

The Quaternary System and its Formal Subdivision

On the problems of correlating the Pleistocene glacial deposits in Russian Altai with Siberian stratigraphic scales

A. R. Agatova¹, R. K. Nepop¹, H. Rodnight²

¹Institute of Geology and Mineralogy, Russia, 630090 Novosibirsk, Ak. Koptjuga av., 3, +7(383)3308363, agatr@mail.ru

²Institute for Geology and Palaeontology, University of Innsbruck, Austria, helena_rodnight@hotmail.com

Analysis of obtained TL, IRSL and ¹⁴C dates for the Pleistocene glacial deposits from the Chagan section (Russian Altai) and previously published dates demonstrates the considerable complexity of absolute dating of such sediments. These results cast doubt on available depositional correlation schemes for the Russian Altai and Siberia based on TL dating.

Keywords: Pleistocene, glacial sedimentation, TL; IRSL, radiocarbon dating, Russian Altai.

The Anthropocene: a geomorphological and sedimentary view

Antony G. Brown¹, members of the British Society for Geomorphology (BSG) Working party on The Anthropocene

¹Palaeoenvironmental Laboratory University of Southampton, Highfields Campus, Southampton, SO17 1BJ, UK

The ‘Anthropocene’, as used to describe the interval of recent Earth history during which humans have had an ‘overwhelming’ effect on the Earth system, is now being formally considered as a possible new geological Epoch. Such a new geological time interval (possibly equivalent to the Pleistocene Epoch) requires both theoretical justification as well as empirical evidence preserved within the geological record. Since the geological record is driven by geomorphological processes, geomorphology has to be an integral part of this consideration given that it is Earth surface processes that produce terrestrial and near-shore stratigraphy. This paper sets a priori considerations concerning the possible formalisation of the Anthropocene from a geomorphological perspective, including the recognition of human dominance in sedimentary transport systems, the boundary problem and the spatial diachrony of ‘anthropogenic geomorphology’.

Keywords: earth surface processes, sediment transport, fluvial geomorphology, alluviation.

The Valle di Manche section (Calabria, Southern Italy): a candidate section for the GSSP of the Ionian Stage (Middle Pleistocene Subseries)

**Luca Capraro^{1*}, Gian Battista Vai², Jan Backman³, James E.T. Channell⁴,
Francesco Massari¹, Domenico Rio¹, Daniele Scarponi², Maria Sgavetti⁵, Fabio Tateo⁶**

¹Department of Geosciences, University of Padova, Via G. Gradenigo 6, I-35131 Padova (Italy)

²Department of Biological, Geological and Environmental Sciences, University of Bologna,
Via Selmi 3, I-40126 Bologna (Italy)

³Department of Geological Sciences, Stockholm University, Svante Arrhenius Väg 8, S-10691 Stockholm (Sweden)

⁴Department of Geological Sciences, University of Florida, P.O. Box 112120, Gainesville, Florida (USA)

⁵Department of Physics and Earth Sciences, Parco Area delle Scienze 7/A, I-43124 Parma (Italy)

⁶IGG-CNR, Department of Geosciences, University of Padova, Via G. Gradenigo 6, I-35131 Padova (Italy)

* Corresponding Author: luca.capraro@unipd.it, Phone: +39-049-8279182, Fax: +39-049-8279134

We present the key features of the Valle di Manche section (Calabria, Southern Italy) and discuss the pros and cons of this stratigraphic succession as the candidate section for the GSSP of the Ionian Stage (Middle Pleistocene Subseries).

Keywords: Middle Pleistocene, GSSP, Southern Italy.

The ‘Anthropocene’ and the Present is the Key to the Past

K. M. Cohen^{1, 2, 3}

¹ Utrecht University, Dept. of Physical Geography, P.O. Box 80.115, 3508 TC, Utrecht, The Netherlands
+31 30 2535774, k.m.cohen@uu.nl

² TNO Geological Survey of the Netherlands, Princetonlaan 6, Utrecht, Netherlands

³ Deltares Research Institute, Dept. of Applied Geology and Geophysics, Princetonlaan 6, Utrecht, Netherlands

With this abstract I want to share my thinking on the coming into existence of the ‘Anthropocene’ as to-be-formalised chronostratigraphical terminology. I present and frame my preferred meaning for it, and my preferred slotting: as an uppermost unit in the Holocene Series, following the Late Holocene. The Anthropocene is more or less synonym to ‘the present’ and ‘the now’ in modern earth science. It covers the time when observant scientists were around and from which we have more than geology alone to base earth scientific records on (the age of measurement). This happens to coincide with humans becoming a geological factor, mostly because mankind discovered what it could do with geology: change the earth. In that vein, I opt to link the base of the Anthropocene with the appearance of Lyell’s catchphrase ‘The Present is the Key to the Past’ in literature at 1830 AD. Defining the exact beginning of the ‘Anthropocene’ is an arbitrary matter and more or less the same as defining the Present. Linking the definition to Lyell’s key principle makes a point and has benefits.

Keywords: Anthropocene, GSSA, Charles Lyell, Industrial Revolution, Enlightenment, modern Earth Sciences.

The transgressive Early-Middle Holocene boundary – the case for a GSSP at Rotterdam, Rhine Delta, North Sea Basin

K. M. Cohen^{1, 2, 3}, M. P. Hijma³

¹ Utrecht University, Dept. of Physical Geography, P.O. Box 80.115, 3508 TC, Utrecht, The Netherlands
+31 30 2535774, k.m.cohen@uu.nl

² TNO Geological Survey of the Netherlands, Princetonlaan 6, Utrecht, Netherlands

³ Deltares Research Institute, Dept. of Applied Geology and Geophysics, Princetonlaan 6, Utrecht, Netherlands

Postglacial sea level rise was ongoing at the start of the Holocene, drowning continental shelves all around the world. By the time of the Early-Middle Holocene transition deltas and other coastal systems began stabilizing their positions – and these have since been maintained. The last major accelerated sea level rise occurred between 8.5 and 8.2 ka BP, due to the largest single-source meltwater-pulse released from the thawing Laurentian ice sheet in the Hudson Bay area. This event left a marked transgressive impact on sedimentary sequences of river mouths around the world, exemplified in most excessive detail in the Rhine delta (North Sea, The Netherlands), from boreholes and underground exposures in the city of Rotterdam and its mega-harbour.

What ended as the 8.2 climatic event began as freshwater release ~8.45 ago: it is an 8.5-8.2 event. Rather than the temporary, globally highly variant, and sedimentary indirect and often insignificant registration of the climatic 8.2-event, the sea-level imprint from the freshwater release was permanent, circum-oceanic, predictably spatially variant and of direct impact to sedimentation on either side of the migrating coastline. Consequently, it left lithostratigraphical and environmental event-boundaries in coastal sequences around the world, in the zone where Holocene accumulations are thickest and functional subdivision is most important architecturally. This is reason

to consider the sea-level signal of the 8.5-8.2 event as the beginning of the Middle Holocene, and not the somewhat later 8.2 cold spell maximum over Greenland, as is the current proposal. In that vein, the transgressive contact found at the base of the Rhine delta at Rotterdam is presented as a potential GSSP (8450 ± 44 cal BP).

Keywords: Transgressive surface, Transgressive Systems Tract, Sequence Stratigraphy, Chronostratigraphy, Holocene Sea-level Rise, ¹⁴C Dating, palaeogeography, Estuary, Delta, Sedimentology, GSSP.

Clastic cave sediments and speleogenesis of the Buraca Escura archaeological site (western-central Portugal)

Luca Antonio Dimuccio^{1,2*}, Jorge Dinis^{2,3}, Thierry Aubry⁴, Lúcio Cunha¹

¹CEGOT - Centro de Estudos em Geografia e Ordenamento do Território & Departamento de Geografia, Faculdade de Letras, Universidade de Coimbra, Praça da Porta Férrea, 3004-530, Coimbra, Portugal

²Departamento de Ciências da Terra, Faculdade de Ciências e Tecnologia, Universidade de Coimbra, Largo Marquês de Pombal, 3000-272 Coimbra, Portugal

³IMAR-CMA, Centro do Mar e do Ambiente, Universidade de Coimbra, 3004-517 Coimbra, Portugal

⁴Fundação Côa Parque, Rua do Museu, 5150-610 Vila Nova de Foz Côa, Portugal

*Corresponding author: Tel.: +351 965499004; Fax: +351 239836733; luca@ci.uc.pt

New geomorphological and structural cave survey, as well as sedimentological/stratigraphic analysis of clastic cave sediments and local post-Jurassic siliciclastic covers, was performed at Buraca Escura archaeological site (Poio Novo valley, Sicó Massif, western-central Portugal). An approach to provenance and endokarstic transport was attempted by examination of clastic cave sediments and comparison with new and published data on the siliciclastic regional covers. Speleogenesis framework, beginning during the Late Cretaceous-Miocene, is determined.

Keywords: Clastic cave sediments, Speleogenesis, Paragenesis, Alluviation, Middle and Upper Palaeolithic.

It's Time to Revitalize the Tertiary

Lucy E. Edwards^{1*}, Randall C. Orndorff¹, Martin J. Head², Robert A. Fensome³

¹U.S. Geological Survey, 926A National Center, Reston, VA, 20192 U.S.A. *leedward@usgs.gov

²Department of Earth Sciences, Brock University, 500 Glenridge Avenue, St. Catharines, Ontario L2S 3A1, CANADA

³Natural Resources Canada, P.O. Box 1006, Dartmouth, NS Canada B2Y 4A2

Tertiary, Paleogene, and Neogene are all useful terms. In the interest of practicality, all three should be available for formal stratigraphic usage.

Keywords: Tertiary, Quaternary, Paleogene, Neogene, stratigraphy.

Evaluating the concept of a global 'Last Glacial Maximum' (LGM): a terrestrial perspective

Philip D. Hughes¹, Philip L. Gibbard²

¹Geography, School of Environment and Development, The University of Manchester, Oxford Road, Manchester M13 9PL, United Kingdom

²Cambridge Quaternary, Department of Geography, University of Cambridge, Downing Place, Cambridge CB2 3EN, United Kingdom

The concept of a Last Glacial Maximum (LGM) dominates the Quaternary literature and ideas associated with the last glacial cycle (Weichselian, Wisconsinan, Valdaian Stage, Marine Isotope Stages [MIS] c. 5d-2). However, its meaning and stratigraphical definition is not well-defined. This is despite recent efforts to formalise the term and to define the event or period within time (e.g. Mix et al., 2001). The prevailing view associates the LGM with the maximum extent of ice on land and a corresponding low-stand in global eustatic sea levels – the lowest of the last glacial cycle. However, the global ice signal is based on the marine isotope record and on land the LGM is not clearly represented in glacier records (Hughes et al., 2014). The former is a composite signal and as such provides no indication of spatial and temporal variability of glaciers on the Earth's surface.

Keywords: LGM, Last Glacial Maximum, Stratigraphy; chronozone, chron, event, climatostratigraphy, asynchronous.

High resolution magneto-climatostratigraphy of MIS 19 from the Osaka Group, Japan

Masayuki Hyodo, Ikuko Kitaba

Research Center for Inland Seas, Kobe University, Rokkodai 1-1, Nada, Kobe 657-8501, Japan
Tel: +81-78-803-5734, Fax: +81-78-803-5734, e-mail: mhyodo@kobe-u.ac.jp

Marine oxygen isotope stage (MIS) 19 has an abnormal climate that the temperature maximum about 5 kyr postdated the sea-level peak in mid-latitudes, and includes the Matuyama-Brunhes magnetic polarity transition persisting for several kyr. The stratigraphy of this stage must be precisely understood as a candidate for the early-middle Pleistocene boundary. The marine clay layer correlated with MIS 19 in the Osaka Group can provide millennial scale magneto-climatostratigraphy because of its high accumulation rate of about 60 cm/kyr. A new age model based on a diatom sea-level proxy curve tuned to oxygen isotope stack LR04 reveals the sedimentation is almost uniform. The following events dated provide a useful time scale. 1) Two high sea-level intervals that span from 784-778 ka and from 768-762 ka, correlated with substages 19.3 and 19.1, respectively. The first one includes the sea-level peak at 780 ka. 2) The warmest temperature interval spans from 777-774 ka. 3) The low paleointensity interval (LPI) spans from 784-776 ka includes multiple polarity swings. We confirm the LPI is a useful time measure, applying to the preliminary paleomagnetic result from the Chiba section of the Kazusa Group in east Japan. The beginning of the warmest temperature interval almost coincides with the end of the LPI at 777-776 ka may provide an important datum level near the early-middle Pleistocene boundary.

Keywords: early-middle Pleistocene boundary, Matuyama-Brunhes, MIS 19, Osaka Bay, Chiba section, paleoclimate.

Peat stratigraphy and changes in peat formation during the Holocene in Latvia

Laimdota Kalnina, Eliza Kuske, Ilze Ozola

University of Latvia, Faculty of Geographical and Earth Sciences, Alberta 10,
LV- 1010, Riga, Latvia, E-mail: Laimdota.Kalnina@lu.lv;

Mires represented by raised bogs, fens and transitional mires cover approximately 10% of Latvia. They started to form at the very Late Glacial and the beginning of the Holocene under different geological and paleoecological conditions.

This study illustrates that pollen, peat botanical composition, peat decomposition degree of mire deposits and deposit ¹⁴C dating can yield valuable information about environmental conditions during peat accumulation and give insight in peat stratigraphy, which help to understand both geological development of mires and mire ecosystem itself. The aim of study is to evaluate how peat paleobotanical investigation results and their

interpretation indicate the changes in peat formation conditions and allow to subdivide the Holocene according the scheme suggested by INTIMATE group (WALKER *et al.*, 2012).

Records from 21 mire have been evaluated with aim to found evidence of changes in mire vegetation and peat formation, along searching for possibility to find records to define boundaries allowing to subdivide the Holocene deposits into the Early Holocene, Middle Holocene or the Holocene Thermal Maximum (HTM) and the Late Holocene. Information from earlier studies and data from recent investigations have been used for peat stratigraphy revision.

Peat accumulation and fen formation during the Early Holocene took place in the oldest mires started to develop by the infilling of shallow lake depressions.

During the second part of the Early Holocene before 9,500 cal. years BP the climate became warmer and less humid, the eutrophic plant species were gradually replaced by mesotrophic ones. At the end of the Early Holocene part of fens gradually turn to transitional mires, and the first layers of raised bog peat started to form.

The boundary between the Early and Middle Holocene or the HTM can be established at the level of 8,100 to 8,000 cal. years BP because of sharp changes in peat formation conditions. The further development of raised bogs and fens, including coastal areas, where ground paludification and bog development in the depressions caused by groundwater rise because of water level rise due to transgression of the Baltic Sea Littorina Sea stage took place.

Boundary between the HTM and the Late Holocene in this study is drawn at the 4,200 cal. years BP as suggested by INTIMATE group. During the Late Holocene, the bog plant phytocenoses were basically formed by *Sphagnum* and cotton-grass which, on decay, produced low decomposed *Sphagnum Magellanicum*, *Sphagnum fuscum* or *Sphagnum*-cotton-grass peat. An intensive accumulation of peat occurred all over, followed by intensive development of bog cupolas. After the regression of the Littorina Sea stage of the Baltic Sea terrestrialisation processes and peat formation started at the former lagoonal areas. The inter-dune mires started to form in the north-western coastal area of Latvia before 3,500-3,000 cal. years BP.

The results of this study and comparison with earlier materials allow conclude that for peat stratigraphy and the Holocene subdivision in Latvia in generally can be used scheme suggested by INTIMATE group, however local peculiarities of mires should be taken in account.

Keywords: Holocene, peat botanical composition, pollen, bog.

Stratigraphic sequence of the Con Moong Cave, Thanh Hoa Province, its implication for Late Quaternary stratigraphy in North Vietnam

Doan Dinh Lam¹, Nguyen Khac Su²

¹ Institute of Geological Sciences, Vietnam Academy of Science and Technology
18, HoangQuocViet, CauGiay, Hanoi, Vietnam

² Institute of Archeology-Vietnam Academy of Social Science
161, PhanChuTrinh, HoanKiem, Hanoi, Vietnam

The Con Moong Cave, situated in Thanh Yen Commune, Thach Thanh District, Thanh Hoa Province is one of the most famous caves in Vietnam from an archeological and a stratigraphic point of view. The cave contains sedimentary deposits consisting of 7 units dated from 19kyBp and represents a very good record of paleoclimate, stratigraphy as well as human life in the past. Totally twenty seven 14C samples from this cave were collected and analyzed. Palynological, and mollusc samples also have been collected and analyzed. Magnetic susceptibility analyses were also performed. This cave is of national heritage value and a proposal for world heritage recognition is being submitted to UNESCO.

Keywords: Con Moong cave, Unit, artifact, stratigraphy, snails.

Climate-stratigraphy of Kazantsevo horizon (as an analogue of MIS-5) in boreal zone of Western Siberia

**Stanislav Laukhin¹, Vladislav Kuznetsov², Fedor Maksimov², Galina Shilova³,
Aleksey Firsov⁴**

¹ Russian State Geological Prospecting University, Russia, Moscow, Miklukho-Maklay str., 23; Earth Cryosphere Institute SB RAS, Moscow branch, Russia, Moscow, Vavilov str., 30/6. E-mail: valvolgina@mail.ru

² S-Petersburg State University, Russia, S-Petersburg, V.O., 10th Line, 33/35.

E-mail: v_kuzya@mail.ru, maksimov-fedor@yandex.ru

³ Aerogeology, Russia, Moscow, Volgina str., 8/2

⁴ Fundamentproect. Russia, Moscow, Volokolamskoe av., 1

Terrestrial deposits in Western Siberia, the age of which fits the time frame of MIS-5, are sufficiently studied using the palaeobotanical methods. Because of the small number of isotope data there is no possibility to identify the palaeoclimatic events relevant the sub-stages within the MIS-5. Therefore, a large number of palaeobotanical results could be used only in a small degree for the purposes of climate-stratigraphy. The ²³⁰Th/U dates have been received in the past 2 decades allowed to determine the vegetation changes during the 1st half of the Late Pleistocene. It gave possibly to compare its with palaeoclimate events reflected in the Greenland ice core and to reveal in Western Siberia the analogues of substages MIS-5a, 5b, 5c, 5d, 5e as well as 5e1, 5e2, 5e3, 5e4 and 5e5 events within the MIS-5e.

Keywords: Climate-stratigraphy, Palaeobotany, Western Siberia, ²³⁰Th/U-dating.

Well-preserved beach landform and sedimentary structure in East Antarctic coast affected by glacial-isostatic rebound

Hideki Miura¹, Jun'ichi Okuno², Hideaki Maemoku³

¹ National Institute of Polar Research, 1-10 Midori-cho, Tachikawa-shi, Tokyo JAPAN, 190-8518,

Tel: +81-42-512-0703, E-mail: miura@nipr.ac.jp

² Japan Agency for Marine-Earth Science and Technology, Showa-machi, Kanazawa-ku, Yokohama Kanagawa 236-0001,

Tel: +81-45-778-5622, E-mail: okuno@jamstec.go.jp

³ Hiroshima University, 1-1, Kagamiyama 1, Higashi-hiroshima, 739-8524,

Tel: +81-82-424-7069, E-mail: maemoku@hiroshima-u.ac.jp

A well-marked stepped topography is observed in beach which faces an inner cove of East Antarctic coast with mild wave action and glacial-isostatic upheaval. This sedimentary structure suggests that the landform is formed by gradual migration of the progradation processes of upper shoreface slope in the offing direction during the upheaval after Antarctic ice retreat.

Keywords: Antarctic ice sheet, glacial-isostatic rebound, relative sea level change, raised beach.

Searching for a stratotype section for the Late Pleistocene: news from the Fronte section (Taranto area)

Alessandra Negri^{1*}, Alessandro Amorosi², Fabrizio Antonioli³, Adele Bertini⁴, Giuseppe Mastronuzzi⁵, Stefano Marabini², Paolo Montagna⁶, Veronica Rossi², Daniele Scarponi², Marco Taviani⁶, Luigi Vigliotti⁶, Gian Battista Vai²

¹ Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italy

² Dipartimento di Scienze Biologiche, Geologiche e Ambientali, University of Bologna, Italy

³ ENEA, S. Maria di Galeria, Rome, Italy

⁴ Dipartimento di Scienze della Terra, University of Florence

⁵ Dipartimento di Geologia e Geofisica, University of Bari, Italy

⁶ Istituto di Scienze Marine ISMAR Consiglio Nazionale delle Ricerche, Bologna, Italy

*Corresponding author: phone +39071 2204709; fax +39071 2204650; a.negri@univpm.it

We present the result of detailed litho- bio- magnetostratigraphic investigations along the Fronte section (Taranto), where facies distribution is interpreted using a combined paleoecological and sequence stratigraphic approach, the data obtained so far suggest a continuous sedimentary record at the Fronte Site, where MIS 5e peak and the subsequent highstand are documented, thus providing robust evidence for the last interglacial sedimentary interval.

Keywords: Chronostratigraphy, Integrated approach, Upper Pleistocene, Taranto.

A reassessment of the Matuyama–Brunhes boundary age based on post-depositional remanent magnetization (PDRM) lock-in effect for marine sediments

Yusuke Suganuma

National Institute of Polar Research, 10-3 Midoricho, Tachikawa, Tokyo 190-8518, Japan

Tel: 81-42-512-0702, E-mail: suganuma.yusuke@nipr.ac.jp

The Matuyama-Brunhes (M-B) boundary age has been estimated from the astronomical ages of marine sediments and the ⁴⁰Ar/³⁹Ar ages of volcanic rocks. Although the accepted age for the M-B boundary is 780 ka, recent studies have questioned conventional estimates of the boundary age. In this presentation, I present clear evidence for the existence of errors in paleomagnetic dating due to the effect of the post-depositional remanent magnetization (PDRM) lock-in depth, based on a comparison between previously published marine isotope ages for the M–B boundary and sedimentation rates. These findings indicate that the age of the M–B boundary should be revised to *ca.* 770–773 ka and that the boundary most likely lies in late Marine Isotope Stage (MIS) 19 rather than in the middle of MIS 19. This new age for the M–B boundary is consistent with that obtained from the EPICA Dome C ice core using an EDC3 age model. In contrast, an age offset for the M–B boundary is recognized between marine sediments and ⁴⁰Ar/³⁹Ar ages. To resolve this discrepancy, additional data are required from marine sediments, volcanic rocks, and ice cores.

Keywords: Matuyama–Brunhes boundary, marine sediments, ⁴⁰Ar/³⁹Ar age, post-depositional remanent magnetization (PDRM), lock-in depth.

Do old mining waste deposits from Austria define an "old" Anthropocene?

Michael Wagemich

Department of Geodynamics and Sedimentology, University of Vienna, Althanstraße 14, 1090 Vienna, Austria,
Tel. +43-1-4277-53465, Fax +43-1-4277-9534, michael.wagemich@univie.ac.at

Mining waste deposits from Austrian Stone Age mining are the oldest anthropogenic deposits recognized on geological maps of Austria. These anthropogenic deposits come from extensive Bronze Age mining for copper (e.g. Mitterberg area, district Salzburg) and salt (e.g. Hallstatt area, Upper Austria), having an age around 1400 BC. Based on these mapped geological units which should be included into a coming definition of the Anthropocene, we argue for an "old" base of the "Anthropocene" to include such anthropogenic deposits.

Keywords: Anthropocene, mining waste, Austria, Stone Age.

Formal subdivision of the Holocene Series/Epoch

**M. J. C. Walker^{1*}, P. L. Gibbard², M. Berkelhammer³, S. Björck⁴, L. C. Cwynar⁵,
D. A. Fisher⁶, A. J. Long⁷, J. J. Lowe⁸, R. M. Newnham⁹, S. O. Rasmussen¹⁰, H. Weiss¹¹**

¹School of Archaeology, History and Anthropology, Trinity Saint David, University of Wales, Lampeter, Wales, UK, and
Institute of Geography and Earth Sciences, Aberystwyth University, Aberystwyth, Wales, UK

²Department of Geography, Cambridge University, Cambridge, UK

³Department of Atmospheric and Oceanic Sciences and Cooperative Institute for Research in Environmental Sciences,
University of Colorado, Boulder, USA

⁴Department of Geology, Quaternary Sciences, Lund University, Lund, Sweden

⁵Department of Biology, University of New Brunswick, Fredericton, Canada

⁶Natural Resources Canada, Ottawa, Canada

⁷Department of Geography, Durham University, Durham, UK

⁸Department of Geography, Royal Holloway, University of London, Egham, UK

⁹School of Geography, Environment and Earth Sciences, Victoria University of Wellington, Wellington, New Zealand

¹⁰Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark

¹¹School of Forestry and Environmental Studies, Yale University, New Haven, USA

*Corresponding author: email: m.walker@tsd.ac.uk; Telephone: 0044 1570 422822

This proposal, by a Working Group of INTIMATE (Integration of ice-core, marine and terrestrial records) and the Subcommittee on Quaternary Stratigraphy (SQS) of the International Commission on Stratigraphy (ICS), is for a formal subdivision of the Holocene Series/Epoch. Although previous attempts to subdivide the Holocene have proved inconclusive, recent developments in Quaternary stratigraphy, notably the definition of the Pleistocene-Holocene boundary and the emergence of formal subdivisions of the Pleistocene Series/Epoch, mean that it may be timely to revisit this matter. The Quaternary literature reveals a widespread but variable informal usage of a tripartite division of the Holocene ('Early', 'Middle' or 'Mid', and 'Late'), and we propose that this *de facto* subdivision should now be formalised to ensure consistency in stratigraphic terminology. We advocate an Early-Middle Holocene Boundary at 8200 a BP and a Middle-Late Holocene Boundary at 4200 a BP, each of which is linked to a Global Stratotype Section and Point (GSSP).

Keywords: Holocene, Stratigraphic subdivision, 8.2 ka and 4.2 ka events, NGRIP ice core, Mawmluh Cave stalagmite.

Evidence for a stratigraphical basis for the Anthropocene

Colin N. Waters^{1*}, Jan Zalasiewicz², Mark Williams², Simon J. Price¹, Jon R. Ford¹,
Anthony H. Cooper¹

¹ British Geological Survey, Environmental Science Centre, Keyworth, Nottingham, NG12 5GG UK.

Tel: +44 (0)115 9363100; Fax: +44 (0)115 9363200. *Corresponding author e-mail: cnw@bgs.ac.uk

² Dept. of Geology, University of Leicester, Leicester LE 1 7RH, UK. Tel: +44 (0)116 2523933; Fax: +44 (0)116 2523918

The Anthropocene was proposed as a term (CRUTZEN & STOERMER 2000) before consideration was given to the nature of the key signatures, contrasting with standard procedures for defining such units. The term is being widely used in both popular and scientific publications before a decision is made as to whether it warrants formalisation and definition of a Global Stratigraphic Section and Point (GSSP). The deliberate human modification of the landscape and its subsurface and the creation of human-generated novel sedimentary deposits, minerals and landforms is a characteristic feature of the development of the Earth's surface and near surface, which has accelerated in the past two centuries. The large-scale intentional excavation, transport and deposition of mixtures of rock and soil to form anthropogenic deposits and landforms represent a new geological process that could be used as a diagnostic signature of the Anthropocene.

Keywords: Anthropocene, stratigraphy, anthropogenic deposits.

Stratigraphy of the Caspian Sea Neopleistocene (on the base of *Didacna* Eichwald mollusks)

Tamara Yanina

Moscow State University, Faculty of Geography, Leninskie Gory, 1, Moscow, 119991, Russia
didacna@mail.ru +7(495)9391608

Stratigraphy of the Caspian Neopleistocene (middle and upper Pleistocene according to International stratigraphic scheme) is based on changes in evolutionary patterns and ecological assemblages of the mollusk genus *Didacna* Eichwald. The molluscan fauna represent a complex hierarchical system of faunal assemblages with different taxonomic composition and at different taxonomic levels: faunas, complexes, subcomplexes, associations. Based on molluscan fauna, namely on distinguished faunal units at different hierarchical levels, we built a regional biostratigraphic (ecostratigraphic) scheme of the Neopleistocene of the Caspian, supplementing and specifying the existing schemes.

Keywords: Caspian Sea, Neopleistocene, mollusks, *Didacna* Eichwald, biostratigraphy, type sections.

Potential formalization of the Anthropocene: a progress report

Jan Zalasiewicz^{1*}, Colin Waters², Mark Williams¹

¹ Department of Geology, University of Leicester, University Road, Leicester LE1 7RH, UK. Tel: +116 2523928.

*Corresponding author e-mail: jaz1@le.ac.uk

² British Geological Survey, Keyworth, Nottingham, NG12 5DP. Tel. +115 9363100

The geological rationale for a potential formal Anthropocene Epoch includes evidence of lithostratigraphic, biostratigraphic and chemostratigraphic change. These changes represent the early stages of what will be a long-lasting geological event, and at present range from substantial (e.g. lithostratigraphic changes, species invasions) to minor (e.g. sea level rise), while some (e.g. new mineral species) are geologically novel. On current evidence, a practicable base for an Anthropocene Series may be placed around 1950 CE, coincident with global

chemostratigraphic and other changes. This possibility needs examining via the assembly and debate of further stratigraphic evidence, and consideration of the utility of the term as a formal unit.

Keywords: Anthropocene, Holocene, Quaternary, anthropogenic.