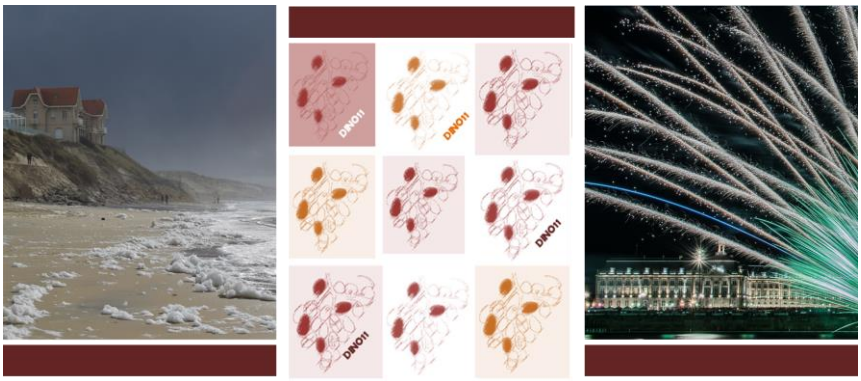

11th INTERNATIONAL CONFERENCE ON MODERN AND FOSSIL DINOFLAGELLATES

17–21 July 2017, Bordeaux (France)

With the kind support of:

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Program and abstract volume

SUMMARY

Final meeting program

Monday 17/07/2017

10h30-13h30: Onsite Registration (NB18 building, Allée Geoffroy St Hilaire, U Bordeaux, see the map here)

13h30-14h: Welcome, DINO 11 opening talks. NB18 Amphitheater (NB18 building, Allée Geoffroy St Hilaire, U Bordeaux, see the map here)

14h-14h20: How sequence data will drive systems thinking of dinoflagellate biology. JANOUSKOVEC, Jan

14h20-14h40: Diversity and taxonomy of benthic *Prorocentrum* species in Anse Dufour, Martinique Island (Caribbean Sea). CHOMÉRAT, Nicolas et al.

14h40-15h: From the phylogeography of the *Prorocentrum lima* complex to the morphospecies concept in *P. lima* sensu stricto and *P. arenarium*. LAZA-MARTÍNEZ, Aitor et al.

15h-15h20: *Heterocapsa triquetra* sensu Stein - plate pattern clarification and nomenclatural issues. HOPPENRATH, Mona et al.

15h20-15h40: Reclassification, distribution and genetic diversity of *Cochlodinium geminatum* (= *Polykrikos geminatum*). HU ZHANGXI et al.

15h40-16h: Cryptic diversity within the harmful dinoflagellate *Akashiwo sanguinea* in coastal Chinese waters is related to differentiated ecological niches. GU, Haifeng et al.

Coffee break (16h-16h30) - Poster

16h30-16h50: Repeated diatom capture in dinophytes hosting a tertiary endosymbiont (Kryptoperidiniaceae, Peridiniales). ZERDONER CALASAN, Anze et al.

16h50-17h10: Cyst-theca relationships in dinoflagellates – Wall and Dale revisited. LEWIS, Jane M.

17h10-17h30: A novel morpho-molecular analysis of Podolampadaceans: are morphological concepts supported by phylogenetics? MERTENS, Kenneth N. et al.

17h30-17h50:DinoREF: an updated and curated dinoflagellate (Dinophyceae) reference database for the 18S rRNA gene region. MORDRET, Solenn et al.

18h-18h30: Poster session

18h30-19h30 Keynote: The evolution of toxin synthesis in dinoflagellates, MURRAY, Shauna

19h30: Icebreaker, Welcome reception (NB18 building, Allée Geoffroy St Hilaire, U Bordeaux, see the map here)

Tuesday 18/07/2017

Talks will take place in the NB18 Amphitheater, see campus map here.

8h-8h20: Evolution of sea surface conditions in northeastern Baffin Bay during the Holocene based on dinoflagellate cyst assemblages – Preliminary results. CARON Myriam et al.

8h20-8h40: Paleoceanographical conditions of North Pacific Ocean during the Pliocene based on organic-walled dinoflagellate cysts. ZORZI, Coralie et al.

8h40-9h: A new centennial scale Holocene dinoflagellate cyst record from Vancouver Island (British Columbia, Canada). GURDEBEKE, Pieter R. et al.

9h-9h20: A cool Last Interglacial Period in the SW Pacific, evidence from new dinocyst records. MARRET, Fabienne et al.

9H20-9h40: Paleoproductivity changes over the last 30ky in the NW Moroccan margin as reconstructed from palynological (dinocyst) and stable isotopic tracers. PENAUD, Aurélie et al.

9h40-10h: Palynological records of the last million years in the Central North Atlantic Ocean, IODP Site 303-U1304. RADI Taoufik & DE VERNAL Anne

Coffee break (10h-10h30) - Poster

10h30-10h50: Dinoflagellate cysts in deep-sea sediment traps around the northern North Atlantic: implications for paleoceanography. DALE, Barrie & DALE, A. L.

10h50-11h10: Modern Analogue Technique at test in the South Italian Region – a 300 year record. ZONNEVELD, Karin A.F & SICCHA, Michael (ENDING session 2.1.)

11h10-11h50: Aspects of Mesozoic dinoflagellate cyst palaeobiology. RIDING, James B. **Introductive talk to session 2.2**

11h50-12h10: The dinoflagellate cysts of the Bajocian GSSP (Middle Jurassic) at Cabo Mondego, Lusitanian Basin, Portugal. CORREIA, Vânia F. et al.

12h10-12h30: Dinocyst biostratigraphy of the southeastern US, selections from Cretaceous to Quaternary. EDWARDS, Lucy E.

12h30-14h: Lunch and poster session

14h-14h20: New Dinophysoid-related dinoflagellates from the Central Equatorial Pacific. CARBONELL-MOORE, Consuelo

14h20-14h40: Taxonomic reinvestigation of type species *Dinophysis acuta* Ehrenb. and *Dinophysis* s. s. (Dinophysales). ZINSSMEISTER, Carmen et al. (ENDING session 1.1.)

14h40-15h: Palynological study of sediments associated to cold-water coral carbonate mounds in the moroccan atlantic and mediterranean margins (MD194/eurofleet-gateway oceanographic cruise). RACHID J. et al.

15h-15h20: Developing new approaches for the harmful dinoflagellate diversity studies and management of their toxic blooms. PENNA, Antonella et al.

15H20-15h40: Different life cycle strategies of the dinoflagellates *Fragilidium duplocampanaeforme* and its prey *Dinophysis acuminata* may explain their different susceptibilities to the infection by the parasitoid *Parvilucifera infectans*. LEE, Bora & PARK, Myung G

15h40-16h: Metabolomic differences between modern and ancient dinoflagellates in phosphorous-limited culture conditions. SIANO, Raffaele et al.

Coffee break (16h-16h30) -Poster

16h30-16h50: Transcriptomic analyses of *Scrippsiella trochoidea* revealed processes regulating encystment and dormancy in the life cycle of dinoflagellates, with a particular attention to the role of abscisic acid. DENG YUNYAN (/Tang Ying Zhong) et al. (ENDING session 1.2.)

16h50-17h10: Benthic Harmful Algal Blooms of *Ostreopsis fattorussoi* in Beirut, Lebanon (Eastern Mediterranean) in relation with environmental factors. AÇAF, Laury et al.

17h10-17h30: Physiological responses of the toxic dinoflagellate *Ostreopsis* cf. ovata to the allelopathic effect of three macrophytes species. BEN GHARBIA, Hela et al.

17h30-17h50:Distribution and abundances of benthic toxic dinoflagellates in French West Indies. BOISNOIR, Aurélie et al.

18h-18h30: Poster session

18h30-19h30 Keynote: Pliocene Nordic Seas surface circulation and sea ice evolution. DE SCHEPPER, Stijn

Wednesday 19/07/2017

Talks will take place in the NB18 Amphitheater, see campus map **here**.

8h-8h20: Freshwater dinoflagellate ecology determined from 40-lake calibration set in the Experimental Lakes Area in northwest Ontario, Canada. DANESH, Donya et al.

8h20-8h40: What are the main environmental factors determining recurrent blooms of the neurotoxic *Alexandrium pacificum* Litaker sp. nov (Group IV) in a Mediterranean ecosystem ? LAABIR, Mohamed et al.

8h40-9h: Heterotrophic marine palynomorphs were dominant in tropical coastal shallow water sediments in Southeast Asia. MATSUOKA Kazumi et al.

9h-9h20: Interplay among mixotrophy, allelopathy, and parasitism: a case study of the mixotrophic ciliate *Mesodinium rubrum*, the mixotrophic dinoflagellates *Dinophysis* spp. and *Fragilidium duplocampanaeforme*, and the parasitoid *Parvilucifera infectans*. PARK, Eunkyung et al.

9h20-9h40: Dinoflagellate HAB-complex in the north-western Arabian/Persian Gulf. POLIKARPOV, Igor et al.

9h40-10h: Particularities of dinomitosis pattern in different dinoflagellates. BERDALET, Elisa et al.

Coffee break (10h-10h30) - Poster

10h30-10h50: New records of benthic dinoflagellates (Dinophyceae) from the Canary Islands: consequence of the global change? SOLER-ONÍS, Emilio et al.

10h50-11h10: Benthic dinoflagellates ecology: Testing the Artificial Substrate Method across environmental gradients. ZABALA, F. Juan et al. (ENDING session 1.3.)

11h10-11h30: A new *Gonyaulax* species causing a red tide in the tropical Mexican Pacific, *Gonyaulax undistortata* nov. sp.. HERNÁNDEZ BECERRIL David U. et al.

11h30-11h50: Characterisation and comparison of toxin-producing isolates of *Dinophysis sacculus* and *D. acuminata* from Arcachon Bay. SÉCHET, Véronique et al. (ENDING session 1.4.)

11h50-12h10: Phycological and palynological evidence of marine – freshwater transition in the family Thoracosphaeraceae. McCARTHY, Francine M.G. et al. (ENDING session 1.5.)

12h10-12h30: Studies of dinoflagellate cysts and ecological importance in and around the seas of Turkey. AYDIN, Hilal et al.

12h30-14h: Lunch and poster session

14h-14h20: L'intérêt des kystes de Dinoflagellés pour la datation des terrains mésozoïques et la reconstitution des paléoenvironnements. Le domaine rifain, le Maroc Nord Oriental et la marge atlantique marocaine. HSSAIDA Touria

14h20-14h40: Lithostratigraphic problem solving with dinoflagellate cysts. An example from the Netherlands: Updated and revised (Miocene-Early Pliocene) stratigraphic framework of the Breda Formation. MUNSTERMAN, Dirk K et al.

14h40-15h: Cretaceous dinocysts as paleoenvironmental reconstruction tool. The Aptian in the Southern Provence Basin (SE France). SANCHEZ-PELLICER, Raquel et al.

15h-15h20: Revisiting the Ypresian Kallo record (North Sea Basin), a dinoflagellate cyst analysis of an Eocene hyperthermal (ETM-2) interval. STEEMAN, Thomas et al.

15h20-15h40: Taxonomic review of selected dinocysts from the Middle to Late Jurassic of the Bonaparte Basin, Western Australia. VITACCA, Jesse et al.

15h40-16h: Biostratigraphic correlation of the western and eastern margins of the Labrador – Baffin Seaway. NØHR-HANSEN, Henrik et al.

Coffee break (16h-16h30) - Poster

16h30-16h50: Organic-walled dinoflagellate cysts as indicator of sea-surface salinity in the subpolar Late Cretaceous Greenland-Norwegian Seaway. RADMACHER, Wieslawa et al.

16h50-17h10: Which early Palaeozoic acritarchs might be dinoflagellate cysts? SERVAIS, Thomas et al.

17h10-17h30: New gonyaulacacean dinoflagellate cysts from the Late Miocene (Tortonian). SOLIMAN Ali & James B. RIDING

17h30-17h50: Dinoflagellate cyst stratigraphy and paleoecology of the Upper Miocene–Pliocene, Rees Borehole, Northern Belgium. AL-SILWADI, Saif et al. (ENDING session 2.2. to 2.4)

18h-18h30: Poster session

18h30-19h30: Keynote: Dinoflagellate evolution: a fossil perspective with modern overtones, FENSOME, Robert A. et al.

20H30: Gala dinner. Chateau Luchey-Alde (see http://luchey-halde.com/fr/chateau-pessac-leognan/)

Thursday 20/07/2017

Talks will take place in the NB18 Amphitheater, see campus map **here**.

8h-8h20: First record of cellulosic resting cysts of the benthic dinoflagellate *Prorocentrum leve* in a natural reservoir in Gujan-Mestras, Gironde, France. MERTENS, Kenneth N. et al.

8h20-8h40: Late Cretaceous (Cenomanian to Campanian) dinoflagellate assemblages, paleoproductivity signals and carbon isotope data from the Kanguk Formation, Sverdrup Basin, Nunavut, Canada. FROUDE, Gregory P. et al.

8h40-9h: Selective dinoflagellate cyst degradation in Madeira Abyssal Plain (MAP) turbidites in an organic and inorganic geochemical context. VERSTEEGH, Gerard J. M. et al. (ENDING session 2.5.)

9h-9h20: The status of dinocysts in the use of multiproxy approaches for reconstructing sea-surface conditions in late Quaternary sediments of mid-high latitudes of the Northern Hemisphere. DE VERNAL, Anne et al.

9h20-9h40: Long-term climate and ocean environment reconstruction basedon pollen and organic walled dinoflagellate cysts in western South Atlantic Ocean during the last 73.000 years. GU Fang et al.

9h40-10h: Last Glacial-Holocene productivity reconstructions off Congo River from the revised tropical dinocyst-based modern database. HARDY William et al.

Coffee break (10h-10h30) - Poster

10h30-10h50: Regional seesaw between North Atlantic and Nordic Seas during the last glacial abrupt climatic events. WARY Mélanie et al.

10h50-11h10: Organic walled dinoflagellate cysts distribution in the sediments of northeast Persian Gulf. HOSSEINI Araghy, Hesameddin

11h10-11h30: Anthropogenic eutrophication overlapping natural climate variability over the last 150 years: palynological evidences (Bay of Brest, NW France). LAMBERT Clement et al.

11h30-11h50: Dinoflagellate cyst production in the Cariaco Basin: a 12 year-long sediment trap study. BRINGUÉ, Manuel et al.

11h50-12h10: Dual taxonomy and nomenclature in dinoflagellate cysts: history, present status, and challenges of molecular phylogeny. HEAD, Martin J. et al

12h30-14h: Lunch and poster session

14h-14h20: Diversity and distribution of dinoflagellate cysts in Arctic fjords from Greenland, with focus on sea-ice associated species. RIBEIRO, Sofia et al. (ENDING session 2.6.)

14h20-14h40: Dinoflagellate cysts – an important component of aquatic "seed banks". ELLEGAARD, Marianne & RIBEIRO, Sofia

14h40-15h: Assessing the impact of the 1989 Exxon Valdez oil spill on phytoplankton in Prince William Sound (Alaska, USA) through the use of dinoflagellate cysts preserved in the sedimentary record. GENEST, Maximilien et al.

15h-15h20: Dinocysts as proxy off sea ice conditions in the Arctic? Preliminary results of a new method to estimate sea ice condition. KUCHARSKA Malgorzata et al.

15h20-15h40: Dinoflagellate cyst production in the presence/absence of sea ice cover in the Beaufort Sea (Arctic Ocean): one year sediment trap record. POSPELOVA, Vera et al.

15h40-16h: Cyst-theca relationship and molecular data of three cysts from the Gulf of St. Lawrence (Canada). ROCHON, André et al.

Coffee break (16h-16h30) - Poster

16h30-16h50: Transport and preservation of organic-walled dinoflagellate cysts in nepheloid layers off Cape Blanc (N-W Africa). ZONNEVELD, Karin A.F. et al. (ENDING session 1.6.)

17h-18h30: AWARDS, Next dino. Meeting information, closure of the meeting. Workshop Introduction

Friday 21/07/2017

8h-10h Workshops (NB18, B16, *map* **here**)
10h50-13h Workshops (NB18, B16, *map* **here**)
13h-18h Workshops /or Fieldtrips

Poster list

Session 1.1 Biodiversity and systematics

Rare tropical and subtropical oceanic dinoflagellates rediscovered
CARBONELL-MOORE, Consuelo[1]; *HALLEGRAEFF, Gustaaf*[2];

The extant representation of the fossil dinoflagellate cyst *Cladopyxidium* McLean 1978
CARBONELL-MOORE, Consuelo[1], *FENSOME, Rob*[2], *and WILLIAMS, Graham*[2]

Molecular approaches for identification and quantification of harmful dinoflagellates
CASABIANCA, Silvia[1]; *CAPELLACCI, Samuela*[1]; *CASABIANCA, Anna*[1]; *GALLUZZI, Luca*[1]; *VERNESI Cristiano*[2]; *PENNA, Antonella*[1]

Epitypification - a promising method to lead us out of this taxonomic mess
KRETSCHMANN, Juliane [1], *ZERDONER CALASAN, Anze* [1], *ELBRÄCHTER, Malte* [2], *GOTTSCHLING, Marc* [1]

First report of an *Alexandrium* bloom in the Bilbao estuary and its unexpected composition
LAZA-MARTÍNEZ, Aitor[1]; GIULIETTI, Sonia[1]; DAVID, Helena I. [1]; SEOANE, Sergio[1]; HEVIA-ORUBE, Joana[1]; ORIVE, Emma[1]

Diversity of benthic dinoflagellates in Jeju Island, Korea
LEE, Joon-Baek[1]; Kim, Gyu-Beom[1]; Kang, Su-Min[1]; An, So-Jeong[1]; SHAH, M.M.R.[2]

Dinoflagellates from the Pontocaspian region: from biodiversity to phylogeny
SALA-PÉREZ, *Manuel*[1]; *LEROY,* Suzanne A.G.[2]; LOCKYER, Anne E.[3]

Session 1.2 Dinoflagellate life cycles and nutritional strategies

Feeding characteristics and molecular phylogeny of the thecate mixotrophic dinoflagellate *Fragilidium mexicanum*
Kim, Sunju[1]; Park, Myung G.[2]

Session 1.3 Dinoflagellate ecology

Genome-wide survey of polyketide synthases in the symbiotic dinoflagellate *Symbiodinium minutum*
BEEDESSEE, Girish[1]; *HISATA, Kanako*[2]; *MUNGPAKDEE, Sutada*[3]; *SATOH, Noriyuki*[4]; *SHOGUCHI, Eiichi*[5]

Dinoflagellate community composition in Colombian reservoirs: preliminary results
BUSTAMANTE-GIL, Carolina[1]; *BOLTOVSKOY, Andrés* [2]; *RAMIREZ-RESTREPO, John J.*[3]

Physiological response of *Prorocentrum lima* (Dinophyceae) to varying light intensities
DAVID, Helena[1]; LAZA-MARTÍNEZ, Aitor[1]; KROMKAMP, Jacco C.[2]; ORIVE, Emma[1]

The synonymy of *Parvilucifera infectans* and *P. sinerae* (Alveolata, Perkinsozoa), the parasitoids of dinoflagellates

JEON, Chang B.[1]; *NAM, Seung W.*[1], *KIM, Sunju*[2], *PARK, Myung G.*[1]

New cytotoxic Ostreols from the epiphytic dinoflagellate *Ostreopsis* cf. ovata isolated from Jeju coastal waters Korea

Kim, Hyung Seop[1]; Rho, Jung-Rae[1]; Lee, Young Kyung[1]; Yoo, Yeong Du[1]; Yih, Wonho[1]

Species composition, abundance and distribution of the genus *Protoperidinium* Bergh (Dinophyceae) from the central region of the Gulf of Mexico.

LICEA, Sergio[1] (Dr.) and GONZALEZ-FERNÁNDEZ José M[1] (Biol.)

Check list of recent Dinoflagellates (Dinophyceae) from the southern Gulf of Mexico: Data-base (1979-2013) and new records

LICEA, Sergio[1] (Dr.); MORENO-RUIZ José L.[2] (Dr.); LUNA, R[1] (MS).

Assessing the monsoonal control on dinoflagellate cyst distribution in recent sediments along the western margin of Bay of Bengal

NARALE, Dhiraj D.[1], *Anil, Arga C.*[1]

Competition between two Mediterranean benthic microalgae: Endo/Exo metabolome study and physiological responses

PAVAUX, Anne-Sophie[1] ; TERNON, Eva[2] ; MARRO, Sophie[1] ; THOMAS, Olivier[3] ; LEMEE, Rodolphe[1]

Mixotrophic growth of the sand-dwelling dinoflagellate *Thecadinium kofoidii*

Yih, Wonho[1]; Kim, Hyung Seop[1]; Rho, Jung-Rae[1]; Oh, Mi Ryoung[2]; Lee, Young Kyung[2]; Kim, Ji Min[2]; Yoo, Yeong Du[1]

Session 1.4 Toxic dinoflagellates: from cells to cysts

Bloom of *Gambierdiscus caribaeus* in the temperate-subtropical waters of El Hierro, Canary Islands (North East Atlantic)

AMORIM, Ana[1,2]; ZABALA, Juan F.[3]; CARBÓ-MESTRE, Pol.[3] , CAEIRO, M.Filomena[2,4]; SOLER-ONIS, Emilio[3]

Investigation of the metabolic pathways and interactions of DMSP and STX in *Alexandrium*

CARUANA, Amandine M. N.[1] ; LE GAC, Mickaël[2] ; HERVÉ, Fabienne[1] ; ROVILLON, Georges-Augustin[1] ; AMZIL, Zouher[1]

Purification assays of ovatoxins and screening for identification of new toxic metabolites in *Ostreopsis ovata*, a toxic benthic dinoflagellate

GEMIN, Marin-Pierre[1]; HERVE, Fabienne[1]; SECHET, Véronique[1]; LEMEE, Rodolphe[2]; AMZIL, Zouher[1]

Sexual reproduction in subtropical strains of *Fukuyoa yasumotoi* (Dinophyceae)

SABUROVA, Maria

Session 1.5 Marine to freshwater transition and gradient in the dino world

Atlas of modern dinoflagellate cyst distribution in the Black Sea Corridor from the Marmara Sea to the Aral Sea including the Black, Azov and Caspian Seas

MARRET, Fabienne[1]; MUDIE, Peta J.M.[2]; MERTENS, Kenneth N.[3]; SHUMILOVSKIKH, Lyudmila[4]; LEROY, Suzanne A.G.[5]; BRADLEY, Lee[6]

Session 1.6 From theca to cyst: modern dinoflagellates as a sedimentary component

Distribution of recent dinoflagellate cysts in the Gulf of Annaba (Algeria, southwestern Mediterranean Sea)

BEHNAS, Soumaya[1]; FRIHI, Houcine[1]; ROCHON, André[2.]

A dinoflagellate's sedimentary journey: from the water column to the lakebed

KRUEGER, Andrea M.[1], MCCARTHY, Francine M. G.[1], VASSEUR, Liette[1], HUBENY, J. BRADFORD[2], Schuler, Matt S.[3], PATERSON, Andrew[4]

Session 2.1 Neogene to modern dinocysts in palaeoceanographic studies

Palynological records of the Labrador Sea during the intensification of the North Hemisphere glaciation

AUBRY Aurélie M. R.[1]; DE VERNAL Anne [1]

(1) GEOTOP, Université du Québec à Montréal aurelieaubry@gmail.com (student, travel grant validated)

Environmental ancient DNA: a new proxy for sea ice?

DE SCHEPPER, Stijn; RAY, Jessica L.; SANDNES SKAAR, Katrine; SADATZKI, Henrik; STRØMSØE, Jørund

Mid to late Miocene dinocyst assemblage from the Ulleung Basin, East Sea, offshore Korea and its paleoceanographic implication: preliminary results of IODP EXP. 346 Site U1430

KIM Yongmi[1], Yi Sangheon[1]; KIM Gil-Young[1]

Role of the Mediterranean Outflow Water on the North Atlantic climate and ocean circulation during past climate warming events.

WARY, Mélanie[1,2]; LONDEIX Laurent[2]; EYNAUD Frédérique[2]; OLIVEIRA Dulce[1,2,3,4]; MORALES DEL MOLINO César[1]; NAUGHTON Filipa[3,4]; DUCASSOU Emmanuelle[2]; SANCHEZ-GONI Maria Fernanda[1,2]

Session 2.2 Mesozoic and Cenozoic dinocyst stratigraphies

***Subtilisphaera* cysts from the Santana Formation (Aptian, Araripe Basin, Brazil): characterization of their peculiar fibrous wall structure**

ARAI, Mitsuru[1]; MASURE, Edwige[2]; BRITO, Hermes D.[1]

Dinoflagellates from the GEM project: aspects of Mesozoic–Cenozoic biostratigraphy from Canada's North

FENSOME, Robert A.; WILLIAMS, Graham L.

Quaternary Palynomorph Stratigraphy in the Arctic Ocean
MATTHIESSEN, Jens[1]; SCHRECK, Michael[2]; De SCHEPPER, Stijn[3]; ZORZI, Coralie[4], DE VERNAL, Anne[4]

The *Decahedrella*-event in ODP Hole 909C – Implications for Miocene stratigraphic and paleoceanographic interpretations across the Fram Strait gateway
SCHRECK, Michael[1]; FORWICK, Matthias[1]; MATTHIESSEN, Jens[2]

Dinoflagellate cyst stratigraphy of the Lower Cretaceous strata from the central part of the Hammerfest Basin, SW Barents Shelf, offshore Norway
ŚLIWIŃSKA, Kasia K.[1]; NØHR-HANSEN, Henrik [1]; MARIN, Dora [2]; OLAUSSEN, Snorre [3]

Session 2.3, Phanerozoic and deep time scales /2.4, Dinocyst systematics /2.5, Dinocyst chemistry and preservation / carbon cycles

Dinoflagellate cyst contribution to settling organic matter in the coastal ocean
BRINGUÉ, Manuel[1,2]; THUNELL, Robert C.[1]; POSPELOVA, Vera[2], TAPPA, Eric J.[1]; JOHANNESSEN, Sophia C.[3]; MACDONALD, Robie W.[3]

Ecophenotypism in early Palaeozoic acritarchs – Comparisons with recent dinoflagellates
Authors: KROECK, David M.; BLANCHON[1], Mathilde; MONNET, Claude[1]; SERVAIS, Thomas[1]

Session 2.6 . Integrated studies derived from dinocysts: recent past to modern scales

Centennial scale variations of sea-surface in the Disko Bugt, west Greenland
ALLAN, Estelle[1]; de VERNAL, Anne[1]; KNUDSEN, Mads Faurschou[2]; MOROS, Matthias[3], RIBEIRO Sofia[4]; OUELLET- BERNIER, Marie-Michèle [1]; HENRY, Maryse[1].

Ship traffic and the introduction of diatoms and dinoflagellates via ballast water in the port of Annaba, Algeria
CHENITI Radhia, [1]; FRIHI Hocine [1], ROCHON André [2]

Paleoceanography of northeastern Fram Strait since the Last Glacial Maximum: Palynological evidence of large amplitude changes
FALARDEAU, Jade[1]; DE VERNAL, Anne [1]; SPIELHAGEN, Robert F.[2, 3]

Spatial distribution of dinocysts in surface sediment from the Gulf of San Jorge (Patagonia, Argentina)
FAYE, Simon[1,2]; ROCHON, André[2]; ST-ONGE, Guillaume[1, 2]

Tracers of sea ice, primary production and terrigenous inputs: distribution of organic-walled microfossils in a High Arctic fjord system, Northeast Greenland
HEIKKILÄ, Maija[1]; RIBEIRO, Sofia[2]; LIMOGES, Audrey[3]; SEJR, Mikael[4]; WECKSTRÖM, Kaarina[1], TALLBERG, Petra[1]; MASSÉ, Guillaume[5]

Multi-proxy study in Arctic Late Holocene sediment cores on the continental margin of the western Canadian Beaufort Sea

KUTOS, Omnain[1]; ROCHON, André[1]; MONTERO-SERRANO, Jean-Carlos[1]

11th INTERNATIONAL CONFERENCE ON MODERN AND FOSSIL DINOFLAGELLATES

17 to 21 July 2017, Bordeaux (France)

SESSION 1 ABSTRACTS

1.1. Biodiversity and systematics

CONVENERS: Lemée Rodolphe & Nicolas Chomérat (from the organization committee); Mona Hoppenrath (German Centre for Marine Biodiversity Research, Wilhelmshaven, Germany); Jane Lewis (School of Life Sciences, University of Westminster, UK); Antonella Penna (Lab. of Environmental Biology, University of Urbino, Italy)

1.2. Dinoflagellate life cycles and nutritional strategies

CONVENERS: Raffaele Siano (from the organization committee);

1.3. Dinoflagellate ecology

CONVENERS: Yolanda del Amo (from the organization committee); Elisa Berdalet (Institut de Ciències del Mar (CSIC) de Barcelona, Spain); Kazumi Matsuoka (Institute for East China Sea Research, Nagasaki University, Japan); Sofia Ribeiro (Geological Survey of Denmark and Greenland – GEUS, Denmark)

1.4. Toxic dinoflagellates: from cells to cysts

CONVENERS: Mohamed Laabir (from the organization committee), Marianne Ellegaard (Department of Plant and Environmental Sciences, University of Copenhagen, Denmark), André Rochon (Institut des sciences de la mer de Rimouski - ISMER, Université du Québec à Rimouski, Canada)

1.5. Marine to freshwater transition and gradient in the dino world

CONVENERS: Martin J. Head (Department of Earth Sciences, Brock University, Canada); Susan Carty (Heidelberg University in Tiffin, Ohio, USA)

1.6. Modern dinoflagellates and cysts: what we can learn from sediments

CONVENERS: Kenneth Neil Mertens (from the organization committee); Vera Pospelova (School of Earth and Ocean Sciences, University of Victoria, Canada)

Benthic Harmful Algal Blooms of *Ostreopsis fattorussoi* in Beirut, Lebanon (Eastern Mediterranean) in relation with environmental factors.

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Following several HAB occurrences of *Ostreopsis* cf. *ovata* and *O.* cf. *siamensis* in the NW Mediterranean Sea, some of them linked to mass human intoxications, the ecology of these species in relation to environmental factors has become well studied in that area. On the other hand, few of these studies are available in the Eastern part of the Mediterranean; in particular, the species found in Lebanon is the newly described *O. fattorussoi*. The present study aims to quantify the toxic *O. fattorussoi* in coastal waters of the country's capital Beirut, and determine the effect of environmental factors on the bloom dynamics. The sampling campaign covers one full year cycle and 2 summer bloom seasons (June 2014- to December 2015). Both epiphytic (on macroalgae) and planktonic samples of *O. fattorussoi* were collected, along with environmental parameters: air and water temperature, salinity, precipitation, wind speed, and nutrients (nitrites, nitrates and orthophosphates). Yearly maximum abundances occurred in the summer. The maximum abundance reached is 880,694 cells/g FW in epiphytic samples and 4024 cells/L in planktonic samples, both in the summer of 2014. These abundances showed a negative correlation with precipitation and nitrate concentrations. They showed a strong positive correlation with water temperature, and highest densities (>100,000 cells/g FW) occurred between 27.5°C and 28°C suggesting that *O. fattorussoi* is a thermophilic species.

Bloom of *Gambierdiscus caribaeus* in the temperate-subtropical waters of El Hierro, Canary Islands (North East Atlantic)

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The Canary Archipelago is located in the southern limit of the temperate Northern Atlantic (28°06´N, 15°24´W) and is part of a unique biogeographical region known as Macaronesia. El Hierro is the southernmost, smallest and most isolated island of the Canary archipelago. The Canary Islands were considered outside the recognized endemic area for Ciguatera Fish Poisoning (CFP) until 2004, when a CFP event was reported after the ingestion of a locally captured amberjack (Seriola rivoliana). Since then, five toxic species of *Gambierdiscus* have been reported for the Canary Islands: *G. australes*, *G. excentricus*, *G. silvae*, *G. carolinianus* and *G. caribaeus*. However, the local or allocthonous toxification of fish is not clear since high densities of *Gambierdiscus* spp. have never been recorded. In the present work, we document the first record of a *Gambierdiscus* bloom in the Canary archipelago. The bloom was recorded in the harbor of La Restinga (27º 37,5' N 17º 59' 5" W) (El Hierro island) in October 2016 when scuba divers observed a brownish matt covering the sea bottom. The epiphytic community on several species of macrolagae was investigated by light microscopy and scanning electron microscopy. Clonal cultures of *Gambierdiscus* were also established. The concentration of *Gambierdiscus* was estimated in *Halopteris scoparia*, reaching more than 10^4 cells.g^{-1} wet weight. Morphological observations and single cell PCR of isolated strains, allowed the unambiguous identification of *G. caribaeus* as the dominant species. The high concentrations of *Gambierdiscus caribaeus*,

reported here from La Restinga, suggest that the Ciguatera outbreaks reported for the Canary Archipelago in the last two decades, may result from locally toxified fish and not long-distance migration of fish from other affected areas.

Session 1.4: Toxic dinoflagellates: from cells to cysts. Poster presentation

Studies of dinoflagellate cysts and ecological importance in and around the seas of Turkey

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Studies of dinoflagellate cysts ecology and their dynamics offer a great opportunity for understanding marine ecosystems. Turkey has a unique location geographically, and is surrounded by seas with different environmental features, such as the Marmara Sea, Black Sea, Aegean Sea, and Mediterranean Sea. Fossil and modern dinoflagellate cysts have been researched in various sediment samples from these locations. Dinoflagellate cyst distributions were also investigated alongside environmental changes in past and recent years. Fossil dinoflagellate cyst studies around seas of Turkey have provided some great information regarding paleoenvironmental conditions especially salinity, cyst ecology as well as indicator species. Modern cyst studies have also focused on cyst distribution, abundance and relationship to environmental conditions. These studies help to monitor ecological valance of dinoflagellate cysts from these regions. Distribution of potentially harmful and toxic dinoflagellate cysts (*Lingulodinium machaerophorum, Alexandrium catenella/tamarense, Operculodinium centrocarpum*) also brought attention for those coastal areas due to their ecological importance in aquatic environments. Cyst are considered useful paleoecological indicators such as biogeographic, biostratigraphic markers. Here, we review the existing dinoflagellate cysts studies and provide different future perspectives to contribute to the dinoflagellate cysts studies from the seas of Turkey.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

Genome-wide survey of polyketide synthases in the symbiotic dinoflagellate *Symbiodinium minutum*

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Dinoflagellates are important unicellular eukaryotes found in both marine and freshwater environments and are rich sources of unique bioactive secondary metabolites of polyketide origin. The symbiotic marine dinoflagellate *Symbiodinium* sp. is a dominant symbiont in corals and despite the availability of the 616 Mbp draft genome of *Symbiodinium minutum* B1, no gene cluster for polyketide synthases (PKS) has been reported. To find enzymes involved in polyketide synthesis namely ketosynthase (KS), acyl transferase (AT) and acyl carrier protein (ACP), we surveyed the *S. minutum* genome and identified 31 KS genes to be expressed as several functional domains within a single protein. Additionally, a maximum likelihood phylogenetic analysis of the KS domain formed a clade placing well within the protest Type I PKS when compared with other dinoflagellates and eukaryotes, confirming their Type I PKS nature. The predicted proteins had functionally important amino acids required for catalysis (cysteine, histidine and lysine) within the DTACSS-motif of KS domain in 28/31 sequences. Interestingly, the largest enzyme is likely to be expressed as a hybrid NRPS-PKS assembly of 10,601 amino acids. Our findings support the modular nature of Type I PKS in *Symbiodinium* in contrast to previous reports of monofunctional Type I PKS.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Distribution of recent dinoflagellate cysts in the Gulf of Annaba (Algeria, southwestern Mediterranean Sea)

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Several species of dinoflagellates have been associated to significant recurring blooms in colored waters in Annaba's Gulf (Algeria), some of which are potentially toxic. This study focuses on the establishment of dinoflagellate cysts assemblages present in surface sediments and which will allow us to establish a relationship between the latter and the mobile species present in the water column. After several prospections of muddy bottoms, from the outfall of Oued Mafragh to Cap de Garde, at a depth of -10m to -30m. Twenty sites potentially containing cysts were sampled using an Ekman bottom grab sampler. The thickness of the sediment layer collected is 10 cm. The extraction of the cysts was carried out by wet sieving with distilled water without using acid. More than 27 taxa of dinoflagellate cysts belonging to 9 genera were identified. Cyst concentrations ranged from 37 to 5884 cysts.g-1 dry sediment. The most abundant species in the sediments of the Gulf of Annaba were: *Lingulodinium machaerophorum, Scrippsiella trochoidea, Alexandrium tamarense/minutum, Polykrikos schwartzii, Selenopemphix quanta*.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Poster presentation.

Physiological responses of the toxic dinoflagellate *Ostreopsis* cf. *ovata* to the allelopathic effect of three macrophytes species

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Ostreopsis cf. *ovata* is a benthic dinoflagellate producing toxins. Toxic events were associated to this species in the Northern Mediterranean Sea. Recent studies showed that Macrophytes could release secondary metabolites that reduce the proliferation of red tide-causing microalgae, suggesting that these macrophytes could affect the ecosystem diversity and functioning, representing thereby potential candidates for blooms mitigation. Here, we investigated the nature of the allelopathic interactions between an *Ostreopsis* cf. *ovata* strain "OOBZT14" and three macrophytes: *Cymodocea nodosa*, *Zostera noltei* and *Ulva rigida*. OOBZT14 was co-cultured during 10 days with fresh tissues from the three species and the effects were evaluated on the growth, photosynthesis, morphology and toxicity of this dinoflagellate. Growth rates inhibition ranged from 0.96% to 11.57% in presence of *C. nodosa*, from 11.30% to 23.93% with *Z. noltei* and from 42.16% to 62.14 % with U. rigida. No inhibitory effects of the two magnoliophytes were recorded on the photosynthetic efficiency of *O*. cf. *ovata*. Nevertheless, a slight decrease in Fv/Fm ratio was noticed after 6 and 10 days of co-culture with *U. rigida*. Structural cell damages were observed only in presence of *U. rigida*. No clear pattern was observed for toxin production, even if it seems to be stimulated by the presence of low macrophytes weights. This study suggests that U. rigida could play an important role in *O.* cf. *ovata* bloom dynamic and could be effective in inhibiting its proliferation. Further studies are needed to characterize the involved molecules released by this macroalgae

Session 1.3: Dinoflagellate ecology. Oral presentation.

Distribution and abundances of benthic toxic dinoflagellates in French West Indies

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Dinoflagellates are primitive unicellular eukaryotes showing nuclear and mitotic peculiarities. Their chromosomes are visible and remain condensed at all stages of the cell cycle, they do not have true histones, the nuclear envelope persists during mitosis, whereas the mitotic spindle is usually cytoplasmic, making their division a complex process called dinomitosis. While there presently exist about 2000 species of dinoflagellates, only a few of them have been studied at the cellular level.

Here, we show that dinomitosis differs greatly in several species, namely, *Akashiwo sanguinea*, *Karenia brevis*, *Oxyrrhis marina* and *Prorocentrum micans*. We suggest that dinoflagellates, which represent an heterogeneous group in various cellular, physiological and structural aspects, are also heterogeneous in terms of mitosis. Dinoflagellates must be regarded as an "experimental group" making an evolutive link between bacteria, fungi and higher eukaryotes in terms of cell division processes, that we call dinomitoses.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Oral presentation.

Distribution and abundances of benthic toxic dinoflagellates in French West Indies

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Benthic Toxic Dinoflagellates (BTD) are often linked with health problems in tropical and temperate areas. Species of genus *Gambierdiscus* are associated with Ciguetera Fish Poisoning (CFP) due to the accumulation of phycotoxins in the food web. Species of genus *Ostreopsis* are more often linked to health problem after direct contact with contaminated water or bioaerosols, even if phycotoxins were already found in seafood. The Caribbean area is the second region of the world affected by CFP and our bibliography analysis reveals few studies on ecology and distribution of BTD in the French West Indies. In order to evaluate the potential risk of BTD in this area, a first survey, followed by a more formal monitoring (18 months) of BTD has been undertaken in Guadeloupe and Martinique Islands. *Ostreopsis, Prorocentrum, Gambierdiscus, Amphidinium, Sinophysis*, *Coolia* genera were found around both islands. *Ostreopsis* and *Prorocentrum* were the most abundant. *Gambierdiscus*, *Coolia*, *Amphidinium* and *Sinophysis* genera were present but in lower extent. In average, BTD were 5 times more abundant in Guadeloupe than in Martinique. Same *Gambierdiscus* spp. abundances were found in Guadeloupe and Martinique while those islands are respectively inside and outside of the ciguatera outbreak area. Moreover, species of this genus were more abundant at deep sites (1,50 m) than shallow sites (0,5 m). No clear season patterns of BTD were observed. Dinoflagellates variations were mainly controlled by water temperature but other parameters can interfere like wind force on planktonic cells and biotic substrates for benthic dinoflagellates.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Dinoflagellate community composition in Colombian reservoirs: preliminary results

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Colombia is located in the tropical zone of the Neotropical region. This country is rich in water ecosystems, distributed in floodplain and lowland plains systems (0-1000 masl), Andean systems (1,500-3,000 masl) and high mountain systems or paramos (3,000-4300 masl). Among them are the reservoirs used for power generation and potable water supply. The aim of the present study is to examine the specific composition of dinoflagellates in these ecosystems, which could be used as an indicator of the fluctuation of their trophic conditions. For this purpose, ten reservoirs with different trophic conditions (oligotrophic to hypereutrophic), located between 900 and 3,100 masl were sampled between November 2016 and January 2017. Vertical trawls were performed with a phytoplankton net in the photic zone of each reservoir and following variables were quantified: Secchi disk depth, temperature, pH, conductivity, oxygen, and Chlorophyll a. *Ceratium furcoides*, an invasive species in several freshwater ecosystems of South America was found in all sampled reservoirs. *Peridinium volzii*, characterized as a species from cold, alkaline and oligotrophic systems was recorded in highlands reservoirs (2,800-3000 masl). *Peridinium gatunense*, a cosmopolitan tropical-subtropical species and *Peridinium volzii* f. *botanicum* which mainly inhabit eutrophic and warm systems, were found at medium-altitude mountain systems (900-2,800 masl). In addition, the presence of *Naiadinium polonicum* and *Peridinium quadridens* was recorded for the first time in Colombia.

Session 1.3: Dinoflagellate ecology. Poster presentation.

New Dinophysoid-related dinoflagellates from the Central Equatorial Pacific

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The 1991-2 central equatorial Pacific phytoplankton samples collected during US-JGOFS (US Joint Global Ocean Flux Study) cruises showed incomparable dinoflagellate diversity. A Mocness-eight-net set (25µm- mesh opening) horizontally sampled at eight discrete depths distributed through a 200 m water column. The two deepest nets were towed for 30 min allowing the collection of many phytoplankters never recorded before. Among them, 38 intriguing cells, with the appearance of thecate dinoflagellates were observed. Light and scanning electron microscope imaging was used to elucidate their plate pattern, resulting in a hypotheca typically dinophysoid, but an epitheca with variable plate size and location of a dinophysoid apical pore homologue. Four types of plate arrangements around the apex resemble those found on prorocentroids. The cells show a sagittal suture, four cingular plates forming a displaced cingulum, and very well-developed cingular lists. The cell surface may be smooth or with large reticulations which have one pore in the middle. Some of the cells have two fine antapical spines, accompanied of a long apex. Due to the inaccessibility of the sampling location, adequate material for DNA sequencing might not be available for a long time. Average dimensions: length: 41µm; dorso-ventral: 36 µm; width: 39 µm.

Session 1.1: Biodiversity and systematics. Oral presentation.

The extant representation of the fossil dinoflagellate cyst *Cladopyxidium* McLean 1978

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Extant dinoflagellates with a similar tabulation to *Cladopyxis hemibrachiata* but lacking the process-like extensions unique to *Cladopyxis* have been observed in plankton samples from the Atlantic, Indian, and central equatorial Pacific oceans, mostly from surface waters. The tabulation is closely similar to that of the fossil dinoflagellate cyst *Cladopyxidium*, which has a partiform gonyaulacalean (cladopyxiacean) plate pattern consisting of six precingulars, six postcingulars, two antapicals (equivalent to the 1'''' and 1p of the standard gonyaulacalean pattern) and up to 7 climactal (apical + anterior intercalary) plates. Partiform dinoflagellates are diverse in the fossil record, especially in Middle Jurassic to Paleocene strata, but are uncommon in the later Cenozoic, and only a few genera, including *Cladopyxis*, live in modern oceans. Partiform dinoflagellates share features in common with gonyaulacaleans and peridinialeans, and so may have important evolutionary significance. The co-occurrence in some samples of *Cladopyxis brachiolata* and forms with similar tabulation to this species but lacking extensions suggests that the number of cladopyxiaceans in the modern plankton has been underestimated. The largest number of cladopyxiaceans was observed in the Indian Ocean, so the potential exists to collect enough material to sequence these dinoflagellates. This would lead to a better understanding of the evolutionary relationship between gonyaulacaleans and peridinialeans.

Session 1.1: Biodiversity and systematics. Poster presentation.

Rare tropical and subtropical oceanic dinoflagellates rediscovered

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Early dinoflagellate light microscopists such as Charles Kofoid and FJR (Max) Taylor have shown repeated evidence of outstanding observational powers, and their historic observations cannot be underestimated and ignored. We provide examples of our rediscovery in deep tropical open ocean waters of the Central Equatorial Pacific, Indian Ocean, and Coral Sea of dinophysoid, gonyaulacoid and peridinioid dinoflagellate taxa, which in some cases had been described from single cells and not since been seen for more than 100 years. These include for example: (1) the cladopyxiinean *Acanthodinium spinosum* Kofoid 1907 from the Coral Sea, holotype of *Acanthodinium*, which sometimes erroneously has been considered a junior synonym of *Cladopyxis*; (2) the dinophysoid *Histiophysis rugosa* (Kofoid & Michener 1911) Kofoid & Skogsberg 1928, from the Coral Sea, holotype of the genus *Histiophysis*, intermediate between *Dinophysis* and *Histioneis*; (3) the dinophysoid *Thaumatodinium molischii* Bohm (4) oceanic Indian Ocean cells of a small *Pyrodinium*/*Alexandrium* gonyaulacoid species sensu Taylor 1976. These and several other dinoflagellates are here illustrated with light and/or scanning electron microscopy confirming the existence of these rare species, which in many cases had been considered "phantoms" by well respected dinoflagellate experts.

Session 1.1: Biodiversity and systematics. Poster presentation.

Investigation of the metabolic pathways and interactions of DMSP and STX in *Alexandrium*

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Certain microalgae, such as the cosmopolitan *Alexandrium* genus, are able to produce metabolites that play a putative role in cell-to-cell signaling and defense mechanisms. At a larger scale, these molecules may also impact whole ecosystems and contribute to climate regulation. This is the case for dimethylsulphoniopropionate (DMSP) a molecule that influences climate via DMS emissions and saxitoxin (STX) that affects food safety. At the ecosystem level, both compounds may be part of the range of metabolites that structure relationships between marine organisms through chemical ecology for instance, in interactions of microalgae with their predators, viruses and parasites. Although DMSP and STX are very different chemically, these two relevant metabolites have methionine as a common precursor and unclear biosynthesis pathways. We present here the first results on our investigation of DMSP biosynthesis pathway in *A. minutum* and *A. catenella*. It includes search in an *A. minutum* transcriptomic database of transcripts corresponding to the diatom genes proposed for DMSP biosynthesis. To give a full picture, results also include search in *A. minutum* and *A. catenella* of the metabolic intermediates of DMSP biosynthesis proposed in algae. Therefore, new data lead to an update of the DMSP metabolic pathway in dinoflagellates, useful to pursue in investigating interactions with STX biosynthesis pathway.

Session 1.4: Toxic dinoflagellates: from cells to cysts. Poster presentation.

Molecular approaches for identification and quantification of harmful dinoflagellates

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In recent years, harmful algal blooms caused by dinoflagellates have become increasingly common in coastal waters throughout the world, causing negative impacts on human health, ecosystem quality and also affecting economic and commercial activities of the interested coastal areas. For the identification of potentially harmful microalgae, microscopy based methods are commonly used, but they are time consuming also requiring great taxonomic expertise. Thus, for the identification, counting and genetic characterization of these protists, more rapid, sensitive and specific molecular methods, such as real time PCR or microarray systems, have been developed and applied. Genus, species- specific primers and probes were designed on ribosomal DNA sequences (i.e. SSU, LSU and 5.8S genes, and ITS1 and ITS2 regions); they are suitable and highly informative molecular markers for studying the phylogeographic or phylogenetic relationships and the population genetic structure of the marine toxic dinoflagellates. The molecular methods have been applied to different kind of samples from cultured strains to field samples as surface seawater, macrophyte, sediment and aerosol samples in the Mediterranean Sea. These molecular systems proved to be effective tools for rapid, specific and sensitive detection and enumeration of potentially harmful microalgae, and thanks to their high throughput they can be applied in water monitoring programmes, to explore the community biodiversity and dynamics and to control and manage harmful blooms in marine coastal waters.

Session 1.1: Biodiversity and systematics. Poster presentation.

Diversity and taxonomy of benthic *Prorocentrum* species in Anse Dufour, Martinique Island (Caribbean Sea)

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The genus *Prorocentrum* comprises about sixty species, of which almost half are marine and benthic. Several benthic species have been described from the Caribbean area using morphological analysis, but sequences corresponding to these taxa have never been obtained. Since 2012, samples from Martinique Island were collected every year in March and a taxonomic survey has been undertaken in order to identify the different species present using both morphological and molecular studies. Morphological features were investigated using light and scanning electron microscopy. Sequences of the large subunit of ribosomal DNA (LSU rDNA) were acquired from single cells isolated from natural samples, after a detailed morphological examination in order to associate the exact morphology with a sequence. In some cases, the theca of cells used for DNA amplification was removed and studied by SEM using a special technique. Morphological and molecular data identified 10 different species, with 40 novel sequences included in a phylogenetic analysis inferred from partial LSU rDNA. A probably new, undescribed species, related to *P. leve* and an unidentified clade within P. *emarginatum-fukuyoi* complex were identified in this analysis. The position of *P. norrisianum*, a species originally described from Belize, was resolved among other benthic species. Furthermore, the molecular phylogeny revealed the large genetic divergence and difficult species delineation within the *P. emarginatum-fukuyoi* complex. In this group, the taxonomic identity of *P. sculptile* originally described from the Caribbean is discussed on the basis of our observations and molecular data.

Session 1.1: Biodiversity and systematics. Oral presentation.

Freshwater dinoflagellate ecology determined from 40-lake calibration set in the Experimental Lakes Area in northwest Ontario, Canada

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Dinoflagellate cysts are common in lacustrine sediments and several multiproxy studies have illustrated their sensitivity to environmental perturbation, particularly anthropogenic impact. This study is the first of its kind, producing a calibration set relating lakebed cyst assemblages with environmental conditions in 40 lakes, including 5 reference lakes of which 2 are regularly monitored, in the Experimental Lakes Area in NW Ontario, Canada. The relatively undisturbed lakes in the boreal forest region range from 2 to 30 m in maximum depth and exhibit a range of water chemistry, e.g., concentrations NO2/NO3, TKN, TP, DOC, and pH. The most abundant cysts in sediments from the 40 lakes examined are "*Peridinium*" *wisconsinense*, *Peridinium willei*, and *Parvodinium umbonatum*, and the large, distinctive cysts of *Peridinium limbatum* are abundant in a few lakes. In addition to lesser abundances of known cysts, the relatively diverse assemblages include several distinctive cysts whose affinities have yet to be determined; these have been described and enumerated separately as "cyst types" for inclusion in this dataset. Quantitative relationships derived from

multivariate analysis comparing cyst assemblages with environmental parameters will be applied to Holocene records, enhancing the utility of dinoflagellate cysts as paleolimnological proxies.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Physiological response of *Prorocentrum lima* (Dinophyceae) to varying light intensities

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The morphospecies *Prorocentrum lima*, which shows a cosmopolitan distribution, is among the most common toxic benthic dinoflagellates. This study aimed to explore if strains originating from three locations in the Atlantic Iberian Peninsula (north, centre and south), and two from the Western Mediterranean Sea showed different responses to varying light regimes after confirming that all strains belonged to the same ribotype. Growth rates and photosynthetic parameters such as Fo, Fv/Fm, and rETRmax were analyzed with a Coulter counter, a Water-PAM and a FRRF (fast repetition rate fluorometer). The photosynthetic properties were investigated in a high light stress experiment using strains acclimated to Low Light (LL) and High Light (HL). The highest growth rate found was of 0.23 day-1 at 80 and 100 µmol photons m-2 s-1 for strains Dn150EHU and Dn60EHU, originated from different locations. Under control conditions, growth rate was on average 0.10 day-1. The HL stress exposure induced photodamage to all strains and the recovery period was not sufficiently long for full recovery of Fv/Fm. However, cells acclimated to HL showed a better recovery than the LL acclimated ones. Although no significant differences were found between the strains, identical at a molecular level, some assumptions are discussed in relation to strains original location.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Dinoflagellate cysts – an important component of aquatic "seed banks"

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Many phytoplankton species form resting stages as part of their life-cycle, contributing to aquatic seed banks that are typically diverse and abundant in coastal sediments of both freshwater and marine environments. Although these resting stages in many ways play similar roles in aquatic environments to those of seeds in terrestrial environments, the study of aquatic seed banks is, by comparison, only in its infancy. As marine phytoplankton are estimated to be responsible for half the global primary production these seed-banks of phytoplankton in marine sediments are potentially of enormous ecological importance. Phytoplankton resting stages are found in such diverse phylogenetic groups as dinoflagellates, diatoms, green algae, cyanobacteria, chrysophytes, haptophytes, cryptophytes, raphidophytes and euglenophytes. In the past decade, research on the long-term persistence of these resting stages has intensified, and, with focus on the dinoflagellates, we will discuss the possible roles of these aquatic seed-banks in evolutionary resilience, survival to catastrophic events and bet-hedging population dynamic strategies.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

Purification assays of ovatoxins and screening for identification of new toxic metabolites in *Ostreopsis ovata*, a toxic benthic dinoflagellate

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During the last decade, the increasing proliferation of a toxic benthic dinoflagellate belonging to the genus Ostreopsis was observed along the Mediterranean coasts. The blooms of Ostreopsis ovata were accompanied by the occurrence of human intoxication through exposure to marine aerosol or seawater (upper respiratory tract symptoms and skin irritation). The presence of Ostreopsis cells led to significant concentrations of mainly ovatoxins (A-K) and palytoxin in fish crustacean, mollusk and echinoderm. In the absence of standards, the lack of toxicologic data on ovatoxins is still a challenge for the assessment of the hazard associated with these toxins in the food web. In this context, the purification of ovatoxins for validation of detection methods and toxicological assays are still needed. The toxins from the cells pellet were extracted by sonication in methanol then fractionated on LH-20 column. The cytotoxic activity of the fractions was tested on Neuro-2A cells and analyzed by LC-MS/MS. The active fractions contained ovatoxins are pooled for their purification and the fractions contained unknown molecules are analyses for identification of new toxic metabolites.

Session 1.4: Toxic dinoflagellates: from cells to cysts. Poster presentation.

Assessing the impact of the 1989 Exxon Valdez oil spill on phytoplankton in Prince William Sound (Alaska, USA) through the use of dinoflagellate cysts preserved in the sedimentary record.

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Our understanding of how oil spills affect environment is severely limited by the lack of research on the impacts of such events on phytoplankton. This is partially attributed to the lack of pre-spill data, making it impossible to compare pre-spill and post-spill populations. This first-of-its-kind research aims to identify how one of the major groups of phytoplankton, dinoflagellates, has been affected by the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. To do this, sedimentary records of dinoflagellate cysts were analyzed from the area directly affected by the spill and the use of oil dispersant. Two sediment cores are well-dated with ^{210}Pb and ^{137}Cs and have high sedimentation rates, allowing for an annual resolution starting from ~1980. Samples were treated using a standard palynological processing technique to extract dinoflagellate cysts and ~300 cysts were counted per sample. In both cores, cysts were abundant, diverse and well preserved with the average cyst assemblage being characterized by an equal number of cysts produced by autotrophic and heterotrophic dinoflagellates. Changes in the sedimentary sequence of cysts were analyzed by determining cyst relative abundances, species richness and total cyst concentrations before, during and after the oil spill. Cyst diversity stayed consistently high throughout the studied sequence and was not affected by the oil spill. A noticeable shift

in cyst assemblage composition and a major increase in cyst concentration coincided with the timing of the spill. This was short lived and the system appears to have recovered within a few years of the event

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

Cryptic diversity within the harmful dinoflagellate *Akashiwo sanguinea* in coastal Chinese waters is related to differentiated ecological niches

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It is critical to understand cryptic diversity of harmful dinoflagellates as they might differ in ecological and physiological traits. Four clonal cultures of Akashiwo sanguinea were established in Xiamen Harbour, East China Sea for morphological and genetic analyses to examine whether cryptic diversity exists in the study area. They displayed identical morphology but were genetically different. To investigate whether the observed cryptic diversity was related to environmental differentiation, 634 cells obtained from seasonal water samples collected between 2008 and 2012 were sequenced by single-cell PCR. Our results showed four well resolved ribotypes of A. sanguinea of which ribotypes A and B co-occurred in Xiamen Harbour. Akashiwo sanguinea ribotype A was present throughout the year in Xiamen Harbour; however, it only bloomed in the winter and spring. In contrast, A. sanguinea ribotype B bloomed only in the summer. Our results support the idea that the various ribotypes of A. sanguinea are correlated with distinct ecotypes.

Session 1.1: Biodiversity and systematics. Poster presentation.

A new *Gonyaulax* species causing a red tide in the tropical Mexican Pacific, Gonyaulax undistortata nov. sp.

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Blooms of marine planktonic dinoflagellates are usual in coasts of the Mexican Pacific Ocean, sometimes producing toxic red tides. We report here a red tide event, initially observed from satellite imagery, during an oceanographic cruise, which was produced by high densities of an unidentified species of the thecate dinoflagellate genus *Gonyaulax*. Morphological and phylogenetic studies revealed that the red tide causative organism was, in fact, a new species, here proposed as *Gonyaulax undistortata* nov. sp. The morphology of *Gonyaulax undistortata* was studied by LM and SEM, and showed cells relatively small in size (32-37 µm length, 26-28 µm width), polyhedral in shape, with a short apical protrusion and shoulders in the epitheca, and usually two short, asymmetrical antapical spines. Cells are strongly ornamented with striae and pores, cingulum is nearly median, fairly displaced (1-1.5 the cingulum width), cavozone, and with no (or slight) overhang. Specimens have the typical formula plate of the genus: Po, 4', 0a, 6", 4-5s, 6c, 5"', 0p, 2"''. Po is large, conspicuous and well defined, 1' is narrow and elongate, and 4' has a conspicuous ventral pore. The first posterior sulcal plate (1"") has a poorly developed list and the second one (2"") is large. *Gonyaulax undistortata* is phylogenetically related to *Gonyaulax spinifera*. The

maximum density of *Gonyaulax undistortata* reached 1.74 X 106 cells L-1, and the planktonic flora included other dinoflagellates and diatoms in low numbers. Environmental conditions were: temperature 23° C, salinity 34.7, dissolved Oxygen 10.8 mg L-1, and Chla 14 µg L-1.

Session 1.4: Toxic dinoflagellates: from cells to cysts. Poster presentation.

Heterocapsa triquetra sensu Stein - plate pattern clarification and nomenclatural issues

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Heterocapsa triquetra (Ehrenb.) F.Stein is one of the most common marine dinoflagellate species. There are two major taxonomic and nomenclatural issues linked to it. The thecal plate pattern of H. triquetra sensu Stein (1883) has been controversial in the past. In order to clarify the morphology, samples were collected at the same locality in the Baltic Sea off Kiel (Germany), from which S.N.F.R. von Stein gained his species. One of the established clonal strains was investigated in detail using light and electron microscopy. A natural population (mass development) was used for comparison. The predominant Kofoidean plate pattern was APC (Po, cp, X), 4', 2a, 6'', 6c, 5s, 5''', 2'''' and the morphological variability was documented. Ribosomal RNA sequence data were gained and the systematic position was inferred using molecular phylogenetic analyses When Stein introduced the genus Heterocapsa he formally based H. triquetra on the basionym *Glenodinium triquetrum* Ehrenberg. This taxon is most likely a species of *Kryptoperidinium* as circumscribed today. That recently discovered issue caused a currently unresolved nomenclatural situation.

Session 1.1: Biodiversity and systematics. Oral presentation.

How sequence data will drive systems thinking of dinoflagellate biology

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The use of molecular sequences in understanding dinoflagellate phylogeny and evolution is increasingly popular. Evidence from sequences is now viewed as complementary to morphological, biochemical and fossil data, and comparing these sources of evidence has generated important progress. But treating sequence and non-sequence data as principally independent obscures the depth of their integration - 'reconciling them' is only to give way to 'studying them as one'. At times when sequencing is cheap and tools for molecular cell biology increasingly pervasive the understanding of dinoflagellate biology becomes interdiscplinary by definition. As key determinants for morphological and chemical variation will become identified, the knowledge of paleontologists, biochemists and taxonomist is critical to interpreting them in context. Recent evidence gives promise in this direction by suggesting that molecular-level studies on the genesis of theca and dinosterol can inform knowledge of their evolution. Molecular data also suggests that all non-photosynthetic dinoflagellates contain remnant plastids and that these are the ultimate and indispensable sources of dinosterol,

heme, and bioluminescence. This makes dinoflagellate plastids a model for dependency on remnant organelles in all eukaryotes. It also implies that dinoflagellates were photosynthetic throughout their evolutionary history, reviving considerations on their roles in the pre-Mesozoic oceans. Sequence data-driven hypotheses will likely continue to play a critical role in understanding dinoflagellate biology and evolution. Because most dinoflagellates remain uncultured an important source of this data will be transcriptome sequencing from single cells.

Session 1.1: Biodiversity and systematics. Oral presentation.

The synonymy of *Parvilucifera infectans* and *P. sinerae* (Alveolata, Perkinsozoa), the parasitoids of dinoflagellates

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The genus *Parvilucifera* (Alveolata, Perkinsozoa) is one of the well-known dinoflagellate parasitoids along with *Amoebophrya ceratii* species complex and contains five species (i.e., *P. infectans, P. sinerae, P. prorocentri, P. rostrata*, and *P. corolla*) so far. Among *Parvilucifera* species, the two species, *P. infectans* and *P. sinerae*, are very similar or almost identical each other morphologically and genetically, which makes it difficult to distinguish between the two. The only main difference between the two species known so far rely on the number of sporangium wall (i.e., 2 layers in *P. infectans* vs. 3 layers in P. sinerae). During sampling in Masan bay, Korea during the spring season of 2015, the dinoflagellate *Akashiwo sanguinea* cells infected by the parasite *Parvilucifera* were observed and this host-parasite system was established in culture. Using this culture, we investigated its morphological and ultrastructural features with special emphasis on the variation in the number of sporangium wall over developmental times, along with determination of the sequences of rDNA regions and β-tubulin genes. Our result clearly demonstrated that the trophocyte at 36 h was covered with three layers, and then outer layer of the sporocyte gradually degraded over time, resulting in wall structure consisting of two layers, with even processes being detached from 7 days-old sporangium with smooth surface, indicating that the difference in the number of layers seems not to be an appropriate ultrastructural character for distinguishing *P. infectans* and *P. sinerae* and they may be the same species.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Feeding characteristics and molecular phylogeny of the thecate mixotrophic dinoflagellate *Fragilidium mexicanum*

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Prey spectrum and feeding process of the mixotrophic thecate dinoflagellate *Fragilidium mexicanum* strain Fm-LOHABE01 were examined using a culture isolated from Masan Bay, Korea in 2011 during a summer bloom of the toxic dinoflagellate *Alexandrium pacificum*. The novel 18S and 28S rDNA sequences for *F. mexicanum* were also used to explore inter-species relationships within the genus *Fragilidium*. The *F. mexicanum* fed on species belonging to four dinoflagellate genera (i.e., *Alexandrium*, *Ceratium*, *Heterocapsa*, and *Scrippsiella*) when separately offered a variety of prey, including dinoflagellates, raphidophytes, cryptophytes, and a ciliate. In addition, *F. mexicanum* displayed different levels of feeding frequency for prey species of *Alexandrium*. While *F. mexicanum* consistently fed on *A. catenella* and *A. pacificum*, feeding on A. affine was rarely observed. The *F. mexicanum* ingested prey by direct

engulfment through the sulcus, after capturing the prey by a tow filament. Phylogenetic analyses of 18S and 28S rDNA datasets demonstrated that *Fragilidium* sequences formed a monophyletic group with high statistical supports and diverged into four distinct clades. The *F. mexicanum* formed a separate clade with *Fragilidium* sp. EUSK D from Angola and Korean isolate of F. fissile with very strong supports.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Poster presentation.

Epitypification - a promising method to lead us out of this taxonomic mess

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The biodiversity assessment of dinophytes started in the late 18th and early 19th century using light microscopy. Type material, particularly of older descriptions, consists of specimens permanently mounted on glass slides or of illustrations only. In many cases, type material is ambiguous and makes reliable species determination problematic or impossible. To clarify the taxonomic identity of such ambiguous scientific names and for a correct application, the International Code of Nomenclature for algae, fungi and plants (ICN) provides a tool for designating an epitype. Epitypification has great potential for a stable taxonomy, but relatively few such studies have employed this approach in the past. In our ongoing research, we clarify the taxonomic identity of dinophyte species such as *Durinskia oculata*, *Scrippsiella acuminata*, *Scrippsiella erinaceus* and *Spiniferodinium limneticum* by collecting material at type localities. After establishment of living strains, the species are DNA-barcoded using rRNA sequences and investigated using modern light and scanning electron microscopy. Strains being morphologically consistent with corresponding protologues are used for designation of interpretative epitypes in form of permanent slides. The significant difference from the historical types is that epitypes are linked to the living material enabling the extraction of DNA sequences as well as experiments in ecology and physiology. Corresponding strains are therefore also deposited in public collections. Thus, epitypification is a key tool for reliable species determination ensuring unambiguous links between a scientific species name, its protologue, morphology, ultrastructure, genetic characterisation and spatial distribution, all of which are of great importance especially for character-poor, unicellular organisms.

Session 1.1: Biodiversity and systematics. Poster presentation.

New cytotoxic Ostreols from the epiphytic dinoflagellate *Ostreopsis* cf. ovata isolated from Jeju coastal waters Korea

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The *Ostreopsis* genus has long been paid attention due to its highly cytotoxic compounds such as ovatoxin and palytoxin. Specifically, the occurrence of this species in the Mediterranean Sea has evoked the human health issues. In this respect, we have noted on this species in Korean seas. We set up a strain of the epiphytic dinoflagellate, *Ostreopsis* cf. o, from Jeju coastal waters, and accomplished successully massive cultivation for marine natral product screening. During this research, we reported a cytotoxic compound, ostreol A, from the mass culture. Recently, we further isolated four new cytototoxic polyhydroxy compounds (ostreols B, C, D, and E) from the same culture. In this presentation, we will show the isolation and structure determination of all the new compounds, along with the evaluation of

cytotoxicity. The structure of the compounds was elucidated by the combination of spectroscopy method and chemical reactions.

Session 1.3: Dinoflagellate ecology. Poster presentation.

A dinoflagellate's sedimentary journey: from the water column to the lakebed

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Dinoflagellates are common phytoplankton in lacustrine ecosystems and their resting cysts have been reported in Cretaceous – Recent sediments. Dinocysts have been shown to have potential in paleolimnological studies, especially of anthropogenic impacts. Their use as paleoenvironmental proxies remain limited because: 1) the identification of both thecae and cysts is not straightforward due to infraspecific variation; 2) theca-cyst relationships remain poorly understood, and phycological and palynological communities are largely isolated; and 3) the taphonomic factors controlling their distribution in sediments are poorly understood. Using a combined phycological and palynological approach, we investigated the relationship between the phytoplankton in the water column and the fossil record of cysts. Plankton tows, sediment traps and lakebed sediment samples were collected from spring through fall of 2016 from Plastic Lake, ON, Lake George, NY, and Sluice Pond, MA. Surface sediments and sediment trap samples were processed using standard palynological procedures, and water samples were preserved with Lugol's iodine, fixed to slides and analyzed using light and scanning electron microscopy. *Lycopodium* marker spores were added to all samples in order to assess the absolute abundance (concentration) of dinoflagellates as well as the relative abundance of dinoflagellate species in the water column and in sediments. Seasonal sampling of the water column and use of sediment traps is providing a better understanding of the life cycle and preservation potential of common dinoflagellates. Understanding taphonomic factors that affect cyst preservation is critical to fully exploiting their value as paleoenvironmental proxies.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Poster presentation.

Dinocysts as proxy off sea ice conditions in the Arctic? Preliminary results of a new method to estimate sea ice condition.

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Sea ice is one of the most important factors influencing the climate of the Arctic. White ice reflects a great portion of the sun radiation (including heat) while dark sea surface absorbs it. The loss of sea ice has an essential impact on the heat budget, sea ice stability, carbon cycle feedback, atmospheric and oceanic circulation. Collected dinocysts were well preserved in the sediments around Svalbard, and wherein some of the species like cysts of *Polarella glacialis, Islandinium minutum, Islandinium? cezare* and *Echinidinium karaense* show a strong correspondence with the sea ice cover presence. Surface 2 cm sediment samples were collected with box-corer in 2014 and 2016 from the board of R/V Oceania. Seven locations around Svalbard were sampled: five fjords and two sites in front of open marine tidewater glaciers. Sediment was treated with hydrochloric acid and hydrofluoric acid to remove carbonates and silicates. Species were identified using light microscopy. Obtained data showed the presence of 39 species of dinocyst from 23 genera. Cysts of *P. glacialis*, *I. minutum*, *I.? cezare* and *E. karaense* were quoted most frequently in the locations where sea ice

is present seasonally. This finding confirms a relationship between the appearance of seasonal sea ice and the occurrence of associated dinoflagellates species responsible for the production of the above-mentioned cysts. We will discuss the importance of this study for sea-ice reconstructions using dinocysts. These studies were funded by the National Science Centre through grants number 2013/11/B/ST10/00276 and 2014/15/N/ST10/05115.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

What are the main environmental factors determining recurrent blooms of the neurotoxic *Alexandrium pacificum* Litaker sp. nov (Group IV) in a Mediterrnean ecosystem ?

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Since 1998, recurrent toxic blooms of the dinoflagellate *Alexandrium pacificum* (former *Alexandrium catenella*) occur regularly in Thau lagoon (Mediterranean, France) during spring and autumn. Vegetative cells intoxicate shellfish (oysters and mussels) periodically threatening economic activities. The hypotheses put forward to explain such developments are related to favorable conditions for cyst germination, and later for vegetative cell division. *A. pacificum* cyst germination is controlled mainly by temperature, irradiance and the hydrodynamics resulting in cyst resuspension. Under favorable environmental conditions, cysts of A. *pacificum* can germinate and inoculate the water column. Vegetative growth of this dinoflagellate mainly depends on temperature, irradiance, nutrient availability and biological interactions. Interestingly, the apparition of *A. pacificum* in Thau coincided with the oligotrophication of this area. In situ survey suggests that sea surface temperatures and the wind patterns appear to influence greatly the bloom occurrences. Considering the biological control of A. pacificum, we discuss here the inhibitory effect of allelochemicals (phenolic acids) produced by *Zostera* species on the growth of this dinoflagellate and potentially on the bloom development. Finally, we highlight the intraspecific variability in the growth and toxin content which determine the success of blooms and toxicity level in shellfish during blooms. Key words: *Alexandrium pacificum*, Mediterranean Thau lagoon, cysts, growth, toxicity

Session 1.3: Dinoflagellate ecology. Oral presentation.

First report of an *Alexandrium* bloom in the Bilbao estuary and its unexpected composition

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The Bilbao estuary (SE Bay of Biscay) has been monitored for phytoplankton taxonomic composition and abundance since 2000, paying special attention to potentially harmful taxa. Blooms of potentially toxic microalgae such as *Heterosigma akashiwo* or *Pseudo-nitzschia* spp. have been reported, whereas other toxic algae have been commonly found although not in bloom proportions (e.g. *Karlodinium veneficum, Dinophysis tripos*…). The dinoflagellate genus *Alexandrium* is of great concern in this context due to the capability of some of its species to produce paralytic shellfish poisoning toxins. During more than 10 years, *Alexandrium* spp. cells were seldom detected in the Bilbao estuary and, when present, only one or two cells were found. However, cells of this genus have started to appear more frequently in the last few years and, during a routine sampling in September 2015, a bloom of 4220 cells/L was

observed at the seaward end of the estuary. Despite this amount was not too-high, the number was noticeably higher than any previously reported in the area, being the dominant alga in the microplankton fraction. The analysis of the thecal plates revealed that cells belonged to the *Alexandrium tamarense* species complex. An initial biogeographic interpretation pointed to *A. catenella* and/or *A. tamarense*, which are the two species from the complex reported in European Atlantic waters. However, the molecular analyses (regions LSU and ITS of the rDNA) of the seven strains isolated from the bloom revealed that all of them belonged to *A. mediterraneum*, a species only known previously in the Mediterranean Sea.

Session 1.1: Biodiversity and systematics. Poster presentation.

From the phylogeography of the *Prorocentrum lima* complex to the morphospecies concept in *P. lima* sensu stricto and *P. arenarium*

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Prorocentrum lima is the most commonly reported benthic *Prorocentrum morphospecies*. As more strains of *P. lima* from different geographic origins are analysed, more complex phylogenetic structures are uncovered, showing well-differentiated clades in a natural group that also includes other morphospecies (at least *P. arenarium, P. maculosum, P. belizeanum* and P. *hoffmannianum*). The concept "P. lima complex" can be used to refer to this natural group. The presence of different phylogenetic groups implies that the delineation of morphological variability within the complex needs to be addressed in this framework. Here we studied 15 strains from the Atlantic Iberian Peninsula and the Mediterranean Sea. From the phylogeny, we depicted four groups (I-IV) with a species or higher taxonomic rank based on among clades ITS-region genetic distances (ρ-value > 0.08). The distribution of the strains in the phylogeny showed a coherent biogeographic pattern. The phylogeographic analysis allowed assigning *P. lima* sensu stricto to the group I, since it contained all the strains from the Mediterranean Sea, where its holotype comes from. One of our strains showed a roundish shape and elongated thecal pores (i.e. fitting the morphospecies concept of *P. arenarium*) whereas the others showed the typical elongated shape and round pores. Despite the morphological disparity, they clustered together in group I. However, the phylogeographic analysis also allowed to reject the view that P. *arenarium* is synonym of *P. lima*, since the type locality of this species is in the Caribean Sea, where *P. lima* s. s. has not been reported.

Session 1.1: Biodiversity and systematics. Oral presentation.

Diversity of benthic dinoflagellates in Jeju Island, Korea

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A study on the presence of benthic dinoflagellates in the intertidal and subtidal zone along the coast of Jeju Island Korea was conducted from 2011 to 2016. Samples were collected from sand sediments and surface of macroalgae at sand beach and subtidal stations. Samples were isolated by shaking method of plastic bag or by picking method, and then fixed with 1% formaldehyde or 1% Lugol solution. Species identification was done by light and scanning electron microscope. We identified more than 50 benthic dinoflagellates, which are newly recorded to Korean waters, belonging to 23 genera such as *Amphidiniella*, *Amphidiniopsis, Amphidinium, Bispinodinium, Bysmatrum, Cabra, Coolia, Dinothrix, Durinskia, Galeidinium, Gambierdiscus, Gymnodinium, Herdmania, Heterocapsa, Katodinium, Ostreopsis, Planodinium, Polykrikos, Prorocentrum, Roscoffia, Testudodinium, Thecadinium,* and *Togula*. The

commonly occurring genera were *Amphidinium, Coolia, Ostreopsis, Prorocentrum*, and *Thecadinium*. The detailed nomenclature, distribution, and illustrations are presented here.

Session 1.1: Biodiversity and systematics. Poster presentation.

Different life cycle strategies of the dinoflagellates *Fragilidium duplocampanaeforme* and its prey *Dinophysis acuminata* may explain their different susceptibilities to the infection by the parasitoid *Parvilucifera infectans*

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Whether the dinoflagellates form ecdysal cysts or not may influence susceptibility to parasitism. In this study, we examined parasite prevalence relative to inoculum size of the parasitoid *Parvilucifera infectans* zoospores for two dinoflagellate hosts (i.e., *Fragilidium duplocampanaeforme* and *Dinophysis acuminata*), which have different life cycle strategies. Further, we explored susceptibility of cysts to parasitism, encystment signal, duration of encystments, and effects of induced encystment on diel periodicity, using ecdysal cyst-forming *F. duplocampanaeforme*. While the parasite prevalence in *D. acuminata* increased to a maximum of 78.8 (±2.4%) by a zoospore:host ratio of 20:1, it in F. duplocampanaeforme only reached 8.9 (±0.3%), even at a zoospore:host ratio of 120:1. In F. duplocampanaeforme, infections were observed only in the vegetative cells and not observed in ecdysal cysts. When exposed to live, frozen, and sonicated zoospores and zoospore filtrate, *F. duplocampanaeforme* formed ecdysal cysts only when exposed to live zoospores, suggesting that temporary cyst formation in the dinoflagellate resulted from direct contact with zoospores. When the *Parvilucifera* zoospores attacked and struggled to penetrate *F. duplocampanaeforme* through its flagellar pore, the *Fragilidium* cell shed all thecal plates, forming a 'thecal cloud layer', in which the zoospores were caught and immobilized and thus could not penetrate anymore. The duration (35±1.8 h) of ecdysal cysts induced with addition of zoospores was significantly longer than that (15±0.8 h) of normally formed cysts (i.e., without addition of zoospores), thereby resulting in delayed growth as well as influencing the pattern of diel periodicity.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Oral presentation.

Polyhydroxy Compounds isolated from the epiphytic dinoflagellate *Ostreopsis* cf. *ovata*

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Ostreopsis spp. are benthic dinoflagellate, epiphytic on red and brown seaweeds and on rocks, sand, mussel shells and benthic invertebrates. Recently many studies have reported that the genus *Ostreopsis* produces palytoxin-like compounds, ostreocin D and ovatoxins which are one of the most potent biotoxins. For the purpose of exploring these compounds from *O.* cf. *ovata* in the Korean seawater, we cultivated this specimen to the massive volume from its single cell. From this biomass, a non-palytoxin compound, ostreol A containing a primary amine group at one terminus and the central hairpin portion, was isolated and reported a few years ago. Three polyhydroxy compounds were additionally isolated the same pellet extracted with 50% aqueous methanol at room temperature. The planar structure of three compounds was determined by using a 900MHz NMR spectrometer and MS spectrometer. All compounds showed weaker toxicity than ostreol A. In this presentation, we will show the isolation

and structure of the cytotoxic compounds.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Poster presentation.

Cyst-theca relationships in dinoflagellates – Wall and Dale revisited

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Next year will mark 50 years since the publication of the classic paper of Wall and Dale (1968) describing cyst-theca relationships in the modern dinoflagellates and the evolution of the Peridiniales. The work presaged a number of important themes - including observations on the life history of dinoflagellates; observations of the morphological variability of some cyst species; the difficulties of identification of some groups; the variability of taxonomic information displayed by cysts and thecae; the possibility of a deepened understanding of evolution through the use of both life cycle stages and the need to develop a classification system that had the possibility to reflect all of this biological and evolutionary information. All of these aspects have been further investigated in subsequent years and this presentation will reflect on the progress we have made on these various themes and the gaps in our knowledge that still remain.

Wall, D & Dale, B (1968). Modern Dinoflagellate Cysts and Evolution of the Peridiniales Micropaleontology, 14 (3) (Jul., 1968), pp. 265-30

Session 1.1: Biodiversity and systematics. Oral presentation..

Species composition, abundance and distribution of the genus *Protoperidinium* Bergh (Dinophyceae) from the central region of the Gulf of Mexico.

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This study discusses the genus *Protoperidinium*, its distribution and its relationship with temperature, salinity, dissolved oxygen, chlorophyll-a and nutrients. Phytoplankton material consisted of net tows from the surface to 200 m depth was observed during the oceanographic cruises: MARZEE-I (July 2010) and MARZEE-II (January 2011). Additionaly, during UEYATL-I cruise (October, 2013) water samples were collected with Niskin bottles at 10 m depth and vertical net tows from surface to 200 m were studied. The qualitative and quantitative analyses of Protoperidinium by the Utermöhl method revealed the presence of 38 species : *P. tuba* (623 cells. L^{-1}), *P. ovum* (473 cells. L^{-1}), *P. bipes* (358 cells. L^{-1}), *P. elegans* (275 cells. L^{-1}), *P. pyriforme* (259 cells. L^{-1}), and *P. venustum* (190 cells. L^{-1}). The species composition of July 2010 and January 2011 allowed the identification of 25 and 22 species, respectively. By cluster analyses three regions were found: 1) the oceanic; 2) the shelf break and 3) the coastal regions in three sampling periods. In total, widely distributed 44 species of *Protoperidinium* were identified. Among them, 36% species were found in all sampling sites (*P. cassum, P. conicum, P. crassipes, P. divergens, P. leonis, P. oceanicum, P. oviform, P. ovum, P. pellucidum, P. pentagonum, P. pyriforme, P. quarnerense, P. steinii, P. tuba, P. venustum* and *Protoperidinium* sp 1). Nutrient and chlorophyll-a data corroborate the oligotrophic conditions of the regions studied. Statistical methods (PCA) showed that temperature, silicates and chlorophyll-a are important factors to understand the species distribution in all sampling periods.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Check list of recent Dinoflagellates (Dinophyceae) from the southern Gulf of Mexico: Data-base (1979-2013) and new records

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The objective of this study was to compile a coded checklist of 302 taxa of dinoflagellates collected over a span of 30 years (1979-2013) from water and net-tow samples in the southern Gulf of Mexico. The checklist is based on a long-term survey involving 24 oceanographic cruises. The material for this study comprises water and net samples obtained at 692 sites. Most species were identified in water mounts and permanent slides, and, in a few cases the scanning electron microscope was used. The most diverse genera in both water and net samples were *Tripos* (78 spp), *Protoperidinium* (48 spp), *Oxytoxum* (20 spp), *Dinophysis* (18 spp), *Prorocentrum* (15 spp), *Histioneis* (10 spp) and *Amphidinium* (10 spp) genera. The most frequent species in net and water samples were: *Amphidinium carterae, Dinopysis caudata, Gonyaulax polygrama, Oxytoxum ovale, O. scolopax, Podolampas bipes, P. palmipes, Prorocentrum gracile, P. micans, Protoperidinium conicum, P. crassipes, P. divergens, P. lomgipes, P. oceanicum, P. ovum, P. pentagonum, P. quarnerense, P. steinii, Pyrophacus horologium, Tripos fusus, T. furca, T. breve, T. candelabrum T. hircus* and *T. teres*. Nine taxa were new records for this region.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Atlas of modern dinoflagellate cyst distribution in the Black Sea Corridor from the Marmara Sea to the Aral Sea including the Black, Azov and Caspian Seas

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We present the first compilation of dinoflagellate cysts from 185 surface samples in the Black Sea Corridor (BSC), from the Aegean to the Aral Sea (including Marmara, Black, Azov and Caspian Seas). Here recent anthropogenic activities have strongly influenced marine ecosystems and biodiversity, apparently increasing harmful algal blooms. A large diversity of 71 taxa has been identified, and their taxonomy has been reviewed and updated. Several species show distinct morphotypes that are related to specific sea-surface conditions in low salinity seas. Maps of distribution and statistical analyses show the strong influence of annual and seasonal sea-surface salinity; temperature seems less important. *Lingulodinium machaerophorum* dominates most assemblages except in the Caspian Sea, where *Impagidinium caspienense* is the dominant species. Other species associated with normal marine conditions are well distributed only in Marmara and Black Seas: *Operculodinium centrocarpum* sensu Wall & Dale 1966, *Spiniferites mirabilis* and *S. ramosus*. In contrast, *Spiniferites cruciformis*, which dominates early Holocene sediments in the Black and Marmara Seas, today occurs in low abundance in the northern Black Sea, and in the Caspian and Aral Seas. We use the new modern distributions to re-examine past Mediterranean-Black Sea linkages. A total of 40 well-dated Late Quaternary records are used to estimate when species entered the BSC, either due to sea level change or anthropogenic activities. This modern database also fills the need for a low salinity baseline for quantitative reconstructions of past salinity Preliminary results of sea-surface salinity

reconstructions based on the Modern Analogue Technique will be presented.

Session 1.5: Marine to freshwater transition and gradient in the dino world. Poster presentation.

Heterotrophic marine palynomorphs were dominat in tropical coastal shallow water sediments in Southeast Asia

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The goal of this study was to characterize palynomorph assemblages in tropical marine coastal shallow water sediments collected from the southern coast of Myanmar and Selangor costs of Malaysia for understanding them as useful tools for reconstructing tropical coastal environmental changes. These sediment samples were dominated by heterotrophic marine palynomorphs, in particular microforaminiferal linings and heterotrophic dinoflagellate cysts. In addition, subtropical-tropical marine palynomorph assemblages were characterized by low cell/grain concentrations, especially photo/mixotrophic dinoflagellate cysts. These marine palynomorph characteristics are common to other coastal surface sediments collected from Southeast Asia. These assemblages may reflect a diagnostic food-web characterizing tropical coastal shallow (mangrove) waters. For example, benthic foraminifers (microforaminiferal linings) usually consume prey organisms composed of bacteria, diatoms, and dinoflagellates. Bacteria can utilize dissolved organic matter delivered from terrestrial and marine environments by various organisms inhabiting water and sediment surfaces. The dominance of microforaminiferal linings appears to result from both microbial food webs and grazing food webs in tropical coastal shallow water sediments.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Phycological and palynological evidence of marine – freshwater transition in the family Thoracosphaeraceae

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Cysts described as *Geiselodinium tyonekensis* Engelhardt, 1976 from nonmarine strata in the Tyonek Formation of Alaska appear identical to cysts produced by the dinoflagellate described as *Peridinium wisconsinense* Eddy, 1930 from the epilimnion of Lake Oconomowok, Wisconsin. Phylogenetic analysis identified close relationship between *P. wisconsinense* and the freshwater genera *Chimonodinium* Craveiro, Calado, Daugbjerg, Gert Hansen & Moestrup 2011 and *Apocalathium* Craveiro, Daugbjerg, Moestrup & Calado, 2016, and with various heterotrophic marine pfiesteraceans. Thoracosphaeracean affinity was confirmed by morphological analysis of the distinctive spindle-shaped theca of *P. wisconsinense*, so it was transferred from Peridiniaceae Ehrenberg, 1828 to Thoracosphaeraceae Schiller 1930 emend. Tangen in Tangen et al., 1982, and a new genus was erected:

Fusiperidinium gen. nov. McCarthy, Gu, Mertens & Carbonell-Moore. *Fusiperidinium wisconsinense* (Eddy) McCarthy, Gu, Mertens & Carbonell-Moore comb. nov. exhibits morphological characteristics inconsistent with peridinialeans, so it was assigned to the order Thoracosphaerales Tangen, 1982. Proximocavate cysts of *Fusiperidinium wisconsinense* comb. nov. are commonly reported in palynological studies due to their high fossilization potential and distinctive morphology that reflects the fusiform theca. The occurrence of identical cysts in the upper middle Miocene Tyonek Formation constrains the timing of transition to freshwater environments in this lineage and coincides with rapid expansion of the Antarctic Ice Cap, suggesting that *F. wisconsinense* (= *G. tyonekensis*) evolved from a euryhaline thoracosphaeracean ancestor when coastal embayments were glacioeustatically isolated. Molecular phylogeny inferred from concatenated SSU and LSU sequences suggests that this transition occurred independently from that which produced the family Peridiniaceae.

Session 1.5: Marine to freshwater transition and gradient in the dino world. Oral presentation.

A novel morpho-molecular analysis of Podolampadaceans: are morphological concepts supported by phylogenetics?

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The Podolampadacean dinoflagellates are often found in oceanic waters with a wide distribution and maximal species diversity in the tropics. Currently six genera are described in this family: *Blepharocysta* (five species), *Gaarderiella* (four species), *Heterobractum* (one species), *Lissodinium* (18 species), *Mysticella* (two species) and *Podolampas* (5 species). Usually, they are scarce in coastal plankton samples and are difficult to discriminate in light microscopy (LM), except for *Podolampas*, a genus with a distinct shape. So far, only small subunit (SSU) ribosomal DNA (rDNA) sequences of four *Podolampas* and one *Blepharocysta* have been published. Here we have studied several *Podolampadaceans* from the French Atlantic (coastal Brittany and "K VIII" Deep-sea Expedition 2015), French Mediterranean Sea (Gulf of Bastia (Corsica), Villefranche-sur-mer and Banyuls-sur-mer) and Reunion Island samples. Specimen were isolated by micropipette under an inverted light microscope for both morphological analysis using field emission scanning electron microscopy and genetics. Additionally, from specimens that were measured and photographed using a digital camera, we used single-cell PCR to obtain large subunit (LSU) and SSU rDNA sequences. We will present new LSU and SSU based phylogenies including species of genera that have not been sequenced before (e.g. *Lissodinium*, *Mysticella*, *Gaarderiella*). We will show how the morphological genus and species concepts are supported by phylogenetics.

Session 1.1: Biodiversity and systematics. Oral presentation.

DinoREF: an updated and curated dinoflagellate (Dinophyceae) reference database for the 18S rRNA gene region

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Dinoflagellates are a heterogeneous group of protists, present in all aquatic ecosystems and occupying various ecological niches. Environmental meta-barcoding studies have shown that dinoflagellates

dominate marine planktonic assemblages both in terms of sequence abundance and diversity. To facilitate interpretation of meta-barcoding data, we provide an updated 18S rRNA reference database of dinoflagellates. The sequences were downloaded from GenBank and filtered based on quality criteria, such as sequence length and presence of the V4 region. Then they were taxonomically curated, annotated and linked to available morphological, ecological and geographic information. The obtained database included 1671 sequences belonging to 147 genera and covering 22% of the number of taxonomically described dinoflagellate species. The largest number of sequences belongs to two autotrophic groups, including toxic and symbiotic species (Gonyaulacales, Suessiales). Instead, mixotrophic/heterotrophic groups, such as Dinophysiales and the genus *Gyrodinium*, are scarcely represented. The V4 region does not capture all of the sequence diversity present in the 18S. In fact, the number of unique sequences is reduced from 1540 to 954 if only the V4 region is taken into account. Overall, 18% of the species (82 species over 456) represented in the database were not differentiated by the V4 region, which however allowed to identify the genus level in 95% of the cases. The DinoREF Database is currently tested to analyse the NGS meta-barcode data collected from the LTER MareChiara station in the Gulf of Naples between 2011 and 2013 (48 sampled dates). We will present an overview of the results.

Session 1.1: Biodiversity and systematics. Oral presentation.

KEYNOTE

The evolution of toxin synthesis in dinoflagellates

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Dinoflagellates are common in aquatic ecosystems, inhabiting benthic, planktonic, symbiotic and parasitic niches. Certain species can become abundant and even dominant, despite being slower growing and less efficient at nutrient uptake compared to other phytoplankton. The production of an unprecedented array of chemical compounds, some of which have alleolopathic, anti-predator, and other toxic impacts, may help enable their growth. Our growing consensus regarding the phylogenetics and evolution of dinoflagellates; our increasing understanding of which species of dinoflagellates produce certain toxins, driven by the needs of shellfish safety managers; and the use of transcriptomic methods for exploring the genes potentially involved in toxin production in dinoflagellates, are now enabling us to attempt to piece together the evolution of toxicity in dinoflagellates. In this talk, what is known of the molecular basis and molecular evolution of polyketide and other toxins in dinoflagellates will be discussed. The potential roles of the processes of gene duplication, gene loss, selection, and lateral transfer in the evolution of these toxins will be discussed, as well as shellfish safety applications of this information.

Assessing the monsoonal control on dinoflagellate cyst distribution in recent sediments along the western margin of Bay of Bengal

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The Bay of Bengal (BoB) has a uniquely connected systems of climatic and oceanographic processes controlled by the seasonality in the Indian monsoons and resultant freshwater-sediment influx through the Himalayan (in the north) and Indian peninsular (in the west) riverine systems. Spatial variation in these processes controls the ecological and biological

productivity differences over the BoB. Information is, however meager about the responses of different phytoplankton functional groups, including the dinoflagellate cysts, to monsoonal environmental variability and productivity changes in the BoB. Our main objective was to assess the influence of monsoonal variability on a coastal assemblage of dinoflagellate cyst along the BoB. Over 39 dinoflagellate cyst taxa were recorded from the 24 surface sediments samples collected along the western and north-western margins of the BoB. Although low cyst abundance reported in this region (in few hundreds) as compared to other productive regions, the relative assemblage variances signify differences within the regional biogeographic zone. Relative dominance of Protoperidinoid species mainly, *Quinquecuspis concreta, Votadinium calvum, Trinovantedinium applanatum, Brigantedinium* spp., *Selenopemphix quanta, Stelladinium robustum, Lejeunecysta* sp., cyst of *Protoperidinium latissimum* together with the Gonyaulacoid species like *Bitectatodinium spongium*, *Lingulodinium machaerophorum* and *Spiniferites membranaceus* illustrates regional oceanographic and resultant productivity differences within the study region. Further, the multivariate statistical analysis of relative cyst assemblage results thus far indicates regional and seasonal salinity and nutrient variations controls the productivity variability as highlighted in the cyst archives.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Interplay among mixotrophy, allelopathy, and parasitism: a case study of the mixotrophic ciliate *Mesodinium rubrum*, the mixotrophic dinoflagellates *Dinophysis* spp. and *Fragilidium duplocampanaeforme*, and the parasitoid *Parvilucifera infectans*

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While mixotrophy, allelopathy, and parasitism are each well known to play important roles in plankton dynamics, their interplay occurring at the same time in the food chains remains not well understood. To better understand the complex interplay among them in plankton dynamics, we used cultures of the mixotrophic ciliate *Mesodinium* cf. *rubrum*, the mixotrophic dinoflagellates *Dinophysis* spp. and *Fragilidium duplocampanaeforme*, and the dinoflagellate parasitoid *Parvilucifera infectans* as model organisms. The result revealed that the trophic dynamics from ciliate M. cf. rubrum through dinoflagellates *Dinophysis* spp. to dinoflagellate F. duplocampanaeforme could be greatly affected by predator-prey and allelopathic interactions, depending on which *Dinophysis* species (*Dinophysis acuminata* vs. *Dinophysis fortii*) are included in the trophic series, as well as by the absence or presence of parasitism.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Competition between two Mediterranean benthic microalgae: Endo/Exo metabolome study and physiological responses

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Blooms of the benthic toxic dinoflagellate *Ostreopsis* cf. *ovata* have increased in frequency in temperate areas during the past decades. Adverse effects on Human health of those blooms have been recorded with skin and eye irritations, fever, headaches and breath difficulties among main symptoms. Few deleterious effects have also been measured on the marine fauna. The toxicity of this dinoflagellate is attributed to the synthesis of palytoxin analogs

(ovatoxins), although the ecological role of those toxins remains poorly understood. The ecological role of the secondary metabolites synthetized by O. cf. ovata, including the ovatoxins, was assessed on a benthic diatom *Licmophora paradoxa*. Both species occupy the same ecological niche, but rarely co-occur in the field. Through a co-culture without contact, allowing only diffusion of allelochemicals, we observed that toxins released by O. cf. ovata were not prone to diffusion and did not inhibit the diatom growth. This suggests that ovatoxins are unlikely produced for diffusive allelopathics interactions between *Ostreopsis* cf. *ovata* and its environment. The analyses of the molecular content of the media using comparative metabolomics (UHPLC-HRMS) highlighted the diffusion of few compounds structurally close to ovatoxins. Interestingly, a negative effect on the physiology of *O.* cf *ovata* was measured throughout the experiment, suggesting the synthesis of toxic allelochemicals by the diatoms.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Developing new approaches for the harmful dinoflagellate diversity studies and management of their toxic blooms

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The huge and complex biodiversity of dinoflagellates stimulated for many years interesting genetic and molecular studies mainly aimed at harmful species worldwide. Their toxic blooms cause serious impacts to human health, marine environment and economic maritime activities at many coastal sites. Therefore, there is a urgent need for new methods not only for rapid and accurate detection and count of HAB species, but also for species-specific identification and reliable quantification of cell densities, the ultimate goal being the development of early warning and forecasting systems for HABs. Phylogenetic relationships and genetic population studies proved the identity of new species (i.e. in *Alexandrium* or *Ostreopsis* genera) and allowed to gain new insights into phytoplankton assemblage structure in the Mediterranean Sea. Genus- and species-specific primers and probes designed on rDNA ribosomal and *saxitoxin* genes allowed to develop and apply new identification and counting qPCR and microarray based assays, which proved to be more rapid, sensitive and specific when applied in various substrates, such as the water column, hard and soft bottoms and aerosol. In the recent aquaculture system investigated for the PSP toxin producing species, the *sxtA1* gene qPCR assay can support the analytical methods for STX determination in seawater and shellfish especially at early warning stage of toxic blooms. Further, predictive models can play an important role in managing and forecasting HABs. Models based on Machine Learning techniques and principally those based on Random Forests are very promising both at regional and at wider scale.

Session 1.1: Biodiversity and systematics. Oral presentation.

Dinoflagellate HAB-complex in the north-western Arabian/Persian Gulf

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Based on decennial taxonomic survey, the assessment of harmful algal blooms (HABs) status of the north-

western area of the Arabian/Persian Gulf (Kuwait's marine environment) has revealed the diverse assemblage of harmful dinoflagellate species. Dinoflagellates known to cause common HAB poisoning syndromes in humans were detected, including diarrhetic (*Dinophysis, Phalacroma, Prorocentrum lima*), neurotoxic (Karenia), paralytic (*Alexandrium, Pyrodinium bahamense, Gymnodinium catenatum*) shellfish poisoning, and ciguatera fish poisoning (*Fukuyoa yasumotoi*). Many of these potentially toxigenic species are normal component of the phytoplankton or periphyton occurring typically in low numbers and never attaining bloom concentrations. A wide range of potentially toxic microalgae known to be associated with massive mortality of marine biota was observed routinely in Kuwait's waters, including ichthyotoxic dinoflagellates *Akashiwo, Amphidinium, Cochlodinium, Karenia, Karlodinium, Prorocentrum, Protoceratium*, and *Takayama*. Algal blooms in Kuwait's marine environment were largely associated with coastal waters, which has been increasingly affected by HABs over the past decade. The presence of known toxic dinoflagellate species may indicate a potential risk of toxicity in the marine environment, and necessitates conducting further studies on taxonomy, ecology and toxicology of the dinoflagellates of the north-western Gulf area. The newly detected from Kuwait's waters fish-killing dinoflagellate *Cochlodinium polykrikoides* is the most immediate concern because of its recent severe and extensive bloom in the Sea of Oman and the southern Gulf area in 2008-2009, which resulted in significant economic loss and ecological consequences.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Dinoflagellate cyst production in the presence/absence of sea ice cover in the Beaufort Sea (Arctic Ocean): one year sediment trap record.

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Studies of dinoflagellate cyst time series in sediment traps provide essential information on weekly, monthly, seasonal, annual, and/or multi-annual changes in cyst fluxes in relation to measured or implied environmental parameters. Such information is essential for understanding ecological preferences of individual cyst taxa which is the foundation for performing reliable (paleo)environmental high-resolution regional reconstructions. Up to date, sediment trap studies are rare, and only three of those deal with dinoflagellate cysts production in ice-covered conditions: in Antarctic waters (Harland and Pudsey, 1999); Arctic fjords in the Svalbard archipelago (Howe et al., 2010); and Hudson Bay (Heikkilä et al., 2016). All these studies consistently show a very limited or no cyst recovery from the samples that were collected during the ice-covered intervals. However, the timing of individual species production (e.g. cysts of *Pentapharsodinium dalei, Islandinium minutum,* and *Spiniferites elongatus*) within the ice-free condition is inconsistent as it varies from region to region. In this talk, we will present our preliminary results on dinoflagellate cyst continuous bi-weekly record at the Beaufort Sea shelf break from September 2014 to August 2015.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

Palynological study of sediments associated to cold-water coral carbonate mounds in the moroccan atlantic and mediterranean margins (MD194/eurofleet-gateway oceanographic cruise)

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This work was carried out within the framework of the COCARDE program « Cold- water Carbonate Reservoir systems in Deep Environments ». It concerns palynological study of six Box cores, taken from the carbonates mounds in the Alboran and the Atlantic Moroccan margins during the cruise MD194 / Euro-FLEETS Gateways on board the R/V Marion-Dufresne (10-21 June 2013). The objective of this work is to determine the dinoflagellate cysts, identify the carbonate mounds environments and to precise the impact of climate control on the dynamics of phytoplankton populations during the Pleistocene-Present interval. The results of this study indicate the presence of two types of associations of dinoflagellate cysts and a global warming during the Holocene-current interval. The first association consists of: *Ataxiodinium choanum, Lingulodinium machaerophorum, Spiniferites bulloideus, Spiniferites mirabilis, Impagidinium sphaericum, Impagidinium aculeatum, Impagidinium paradoxum, Polysphaeridium zoharyi, Selenopemphix quanta*, that indicates a cold climate. The second association composed of: *Brigantedinium simplex, Trinovantedinium applanatum, Selenopemphix* spp…and the pollens of *Artemisia* indicate a warm climate

Session 1.3: Dinoflagellate ecology. Oral presentation.

Cyst-theca relationship and molecular data of three cysts from the Gulf of St. Lawrence (Canada)

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We present new morphological and molecular data on three dinoflagellate cyst taxa collected from the Gulf of St. Lawrence (Canada) in September 2015. Cysts of *Spiniferites mirabilis, Spiniferites ramosus* and *Nematosphaeropsis labyrinthus* with cell content were isolated from surface sediments and incubated in a growth chamber (f/2 culture medium, T = 15°C, S = 34, light:dark cycle 12:12). *S. mirabilis* and *S. ramosus* excysted after ~1 week and rapidly developed into one (Smir003) and two (Sram028 and Sram031) viable cultures respectively, while *N. labyrinthus* did not. The 18S Ribosomal RNA of motile cells of both *S. mirabilis* and *S. ramosus* cultures, and of two cysts of *N. labyrinthus* was extracted, amplified by PCR, and sequenced at the Centre de recherche du Centre hospitalier de l'Université Laval in Quebec City (Canada). A BLAST search (Basic Local Alignment Search Tool) indicated that both cysts of N. labyrinthus showed no significant similarity found with any of the published sequences from public databases. Motile cells produced by *S. ramosus* had 97% identity and 94% recovery with sequence CCAP1118/2 – *Gonyaulax spinifera*, while those of S. mirabilis had 91% identity and 90% recovery with uncultured dinoflagellate clone F.13_519. These results suggest that *S. ramosus* is indeed the cyst produced by *Gonyaulax spinifera*. We are describing the motile stage of *S. mirabilis* under the name *Gonyaulax mirabile* Rochon Doiron et Lemarchand sp. nov., and we further describe the taxonomical and ecological implications of our findings.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation.

Sexual reproduction in subtropical strains of *Fukuyoa yasumotoi* (Dinophyceae)

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The life cycle of the toxic benthic dinoflagellate *Fukuyoa yasumotoi* isolated from a subtropical area (Gulf of Aqaba, northern Red Sea) is described for the

first time under laboratory conditions. *F. yasumotoi* is homothallic and isogamous, producing gametes in dense populations in nutrient depleted growth medium. The thecate gametes were smaller than vegetative cells and less pigmented. Fusion of gametes resulted in long-lived motile planozygotes with two longitudinal flagella. The planozygotes enlarged and became heavily pigmented and more laterally compressed within 8-24 days. Mature planozygotes settled on the bottom, attached laterally to the substrate, and developed into distinct resting cysts (hypnozygotes). The cysts were broadly elliptical in shape and lenticular in side view, with a thick two-layered wall surrounded by mucilage. After dormancy (from 7-16 days up to more than 2 months), cyst germination released a large naked globular planomeiocyte with two trailing flagella; it slowly rotated around outer edge of the empty cyst forming a doughnut-shaped mucilage envelope. Inside this envelope, two meiotic divisions and subsequent mitosis took place within a few days resulting in a total of eight daughter cells that released into the water. The ability of *F. yasumotoi* to form sexual resting cysts may be advantageous for survival of this tropical species in the northernmost limits of its geographic range during winter temperatures.

Session 1.4: Toxic dinoflagellates: from cells to cysts. Poster presentation.

Dinoflagellates from the Pontocaspian region: from biodiversity to phylogeny

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The Pontocaspian region (Black Sea, Caspian Sea, Anatolia and surroundings) has experienced highly dynamic changes in geology and climate that have induced abrupt changes in lake levels and environmental parameters, particularly salinity. As a result, over the last two million years, this area has developed a unique and diverse endemic biota adapted towards low salinity. Numerous palynological studies have described endemic species assemblages dominating the dinoflagellate community in this area. However, the complete life cycle and ecology of most of these endemic species as well as their speciation events are still unknown. An extensive sampling strategy across the Pontocaspian region has been designed to infer dinoflagellate biodiversity and the biogeography of these brackish species. By applying palynological methods to surface sediments, microalgae cultures from environmental samples and molecular techniques using dinoflagellates-specific primers (COI and ITS), this project aims to examine the extent to which dinoflagellate phylogeny, current taxon biodiversity and species ecology from the Pontocaspian region have been influenced by the history of natural events during the Quaternary period. Moreover, using dated molecular phylogenies, we aim to reconstruct the evolution and to infer endemic dinoflagellate biodiversity. We present preliminary species assemblages inferred from the identification of dinocyst (taxonomy) and planktonic cells (eDNA) from phytoplankton samples along salinity gradients from three brackish environments along the Black Sea coast linked to their environmental setting.

Session 1.1: Biodiversity and systematics. Poster presentation.

Characterisation and comparison of toxin-producing isolates of *Dinophysis sacculus* and *D. acuminata* from Arcachon Bay.

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Regular monitoring of phytoplankton in Arcachon Bay has revealed the presence at low level of several species of *Dinophysis* sp. all throughout the year and with high abundances of *Dinophysis acuminata* generally in spring. and *D. caudata* during autumn (Maurer et al., 2010). Cells of *Dinophysis sacculus* and *D. acuminata*, two species difficult to distinguish by morphology and molecular sequencing of ribosomal DNA, were isolated from Arcachon Bay during spring, and were incubated with *Mesodinium rubrum* cells. *Dinophysis sacculus* grew at a maximum rate of 0.45 j-1 with maximum biomass of 15 000 cells per mL whereas *D. acuminata* grew more slowly (µ =0.08 j-1, maximum biomass of 250 cells per mL). Without nutrition and chloroplast acquisition through kleptoplastidy, *Dinophysis* cells did not undergo cell division, hence both *Dinophysis* species may be classified as obligate heterotrophs. Even though *D. sacculus* and *D. acuminata* were given the same prey species, toxin profiles were distinctly different, which re-enforces the separation into several species in the *D. acuminata* complex. LC-MS analysis of *Dinophysis acuminata* showed moderate amount of OA (29pg/cell) and no DTXs. *Dinophysis sacculus* cultures contained trace amount of OA (0.9 pg.cell-1) and moderate level of PTX2 and analogs (33.5 pg eq.PTX2.cell-1) comparable even higher than those measured in natural picked cells (0.1 pg and 5.1 pg.cell-1 respectively). The clear predominance of PTX2 over okadaic acid is in accordance with previous results obtained from laboratory culture of *D sacculus* from the Galician rias atlas (Riobó et al., 2013).

Riobó, P.; Reguera, B.; Franco, J.M.; Rodríguez, F. First report of the toxin profile of Dinophysis sacculus Stein from LC-MS analysis of laboratory cultures. Toxicon 2013, 76, 221–224.

Maurer, D., Bec, B., Neaud-Masson, N., Rumebe, M., Auby, I., Grémare, A., 2010. Etude des relations entre le phytoplancton et les phénomènes de toxicité d'origine inconnue dans le Bassin d'Arcachon. Tâche T3b du Programme National Arcachon (AFSSA):«Toxicité due à des espèces phytoplanctoniques réputées toxiques ou encore méconnues dans le Bassin d'Arcachon»: Rapport Ifremer RST/LER/AR/10.004

Session 1.4: Toxic dinoflagellates: from cells to cysts. Oral presentation.

Metabolomic differences between modern and ancient dinoflagellates in phosphorous-limited culture conditions

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Adaptations of dinoflagellate populations to environmental changes can be studied by comparing the physiology of modern and ancient strains revived from cysts buried in sediments. This approach presumes that resting stages have preserved the physiological adaptations to the ecosystem of the time in which the corresponding strains lived. Starting from this assumption, we revived strains of the dinoflagellates *Alexandrium minutum* and *Scrippsiella donghaienis* from up to ca. 20 and ca. 30 years-old sediments of the bays of Morlaix and Brest (Brittany, France), respectively. Non-axenic, batch cultures (3 strains for each of 2 species, for 2 ages per ecosystem) were established to examine physiological responses and adaptations to phosphorous (P) limitation. Phosphate was spiked in stationary phase to verify P limitation. Metabolite profiles were analysed using liquid chromatography coupled to high resolution mass spectrometry at different growth phases. Photophysiological cellular stress and cell-size increase were simultaneously observed after 8-11 days of culture in P-limited conditions, depending on the strains and species. Contrarily to ancient strains (1986), modern strains (2006-2010) of *S. donghaienis*

were coherently able to restart growth after the P spike. Except for one strain, neither modern (2006) nor ancient (1998) *A. minutum* strains were able to restart growing. The two species and the strains of different ages were significantly differentiated by 53 lipophilic compounds. Profiles of *S. donghaienis* of different ages and growth conditions were significantly different in 27 lipophilic compounds. These findings show inter- and intra-specific differences in physiological responses to P limitation for the studied dinoflagellates.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Oral presentation.

New records of benthic dinoflagellates (Dinophyceae) from the Canary Islands: consequence of the global change?

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From the phycological point of view, especially regarding the microalgae and cyanobacteria, Canary islands (temperate Northern Atlantic limit 28°06´N, 15° 24´W) have until recently been little-known. The knowledge on marine dinoflagellate assemblages in the archipelago begins in the early 1970´s with studies dealing with chlorophyll and primary production of phytoplankton. However, it is not until 2008 when the first benthic dinoflagellate records were published. In this study, 11 species of benthic dinoflagellates assigned to the genera *Prorocentrum*, *Ostreopsis*, *Coolia*, *Polykrikos*, *Cabra*, *Sinophysis* and *Lavanderina* are reported for the first time the Canary Islands. Samples were collected between 2013 and 2016, by SCUBA diving and snorkelling, in contrasting habitats such as meadows of *Cymodocea nodosa*, sandy bottoms and rocky bottoms with photophilic algae biocenosis (*Padina pavonica*, *Lobophora variegata*, *Halopteris scaparia* and *Cystoseira* spp.). The specimens were identified by means of light microscopy and scanning electron microscopy (SEM). These new records are discussed within the context of global change.

Session 1.3: Dinoflagellate ecology. Oral presentation.

A cellulose synthase orthologue dCesA1 was dramatically upregulated early during pellicle cyst-swarmer cell transition in thecate dinoflagellate Lingulodinium polyedrum

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Being one of the important contributors to aquatic primary production and symbiotic partners of coral reefs, dinoflagellates are also major causative agents of harmful algal blooms. They can be found in both pelagic and benthic habitats, transforming from motile swarmer cells to immotile cysts (resting, pellicle, or temporal cysts) in response to the environment stimuli. We report here the isolation of the cellulose synthase ortholog from dinoflagellates and investigated its expression during swarmer cell regeneration from pellicle cysts. During cysts formation, the cells ecdysed from their existing cell walls at the girdle region and subsequently discarded their cellulosic thecal plates and flagellar, forming immotile spheroplast-like cells with thin and smooth surface and stained weakly with Calcofluor white fluorescence stain (CFW). It took around two hours to complete the encystment process. The spheroplast-like cells required relatively short time (T=4-8 hours) to start new cellulosic thecal plates synthesis as revealed by CFW staining. Most of the cells successfully regenerated new cell walls and regained swimming ability at T=12. Interestingly the transcript

of dCesA1 was upregulated 40 times within the first two hours in the course of regeneration, whereas the protein level only started to increase after four hours. In agreement with this, increase in CFW value and CTP formation was observed between 4-8 hours new cell walls formation. The present work was supported by grant GRF16101415 from the Hong Kong Research Grant Council to JTYW.

Session ? 1.3. Dinoflagellate ecology Poster presentation

Mixotrophic growth of the sand-dwelling dinoflagellate *Thecadinium kofoidii*

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We first reported here that the sand-dwelling dinoflagellate *Thecadinium kofoidii* was a mixotrophic species. We investigated the kind of prey species and feeding mechanism that *T. kofoidii* feeding on diverse benthic prey species. In addition, we explored the growth and ingestion rates of *T. kofoidii* on the benthic cryptophyte *Rhodomonas salina* as a function of prey concentration. Among the algal prey species provided, *T. kofoidii* ingested small algal prey species that had equivalent spherical diameters (ESDs) ≤ 10.1 µm (e.g. the benthic cryptophyte *R. salina* and the benthic dinoflagellate *Symbiodinium voratum*) using a peduncle while larger prey species that had ESDs ≥ 15 µm (the dinoflagellates *Levanderina fissa*, *Prorocentrum concavum*, *P. lima*, *Ostreopsis* cf. *ovata*) were not consumed. With increasing concentrations of *R. salina*, the ingestion rate of *T. kofoidii* on R. salina increased but soon reached saturation. The maximum ingestion rate of *T. kofoidii* on *R. salina* was 1.3 cells grazer-1 d-1. However, the maximum mixotrophic growth rate of *T. kofoidii on R. salina* was 0.132 d-1, while its phototrophic growth rate was 0.105 d-1. The low maximum ingestion rate of *T. kofoidii* may be responsible for this small difference between mixotrophic and phototrophic growth rates. The results of the present study suggest that predator-prey relationship may affect our view of energy flow and carbon cycling in marine benthic food webs.

Session 1.3: Dinoflagellate ecology. Poster presentation.

Transcriptomic analyses of *Scrippsiella trochoidea* revealed processes regulating encystment and dormancy in the life cycle of dinoflagellates, with a particular attention to the role of abscisic acid

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Due to the vital importance of resting cysts in the biology and ecology of dinoflagellates, a transcriptomic investigation on *Scrippsiella trochoidea* was conducted with the aim to reveal the molecular processes and relevant functional genes regulating encystment and dormancy in dinoflagellates. We identified via RNA-seq 3,874 (out of 166,965) differentially expressed unigenes (DEGs) between resting cysts and vegetative cells; a pause of photosynthesis (confirmed via direct measurement of photosynthetic efficiency); an active catabolism including β-oxidation, glycolysis, glyoxylate pathway, and TCA in resting cysts (tested via measurements of respiration rate); 12 DEGs encoding meiotic recombination proteins and members of MEI2-like family potentially involved in sexual reproduction and encystment; elevated expressions in genes encoding enzymes responding to pathogens (chitin deacetylase) and ROS stress in cysts; and 134 unigenes specifically

expressed in cysts. We paid particular attention to genes pertaining to phytohormone signaling and identified 4 key genes regulating abscisic acid (ABA) biosynthesis and catabolism, with further characterization based on their full-length cDNA obtained via RACE-PCR. The qPCR results demonstrated elevated biosynthesis and repressed catabolism of ABA during the courses of encystment and cyst dormancy, which was significantly enhanced by lower temperature and darkness. Direct measurements of ABA using UHPLC-MS/MS and ELISA in vegetative cells and cysts both fully supported qPCR results. These results collectively suggest a vital role of ABA in regulating encystment and maintenance of dormancy, akin to its function in seed dormancy of higher plants. Our results provided a critical advancement in understanding molecular processes in resting cysts of dinoflagellates.

Session 1.2: Dinoflagellate life cycles and nutritional strategies. Oral presentation.

Benthic dinoflagellates ecology: Testing the Artificial Substrate Method across environmental gradients

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One of the major constraints on the understanding of benthic dinoflagellate ecology is the lack of a standard sampling method. Recently, several protocols using artificial substrates have been proposed to circumvent this problem. These approaches normalize the estimation of dinoflagellate abundances to a known surface area and allow comparison across a variety of habitats and studies. They have the additional advantage of reducing counting error since samples are clean, almost without detritus and other organisms. In the present study, the fiberglass screen protocol proposed by Tester and co-workers (2014) has been used to investigate the influence of different environmental parameters (depth, light intensity and water motion) on the distribution and abundance of benthic dinoflagellate species in the east coast of Gran Canaria (Canary archipelago, Spain). This study reinforces the advantages of using standardized methods in benthic dinoflagellate studies while contributing to a better understanding of the ecology of this group.

Session 1.3: Dinoflagellate ecology. Oral presentation.

Repeated diatom capture in dinophytes hosting a tertiary endosymbiont (Kryptoperidiniaceae, Peridiniales)

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Tertiary endosymbiosis is uniquely known from dinophytes, some of which have engulfed diatom algae containing a secondary plastid (i.e., Kryptoperidiniaceae). Usually, chloroplasts are inherited together with the host cell permanently, leading to co-phylogeny. We performed a multilocus phylogenetic analysis of diatoms and included all sequences derived from endosymbionts of Kryptoperidiniaceae in our data matrix. Almost all endosymbionts found their closest relatives not in other harboured algae but in free living diatoms. Tertiary endosymbiosis therefore either evolved early,

with many extant free-living diatoms deriving from captured cells or more likely, endosymbionts were taken up by dinophytes multiple times independently. The evolutionary dynamics of Kryptoperidiniaceae are thus more complex than previously assumed, and our data indicate that diatom acquisition might be ongoing. To accurately address these statements to particular species, however, one has to irrefutably determine the taxonomic identity of particular species. Like all dinophytes, Kryptoperidiniaceae comprise of character-poor unicellular organisms, whose morphological features only are insufficient for reliable species determination particularly in case of older scientific names. To apply genetic information and therefore clarify species' identities, the epitype tool is provided by the International Code of Nomenclature for algae, fungi and plants (ICN). We have successfully clarified the taxonomic identity of one Kryptoperidiniaceae species, namely *Durinskia oculata*, based on material collected at the type locality in Prague (Czech Republic). However, this is only one step towards a fulfilled knowledge about such protistan species.

Session 1.1: Biodiversity and systematics. Oral presentation.

Epitypification – a promising method to lead us out of this taxonomic mess

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The biodiversity assessment of dinophytes started in the late 18th and early 19th century using light microscopy. Type material, particularly of older descriptions, consists of specimens permanently mounted on glass slides or of illustrations only. In many cases, type material is ambiguous and makes reliable species determination problematic or impossible. To clarify the taxonomic identity of such ambiguous scientific names and for a correct application, the International Code of Nomenclature for algae, fungi and plants (ICN) provides a tool for designating an epitype. Epitypification has great potential for a stable taxonomy, but relatively few such studies have employed this approach in the past. In our ongoing research, we clarify the taxonomic identity of dinophyte species such as *Durinskia oculata*, *Scrippsiella acuminata*, *Scrippsiella erinaceus* and *Spiniferodinium limneticum* by collecting material at type localities. After establishment of living strains, the species are DNA-barcoded using rRNA sequences and investigated using modern light and scanning electron microscopy. Strains being morphologically consistent with corresponding protologues are used for designation of interpretative epitypes in form of permanent slides. The significant difference from the historical types is that epitypes are linked to the living material enabling the extraction of DNA sequences as well as experiments in ecology and physiology. Corresponding strains are therefore also deposited in public collections. Thus, epitypification is a key tool for reliable species determination ensuring unambiguous links between a scientific species name, its protologue, morphology, ultrastructure, genetic characterisation and spatial distribution, all of which are of great importance especially for character-poor, unicellular organisms.

Session 1.1: Biodiversity and systematics. Oral presentation.

Reclassification, distribution and genetic diversity of *Cochlodinium geminatum* (= *Polykrikos geminatum*)

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Since 2006, harmful algal blooms (HABs) of different scales caused by a dinoflagellate species have frequently occurred in Pearl River Estuary. These blooms ranged from several to 300 km2 with the maximum cell density recorded to be 2.77×107 cells L-1, which caused severe water discoloration and economic losses. The species was firstly identified as *Cochlodinium geminatum* and then was revised as *P. geminatum* based on the shape of apical groove and molecular phylogeny. However, via further morphological observations on an isolate from the blooming area (Zhuhai, Guangdong province), a review of original descriptions and observations for *Cochlodinium* and *Polykrikos*, and particularly phylogenetic analysis based on the LSU rDNA sequences, we found this species should be classified as neither *Cochlodinium* nor *Polykrikos*, but rather a new genus and species. We re-described this species as *Parapolykrikos geminatum* n. gen. et sp., mainly based on its cingulum with a turn number less than 1.5, non-closed, “tadpoles” shape apical groove, cell size, and evolutionary distances from *Cochlodinium* and *Polykrikos* on the phylogenetic trees. Furthermore, via a metagenomic investigation on sediment samples, we found this species widely distributed in the coastal waters of China (South China Sea, East China Sea, Yellow Sea, and Bohai Sea), while it distributed in the SCS most abundantly. In addition, based on an alignment of 19 OTUs of its partial LSU rDNA sequences obtained from sediment samples, we also identified 41 SNPs on the 500 bp-long LSU rDNA sequences, suggesting a high intraspecific genetic diversity. Interestingly, based on the different distributions and relative abundance of the 19 OTUs along the Chinese coastal waters, it appeared that this species may have expanded its distribution from the south to north coast of China, or/and prefers a habitat of warm waters. We believe that our work provides a better taxonomy and important insights into the geographic distribution and genetic diversity of the species.

Session 1.1: Biodiversity and systematics. Oral presentation.

Taxonomic reinvestigation of type species Dinophysis acuta Ehrenb. and Dinophysis s. s. (Dinophysales).

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Dinophysoid dinoflagellates (Dinophysales) are cosmopolitan. The thecate cells have a particular dinophysoid tabulation with constant plate pattern, and a laterally flattened cell body. Especially the species-rich genus *Dinophysis* attracts attention through the high number of potential toxin producing taxa. *Dinophysis* species identification is often a challenge because of insufficient protologues, high intra-specific morphological variability, uncertain delimitation of character states between the genera *Phalacroma* and *Dinophysis* and unknown life history stages. Furthermore, molecular phylogenetic analyses have shown discrepancies to morphology based classification. So far it becomes apparent, that the suitability of the character traits used for taxonomic work is not given and a revision is needed. *Dinophysis* acuta cells have been collected and isolated from the type locality, the Kieler Fjord (Baltic Sea, Germany). Further cells belonging to *Dinophysis* sensu stricto taxa from different regions/oceans have been investigated as well. For detailed (re)investigations

taxa have been morphologically analyzed using light and scanning electron microscopic techniques as well as molecular approaches. Intra-specific variations and character traits enabling an unambiguous identification of D. acuta and *Dinophysis* sensu stricto taxa and the delimitation to *Dinophysis* sensu lato as well as *Phalacroma* sensu stricto taxa will be discussed.

Session 1.1: Biodiversity and systematics. Oral presentation.

Transport and preservation of organic-walled dinoflagellate cysts in nepheloid layers off Cape Blanc (N-W Africa)

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For establishment of adequate environmental, oceanographic and climatic reconstructions based on fossil dinoflagellate cysts associations detailed information on selective transport and preservation is required. Here we present a comparison of export rain of dinoflagellate cysts with cyst associations in different intermediate nepheloid layers in the water column, the bottom nepheloid layer and surface sediments collected along two onshore-offshore transects off Cape Blanc (NW Africa) during active upwelling in November 2015. Highest cyst export production took place at the rim of a newly formed upwelling eddy/filament. Lateral transport of cysts up to 130 km off the shelf break was observed in a nepheloid layer varying in depth of 600 - 1300 m (shelf break - deep ocean) and in the bottom nepheloid layer. No indication of lateral transport could be documented in a second intermediate nepheloid layer deeper in the water column as well as in the more offshore part of the bottom nepheloid layer. The effects of lateral transport as registered from the water column was not reflected in underlying sediments. Selective degradation altering the cyst associations was not observed in the water column but the surface sediment cyst association differed considerable from that of the nepholoid layers and the upper water column. Comparison with long term sediment trap time series of cyst production in the region indicate that the surface samples are modified predominantly by species specific post depositional degradation rather than inter-annual variation in transport and/or production of cysts.

Session 1.6: Modern dinoflagellates and cysts: what we can learn from sediments. Oral presentation

11th INTERNATIONAL CONFERENCE ON MODERN AND FOSSIL DINOFLAGELLATES

17 to 21 July 2017, Bordeaux (France)

SESSION 2 ABSTRACTS

2.1 Neogene to modern dinocysts in palaeoceanographic studies

CONVENERS: Aurélie Penaud (from the organization committee); Stijn De Schepper (Uni Research Climate and Bjerknes Centre for Climate Research, Bergen, Norway); Fabienne Marret-Davies (School of Environmental Sciences, University of Liverpool, UK)

2.2. Mesozoic and Cenozoic dinocyst stratigraphies

CONVENERS: Edwige Masure & Daniel Michoux (from the organization committee); James B. Riding (British Geological Survey, Keyworth, UK)

2.3. Phanerozoic and deep time scales

CONVENERS: Thomas Servais (from the organization committee); Jörg Pross (Paleoenvironmental Dynamics Group, Institute of Earth Sciences, Heidelberg University, Germany);

2.4. Dinocyst systematics

CONVENERS: Martin J. Head (Department of Earth Sciences, Brock University, Canada); Marianne Ellegaard (Department of Plant and Environmental Sciences, University of Copenhagen, Denmark)

2.5. Dinocyst chemistry and preservation / carbon cycles

CONVENERS: Gerard Versteegh (Alfred Wegener Institute, Bremerhaven, Germany; MARUM, Bremen University, Germany); Stephen Louwye (Ghent University, Belgium)

2.6. Integrated studies derived from dinocysts: recent past to modern scales

CONVENERS: Anne de Vernal, (GEOTOP, Université du Québec à Montréal, Canada); Karin Zonneveld (Department of Historical Geology/Palaeontology, University of Bremen/MARUM, Germany)

Centennial scale variations of sea-surface in the Disko Bugt, west Greenland

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The dinocysts are well preserved in the sediment and they lived in a wide range of environmental conditions, from freshwater to fully marine and from equatorial to polar settings. They can be used to reconstruct various parameters like the sea-ice cover, the sea-surface temperature, the sea-surface salinity and the productivity, by the way of the modern analogue technique. A new update from the dinocyst database that includes 74 taxa and 1777 reference sites was used to reconstruct the sea surface variability from Disko Bugt, West Greenland, during the last 3600 years. The dinocyst assemblages dominated by *Islandinium minutum, Brigantedinium spp., Islandinium? cezare* and the cyst of *Pentapharsodinium dalei* indicates large seasonal gradients of temperature due to stratified surface waters. The application of the modern analogue technique to dinocyst assemblages shows centennial scale variation of sea-surface salinity and temperature in phase with the fluctuation of the δ18O in the Camp Century ice core, thus highlighting the importance of ocean/atmosphere exchanges on regional proxy-climate records. The seasonal sea ice cover records large amplitude variations, with a main change of regime at about 500 AD, from winter only sea ice of about 2 months/year to more unstable conditions marked by successive cooling pulses with up to 8 months/year of ice coverage. Until about 500 AD, a notable link between the sea-surface salinity and temperature with the solar activity are found. This may indicate a strong sun-climate relationship on sea-ice area.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

Dinoflagellate cyst stratigraphy and paleoecology of the Upper Miocene–Pliocene, Rees Borehole, Northern Belgium

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Correlating and dating Neogene deposits along the southern margin of the North Sea Basin have historically been complicated by the fragmentary nature of the outcrops studied, the boreal aspect of the benthic foraminifera present, and scarcity of planktonic microfossils. Dinoflagellate cysts and other palynomorphs from the Rees Borehole, Campine area of northern Belgium, are therefore used to elucidate the paleoenvironmental history of the area. The borehole contains the Upper Miocene Diest and Kasterlee, mid-Pliocene Poederlee, and Pliocene Mol and Merksplas formations. For the Diest Formation, the presence of *Achomosphaera andalousiensis andalousiensis*, *Barssidinium pliocenicum*, *Operculodinium*? *eirikianum*, *Operculodinium tegillatum*, *Selenopemphix armageddonensis* and the acritarch *Nannobarbophora walldalei* are consistent with a late Late Miocene age. The dinoflagellate cyst assemblages of the Kasterlee Formation in the Rees borehole differ from those of the Kasterlee Formation in other areas, and are more similar to assemblages of the underlying Diest Formation. This could be explained by reworking of the Diest into the Kasterlee Formation. The Poederlee Formation assemblages include *Achomosphaera andalousiensis suttonensis*, *Invertocysta lacrymosa*, *Operculodinium*?

eirikianum and, with the absence of *Reticulatosphaera actinocoronata*, *Operculodinium tegillatum* and *Batiacasphaera minuta/micropapillata,* point to a mid-Pliocene age, between 3.7 and 2.7 Ma. For the first time, dinoflagellate cysts were found in the Merksplas Formation, indicating a marine influence. The presence of *Achomosphaera andalousiensis suttonensis*, *Barssidinium pliocenicum*, *Capisocysta lyelli*, *Geonettia waltonensis*, and *Invertocysta lacrymosa* within this formation collectively point towards a Late Pliocene age. Assemblages throughout the Rees Borehole reflect neritic deposition within a restricted marine basin under temperate climates.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Subtilisphaera cysts from the Santana Formation (Aptian, Araripe Basin, Brazil): characterization of their peculiar fibrous wall structure

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Subtilisphaera cysts recovered from the Santana Formation (upper Aptian, Araripe Basin, northeast Brazil) present very peculiar fibrous wall under observation at SEM (Scanning Electronic Microscopy). Under optical microscopy, these cysts present ornamentations that look like simply to be scabrate to microreticulate. The fibrous wall is constituted by woven structure with 50–60 nm diameter threads. In the same samples, other dinocysts (e.g., *Spiniferites* and *Trichodinium*) occur, but only *Subtilisphaera* cysts present woven fibrous wall. It is the first time that fibrous wall structure is reported for *Subtilisphaera* genus and peridinioid cysts. *Subtilisphaera* is the commonest dinoflagellate taxon in the Araripe Basin. Its huge dominance in assemblages, which represents a fossil bloom, is used as environmental event. Probably the restricted marine environment under terrigenous inputs, which characterized the Araripe Basin during late Aptian, favored the occurrence of the bloom. The fibrous wall could be an adaptation to the unstable physicochemical factors of these environments.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

Palynological records of the Labrador Sea during the intensification of the North Hemisphere glaciation

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The Pliocene-Pleistocene transition (2.58 Ma) was marked by global changes, including a significant reduction in the concentration of atmospheric CO^2 (~ 400 ppm to 180-280 ppm vs. Pliocene to Pleistocene), and an intensification of the Northern Hemisphere glaciation that led to the establishment of the Greenland ice sheet. If the Greenland ice sheet is the only one in the northern hemisphere have persisted during the Pleistocene interglacial (unlike the Laurentide ice sheet or Innuitian for example), it is currently threatened by the recent climatic changes. We investigate the marine and terrestrial palynological record from marine core sediment collected in the Labrador Sea southwest Greenland (Site IODP U1307) in order to assess on the vegetation over southern Greenland from pollen and spore and oceanic surface condition from dinocysts during the Pliocene to Pleistocene transition (from 3.3 to 2.3 Ma). The pollen assemblages of Pliocene climatic optimum suggest input from boreal-type forests located in a relatively proximal source, likely the southwest Greenland. In contrast, the assemblages of the early Pleistocene characterized by low pollen concentrations together with higher proportion of herb taxa may indicate that more open tundra-like vegetation established in the source area. The dinocyst assemblages of the Pliocene are more variable but suggest cool, low saline environment and stratified surface water mass, not unlike those

prevailing presently along the southeastern Canadian margins. The palynological assemblage also contains abundant acritarchs, which probably belong to green algae and are often associated with epicontinental marine environments and high primary productivity in the fossil records.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Poster presentation.

Dinoflagellate cyst production in the Cariaco Basin: a 12 year-long sediment trap study

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The seasonality in dinoflagellate cyst production is investigated using sediment trap material from the CARIACO Ocean Time Series. Located off Venezuela, the Cariaco Basin lies under the influence of seasonal upwelling, typically active from January to April. Our time series spans from November 1996 to May 2009 and constitutes the longest such effort focussed on dinoflagellate cysts in the world. Our objective is to better constrain the ecology of cyst-producing dinoflagellates in the Cariaco Basin in the context of their physical and biological environment, which has implications for the interpretations of fossil cyst records. Preliminary results indicate that dinoflagellate cyst assemblages are very diverse, with a total of 72 cyst taxa recorded (including types). Overall, the assemblages are dominated by cysts produced by heterotrophic taxa (93%). The most abundant taxa are *Brigantedinium* spp. (~56%), *Echinidinium delicatum* (10%), "Spiny brown cyst type A" (5%), *Bitectatodinium spongium* (4%) and cyst of *Polykrikos hartmannii* (4%). The contribution of calcareous dinoflagellates seems negligible. Cyst fluxes are high (up to 128,000 cyst m-2 d-1) but show great seasonal and inter-annual variability. On a seasonal scale, the highest cyst fluxes are observed during and right after the upwelling months, while fall and early winter months can be almost barren of dinoflagellate cysts. However, dinoflagellate thecae, predominantly from the genera *Prorocentrum, Dinophysis* and *Ornithocercus*, can be very abundant during upwelling relaxation. In the years 1998 and 1999, following a major El Niño event, dinoflagellate cyst fluxes were reduced by ~50% compared to preceding and following years.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation.

Dinoflagellate cyst contribution to settling organic matter in the coastal ocean

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The coastal ocean hosts much of the global primary production, with an estimated 40% of carbon sequestration occurring along continental margins alone. This study characterizes the variability in organic-walled dinoflagellate cyst fluxes and assemblage composition during sedimentation through the water column, in the context of bulk organic and inorganic particulate matter export, in three different coastal settings: the Cariaco Basin (off Venezuela), the Santa Barbara Basin (Southern California) and the Strait of Georgia (western Canada). At each site, moorings of 2–5 sediment traps positioned at different depths collected settling particles over intervals of 7–14 days. The contribution of dinoflagellate cysts to particulate matter fluxes, and their fate as they are being exported to the seafloor, is investigated by comparing cyst fluxes and assemblages in samples collected simultaneously

from discrete depths at each location. Preliminary results show a remarkable consistency in dinoflagellate cyst assemblages at all depths in all three locations, suggesting rapid cyst export and no selective degradation within the water column, particularly in the oxygen-depleted Santa Barbara and Cariaco basins. On the other hand, several palynomorphs such as dinoflagellate thecae, pellicle cysts, tintinnids and copepod eggs are being degraded within the water column. Overall differences in ratios of "dinoflagellate cyst to organic carbon" between sites are most easily explained by the relative contribution of terrestrial organic matter, while differences in trends along depth gradients may be due to varying concentrations of dissolved oxygen or lateral transport of re-suspended material to the deep trap (Strait of Georgia).

Session 2.5: Dinocyst chemistry and preservation / carbon cycles. Poster presentation.

Evolution of sea surface conditions in northeastern Baffin Bay during the Holocene based on dinoflagellate cyst assemblages – Preliminary results

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In order to reconstruct sea surface conditions in Northeastern Baffin Bay during the Holocene, two sediment cores were collected on the northwest Greenland margin (AMD14-204) and Kane Basin (AMD14-Kane2b). Dinoflagellate cyst assemblages, together with transfer functions based on the Modern Analog Technique, will be used to estimate the evolution of sea surface conditions (temperature, salinity, sea ice cover duration, productivity) in both cores. Here we present the preliminary results of our southernmost core, AMD14-204, which covers most of the last 10 000 years based on a chronology derived from 14C ages on foraminera and paleomagnetic analyses. A succession of three dinocyst assemblage zones was determined from the base to the top of the core. Zone I (738 to 420 cm) is characterized by relatively low concentrations (5x103 dinocysts/cm3) and dominated by heterotrophic taxa (e.g. *Brigantedinium* sp., *Islandinium minutum*), suggesting arctic conditions where sea ice prevails. Zone II (2x104 dinocysts/cm3), from 420 to 180 cm, is dominated by *Operculodinium centrocarpum* and reflects improved sea surface conditions and an increase in warmer North Atlantic waters (West Greenland Current). This warming coincides with the Holocene Climatic Optimum, which occurred between 7.5 and 3.5 ka cal BP in the Arctic. Lastly, zone III (1.5x103 dinocysts/cm3), from 180 cm to the top of the core, is dominated by the autotrophic species *Pentapharsodinium dalei* and reflects the establishment of modern sea surface conditions, with a general cooling trend that started following the Holocene Climatic Optimum around ca. 3.5 ka cal BP.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

Ship traffic and the introduction of diatoms and dinoflagellates via ballast water in the port of Annaba, Algeria

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We present here the first study on the role of ship traffic in the introduction of potentially harmful phytoplankton taxa in the port of Annaba (Algeria). A total of 25 ships of two different types (general cargo and bulk carriers) were sampled and separated into two categories: oceanic and Mediterranean. We estimated propagule pressure of high-risk coastal phytoplankton delivered in ballast water to the port of Annaba. We identified 40 diatom and 38 dinoflagellate taxa, among which, 8 harmful taxa *Alexandrium tamarense, Alexandrium sp. Dinophysis acuminata, Dinophysis rotundata, Dinophysis* sp., *Prorocentrum micans*, *Pseudonitzschia* spp. Several

factors were examined, including ship routes, ballast water age and the volume of ballast water discharged. Our analyses revealed that diatom and dinoflagellate concentrations decreased with ballast water age, possibly as a result of mortality due to voyage length and lack of light and oxygen in ballast tanks. Estimates of actual propagule pressure, diatoms and dinoflagellates cell concentrations varied from 1 to 4 x 108 cells/ ship. The results of this study may serve as an important tool for the implementation of ballast water management measures in ports of Algeria.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

The dinoflagellate cysts of the Bajocian GSSP (Middle Jurassic) at Cabo Mondego, Lusitanian Basin, Portugal

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Dinoflagellates appeared in the Middle Triassic and experienced a major radiation during the Bajocian (Middle Jurassic, 170–168 Ma). Paradoxically, Bajocian dinoflagellate cysts have not been well studied. In order to understand the Bajocian dinoflagellate cyst radiation, and also contribute to the Jurassic palynostratigraphy of the Lusitanian Basin, we have studied the uppermost Toarcian to lower Bajocian strata at Cabo Mondego, west-central Portugal. This section is an important, expanded Middle Jurassic succession, where the Bajocian GSSP has been defined. Therefore, the study of dinoflagellate cysts at Cabo Mondego is essential for the comprehension of evolutionary patterns and high resolution biostratigraphy. We studied 129 samples from Cabo Mondego over nine ammonite biozones (*Pleydellia aalensis* to *Stephanoceras humphriesianum*). A typical low diversity assemblage, characteristic of the Lower Jurassic, was identified in the Toarcian–Aalenian part of the succession, essentially constituted by *Mancodinium semitabulatum*, *Nannoceratopsis* spp. and *Scriniocassis* spp. In the lower Bajocian, especially above the *Witchellia laeviuscula* ammonite biozone, a gradual increase in diversity was observed, with the appearance of typically Bajocian genera such as *Batiacasphaera*, *Ctenidodinium*, *Dissiliodinium* and *Sentusidinium*. The dinoflagellate radiation therefore is well expressed in Cabo Mondego and probably it formed part of the wider Mesozoic Marine Revolution.

Session 2.2: Mesozoic and Cenozoic dinocysts stratigraphies. Oral presentation.

Dinoflagellate cysts in deep-sea sediment traps around the northern North Atlantic: implications for paleoceanography

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We report new cyst fluxes from sediment traps in the Norwegian Basin, on the Iceland Plateau, and from the Barents Sea. With previous reports by Dale A. & B. Dale, 1992, these provide a database of 110 time-series samples. The northern North Atlantic, an important source of heat exchange affecting global climate, is a major focus for paleoclimate and paleoceanographic studies. Near-surface hydrography is heavily influenced by the warmer Norwegian Atlantic Current on the eastern side (ca. 3-11oC) and the colder East Greenland Current on the western side (-1-4 oC). Cysts in surface sediments from the deep-sea are widely accepted as statistical modern analogues for estimating sea-surface temperatures (SST), salinities and ice-cover in Quaternary paleoceanography. Here, we compare the cyst fluxes

directly with the assemblage database from surface sediments used in paleoceanography, to investigate the accuracy with which the cysts sedimenting into the deep sea reflect conditions in the overlying surface waters. Despite limitations when comparing cysts collected in one year with hydrographic data from tens of years, and cyst assemblages from sediments representing up to hundreds or even several thousand years, the cysts in traps do generally reflect the different water masses present. That should prove useful for paleoceanography. However, cyst cell contents showing seasonality were only recorded at the shallower water depths. There was no evidence of the rapid transport to depth through the water column required if cysts are to reflect overlying waters, and the study produced additional results supporting long-term transport of cysts from continental margins.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

KEYNOTE

Pliocene Nordic Seas surface circulation and sea ice evolution

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The Nordic Seas link the North Atlantic and Arctic Ocean, and play an important role in the global overturning circulation and heat transport into the Arctic. This region underwent fundamental changes during the Pliocene, a time period when global climate was generally 2–3˚C warmer than today. Understanding the Pliocene Nordic Seas paleoceanography can shed light on how ocean circulation, northward heat transport and regional climate operate under globally warmer conditions. In this challenging region, traditional paleoceanographic proxies based on calcareous microfossils often only have restricted potential due to poor preservation, limited diversity and extinct taxa. In contrast, marine palynology and organic geochemistry prove instrumental for establishing solid chronologies, documenting variability in surface ocean circulation and reconstructing sea ice extent. I will discuss marine palynological and geochemical records from the Norwegian and Iceland Seas to illustrate their importance (1) for documenting and understanding the development of the modern Nordic Seas surface circulation during the Early Pliocene, and (2) for reconstructing the sea ice extent during the Pliocene and early Quaternary of the Iceland Sea.

Environmental ancient DNA: a new proxy for sea ice?

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Environmental ancient DNA (aDNA) as a paleoceanographic proxy is still in its infancy and its potential is not yet fully explored. However, emerging multidisciplinary studies suggest that, through its geochemical link with biological diversity, aDNA can become a valuable tool to deepen our understanding of palaeoceanography and sea ice history. We investigated a sediment core off East Greenland for aDNA, dinoflagellate cysts and the sea ice biomarker IP25. All samples yielded aDNA, with a long-linear decreasing trend in the total amount of aDNA recovered from the youngest (~14 ka) to the oldest sample (~100,000 ka). aDNA sequences in a sample dated to ~34 ka are unique in the study interval with nearly-absent diatoms and a dominance of dinoflagellates, cercozoans and unclassified sequences. In the same sample, the dinoflagellate cyst assemblage was dominated by the sea-ice-associated dinoflagellate cyst *Islandinium* and also the organic biomarker IP25 was detected, together suggesting a seasonal sea ice cover. Our preliminary aDNA work demonstrates (1) the presence of amplifiable aDNA back to ~100,000 years ago in the Greenland Sea and

(2) the potential of aDNA to complement traditional microfossil analyses in order to strengthen estimates of past seasonal sea ice cover.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Poster presentation.

The status of dinocysts in the use of multiproxy approaches for reconstructing sea-surface conditions in late Quaternary sediments of mid-high latitudes of the Northern Hemisphere

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Large dinocyst databases have been developed from the analysis of surface sediment samples to provide tools for quantitative estimates of ocean and climate changes. Hence, dinocyst assemblages permit reconstructions of sea-surface salinity and temperature in summer and winter, sea-ice cover extent and productivity in subpolar seas. The results are however challenges by other proxies including the diatom assemblages, IP25 biomarkers or alkenones. Using the example of multi-proxy data from Holocene and recent sediment samples collected along the west Greenland margins, we document the results from the different proxies with special attention paid to dinocysts. The results show some discrepancies, but we argue that the overall data are consistent inasmuch as we consider that each proxy capture specific characteristics or parameters in the environmental system, notably with regard to the locus and time of biogenic production.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation.

A Messinian glacial event and a concurrent significant sea-level fall recognized in the North Sea Basin

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Debate of the relative roles of tectonic processes and sea-level changes as triggers for the late Miocene Mediterranean Salinity Crisis (5.96-5.33 Ma) are still going on. Several detailed age-correlations between global climatic changes and the initial phases of deposition of gipsum and salt within the Mediterranean have been published during the last decades presenting different conclusions (Jimenez-Moreno et al. 2012 and references therein).

Tectonism uplifted the western parts of the Mediterranean area, resulting in a narrowing of the sea-ways connecting the Mediterranean and the Atlantic Ocean. Eustatic sea-level must have had an essential influence on the circulation through these sea-ways. In spite of that, precise information about the magnitude of the eustatic sea-level changes occurring in the Messinian time-interval is a critical factor that has not been paid much attention.

In the latest Miocene in the Danish North Sea well Nora-1, a short-spanned, but very distinct increase in abundance of *Filisphaera filifera* indicates the influx of cold surface waters. This change in the dinocyst assemblage is followed by a strong influx of freshwater algae (*Pediastrum* spp., *Botryococcus* spp. and *Mougeotia latevirens*) possibly reflecting a sea-level fall. Correlation with seismic data reveals that this event correlates with a prograding depositional system and incision, indicating a sea-level fall of 70-80m (Møller et al. 2009). There is no evidence for tectonism in this part of the North Sea Basin during this time interval. The observations from the Nora-1 well thus probably reflect the eustatic sea-level fall related with the Messinian Salinity Crisis.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation

Dinocyst biostratigraphy of the southeastern US, selections from Cretaceous to Quaternary

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The broad coastal plain of the southeastern US provides many opportunities to explore Mesozoic and Cenozoic dinocyst stratigraphies. Although a few classic outcrops are found along major waterways, unweathered outcrops quite rare. In the last four decades, scientific drill cores have recovered nearly continuous sections recording broad segments of time. Cores drilled for earthquake, groundwater, and impact crater studies were used for basic biostratigraphic documentation and are available for detailed biostratigraphic, taxonomic, and paleoecological dinocyst research. Most cores recovered deposits from shallow shelf, relatively inshore neritic environments. Clastic sediments are more abundant in Maryland and Virginia; carbonates are more abundant to the south. Marine Cretaceous material has been recovered from multiple cores in the Atlantic Coastal Plain, but only studied at a reconnaissance level. Promising cores include the Holland (Virginia, Cenomanian and Turonian) and the Santee Coastal Reserve cores (South Carolina, Campanian and Maastrichtian). Much of the lower Paleogene is well represented in multiple cores in Georgia, South and North Carolina, Virginia, and Maryland. Continued post-impact subsidence has resulted in thick upper Eocene and Oligocene deposits recovered in cores from inside the Chesapeake Bay impact structure. Neogene cores have recently been taken for groundwater studies (Upper Floridan Aquifer) in Georgia and South Carolina and for regional mapping and tectonic studies in Virginia and Maryland. For the most part, Quaternary material is disappointing (of low diversity and low absolute abundances). This presentation will be a “cook’s tour” of select USGS cores and key biostratigraphic markers.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Dinoflagellate cyst evidence for the age and paleoenvironments of the Late Eocene–Oligocene Dabaa Formation, Qattara Depression, north Western Desert, Egypt

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The palynological investigation of 30 surface samples from seven sites in and near the Qattara Depression, north Western Desert, Egypt, has yielded six samples from three sites containing well-preserved assemblages including dinoflagellate cysts (dinocysts), freshwater algae, acritarchs, pollen and spores. Dinocyst species include Cleistosphaeridium placacanthum, Dapsilidinium pastielsii, Dinopterygium cladoides sensu Morgenroth, Distatodinium paradoxum, abundant Impletosphaeridium spp., Lentinia serrata, Pentadinium laticinctum, and Samlandia chlamydophora. The sites have not been dated previously, but dinocyst evidence (overlapping ranges of Tuberculodinium vancampoae and Phthanoperidinium comatum) reveals an Early Oligocene (Rupelian) age for one sample, establishing time equivalence with the Late Eocene–Oligocene Dabaa Formation. The dinocyst assemblages reflect neritic conditions on the southern margin of the Mediterranean Sea, and the frequent co-dominance of Homotryblium floripes points to the development of hypersaline lagoonal paleoenvironments. The abundance of Pediastrum and Botryococcus in several samples attests to nearby freshwater bodies and/or seasonal rains. Outcrops in the north Western Desert typically have deep weathering, and this is significantly the first report of dinocysts from surface sections of the Qattara Depression and its surroundings.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

Paleoceanography of northeastern Fram Strait since the Last Glacial Maximum: Palynological evidence of large amplitude changes

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Two sediment cores from northeast Fram Strait (MSM5/5-712-2, 78°54.94'N - 6°46.04'E; PS2863, 80°33.46'N - 10°17.96'E) were analyzed for their palynological content in order to reconstruct the sea-surface conditions in relation with the inflow of North Atlantic (NA) waters, which play a crucial role on the energy budget and climate in the Arctic. Changes in sea-surface temperature (SST), salinity (SSS) and sea ice cover since the Last Glacial Maximum (LGM) were reconstructed based on the modern analogue technique (MAT) applied on dinocyst assemblages. The LGM sediments are characterized by abundant *Bitectatodinium tepikiense*, which led to reconstruct high seasonal amplitude of temperatures and relatively warm summer SSTs, probably during episodic inflows of NA waters. The deglaciation started at about 19 kyrs BP with a shift towards cold conditions and the dominance of heterotrophic taxa. At 14.5-12.5 kyrs BP, summer warming is recorded together with large seasonal contrasts of SSTs and generally low SSSs. This interval is marked by the occurrence of *Spiniferites ramosus* specimens showing a wide range of morphological variations, especially with regard to the development of a trabecular network. At 12.5 kyrs BP, the high occurrence of *Islandinium minutum* and Cyst of *Pentapharsodinium dalei* in western and northern Svalbard, respectively, suggested the formation of coastal fronts around Svalbard and probably an important rearrangement of sea-surface currents. This transition lasted until 7.5 kyrs when a shift from *Nematosphaeropsis labyrinthus* to *Operculodinium centrocarpum* marked the establishment of modern conditions in eastern Fram Strait.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

Spatial distribution of dinocysts in surface sediment from the Gulf of San Jorge (Patagonia, Argentina)

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We present the first study of spatial distribution of modern and fossil dinocyst assemblages in the Gulf of San Jorge (GSJ) based on 52 surface sediment samples and 3 sediment cores collected on board the R/V Coriolis II. Radiogenic isotope analyses (210Pb and 14C) indicate sedimentation rates ranging from ~11-23 cm/kyr during the Holocene and 65~90 cm/kyr during deglaciation. The first step will consist of establishing the spatial distribution of modern dinocyst assemblages in the study area. We will then establish the spatial distribution of seed banks of toxic dinocyst species that can initiate toxic blooms in the GSJ. Finally, fossil pollen & spore and dinocyst assemblages will allow documenting the evolution of continental and surface oceanic conditions (temperature, salinity, sea ice, productivity) since deglaciation. Preliminary results of dinocyst assemblages indicate concentrations ranging from 16275 to 97110 cysts/cm3, with the dominance of *Spiniferites ramosus* and *Operculodinium centrocarpum* accompanied by *S. mirabilis*, *S. delicatus*, *Brigantedinium* spp. and *Polykrikos kofoidii*.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

Dinoflagellates from the GEM project: aspects of Mesozoic–Cenozoic biostratigraphy from Canada's North

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The Geological Survey of Canada's Geoscience for Energy and Minerals (GEM) project is focussed on regions of northern Canada. Mesozoic and Cenozoic rocks play a significant role in the geology and petroleum systems of several GEM regions of interest. Dinoflagellate cysts (dinocysts) are key to establishing the ages of many Jurassic through Neogene sections and in determining paleoenvironments. Our work is currently centred on the Baffin, Mackenzie, and Western Arctic regions. In the Baffin region, a focus is Bylot Island sections that encompass Albian–Cenomanian to middle Paleocene (Selandian) rocks, previously dated using spores and pollen. The dinocyst assemblages are helping to refine age control and marine paleoenvironmental interpretations. Mesozoic rocks in the Mackenzie region form a central link between the better constrained strata of the Western Interior Seaway further south and coeval strata of the Western Arctic. Sections along the Hume River and Olympic River have yielded diverse Albian to possibly Turonian assemblages, allowing refinement of ages that may impact a broader area. The Hume River section has yielded a rich variety of areoligeracean dinocysts and is providing vital material for a taxonomic revision of *Cyclonephelium* and similar genera. In the Western Arctic, the dinocyst assemblages from the middle Cretaceous part of the Glacier Fiord section on Axel Heiberg Island contain primarily poorly preserved dinocyst assemblages dominated by *Oligosphaeridium*, *Odontochitina* and areoligeraceans. In combination with other data, these will help develop a better understanding of Cretaceous age control and paleoenvironments in the Canadian Arctic.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

KEYNOTE

Dinoflagellate evolution: a fossil perspective with modern overtones

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Some extant dinoflagellate species produce cysts (dinocysts) that can be preserved as fossils, the record of which strongly attests to a real radiation in the early Mesozoic. Recent molecular phylogenetic evidence also supports such a radiation, especially with regard to a common origin for thecate dinoflagellates. The earliest fossils are from the later Triassic, and early forms show a diversity of morphologies not closely reflected in later taxa. Most modern thecate dinoflagellates can be classified as gonyaulacoid or peridinioid, reflecting a divergence that occurred during the Jurassic. Although incomplete, the dinoflagellate fossil record reveals critical evidence, such as the occurrence of now-extinct groups, including the nannoceratopsialeans (a "missing link" between dinophysioids and gonyaulacoid-peridinioids) and the peridiniacean subfamily Wetzelielloideae. Also, some groups were more common once than they are today, for example the Cladopyxiaceae. Modern cladopyxiaceans have not yet been sequenced, but details of their tabulation suggest that they may be close to the common ancestry of gonyaulacaleans and peridinialeans. Molecular evidence shows that

gonyaulacoids are a unified branching clade, but the coherence of modern peridinioids has been more equivocal. Tabulation is variable among modern peridiniaceans, in contrast to the strikingly stable tabulation of fossil peridinioids. Perhaps most non-calcareous fossil organic-walled peridiniaceans (in contrast to protoperidiniaceans) belong to a clade that ended with the extinction of Palaeocystodinium in the Miocene. All such examples show that the fossil record is integral to understanding dinoflagellate evolution when integrated with molecular and anatomical evidence from modern forms.

Late Cretaceous (Cenomanian to Campanian) dinoflagellate assemblages, paleoproductivity signals and carbon isotope data from the Kanguk Formation, Sverdrup Basin, Nunavut, Canada

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The response of the Polar Sea to Cretaceous carbon perturbations is poorly understood and paleotemperature data from the Arctic are limited. To understand high latitude paleoceanographic dynamics, Cenomanian to Campanian dinocyst assemblages were collected from the Kanguk Formation within the Sverdrup Basin at Glacier Fiord on Axel Heiberg Island and Slidre Fiord on Ellesmere Island. Dinocyst assemblages in combination with carbon isotope and benthic foraminiferal data suggest that age ranges for several Late Cretaceous (Cenomanian to Santonian) dinocyst taxa need regional revision. The Oceanic Anoxic Event 2 at Glacier Fiord is marked by a positive isotope shift. The increase in total organic carbon is associated with increased levels of Type I organic matter (marine sapropel) and a sporomorph/dinocyst index of 0.86 within the upper Cenomanian to lowermost Turonian. Thus, the Cenomanian/Turonian Boundary (CTB) increase in primary productivity within this high Arctic locality was due to higher levels of nitrogen fixing cyanobacteria rather than the product of dinocysts during the Late Cretaceous temperature maximum. At the base of the Slidre Fiord section the dinocysts *Trithyrodinium suspectum*, *Chatangiella* sp. and *Heterosphaeridium difficile* provide indicators for the CTB and the end of the OAE2. An abrupt palynological change from predominantly organic matter of Type II (marine and terrestrial palynomorphs) to Type III (brown to black wood and plant tissue) corresponds to a lithological change from grey shale to brown silty mudrock which is associated with a globally recognizable regression during the upper Santonian. The first occurrence (FO) of the dinocyst *Kiokansium unituberculatum* and a positive carbon isotope excursion may be connected with dynamic tectonic changes during the Campanian opening of marine passages between the Arctic and Atlantic oceans.

Session 2.5: Dinocyst chemistry and preservation / carbon cycles. Oral presentation.

Long-term climate and ocean environment reconstruction based on pollen and organic walled dinoflagellate cysts in western South Atlantic Ocean during the last 73.000 years

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Long-term vegetation, climate, ocean dynamics as well as relationships between southern Brazil continent and the adjacent South Atlantic Ocean, the 770 cm-long marine sediment core GeoB2107-3 off southern Brazil has been studied to reconstruct past environmental changes. Pollen, spores and organic-walled dinoflagellate cysts analysis was applied to reconstruct terrestrial and marine environmental changes during the last glacial and Holocene periods. The 73 kyr BP pollen record indicates that grasslands were frequent in the landscapes of southern Brazil during glacial periods, reflecting relatively cold and dry climatic conditions. In the lowland occurred patches of forest and probably as well on the exposed continental shelf, which in general was dominated by salt marsh vegetation due to low eustatic sea levels. Interestingly, Araucaria trees were frequent in the highland until 65 kyr BP, similar to the late Holocene, and were rare during the remaining last glacial period. Tropical Atlantic rainforest existed in the northern lowlands of southern Brazil during glacial times, but was strongly reduced, in particular during pre-Last Glacial Maximum (LGM) and LGM, reflecting very cold and dry climatic conditions. Tropical Atlantic rainforest expanded to the South since the Late-glacial period. The Araucaria forests expanded on the highland only since the late Holocene. The eutrophic environment dinocyst taxa reflect the nutrient input transported mainly by the Brazil Coastal Current (BCC) and Rio Itajaí which is well related to the last glacial and Holocene eustatic sea level changes. Dinoflagellate cysts data indicate that the study area was in general influenced by the Brazil Current (BC) with warm tropical water. A stronger influenced of the BCC, with nutrient rich fresh water occurred during MIS 4 and in particular during the late MIS 3 and MIS 2 period. Evidence of Nothofagus pollen grains form southern South America during late MIS 3 and MIS 2 (pre-LGM and LGM), suggests that the Malvinas Currents (MC) shifted to the North allowing the transportation by the BCC to the study site. The data analysis shows that major changes in the pollen/spore and dinocyst assemblages occurred at similar time periods, indicating a strong relationship between continental and marine environmental changes. The proxy comparisons suggest that the changes occurred under similar overarching factors, of which the most important was the orbital obliquity.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation

A new centennial scale Holocene dinoflagellate cyst record from Vancouver Island (British Columbia, Canada)

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Organic-walled microfossils were retrieved from sediments in a core from the Kyoquot Sound, a fjord on the west coast of Vancouver Island (Canada), using standard palynological processing. Radiocarbon dating of five pieces of plant macrodebris shows that the sediments were deposited over the last ~12 kyr, and that sedimentation rates have been uniform. The sampling resolution is centennial and it is the first continuous marine geological record of this time span and resolution that is presented for this region. Dinoflagellate cyst assemblages are dominated by cysts of autotrophic taxa (mainly by *Operculodinium centrocarpum* sensu Wall & Dale 1966 = cysts of *Protoceratium reticulatum*) from 11.1 to 10.7 14C ka BP. After this, *O. centrocarpum* ss. Wall & Dale 1966 declines in abundance and cysts produced by heterotrophic taxa drastically increase in relative and absolute abundances. Thus, since 10.7 14C ka BP, cyst assemblages were dominated by *Dubridinium caperatum* and round brown cysts, with a notable contribution by *Selenopemphix quanta, Quinquecuspis concreta* and a number of *Brigantedinium* and

Echinidinium species. Total cyst concentrations reach up to 184,330 cysts g-1. The genus *Spiniferites* contributes up to 6% of the assemblages (~30,000 cysts g-1) and it includes morphotypes (type A and B) that have not been previously observed in surface sediments around Vancouver Island. Type A resembles *Spiniferites solidago*, described from the Miocene of Maryland, but not observed in modern sediments. At ~7.5 14C ka BP, *O. centrocarpum* var. *truncatum* abruptly increased relative to the abundance of *O. centrocarpum* with normal processes, to more gradually decrease back to previous levels. Process lengths of *O. centrocarpum* were measured for quantitative assessment of salinity variations.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

Last Glacial-Holocene productivity reconstructions off Congo River from the revised tropical dinocyst-based modern database

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In order to refine the relevance of quantitative reconstructions of net primary productivity conditions through the dinocyst-based transfer function method, we deeply revised the tropical Atlantic modern database n=208 (Marret et al., 2008). 84 new surface sediment samples have been added to provide a better geographical coverage of the South Atlantic Ocean, while 55 have been removed due to low dinocyst concentrations and/or ages older than 1,000 years BP. We also have updated the environmental dataset, using the World Ocean Atlas 2013v2 for SST and SSS data as well as for 1978-2015 mean values of net primary productivity recorded during CZCS, SeaWifs and Modis spatial programs, and calculated with chlorophyll-based VGPM and Eppley models, as well as carbon-based CBPM model. We also have experimented new environmental datasets in order to track past upwelling activity, using SST/SSS-based water density and SST anomalies regarding mean latitudinal SST. Finally, preindustrial net primary productivity values, simulated with IPSL-CM5A-LR model developed at the IPSL (le Mézo et al., 2016), have also been added in the dinocyst transfer function so as to provide more relevant modern values for each modern analogue available in the dinocyst database. Our results argue for an obvious orbital forcing, with higher net primary productivity values reconstructed during minima of precession (MIS 3 and the last deglaciation). Higher productivities appear mainly led by the Congo River activity, with maximal terrigenous inputs also occurring during these periods, and probably generating powerful river-induced upwelling cells during the last deglaciation.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation

Dual taxonomy and nomenclature in dinoflagellate cysts: history, present status, and challenges of molecular phylogeny

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Two separate taxonomic traditions have arisen in dinoflagellates at the generic level and below: one centred on the living motile cell but potentially incorporating all aspects of the biology, and the other

based exclusively on resting cyst morphology including the fossil record. Where a cyst has been described and named as a fossil and subsequently shown through life-cycle observations to be equivalent to a named living species, the cyst morphotype may then bear two names. This dual nomenclature is supported for all algae (diatoms excepted) by the International Code of Nomenclature for Algae, Fungi and Plants (ICN) through Articles 1.2, 11.1, and 11.7 (Head, M.J. et al., 2016, Taxon 65: 902–903). The ICN acknowledges that a fossil-taxon (having a fossil as its type) is conceptually distinct from its living (non-fossil) counterpart, and that equivalency need not mean synonymy. This distinction reflects the different species concepts involved, based on different stages of the same life cycle, and acknowledges that cyst morphology alone retrieves only limited genetic information from the fossil record. While cyst-based taxonomy strives to reflect evolution, there is a long observed mismatch between fossil-defined genera and the genera of living equivalents. Molecular phylogenies from living material now expose these discrepancies and others with new clarity. This requires the reassessment of our current taxonomic schemes if they are to be more reflective of evolution, although any major nomenclatural changes should be balanced against the value of stability in connecting living dinoflagellates to their fossil lineages.

Session 2.5: Dinocyst chemistry and preservation / carbon cycles. Oral presentation.

Tracers of sea ice, primary production and terrigenous inputs: distribution of organic-walled microfossils in a High Arctic fjord system, Northeast Greenland

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The coastal Northeast Greenland serves as a filter for terrigenous inputs into the Arctic Ocean. Here, we assess the modern distribution of organic-walled microfossils from a transect of 13 surface-sediment samples from Young Sound-Tyrolerfjord, NE Greenland (74°N) against modern sea-ice conditions, primary production and terrigenous inputs. The Young Sound-Tyrolerfjord presents a well-suited study arena, as the Greenland Ecosystem Monitoring (GEM) program provides a unique high arctic time-series of measurements since the mid-1990s against which the sediment signatures can be compared. Furthermore, biogenic silica, carbon and nitrogen contents and biomarkers (IP25, HBI III) were analysed from the same samples. Organic carbon contents, diatom production, HBI III and heterotrophic dinoflagellate cyst abundance were higher in the outer Young Sound, where turbidity is lower, salinity higher and waters more nutrient-rich compared to the inner fjord. Conversely, in the Tyrolerfjord and inner Young Sound, these production proxies follow an opposite pattern. The seasonal sea-ice proxy IP25 and sea-ice-dwelling taxa (e.g. *Polarella glacialis*) are present in varying abundances, which reflects the seasonal character of the sea-ice cycle together with species-specific habitat preferences of these taxa. Our results support the notion that future warming and freshening will likely have a negative impact on primary productivity and organic matter sequestration in the fjord.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

Organic walled dinoflagellate cysts distribution in the sediments of northeast Persian Gulf

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In this study 12 stations in the northeast Persian Gulf are studied. Multivariate statistical analysis is applied to find environmental parameters effect on the cysts distribution. *Polysphaeridium zoharyi, Lingulodinium machaerophorum* and *Spiniferites* spp. are the most abundant dinocysts in the studied area. Peridinial species are quite rare despite their diversity. RDA analysis illustrates sea surface temperature and salinity are the most effective parameters in dinocyst distribution. Phosphate also plays an important role in *P. zoharyi* and *L. machaerophorum* distributions. Heterotrophic to phototrophic ratios indicate overall low productivity in the studied area.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation.

The interest of dinoflagellate cysts for datation of the Mesozoic terrains and the reconstruction of paleoenvironments. The Rifain domain, the North Eastern Morocco and the Moroccan Atlantic margin

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This study constitutes a work of palynostratigraphic synthesis, based on dinoflagellate cysts,performed on several surveys and cuts of Moroccan Mesozoic terrain.
Currently, it was possible to establish thanks to dinoflagellates, stratigraphic scales, of unmatched resolution, especially for the Boreal domain and sub-Boreal. For the Tethys domain (North Eastern Morocco: Guercif basin, Atlantic margin: Essaouira basin, Rifain domain (external Rif, internal Rif , Mesorif) and South Rifain Rides), datation of high precision were made in several surveys and field cuts.
In addition to their stratigraphic role by fossilized cysts in sediments, the dinoflagellates show a distribution according to the nature of the sediments, physicochemical parameters and a latitudinal distribution: From coast to large, this gives them the title of an excellent ecological marker. Thus the variations in the composition of their assemblages in the sediments, has enabled us to reconstruct paleoenvironments (deposition environment, bathymetry, etc.) in all the studied regions.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

The distribution of dinoflagellate cysts in sediments of three islands in Kuwait

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The distribution and abundance of dinoflagellate cyst was investigated in surface sediments of three islands in Kuwait, FAILAKA, KUBBAR and BUBIYAN. (12 stations is presented). A total of 32 species were identified mainly belonging to the genera *Protoperidinium Gonyaulax, Scrippsiella, Cochlodinium polykrikos, Prorocentrum minimum, Dinophysis* acuminata, and. *Pyrophacus*. Potentially harmful cyst species found were the paralytic shellfish poisoning (PSP) causative species *Alexandrium* and *Pyrodinium bahamense*, and *Lingulodinium polyedrum* and *Protoceratium reticulatum*, which are known to produce yessotoxins. The sampling sites showed a similar cyst assemblage and densities between 23 – 1654 cyst/g dry sediment. Cyst abundance was strongly correlated with sediment characteristics, the highest numbers being recorded in sediments with large contents of organic carbon, silt and clay. This study shows that we have sediment-based reservoir of some potentially harmful species in islands.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

Mid to late Miocene dinocyst assemblage from the Ulleung Basin, East Sea, offshore Korea and its paleoceanographic implication: preliminary results of IODP EXP. 346 Site U1430

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Dinoflagellate analysis for paleoceanography of the East Sea, offshore Korea, was conducted from the middle Miocene core section of Site U1430, IODP Exp. 346. A total 20 species belonging to 12 genera were identified and of which ecological indices were used to reconstruct the paleoceanography. The dominant cold-water species such as *Operculodinium centrocarpum* and *Nematosphaeropsis labyrinthus* are known today as inner neritic to outer neritic and outer neritic to oceanic indicators, respectively, around western Pacific region. These taxa can be used to assume the sea-level change during the middle Miocene. A warm-water species, *Tuberculodinium vancampoae*, which inhabits at low latitude today is known as an index of Tsushima Warm Current (TWC) in East Sea and East China Sea. This species may indicate the history of the variability of TWC. A preliminary paleoceanographic implication can be done based on relative frequency in occurrence of these ecological indices. Cold-water species were dominated during the middle-late Miocene, and subsequently cold-water and warm-water species were present together indicating that the Ulleung Basin, East Sea, were in cold water environment during the middle-late Miocene and TWC has been inflow since the late Miocene. This assumption should be further investigated comparing with relevant data available future.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Poster presentation.

Ecophenotypism in early Palaeozoic acritarchs – Comparisons with recent dinoflagellates

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The classification of acritarchs represents a major problem concerning the study of this group, as it is based only on morphological aspects, resulting in a very high number of described genera and species. Different morphologies however are not always a signal of genetic difference but often reflect changing ecological conditions. Many acritarch taxa therefore likely represent different (eco-) phenotypes of taxa with a greater morphological variability being influenced by various environmental factors.
This new study focuses on the lower Palaeozoic acritarch genus Vulcanisphaera Deunff, 1961, and provides an attempt to investigate the possible factors influencing the morphology in this genus. Previous works have shown the importance of palaeoecological aspects for the morphological variability of certain acritarch taxa (e. g. Stricanne & Servais, 2002; Servais et al., 2004). The revision of the genus Vulcanisphaera shows a high intraspecific morphological variability, especially in respect of length and form of the processes.
Cultural experiments on living dinoflagellates and observations of surface sediments show that environmental factors can influence morphological characteristics of dinoflagellate cysts (e. g. Kokinos & Anderson, 1995; Dale, 1996; Ellegaard, 2000; Mertens et al. 2009). Within these studies variations in process length and vesicle diameter in response to different water temperatures and salinities are observed. Considering that many acritarchs, such as Vulcanisphaera, possibly represent precursors of dinoflagellate cysts it can be reasonably assumed that these ecological factors also have caused morphological changes in acritarchs.

Session 2.3: Phanerozoic and deep time scales. Poster presentation.

Multi-proxy study in Arctic Late Holocene sediment cores on the continental margin of the western Canadian Beaufort Sea

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Given the current context of climate change, sedimentary records are of great importance to study climate and oceanographic variability of western Arctic Ocean, for time periods prior to instrumental data. In this master project, two short sedimentary sequences (box core and trigger weight core AMD0214-03) were recovered on the Mackenzie slope. Dinoflagellate cyst assemblages, bulk mineralogy and elemental geochemistry will be studied in order to reconstruct and document the hydrological variability over the last 2000 years in the Southeastern Beaufort Sea (Canadian Arctic), and their influence on the sedimentary dynamics. These assemblages will allow reconstructing the evolution of sea-surface conditions (temperature, salinity, productivity and the duration of sea-ice cover), while fluvial influence will be assessed from freshwater indicators. The sediment chronology will be assessed from 210Pb and 137Cs measurements for the box core, while that of the trigger weight core will be based on physical (L*, a*, b*, CAT-Scan) and paleomagnetical (inclination, declination and relative paleointensity of the Earth's magnetic field) analyses. The mineralogical (bulk and clay fraction) and geochemical (trace metals and rare earth elements) data will allow assessing changes in sediment inputs and transport pathways. Overall, this study will allow to better document and understand the fundamental processes controlling the hydrological variability in the Canadian Beaufort Sea beyond the time period covered by instrumental measurements.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Poster presentation.

Anthropogenic eutrophication overlapping natural climate variability over the last 150 years: palynological evidences (Bay of Brest, NW France)

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The Bay of Brest is an estuarine system open to the North Atlantic and connected with the Aulne, Elorn and Daoulas rivers. Palynological analysis conducted on sedimentary archives allows discussing in parallel marine (dinocysts) and continental (pollen/spore) influences affecting the Bay and its watersheds. These data are integrated within the framework of a French CNRS project INSU-EC2CO/LEFE ("CAMOMI") that aims at comparing micropaleontological and molecular analysis to calibrate paleoecological tools and to decipher the complexity of recent palaeoecological changes affecting coastal environments. Here, we present coastal palaeoecological changes that occurred over the last century (1870-2013 AD) thanks to a sediment core (Daoulas estuary: inner/western Bay). Previous studies demonstrated increased occurrences of the toxic dinoflagellate species *A. minutum* since the 1970s. The palynological study conducted on the same core, allows us discussing eutrophication forcings responsible for such toxic blooms. The increases in *Alnus* percentages and Ti/Ca XRF ratio with a decrease in marine micro-algae concentrations

suggest a rise in fluvial runoff, supported by a trend in increasing discharge of the Daoulas River.This may have also brought fertilizers (industrialized agriculture) that promoted the increase of toxic planktonic species. Moreover, significant changes of arboreal taxa percentages appear correlated with the Atlantic Multidecadal Oscillation. We then suggest a link between North Atlantic Ocean sea-surface temperatures/climate in western France and pollination rates of arboreal species. This study will allow us to understand climatic/anthropogenic mechanisms responsible for paleoenvironmental changes in the region over the Holocene.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation

Dinoflagellate cyst distribution in surface sediments from the South China Sea in relation to hydrological conditions and marine primary productivity

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Geographical distribution of dinoflagellate cyst was investigated the South China Sea (SCS) to identify taxa-indicators of modern environmental conditions. A total of ~ 50 cysts taxa were identified from 42 surface samples. The most common cysts of heterotrophic dinoflagellates are *Brigantedinium* spp., *Echinidinium* spp., *Quinquecuspis concreta*, *Selenopemphix quanta*, *S. reidii*, and *Trinovantedinium applanatum*. Cysts of autotrophic taxa include *Lingulodinium hemicystum*, *Spiniferites* spp., *Operculodinium centrocarpum*, *O. israelianum*, O. cf. *janduchenei*, O. *longispinigerum*, *Polysphaeridium zoharyi*, and *Impagidinium* spp. The highest cyst concentrations was found in the coastal waters near Hainan Island (~690 cysts g^{-1}), whereas the lowest (~40 cysts g^{-1}) abundances were recorded in the deep basin to the west of Philippine, where water depth ranges from ~2500 to 4000 m. Our preliminary results indicate that cyst assemblages on the northern shelf change with the proximity to the shore and there is a general increase in the ratio of heterotrophic to autotrophic taxa from Hainan area to Taiwan area, which may be associated with a local primary productivity trend. This research also contributes to the modern dinoflagellate cyst database for the SCS.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Poster presentation.

Dinoflagellate cyst biostratigraphy of the Aquitanian historical stratotype (Lower Miocene, France)

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Defined by Mayer-Eymar in 1858, the historical stratotype of the Aquitanian geological stage was reduced by use to three main outcrops (e.g. Dollfus, 1909; Dutertre, 1920; Vigneau & Marks, 1971; Alvinerie & Caralp, 1977). New field studies, taking into account the neotectonics in the stratotype zone, lead to consider (Londeix et al., 2014) a more complete composite section, 35 meters thick, with marine beds never studied up to now. Based on a palynological processing adapted to crags (Londeix & Jan du Chêne, 1987), a biostratigraphical study of dinoflagellate cysts was carried out on the whole stratotypical section. Dinoflagellate cysts were found in most of the 51 levels analyzed, but they do not show a great diversity. The assemblages are widely dominated by *Polysphaeridium zoharyi*, as previously reported by Caratini & Sivak (1974) who encountered only this taxon with *Operculodinium centrocarpum*. On the other hand, the present work allowed to

identify more than thirty other taxa, among which euryhaline species are abundant. In addition to some ubiquitous species, there is a typical set of Early Miocene dinoflagellate cysts. The great majority of these taxa are still present in the overlying stratotypical Burdigalian (Londeix & Jan du Chêne, 1998) but some of them appear to be good biostratigraphical indicators. The FAD of *Achomosphaera callosa* occurs at the base of the Aquitanian historical stratotype that does not correspond to that of the geochronological age. Associated to a Sequence boundary dated ca. 21.3 Ma (Londeix, 2014), a biostratigraphical boundary is marked by the LAD of *Chiropteridium* spp., *Glaphyrocysta circularis* and *Pentadinium laticinctum granulatum*, and the FAD of *Hystrichokolpoma ellipticum*, *Hystrichokolpoma pacificum* and *Spiniferites falcipedius*. The LAD of *Areoligera* spp., *Cooksonidium* spp., *Glaphyrocysta* spp. (except *G. texta*) and *Cordosphaeridium gracile* seem to prelude the end of the Aquitanian.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

A cool Last Interglacial Period in the SW Pacific, evidence from new dinocyst records

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The Last Interglacial period (LIG) (~130-115 ka) has been the focus of international research interest over the last few decades as its study (either proxy-based or modelling) underlines temperatures globally warmer by 2 to 3 °C and a sea level 4 to 6 m higher. Because these conditions may represent the likely increase in SST (~0.6 to 2ºC) in the next 85 years as forecast by the latest IPCC scenarios in 2013, it is therefore crucial that LIG climatic variability and its regional expression are understood. Contrary to the Atlantic Ocean, the SW Pacific Ocean yields sparse records of past LIG conditions. Annual sea-surface temperatures have been estimated there for the LIG time-slices using foraminiferal assemblages, and there are a handful of core sites in the region where SST has been estimated using other proxies. To this end, dinocyst assemblages from several cores, collected around New-Zealand, are being studied and the Holocene and the LIG records compared. Preliminary results from three cores (one located south of Tasmania, one located north of NZ and one located east to NZ) show contrasting results with overall annual SST anomalies of the interval 115-130 ka (compared to today conditions) being negative in the north and west, and positive in the east. Annual SST at 125 ka are overall cooler than today, with a maximum of cooling up to about 3ºC north of NZ. These new results are comparable to the trends observed by planktonic foraminiferal assemblages, although dinocyst SSTs are systematically cooler and close to modelling outputs.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

Quaternary Palynomorph Stratigraphy in the Arctic Ocean

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Dinoflagellate cysts and other aquatic organic-walled palynomorphs are valuable microfossils for both biostratigraphy and paleoenvironmental reconstructions in the high northern latitudes. In the course of the DSDP, ODP and IODP programs, a number of arctic and subarctic sites revealed that palynomorphs are the only microfossil group with an

almost continuous Quaternary record. Furthermore, their relatively high diversity predisposes them to detailed and reliable biostratigraphic correlations in a region critical for understanding the history and future of Northern Hemisphere climate. Initial studies on sub-arctic sequences with excellent independent chronostratigraphy demonstrate that robust numerical ages may be defined for palynomorph events in the Neogene and Quaternary. Despite their biostratigraphic potential, neither biozonations on a regional and supra-regional scale have been defined nor palynomorph events have been thoroughly calibrated to an independent chronostratigraphic framework. We reviewed the stratigraphic distribution of aquatic palynomorphs in the Arctic Ocean and the adjacent subarctic basins to demonstrate their potential for establishing a high-latitude Quaternary chronostratigraphy. Palynomorphs are rare and are restricted to few intervals in the Central Arctic Ocean in contrast to the rich and diverse assemblages in the marginal Arctic Ocean, but some events calibrated in the subarctic basins may be useful for providing (sub) arctic-wide stratigraphic datums showing that palynomorphs remain a promising tool for future stratigraphic work in the Arctic Ocean.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

First record of cellulosic resting cysts of the benthic dinoflagellate *Prorocentrum leve* in a natural reservoir in Gujan-Mestras, Gironde, France

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Here we describe resting cysts of the potentially toxic benthic dinoflagellate *Prorocentrum leve* from a natural reservoir in Gujan-Mestras (Gironde, France). The urn-shaped cysts were incubated and gave rise to cells of *Prorocentrum leve*. Morphological observations through light microscopy and scanning electron microscopy combined with large subunit ribosomal DNA sequences obtained through single-cell analysis confirm their affinity to the species *Prorocentrum leve*. This is the first conclusive evidence for fossilizing resting stages within the Prorocentrales, one of the major orders within the Dinophyceae. Resting cysts were previously described for the benthic species *Prorocentrum lima* and *Prorocentrum foraminosum* (as *Prorocentrum marinum*) but these findings were not considered reliable. Palynological treatments show that the cysts withstand hydrochloric and hydrofluoric acid. MicroFTIR analysis on single specimens suggests that the cyst wall composition is cellulosic, as well as the underlying endospore, which would explain that the cysts do not preserve long-term in the sedimentary record, and the lack of a fossil record for this large order of dinoflagellates. In the same sample several other cyst-producing species were present. Cysts of a *Bysmatrum* sp. were also discovered, as well as an undescribed Pfiesteriacean. Other species present were *Spiniferites* cf. *scabratus*, *Peridinium* cf. *ponticum* and *Kryptoperidinium* sp. Despite high abundances of *Dinophysis sacculus* cells in the plankton, we could not identify any cyst stages of this species in the sediment. Several other species of dinoflagellates occurring in brackish waters possibly also produce cellulosic cysts, which suggests that this is a particular strategy to survive in such environments.

Session 2.5: Dinocyst chemistry and preservation / carbon cycles. Oral presentation.

Lithostratigraphic problem solving with dinoflagellate cysts. An example from the Netherlands: Updated and revised (Miocene-Early Pliocene) stratigraphic framework of the Breda Formation.

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In the Netherlands, the bulk of Miocene to earliest Pliocene sedimentary sequences are currently assigned to a single lithostratigraphical unit, the Breda Formation. Although already introduced more than 40 years ago, this formation is still poorly defined. Two main problems are involved with the current definition of the Breda Formation: 1. Well log correlations show that the new lecto-stratotype well section for the Breda Formation in well Groote Heide overlaps in part with the reference section of the (considered older) Veldhoven Formation in the nearby well Broekhuizenvorst. 2. The difficult distinction between the Breda and the overlying Oosterhout Formation gives rise to unceasing discussion, in particular due to changing concentration of glauconitic content within both formations. In order to resolve the first major problem the results of dinocyst analyses were integrated with wire-line, lithological and seismic studies on multiple wells, including the wells Groote Heide and Broekhuizenvorst. In this process, we used an updated dinocyst zonation of Munsterman & Brinkhuis (2004), recalibrated to the Geological Time Scale of Ogg et al. (2016). To establish a consistent top for the Breda Formation an additional north-south oriented correlation-panel was created, located relatively westbound from the distribution area of the Kieseloölite Formation. This panel runs from the center (well Sint Michielsgestel-1) towards and across the edge (well Goirle-1) of the Roer Valley Graben. The results of this study show that correlation of dinocyst events between wells in the southern Netherlands significantly contributes to the establishment of a consistent definition of the Breda Formation.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Biostratigraphic correlation of the western and eastern margins of the Labrador – Baffin Seaway.

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New analyses of the palynological assemblages in 13 offshore wells on the Canadian margin and six on the West Greenland Margin, in conjunction with onshore data, have led to a new biostratigraphic framework for the Cretaceous–Cenozoic strata of the Labrador Sea – Davis Strait – Baffin Bay (Labrador–Baffin Seaway) region and the first broad biostratigraphic correlation of the Canadian and Greenland margins. This framework is based on 167 last occurrences and 18 local or regional, peak- or common-occurrence events for dinocysts (which include three new genera and 16 new species), acritarchs (including one new species), miospores (including one new species), fungal spores and massulae of the fresh-water fern *Azolla*. Our findings delineate several local and regional hiatuses on both sides of the seaway. The palynomorph assemblages show that most Aptian to Albian sediments were deposited in generally non-marine to marginal marine settings, interrupted by a short-lived shallow-marine episode in the Aptian. A marine transgression commenced in the

Cenomanian–Turonian and led to the most open-marine, oceanic conditions in the Campanian–Lutetian. Subsequent shallowing probably began in the late Lutetian and continued into the Rupelian, when inner neritic and marginal marine palaeoenvironments predominated. Throughout the rest of the Cenozoic, inner neritic palaeoenvironments alternated with marginal marine conditions on the margins of the Labrador–Baffin Seaway. Our findings broadly reflect the tectonic evolution of the seaway, with rift conditions prevailing from Aptian to Danian times, followed by drift through much of the Paleocene and Eocene, and post-drift from Oligocene to the present.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Paleoproductivity changes over the last 30 ky in the NW Moroccan margin as reconstructed from palynological (dinocyst) and stable isotopic tracers

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Past hydrological and primary productivity regimes, on the basis of dinocyst and planktonic foraminiferal fossil assemblages as well as on planktonic (*G. bulloides*) and benthic (*U. mediterranea*) stable isotopes together with alkenones, were investigated over the last 30 kyr BP at upwelling site MD04-2805 CQ off NW Morocco. These data previously published and compiled in regional synthesis for the NE subtropical Atlantic Ocean (Penaud et al., 2010, 2011, 2016) have been implemented by new recently ones especially including benthic foraminiferal assemblages and related new isotopic data (*C. wuellerstorfi*) together with dinocyst-based quantitative reconstructions of sea surface productivity. This multiproxy data set enables to deepen the discussion about paleoproductivity changes across rapid climate events such as Heinrich Stadials (HS2 and 1) or the Younger Dryas (YD). Our previous published results showed higher upwelling intensity during HS1 and the YD and lower upwelling cells during the LGM and HS2. We also presented coherent regional reconstructions of sea-surface temperatures modulated by well-known Northern Hemisphere climatic fluctuations using three independent proxies: dinocyst and foraminiferal transfer functions as well as alkenones. Also, a very pronounced shift during HS2, HS1 and the YD between the planktonic communities was interpreted as indicating the presence of a distinct hydrological structure in the vicinity of the strait of Gibraltar separating different water masses at that time. In parallel with the well discussed southward shift in planktonic population in response to the migration of polar water masses (Eynaud et al., 2009), we here focus on productivity regime changes reconstructed thanks to an enlarged isotopic dataset and to new dinocyst-based quantitative reconstructions obtained with the Modern Analog Technique as recently tested in the central Gulf of Cadiz (Penaud et al., 2016).

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

Palynological records of the last million years in the Central North Atlantic Ocean, IODP Site 303-U1304

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A sequence of 165 m of sediment from IODP site U1304 at the southern edge of the Gardar Drift in the central North Atlantic Ocean was sub-sampled at about 50 cm intervals for palynological analyses. The studied sequence corresponds to the last one million years and consists mostly in laminated sediment with interbedded diatom oozes and nannofossil oozes. The sediments contain abundant dinocysts (up to 4 104 cysts/cm3) and relatively high species diversity. The dinocyst data show alternation of two types of assemblages. Some intervals are marked by the dominance of Peridiniales, notably *Brigantedinium*

spp. Such assemblages are typically found in coastal upwelling areas with extremely high primary productivity. Other intervals are dominated by open ocean, subarctic-cool temperate species such as *Nematosphaeropsis labyrinthus, Operculodinium centrocarpum, Impagidinium pallidum, I. aculeatum, I. sphaericum*. They are accompanied by *Bitectatodinium tepikiense, Spiniferites elongatus* and *Brigantedinium* spp. The changes in dinocyst assemblages suggest large amplitude variations in sea-surface conditions with regard to productivity and temperature, possibly related to the respective influence of the Labrador Sea Current and the North Atlantic Current. During the mid-Pleistocene at about 0,6 Ma, there is a transition marked by a large change from assemblages with *B. tepikiense, S. elongatus*, *P. dalei* and *I. pallidum*, which suggest cool conditions to assemblages indicating relatively mild conditions. The dinocyst assemblages contain also many extinct species such as *Corrodinium labradori, C. harlandi, Pyxidinopsis braboi, Filisphaera microornata, Amiculosphaera umbraculum* and *Impagidinium cantabrigiense*. The last occurrence of these species at IODP Site U1304 led us to propose a regional biostratigraphical scheme.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation

Organic-walled dinoflagellate cysts as indicator of sea-surface salinity in the subpolar Late Cretaceous Greenland-Norwegian Seaway

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High abundances of organic-walled hypnozygotic cysts produced by reduced salinity tolerant dinoflagellates are recorded from the Greenland-Norwegian Seaway. The unique composite section, representing the Campanian and upper Maastrichtian sediment was analysed from the shallow stratigraphic core 6711/4-U-1 and core-samples from well 6707/10-1. Species of the gonyaulacoid *Heterosphaeridium bellii* Radmacher et al. (2014), and peridinioid *Palaeoperidinium pyrophorum* Ehrenberg (1838), that dominate the Campanian assemblages (>25%) in the Greenland–Norwegian Seaway, may reflect 'long-term blooms' in the sea-surface waters. In modern sediments, algal blooms commonly occur in coastal areas, bays and estuaries due to stressed conditions often caused by increased primary production, nutrient and oxygen depletion. In conditions of reduced salinity, the primary production is likely reflected in the sediment by euryhaline dinoflagellate cysts. It is suggested that the influx of fresh water via river discharge from Greenland and Fennoscandia, associated with lower salinity surface waters outflowing from the Late Cretaceous Arctic Basin resulted in an elevated nutrient supply that triggered this specific dinoflagellate blooms and further production of the cysts. Multiple correspondence analyses, as well as the Earth system climate model results compared to proxy data are in accordance with the reconstructed salinity. The model simulates strong water stratification and indicates decreased sea-surface salinity that ranges from 30 psu in the Greenland-Norwegian Seaway to 13 psu in the Arctic in the Campanian to Maastrichtian interval.

Session 2.4 : Dinocyst systematics. Oral presentation.

Diversity and distribution of dinoflagellate cysts in Arctic fjords from Greenland, with focus on sea-ice associated species

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A total of 58 surface sediment samples from 5 Arctic fjords around Greenland have been analysed for their dinoflagellate cyst assemblage composition, and compared to present-day environmental conditions based on satellite data and in-situ measurements obtained within the framework of the Greenland Ecosystem Monitoring Programme. The 5 locations studied are all influenced by seasonal sea ice, and cover a large latitudinal range, from the low to the high Arctic (64-81°N). The dinoflagellate cyst assemblages clearly reflect the interplay of ocean and land influence, and a marked gradient towards the innermost fjord sites of increasing freshwater influence from glacial runoff. Particular attention has been given to cyst-forming dinoflagellates that are found in sea-ice environments, but not yet included in global cyst datasets, namely the phototrophs *Polarella glacialis* and cf. *Biecheleria* sp. Complementary information on sea ice and primary production biomarkers (IP25, Triene, Biogenic silica) as well as sea-ice core samples have been used to further interpret the results. The ultimate goal of this study is to improve our understanding of the ecology of high latitude dinoflagellate cysts, and to refine their use as indicators of seasonal sea-ice cover in paleoenvironmental studies.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation.

Aspects of Mesozoic dinoflagellate cyst palaeobiology

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Dinoflagellate cysts emerged during the Triassic. The earliest dinoflagellate cysts formed part of the dawn of the era of modern plankton, and coincide with the inception of calcareous nannoplankton. The majority of Triassic dinoflagellate cysts were wiped out during the end-Triassic mass extinction. Dapcodinium priscus, however, survived and may have been the rootstock of the subsequent recovery. During the Late Sinemurian, the peridinioid species Liasidium variabile briefly flourished. Other evidence indicates that this species was strongly thermophylic. There was a major oceanic anoxic event during the Early Toarcian. This badly disrupted the benthos, including dinoflagellate cysts, and the surface-dwelling prasinophytes briefly exploited the vacant ecological niche. In the Middle Jurassic (Middle Bajocian), the gonyaulacacean dinoflagellates underwent an evolutionary radiation. This may have been the result of continental breakup, and it may form part of the wider Mesozoic Marine Revolution. At the Middle–Late Jurassic transition, there is evidence for global cooling which may have been caused by the deposition of organic-rich shales. Arctic/cool water dinoflagellate cysts record this phenomenon. In terms of provincialism, Eurasian floras are markedly different in character to their Austral counterparts. The level of endemism increased in the Late Jurassic. During the latest Mesozoic, global climates cooled, and rapid sea level falls suggest ephemeral high latitude ice sheets. In the expanded Maastrichtian of the Antarctic Peninsula there were several sporadic superabundances of the dinoflagellate cyst Impletosphaeridium clavus. These are interpreted as periods of enhanced blooms, and appear to be associated with the melting of winter sea ice.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Cretaceous dinocysts as paleoenvironmental reconstruction tool. The Aptian in the Southern Provence Basin (SE France).

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Dinoflagellate cysts have proved their utility as paleoenvironmental proxies in the recent past. However, our knowledge about the environmental preferences of Mesozoic dinocyst taxa is still limited. The integrative analysis of dinocyst assemblages diversity, dinocyst assemblages multivariate analysis and the dinocyst taxa relative abundance distribution allowed us to identify dinocyst associations sharing similar environmental preferences. The comparison of the variations in the analyzed dinocyst assemblages with previous data allowed us to propose a lower Cretaceous dinocyst paleoenvironmental model (Sanchez-Pellicer et al., in prep). This model is herein applied to outline the environmental evolution of the Southern Provence Basin (SE France) during the Aptian. The Southern Provence Basin was originated from the Provence carbonate platforms as a result of a crisis, modulated by regional tectonic deformations. Its intraplatform position allowed this basin to record the complete transformation of the surrounding carbonate platforms, not only the carbonate platform crises but also the posterior regional evolution and carbon cycle perturbation events like the global OAE 1a or the regional White and Fallot levels. The comparison of the variations in the dinocyst and structured sedimentary organic matter assemblages herein analyzed with previous multidisciplinary results allowed us to identify changes in marine productivity, humidity and source and composition of the continental influx. Thereby the environmental evolution of the Southern Provence Basin during the Early Aptian was outlined. The barrier effect of carbonate platforms and temperature and humidity changes are seen as the most influencing factors.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

The *Decahedrella*-event in ODP Hole 909C – Implications for Miocene stratigraphic and paleoceanographic interpretations across the Fram Strait gateway

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ODP Site 909 is located on a small abyssal terrace immediately north of Hovgaard Ridge within the Fram Strait. This major arctic gateway constitutes the only deep-water connection between the Arctic Ocean and North Atlantic, thus is of crucial importance for global ocean circulation and hence climate. Its age model is primarily based on the interpretation of the magnetic polarity record, but limited recovery and the uncertain occurrence of hiatuses results in 2 widely divergent correlations to the global polarity timescale below 200 mbsf, which seriously hampers reliable paleoenvironmental reconstructions in the Neogene of the gateway region. A detailed palynological study on a transect across Fram Strait comprising IODP Site M2, ODP Site 909, and ODP Site 907 revealed the presence of a significant acme of the endemic high-latitude acritarch Decahedrella martinheadii at all three sites. This acme, as well as the highest and lowest occurrence of this species, has been independently calibrated to the pristine magnetostratigraphy of ODP Site 907, thus providing new tie-points for the age model and the interpretation of the paleomagnetic record at ODP Site 909. Initial results indicate that the existing age models may have to be shifted by roughly 2 Ma towards a younger age within the Middle to Late Miocene interval, resulting in a much younger age for the base of the hole than previously thought. Here we

present a revised age model for the Miocene of ODP Site 909 and discuss resulting implications for previous paleoceanographic and paleoclimatic interpretations.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Which early Palaeozoic acritarchs might be dinoflagellate cysts?

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Small, organic-walled microfossils were usually attributed to the general term 'hystrichospheres' until the early 1960's. After the discovery that many of these 'hystrichospheres' displayed morphological characteristics that are specific for dinoflagellates namely having a cingulum, a sulcus, an operculum and a para-tabulation, Evitt (1963) created the new term 'acritarchs' to classify all the remaining forms of unknown biological affinity and separate these from dinocysts. The acritarchs therefore include various kinds of organisms that have been affiliated to animal remains, fossil spores of various groups, and to several classes of (green) algae, including the prasinophycean, zygnematophycean or chlorophycean groups, for example. Although of unknown biological affinities by definition, many Palaeozoic acritarchs, in particular taxa from the Ordovician, Silurian and Devonian, have been compared morphologically to dinoflagellates. Such morphotypes have therefore been considered to be the resting cysts of phytoplankton since many years. The diversity of (planktonic) dinocyst-like taxa strongly increases in the late Cambrian, triggering probably the onset of the 'Ordovician plankton revolution.' These acritarchs are virtually impossible to differentiate from dinocysts, showing often the same process morphology (see Kröck et al., this conference). Furthermore, their palaeoecological distribution patterns, following inshore-offshore trends, is identical to those of dinoflagellates. Also, their biogeographical distribution is comparable to that of modern dinoflagellate taxa. We consider that some Palaeozoic acritarchs might therefore have been produced by dinoflagellate-like species, although they do not display all morphological criteria necessary to be recognized as a dinoflagellate cyst.

Session 2.3: Phanerozoic and deep time scales. Oral presentation.

Dinoflagellate cyst stratigraphy of the Lower Cretaceous strata from the central part of the Hammerfest Basin, SW Barents Shelf, offshore Norway

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Traditionally, the Lower Cretaceous strata of the SW Barents Shelf are subdivided into the Knurr, Klippfisk, Kolje and Kolmule formations. Recently, the succession has been divided into seven third-order sequences (S0–S6) which are bounded by regionally extensive flooding surfaces. These surfaces cut across the conventional lithostratigraphic boundaries and capture the progradational character of the Lower Cretaceous succession. Here we present the dinoflagellate cyst (dinocyst) stratigraphy of the interval referred to S0-S6 from two industrial wells (7121/5-1 and 7121/5-2) located in the Hammerfest

Basin. The analysed material represents ditch cutting and sidewall core samples. Sequence 0 is dated as Berriasian–early Valanginian. The lower part of Sequence 1 is dated to the Hauterivian. The middle and upper part of Sequence 1 is referred to the lower Barremian. The dinocyst assemblages of Sequence 2 are tentatively dated as late Barremian to earliest Albian. The base of Sequence 3 is dated as earliest Albian. The boundary between Sequence 3 and 4 is somewhere within the middle Albian. The upper part of Sequence 4 is dated to late Albian. Sequence 5 is dated to latest Albian to Cenomanian. Sequence 6 is of early to middle Cenomanian age. Our results suggest that the Knurr Formation is equivalent to S0 and the lower part of S1. The Kolje Formation is equivalent to the upper part of S1 and lower to middle part of S2, while the Kolmule Formation is equivalent to the interval from the top of S2 to S6.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Poster presentation.

New gonyaulacacean dinoflagellate cysts from the Late Miocene (Tortonian)

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During the Late Miocene (Tortonian or Pannonian regional stage), at around 11.6 Ma, a glacioeustatically-driven sea-level fall caused the final closure of the Paratethys Ocean and Lake Pannon was formed in central Europe. The lake was initially brackish, but slowly freshened and became slightly alkaline. These unusual changes in water chemistry produced the radiation of a characteristic assemblage of gonyaulacacean dinoflagellate cysts. This study examined 94 samples from the Pannonian of Hennersdorf Clay Pit, south of Vienna, Austria. From this material, *Achomosphaera brevis* sp. nov., *Seriliodinium*? *imperfecta* sp. nov. and *Spiniferites hennersdorfensis* sp. nov. were apparently to be endemic to the Central Paratethys during the Late Miocene. *Spiniferites bentorii* (Rossignol 1964) Wall and Dale, 1970 subsp. *oblongus* Sütőné-Szentai 1986 and *Spiniferites bentorii* (Rossignol, 1964) Wall and Dale 1970 subsp. *pannonicus* Sütőné-Szentai 1986 are elevated to species status.

Session 2.4 : Dinocyst systematics. Oral presentation.

Revisiting the Ypresian Kallo record (North Sea Basin), a dinoflagellate cyst analysis of an Eocene hyperthermal (ETM-2) interval.

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A lot of the research surrounding the early Eocene hyperthermals has focused on the Arctic region and deep sea settings, such as the Gulf of Biscay. This has resulted in a general lack of detailed biotic data from shelf settings, although these areas are very sensitive to bio-geosphere interactions during global warming events. A prime target locality to help fill this gap is the Kallo borehole in the southern North Sea Basin. This reference site for the midshelf of the Belgian Basin during the early Eocene provides an extensive and almost complete record of the Ypresian, regionally known as the Ypresian clays. Early Eocene hyperthermal research in the North Sea Basin is still in progress and a recent update of the regional stratigraphic framework revealed the existence of multiple carbon isotope excursions. Paleogene dinoflagellate cyst research in Belgium is synonymous with Dr. Jan De Coninck, who spent a significant part of his professional career working on the Kallo core, and who recognized levels with distinct biotic events. This regional biostratigraphic framework of the Ypresian Clays can now be linked with the sequence of Eocene climate events and has paved the way for a detailed reevaluation of the dinocyst record. The

reassessment of the ETM-2 interval recovered from the Kallo core, allowed a better understanding of important stratigraphic and ecological events before, during and after ETM-2, and has helped evaluate the impact of paleoclimatic and paleoceanographic changes on the dinoflagellate cyst associations at the southern edge of the North Sea Basin.

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Selective dinoflagellate cyst degradation in Madeira Abyssal Plain (MAP) turbidites in an organic and inorganic geochemical context

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Assessment of selective preservation is of prime importance for the interpretation of proxies. Zonneveld et al. (1997) demonstrated strong selective changes in dinocyst assemblages as a result of aerobic degradation in the MAP F-turbidite. Based on two sets of 3 samples only, this did not allow much further differentiation. The present study relates palynological with geochemical changes at the transition from anoxic to oxic conditions in MAP turbidites with a high, 0.5-1 cm resolution. We now can understand why the geochemical processes already modify the peridinioid component of the dinoflagellate assemblage in the anoxic zone below the oxidation front, and why they lead to increasing cyst concentrations for some species close to the front. We demonstrate how taxon-specific differences in cyst degradation lead to successive dominance of Brigantedinium, Spiniferites and Impagidinium when degradation proceeds. We show the importance of knowledge of selective preservation by interpreting the assemblages with and without taking this process into account.

Session 2.5: Dinocyst chemistry and preservation / carbon cycles. Oral presentation.

Taxonomic review of selected dinocysts from the Middle to Late Jurassic of the Bonaparte Basin, Western Australia

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The Late Jurassic strata of the North West Shelf of Australia contain numerous world-class oil and gas fields and are currently still the focus of significant investment from major international oil companies. This study presents the Bathonian-Kimmeridgian (Middle-Late Jurassic) dinocyst assemblages of the Alaria-1 and Laminaria-2 wells of the Laminairia High, and the Elm-1 and Taltarni-1 wells of the Vulcan Sub-basin, Bonaparte Basin, NW Australia. 73 core and sidewall core samples were studied from the Laminaria-2. A total of 15 informal taxa previously recorded in unpublished reports from these wells, and other Middle-Late Jurassic successions from the North West Shelf of Australia, are herein assigned to known species. A further 4 new species are first described in the present study. This work represents the first results of a PhD project aiming to refine the biostratigraphic zonation of the Wanea indotata-Dingodinium swanense interval in the Bonaparte Basin :

Session 2.2: Mesozoic and Cenozoic dinocyst stratigraphies. Oral presentation.

Regional seesaw between North Atlantic and Nordic Seas during the last glacial abrupt climatic events

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The last glacial period has been punctuated by millennial abrupt climatic variations strongly imprinted in Greenland ice core records, where cold phases are associated with pan-North Atlantic ice-sheet collapses and iceberg delivery. These variations are thought to be linked to changes in the North Atlantic meridional overturning circulation, potentially in response to iceberg-derived freshwater injections in the North Atlantic. Indirect marine proxy records and sensitivity tests performed with atmospheric models have also suggested that the expansion of sea ice in the Nordic Seas during cold phases could be a key amplifier, explaining the large 5-16 °C magnitude of Greenland cooling. Here we provide direct and quantitative evidence of a regional paradoxical seesaw pattern: cold Greenland and North Atlantic phases coincide with warmer sea-surface conditions and shorter seasonal sea-ice cover durations in the Norwegian Sea as compared to warm phases. Our results are based on dinocyst analyses conducted in four sediment cores from the northern Northeast Atlantic and southern Norwegian Sea, for Marine Isotopic Stage 3 (48- 30 ka BP). Combined with additional paleorecords and multi-model hosing simulations, our results suggest that during cold Greenland, reduced Atlantic overturning circulation and cold North Atlantic sea-surface conditions were accompanied by the subsurface propagation of warm Atlantic waters that re-emerged in the Nordic Seas, warming the topmost layer, limiting sea-ice extent, and providing high deuterium excess moisture towards Greenland summit. This mechanism potentially enhanced iceberg discharges from the bordering ice sheets.

Session 2.6: Integrated studies derived from dinocysts: recent past to modern scales. Oral presentation.

Role of the Mediterranean Outflow Water on the North Atlantic climate and ocean circulation during past climate warming events.

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The Atlantic Meridional Overturning Circulation (AMOC) is a key component of the climate system. The relation linking AMOC strength variations and climate changes appears as non-linear, thus suggesting important feedback mechanisms which unfortunately remains poorly constrained. Yet, as the North Atlantic salinity budget strongly impacts the AMOC vigor, these feedbacks are likely to be related to processes able to affect this salinity budget. Amongst these processes, the Mediterranean Outflow Water (MOW), i.e. the warm and salty intermediate-depth water-mass overflowing from the Mediterranean Sea to the North Atlantic, appears as a good candidate. Our work thus aims to study the role of the MOW on the North Atlantic climate and oceanic circulation during past climate warmings. The study site (U1385, IODP Expedition 339), located on the southwestern Iberian margin, has been the subject of many paleostudies which have shown its strong potential to record 1) AMOC strength changes (benthic δ13C), 2) North Atlantic – Mediterranean Sea water-mass exchange variations through their impact on surface hydrographical conditions (dinocyst assemblages), and 3) precipitation changes over the

western Mediterranean Sea which are likely to affect the MOW intensity (pollen assemblages). Here we present such kind of data for MIS16-15 (635-610 ka BP) and MIS12-11 (440-405 ka BP) transitions, which are characterized by different insolation conditions. We especially focus on new dinocyst data which were obtained at unprecedented high temporal resolution (around 600 years). The observed population shifts provide new insights on oceanic circulation changes characterizing the abrupt and gradual climate warmings of these glacial-interglacial transitions.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Poster presentation.

Modern Analogue Technique at test in the South Italian Region – a 300 year record

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Dinoflagellate cyst based environmental reconstructions are often established using the "Modern Analogue Technique" (MAT). Since its introduction, the reliability and usability of this method has been debated. Unfortunately most of these discussions were carried out orally during conferences and workshops and only very few systematic studies have tested, evaluated and optimized the method. Here we present the results of a test where both quantitative MAT and qualitative dinoflagellate cyst association based reconstructions of temperature and salinity are compared to the world-wide longest instrumental records of temperature and precipitation. We show that MAT based reconstructions improve when a local rather than an extra-regional reference dataset is used. Excluding cysts sensitive for post depositional degradation from the datasets leads to considerable loss of variability and unreliable reconstructions. MAT-based reconstructions reflect instrumental data for industrial times but not for pre-industrial times whereas qualitative reconstructions provide a relatively good fit. We show that this is a result of the quality of the reference dataset used in MAT studies. To date surface waters in many regions are polluted resulting in trophic conditions that do not correspond to those in pre-industrial times. Consequently, no modern day analogues can be found for downcore pre-industrial sediment samples from these regions. We advise users of dinoflagellate cyst transfer functions to pay more attention to this aspect.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

Paleoceanographical conditions of North Pacific Ocean during the Pliocene based on organic-walled dinoflagellate cysts

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The analysis of organic-walled dinoflagellate cyst (dinocyst) assemblages at ODP Site 887 in the Gulf of Alaska, northeastern North Pacific, was undertaken in order to document ocean changes over the last 5million years. Our results show a dramatic change in the composition of dinocyst assemblage at ~2.5Ma, coinciding with the Pliocene-Pleistocene climatic transition. Prior to 2.5Ma, the assemblages are characterized by *Bitectatodinium tepikiense*, *Nematosphaeropsis labyrinthus*, *Impagidinium pallidum* and *Impagidinium paradoxum*, which occur in the modern cool-temperate North Atlantic Ocean. After 2.5 Ma, the assemblages are often dominated by *Operculodinium centrocarpum* and *Brigantedinium* sp., which indicates a change towards colder conditions. The occurrence of heterotrophic taxa such as *Brigantedinium* is in line with biogenic opal variations, which suggests changes in productivity, possibly related to upwelling conditions more intense during the Late Pleistocene. Beyond these general features, large amplitude variations in concentrations and taxa percentages reflect large changes in sea-surface conditions, possibly related to glacial-interglacial cycles. Furthermore, comparisons with

published records from the northern North Atlantic indicate very distinct dinocyst and acritarch assemblages and biostratigraphical marks during the Pliocene, which suggests limited connections between the subpolar North Atlantic and North Pacific.

Session 2.1: Neogene to modern dinocysts in palaeoceanographic studies. Oral presentation.

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