriculture in Southeast China** SS35-O06 (561)

Wei-Ming Wang, Jun-Wu Shu

11:30-11:50 **30 000-year vegetation and climate change around the East China Sea Shelf inferred from a high resolution pollen record** SS35-O07 (578)

Deke Xu, Houyuan Lu, Naiqin Wu, Zhenxia Liu

11:50-12:10 **Phytolith analysis for differentiating between foxtail millet (*Setaria italica*) and green foxtail (*Setaria viridis*)** SS35-O08 (606)

Jianping Zhang, Houyuan Lu, Naiqin Wu, Xiaoyan Yang, Xianmin Diao

Aug. 29 [PM2] Room: 5333

Chair: Wei-Ming Wang

14:30-14:50 **Contrasting human's role in Holocene vegetation history in the lower Yangtze River, east China and Aso Caldera, southwest Japan: evidence from pollen, phytolith and charcoal data** SS35-O09 (474)

Jun-wu Shu, Hikaru Takahara, Wei-Ming Wang, Naoko Sasaki, Le-Ping Jiang, Yoshitaka Hase

Poster Presentation

Aug. 29 [PM1] Room: 6317

13:30-14:30 **Vegetation and fire history since the last glacial based on pollen and macroscopic charcoal records in the southern area of Mt. Yufu, northeast Kyushu, Japan** SS35-P01 (566)

Ayaka Watanabe, Hikaru Takahara, Ryoma Hayashi, Keiji Takemura

Palaeobiome changes in eastern Asia since 20 kaBP SS35-P02 (368)

Jian Ni, Xianyong Cao, Urike Herzschuh, Yongbo Wang

Cultural dynamics in the context of climatic changes: A multidisciplinary case study for the Late Glacial and Final Palaeolithic from Northern Germany SS35-P03 (533) (Cancelled)

Falko Turner, Johann Friedrich Tolksdorf, Finn Viehberg, Anja Schwarz, Ullrich von Bramann, Felix Bittmann, Knut Kaiser, Ulrich Staesche, Klaus Breest, Antje Schwalb, Stephan Veil

A palynological study of environmental changes and their implications for prehistoric settlement in NE Romania SS35-P04 (88)

Mihaela Aurelia Danu, George Bodi, Radu Pirnau

Phytolith evidence for rice cultivation and spread in Mid-Late Neolithic archaeological sites in central North China SS35-P05 (605)

Jianping Zhang, Houyuan Lu, Naiqin Wu,Fengjiang Li, Xiaoyan Yang, Weilin Wang, Mingzhi Ma, Xiaohu Zhang

Phytolith evidence of millet agriculture during about 6000-2100 cal. aBP. in the Guanzhong Basin, China SS35-P06 (575)

Naiqin Wu,Houyuan Lu, Jianping Zhang,Fengjiang Li, Xiaoyan Yang, Weilin Wang, Mingzhi Ma, Xiaohu Zhang

Vegetation change and anthropogenic influence during the past 2000 years in the Appi Highland, Northern Tohoku, Japan SS35-P07 (470)

SS35-O02 (508)

Vegetation and fire history in western Japan

Hikaru Takahara

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Recently, vegetation and fire history in many sites, especially in western Japan, has been revealed. Main fire regimes were recognized in the early Holocene and the late Holocene in western Japan. Sediment in Kyushu Island contains much charcoal fragments in the Holocene. Fire frequency has been very high especially in the Aso caldera region during the whole Holocene (Miyabuchi et al, 2012, Kawano et al, 2012). The grass vegetation has been sustained to the present time, related to the fire regime. Shu *et al.* will present new data of charcoal and pollen in in this region (SS35, oral). Also, Watanabe *et al* will indicate the long fire history since MIS3 in northern Kyushu (SS35, poster). Also, from the western end of Honshu Island to the Kinki region including Lake Biwa, high concentration of charcoal fragments was recognized in the early Holocene sediment. Sugita and Tsukada (1983) made clear the early Holocene fire regime in Nonbara, Shimane Prefecture. Also, several sites in and around Lake Biwa, the vegetation and fire history in early Holocene was made clear (Inoue *et al*. 2001, Inoue *et al*., 2005, Takahara *et al*. unpublished). The vegetation types during early Holocene in the western Japan were deciduous broadleaved forests composed mainly of deciduous oaks including *Quercus dentata* (Hayashi *et al*., 2012), which has fire-resistance. In late Holocene, before 2500 yr BP, fire frequency became high in the lowland (Sonenuma site and Fusedame site, Takahara *et al*., unpublished) near Lake Biwa, and then rice cultivation began 2500

cal yr BP. In almost sites from plains to mountainous region in the Kinki region, fire frequency became high, around 1000 cal yr BP. The vegetation was began to be replaced by intolerant species such as *Pinus densiflora* around 1000 cal yr BP. In northern Kyushu, pollen influx dated by the wiggle matching indicates that biomass of the vegetation reduced remarkably, 700 cal yr BP (Shimada *et al*, will present as a poster session (SS35)). In Kyoto Basin, the ancient capital was established in AD.794. At just before this age (1300 cal yr BP) evergreen broadleaved forests began to reduce and pine started to increase (Sasaki and Takahara, 2011). The pine forests as the secondary forests were sustained everywhere in the western Japan until several decades before when the pine wilt decease raged throughout the area.

Keywords: fire regime, charcoal fragments, early Holocene, late Holocene.

SS35-O03 (281)

Early agriculture and its impact on the landscape in NW China

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The agriculture, as one of the most important events, appeared in the early Holocene and developed rapidly. Early agriculture is the most important economic activity in prehistoric society and the important base of the forming and development of civilization. The early agriculture development included population growth, the expansions of material cultures, and its impacts on the landscape. Millet and rice based agriculture originated in the Yellow and Yangtze valleys in the early Holocene respectively. Wild wheat strains were first used in the Fertile Crescent of southwest Asia in the late-glacial and domesticated wheat was widespread in that region by 10500 BP. The Northwestern China lies between the heartlands of wheat, rice and rain-fed agriculture and is also crossed by the famous 'Silk Road'. Based on the records of pollen, charcoal, seeds, phytoloth, and high resolution AMS 14C dating, Neolithic agriculture in NW China had a simple organization and was dominated by the production of common millet in the early-middle Yangshao Culture. After the late Yangshao age, the agriculture were dominated by both common and foxtail millet. Approximately 5000 cal BP ago, the rice and soybeans have been cultivated and continued to exist in the Qijia culture. The earliest wheat ages cluster around 4100 to 3800 cal BP in northern China's Hexi corridor of Gansu Province and the likely route of wheat into China was via Russia and Mongolia. Wheat was added as a new crop to the existing millet and rice based agricultural systems. Eight crop types of foxtail millet, broomcorn millet, rice, wheat, barley, oats, soybean and buckwheat appeared and covered the main crop types of the two origin centers of East and West Asia around 4000 cal BP, which suggest the earliest complexity agriculture in Neolithic China. The land use and fire activity by early farmers are much different from the hunting-gathering society. Prehistoric humans needed cultivated land and plants to live and caused an increase in farmland and influence on the landscape greatly during the Neolithic. When the forest were destroyed by early farmers, the vegetation was hard to be rebuilt. Agriculture induced soil fertility loss and land salinization contributed to the process of land degradation. The intensity and scale that prehistoric human impact on the landscape were much greater than previously thought during the Neolithic in NW China.

Keywords: early agriculture, expanding, agriculture impact, Neolithic, NW China.

SS35-O04 (222)

Pollen-based Holocene vegetation and climate in southern Italy: the case of Lago di Trifoglietti

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Climate changes which occured during the end of the last Glacial and the Holocene are well established in Europe. On the continent, this climate pattern is recorded through vegetation changes driven by climate parameters such as precipitation and temperatures of the growing season as well as the orbitally-induced insolation change. The Holocene climate corresponds to a period with numerous and rapid climate changes which originated from high-latitude regions. These are, for example, the cold preboreal and boreal oscillations, the cold 8.2 kyr event and the Neoglacial climate cooling at ca 6000-5000 cal. BP. These events are also recorded in European and Mediterranean paleoenvironments, therefore showing the strong connection between high and lower latitude regions. More in details however, paleoenvironmental records point the regional variability in rapid climate change effects throughout the Mediterranean region. It underlines the Mediterranean climate complexicity, being subject to both high-latitude (i.e., North Atlantic Oscillation) and low-latitude influences (tropical monsoon) which could have forced westerlies activity and the associated precipitation changes over the Italian Peninsula. Moreover, particularly in the Mediterranean regions where human impact is widespread at least since the Neolithic, it is sometimes difficult to disuntangle the anthropogenic and climatic forcing in the palaeoenvironmental records. This complexity is reinforced by a possible climate determinism over human society changes and by human-induced environmental changes (at a larger than local scale) which are expected to enhanced regional climate impact. The pollen proxy therefore does not escape this common trend in paleoenvironmental reconstructions but may be of great interest by delivering direct or indirect indicators of anthropogenic activity. Southern Italy is a place where climate and human influences are superimposed: (1) orbitally induced long lasting climate changes and the debated asynchronic short lasting climate changes that could have develop according to latitude; and (2) major cultural changes like the Neolithic widespread between 9000 and 8000 cal. BP in southeastern Italy and between 8000 and 7500 cal. BP in southwestern Italy. Southern Italy is therefore of great importance in order to discuss vegetation forcings. For instance, however, Holocene pollen-based vegetation records from southern Italy are sparse. The palynological study of Trifoglietti site in the meridional part of the Apennines may contribute fo fill the gap between previous studies. It will provide elements considering the long lasting vegetation dynamics in a place close to glacial refugia, effects of holocenic rapid climate change and cultural widespread on the vegetation.

SS35-O05 (118)

The reconstruction of the historic landscape of the Moskva river valley based on palynological data, digital landscape models and climatic series

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At present time there is much data collected as a result of integrated archeological and paleobotanic research in the Moskva river valley. Pollen, spores, macrofossils and charcoal of cultural layers and natural sediments (peat, buried soils) from the uplands, the riverbanks and the flood plain were analyzed. Radiocarbon dating show a period from 9000 BC to the Middle Age. The data was numerically processed, using inter alia the models of pollen dispersal and deposition by Shinya Sugita. For the first time these findings allow us to trace the characteristic features of the formation of local vegetation against the background of regional climatic changes and in connection with anthropogenic impact. Indications of forest fires can be observed both in the flood plain and the upland, going all the way back to the Atlantic period, i.e. the Mesolithic and Neolithic. For the first time indications of local removal of floodplain oak forest and, presumably, agriculture have been registered in a flood plain, in a cultural layer of a Neolithic settlement (about 5000 BP). There were also traces of considerable forest removal and agriculture in layers that relate to the middle of the Subboreal period (about 4000 BP), i.e. the time of the domination of deciduous forests. Archeological data allows us to connect this with the activity of Bronze Age people. Paleobotanical and archeological data indicate that there was developed agriculture and forest removal in the Iron Age. Traces of many fires in the soils and peats indicate that the dominance of pine forests in divides up to the second half of the 20th century may be the result of the repeating many times over the last 2000 years cycles of postfire forest renewal. The data, and the conclusions based on them, allow us to proceed to the spatial reconstruction of historic landscapes. It can be done using an expert-statistical model that is based on the connection between orographic and microclimatic features of a landscape and the natural vegetation cover and agricultural use of the territory. The analysis of connections between types of vegetation and orographic-climatic factors is done by statistical processing of modern remote sensing information. The connection between agricultural activity and these factors can be defined through an expert estimation and statistical analysis of the placement of archeological sites. Since the palynological data shows the structure of landscape types and their approximate correlation, there is a possibility to compose probabilistic landscape reconstructions.

Keywords: vegetation history, climate change, development of agriculture, spatial analysis.

SS35-O06 (561)

Environmental and cultural dynamics, recent development in study on natural background of prehistorical agriculture in Southeast China

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Accumulated evidence have already shown an overall development process of early rice farming in the middle and lower reaches of the Yangtze River (Wang et al., 2010a). Extensive studies including natural vegetation sequences, surface samples and Neolithic sites well demonstrated the relationship between environmental changes and human activates in the lake Taihu area (Shu et al., 2007; Wang et al., 2010b). Additionally, well-dated archaeological sedimentary microfossil records at Kuahuqiao

in Hangzhou, proposed an environmental context for the first rice cultivation at about 7750 cal. yr BP (Zong et al., 2007; Innes et al., 2009; Shu et al., 2010). It reveals that local woods dominated by oak (*Quercus*) and pine (*Pinus*) were targeted for burning before the start of rice agriculture (Shu et al., 2012). The initiation of agriculture is suggested to come with the establishment of more or less sedentary residences in the study area. Warming climate after the last glaciations is considered as a major factor that allowed the distribution of the wild rice northward. Food requirement and storage are another factor in initiating early rice farming, while the increasing population and climatic variation might greatly promote its development (Wang et al., 2010a). The global climate of the last 21,000 years exhibits dramatic climatic changes and abrupt events, which engendered a great control to the formation and afterward development of local agriculture. To explore the detailed interaction between the natural background and the prehistorical agriculture, a series of deep drill cores form some representative sites in Southeast China are under description for further studies. This project is supported by the Pilot Project of Knowledge Innovation, CAS (KZCX2-YW-155), and the CAS Strategic Priority Research Program (Grant No. XDA05120101).

Keywords: prehistorical agriculture, palaeoenvironment, Southeast China.

SS35-O07 (578)

30 000-year vegetation and climate change around the East China Sea Shelf inferred from a high resolution pollen record

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A high-resolution pollen record derived from DG9603 core reveals vegetation and climate changes on the East China Sea Shelf (ECSS) during the past 30 000 years. From 29.8 to 26.6 cal kyr BP, the ECSS was covered by warm temperate forest-steppe and wetland, indicating a relatively temperature and moist environment. During the period of 26.6 - 14.8 cal kyr BP (including the Last Glacial Maximum), wetland and temperate forest-steppe developed around the ECSS. From 14.8 - 5.3 cal kyr BP, sea-level continuously rose, and the ECSS was gradually submerged. In some exposed areas of the ECSS and low reaches of the Yangtze River, northern subtropical forest (with plants of *Quercus*-evergreen, *Castanopsis-Lithocarpus* and *Tsuga*) developed instead of temperate forest-steppe and wetland. Our pollen record shows that the rainfall and temperature increased continually during the period of 14.8 - 12.8 cal kyr BP. At the end of this period, subtropical forest expanded and even reached the level of "Holocene Optimum period" (early-mid Holocene). At the Younger Dryas period (12.8 - 11.1 cal kyr BP), a quick increase in the proportion of arboreal taxa especially *Quercus*-deciduous tree, and a slight decrease in *Quercus*-evergreen, *Tsuga* and herbs component indicates a mild climate with higher precipitation. From 11.1 to 5.3 cal kyr BP, the northern subtropical forest was widely distributed around the ECSS region, suggesting a relative warm and humid condition in the early Holocene. But subtropical forest component declines slightly and herbaceous taxa increase, reflecting a relatively drier and cooler climate during the period of 9.0 - 7.0 cal kyr BP. Since the past 5.3 cal kyr BP, forest vegetation in low reaches of the Yangtze River might be deforested severely, possibly caused by human activity.

Keywords: pollen record, vegetation and climate change, East China Sea, Last Glacial Maximum.

SS35-O08 (606)

Phytolith analysis for differentiating between foxtail millet (*Setaria italica*) and green foxtail (*Setaria viridis*)

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Foxtail millet (*Setaria italica*) is one of the oldest domesticated cereal crops in Eurasia, but identifying foxtail millets, especially in charred grains, and differentiating it from its wild ancestor, green foxtail (*Setaria viridis*), in the archaeobotanical remains, is still problematic. Phytolithic analysis provides a meaningful method for identifying this important crop. In this paper, the silicon structure patterns in the glumes, lemmas, and paleas from inflorescence bracts in 16 modern plants of foxtail millet and green foxtail from China and Europe are examined using light microscopy with phase-contrast and a microscopic interferometer. Our research shows that the silicon structure of ΩIII from upper lemmas and paleas in foxtail millet and green foxtail can be correspondingly divided into two groups. The size of ΩIII type phytolith of foxtail millet is bigger than that from green foxtail. Discriminant function analysis reveals that 78.4% of data on foxtail millet and 76.9% of data on green foxtail are correctly classified. This means certain morphotypes of phytoliths are relatively reliable tools for distinguishing foxtail millet from green foxtail. Our results also revealed that the husk phytolith morphologies of foxtail millets from China and Eastern Europe are markedly different from those from Western Europe. Our research gives a meaningful method of separating foxtail millet and green foxtail. The implications of these findings for understanding the history of foxtail millet domestication and cultivation in ancient civilizations are significant.

Keywords: foxtail millet, green foxtail, phytolith, domestication, plant origin.

SS35-O09 (474)

Contrasting human's role in Holocene vegetation history in the lower Yangtze River, east China and Aso Caldera, southwest Japan: evidence from pollen, phytolith and charcoal data

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The comparison of Holocene anthropogenic vegetation history among regions helps improve our understanding of the impact of early human cultures on landscape modification. Here, we present a comparative study aiming to reconstruct Holocene vegetation, fire and human activities from sediment archives using pollen, phytolith, and charcoal to explore whether different ancient subsistence systems, i.e. wetland rice (*Oryza*) cultures in east China and forest Jomon cultures in Japan, have similar or dissimilar imprints on vegetation. **China sites**: during the past decade, the lower reaches of the Yangtze River was identified as one of centers of rice cultivation where the

earliest rice remains were unearthed ca.11000 cal.yr BP. Our data show two strikingly different pollen sequences in the study areas. High proportions of Poaceae, aquatics (*Typha*, Cyperaceae) and low frequency of charcoal characterise pollen data from low coastal plains whereas dominance of arboreal taxa and high concentration of charcoal from inner basin-situated highlands. This contrasting pollen sequences reflects different human subsistence strategies of each culture when managing their local environment prior to commencing rice cultivation. For example, early cultivators may favor wetlands to prepare ground for direct labor-saving rice cultivation in the plains. By contrast, in the inner highlands, early humans must have practiced slash-and-burn to facilitate rice domestication. For instance, early humans began predominantly burning oak (*Quercus*) and pine (*Pinus*), starting ca.7750 cal.yr BP, which permitted the start of dedicated rice cultivation at Kuahuqiao (Shu et al., 2010; 2012). **Japan sites:** the largest present widespread semi-natural grassland in Aso Caldera, Kyushu in Japan has received much attention concerning its history (Miyabuchi and Sugiyama, 2006, 2008, 2012a, 2012b; Miyabuchi et al., 2012). Our work shows that deciduous and evergreen oak forests dominated inside the caldera throughout the Holocene with the exception of periodic expansions of deciduous oaks and increase of charcoal suggesting fire deforestation in the late Holocene. In contrast, Poaceae-dominated grasslands developed persistently during the Holocene probably resulting from long-term anthropogenic fire maintenance. In summary, the contrasting vegetation response to human impact is primarily attributed to different subsistence strategies, i.e. wetland rice cultures in east China and highland grassland/ forest cultures in Kyushu, southwest Japan. **Acknowledgement** The research is jointly funded by the National Science Foundation of China (no. 40901032) and the Japan Society for the Promotion of Science (no. P10102).

SS35-P01 (566)

Vegetation and fire history since the last glacial based on pollen and macroscopic charcoal records in the southern area of Mt. Yufu, northeast Kyushu, Japan

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Almost all parts of Japan climatically belong to the forest zone because of high precipitation. However, one of the largest grasslands of Japan exists in Kyushu. This grassland is "semi-natural grassland" which has been maintained by regular burning, mowing and grazing. An environmental reconstruction of north part of Kyushu has been conducted especially around the Aso caldera region where is famous for the extensive grassland, while it not yet in the Yufu area that also has large one. The aim of this study is to reconstruct the grassland and fire history in the southern area of Mt. Yufu. Sediment samples were collected from an outcrop located in southern area of Mt. Yufu. This outcrop is in the grassland that has maintained by burning. The sediment of this outcrop includes several tephra layer which are identified and dated, and is considered to cover at least for last 50,000 years. Charcoal fragments were detected before 50 ka but basically low values in before 12 cal ka. During the Holocene, macroscopic-charcoal fragments were abundant and herb pollen were predominately detected at most horizon. The period from 12 to 7.3 cal ka was characterized by dominance pollen of Umbelliferae and Gramineae indicating grassland vegetation. The amount of charcoal increased rapidly from 7.3 ka. This shows that fire event were more frequent around the site. After 7.3 cal ka, arboreal pollen such as *Salix*, *Acer* and *Quercus* subgen. *Lepidobalanus* increased, but relatively high percentages of herb pollen were appeared. These results suggest that grassland had been existed around the study site, and forest trees around the site or shrubs on the grassland were increased. Around historical period, Fire episode became most active. In this preriod, *Pinus* and *Cryptomeria*

pollen occurred indicating that secondary forests and plantation developed by human activities. These results demonstrated that the grassland vegetation established in southern area of Mt. Yufu in the early Holocene. Also, the continual fire has disturbed the vegetation and contributed to the establishment of the grassland in southern part of Mt. Yufu.

Keywords: palaeoenvironmental reconstruction, semi-natural grassland, herb pollen, human impact, Holocene.

SS35-P02 (368)

Palaeobiome changes in eastern Asia since 20 kaBP

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Global and regional changes of palaeovegetation have been well documented based on a pollen-biome assignment technique, the Biomisation. However the target period for large-scale palaeovegetation reconstruction was only focused on two time slices: the mid-Holocene (6000 14C year before present, aBP) and the Last Glacial Maximum (18,000 aBP). Dynamic changes of palaeobiome distribution at global and regional scales were so far few reported. Here we present a pollen-based numerical reconstruction of palaeobiome changes in eastern Asia (including China, Mongolia, southern Siberia of Russia, Kazakhstan, and Kyrgyzstan) since 20 ka BP. In total 272 pollen records were used and biome changes in 500 year interval were quantitatively reconstructed based on the Biomisation method. Modern biome reconstructions based on large-scale surface pollen records present a reasonable reflection of the latitudinal and altitudinal distributions of modern vegetation. During late Pleistocene most of forest biomes were displaced to the south, while some temperate, warm-temperate and tropical forest biomes were restricted or absent from the mainland of southeastern Asia, implying colder winters than present. Strong shifts of temperate shrubland, grassland and desert to the south and east in central Asia imply drier conditions than present. In early Holocene forest biomes were still distributed south to their present positions, but retreated in comparison with late Pleistocene. Temperate shrubland, grassland and desert were distributed in mosaic with forest biomes until ca. 8-9 ka BP. Since then forest biomes expanded their area and non-forest biomes shrank gradually, implying warmer and wetter climates. In the mid-Holocene forest biomes were shifted northward than present day. The forest-shrubland-grassland and grassland-desert boundaries were shifted westward than their present positions. Temperate xerophytic shrubland, temperate grassland and desert covered a large area on the Tibetan Plateau, but the area of tundra was reduced. Treeline was higher than present in Tibet. These changes imply generally warmer winters, longer growing seasons and greater moisture availability during the mid-Holocene. During late Holocene temperate shrubland and grassland expanded their areas in central Asia. Cool-temperate, temperate and warm-temperate forest biomes were gradually restored southward to their current positions. This implies a drier and colder climate since the mid-Holocene. Human disturbance has added strong impacts on forest reduction and grassland/shrubland expansion in eastern Asia during late Holocene.

Keywords: palaeobiome, palaeoclimate, biomisation, Holocene, LGM.

SS35-P03 (533)

Cultural dynamics in the context of climatic changes: A multidisciplinary case study for the Late Glacial and Final Palaeolithic from Northern Germany

Falko Turner[1], Johann Friedrich Tolksdorf[2], Finn Viehberg[3], Anja Schwarz[4], Ullrich von Bramann[4], Felix Bittmann[5], Knut Kaiser[6], Ulrich Staesche[7], Klaus Breest[7], Antje Schwalb[4], Stephan Veil[7]

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In contrast to younger periods, studies integrating archaeological and environmental records for the European Palaeolithic are still rare. Especially our knowledge about interactions between the drastic climatic/environmental changes and cultural developments during the Late Glacial is very limited. This multidisciplinary case study from the Elbe river system in lowland Germany combines high resolution palaeoenvironmental investigations with fine-scaled archaeological research on stratified and surface sites. Various dating methods (palynostratigraphy, radiocarbon- and OSL-dating) and analyses of environmental and climatological proxies (pollen and plant macro-remains, ostracods, diatoms and green algae) on river palaeochannel sediments allow detailed reconstruction of interactions between Late Glacial climate, vegetation and fluvial developments. Biostratigraphical analyses on stratified archaeological sites and dating of charcoal / bone fragments from artefact scatters place the Late Palaeolithic occupation of Early Federmesser groups in this environmental context. Thus the former production of hitherto unknown amber art (amongst others a figurine representing a moose) can be ascribed to the Older Dryas and Early Allerød, which are the periods of main Late Glacial geomorphic and vegetation transitions, most notably afforestation of the former long-time deforested landscape. Therewith our investigations suggest that Final Palaeolithic cultural changes may have been triggered by climatic and environmental transformations.

Keywords: NW-Europe, multiproxy palaeoenvironmental analyses, climate-vegetation-interactions, fluvial developments, amber art.

SS35-P04 (88)

A palynological study of environmental changes and their implications for prehistoric settlement in NE Romania

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Traditional agriculture has been an important centre of human development from 10,000 years before. It is clear that the major aspect in the formation of a Neolithic cultural landscape is agriculture as a crucial factor in human subsistence strategy. The main aim of our study is to understand the development of a prehistoric landscape as result of a co-evolution of cultural influence and environmental process. Two Neolithic sites from North-East Romania (an area largely covered by the Cucuteni culture) have been surveyed in order to define the edaphic factors, to characterise the ancient climatic conditions and soils, to identify the vegetal taxa and their evolution. Pollen analysis reveals past vegetation conditions, vegetation change and human impact in

investigated areas. Thus, taking into consideration our researches, it was possible to observe those prehistoric communities enjoys a productive environment, with traditional subsistence strategies, based on cereal cultivation and animal breeding. **Acknowledgements:** This work was supported by the CNCSIS-UEFISCSU, project number PN II-RU code T.E. 172/2010. Mihaela Danu has a postdoctoral fellowship (POSDRU/89/1.5/S/49944 project: "Developing the innovation capacity and improving the impact of research through post-doctoral programmes")

Keywords: Neolithic, North-East Romania, palynology, pedology, landscape archaeology.

SS35-P05 (605)

Phytolith evidence for rice cultivation and spread in Mid-Late Neolithic archaeological sites in central North China

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The history of rice (*Oryza sativa*) cultivation in North China is ambiguous owing to a lack of evidence from rice remains with precise ages in archaeological sites. In this paper, we present rice phytolith evidence from six archaeological sites in the Guanzhong Basin, central North China, dating from c. 5500 to 2100 cal. aBP (calibrated/ calendar ages) based on 19 AMS-dates. The phytoliths found in the three archaeological sites located on the second river terrace (Quanhu, Yangguanzhai and Anban) include three types of phytoliths from rice, namely bulliform, parallel-bilobe and double-peaked. These findings suggest that the earliest cultivated rice in central North China occurred not later than c. 5690 cal. aBP. After c. 5500 cal. aBP, the farming pattern in the Guanzhong Basin was characterized by dominant dry crops (e.g. millets) and locally cultivated rice. A likely spread route of rice from the lower reaches of the Huanghe (Yellow) River towards the Guanzhong Basin in central North China is speculated to have happened at c. 5690 cal. aBP. The findings of this study help us to understand the farming pattern in the area and how rice spread across the semi-arid regions of East Asia.

Keywords: rice phytolith, rice spread, rice-millet complex, Guanzhong Basin, North-central China.

SS35-P06 (575)

Phytolith evidence of millet agriculture during about 6000-2100 cal. aBP. in the Guanzhong Basin, China

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Foxtail millet (*Setaria italica*) and common millet (*Panicum miliaceum*) are vitally important food crops for people living in East Asia and even in the entire Eurasian continent prior to the popularity of rice and wheat. However, due to constrained methodology in millet identification and limited archaeological samples, the history of millet cultivation in the Guanzhong Basin, North China is still problematic. In this paper, we firstly analyzed the phytoliths from modern millets and rice husks (4 species respectively) to clarify the implications of crop phytolith quantity in archaeological samples by using nitric acid oxidative method (nitric acid to oxidize organic materials completely) and high temperature oxidative method (high temperature baking to oxidize organic materials completely). Then we identified millet and rice husk phytoliths from 47 archaeological samples in the Guanzhong Basin, including 18 samples from the Quanhu profile, 19 samples from the Yangguanzhai profile, and 10 pit samples from Quanhu, Yangguanzhai, Huxizhuang, Anban, Wangjiazui and Shuigou sites, based on a newly method of distinguishing common millet and foxtail millet which was developed recently by Lu *et al*., 2009. The analysis of modern crop husk phytoliths reveals that the same weight of common millet and foxtail millet yield almost the same amount of phytoliths. The quantity of these husk phytoliths reflects the relative production of the two millets, rather than the quantity of individual grains collected by the flotation method. We consider that the quantity of foxtail millet grains concentrated by the flotation should be divided by 3 or more which can substantially reflect the relatively real production of the two millets in the archaeological samples. Moreover, the percentage of double peaked phytolith of rice husk may underestimate the actual quantity of rice. All 47 archaeological samples with 17 ^{14}C age data from Quanhu, Yangguanzhai, Huxizhuang, Anban, Wangjiazui and Shuigou sites indicate that the percentage of common millet is always much higher (3.4~34.5%) than that of foxtail millet (0~6.2%) from ca. 6000~2100 cal. aBP. Even in the relative warm-wet phase, the output of common millets is still higher than that of foxtail millet. Rice may be locally cultivated in Quanhu, Yangguanzhai, Huxizhuang, and Anban sites. These results provide pieces of new evidence to evaluate the relationship in different agricultural patterns, socio-economic mode and climate changes in the Guanzhong Basin during Neolithic epoch.

Keywords: phytolith, foxtail millet, green foxtail, rice, Guanzhong Basin.

SS35-P07 (470)

Vegetation change and anthropogenic influence during the past 2000 years in the Appi Highland, Northern Tohoku, Japan

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We describe vegetation change and anthropogenic influence in the Appi Highland during the past 2000 years based on pollen and charcoal analyses by using a core from a small pond surrounded by cool temperate broad-leaved forests composed mainly of *Fagus crenata*, *Quercus crispula*, and *Betula maximowicziana*. The core is composed of organic clay with plant remains of leaves and seeds of *F. crenata.* The age-depth relationship of the core was determined by linear interpolation of the six calibrated radiocarbon dates and the age of the Towada-a tephra (To-a: AD 915). From the pollen assemblage, *Fagus* forests widely covered this area between ca. AD 80-900. Then the development of riparian trees, such as *Pterocarya* and *Juglans*, with *Fagus* indicated the expansion of a humid environment after the fall of the To-a tephra. Expansion of *Betula* and herb species, such as *Artemisia* and Gramineae, corresponded to an increase in fire frequency, indicated by the high content of macroscopic charcoal fragments from ca. AD 1550. It is thought that grass vegetation in the Appi Highland developed from ca. AD 1600 by prescribed burning to keep horses. Thus,

frequent fire is considered to be due to anthropogenic activity for the maintenance of grassland for horse keeping. *Betula* forests widely developed and *Fagus* forests declined between ca. AD 1700-1950, indicative of strong anthropogenic activity in the Appi Highland. Increases in *Fagus* and *Quercus* and decreases in *Betula* since ca. AD 1950 reflect a decline in anthropogenic disturbance and the development of secondary forests in the Appi Highland.

Keywords: pollen, macroscopic charcoal, *Fagus crenata*, *Betula*, horse keeping.

SS35-P08 (38)

Correlation of vegetation, climatic, and archeological events in the Western Sayan Mountains according to pollen data from the mire Lugovoe (Southern Siberia, Russia)

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Changes of vegetation and climate on the Western Sayan Mountains (Southern Siberia) and in surrounding plains located in the middle of Eurasian continent (Russia) since 6000 yr BP have been reconstructed on the base of spore-pollen analyses and radiocarbon dates from mire Lugovoe. This data have been correlated with data about development of archeological cultures in this region as well as with published palaeoclimatic reconstructions for forest-steppe zone of Western Siberia. Three stages in the development of vegetation (*Abies*, *Betula*, and *Pinus*) have been revealed in the pollen diagram Lugovoe. The first penetration of ancient hunting-fishing tribes of people into this area happened during the "*Abies* stage" in the development of vegetation. Bronze Age archaeological cultures practiced agriculture and cattle-breeding mostly during the "*Betula* stage". Blooming of archaeological cultures of Iron Age started on the back ground of expanding of *Pinus sylvestris* forests. According to archeological data the origin of all local cultures in studied area of southern Siberia was connected with migrations of people from the southwestern and southeastern areas of Eurasia. By correlation of palaeoecological and archelogical data for south of central Siberia we concluded that one of the important reason of these migrations were dry climatic intervals of the global climatic rhythms, which influenced especially strongly the more southerly areas from where the ancient tribes migrated to Siberia.

Keywords: pollen data, archaeology, climatic change.

SS35-P09 (6)

Late Holocene Older Kurosuna (black humus sand) Event and ecosystem change in Japan

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Many late Jomon artifacts were found from the middle part of the Older Kurosuna, characteristic black humus sand, corresponds to the Middle Member of the Holocene Dekijima Formation at the Kamita site in the southern part of the Shichirinagahama, west coast region of Tsugaru district, Aomori prefecture. The lowermost and upper layers of the Older Kurosuna were dated back to 4260

yr BP and 2395 yr BP by AMS radiocarbon dating. Older Kurosuna contains many macrofossils and microfossils. Fossil wood, seeds and fruits and pollen indicates a formation of deciduous broad-leaved forest dominated by *Quercus* subgen. *Lepidobalanus* and *Fagus crenata* during the time of the Older Kurosuna. At the Kamita archaeological site, the pollen assemblage showed *Aesculus turbinata* became increase around 4260 yr BP, and the *Aesculus turbinata* forest was formed about 4025 yr BP. It seems that the vegetation changes related to the climatic deterioration in the middle-late Jomon period. An expansion phenomenon of *Aesculus turbinata* corresponded with that at the Sannai-maruyama site and Ohyazawa-noda site in the Aomori plain. This fact showed an expansion of *Aesculus turbinata* occurred in a wide area in the northern Tohoku district, Japan.

Keywords: Jomon period, black humus sand, climatic deterioration, pollen analysis, *Aesculus turbinata*.

SS35-P10 (471)

Late Holocene human impact on vegetation changes around Beppu Bay in northeast Kyushu, southwest Japan based on the influx pollen data dated by a wiggle-matching

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Vegetation changes in the late Holocene are recognized as results of human activities in many cases. However, detailed age control for the upper part of sediment is difficult, because of disturbance of sediment, changes of sedimentation rate, and other factor. We have taken marine cores from deepest sites in Beppu Bay in northeast Kyushu, southwest Japan. Forty-two AMS ^{14}C dates from bivalve mollusk shells were used to construct a wiggle-matching –based age-depth model for the late Holocene sequence in these cores (Kuwae *et al*, in review). Pollen and charcoal analyses were carried out on the core with high-resolution age control by the wiggle-matching. Results of these analyses indicated that vegetation composition around Beppu Bay changed and biomass reduced extensively by human activities in 700 years BP (AD.1250) as follows. The forests around Beppu Bay were dominated by evergreen broad-leaved trees such as *Qercus* subgen. *Cyclobalanopsis* and *Castanopsis* before 1150 years BP (AD.800). After this age, the pollen record indicates that *Pinus densiflora* increased following decrease of *Quercus* subgen. *Cyclobalanopsis* trees. After 700 years BP (AD.1250), the pollen influx of arboreal trees decreased remarkably, but the influx of *Pinus* subgen. *Diploxylon* did not decrease extensively. These suggest that biomass around Beppu Bay reduced markedly, and *Pinus densiflora* trees expanded into an open landscape due to deforestation. Besides, *Pinus densiflora* secondary forests remarkably expanded from 200 years BP (AD.1750). *Cryptomeria* pollen increased markedly with development of artificial forest of Japanese cedar after 150 years BP (AD.1800) around Beppu Bay. According to herbaceous pollen and macroscopic charcoal, the grassland was established by regular burning at least after 700 years BP (AD.1250). The decrease of *Quercus* subgen. *Cyclobalanopsis* and the increase of *Pinus densiflora* corresponded to the population increase of northern Kyushu indicated on historical documents. This suggests that the population increase accelerated destruction of original forests, expansion of *Pinus densiflora*

forests, and land development.

Keywords: human impact on vegetation, influx pollen data, wiggle-matching, late Holocene, macroscopic charcoal.

SS35-P11 (613)
Land degradation during the Bronze Age in Hexi Corridor (Gansu, China)

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The rise and fall of ancient societies and its connection with the past environmental variations are frequently reported and well concerned in recent studies. That is probably important for understanding the potential trend of the environment change and providing develops strategies for modern societies against the climate changes. Hexi Corridor (E106°20-108°45′N35°15-37°10′), which located in west Gansu between Mahanshan mountain and the desert of East Xinjiang, is well known as the main path of the ancient Silk Road, and it is a most important east-west communicated route via oasis scattering in the long and narrow desert between Qilian Mountain and Mongolia highland. A large amount of cultural remains from the Neolithic period to Bronze Age have survived in the Hexi Corridor, providing an integrated sequence of prehistory cultures and abundant research materials for the study of bio-archeological and paleo-global changes. Updated pollen and charcoal analysis along with high resolution AMS^{14}C data of two sections of different stage illuminate the process of the settlements development of Bronze Age in Hexi Corridor. The evidences show that land degradation is the prevalent cause of decrease of the agricultural activities and the settlement abandon. Agriculture induced Soil fertility loess and land salinization contributed to the process of the land degradation. But the increasing climate aridity during the 4000-3500 cal a BP is the most likely the main reason of the shrinking of arable land and vegetation degradation in Hexi corridor. And those further cause the decrease of the agricultural activities and collapse of the Bronze Age societies in Hexi corridor.

Keywords: environmental variations, pollen, charcoal, agricultural activities, land salinization.

SS35-P12 (309)
Pollen morphology of cereals and associated wild relatives: reassessing potentials in tracing agriculture history and limitations

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Many attentions have been paid to agriculture history based on cereal pollen and phytolith records. In connection with Poaceae pollen identification, it's still a big challenge to explicitly distinguish cereals from wild relatives, which arises a problem in interpreting pollen signals with respect to agriculture activities (e.g. rice domestication). Some researchers have reported diagnostic keys to Poaceae pollen using light microscope and scanning electron microscope, particularly for those

cereals associated with human activities. However, mono-apertural Poaceae pollen shows no diversity in morphology, so pollen grain size and frequency have been widely used as important criteria in grouping Quaternary dispersed Poaceae pollen types regardless of overlaps in size. We propose biometrics coupled with morphological traits (such as ornamentation pattern) to refine pollen information as aids in determinating dispersed pollen types. Nevertheless limitations of morphological characters render it difficult to distinguish cereal pollen from wild relatives. Therefore statistics based on biometric data may reduce bias in pollen determination for those types with morphological similarities.

Keywords: Poaceae, pollen morphology, cereals, wild relatives, agriculture history.