Newsletter of the Anthropocene Working Group

Volume 10: Report of activities 2020

December 2020

International Union of Geological Sciences
International Commission on Stratigraphy

Subcommission on Quaternary Stratigraphy
http:/ /quaternary.stratigraphy.org/workinggroups/anthropocene/

Table of Contents

Newsletter compiled by Simon Turner and Colin Waters.

Thanks to all colleagues who contributed to this Newsletter.

Cover Illustration: We celebrate the life and work of Paul Crutzen, here seen in 2017 with Jan Zalasiewicz who in 2020 stood down as Chair of the AWG to become Chair of the Subcommission on Quaternary Stratigraphy. Photo by Colin Waters.

CHAIRMAN'S COLUMN

Dear all,

In the context of the AWG's history, 2020 can be seen as a transformative year. Reaching the end of the current ICS eight-year cycle, the Subcommission on Quaternary Stratigraphy Executive stood down at the end of August 2020, delayed by six months due to the postponement of IGC Delhi. Jan Zalasiewicz became the new SQS Chair, replacing Martin Head who has been so supportive of AWG research since 2016. But very sadly, Jan had to stand down as AWG Chair, having been our inspirational leader since establishing the task group in 2009. Paul Crutzen can be considered the father of the Anthropocene, but there is no doubt that the current popularity of the term results in large part to Jan's exhaustive activities, leading on the publication of many diverse and innovative topics concerning the understanding of the term as a potential new geological time unit. But importantly, he also wanted to engage with audiences outside of geology and through his selection of an AWG membership with such diverse backgrounds, ensured that this would be no insular geological debate. Fortunately for us, both Jan and Martin continue as AWG members and their contributions in future activities will be greatly valued.

ICS statutes indicated that by the end of the current cycle the AWG would need to dissolve and at the invitation of the new SQS Chair to reassemble for a further four-year term. It was a great honour to be asked to step up from the groups' position as Secretary to the role of Chair at this critical time of GSSP analysis, which is anticipated to be completed within this term and a proposal be formulated in time for IGC 2024. In preparation for this, the group reassembled with voting members (those with chronostratigraphic expertise suitable for voting on the GSSP proposals) and advisory members, who will continue our work on investigating the stratigraphic and wider meaning of the Anthropocene. We regard both of these as key, and complementary, tasks for our work over the next few years. Most of the membership continued, though we said a sad farewell to longstanding members Mike Ellis and Cath Neal. But this also provided the opportunity to invite new members specifically selected because of their already significant contributions on the GSSP assessments, with skill sets which will help broaden our expertise. So we welcome Francine McCarthy, Yoshi Saito, Han Yongming, Jens Zinke, Andy Cundy and Simon Turner to the group (see the short biographies). Simon has very kindly stepped forward to replace me as Secretary. His significant role as coordinator of the GSSP study makes him eminently suitable as Secretary.

The initiative of the Haus der Kulturen der Welt to provide engagement with the GSSP candidate site assessments, each represented by its own scientific team working in partnership with the AWG, has progressed this year, but the pandemic curtailed developments for at least six months. This delayed collection of some cores, and with many laboratories closed or working on restricted schedules we are fortunate that Simon's report on development shows some promising progress. We also welcome the independent studies of Yoshi Saito for the estuarine succession of Beppu Bay, Japan and Barbara Fiałkiewicz-Kozieł for a peat succession at Śnieżka Mountain, Poland that are now working towards producing candidate GSSPs and the multidisciplinary study of the City of Vienna anthropogenic sediments. Covid-19 has also greatly restricted opportunities to present our research at conferences, including importantly at IGC2020 in Delhi. But it is rewarding to see how we have been able in our respective versions of

lockdown to continue the production of publications that help inform on the nature of the Anthropocene, notably with Jaia's leadership of the Communications Earth & Environment paper and Jan's sterling contributions in bringing together the diverse interpretations of the Anthropocene in the Earth's Future paper. Hopefully, in 2021 we will return to some form of normality and I look forward to continuing working with you as we progress towards developing the GSSP proposals.

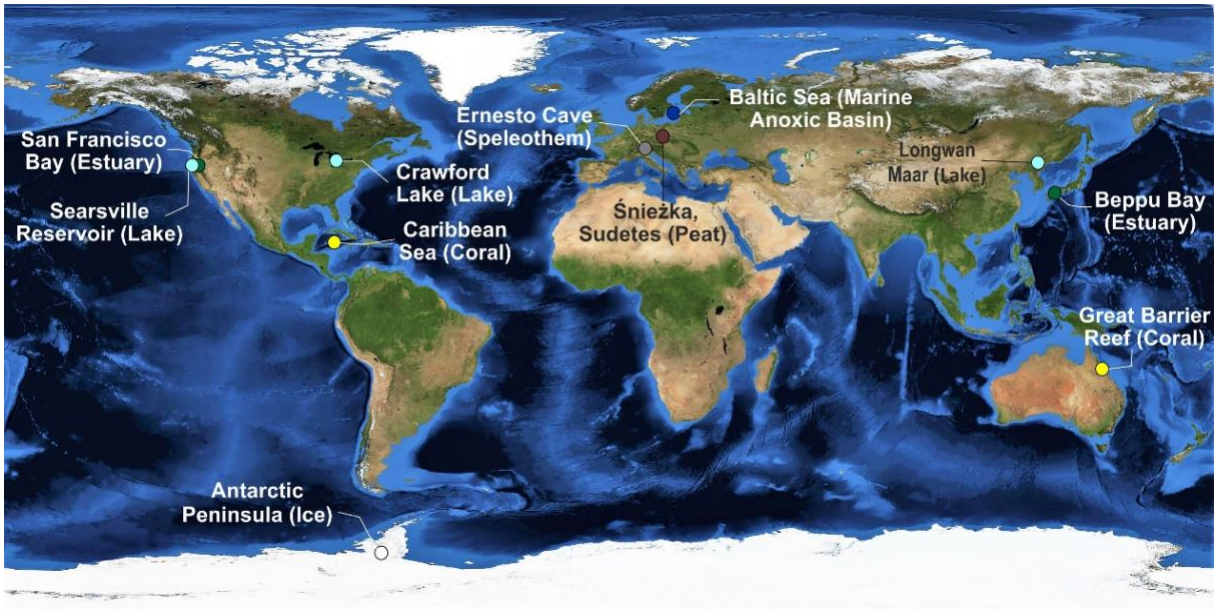
Finally, on the 28th January 2021, shortly before this Newsletter was due for release, we learnt of the very sad news of the passing of Paul Crutzen. In a remarkable career, he will be remembered for conceptualising the effects of a nuclear winter and determining the mechanisms of atmospheric ozone loss, for which he became Nobel laureate. But it is for his impulsive genesis of the term Anthropocene and early promotion of the concept that humans have fundamentally shifted the Earth state into a new geological epoch that may be his greatest legacy. We have had the great fortune that Paul became a member of the AWG at its inception in 2009 and continued an interest in our work despite failing health. It was having the fortune to see Paul give a lecture on the Anthropocene in 2011 at the Geological Society of London that inspired me to become involved with the AWG. For those who have had the privilege to have met Paul, notably through his involvement in our 2018 AWG meeting at his home institute of the Max Planck Institute for Chemistry, Mainz, they will fondly remember him as not only one of the pre-eminent scientists of his generation, but also a modest, kind and approachable person who will be greatly missed. As we come to terms with this news, we as a group will reflect as to how we should arrange for a fitting memorial to his incredible contributions to our focus of research.

Colin Waters

The updated version of the **AWG website** is available at
http://quaternary.stratigraphy.org/working-groups/anthropocene/.

ANTHROPOCENE GSSP PROJECT

At the end of 2018, Bernd Scherer, Director of the Haus der Kulturen der Welt (HKW) in Berlin announced that funding for the cultural-scientific project "Earth Indices" (WT) as part of the HKW's long-term investigation on the Anthropocene had been secured. This would allow the HKW a closer collaboration with the Anthropocene Working Group and would contribute to the programme of GSSP analysis which is to be presented to the public at HKW in summer 2022. Collection and analysis of cores from additional sites, and further sites have joined the study. Work is underway to provide a broad suite of proxy analyses across diverse environments for eleven globally distributed locations. 2020 was scheduled to be the main year of data acquisition and the various projects have worked valiantly to try to progress the research despite laboratory closures and restrictions for field work for large parts of the year.



Location of candidate GSSP sites currently under investigation. Satellite image credit: NASA Visible Earth.

In May 2022 there is planned a major conference/exhibition hosted by HKW in Berlin which will show off the work undertaken at each of the sites and the debate can start within the AWG (and beyond) on the relative suitability of the sites.

The aim is that we will have a thematic set of papers in *Anthropocene Review*, with data-rich accounts for each location, and explanations of how this data supports the individual cases. These accounts need to be in with AR during the summer of 2022 so that they can be used by the AWG voting membership in order that they can cast their vote on the preferred GSSP site and suggest possible auxiliary sites. Our anticipation is that the voting will take place over October and November 2022. Then in December 2022 there will be a further event at HKW where we will announce the result of the vote. Soon after, in Spring 2023 we hope to have compiled the final summary of the investigations synthesizing the results of the studies and why the GSSP and auxiliary sites were selected. We would be looking into publishing this in order to get feedback in advance of submitting the final documents to the Subcommission on Quaternary Stratigraphy.

One-page summaries of the sites and progress being made are on the following pages. There is a hyperlink for the location that will take you to the approximate location of the core using Google Maps.

Searsville Reservoir. California, USA
Location: N 37.407, E-122.238
People: Allison Stegner, Anthony Barnosky & Elizabeth Hadly
Institution: Stanford University, USA

Photo Credit: Nona Chiariello, 2018

Description of Site:
Searsville Reservoir is a ~127-year-old reservoir located at Jasper Ridge Biological Preserve (JRBP) at Stanford University, California, USA. Construction of the dam was completed in 1892 and impounded the San Francisquito creek which empties into San Francisco Bay. Today, the reservoir is filled >95% with sediment.

General description of stratigraphic sequence:
The candidate GSSP core is 1103 cm long, suggesting an average deposition of ~7.5 cm/year. Computed tomography scans of the cores reveal >300 distinct layers ranging in thickness from <1mm to ~30mm. Thinner, low density laminae are interpreted as summer organic layers, alternating with thicker, higher density winter storm deposition.

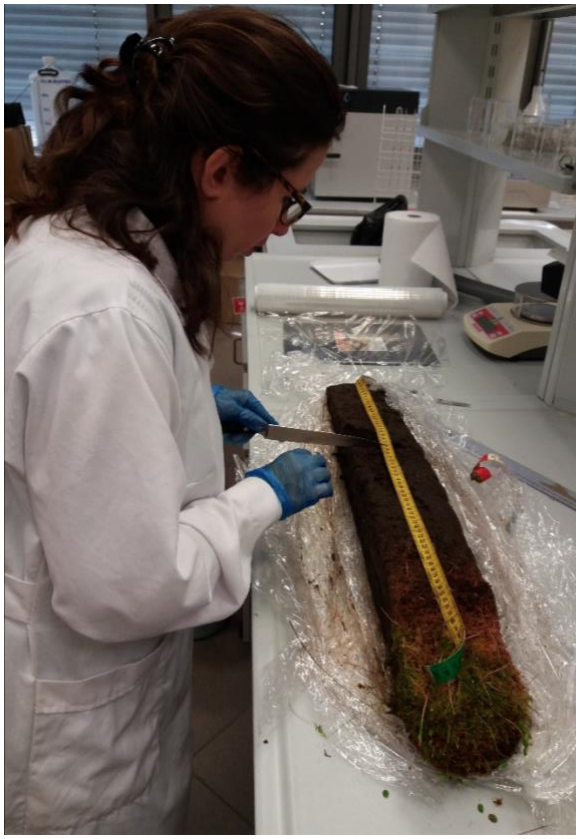
Work completed:
We have completed an initial age model, high-resolution imaging, computed tomography (CT) scanning, X-ray fluorescence (XRF) scanning, and preliminary sediment description. We have analysed stable C and N isotopes, Mercury, and pollen. ^{210}Pb, ^{137}Cs and ^{241}Am have been measured in the core to refine the sediment chronology. A pilot study of environmental DNA has shown promising results.

Work currently underway:
ICP-MS/OES analysis of lead levels and isotopes is in progress at Stanford. SCPs are in the process of being counted at UCL. Plutonium is being measured at NOC Southampton. Diatom samples are currently being processed at the National Lacustrine Core Facility (LacCore) and will be counted by Trisha Spanbauer (University of Toledo). We are in the process of determining the feasibility of measuring PCBs in the core.

Na Równi pod Śnieżką peat core, Czech Republic/Poland Border
Location: N 50.7383, E 15.6997
People: Barbara Fiałkiewicz-Kozieł
Institution: Adam Mickiewicz University, Poland

Description of Site
The Na Równi pod Śnieżką (NRS) peatland is located on a plateau (1350–1450 m a.s l.) in the Karkonosze range, close to the highest summit of Mt Śnieżka (1602 m a.s.l.).

General description of stratigraphic sequence
A core collected from the peatland and ^{210}Pb-dated show recent peat (0 - 49 cm) has accumulated in 149 years, corresponding to an average accumulation rate of 0.53 ± 0.11 cm yr^{-1}. Multi-proxy geochemical work reveals the site has received trace elements and combustion products via long- and short-range atmospheric transport. We expect similar patterns of accumulation in the adjacent GSSP core collected in 2019.



Work completed
^{210}Pb, ^{137}Cs, ^{238}Pu, $^{239+240}$Pu, ^{234,238}U isotopes, physical properties, ^{204}Pb, ^{206}Pb, ^{207}Pb, ^{208}Pb isotopes, macrofossils, pollen analysis, TA analysis, Trace element concentration, REE, mineralogical analysis by SEM (SAP, mullite)

Work currently underway New ^{210}Pb, ^{238}Pu, $^{239+240}$Pu, Carbon isotopes, SCP (fly-ash).

Sihailongwan Maar Lake Jingyu County, Jilin Province, China
Location: N 42.2885, E 126.607
People: Yongming Han, An Zhisheng
Insitution: Institute of Earth Environment, Chinese Academy of Sciences, Xi'an

Description of Site
Sihailongwan Lake is a typical maar lake of the Cenozoic Longgang Volcanic area (CLVA) in north-eastern China. The lake has an elevation of 776 m a.s.l., with a water area of ca. 0.5 km^2, a catchment of 0.7 km^2 and maximum depth of ~53 m.

General description of stratigraphic sequence
The core is clearly laminated (annual) in the upper 33 cm. Distinct 1 mm white layers occur at 33 and 6.8 cm in the sequence. Colour changes occur in the core from dark mud (0-6.8 cm) turning grey to yellow (6.8 – 10cm) and lighter grey muds below 10 cm.
Work completed Freeze cores were collected in January 2020 along with gravity cores in September 2020. Core halves have been scanned for XRF and high-definition imagery. Subsamples have been extracted and prepared for thin-section microscopy. Varve counting has taken place with 1950 being found ~10 cm below the water - sediment interface.

Work currently underway
We are currently measuring ^{210}Pb and ^{137}Cs and preparing samples for Pu analysis in gravity core samples. Pu and I isotope measurements will then take place on the freeze core samples. Measurement of black carbon, char, and soot and soot ^{14}C will occur soon on the freeze cores.

San Francisco Bay, California, USA
Location: N 37.549533, E-122.183133
People: Stephen Himson, Mark Williams, Jan Zalasiewicz, Colin Waters, Juan Carlos Berrio, Ian Wilkison and Mary McGann
Institutions: University of Leicester, UK, United States Geological Survey (USGS) and British Geological Survey (BGS).

Description of Site
San Francisco Bay is the largest and busiest seaport on the Pacific coast of the USA, with an area of up to 4000 km². The core was taken in the south of the bay in brackish waters between the Dumbarton and San Mateo Bridges on the central sub-tidal mud flats. Average water depth in the area is 5-15 m.

General description of stratigraphic sequence
The maximum depth of the core is 2.3 m below the bay floor. The core is composed of massive, unconsolidated silts and fine sand with occasional coarse sand and shell layers. The core represents the upper section of the Bay muds, a sequence of unconsolidated muds that date to the early Holocene which overlie coarse Pleistocene fluvial deposits.

Work completed
Sub-sampling and preparation of samples for microfossil analysis and fly ash analysis.

Work currently underway
Radiometric dating began in late summer and is currently underway at UCL. Microfossil and fly ash (SCP analysis in in collaboration with Neil Rose, UCL) is in the early stages at University of Leicester.

Crawford Lake. Milton, Ontario, Canada
Location: N 43.468464, E -79.948797
People: Francine McCarthy, Tim Patterson
Institutions: Brock University, Carleton University

Crawford Lake from the boardwalk near north shore, morning of August 20, 2020; note the dolomitic outcrop and the interpretive signage. Photo credit M. MacKinnon.

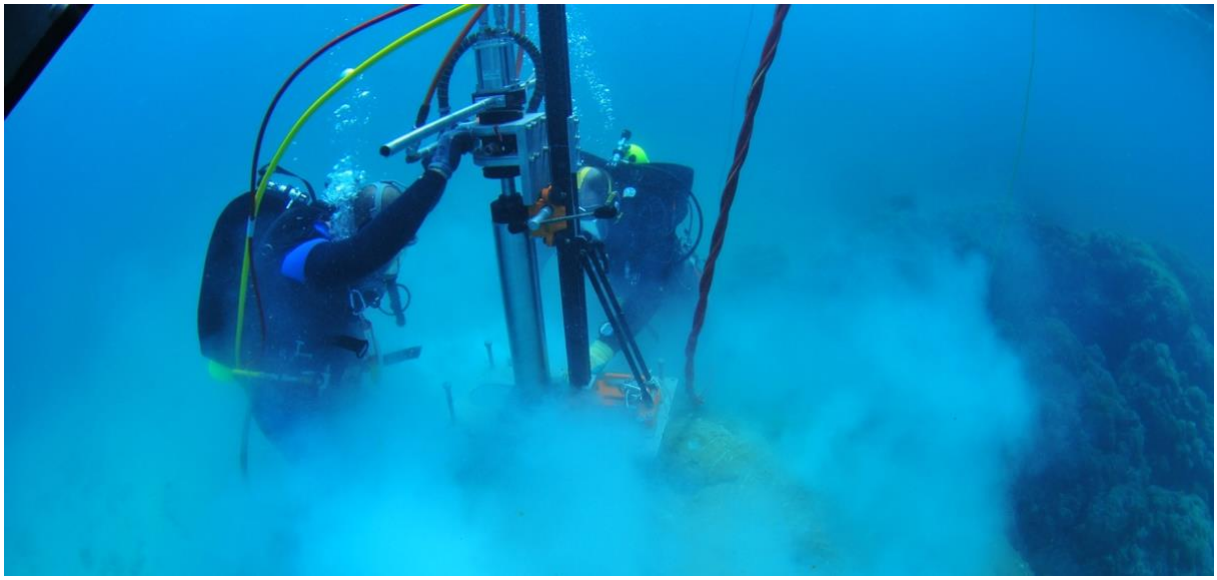
Description of Site: Crawford Lake is a meromictic lake with a highly unusual oxygenated monimolimnion. The small, deep (25 m) lake occupies a karstic basin (sinkhole) in the dolomitic Niagara Escarpment.

General description of stratigraphic sequence: Annually laminated sediments (varves) accumulate largely undisturbed below the chemocline of this permanently stratified lake. Couplets of light-coloured inorganic calcite precipitate in warm waters of the epilimnion during summer and dark organic matter primarily derived from plankton in the fall

Work completed: Samples from freeze cores and gravity cores collected in August 2018 and February 2019 have been processed and analysed for siliceous microfossil (Queens U) and palynological analysis (Brock U). AMS radiocarbon analysis of bulk sediment samples from the 2019 freeze core. High-resolution imaging of varves (Carleton U) and pixel counting of the thickness of high-resolution sub annual varve layers has yielded data suitable for time series analysis.

Work currently underway:
Palynological analysis of freeze core samples, fossil pigment analysis (U Regina) of the push core collected from the deep basin in 2018 and geochemical analysis using a u-XRF core scanner (Cox- ITRAX- McMaster U) at 200 µm intervals.
Analysis of siliceous microfossils from the 2019 freeze core at sub-annual resolution.
Preliminary sediment eDNA analysis is underway through a collaboration between Brock U and McMaster Universities. Collection of additional large freeze cores planned for late January – February 2021 for Anthropocene markers

Flinders Reef, Queensland Plateau
Location: S 17.5°, E 148.3°
People: Jens Zinke, Janice Lough
Institutions: University of Leicester, Australian Institute of Marine Science



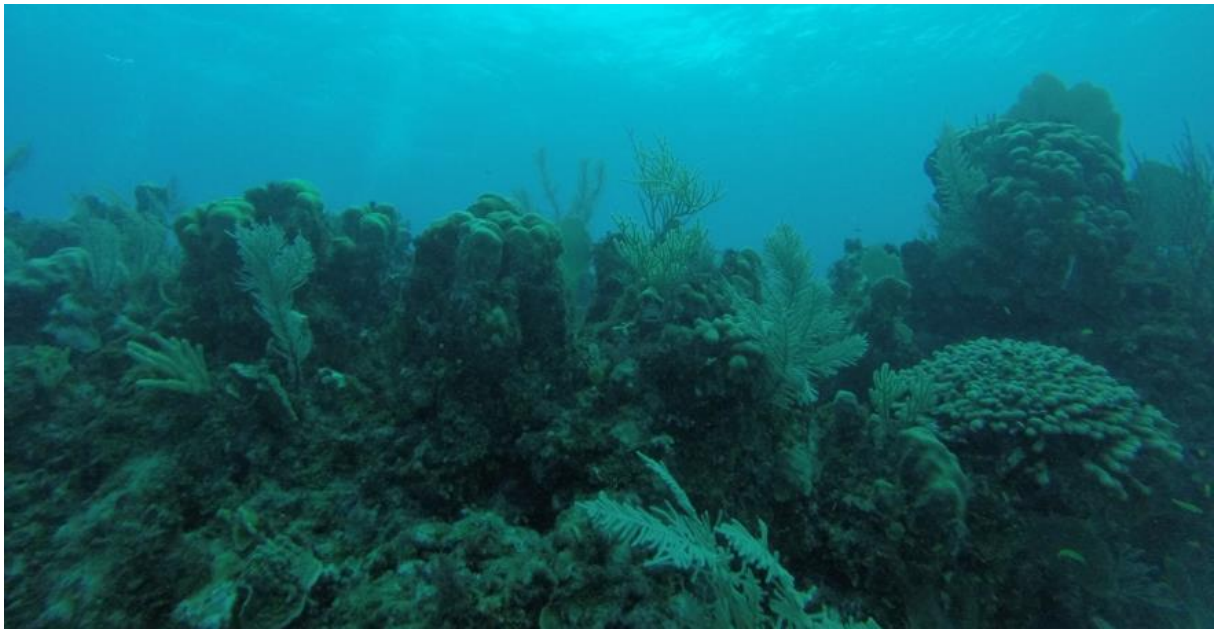
Description of Site
In May 1992 and 2017, long cores from a *Porites* sp. coral head were collected from Flinders Reef, an offshore reef on the Queensland Plateau, 250 km from the north-east coast of Australia and one of the largest discrete reef systems in the Coral Sea.

General description of stratigraphic sequence
The coral core was cut lengthwise into 7 mm thick slices and X-rayed to reveal regular and well-defined annual density bands, which were used to establish the coral chronology. The banding allows for precise absolute age control. Samples were collected in bimonthly (1940-1992; 1940-2017), and 1-year intervals (pre-1940 until approx. 1710 A.D.) along the main growth axis

Work completed
We have completed the following analyses 1) X-ray of coral cores, 2) growth parameter analysis of the cores, 3) sampling of powder samples for two Flinders cores and two additional cores from Britomart Reef by our colleagues at the Australian Institute of Marine Science (Grace Frank), 4) shipping of coral powder samples to Leicester and 5) splitting 75% of powder samples for radiogenic carbon isotopes, nitrogen isotopes and paired Sr/Ca and oxygen/carbon isotope analysis.

Work currently underway
The splitting of powder samples is well underway with 75% of work completed for radiogenic and nitrogen isotopes. Next will be the splitting for annual samples for Sr/Ca, oxygen and carbon isotope analysis. We will ship samples to ETH Zurich (Switzerland), Max-Planck Mainz (Germany) and Kiel (Germany) for radiogenic carbon isotope, nitrogen isotope and Sr/Ca analysis, respectively. Test samples for the determination of SCP concentrations (UCL London), Pu analysis (Southampton) and pollution indicators (University of Leicester) have been prepared and will be analysed once Covid regulations allow for it.

Little Cayman Island, Cayman Island, Central Caribbean
Location: N 19.6955, W 80.0602
People: Kristine DeLong
Institution: Geography and Anthroplogy, Louisiana State University, USA



Description of Site

Little Cayman Island was selected due to its location in the central Caribbean, which is climatically representative of the Tropical Atlantic. Its relative isolation from many direct human impacts is in part due to the islands being distant to continental input. Several large coral colonies have been identified by local experts for coring. Cores will be extracted from by scuba diving using an underwater drilling system.

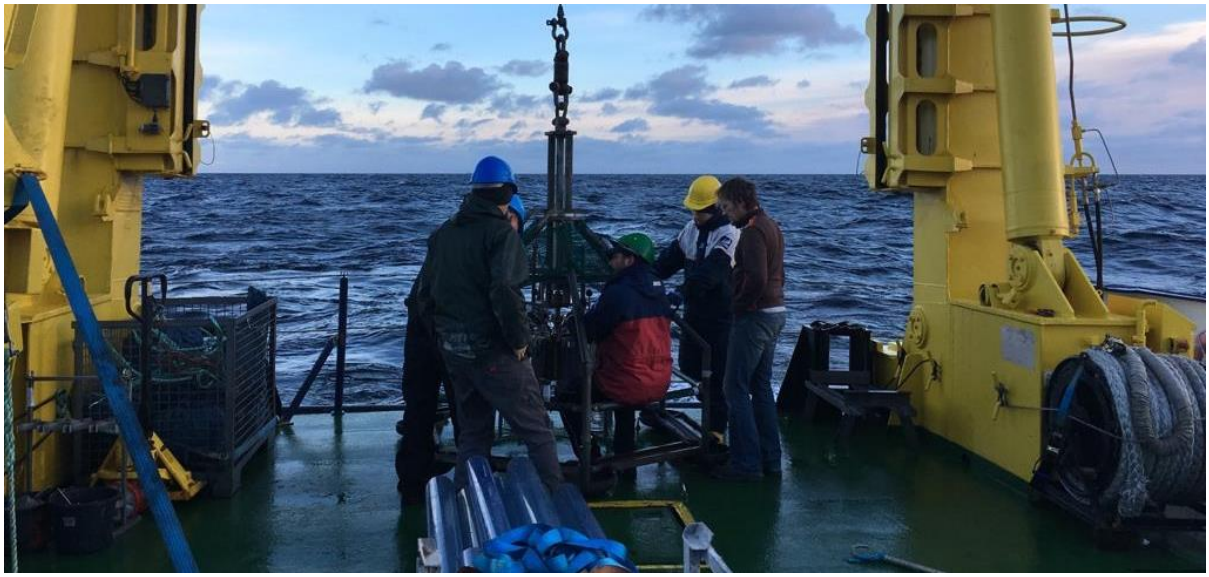
General description of stratigraphic sequence

Coral proxies to be analysed over a target of 300 years include carbon isotopes showing the the shift in carbon isotopes in the atmosphere resulting from fossil fuel combustion that started in early 1700s, oxygen isotopes (SST and salinity), Sr/Ca, Mg/Ca, Li/Ca, Li/Mg, (temperature), $\delta^{11}B$ (pH proxy), NO_3 and $\delta^{15}N$ (agricultural proxies), heavy metals including V (fossil fuel derivative), and Pb isotopes (pollution and fossil fuel derivative), nuclear testing products (^{14}C, ^{239}Pu, ^{241}Am, and ^{137}Cs), fly ash (black carbon), and bleaching events as biotic markers.

Work currently underway

The global Covid-19 pandemic has stopped all travel to the Caymans to recover the cores, yet preliminary lab analyses continues with other coral samples collected from Little Cayman that are being used to establish the calibrations for coral proxies for this location so work can move forward quickly once travel is allowed. Coral samples for establishing the analytical methods for Pb isotope and nuclear testing products have been sent to collaborators.

Eastern Gotland Basin, Baltic Sea
Location: N 57.2830; E 20.1204
People: Jerome Kaiser, Juliana Assunção Ivar do Sul
Institutions: Leibniz Institute for Baltic Sea Research Warnemünde (IOW), Germany



Description of Site

Core EMB201/7-4 has been retrieved at a water depth of 241 m from the Eastern Gotland Basin (EGB) located in the central part of the Baltic Sea in December 2018. The EGB is hypoxic to euxinic throughout the year. It has been extremely well-studied for decades in terms of sedimentology, oceanography, water chemistry, and biology.

General description of stratigraphic sequence

Core EMB201/7-4 is 45 cm in length. The lower part of the core is grey and homogenous. At about 25 cm there is a pronounced change in the lithology due to an abrupt and strong increase in the content of organic carbon. The upper part of the core is characterized by light to dark brown laminations (mm to cm scale). The abrupt lithological transition in the middle of the core marks very likely the early 1950s, which should represent the beginning of the Anthropocene.

Work completed

EMB201/7-4 has been scanned with a XRF core scanner to analyse major and minor elements and also for magnetic susceptibility. Half of the core has been sampled continuously with a sampling interval of 1 cm (0-27 cm) to 0.5 cm (27 to 45 cm).

Work currently underway

All samples (n = 63) are being measured for radionuclides (^{210}Pb, ^{137}Cs, ^{241}Am) at the IOW. Samples (n = 55) are being processed for SCP analysis at UCL. Samples (n = 20) have been extracted for microplastics at the IOW, but not analysed yet.

Palmer Ice Core, Antarctic Peninsula
Location: S 73.95, W 65.45
People: Liz Thomas
Institutions: British Antarctic Survey, Natural Environment Research Council, UK

Description of Site

The Palmer Ice core was collected at the southern end of the Antarctic Peninsula (AP) at 1897 m asl. The AP is a region of warmer Antarctic temperatures and high snow accumulation due to its northward extension into the Southern Ocean. AP ice cores reveal an increasing trend in snow accumulation during the 20th century. The Palmer ice core was drilled in 2012 without drilling fluid and following field sampling has been kept archived in cold storage since.

General description of stratigraphic sequence

The core is ~133 m of ice with annual laminae extending back to c. 1617 CE. The core will have a well-resolved stratigraphy by counting annual cycles of $\delta^{18}O$ and SO_4^{2-} with confirmation against known volcanic events

Work completed

Discrete $\delta^{18}O$ isotope measurements (2800 samples) have been completed to provide an initial age-scale. 40 m of the core has been analysed by Continuous Flow analysis (CFA) ionic chemistry (F-, Cl-, Methanesulfonic acid, SO_4^{2-}, NO_3^{2-}, Br^{2-}, Na^+, K^+, Mg^{2+}, Ca^{2+}, NH_4^{2+}) at BAS.

Work currently underway

CFA for the rest of the core has been paused due to Covid and will restart in February/March 2021.

Ernesto Cave, Trentino, Northern Italy
Location: N 45.976944, E 11.657778
People: Andreas Borsato, Ian Fairchild and Silvia Frisia
Institutions: University of Newcastle, Australia and University of Birmingham, UK

Description of Site

A small, shallow cave (1167 m a.s.l.) developed under a forested slope in the Italian Pre-Alps. It contains speleothems grown during the last 130,000 years including several annually laminated stalagmites covering the last 8,500 years.

General description of stratigraphic sequence

Most of the studies focused on three annually laminated stalagmite records covering the last ~600 years (ER76, ER77, ER78). Each annual lamina consists of a translucent, non-fluorescent clear calcite layer and a brown thin fluorescent calcite layer enriched in soil-derived organic matter and a number of transition metals.

Work completed

A clear change from thin impurity-rich laminae to thicker clean calcite laminae is documented in stalagmites since 1840 - 1870 CE in response to the temperature increase at the end of the Little Ice Age. At ~1880 CE an increase in sulphate concentrations in stalagmites reflects the response to the atmospheric pollution following the Industrial Revolution. The ^{14}C bomb-spike is encoded in stalagmite ER77 with a decade lag compared with atmospheric signal. Records of sulphur loading and decreasing $\delta^{34}S$ in stalagmite ER78 show a similar lag of about 15–20 years; the peak atmospheric S loading occurred in 1976 but is recorded in the late 1990s in both stalagmite and tree rings above the cave.

Work currently underway

Fluorescence imaging and synchrotron XRF mapping of Sr and transition metals for the last ~300 years.

City of Vienna, Austria
Location: N 48.199188, E 16.372494
People: Maria Meszar, Kira Lappé, Karin Hain, Katrin Hornek, Michael Wagreich and Martin Mosser
Institutions: University of Vienna, University of Applied Arts, Vienna, and Vienna Urban Archaeology, all Austria

Description of Site

An archaeological excavation including well cores at the Karlsplatz, City of Vienna. It contains anthropogenic sediments and archaeological artefacts from the 19th century upwards to modern layers.

General description of stratigraphic sequence

Archaeological stratigraphy includes the 19th century fill of the Wien River channel and associated embankments and pavements, followed by foundations of a 1922 market hall, and the 1945 WWII rubble dated by its specific artefacts. Followed by the foundations of the Vienna Museum building and corresponding layers around 1956 to the modern superficial park level.

Work completed

Logging, sediment description and sampling for geochemistry started in 2019, excavation continues up to 2021. Sample preparation and homogenization ongoing. The inferred 1950 - 1960 layer was verified by artificial bomb-test related isotopes such as plutonium 239.

Work currently underway

Geochemistry (XRF scans, ICP-MS/OES) and artificial isotope analyses for the post-1922 layer sequence to identify peak(s).

NEW MEMBERS DETAILS

Andy Cundy

I am Professor of Environmental Radioactivity in the School of Ocean and Earth Science at the University of Southampton (National Oceanography Centre, Southampton). My main research interests lie in the areas of applied and environmental geochemistry and environmental radioactivity and cover a range of areas including sediment geochemistry and sediments as pollutant "archives", contaminated land and water management, and use of radioactive and stable isotopes as tracers of contaminant sources and environmental processes. Much of my work focuses on the Anthropocene, using radiometric dating (via fallout and other radionuclides) in sedimentary archives, coupled with geochemical, isotopic, micropaleontological and other studies, to:
(a) assess the sources, timing, fluxes and impacts of long-standing and emerging contaminants to marine and other systems, and
(b) examine recent, often human-driven, environmental change,
with current projects in the UK, Greece, China and remote tropical islands. I also have strong research interests in contaminant risk management and remediation, focusing on "green" or more sustainable land remediation and contaminant risk management methods, and development of new water, waste and soil treatment technologies for nuclear decommissioning and other applications.

Han Yongming

I am an environmental geochemist specializing in combustion markers and the historical reconstruction of regional biomass burning (or wildfire) and fossil fuel combustion emissions, as well as how they are related to climate changes. My research ranges from the relatively short time scale of combustion pollutants in the atmosphere to their longer-term sedimentary records. I am particularly interested in black carbon (BC) in different Earth compartments (atmosphere, soils and sediments), including its analytical methods, origins, transport, deposition, and fate. I developed a method to differentiate two subtypes of BC, char and soot, and based on which I proposed to distinguish flaming and smouldering combustions in biomass burning, as they can have different environmental and climatic impacts on both short- and long-term time scales. I also apply numerical simulation to assess the impacts of fire and its emissions on monsoon precipitation and radiative forcing. Currently, I am leading a major project funded by the National Natural Science Foundation of China to study the Anthropocene in China. We are investigating the Anthropocene sections in China. We seek to distinguish between natural and anthropogenic markers in geological and biological records to study the human impacts on the environment. In addition, I am interested in aerosol and particulate air pollution. Please visit my ResearchGate website: https://www.researchgate.net/profile/Yongming_Han

Francine McCarthy

I am Professor of Earth Sciences at Brock University and appointed to the Department Biological Sciences and the Environmental Sustainability Research Centre. My research focuses on using microfossils in lake sediments to reconstruct paleoenvironmental conditions (climate, hydrology, water quality, anthropogenic impact, lacustrine food-web interactions). I feel that lakes are the best archives of continental environments, and that

reconstructing ecosystems as accurately as possible from the fossil record provides our best insights into past conditions. My work to date has primarily been on the Great Lakes and small lakes in their catchment and on lakes on the east coast of North America – the most iconic of which is Walden Pond, made famous by the naturalist and philosopher Henry David Thoreau. I am leading the effort to investigate the potential of the varved sequence from Crawford Lake (Milton, Ontario, Canada) to define the Anthropocene Epoch. Participation in this venture has led me to explore the broader aspects of this topic, so I am exploring this with a philosopher and a poet and their graduate students at Brock in addition to collaborating with Martin Head and other scientists.

Simon Turner

I am a Senior Research Fellow in Geography at University College London (UCL). I am the Scientific Coordinator for the collaborative Haus der Kulturen der Welt (HKW), Max Planck Institute for the History of Science (MPIWG) and Anthropocene Working Group (AWG) project to define the global boundary stratotype section and point (GSSP) for the start of the Anthropocene.

My research background is in the use of sediment records to resolve the impact of human activity and environmental change in lake and wetland systems. I have used physical, geochemical and radiometric analyses (Hg, trace metals, SCPs, C/N isotopes, POPs, radionuclides, microplastics) to determine temporal and spatial patterns of contaminants in both urban and remote lakes. My work since 2005 with colleagues at UCL has focused primarily on lake sediment records of environmental change over the last 150 years in the United Kingdom and globally. My most recent research has been working on a UK-scale project (NERC Hydroscape) to understand the role that connectivity (linkage of lakes, rivers and their catchments) and environmental stressors, such as legacy metal contaminants, have on the current ecological status of urban and rural lakes. I also have a continued research interest in deciphering longer-term sediment contaminant records from archaeological and historical occupation sites, such as ongoing geoarchaeological work at coastal Mayan sites in Belize.

SELECTED PUBLICATIONS

The Working Group has also published over 2020, or has in press the following:

Syvitski, J., Waters, C.N., Day, J., Milliman, J.D., Summerhayes, C., Steffen, W., Zalasiewicz, J., Cearreta, A., Gałuszka, A., Hajdas, I., Head, M.J., Leinfelder, R., McNeill, J.R., Poirier, C., Rose, N.L., Shotyk, W., Wagreich, M., Williams, M., 2020. Extraordinary human energy consumption and resultant geological impacts beginning around 1950 CE initiated the proposed Anthropocene Epoch. *Communications Earth & Environment*, 1, https://doi.org/10.1038/s43247-020-00029-y

Zalasiewicz, J. Waters, C.N., Ellis, E.C., Head, M.J., Vidas, D., Steffen, W., Thomas, J.A., Horn, E., Summerhayes, C.P., Leinfelder, R., McNeill, J.R., Gałuszka, A., Williams, M., Barnosky, A.D., Richter, D. DeB., Gibbard, P.L., Syvitski, J., Jeandel, C., Cearreta, A., Cundy, A.B., Fairchild, I.J., Rose, N.L., Ivar do Sul, J.A., Shotyk, W., Turner, S., Wagreich, M. & Zinke, J. (in press). The Anthropocene: comparing its meaning in geology (chronostratigraphy) with conceptual approaches arising in other disciplines. *Earth's Future.*

Other Anthropocene-related papers/books published by AWG members over 2020, or in press:

Bancone, C.E.P., Turner, S.D., Ivar do Sul, J.A. & Rose, N.L. (2020). The palaeoecology of microplastic accumulation. *Frontiers in Environmental Science*, 8, article 574008. https://doi.org/10.3389/fenvs.2020.574008

Cearreta, A. & García Artola, A. (2020). Geología, Antropoceno y Cambio climático. In: *50 urte Zientzia eta Teknologia zabaltzen/50 años divulgando Ciencia y Tecnología* (eds. González Mendia, O., Martínez Mazaga, U. & Tomé López, C.). Servicio Editorial de la Universidad del País Vasco UPV/EHU, Bilbao, p. 127-129, ISBN 978-84-1319-271-0

Cearreta, A. & Irabien, M.J. (2020). ¿Qué esconden los sedimentos de la Ría de Bilbao? *UPV/EHU Campusa Newsletter*. https://www.ehu.eus/es/-/%C2%BFqu%C3%A9-esconden-los-sedimentos-de-la-r%C3%ADa-de-bilbao-

Ellis, E.C., Beusen, A.H.W. & Klein Goldewijk, K. (2020). Anthropogenic Biomes: 10,000 BCE to 2015 CE. *Land*, 9, 129. https://doi.org/10.3390/land9050129

Gabbott, S., Key, S., Russell, C., Yonan, Y. & Zalasiewicz, J. (2020). The geography and geology of plastics: their environmental distribution and fate. Chapter 3 In *Plastic Waste and Recycling: Environmental Impact, Societal Issues, Prevention and Solutions* (ed. Letcher, T.). Academic Press, p. 33-63. https://doi.org/10.1016/B978-0-12-817880-5.00003-7

Irabien, M.J., Cearreta, A., Gómez-Arozamena, J. & García-Artola, A. (2020). Holocene vs Anthropocene sedimentary records in a human-altered estuary: The Pasaia case (Northern Spain). *Marine Geology*, 429, 1-15. https://doi.org/10.1016/j.margeo.2020.106292

Irabien, M.J., Cearreta, A., Gómez-Arozamena, J., Gardoki, J. & Fernández Martín-Consuegra, A. (2020). Recent coastal anthropogenic impact recorded in the Basque Mud Patch (southern Bay of Biscay shelf). *Quaternary International*, 566-567, 357-367. https://doi.org/10.1016/j.quaint.2020.03.042

Gałuszka, A., Migaszewski, Z.M., & Rose, N.L. (2020). A consideration of polychlorinated biphenyls as a chemostratigraphic marker of the Anthropocene. *The Anthropocene Review*, 2053019620916488. https://doi.org/10.1177/2053019620916488

Grinevald, J. (2020) Eureka! Il momento di Paul Crutzen a Cuernavaca. *Opera Nuova*, 2, pp. 93-102.

Ivar do Sul J.A., Labrenz M. (2021) Microplastics into the Anthropocene. In: Rocha-Santos T., Costa M., Mouneyrac C. (eds) Handbook of Microplastics in the Environment. Springer, Cham. https://doi.org/10.1007/978-3-030-10618-8_25-2

Knierzinger, W., Drescher-Schneider, R., Knorr, K.-H., Drollinger, S., Limbeck, A., Brunnbauer, L., Horak, F., Festi, D., Wagreich, M. (2020). Anthropogenic and climate signals in late-Holocene

peat layers of an ombrotrophic bog in the Styrian Enns valley (Austrian Alps). *E&G Quaternary Science Journal*, 69, 121–138. https://doi.org/10.5194/egqsj-69-121-2020

Lear, C.H., Anand, P., Blenkinsop, T., Foster, G.L., Gagen, M., Hoogakker, B., Larter, R.D., Lunt, D.J., McCave, I.N., McClymont, E., Pancost, R.D., Rickaby, R.E.M., Schultz, D.M., Summerhayes, C., Williams, C.J.R., & Zalasiewicz. J. (2020). Geological Society of London Scientific Statement: what the geological record tells us about our present and future climate. *Journal of the Geological Society*, 178, jgs2020-239. https://doi.org/10.1144/jgs2020-239

Leinfelder, R. (2020): Das Anthropozän - mit offenem Blick in die Zukunft der Bildung.. In: Sippl, C.Rauscher, E.& Scheuch, M. (Hrsg.): Das Anthropozän lernen und lehren, S. 17-65, Reihe: Pädagogik für Niederösterreich, Band 9, Innsbruck, Wien (StudienVerlag), print ISBN 978-3-7065-5598-2, ebook EAN 9783706560832

Leinfelder, R. (2020): Das Anthropozän - Von der geowissenschaftlichen Analyse zur Zukunftsverantwortung.- In: Heichele, T. (ed.), Mensch - Natur - Technik: Philosophie für das Anthropozän, STEP - Studien zur systematischen Theologie, Ethik und Philosophie, Bd. 19, S. 25-45, Münster (Aschendorff-Verlag) (open access version: https://www.aschendorff-buchverlag.de/detailview?no=11848)

Schwägerl, C. & Leinfelder, R. (2020): Anthropozän - mehr als eine wissenschaftliche Hypothese. In: Gärtig, T. & Veltmann, T. (eds.), Im Steinbruch der Zeit: Erdgeschichten und die Anfänge der Geologie, p. 229-241, Kataloge der Francke'schen Stiftungen, Bd. 37, Wiesbaden (Harrasowitz-Verlag). ISBN 978-3-447-11383-0

Leinfelder, R. (2020): Von der Umwelt zur Unswelt - Das Potenzial des Anthropozän-Konzeptes für den Schulunterricht. In: Schörg, Ch. & Sippl, C. (Hrsg.): Die Verführung zur Güte. Beiträge zur Pädagogik im 21. Jahrhundert. Festschrift für Erwin Rauscher, S. 81-97, Innsbruck, Wien (StudienVerlag). (Reihe: Pädagogik für Niederösterreich Band 8)

Leinfelder, R. (2020): Mit voller Wucht - The Human Epoch - In: Notizen aus dem Anthropozän (Hg. Stiftung Nantesbuch), S. 70-77, München, ISBN 978-3-945674-14-7-

Leinfelder, R. (2020): Zukunftspfade in die Menschenzeit.- In: Notizen aus dem Anthropozän (Hg. Stiftung Nantesbuch), S. 100-106, München, ISBN 978-3-945674-14-7.

Leinfelder, R. (2020). The Anthropocene - The Earth in Our Hands. *Refubium Freie Universität Berlin.* http://dx.doi.org/10.17169/refubium-26459

Milon, A-S. & Zalasiewicz, J. (2020). Carbon dioxide. In (Tsing, A., Deger, J., Keleman-Saxena, A. & Zhou, F., eds) *Feral Atlas: The More-Than-Human Anthropocene*. Digital project, Stanford University. http://feralatlas.org/

Odada, E.O., Olago, D.O. & Olaka, L.A. (2020). An East African perspective of the Anthropocene. *Scientific African*, 10, e00553. https://doi.org/10.1016/j.sciaf.2020.e00553

Richter, D.D. (2020). Game changer in soil science: The Anthropocene in soil science and pedology. *Journal of Plant Nutrition and Soil Science*, 183, 5–11. https://onlinelibrary.wiley.com/doi/pdf/10.1002/jpln.201900320

Richter, D.D. & Billings, S.A. (2020). Ansichten der Calzone: Views of the Calhoun Critical Zone Observatory. In: *Critical Zones: The Science and Politics of Landing on Earth*, (Latour, B. and Weibel, P., eds). MIT Press, .

Sáez-Muñoz, M., Ortiz, J., Martorell, S., Gómez-Arozamena, J. & Cearreta, A. (2020). Sequential determination of uranium and plutonium in soil and sediment samples by borate salts fusion. *Journal of Radioanalytical and Nuclear Chemistry*, 323, 1167–1177. https://doi.org/10.1007/s10967-020-07028-5

Steffen, W., Richardson, K., Rockström, J., Schellnhuber, H.J., Dube, O.P., Dutreuil, S., et al. (2020). The emergence and evolution of Earth System Science. *Nature Reviews Earth and Environment*, *1*, 54–63, https://doi.org/10.1038/s43017-019-0005-6

Summerhayes, C.P., 2020, Paleoclimatology: from Snowball Earth to the Anthropocene. WILEY/Blackwell. 543pp.

Summerhayes, C., Zalasiewicz, J., Vidas, D. & Williams, M. (in press). Polar Regions in the Anthropocene. Chapter 2 in *Research Handbook on Polar Law* (K. Scott and D. VanderZwaag, eds.). Edward Elgar Publishing.

Thomas, J.A., Williams, M. & Zalasiewicz J. (2020). *The Anthropocene: A Multidisciplinary Approach.* Cambridge, UK: Polity Press, 288 pp.

Thomas, J.A. & Zalasiewicz J. (in press). *Strata and Three Stories*. RCC Perspectives: Transformations in Environment and Society 2020/3, 69 pp. Rachel Carson Centre, Munich.

Vidas D., Zalasiewicz, J., Summerhayes, C., & Williams, M. (2020). Climate Change and the Anthropocene: Implications for the Development of the Law of the Sea. In E. Johansen, S. Busch, & I. V. Jakobsen (Eds.), *The Law of the Sea and Climate Change: Solutions and Constraints*. Cambridge, UK: Cambridge University Press, 22–48.

Wade, A.M., Richter, D.D., Cherkinsky, A., Craft, C.B., & Heine, P.R. (2020). Limited carbon contents of centuries old soils forming in legacy sediment. *Geomorphology*, *354*, p.107018. https://doi.org/10.1016/j.geomorph.2019.107018

Waters, C. N. and Jeandel, C. (in press). L'Anthropocène géologique, preuve physique du changement planétaire. *Revue Geosciences*, BRGM.

Zalasiewicz, J. (2020). The fossilization of architecture in the Anthropocene. In (Butcher, M. and O'Shea, M.J., eds.) *Emerging Architectural Research 2009-2018*. UCL Press, 274-286.

Zalasiewicz, J. (2020). The Anthropocene square meter. In *Critical Zones. The Science and Politics of Landing on Earth* (Latour, B. & Weibel, P., Eds). MIT Press, 36-43.

Zalasiewicz, J. (2020). The Anthropocene and global warming – a brief update. Ch. 3 in *Nature and Value* (Bilgrani, A., Ed.), Columbia University Press, pp. 25-28

Zalasiewicz, J. (2020). The extraordinary strata of the Anthropocene. Ch. 4 in *Nature and Value* (Bilgrani, A., Ed.), Columbia University Press, pp. 29-45Zalasiewicz, J., Waters, C. and Williams, M. (2020). City-Strata of Anthropocene. *Annales HSS* (English Edition), 72(2), 225-245. https://doi.org/10.1017/ahsse.2019.11

Zalasiewicz, J., Waters, C. and Williams, M. (2020). Chapter 31: The Anthropocene. In: Gradstein, F., Ogg, J., Schmitz, M. and Ogg, G. (eds.) *A Geologic Time Scale 2020*, Elsevier, 1257-1280

Zalasiewicz, J., Williams, M. and Waters, C. (in press). Anthropocene patterns in stratigraphy as a perspective on human success. In: Desmond, H. and Ramsey, G. (eds.) *Human Success: Evolutionary Origins and Ethical Implications*. Oxford University Press.

KEY REPORTS BY OTHER INTERNATIONAL BODIES

Listed here are key reports from the past year that made extensive reference to the Anthropocene.

- Human Development Report 2020: The next frontier - Human development and the Anthropocene http://hdr.undp.org/en/2020-report

- European Environment Agency (EEA) (2020). Drivers of change of relevance for Europe's environment and sustainability. (EEA Rep. 25/2019). ISSN 1977-8449.

- German Advisory Council on Global Change (2020). Rethinking Land in the Anthropocene: from Separation to Integration, https://www.wbgu.de/en/publications/publication/landshift#:~:text=The%20German%20Advisory%20Council%20on,and%20create%20sustainable%20food%20systems.

- German Advisory Council on Global Change (2020). Rethinking Land in the Anthropocene: from Separation to Integration, https://www.wbgu.de/en/publications/publication/landshift#:~:text=The%20German%20Advisory%20Council%20on,and%20create%20sustainable%20food%20systems.

- WWF (2020) Living Planet Report 2020 - Bending the curve of biodiversity loss. Almond, R.E.A., Grooten M. and Petersen, T. (Eds). WWF, Gland, Switzerland.

CONFERENCES/LECTURES

Alejandro Cearreta:
"Antropoceno: No sólo clima y diversidad", Lemniskata Zientzia Sare Herrikoia Elkartea, Beasain (Basque Country, Spain), 20 November 2020.

Catherine Jeandel:
"L'Anthropocène: du concept environnemental à la réalité géologique", Impacts des activités anthropiques sur l'environnement Working Groupe "terrestrial Environment " in Saclay, Paris (2nd July)

Reinhold Leinfelder
Das Anthropozän-Konzept - Mehrebenenansatz und Zukunftsrelevanz. Thematic Research Network, Uni Heidelberg (online-lecture) 13th January 2021

Das Anthropozän - von der erdsystemaren Analyse zur Zukunftsverantwortung. Interdisziplinäre Ringvorlesung Erdsystemforschung, iSP Umweltwissenschaften, TU-Darmstadt. (online-lecture) 8th December 2020

Wie schmeckt Future Food? Zukunftskongress Next Frontiers. Stuttgart (Haus der Architekten) (Video-Impulse Lecture) 21st October 2020

Fossilien der Technosphäre - Reste und Ressourcen im Erdzeitalter des Menschen. Umundu 2020-Festival. riesa efau. Kultur Forum Dresden *(online contribution to the festival), ->* youtube 9th October 2020

Energie und Ökologie im Anthropozän. Vortragsreihe "Umweltschutz heute". Teil 2: Energie und Ökologie heute, Universität Augsburg und Bayerisches Landesamt für Umwelt 27th January 2020

Von der Umwelt zur Unswelt - Das Potenzial des Anthropozän-Konzepts für nachhaltige Entwicklung. Studium oecologicum - mehr Nachhaltigkeit in der Lehre!, Ringvorlesung der Studentischen Initiative Stud Oec an der Universität Potsdam 21st January 2020

The Health of the Earth System in the Age of Humankind (Anthropocene) - A Multiscale and Multimodal Project. Nikolaus Lecture, BSRT Symposium, Symposium The Hitchhikers's Guide to Regenerative Therapies. The Role of Space and Time in Healing Processes, Berlin Brandenburg School for Regenerative Therapies, Charité Campus Virchow Klinikum. 6th December 2019

Will Steffen:
First interview of the podcast Common Home Conversations Beyond UN75 (23rd September) https://www.theplanetarypress.com/2020/09/will-steffen-common-home-conversations-beyond-un75/

Colin Summerhayes:
Climate change and the Anthropocene. Contribution to Geology for the Future Symposium, De La Beche Club, Imperial College, London. January 29th.

Earth's Climate Evolution: Phanerozoic time including the Anthropocene. Purley Probus, Purley, Surrey. March 12th.

Climate Change and Energy Use, with an emphasis on the Anthropocene.
University of the 3rd Age, Fleet, Hampshire. ZOOM Lecture, November 6th

Jaia Syvitski:
Webinar: "Advent of the Anthropocene Epoch ~1950 CE: Quantifying Drivers and Impacts" Seds Online (26th August) https://www.youtube.com/embed/dKOOezcLHGc

Simon Turner
Webinar 'Earth Indices: Evidence and Experiment: A Golden Spike for the Anthropocene'. UCL

Anthropocene Seminar series (13th October 2020)
https://web.microsoftstream.com/video/6d983818-aded-4d99-8452-761a01ce2bc8

Webinar lecture for project launch of '"Anthropogenic Markers - Historical and Material Contexts of a Twentieth-Century Transition in Earthy Matters" Max Planck Institute for the History of Science (2nd November 2020)

Michael Wagreich:
Workshop of the Vienna Anthropocene Network: Vanishing Ice. Human and natural impacts of a changing cryosphere. 21 - 22 January 2020, University of Vienna.

Wagreich, M.(2020). Im Übergang zum Anthropozän – vom Wiener Neustädter Kanal und der I. Wiener Hochquellenleitung zur Großen Beschleunigung. In: Sippl, C., Rauscher, E. & Scheuch, M. (eds.): Das Anthropozän lernen und lehren, Innsbruck, Wien (StudienVerlag). ISBN 978-3-7065-5598-2.

Colin Waters:
Sopot Literary Festival, Poland (22nd August): in conversation with the authors Dorota Masłowska and Ilona Wisniewska; moderated by the journalist Tomasz Ulanowski.

MEDIA

Specific media output related to work by members of the AWG include:

Alejandro Cearreta:
Interview on the Anthropocene (radio broadcast, in Spanish), Catástofe Violeta #28, Cátedra de Cultura Científica de la UPV/EHU and Fundación Euskampus, 11 June 2020,
http://catastrofeultravioleta.com/antropoceno/

"Anthropocene: Our legacy on the rocks" (television documentary, in Spanish), Spanish National Television RTVE2, Crónicas, 23 September 2020,
https://www.youtube.com/watch?v=hdO6WkIvCNs

Jacques Grinevald:
L'urgence Climatique avec le professeur Jacques Grinevald YouTube, 17 December.
https://www.youtube.com/watch?v=B21A9vHCqgQ

Reinhold Leinfelder
TV:
ARTE TV-Production: Plastic Everywhere
Uhr ARTE , Plastik überall - Geschichten vom Müll. ARTE.tv-info, and Mediathek from 13 June 2020 until 11 Sep 2020 (check contrib. Reinhold Leinfelder at FU e.g. at 1:17:04). 14th July 2020, 20:15 also on youtube

Plastic partout! Histoires de déchets. ARTE France www.arte.tv/fr/videos/077392-000-A/plastic-partout 14th July 2020, 20:50:

RTVE: Documentos TV - Plásticos por todas partes, Information, Mediathek 2nd June 2020 (available until 16 June 2020)

TV-channel ZDF and 3Sat Terra X: Anthropozän - Das Zeitalter des Menschen, Teil 1-3", Expert advisory by H.R. Bork, M. Glaubrecht, R. Leinfelder, R. Simek. Infos, Sendetermine ZDF u. 3Sat, Mediathek 27th February 2020 /8.,15.,22. Mrz 2020,

Print/online:
Berliner Zeitung, Energieverbrauch seit 1950 höher als in Jahrtausenden zuvor. berliner-zeitung.de/news/studie-energieverbrauch-seit-70-jahren-hoeher-als-jahrtausende-zuvor-li.112991 (and other german newspapers) 21st October 2020

Der Tagesspiegel, print, 15th February 2020, S B1. Ökologie im Anthropozän - Tierische Importe. Der Zoologe Jonathan Jeschke erforscht neue, menschengemachte Ökosysteme. Den Geobiologen Reinhold Leinfelder beschäftigen deren globale Auswirkungen. > Tagesspiegel-online version vom 19. Feb 2020

Colin Summerhayes
The MARTINZ Critical Review - Episode #18 - An in-depth investigation of Earth's climate past and present from a marine geology and oceanographic perspective (up to and including the Anthropocene) – with Dr Colin Summerhayes
Available on-line https://anchor.fm/martinz-critical-review/episodes/The-MARTINZ-Critical-Review---Ep-18--An-in-depth-investigation-of-Earths-climate-past-and-present-from-a-marine-geology-and-oceanographic-perspective---with-Dr--Colin-Summerhayes-ek5qc7

Michael Wagreich:
Webpage (https://anthropocene-vienna.univie.ac.at/) and interview on "The Anthropocene Surge" (WWTF Vienna project on the human-made underground of Vienna).
https://www.youtube.com/watch?v=Qx7PKMNF9Do

Colin Waters:
Interview for Stephanie Pappas for Scientific American article on "Human-Made Stuff Now Outweighs All Life on Earth" https://www.scientificamerican.com/article/human-made-stuff-now-outweighs-all-life-on-earth/

Colin Waters and Jan Zalasiewicz:
Recorded interviews for a film produced by Cécile Dumas (www.lookatsciences.com)

Interview with Tanja Traxler for the Austrian daily broadsheet Der Standard appearing in the newspaper in July 2020 to coincide with the 75th anniversary of the Trinity Test and abbreviated on the website https://www.derstandard.at/story/2000118724478/vor-75-jahren-explodierte-die-erste-atombombe-der-welt

Colin Waters, Jan Zalasiewicz, Simon Turner, Neil Rose and Phil Gibbard:
Interviews for Rachel Brazil article on Marking the Anthropocene for Chemistry World
https://www.chemistryworld.com/features/marking-the-anthropocene/4012969.article

Jan Zalasiewicz, Colin Waters, and Will Steffen
Zalasiewicz, J., Waters, C. and Steffen, W. (5th February 2021) Remembering the Extraordinary Scientist Paul Crutzen (1933–2021). *Scientific American*

https://www.scientificamerican.com/article/remembering-the-extraordinary-scientist-paul-crutzen-1933-2021/

Jan Zalasiewicz and Mark Williams:

Zalasiewicz, J. & Williams, M. 2020. Anthropocene: human-made materials now weigh as much as all living biomass, say scientists. *The Conversation*, Dec. 9, 2020. https://theconversation.com/anthropocene-human-made-materials-now-weigh-as-much-as-all-living-biomass-say-scientists-151721

NEWS

- Jürgen Renn, director at the Max Planck Institute for the History of Science in Berlin has a book on 'The Evolution of Knowledge: rethinking science for the Anthropocene', due to be published by Princeton University Press on 14th January 2020.

- Andy Revkin, former member of the AWG, has become founding director of the Initiative on Communication & Sustainability, at The Earth Institute, Columbia University. He is producing a series of webcasts focused on the wider meanings of the Anthropocene, lessons from our recent viral misadventures and more. The overall series is called Sustain What and can be seen here: http://j.mp/sustainwhatlive.

- Jennifer Baichwal and Nick de Pencier report that 'The Anthropocene Education Program was launched in 2020 and is currently available for free in both English and French via Canadian Geographic Education's online classroom. It presents an opportunity for students to learn the history and science behind the Anthropocene and to explore the ways in which humans are changing Earth's natural systems. An emphasis has been placed on accessible, online materials, meaning the program can be used by students in the classroom and at home. Using immersive technology such as augmented and virtual reality, video, and interactive photography, the program is designed for students in grades 4-12 and covers a range of topics, including climate change, species extinction, and bioaccumulation of microplastics. All lessons come with modifications that make each topic relevant to primary, intermediate, and secondary students'. The program can be accessed through https://anthropocene.canadiangeographic.ca/main/

MEMBERSHIP TO DATE

Listed here are names of members to date and their contact details (as of 31st December 2020). New members in 2020 are denoted by an asterisk. Membership is distinguished between voting and advisory. Voting members will vote on the GSSP candidate selection.

An Zhisheng (Advisory)
State Key Laboratory of Loess and Quaternary Geology, The Institute of the Earth Environment, Chinese Academy of Sciences (CAS), 10 Fenghui South Road, Xi'an High-Tech Zone, Xi'an 710075, China
e-mail: anzs@loess.llqg.ac.cn

Tony Barnosky (Voting)
Jasper Ridge Biological Preserve, Stanford University, Stanford, CA 94305 USA.
e-mail: tonybarnosky@stanford.edu

Alejandro Cearreta (Voting)
Departamento de Geología, Facultad de Ciencia y Tecnología,
Universidad del País Vasco UPV/EHU, Apartado 644, 48080 Bilbao, Spain
e-mail: alejandro.cearreta@ehu.es

Paul Crutzen (Honorary, deceased)
Max-Planck-Institute for Chemistry, Department of Atmospheric Chemistry,
PO Box 3060, D-55020 Mainz, Germany.
e-mail: paul.crutzen@mpic.de

Andy Cundy* (Voting)
School of Ocean and Earth Science, National Oceanography Centre (Southampton)
University of Southampton, European Way, Southampton, SO14 3ZH, UK
e-mail: A.Cundy@noc.soton.ac.uk

Matt Edgeworth (Advisory)
Honorary Research Fellow, School of Archaeology and Ancient History, University Road, Leicester, LE1 7RH.
e-mail: me87@leicester.ac.uk

Erle Ellis (Advisory)
Department of Geography & Environmental Systems, 211 Sondheim Hall, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250 USA
e-mail: ece@umbc.edu

Ian Fairchild (Voting)
School of Geography, Earth and Environmental Sciences,
University of Birmingham B15 2TT, UK
e-mail: i.j.fairchild@bham.ac.uk

Agnieszka Gałuszka (Voting)
Institute of Chemistry, Jan Kochanowski University
7 Uniwersytecka St, 25-406 Kielce, Poland.
e-mail: aggie@ujk.edu.pl

Philip Gibbard (Voting)
Scott Polar Research Institute, University of Cambridge,
Lensfield Road, Cambridge CB2 1ER.
e-mail: plg1@cam.ac.uk

Jacques Grinevald (Advisory)
IHEID, Chemin Eugène Rigot 2, 1211 Genève 11 Switzerland
e-mail: jacques.grinevald@graduateinstitute.ch

Peter Haff (Advisory)
Nicholas School of the Environment, Duke University,
103 Old Chem Box 90320 Durham NC27708 USA
e-mail: pkhaff@gmail.com

Irka Hajdas (Voting)
Laboratory of Ion Beam Physics, ETH Otto-Stern-Weg 5, 8093 Zurich, Switzerland
e-mail: hajdas@phys.ethz.ch

Han Yongming* (Voting)
State Key Laboratory of Loess and Quaternary Geology, The Institute of the Earth Environment, Chinese Academy of Sciences (CAS), 10 Fenghui South Road, Xi'an High-Tech Zone, Xi'an 710075, China
e-mail: yongming@ieecas.cn

Martin Head (Voting)
Department of Earth Sciences, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON, L2S 3A1 Canada
e-mail mjhead@brocku.ca

Juliana Assunção Ivar do Sul (Advisory)
Leibniz Institute for Baltic Sea Research Warnemüende (IOW)
Biological Oceanography Section Seestrasse 15, 18119 Rostock – Germany
e-mail: juliana.ivardosul@io-warnemuende.de

Catherine Jeandel (Advisory)
LEGOS, Université de Toulouse, CNES, CNRS, IRD, 14 avenue Edouard Belin, 31400 Toulouse, France.
e-mail: catherine.jeandel@legos.obs-mip.fr

Reinhold Leinfelder (Voting)
Dept. of Geological Sciences, Freie Universität Berlin,
Malteserstraße 74 - 100, building D, D- 12249 Berlin, Germany
e-mail: reinhold.leinfelder@fu-berlin.de

Francine McCarthy* (Voting)
Department of Earth Sciences, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, ON, L2S 3A1 Canada
e-mail: fmccarthy@brocku.ca

John McNeill (Advisory)
Georgetown University Washington DC USA
e-mail: mcneillj@georgetown.edu

Eric Odada (Advisory)
Geology Department, University of Nairobi, Chiromo Campus, Riverside Drive, P.O. Box 30197. Nairobi, Kenya
e-mail: eodada@uonbi.ac.ke

Naomi Oreskes (Advisory)
The Department of the History of Science, Harvard University, Cambridge, MA 02138, USA
e-mail: oreskes@fas.harvard.edu

Clément Poirier (Advisory)
Morphodynamique Continentale et Côtière, Normandie Université, UNICAEN, UNIROUEN, CNRS; M2C, 24 rue des Tilleuls, F-14000 Caen, France
e-mail: clement.poirier@unicaen.fr

Dan Richter (Advisory)
Nicholas School of the Environment
Duke University, 9 Circuit Drive, Box 90328, Durham, NC 27708, USA
e-mail: drichter@duke.edu

Neil Rose (Voting)
Environmental Change Research Centre, Department of Geography, University College London, Gower Street, London WC1E 6BT, UK
e-mail: n.rose@ucl.ac.uk

Yoshiki Saito* (Voting)
Estuary Research Center, Shimane University, 1060, Nishikawatsu-cho, Matsue, 690-8504, Japan
e-mail: ysaito@soc.shimane-u.ac.jp

Bill Shotyk (Advisory)
Department of Renewable Resources, University of Alberta, 348B South Academic Building, Edmonton, Alberta T6G 2H1, Canada
e-mail: shotyk@ualberta.ca

Will Steffen (Advisory)
The Australian National University, Canberra ACT 0200, Australia.
e-mail: will.steffen@anu.edu.au

Colin Summerhayes (Voting)
Scott Polar Research Institute, University of Cambridge, Lensfield Road,
Cambridge CB2 1ER, UK
e-mail: cps32@cam.ac.uk

Jaia Syvitski (Voting)
Institute of Arctic and Alpine Research, University of Colorado, Boulder Campus, Box 545, Boulder CO, 80309-0545, USA
e-mail: jai.syvitski@colorado.edu

Simon Turner* (Secretary, Voting)
Environmental Change Research Centre, Department of Geography,
University College London, Gower Street, London WC1E 6BT, UK
e-mail: simon.turner@ucl.ac.uk

Davor Vidas (Advisory)
Law of the Sea and Marine Affairs Programme, The Fridtjof Nansen Institute,
Fridtjof Nansens vei 17, PO Box 326, 1326 Lysaker, Norway
e-mail: Davor.Vidas@fni.no

Michael Wagreich (Voting)
Department of Geology, University of Vienna Althanstrasse 14, A-1090 Vienna, Austria
e-mail: michael.wagreich@univie.ac.at

Colin Waters (Chair, Voting)
School of Geography, Geology and the Environment, University of Leicester,
University Road, Leicester LE1 7RH, UK
e-mail: cw398@leicester.ac.uk

Mark Williams (Voting)
School of Geography, Geology and the Environment, University of Leicester,
University Road, Leicester LE1 7RH, UK
e-mail: mri@leicester.ac.uk

Scott Wing (Voting)
Dept. of Paleobiology, Museum of Natural History
Smithsonian Institution, Washington DC, 20013 USA.
e-mail: wings@si.edu

Jan Zalasiewicz (Voting)
School of Geography, Geology and the Environment, University of Leicester,
University Road, Leicester LE1 7RH, UK
e-mail: jaz1@leicester.ac.uk

Jens Zinke* (Voting)
School of Geography, Geology and the Environment, University of Leicester,
University Road, Leicester LE1 7RH, UK
e-mail: jz262@leicester.ac.uk

ANTHROPOCENE WORKING GROUP: PROGRAMME FOR 2021

- Arrange AWG meeting to coincide with interim assessment of GSSP study progress.
- Consolidate work on potential GSSP site assessments with support from HKW project funding. Individual groups to start production of detailed publications for respective sites for inclusion within a thematic set of paper.
- Pursue work on analysing and articulating the utility of the Anthropocene as a formal part of the International Chronostratigraphic Chart.
- Finalize ideas about best strategy for initial communication to SQS and ICS; potential involvement of members of both bodies in future AWG meetings.

Colin Waters (Chair)

Simon Turner (Secretary)

January 2021