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Editorial

The Quaternary of Europe and Adjacent Areas: Stratigraphical Perspectives and Tools for Correlations – SEQS-2019

1. Introduction

This Special Issue of Quaternary International present the results of research spanning the bow from marine over brackish to terrestrial environments. It offers palaeoclimate studies from England to the Caucasus and from Kola Peninsula to Mongolia and Turkey. Palaeozoological and palaeobotanical evidence is presented over vast parts of the Eurasian continents. This broad approach and picture of Quaternary Science is the scope and focus of the Section of European Quaternary Stratigraphy (SEQS) in the framework of the Stratigraphy and Geochronology Commission (SACCOM) of INQUA.

The Board of SEQS is very happy to present these papers to the Quaternary community and hopes to continue with this fascinating scientific networking and exchange about the story of geological processes, life, environment and climate in Europe and adjacent Asia. Numerous stratigraphical records and profiles were presented and discussed in the field during the last INQUA-SEQS meetings in Armenia (2016), France (2017) and Slovenia (2018). The excursions focussed on continental areas, like mountain belts and their forelands, and on caves which store unique archives of past living environments in erosional areas. The INQUA congress in Dublin (2019) was the opportunity to summarise, display and now publish the scientific works presented during the past years on SEQS meetings.

Across-Europe stratigraphical correlations is the first step for a full understanding of environmental changes in Europe during the Quaternary. However, the fragmentary nature of the stratigraphical records and the problems related to reliable dating techniques make correlations in terrestrial Quaternary systems problematic. The stratigraphical records involve integration of multiple proxies from a wide variety of terrestrial sediments and their correlation with the marine isotopic record. A geographical-based summary of the main litho-, bio-, pedo-, morpho- and chrono-stratigraphical data, such as the INQUA-SACCOM International Focus Group 1612F "SEQS-DATESTRA" databases, are fundamental for cross-border correlations, Quaternary mapping, climate changes reconstructions and natural hazards and related risks assessment. During the session, new data, correlation of proxies in time and space, and new methods and techniques for data comparisons, synthesis, mapping and sharing have been discussed.

A considerable part of the contributions to the Session "The Quaternary of Europe: Stratigraphical perspectives and tools for correlations" were presented under the umbrella of the SEQS-DATESTRA Project. Around hundred participants joined the sessions, organized by Markus Fiebig, Guzel Danukalova and Pierluigi Pieruccini.

In total, 28 talks and posters were presented by researchers from Austria, Italy, Ukraine, Russia, Germany, France, Lithuania, Netherlands, Poland, United Kingdom and Slovenia, all focussing on Quaternary Stratigraphy from all over the Eurasian continent (Fig. 1).

2. Order and grouping of articles

The contributions to the Special Issue focus on two main topics: a) Stratigraphy and multi-proxies records from the European Regions and b) palaeontological (mainly) settings in Europe and their adjacent areas. All the contributions are also related the activities of the INQUA Funded International Focus Group SEQS-DATESTRA (SACCOM IFG 1612F), providing overviews and summary of information from Quaternary Terrestrial Stratigraphical key-sites from different European regions and adjacent territories.

2.1. Stratigraphy and multi-proxy records from the European Regions

Zupan Hajna et al. (2021, this volume) presented data of a long Pliocene to Holocene chronostratigraphical and paleoenvironmental record from the succession infilling the Račiška Pečina cave (SW Slovenia), which is one of the best-preserved cave records for the last 3.4 Ma. The succession includes several boundaries constrained by magnetostratigraphy; for instance, the Pliocene-Pleistocene and Matuyama-Brunhes boundaries and the Olduvai subchron. Furthermore, small and large mammal fauna, reptile and molluscs, dated by means of different geochronological methods, depict climatic changes and environmental signals.

A new interpretation of the Interglacial Ipswichian Stage deposits of Lincoln Cap in Eastern England is provided by (Gibbard et al., 2021, this volume). This research provides a re-assessment of the River Trent-Witham terrace sequence and attribute the Southrey Terrace deposits to the Middle Devensian (=Weichselian) rather than to the Late Wolstonian (=Saalian). The revision and the new correlation indicate that glaciation of the region did not occur in the Middle Wolstonian (MIS 8) but during Late Wolstonian (MIS 6) Substage.

The presence of a climate anomaly during the Eemian Interglacial (MIS 5e) is discussed by Hrynowiecka et al. (2021, this volume) on the base of the palaeobotanical analysis of the Beckentin profile (NE Germany).

The chironomid and pollen records of Lieporiai palaeolake feed the assessment the climate variability during the Lateglacial and Early Holocene in Northern Lithuania (Šeirienė et al., 2021, this volume). The study suggests that lacustrine sedimentation started at about 14600 cal yrs BP and lasted until the Early Holocene. The data allowed the

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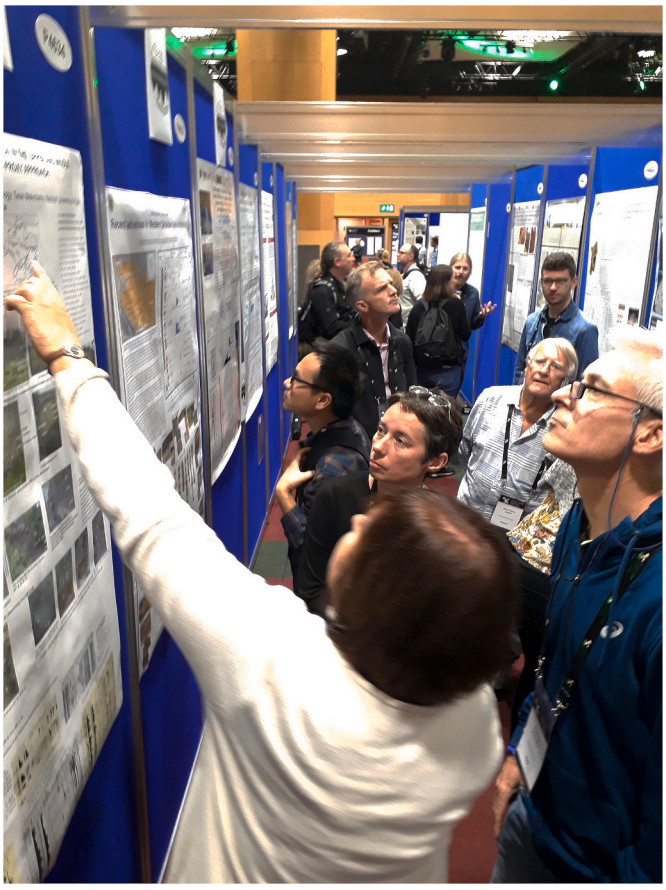

Fig. 1. Presentation of poster at the SEQS poster session during the INQUA Congress in Dublin (Ireland), on the July 30, 2019. Personal discussions are the most valuable key to scientific exchange and scientific progress (Photo by G. Danukalova).

assessment of the mean July air temperature for the time-span under study. The pattern of the temperatures during the Lateglacial is then correlated and discussed following other chironomid based regional and European reconstructions.

Woronko et al. (2021, this volume) investigated the borehole Udryn PIG-1 (north-eastern Poland) contain relict permafrost features at depths between +450 and 357 m. The analysis of sands indicates physical and chemical weathering of the relict-permafrost. In fact, the weathering of quartz grains is not just a near-surface phenomenon, but also occurs deep below Earth's surface. These data expand the known effective realm of sand-grains weathering.

Markova et al. (2021, this volume) presents a research based on the small mammal and freshwater mollusc record from the fluvial deposits of VI terrace of Dniester River (Levada section, Moldova, Transnistria), allowing their attribution to the Middle Pleistocene. The Levada fauna indicates interglacial climate conditions better constrained as Mediterranean-like by the freshwater molluscs' assemblages.

Pleistocene sections in the middle reaches of the Volga River (Spasskoe and Yagodnoe) are described and discussed by Svitoch et al. (2021, this volume). The Authors focus on the small mammals concluding that the successions can be attributed to the beginning of the Late Pleistocene (the early stages of the Valday glaciation) and that periglacial steppe was the predominant environment in the Volga middle reach.

Korsakova (2021, this volume) summarized data on litho- and bio-stratigraphy of the key sedimentological successions of the coastal and inner parts of the Kola Peninsula, geochronologically constrained to the Late Pleistocene and Holocene. Three marine and two glacial events have been assessed for the Late Pleistocene sequences. The first marine transgression is correlated with warm-water Boreal transgression in northern Eurasia (MIS 5e–d in the White Sea and MIS 5 e–c in the Barents See depressions). A second marine episode is correlated to Belomorian transgression (MIS 5a) and a third marine episode is correlated to MIS 3. The existence of a periglacial freshwater lake, a brackish-water basin and a marine reservoir in the White Sea depression during Late Glacial and Holocene is also highlighted. For each episode palaeoenvironmental data are provided based on pollen and faunal data.

An overview of the Late Pleistocene and Holocene stratigraphy palaeoenvironmental settings of the southeastern shelf and coastal land of the White Sea region is provided by Zaretskaya et al. (2021, this volume). The Authors perform a review of the published data integrated with new results, correlating marine and terrestrial archives.

Late Middle Pleistocene interglacial sediments from the northern part of European Russia and Western Siberia are discussed by Astakhov and Semionova (2021, this volume). Two phases of saline Atlantic water ingression within northern Russia during the last 250 ky is demonstrated by the integration of litho-stratigraphy, chrono-stratigraphy and bio-stratigraphy, suggesting that such sedimentary record can serve as stratigraphic marker for the penultimate interglacial in the Region.

2.2. *Palaeontological (mainly) settings in Europe and their adjacent areas*

The Middle Pleistocene – Late Pleistocene transition of European large mammal's fauna (Proboscidea, Artiodactyla, Perissodactyla, Carnivora, *Hystrix* and *Castor*) assemblages is presented by Puzachenko et al. (2021, this volume). Their study is based on the data yielded from numerous palaeontological sites dated between Middle and Late Pleistocene (MIS 6–4). The Authors present descriptive models, based on biodiversity parameters, for the evolution of the faunal assemblages and assessed a common model for the changes occurred to the large mammals' fauna composition in Europe as well as the distribution of individual species and their groups within different Regions.

Stefaniak et al. (2021, this volume) present an interdisciplinary study of the diet of Middle and Late Pleistocene glacial and interglacial forest rhinoceros and woolly rhinoceros from Eurasia. The results of the study indicate that woolly rhinos in both Europe and Asia (Siberia) were mainly grazers, although according to the season and to the geography their diet was also integrated by leaves of shrubs and trees. In contrast, forest rhinoceros were browsers, though its diet included low-growing vegetation. The different diets of both rhinoceros are related not only the different habitats but also to Late Pleistocene climate changes.

A review on the Pleistocene lion *Panthera spelaea* (Goldfuss, 1810) from 18 open-air and 42 cave sites dated in the range 750–28 ka in southern Poland (Silesia) and neighbouring areas is made by (Marciszak et al., 2021, this volume). The extinction of *P. spelaea* is broadly correlated with the general collapse of the "mammoth steppe" ecosystem due to multiple reasons like climatic changes, re-building of herbivore guilds, competition and human pressure.

Ridush et al. (2021, this volume) provides a review of the Quaternary megafauna from collections stored at Kaniv Nature Reserve and the National Museum of Natural History of the National Academy of Sciences of Ukraine. Most of the bones were collected from the Dnieper alluvial successions during the Kaniv hydroelectric power plant building. Based on the species composition of proboscideans, part of the faunal assemblage can be correlated to the end of the Middle Pleistocene (Dnieper Stage = Saale, Warta, MIS 6) whereas other part might be correlated to the Late Pleistocene and/or Holocene.

Markova and Puzachenko (2021, this volume) presented new data and a review of existing data of the European small mammal faunas dated to the penultimate glaciation (Middle Pleistocene, Dnieper Glaciation) and the transition to the Mikulino Interglacial (Late Pleistocene, Eemian). The paper aims to estimate general trends for the small mammal fauna distribution, from individual species to regional faunal complexes. The results show how small mammals reacted to the Glacial/Interglacial transition similarly to the Late Pleistocene

"Mammuthus–Coelodonta Faunal Complex" response to the Late Pleistocene/Holocene warming, though with a lesser loss of the species richness.

The enamel characteristics of fossil and modern first lower molars of the European water vole of the Perm Pre-Urals was investigated by Fadeeva et al. (2021, this volume). This study aimed to determine the applicability of these parameters in regional biostratigraphic reconstruction. The scientists discovered that samples from the Last Interglacial (Mikulino) successions had the highest mean values of enamel differentiation coefficient (91.5–94.8), while samples from the end of the Bryansk Interstadial, the Late Glacial, and the Early Holocene deposits had the lowest (76.3–84.9).

The fossil terrestrial molluscs from Obishir-V, the eponymic Obishirian site in southern Kyrgyzstan, were used to test the hypothesis that the increasing human activity during Early Holocene in Fergana Valley and surrounding lands was driven by climate change, in particular alternating warm and/or wet periods (Osipova et al., 2021). The taxonomic composition of the mollusc assemblages indicates the preferences of temperature and humidity conditions as well as the habitats characteristics and palaeolandscapes and vegetation almost unchanged. In fact, mollusc assemblages reveal constant dry and warm conditions and stable steppe-like vegetation. Therefore, the Authors suggest that the main driving factor for the rapid demographic change during the Pleistocene–Holocene turnover in Central Asia was not mainly related to climate but to other factors such as i.e., cultural affinity.

A review of the palaeoenvironmental and climatic changes during the Late Glacial and Holocene in the Mongolia and Baikal region is provided by Khenzykhenova et al. (2021, this volume). Multi-proxies from lacustrine sediments provide evidence of past lake levels and vegetation dynamics on the watersheds. Palaeontological data from terrestrial deposits indicate a mosaic landscape and a temperate warm and humid climate during the Late Glacial and Holocene, with some regional variability. The end of the Pleistocene is marked by the mass extinction of the Mammoth faunistic complex together with a decrease of the number of tundra species and their migration to the north whereas arid animal species migrated to the south. During the Holocene, the four vegetation types (steppe, forest, taiga, and desert) did not show strong changes, but their ratio and spatial distribution changed. Steppe landscapes were replaced by desert steppes during the arid phases whereas taiga forest expanded during the wet phases, although the steppe landscapes was still dominant in the studied territory.

The paper by Simakova et al. (2021, this volume) presents new data on brackish-water Pliocene and Early Pleistocene deposits from Demirkent (Kars) and Pekecik (Erzurum), NE Turkey. The chronology was assessed by correlation of associations of molluscs, small mammals, palynological spectra, including dinocysts and algae, and magnetostratigraphy. Caspian-type dinocysts in NE Turkey are markers of deep inland ingression of the Akchagylian brackish-water basin during the Early Pleistocene. The topographic position of the Akchagylian brackish-water deposits allowed the estimation of the magnitudes and average rates of Quaternary uplift of the western Lesser Caucasus of ca. 0.6–0.7 mm per year during the last 2.6 Ma.

Findings of shells of molluscs, an indicator of the Akchagylian basin, in the sediments of the homoclinal Qusar Plateau at an elevation up to 2020 m are used by Trikhunkov et al. (2021, this volume) to estimate the rate of the Quaternary uplift in the South-Eastern Caucasus and a correlation with previous studies in Transcaucasia.

3. Conclusion

Field work, field excursions and real-life meetings are mandatory for real progresses in Earth Science. Modelling is important but it is not possible to model the content of the archives in Earth history. Field evidence is (and will be in the future!) the basis for any valuable geoscience-based approach. Also, the discussion of results is much more valuable when approached in the original context, that is the landscape, where we can fully recognise the context of scientific findings. So, if we want to gain further scientific progress in the future, we have to find ways to continue with real-life solutions instead of virtual replacement of scientific activity.

Studying the archives of the past, we can study ecosystems and their relationships with climate, landscape evolution and populations that are still too complex to be fully understood. So, we must be very careful in our modern interventions into the systems of life on the planet. In most cases we are still unable to manage relationships between different species under a holistic perspective. As the functioning of the Earth (eco) systems is the base for our own life, we should not perform "try and error" management, especially not, when we assume simplistic linear assumptions about relationships between different species and focus on our own advantage in the frame of ecosystem services. Earth scientists should stand up for an ethically behaviour of mankind which treats and investigates the long term (Millions of years) connections of species among themselves and with their living environments with respect, mindfulness and caution instead of profit-based exploitation and annihilation of natural resources and diversity. This is true for all parts of life from microorganisms up to the realm of plants and mammals.

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