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PROGRAMME JOURNEE DU MERCREDI 16 OCTOBRE 2019

8h30-9h00	**Café d'accueil**	
9h00-9h30	**Introduction**	***Georges Ceuleneer, Pascal Philippot, Gilbert Camoin***
9h30-10h00	**"The Deep Subsurface Biosphere in Igneous Ocean Crust: A Geochemical Perspective »**	***Keynote : Olivier Rouxel***
10h00-10h15	Abiogenic formation of hydrogen, light hydrocarbons, and other short-chain organic compounds within the serpentinite mud volcanoes of the Marianna Trench	*Olivier Sissmann, Christophe Monnin, Roy Price, Marcus Elvert, Verena Heuer, Virgile Rouchon, Valérie Beaumont, Eric Kohler, Catriona Menzies, and Ken Takai*
10h15-10h45	**Pause-Café**	
10h45-11h15	**"A new view of seafloor spreading: why we need to keep drilling"**	***Keynote : Christopher MacLeod***
11h15-11h30	Ion filtration in oceanic clay-rich sediments: evidence from chlorine stable isotopes of pore fluid chlorides	*Pierre Agrinier*
11h30-12h00	Rupture continentale et première croûte océanique de la Mer de Chine Méridionale : Résultats des Expéditions IODP 367, 368 & 368X	*Michael Nirrengarten, Geoffroy Mohn, and Anne Briais*
12h00-12h15	The role of melt-rock interactions in the formation of slow- and ultraslow-spreading ridges: constraints from IODP drilling at the Mid-Atlantic Ridge and the Southwest Indian Ridge	*Carlotta Ferrando, Lyderic France, and Marine Boulanger*
12h15-14h00	**Pause déjeuner**	
14h00-14h30	**"Les avancées majeures des connaissances sur l'aléa sismique et tsunamique dans les zones de subduction au cours des10 dernières années"**	***Keynote : Marianne Conin***
14h30-14h45	A 25ka paleoseismological record for the Central Corinth Rift	*Gino De Gelder, Mai-Linh Doan, Christian Beck, Nathalie Feuillet, Mary Ford, and Sabine Schmidt*
14h45-15h00	Composition, geometry and emplacement dynamics of a large submarine landslide offshore Martinique Island : integration of drill-core with seismic data and laboratory modeling experiments	*Morgane Brunet, Erwan Hallot, Thierry Nalpas, Anne Le Friant, Georges Boudon, and Jean-Jacques Kermarrec*
15h00-15h15	Assessing multi-scale damage at depth near the Alpine Fault, New Zealand	*Mai Linh Doan, Bernard Celerier, Philippe Pezard, John Townend, Rupert Sutherland, and Virginia Toy*
15h15-15h30	Petrophysical characterisation of the active Papaku thrust fault zone at IODP site U1518 in the frontal wedge of the Northern Hikurangi margin, New Zealand : insights on fault zone evolution	*Jade Dutilleul, Sylvain Bourlange, and Yves Géraud*
15h30-16h00	**Pause-Café**	
16h00-16h15	Environmental protection and safety panel (EPSP), rôle et fonctionnement.	*Philippe Lapointe*
16h15-16h45	**"Natural resources for a low-carbon future"**	***Keynote : Katryn Goodenough***
16h45-17h45	**Présentations Orales des Posters (3 minutes par poster)**	
17h45-19h00	**Apéritif & Posters**	

Abiogenic formation of hydrogen, light hydrocarbons, and other short-chain organic compounds within the serpentinite mud volcanoes of the Marianna Trench

Olivier Sissmann * [1], Christophe Monnin [2], Roy Price [3], Marcus Elvert [4], Verena Heuer [4], Virgile Rouchon [1], Valérie Beaumont [1], Eric Kohler [1], Catriona Menzies [5], Ken Takai [6]

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The only known active sepentinite-hosting mud volcanoes, located in the Marianna forearc subduction zone, were drilled during IODP Expedition 366. Recovered samples from Asùt Tesoru seamount provide new insights on the generation of organic matter from fluid-rock interactions in deep oceanic environments, through Fischer-Tropsch-Type (FTT) reactions. The reduction of water by ferrous iron produces hyperalkaline pore fluids (pH 12.5) rich in H2 (up to 2 mM), prone to react with accompanying DIC (up to 4.5 mM). High amounts of sulfide/oxide minerals observed within the mud may have catalyzed the reaction. This situation is ideal to produce carbon species like volatile fatty acids (VFAs), short-chain alcohols, and light hydrocarbons.
We acquired the full set of stable carbon isotope information of those compounds. VFAs are mostly composed of formate and acetate (up to 100 and 40 μM), associated with methanol (up to 30 μM). These short-chain components have extreme carbon isotope compositions, with heavy δ13C values of up to +4.8% for formate, -8.0% for acetate and +2.3% for methanol, strongly suggesting an abiogenic origin and formation during CO2 reduction with H2. The gas phase of the serpentine mud is composed of a mix of H2 and CH4 (up to 95%). Associated molecular composition monitored via C1/C2+ ratios barely varies down to 100 mbsf, implying low or even absent microbial activity (confirmed by low cell count). Corresponding δ13C values of methane as positive as -16 % are in good agreement with reported abiogenic values. In addition, measured 3He concentration and extrapolated 3He/CO2 ratios suggest a primarily mantle-derived inorganic carbon source. The fractionation between the δD values of CH4, H2 and H2O was also measured, and can be used to discuss potential temperature formation conditions at isotopic equilibrium. Our dataset thus points to the abiogenic formation of low molecular weight organic compounds in the Marianna's mud volcanoes. Furthermore, it brings new constraints on the reaction pathways leading to the formation of precursor molecules essential to life in serpentinizing environments.

Mots-Clés : Serpentinization, Origin of life, mud volcano, Marianna Trench

*Intervenant

Ion filtration in oceanic clay-rich sediments: evidence from chlorine stable isotopes of pore fluid chlorides

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Pore fluids from young clay-rich sedimentary piles (Nankai Though and Japan trench accretion prisms, Black Ridge and Juan de Fuca Ridge flanks; data from Spivack et al., 2002; Wei et al., 2008; Deyhle et al., 2004; Hesse et al., 2000; Bonifacie et al., 2007; Agrinier et al., 2019) systematically show a regular decrease of d37Cl of chlorides with depth from about 0 ‰ (seawater value) at the seafloor down to -8.5 ‰ in low permeability sedimentary levels. Deviations locally interrupt the overall decreasing trends. They are due to the injection of external fluids at higher permeability sedimentary levels.

Using conservation equations for chlorides and water, these d37Cl profiles can be modelled by the compaction of a growing clay–rich sedimentary pile. Isotope fractionations of chlorine isotopes, a37Cl/35Clexpulsed/residual fluid, in the range of 1.006 to 1.001, explain the observed negative d37Cl chlorides at the bottom of the sedimentary piles. They are in agreement with the theory of ion filtration of Phillips and Bentley (1987) in which the mobility of chlorides through semi- permeable clay membrane is determined by ion repulsion. The complementary positive d37Cl chlorides must accumulate at the top, but are very likely diluted beyond recognition with sea- water chlorides across the seafloor interface. As a result, young clay-rich sediments blanketing oceanic crusts are reservoirs of 37Cl-depleted chloride. They might be the source of 37Cl-depleted chloride fluids advected at mud volcanoes on the seafloor. The fact that no such 37Cl-depleted chlorine is documented in subduction zone products is therefore a strong argument to propose that most of the clay-rich sediments pore fluids are released back to the ocean rather than being subducted.

Refs Agrinier, Geochi. Cosmo. Acta, 245, 525 ; Bonifacie, Earth Planet. Sci. Lett. 260, 10; Deyhle, The Island Arc, 13, 258; Hesse, Geofluids, 6, 1 ; Phillips, Geochi. Cosmo. Acta, 51, 683; Spivack, Geophysical Res Letters, 29, 1661; Wei, Earth Planet. Sci. Lett, 266, 90.

Mots-Clés : filtration ionique chlorures pore fluids

*Intervenant

Rupture continentale et première croûte océanique de la Mer de Chine Méridionale: Résultats des Expéditions IODP 367, 368 & 368X

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L'extension continentale suivie de sa rupture et la création d'une nouvelle lithosphère océanique sont des évènements majeurs de la tectonique des plaques enregistrés dans les domaines distaux des marges passives. Les Expéditions ODP au niveau des marges de l'Atlantique, ont investigué des modes de rupture contrastés avec de faibles budgets magmatiques présentant de larges étendues de manteau exhumé ou des systèmes riches en magma caractérisés par des croutes ignées épaisses. L'acquisition et la synthèse des données de ces expéditions ont guidé les différents modèles de ruptures continentales. Cependant la multiplication des profils sismiques met en évidence la variabilité de l'architecture crustale des transitions continent océan. Ces observations questionnent l'applicabilité des modèles de rupture développés en Atlantique Nord sur d'autres systèmes. Les Expéditions IODP 367, 368 & 368X se sont focalisées sur la marge Nord de la Mer de Chine Méridionale où la nature de la transition entre croûte continentale et océanique restait ambiguë.

La Mer de Chine Méridionale est un bassin océanique marginal qui s'est ouvert entre ~32 et ~16 Ma. Grâce à ces nouvelles données de forages sur la marge SE Chinoise, ainsi qu'à l'intégration de données sismiques des deux marges conjuguées nous avons mis évidence les processus et l'agenda de la rupture continentale en Mer de Chine Méridionale. Dans le domaine distal de la marge SE-Chinoise, le haut de socle nommé Ride A a latéralement été foré deux fois et présente d'une part des basaltes extrêmement altérés et d'autre part des sédiments syn- ou pre-rift indiquant la présence du socle continental à cette position. Des basaltes en coussins de composition tholéiitique forment le socle des rides les plus distales (B et C) indiquant leur nature océanique. Ainsi et grâce au calage bio-stratigraphique, une transition abrupte dans l'espace (~5-10 km) et rapide dans le temps (< 3Ma) entre l'extension continentale et l'accrétion océanique est proposée.

Ces résultats ont montré un mode de rupture continental distinct des deux modes généralement invoqués. Ceci confirme l'importance du programme IODP pour notre compréhension des processus de formation de nouvelles limites de plaque en divergence. L'intégration de ces nouvelles données combinée avec d'autres exemples permet d'investiguer les processus génériques contrôlant le mode de rupture continentale en relation avec l'extension tectonique et la formation des liquides magmatiques.

Mots-Clés : Rupture continentale, IODP 367 368 et 368X, Marge SE Chinoise

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The role of melt-rock interactions in the formation of slow- and ultraslow-spreading ridges: constraints from IODP drilling at the Mid-Atlantic Ridge and the Southwest Indian Ridge

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The accretion of oceanic crust at spreading centers is primarily controlled by the cooling and chemical differentiation of primary Mid Ocean Ridge Basalt (MORB)-type melts. In the past decade, many studies highlighted that melts not only crystallize, but may also react with the crystal matrix during their migration to the surface. The melt-rock interactions induced by percolating melts are able to modify the composition of melts and pre-existing matrix. To better understand the role of such reactive processes on the formation of the oceanic crust and the composition of gabbroic series and erupted MORBs, it is imperative to investigate the lower portions of the oceanic crust where the melt extensively crystallize. Along slow-and ultraslow- spreading ridges, gabbroic rocks and ultramafic sections are exhumed at Oceanic Core Complexes (OCC) by long-lived detachment faults. In this contribution we present a comprehensive petrogeochemical study on gabbroic sections drilled by ODP-IODP consortium at the Atlantis Massif OCC (30 N Mid-Atlantic Ridge, MAR) and Atlantis Bank OCC (57°E Southwest Indian Ridge, SWIR).

Textures and geochemical compositions of the most primitive gabbroic rocks found in the crustal sequence of Atlantis Massif suggest that they formed after a process of reactive porous flow of a percolating MORB through a mantle precursor. Partial assimilation of mantle phases occurs only locally and does not modify the overall composition of MORBs. In contrast, at the nearly amagmatic region of the SWIR (61°E-67°E), it was found that MORB compositions are modified by mantle-melt interactions, thus suggesting that the reactive processes through a mantle precursor has major impact on the composition of basalts where magma income is limited.

At Atlantis Bank, gabbros record melt-rock interactions between a pre-existing crystal mush and percolating melts. Locally, during their crystallization, melts may be expulsed while partially reacting with the mush and finally crystallize in discrete portions of the crustal sequence. Processes of assimilation of a crustal component were also described at the Kane Megamullion (24 N MAR), where melts are modified and seafloor basalts record high apparent crystallization pressures.

Our comparison between oceanic crust generated beneath two Mid-Ocean Ridges provide evidence of the importance of melt-rock interactions. Reactive processes are ubiquitous from early stages of melt percolation through the mantle to shallower melt migration in the magmatic crust.

Mots-Clés : IODP drilling, lower oceanic crust, Mid Ocean Ridge Basalt, melt, rock interactions, Atlantis Massif, Atlantis Bank

*Intervenant

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A 25ka paleoseismological record for the Central Corinth Rift.

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Offshore sedimentary cores in tectonically active locations offer the potential for long, continuous and well-preserved records of past seismic events, and may thus provide important constraints for seismic hazard assessment. The cores of IODP expedition 381 drilled in the Corinth Rift provide an exceptional opportunity to obtain such a record, given their cumulative length (~500-700m at each of three drillsites), high sedimentation rates (~0.5-3 mm/yr), and location in one of the most seismically active areas of Europe. Here we present our detailed analysis of these cores for the past ~25 ka, in which our aim is to identify earthquake-induced deposits and understand their occurrence within the framework of the rift's main fault system. We find that the two sites located in the Central Corinth Rift contain abundant homogenite+turbidite (HmTu), which typically form by earthquakes, tsunamis and landslides. They are easily identified visually and through grainsize/shape and XRF measurements, allowing us to distinguish ~125 HmTu layers at both of the sites. We correlate the events between the two sites using their stratigraphic position, chemical signature, and absolute age constraints obtained by radio- carbon and Pb/Cs dating. If all HmTu layers represent earthquakes, the corresponding average recurrence time of ~200 years is lower than estimates for Mw > 6 earthquakes occurring along individual 10-20 km long normal fault segments in the western and eastern Corinth Rift. HmTu layers are more frequent within the pre-Holocene interval (~25-12 ka), suggesting either a lower threshold to record earthquakes, or an increase in non-seismic landslides during colder periods. We compare our findings to the historical seismic record to discuss rupture scenarios, as well as possible implications for seismic hazard assessment in the Central Corinth Rift.

Mots-Clés : Corinth Rift, paleoseismology, turbidites, homogenites

*Intervenant

Composition, geometry and emplacement dynamics of a large submarine landslide offshore Martinique Island: integration of drill-core with seismic data and laboratory modeling experiments

Morgane Brunet * [1], Erwan Hallot, Thierry Nalpas , Anne Le Friant , Georges Boudon , Jean-Jacques Kermarrec

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Mass movement processes are common features in the vicinity of volcanic islands. In this study, we have investigated landslides emplacement and dynamics around the volcanic island of Martinique, from the combined analysis of seismic data and deep drilling datasets. The first ones were gathered during three oceanographic cruises offshore the island (AGUADOMAR, 1999; CARAVAL, 2002 and GWADASEIS, 2009), while drilling data were collected during the IODP Expedition 340 (Site U1399, Site U1400, Site U1401, *Joides Resolution*, March–April 2012), the first of its kind which has drilled into deposits associated to the activity of a volcanic island. The full coverage of marine geophysical dataset allowed us to characterize these deposits's architecture, extent and volume while drilling data better constrained its composition and origin. Based on this integrated analysis, we propose a new model linking subaerial to submarine instability processes, so that flank-collapse events occurring on Montagne Pelée volcano resulting in debris avalanches, triggered seafloor sediment failure and submarine landslides processes offshore the island. In order to test the veracity of this model, we used a laboratory modeling approach to better understand propagation mechanisms of submarine landslides over a slope. To do so, we have simulated the sliding process of a sand layer laying over a silicone layer in various slope geometries (slope lengths and number of slopes with different angles), under both dry and water conditions, and in varying the amount of the additional sand inputs, upstream. The resulting deformations were characterized in each experiment in order to compare the obtained structures with those shown by seismic lines off shore to the west of the Martinique Island. During all the experiments, a compressive frontal deformation zone made by several reverse faults formed downstream, often in the vicinity of the slope breaks. Just below, a portion of sediments was mostly translated and poorly deformed while an extensional zone formed upstream. The displacements of surficial markers were measured through time in order to characterize the sliding dynamics. Steeper and longer slopes, additional sand inputs, as well as the presence of water were observed to promote sliding and deformation in the compressive front. Although crude, the scaling suggests that the process might still be active offshore of the Martinique Island since the last volcano-flank collapses.

Mots-Clés : Submarine landslide, volcano flank collapse, Martinique island, laboratory experiments

*Intervenant

Assessing multi-scale damage at depth near the Alpine Fault, New Zealand

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The Alpine Fault is recognised internationally as an important site for studying earthquake physics and tectonic deformation, as it produces large (~M8) earthquakes approximately every 330 years and last ruptured in 1717. Hence the fault is considered as late in its seismic cycle. Its oblique dextral-slip rate (26mm/yr) is co-occurs with a reverse slip rate up to 10 mm/yr in its central part, exhuming fossile but recent ductile shear zone. The Deep Fault Drilling Project takes advantage of the this globally rare situation to determine what temperatures, fluid pressures, and stresses exist within a plate-boundary fault in advance of an expected large earthquake.
The 2nd stage of the project started in late 2014 to drill down to 1500m. Although the fault slip zone could not be reached, an extensive dataset of geophysical logs could be retrieved in the hanging wall, especially thanks to the French logging team (Montpellier, Grenoble). More than 19 km of logs were run within the 900m deep borehole, with datasets covering among others thermal resistivity, sonic velocities, acoustic borehole imaging and electrical resistivity. They show that the hanging wall is extensively fractured, explaining the high geothermal gradient measured on in the borehole (120 °C/km) by lateral flow of hot water deep-seated in the mountains. Seven dual laterologs logs gave a robust and reproducible datsets to determine conductive fractures. They show that different patterns of damage could be identified within the borehole. A first pattern consists in an extensive and dense pattern of isolated fractures, that could be identified on the whole borehole. A second pattern suggests that decametric zones of low resistivity localize damage and focus thermal anomaly. This suggests a two-phase evolution of the damage zone of the Alpine fault, with an initial phase of diffuse fracturing that is followed by subsequent alteration of the major shear zone, which focuses fluid and heat flow.

Mots-Clés : Alpine Fault, DFDP, Damage zone, Electrical resistivity

*Intervenant

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Petrophysical characterisation of the active Papaku thrust fault zone at IODP site U1518 in the frontal wedge of the Northern Hikurangi margin, New Zealand : insights on fault zone evolution

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In subduction zones, shallow thrusts are thought to accommodate displacement by varied aseismic and seismic fault slip styles. However, the mechanisms involved in the spatial and temporal transitions between slip styles are poorly known because most hypotheses are based on interpretations of remote data and experimental works. In Northern Hikurangi margin, New Zealand, tsunami earthquakes occurred in 1947 and shallow slow slip events (SSEs) recur every 1 or 2 years.
During IODP Expedition 372 and 375 (2017-2018), Site U1518 was drilled in the frontal wedge of the Northern Hikurangi margin ~6.5 km west of the deformation front. This site penetrated an active thrust fault, the Papaku fault, its hanging wall and footwall. The Papaku fault, intersected at ~304 meters below sea floor, is a westward-dipping splay fault which is thought to lie in the SSE rupture area, to host SSEs and to have accommodated substantial shortening within the prism. It is composed of a ~18m-thick main fault zone with a mixture of brittle and ductile structures and ductile features locally overprinted by brittle fractures and faults. Below, there are a ~21m-thick zone of gradually decreasing brittle-ductile deformation and a ~10m-thick subsidiary fault zone. The folded, faulted and pervasively fractured hanging wall corresponds to Early-Mid Pleistocene hemipelagic silty-claystone with fine-grained turbidites sequences. The footwall is composed by relatively undeformed Mid-Late Pleistocene bioturbated hemipelagic mudstones with turbidites sequences.
Here, we use log and core data from IODP Expeditions 372 and 375 and post-cruise analyses to characterize the evolution of physical properties across the Papaku fault zone. We correct total porosity measured onboard accounting for clay-mineral bound water using Cation Exchange Capacity (CEC). CEC is low and constant ~0.14 mol/kg in the sedimentary sequence, suggesting that clay minerals are mainly illite/kaolinite. Total porosity and interstitial porosity are 41% and 36% in average in the hanging-wall and increase across the Papaku fault zone to reach 47% and 42% in average in the footwall. NMR (T2 ~2ms) and mercury intrusion (pore throat size 0.1– 1 μm) show that pore size is similar in the hanging wall and in the footwall but tends to be larger in the footwall. We interpret these results in terms of compaction state variation between the hanging wall and the footwall and discuss the implications for the fault zone evolution.

Mots-Clés : IODP, Hikurangi, New Zealand, porosity, CEC, resistivity, clay, compaction

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Environmental protection and safety panel.(EPSP), rôle et fonctionnement.

Philippe Lapointe *@ [1]

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Le Panel de Protection de l'Environnement et de la Sécurité (EPSP) évalue les sites proposés au forage, l'impact sur l'environnement et la sécurité de l'expédition. Il travaille conjointement avec le groupe d'évaluation scientifique (SEP) pour garantir la sécurité des opérations du Joides Resolution et aux plates-formes mission spécifiques ou au board IODP du Chikyu. Il se compose de 15 à 19 panélistes. Les membres du panel l'EPSP sont des spécialistes qui peuvent fournir des conseils d'experts sur l'optimisation de la sécurité et la réduction de l'impact sur l'environnement associé au forage des sites proposés, y compris des sites situés dans des zones sujettes aux hydrocarbures et biologiquement sensibles. L'EPSP évalue les sites de forage proposés dans un mode de prévisualisation ou de revue. Le comité se réunit au moins une fois par an et par échange de courriels si nécessaire.
Un représentant des promoteurs du projet assiste à la revue et effectue une présentation résumant les informations contenues dans le Safety Review Report.
Cette présentation est divisée en deux sections générales: un aperçu du projet et de son environnement suivi d'un examen site par site. Le panel examine indépendamment et passe en revue chaque site principal et chaque site alternatif, incluant les données caractéristiques du site et les plans opérationnels, afin de déterminer si et comment, les opérations de forage envisagées peuvent être menées à bien afin de maximiser la sécurité et de minimiser l'impact sur l'environnement. Le panel EPSP examine aussi les risques pour la vie marine et l'environnement, ainsi que les autres impacts possibles tels que pêcheries, câbles de communications sous-marins, etc.

Après chaque revue de site, le panel formule une recommandation:

- Approuvé comme demandé.
- Approuvé à une profondeur spécifiée autre que celle initialement demandée.
- Approuvé sur un nouveau site après discussion entre les membres du panel, promoteur du projet et opérateur.
- Reporte toute recommandation jusqu'à ce que des informations spécifiques supplémentaires soient fournies.
- Non approuvé.

Les approbations sont basées sur le jugement des membres du panel EPSP selon lequel un site proposé peut être foré en toute sécurité. Les recommandations de l'EPSP sont basées sur un consensus ou un vote, décidé au cas par cas par le panel. De plus, le panel peut recommander un ordre de forage spécifique et / ou des exigences de contrôle spécifiques.

Mots-Clés : EPSP, rôle, enjeux

*Intervenant

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PROGRAMME JOURNEE DU JEUDI 17 OCTOBRE 2019

8h30	**Café d'accueil**	
9h00-9h30	**"Forages IODP/ICDP de cratères d'impact - Des hublots sur les événements passés, une fenêtre sur ceux à venir"**	***Keynote : Ludovic Ferrière***
9h30-9h45	Apports terrigènes dans les sédiments paéocènes du forage M0077, golfe du Mexique, Yucatan	*Elise Chenot, Christopher Lowery, Johanna Lofi, Jérôme Gattacceca, François Demory, Fabien Garcia, Myriam Ferrand, Lucie Tupinier, Laurent Brun, and Expedition 364 Scientists*
9h45-10h15	**"CHADRILL – The Lake CHAd Deep DRILLing project : Revealing 10 million years of environmental and climate change in Africa"**	***Keynote : Mathieu Schuster***
10h15-10h30	Uncovering a Salt Giant: an IODP initiative to investigate the Mediterranean giant salt deposit	*Johanna Lofi, Clausia Bertoni, Angelo Camerlenghi, Vanni Aloisi, and Dream And Demise Proposals Co-Proponents Teams*
10h30-11h00	**Pause-Café**	
11h00-11h30	**"Apport des longs enregistrements paléoclimatiques continentaux : défis, déboires et succès des forages ICDP"**	***Keynote : Pierre Francus***
11h30-11h45	The ICDP Deepdust project - Probing continental climate of the Late Paleozoic icehouse-greenhouse transition	*Laurent Beccaletto, Stéphane Pochat, and Sylvie Bourquin*
11h45-12h00	Astronomical calibration of the Late Albian from the Mentelle Basin (southwestern Australia)	*Mathieu Martinez, Sietske J. Batenburg, Matthew M. Jones, David K. Watkins, Maria Rose Petrizzo, Brian T. Huber, Hans-Jürgen Brumsack, and Bernhard Schnetger*
12h00-12h15	Climat en Arctique du Paléocène à l'Eocène supérieur (58-40 Ma) d'après les pollens des sites IODP 302 M0004 et M0002 (ACEX)	*Séverine Fauquette, Jean-Pierre Suc, Speranta-Maria Popescu, and Cécile Robin*
12h15-12h30	The geochemical record of Oceanic Anoxic Event 2 (94 Ma) in the Mentelle Basin (SW Australia): New data from Site U1516 (IODP 369)	*Laurent Riquier, Hans-Jürgen Brumsack, Julien Danzelle, and François Baudin*
12h30-14h00	**Pause déjeuner**	
14h00-14h15	Paleogene sea surface temperatures: toward an agreement between models and proxies for the last greenhouse world?	*Maxime Tremblin, Fabrice Minoletti, and Michaël Hermoso*
14h15-14h30	La porosité des tests de Subbotina linaperta (foraminifère planctonique) comme marqueur des températures de subsurface au Paléogène	*Béatrice Below, Christopher Smith, Delphine Desmares, Delphine Dissard, Maxime Tremblin, Loïc Villier, and Bruno Turcq*
14h30-14h45	No direct link between the Oligocene glaciation and the ACC onset: new insights from the foraminiferal record	*Florent Hodel, Romain Grespan, Marc De Rafelis, Guillaume Dera, Carinne Lezin, Elise Nardin, Dominique Chardon, Delphine Rouby, Martine Buatier, Marc Steinmann, Alban Cheviet, Christine Destrignevill1, and Valérie Chavagnac*
14h45-15h00	Le transect IODP Expédition 354 à 8◦N du Cône du Bengale et l'histoire de l'érosion de la Himalaya et de la mousson indienne au Néogène	*Christian France-Lanord, Sarah Feakins, Albert Galy, Valier Galy, Pascale Huyghe, Jérôme Lavé, and Sébastien Lénard*
15h00-15h15	Alternating paleoenvironments in a deep-water rift : initial results from IODP Expedition 381, Gulf of Corinth, Greece	*Mary Ford, Robert Gawthorpe, Lisa Mcneill, Donna Shillington, Gareth Carter, and Iodp Expedition 381 Team*
15h15-15h30	Mediterranean Outflow Water and contourite depositional systems in the Gulf of Cadiz	*Emmanuelle Ducassou, Paul Moal-Darrigade, Johanna Lofi, Viviane Bout-Roumazeilles, and André Bahr*
15h30-16h00	**Pause-Café**	
16h00-17h00	**Avenir des Programmes IODP et ICDP - Conclusion**	*Comité d'organisation et SGF*

Apports terrigènes dans les sédiments paléocènes du forage M0077, golfe du Mexique, Yucatán

Elise Chenot *@ [1], Christopher Lowery [2], Johanna Lofi [1], Jérôme Gattacceca [3], François Demory [3], Fabien Garcia [4], Myriam Ferrand , Lucie Tupinier , Laurent Brun [1], Expedition 364 Scientists

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En 2016, l'Expédition ICDP-IODP 364 (Chicxulub Impact Crater, Yucatán, Mexique) a permis de récupérer 112 mètres de sédiments hémi-pélagiques et pélagiques du Paléogène, accumulés sur le haut topographique formant le " peak-ring " du cratère d'impact de Chicxulub (505,7 à 618 mbsf; Morgan et al., 2016).

Des travaux récents menés sur les sédiments d'âge Paléocène inférieur (-66 à -62 Ma) de ce forage ont mis en évidence une reprise rapide de la productivité marine après l'impact, avec cependant d'importants changements : 1) environ 300 ka après la limite K-Pg, une baisse importante de la productivité primaire (Lowery et al., soumis) mais aussi le renouvellement des groupes de nannofossiles (Jones et al., 2019) et 2) environ 1,5 Ma après la limite K-Pg, un changement des stratégies trophiques des foraminifères planctoniques (Jones et al., 2019). Pour expliquer ces modifications de la productivité primaire, des apports d'eau douce et des changements dans les flux terrigènes ont été évoqués pour contrôler la stratification de la colonne d'eau et les apports de nutriments.

L'objectif de cette étude est d'étudier la nature de ces flux terrigènes liés aux changements environnementaux en couplant plusieurs techniques : l'étude des propriétés magnétiques intrinsèques des carbonates (l'aimantation rémanente anhystérétique, l'aimantation rémanente isotherme et la susceptibilité magnétique) sensibles à l'abondance relative des apports biogéniques et détritiques dans les sédiments, la minéralogie des argiles, mais aussi leur teneur relative grâce au gamma-ray mesuré en forage.

Les premiers résultats ont montré que durant les 300 ka premières années suivant l'impact les apports terrigènes semblent dominés par l'altération des brèches d'impacts. La nature de ces flux terrigènes pourrait avoir contribué aux conditions nocives des eaux de surface dominées par les calcisphères (*Cervisiella spp.*). Le passage de la stratégie trophique d'eutrophe à oligotrophe, enregistrée vers 1,5 Ma après l'impact, coïncide quant à lui avec une forte augmentation de la palygorskite. Ce changement reflète une modification des conditions climatiques, avec la mise en place d'un climat aride, une intensification des apports éoliens et une diminution des flux de nutriments.

Références :
Morgan, J., et al., 2016, *Science*. Jones, H., et al., 2019, *Geology.*
Lowery, C., et al., soumis, *Paleoceanography-Paleoclimatology.*

Mots-Clés : apports terrigènes, minéraux argileux, propriétés magnétiques intrinsèques, Danian, Chicxulub

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Uncovering a Salt Giant: an IODP initiative to investigate the Mediterranean giant salt deposit

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Uncovering a Salt Giant is a multi-platform drilling proposal (857-MDP, coord. A. Camer- lenghi) born out of a series of workshops and international initiatives carried out since 2014. Its objective is to drill the Mediterranean evaporitic sequence in the western and eastern Mediterranean basins to investigate the sequence of climatic, tectonic and hydro-geo-chemical events that formed one of the largest, and by far the youngest, giant salt deposit on Earth. Beyond the salt giant formation mechanism, this initiative will investigate what could be one of the most active and as yet poorly understood deep biosphere environments of the marine realm. Two IODP proposals are currently submitted under the 857-MDP umbrella:

(1) The DREAM pre-proposal P857B aims at drilling with the JOIDES Resolution a transect of four sites on the southern margin of the Balearic promontory (Western Mediterranean), where MSC deposits are found preserved in a series of sedimentary basins lying at different water depths between the present-day coastline and the deep central salt basins. This unique sedimentary record will allow testing 1) the contradictory emplacement models that explain its genesis and 2) the presence a deep microbial biosphere that take advantage of specific habitats and energy-yielding processes associated to the evaporitic salts. Submission of a full-proposal requires the acquisition of complementary geophysical Site Survey Data.

(2) the DEMISE 857-C full proposal proposes to drill two sites in the Ionian Basin and two in the Levant Basin with the JOIDES Resolution, penetrating the terminal MSC successions to investigate : (1) the dramatic environmental changes and salinity fluctuations experienced during terminal stages of the MSC and (2) the development of an exceptionally active deep biosphere involved in extensive mineral transformations, including what could be a currently active *microbial dolomite factory* in the Ionian Abyssal Plain, extending over an area nearly as large as the island of Sicily.

This IODP initiative is developed within the scientific networking MEDSALT COST Action (2016 – 2020) (coord. A. Camerlenghi) and has benefitted from the support of the ANR MED- SALT project (2016, coord V. Aloisi); it is related to the IMMAGE ICDP-IODP amphibious drilling proposal (coord. R. Flecker) and will benefit from the training of a new generation of young scientists within the ongoing SALTGIANT ETN project (coord. V. Aloisi).

Mots-Clés : Mediterranean, Salt Giant, Messisnian, Deep Biosphere

*Intervenant

The ICDP Deepdust project - Probing continental climate of the Late Paleozoic icehouse-greenhouse transition

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The tectonic, climatic, and biotic events of the Permian are amongst the most profound in Earth history. Global orogeny leading to Pangaean assembly culminated by early-middle Permian time, and included multiple orogenic belts in the equatorial Central Pangaean Mountains, from the Variscan-Hercynian system (east) to the Ancestral Rocky Mountains (west). Earth's penultimate global icehouse peaked in early Permian time, transitioning to full greenhouse conditions by late Permian time, archiving our only example of icehouse collapse while the Earth had an expansive terrestrial biosphere. The Late Paleozoic Icehouse was the longest and most intense glaciation of the Phanerozoic, with hypothesized low-moderate-elevation glaciation posited for both eastern and western tropical Pangaea during early Permian time. The atmosphere during this icehouse experienced the lowest CO2 and highest O2 levels of the Phanerozoic, but average CO2 levels were comparable to our present, rapidly warming climate. Fundamental shifts occurred in atmospheric circulation: a global megamonsoon developed and the tropics became anomalously arid with time.
We have assembled expertise in sedimentary and planetary geology and paleoclimatology, climate modeling, structural geology, geochronology, paleobotany, geomicrobiology, and quantitative cyclostratigraphy. We will seek to elucidate paleoclimatic conditions and forcings through the Permian at temporal scales ranging from the sub-millennial to the Milankovitch and beyond by acquiring continuous core in continental lowlands known to harbor stratigraphically complete records dominated by loess and lacustrine strata, and adjacent upland-proximal sites hypothesized to have hosted glaciation.

We have identified locales in the **western U.S. and France** as the 2 key coring sites globally to achieve our objectives, as these represent the western and eastern limits, respectively of the Pangaean tropics. Additionally, the Anadarko Basin (Oklahoma) and **Paris Basin (France)** archive arguably the most complete continental Permian sections at the paleoequator, and their adjacent paleo-uplands are the only sites globally for which Permian tropical glaciation has been hypothesized. We will also address the nature and character of the modern and fossil microbial biosphere and exhumation histories of source regions.
The Deepdust project is still under development and follows the ICDP proposal submission process; our ICDP Workshop took place last March in Oklahoma (USA).

Mots-Clés : ICDP, Deepdust, Permian, paleoclimate, icehouse, greenhouse

*Intervenant

Astronomical calibration of the Late Albian from the Mentelle Basin (southwestern Australia)

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Recent radio-astrochronological time scales deeply revised the durations and ages of the stages in the Early Cretaceous. According to these intercalibrations, the ages and the durations of the Berriasian to the Barremian stages should move toward younger ages by 3 to 5 myr (Lena et al., 2019; Aguirre-Urreta et al., 2019). As the ages are much more constrained in the Late Cretaceous, this arises the problem of the chronology of the Aptian-Albian times. The estimated durations of the Late Albian range from 6 to 9 myr (Grippo et al., 2004; Giorgioni et al., 2012; Laurin et al., 2017), while the geological time scale retains 7 myr. IODP Expedition 369 recovered Late Albian succession at Site U1513 (Mentelle Basin, Indian Ocean, South West of Australia). The mean core recovery was 70%, however well-log data complete the succession. Spectral analyses performed on XRF data and spectral gamma ray indicate a pervasive record of the 100-kyr eccentricity cycle. Filling the gaps of the XRF data with spectral gamma-ray, a total of 47 short eccentricity cycles are recorded, implying a duration of the Late Albian of 4.7 myr. This duration is much shorter than suggested by the geologic time scale. If confirmed, this new duration could reconcile all the radiometric and astronomical time scales of the Early Cretaceous and decreases the uncertainties of the stage ages from 5 myr to 0.3 myr in the next Geologic Time Scale.

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Mots-Clés : Geologic Time Scale, astrochronology, Cretaceous, XRF, Milankovitch cycles

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Climat en Arctique du Paléocène à l'Eocène supérieur (58-40 Ma) d'après les pollens des sites IODP 302 M0004 et M0002 (ACEX)

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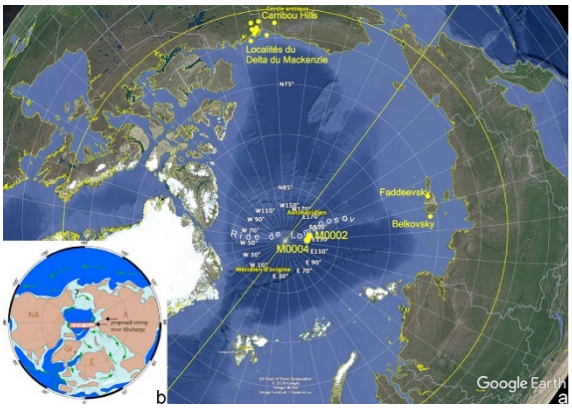

Les forages IODP 302, réalisés au centre de l'Océan Arctique près de la ride de Lomonosov (Fig. 1a), bénéficient d'un cadre bio-chrono-stratigraphique de la fin du Paléocène à l'Eocène moyen-supérieur (Backman *et al*., 2006). Malgré la multiplicité des analyses (sédimentologie, géochimie, micropaléontologie) menées sur ces archives sédimentaires, une seule étude concerne le pollen, concentrée sur la base du forage M0004 (*PETM – ETM2*) et proposant des valeurs paléo-climatiques biaisées par la faiblesse des identifications botaniques des grains de pollen (Willard *et al*., 2019).

Dans notre étude soutenue financièrement par IODP-France, nous avons analysé le contenu pollinique des forages M0004 (68 échantillons) et M0002 (13 échantillons). L'abondance des pollens, leur excellent état de préservation ainsi que la diversité végétale élevée (plus de 100 taxons identifiés le plus souvent au niveau du genre botanique) témoignent du voisinage très proche de terres émergées de la marge sibérienne (Fig. 1b). L'identification botanique du pollen, soignée et rigoureuse, permet des reconstitutions robustes de la végétation et du paléoclimat. L'environnement était forestier, dominé alternativement par *Glyptostrobus* ou *Castanop- sis-Lithocarpus*. Le diagramme pollinique est directement corrélable avec la courbe de δ18O de référence (Cramer *et al*., 2009). Les maxima thermiques sont exprimés par de forts pourcentages de plantes subtropicales avec la présence parfois importante de plantes tropicales. L'élément de mangrove, *Avicennia* (que nous avons, les premiers, signalé dans l'Eocène inférieur de l'île sibérienne de Faddeevsky et du Delta de Mackenzie, Fig. 1a ; Suan *et al*., 2017 ; Salpin *et al*., 2019), signe chaque maximum thermique, du *PETM* au *MECO*, avec des valeurs de la température moyenne annuelle pouvant dépasser 20°C. L'événement à *Azolla* (Brinkhuis *et al*., 2006), bien marqué dans le forage M0004, correspondant à un afflux important d'eaux douces, ne se situe pas après le maximum thermique de l'Eocène (*EECO*) mais dans une brève et subite phase moins chaude au sein de celui-ci (à 50 Ma), annonçant la dégradation climatique qui suivra.

Backman *et al*., 2006. *IODP Proc.* 302.
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Fig. 1. Localisation des sites IODP de l'expédition 302. a, Sites M0004 et M0002 et localités du domaine arctique déjà étudiées ; b, Paléogéographie du domaine arctique (Weller & Stein, 2008)

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The geochemical record of Oceanic Anoxic Event 2 (94 Ma) in the Mentelle Basin (SW Australia): New data from Site U1516 (IODP 369)

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The Oceanic Anoxic Event 2 (OAE 2; 94 Ma) is the most extensive episode of organic matter (OM) burial in marine sediments during the Cretaceous. This event has been particularly well studied in the Atlantic Ocean, mainly in low and middle latitudes, but its sedimentary record in the proto-Indian Ocean is still patchy and the triggering factors associated to OM burial in this ocean are still debated. To improve knowledge of this event in southern high latitude regions, new IODP sites have been drilled during IODP Expedition 369 and a complete OAE 2 record has been recovered at Site U1516 (Mentelle Basin, SW Australia).
To better constrain the environmental conditions in the water column as recorded in marine sediments during OAE 2, a high resolution study, based on organic (Rock-Eval) and inorganic (major and trace elements) proxies, has been performed on the 1.5 meter thick sedimentary sequence, marked by three black shale intervals of 5 to 10 cm thickness.

Rock-Eval analyses reveal a progressive increase of total organic carbon (TOC) values from 0.7 % in the first to 12.5 % in the third black level with no change in origin of OM (mainly derived from marine phytoplankton). Except for these black levels, the entire sequence is not enriched in TOC. The temporal evolution of trace element concentrations is more contrasting. For most redox sensitive elements (e.g., Mo, U, V), the highest values are recorded within the third black level and noticeable peaks are also recorded within the two first black levels. This evolution, coupled to redox ratios (U/Th, V/Cr), highlight punctual oxygen-depleted conditions during the deposition of the three black levels. For elements commonly associated with bio- productivity (Ba, Si, Cu), the highest values are mostly observed within or close to the first black level, suggesting a possible increase in primary productivity at the onset of the OAE 2. Compared to other ODP-DSDP-IODP sites, like the ODP Site 763 (Exmouth Plateau, NW Australia), for which the presence of an expanded oxygen minimum zone has been proposed to explain the deposit of black shale level, it seems that Site U1516 was rather characterized by a stratification of the water column leading to dysoxic-anoxic conditions in the bottom waters during OAE2.

Mots-Clés : OAE 2, TOC, Trace elements, bioproductivity, water stratification

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Paleogene sea surface temperatures: toward an agreement between models and proxies for the last greenhouse world?

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The Paleogene (~23-56 Ma) represents the last "greenhouse" period characterized by relatively high atmospheric CO2 concentrations and warm surface temperatures. Paleoclimate reconstructions of this period are crucial for providing insights into the response of Earth's cli- mate in the context of the ongoing climate change. However, the poor preservation state of the sedimentary archive and uncertainties in the application of geochemical markers bring complexity and inaccuracy in the reconstructions of sea surface temperatures (SSTs) and the meridional temperature gradient (MTG). Therefore, the mechanisms that drove the Earth's climate system from a "greenhouse" to an "icehouse" regime are not well constrained.

Available paleodata suggest steady oceanic temperatures both throughout the Paleogene and between the equator and the austral ocean that climate model simulations struggle to reproduce even with high pCO2 background values. Such a low meridional temperature gradient is difficult to conceive and represents an outstanding conundrum that needs to be resolved by improving the quality of proxy-derived climate data.

In this study, we reconstruct the thermal evolution of the uppermost oceanic waters from the oxygen isotope ratios (δ18O) of well-preserved coccoliths. Four ODP/DSDP oceanic sites spanning the Atlantic Ocean were selected and allow us to quantitatively establish the evolution of the meridional temperature gradient during the Paleogene. Our data reveal a global cooling of surface waters from the Early to the Middle Eocene. During the Late Eocene and the Early Oligocene the cooling of high latitude waters continues, allowing the thermal isolation and the onset of permanent ice sheet over Antarctica, while the intertropical belt warmed. This major change in the distribution of heat fluxes at the Earth's surface is coincident with the progressive deepening of the Drake Passage and to the emplacement of a more vigorous Antarctic Circumpolar Current. These results highlight the driving role of changing oceanic circulations for climate dynamics during this transition. This work also demonstrates the existence of large MTG throughout the Paleogene. Therefore, the hypothesis of a homogeneous distribution of SSTs between the Equator and the poles, still prevailing in the literature, can thus be rejected.

Mots-Clés : Paleogene, Coccoliths, Sea surface temperature, Meridional temperature gradient

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La porosité des tests de Subbotina linaperta (foraminifère planctonique) comme marqueur des températures de subsurface au Paléogène

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Des données empiriques suggèrent que la porosité des tests de foraminifères planctoniques pourrait dépendre de la température des masses d'eau dans lesquelles évoluent ces micro-organismes. Dans les environnements océaniques, un des facteurs de contrôle du taux d'oxygène dissous est la température. Une plus grande porosité du test des foraminifères est susceptible de favoriser les échanges gazeux, et ainsi de faciliter les fonctions métaboliques. L'accroissement de la porosité du test pourrait être un mécanisme fonctionnel et adaptatif permettant aux foraminifères planctoniques de maintenir leur métabolisme dans des eaux plus chaudes.
Pour tester et quantifier l'hypothèse d'une relation entre la température et les variations de porosité au sein d'une espèce, nous nous sommes intéressés à l'enregistrement au cours du Paléogène de la porosité du test de l'espèce de subsurface *Subbotina linaperta* (Finlay, 1939). Les échantillons sont issus des campagnes anciennes de forages océaniques, DSDP (1966-1983) et ODP (1983-2003). Ces sites, bien contraints temporellement et désormais riches de nombreuses analyses, permettent l'accès à un enregistrement continu de la porosité. De part la bonne préservation du matériel, il est possible de coupler les mesures de porosité à des analyses géochimiques (δ18O et Mg/Ca) sur la même espèce permettant de reconstituer les paléotempératures. Trois sites atlantiques de moyennes à hautes latitudes ont été échantillonnés : DSDP 549 (43°N) et 401 (47°N) et ODP 689/690 (68°S) et un site Pacifique équatorial (ODP 865 à 18°N). Pour chaque site, porosité et paléotempératures ont été documentées sur les séries paléogènes avec un pas de temps de 1 à 2 Ma.

Les premiers résultats montrent une distribution latitudinale marquée de la porosité sur tout l'intervalle de temps. Pour les différents sites, des variations à long terme et à court terme de la porosité sont enregistrées en accord avec les variations de températures dérivées du δ18O*linaperta*. Sur le long terme, la diminution de la porosité au niveau de tous les sites rend bien compte du refroidissement global qui s'amorce au cours de l'Eocène. Les perturbations climatiques à court terme telles que le PETM impactent également la porosité.
Si, la calibration des variations de porosité comme *proxy* des températures reste délicate dans le registre fossile, l'analyse de la porosité pourrait pourtant être une alternative pour les sites de basses latitudes où les signaux géochimiques sont oblitérés.

Mots-Clés : Paléogène, Paléotempérature, foraminifère planctonique, porosité, isotopes de l'oxgygène, Mg/Ca

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No direct link between the Oligocene glaciation and the ACC onset: new insights from the foraminiferal record

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Drake and Tasman gateways opening constitute tipping points of the Eocene-Oligocene period due to their potential role in the global climate cooling that characterizes this time period. The latters notably allowed the ACC (*Atlantic circumpolar Current*) onset as well as modern- like oceanic circulation. Nonetheless and despite numerous studies, no accurate dating of these apertures have been assessed, promoting uncertainties on their effective role into the Oligocene glaciation triggering.
In the present study we focus on the Drake gateway opening and the Oligocene glaciation onset by investigating the global past seawater chemistry evolutions during the Eocene-Oligocene, as recorded by foraminifers. For that purpose, we selected foraminifers-bearing sediments from three ODP and IODP expeditions (Legs 113, 320 and 342, located in the Southern Ocean, the Pacific Ocean, and the Northern Atlantic Ocean, respectively).

First, we identified the onset of the Oligocene glaciation as marked by a drop in Mg/Ca ratios around 36 Ma into the Southern Ocean and *c.a.* 34 Ma in the Pacific Ocean and the Northern Atlantic Ocean. We also evidenced a clear convergence of water masses' temperature and redox state (reflected by Mg/Ca and Ce/Ce* ratios, respectively) between the Pacific Ocean and the Southern Ocean from 31 Ma, which likely results from the interconnection of these oceans at that time. Finally, we also identified an inflexion toward less radiogenic values into the strontium isotopes record (87Sr/86Sr) of the Southern Ocean starting at 31 Ma. This inflexion might reflect a dilution effect of the continental supply imputable to an enhanced ocean mixing from that date. Taken together, these three geochemical signals attest to a connection between the Pacific Ocean and the Southern Ocean signing the precise timing of the Drake gateway opening at 31 Ma.
Antecedence of the Oligocene glaciation onset (here dated between 36-34 Ma) relative to the Drake gateway opening (here dated at 31 Ma) testifies that the ACC onset is not the main cause of the Oligocene glaciation and that other phenomena have to be invoked.

Mots-Clés : Climate, Paleoceanography, Oceanic circulation, Ocean chemistry, Foraminifers

*Intervenant

Le transect IODP Expédition 354 à 8°N du Cône du Bengale et l'histoire de l'érosion de la Himalaya et de la mousson indienne au Néogène

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En Himalaya, la mousson et la tectonique contrôlent directement l'érosion. La tectonique engendre l'élévation de la chaîne et les tremblements de terre qui fragilisent l'ensemble. L'intensité de la mousson contrôle les conditions environnementales et une part de l'érosion physique par l'export des sédiments vers la plaine. Dans la plaine, la saisonnalité et l'intensité de la mousson permettent d'atteindre des débits suffisamment élevés pour assurer l'efficacité du transport sédimentaire vers le delta. Ce transport rapide est un facteur limitant de l'altération en réduisant le temps de séjour dans la plaine. Ces sédiments sont ensuite exportés vers la baie du Bengale ou ils alimentent le plus important système turbiditique de la planète.

L'Expédition IODP 354 a foré le Cône du Bengale en 2015 et a restitué un enregistrement quasi continu de l'érosion de l'Himalaya au cours du Néogène et du Quaternaire (Proceedings 354, 2016). Les sédiments sont principalement composés de turbidites issues du bassin du Gange- Brahmapoutre (GB). L'Expédition 354 a foré un transect E-W de sept Sites sur 320 km à 8°N afin de couvrir au mieux les déplacements de dépocentre. Le Site U1451 a atteint la base du cône datant un début de sédimentation turbiditique vers 20 Ma sur le flanc de la ride Ninetyeast. Les sédiments présentent des analogies minéralogiques et géochimiques avec les sédiments modernes du GB. La variabilité interne révèle que les turbidites ne sont pas en permanence un mélange des deux fleuves. Au Quaternaire, il est évident que le Brahmapoutre était parfois la seule source de turbidites. La géochimie des éléments majeurs et des éléments traces montre des compositions relativement stables tout au long du Néogène et du Quaternaire. Ils révèlent un très faible régime d'altération sans variation significative dans le temps. Ces données comparées à celles des sédiments modernes du Gange et du Brahmapoutre impliquent que l'altération ou l'érosion des sols est amplifiée par la pression anthropique.

Au plan paléoenvironnemental, les compositions isotopiques dD et d13C des cires foliaires datent l'expansion connue des plantes de type savane (C4) dans le bassin vers 6 Ma et montrent que depuis le Miocène les paléoprécipitations sont fortement appauvries en deutérium. Ce point implique que dès le Miocène, le régime de mousson indienne est établi, le Pléistocène étant marqué par une augmentation de la variabilité.

Les paléoconcentrations en 10Be du quartz ont pu être déterminées pour la première fois sur des sédiments marins détritiques pour déduire les vitesses d'érosion à cette échelle de temps. Elles démontrent une stabilité depuis le Miocène supérieur qui implique que la mise en place de l'alternance glaciaire interglaciaire a eu un impact limité sur l'intensité de l'érosion en Himalaya.

Mots-Clés : Climat et tectonique, sédiments détritiques, baies du Bengale, turbidites

*Intervenant

Alternating paleoenvironments in a deep-water rift: initial results from IODP Expedition 381, Gulf of Corinth, Greece

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Relatively few detailed studies exist of rift axis depositional systems and the allogenic and autogenic controls on their sedimentology and stratigraphy. New results of IODP Expedition 381 from the central axis of the Corinth rift represent the longest and highest resolution stratigraphic record for an early phase rift. The age model has been constructed by integrating magnetostratigraphy with palynology and micropaleontology results. Cyclic variations of 10s-100s of kyr in sediment flux and paleoenvironment record periodic connection to global oceans across a sill as eustatic sea level varied. Overall deep-water fine grained turbiditic and hemipelagic sediments dominate. Interglacial periods are recorded by marine conditions while glacials are represented by isolated/semi-isolated conditions. Marine sub-units are dominated almost exclusively by homogenous mud with a high bioturbation index and reduced coarser grained sediment. These periods are characterised by relatively low sedimentation rates and higher organic carbon concentration. Isolated/semi-isolated sub-units are characterised by numerous facies associations including laminated greenish gray to gray mud with mud beds, finely bedded mud with silt to fine sand beds sometimes rich in organic carbon, some debris flows, homogenous mud and sand couplets. These interglacial sub-units record relatively higher sedimentation rates. Transitions between terrestrial and marine basin conditions are characterised by finely laminated carbonate- rich intervals. We infer that in the source areas on the rift flanks reduced glacial vegetation cover drove higher sediment flux (in the order of 2-10 times interglacial rates).

Mots-Clés : Corinth Rift, eustasy, cyclic sedimentation

*Intervenant

Mediterranean Outflow Water and contourite depositional systems in the Gulf of Cadiz

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The Contourite Depositional Systems (CDS) in the Gulf of Cadiz are unique archives of the Mediterranean Outflow Water (MOW) variability since the Gibraltar gateway opening. These CDS have been generated by the upper and lower paths of the MOW, MUW and MLW respectively. These CDS have been drilled during the IODP Expedition 339 (2011-2012), offering a new data set over a longer period, allowing comparisons between recent and older climatic cycles, in sites both under the MUW and MLW cores.
This work provides results of a detailed sedimentological and facies analysis of different CDS in the Gulf of Cadiz, using mainly grain size, grain sources (petrography of sands and clay assemblages), natural gamma ray data, and XRF results from specific intervals. Downhole and core gamma ray data coupled to grain-size results provided a regional scale chronostratigraphic framework for the CDS contourite deposits and hiatuses at the regional scale. These long sedimentary records provide an overview of the behavior and circulation regime of the MOW over the large changes in climate and sea-level cyclicities and especially over two periods: the last climatic cycle MIS1-MIS2 and at the mid-Brunhes Event (MIS10-12) which is an analog of the last cycle.

One of the defining characteristics of contourite systems is the marked cyclicity in grain-size and related sediment properties. Drilling in the Gulf of Cadiz during IODP 339 recovered over 4.5 km of contourites with over 600 distinct contourite sequences. These show irregular cyclicity, much variation in thickness (0.5-4.0 m) and estimated duration (4-10 ky). Approximately 60% are bi-gradational sequences, whereas the rest are partial sequences. Three principal controls have been considered as likely causes for the sequences: (a) long-term variation in bottom-current velocity; (b) episodic lateral influx of clastic material; and (c) variation in vertical supply of biogenic material.
The bi-gradational sequence, particularly for the muddy drift sites, validate the primary control exerted by long-term variation in bottom-current velocity. The high degree of cycle correlation between adjacent sites further supports this contention. A secondary control of lateral clastic supply is more evident for the proximal sandy contourite sites, and for partial base-cut sequences. Work is in progress on cycle duration and sediment sources.

Mots-Clés : Mediterranean Outflow, Gulf of Cadiz, contourite, paleoceanography

*Intervenant

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Deciphering earthquake-induced Late Quaternary sedimentary "events" in the Corinth Rift (IODP Leg 381): combined application of X-ray micro-tomography imaging with physical and chemical parameters

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IODP Leg 381 (Oct.-Dec. 2017) was dedicated to the birth and development of the Corinth Rift, through three coring sites down to 700 m below sea-floor, of which two were in the deepest axial rift basin. The sedimentary fill appears clearly controlled by the combination of active normal faulting and alternating marine *vs.* non marine episodes in relation to Pliocene-Pleistocene sea-level fluctuations.
The here-presented results only concern the last alternation, as recorded in the topmost part of Cores 78B and 79A. Within this time interval, we focused on sedimentary "events"; i.e. at first glance "turbidites". We aimed to detect impacts of seismic activity and/or submarine landslides on sediments disturbances and/or gravity reworking, with/without corollary effect of tsunami wave generation. Apart from seismotectonic activity, turbidite-type deposits may be the consequence of hyperpycnal flows directly issued from flooding of the main tributaries and following the deep Gulf axis. In addition, "aseismic" slope failures of delta foresets, sometimes inducing tsunami waves, have been previously reported an analysed by different authors.

In order to characterise depositional processes of the sedimentary "events", a set of analytical procedures and tools were applied to discrete samples and ~20-50 cm-long U-channels crossing turbidites and turbidites+homogenites. Chronological constraints are provided by 14C dating, 210Pb and 137Cs activity profiles; additionally, the last non marine-to-marine transition is a precious time marker. 3D textures of selected layers or sets of layers were imaged through high resolution X-ray scanning (micro-tomography), in parallel with magnetic fabric, bulk magnetic susceptibility, XRF chemical profiles, and laser grain-sizing. X-ray CT scans resolve structures down to 15 μm in voxel size, characterizing finely the geometry of the basal surface of reworking "events" and the internal base-to-top evolution. Basal surfaces of coarse flowing appear either planar or irregular (possibly micro-fractured); the second case implies previous disturbance of underlying fine-grained hemipelagic mud. In several cases, the transition from coarse base to fine-grained settled suspension is defined by a sharp limit, and the fine-grained upper part displays discontinuous settling features.
The distinguished types of reworking "events" (single flooding *vs.* more complex depositions) from marine and from non-marine intervals are compared in terms of possible earthquake/tsunami triggering and frequencies.

Mots-Clés : turbidite, homogenite, microtomography, Corinth Rift

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@Intervenant

Fluid circulation and horizontal stress orientations in the Chicxulub impact crater's peak ring, determined from Hole M0077A

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In 2016, the IODP/ICDP joint Expedition 364 drilled a 1.3 km deep borehole (Hole M0077A) into the peak ring of the Chicxulub impact crater currently buried below the surface of the Yucatán continental shelf. The Hole was cored and open hole logs were acquired with a suite of slime-line tools. Published results (Morgan et al., 2017; Christeson et al., 2018) showed that the shocked target rocks within the peak ring consist of uplifted, highly fractured, granitic rocks with unusually low densities and high porosities. This suggests a possibly relatively high permeability of the impact-deformed rocks at both microscopic and macroscopic scale.

In this study, we investigate for the first time the present-day hydrology of the peak ring, based on the use of downhole logging data. Acoustic borehole images provide invaluable source of in- formation for sub-surface geology characterization, and allowed the detection and measurement of fractures with apparent aperture at the borehole scale. The distribution of those fractures, combined with borehole fluid temperature and conductivity data, allow evidencing that some of them are fluid-conducting fractures associated with present-day, large scale, downward circulation of fluids in the peak ring fractured rocks. Acoustic borehole images also revealed drilling-induced tensile fractures (DIFs) that we analyzed to constrain the present state of stress in a poorly documented area of the Yucatan Peninsula.

The azimuth of the maximum principal horizontal stress direction, SHmax, is ENE-WSW (N73°E ± 11.2°). We combine the occurrence of these DIFs with the absence of evidence for breakouts to quantitatively constrain the magnitudes of the horizontal stresses. We believe that the development of the DIFs, which are present along a specific interval of depth only, are related to changes in drilling operation parameters.

Mots-Clés : peak, ring, acoustic borehole image, drilling induced fracture, open fracture, fluid ciruclation

*Intervenant

Dynamics of the Tuaheni Landslide Complex (TLC), Hikurangi Margin, New Zealand: insights from X-ray CT-scans analysis of the IODP Expedition 372 cores

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The IODP Expedition 372 "Creeping Gas Hydrate Slides and LWD for Hikurangi Subduction Margin" occurred from 26th November 2017 to 4th January 2018. Among the different scientific objectives, the expedition aimed to investigate the relationship between gas hydrate processes and the kinematics of Tuaheni Landslide Complex (TLC). Key drilling, downhole logging and coring data were gathered within this submarine landslide at site U1517-C. First results support the hypothesis of a slow-motion, repeated reactivation behaviour of the TLC slid masses. However, key role of gas hydrate dissociation processes could not be confirmed with first preliminary results. Therefore, we aim to study the micro-textures/structures, particularly the nature of micro-deformations of the slid masses based on X-ray CT-scans (resolution: 350 μm). These data allow to see features which cannot be observed from direct, naked-eye observations on sediment cores and to reconstruct the core sections in 3D-high-resolution images. Together with the IODP Expedition 372 dataset (sedimentology descriptions, LWD, physical properties), we will test the different hypotheses between gas hydrates versus liquefaction into the Tuaheni Landslide dynamics. This study will also provide a better understanding of a specific poorly documented submarine mass movement process, not only in terms of fundamental mechanisms of landslides, but also in the associated geohazards assessment.

Mots-Clés : Submarine landslide, New Zealand, X, ray CT scans, deformation structures

[*]Intervenant

Intensité du champ magnétique terrestre enregistré dans des roches volcaniques de l'arc Izu-Bonin-Marianne (Exp. IODP 352)

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Lors de l'Expédition IODP 352, 1200 m de séries volcaniques ont été forées dans la région avant-arc de l'arc volcanique Izu-Bonin-Marianne. Les séries volcaniques forées dans les Puits U1439C et U1442A sont des séries boninitiques, tandis que celles forées dans les Puits U1440B et U1441A sont des séries basaltiques constituées de laves aphyriques. Elles ont été datées par Ar-Ar après l'expédition entre 50 et 52 Ma. Pour les mesures de paléointensités, nous avons sélectionné 93 échantillons des Puits U1439C, U1440B et U1442A. Les courbes d'hystérèses et d'aimantation à haute et basse température montrent que les échantillons du Puits U1440B subissent des changements magnéto-chimiques lors de la chauffe et sont surtout composés de titanomaghémite monodomaine (SD) ou pseudo-monodomaine (PSD). Les mêmes mesures sur les échantillons des Puits U1439C et U1442A montrent au contraire que ces échantillons sont stables thermiquement et se composent principalement de titanomagnétite SD ou PSD faible en titane, qui peut aussi être associée à une importante contribution d'un minéral paramagnétique. La méthode Thellier-Thellier donne un bon taux de succès pour les échantillons des Puits U1439C et U1442A et des valeurs de Moment du Dipole Virtuel (VDM) entre 1.3 and 3.5 1022 Am2. La méthode multispécimen, qui a été utilisée sur les échantillons du Puits U1440B et certains échantillons du Puits U1439C, donne des résultats de qualité médiocre, mais indiquent cependant un VDM autour de 4-6 1022 Am2 dans les basaltes du Puits U1440B. Ces résultats sont en accord avec les quelques valeurs mesurées précédemment dans des roches de l'Eocène, qui sont généralement faibles. Par contre, le taux d'inversion du champ étant faible à l'Eocène, nos résultats ne sont pas en accord avec une relation inverse entre l'intensité du champ et son taux d'inversion.

Mots-Clés : Paléointensité, Magnétisme, Titanomagnétite

*Intervenant

Déformation syn-accrétion d'une croute océanique : caractérisations microstructurales d'une section de référence dans les gabbros à la dorsale sud-ouest Indienne (Puits IODP U1473A)

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L'architecture de la croûte océanique accrétée aux dorsales lentes reflète des processus et des interactions complexes entre magmatisme, refroidissement et tectonique. Le puits IODP U1473A a été foré depuis le sommet de l'Atlantis Bank à la dorsale sud-ouest Indienne lors de l'expédition IODP 360 en 2015-2016. L'Atlantis Bank est un massif sous-marin plurikilométrique, daté à 11- 13 Ma et interprété comme un "core complex océanique". Le puits carotté, d'une longueur totale de 789.7 m, a été intégralement foré dans des unités gabbroïques (en majorité gabbros à olivine) exhumés par une faille de détachement. L'étude pétrographique de 127 échantillons nous a permis de caractériser les zones déformées de la section. Sur l'ensemble du puits, la déformation plastique cristalline est omniprésente, et distribuée de manière hétérogène et localisée. Dans les 600m supérieurs de carotte, elle est possiblement liée partiellement à une zone de faille tardive. La déformation des gabbros s'initie pendant l'accrétion durant le stade magmatique précoce et se prolonge jusqu'au domaine cassant tardif. Le gabbro présente des textures magmatiques isotropes (sub-ophitiques et granulaires) ou foliées. Des zones à textures porphyroclastique témoignent d'une déformation HT post-magmatique. Les clastes de pyroxènes sont partiellement recristallisés en périphérie, tandis que ceux d'olivines présentent des évidences de restauration. Les plagioclases, majoritaires dans la roche, sont fortement recristallisés, et forme une matrice à grains fins, contrastant avec le comportement des autres phases et attestant du rôle prépondérant de ces minéraux dans l'accommodation de la déformation HT des gabbros. La déformation est fréquemment très localisée, exprimée par des zones mylonitiques et ultramylonitiques, dont certaines sont liées à la progression de la déformation à température décroissante, en facies granulite puis amphibolite. Les analyses par diffraction d'électrons rétrodiffusés (EBSD) sur ces gabbros déformés montrent de relativement faibles orientations cristallographiques préférentielles (CPO), qui résultent d'une histoire intégrant déformation magmatique et plastique. La désorientation dans les plagioclases est cohérente avec le système de glissement principal (010)[001]. Néanmoins, les CPO, avec une foliation définie par (010) et une linéation par [100], ne traduisent pas clairement ce mécanisme.

Mots-Clés : gabbros, déformation, EBSD, dorsale lente, dorsale sud, ouest Indienne

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Using data of IODP Expedition 362 (Sumatra Seismogenic zone) in a classroom activity to illustrate the erosion of the Himalaya mountains

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In 2004, a magnitude > 9 earthquake struck North Sumatra and the Andaman-Nicobar islands leading to a huge tsunami. In order to find some explanation to this event, Expedition 362 (August-September 2016) drilled sites U1480 (until 1432 m below the seafloor) and U1481 (until 1500 m below the seafloor) on a section of the seafloor ~200 km west of Sumatra, before the Indian Plate reaches the Sunda subduction zone. What makes the subduction zone offshore Northern Sumatra quite unusual is the amount of sediment on the subducting oceanic plate (up to 5 km thick just before subduction).
Geologists have determined that the sedimentary materials being incorporated into the North Sumatra subduction zone are related to the Bengal-Nicobar Fan system, which originates more than 3000 km away from the drilling site! This fan is the largest submarine fan currently on the planet. This sedimentary system originates from erosion of the Himalayan mountains. Rivers carry the eroded material to the coast. Most of the sediment (~80%) is deposited onshore and offshore quite close to the coastline. But a huge amount still makes its way along deep-sea canyons to the deep sea portion of the Indian and even Australian plate. A lot of turbidites coming from the erosion of the Himalaya mountains have been described on board.
The propose classroom activity use this unusual tectonic setting and aims to highlight the concept of erosion and transport of sediments adjusted to the French high school programs.
The students start from the localization of Expedition 362 with Google Earth Pro and observe some photos of the cores showing turbitides. They analyze some of the smear-slides made onboard during the expedition. This way, they will be able to find some minerals which characterize plutonic and metamorphic rocks (such as biotite). They also look at the topography of the sea floor using Google Earth Pro and rule the possibility that these turbidites come from the erosion of the Himalaya mountains. To confirm this idea, they analyze a figure extracted from an article written by the Expedition 362 scientists in 2017*. In this article, the detrital zircons ages of samples of the expedition are plotted and compared to regional rivers (Brahmaputra, Ganges and Irrawaddy) and to regional formations. Students can then conclude that most of the material of sediments found in the turbidites come from the Himalaya mountains. They can also estimate the length of their journey using Google Earth Pro. An analogic modelling of a turbidite flow can be realized in class.

Most scholarly books show schematics, models and interpretation and the aim of this classroom activity is to use real data from a recent IODP Expedition to make the students "touch" the science.

** "Understanding Himalayan erosion and the significance of the Nicobar Fan", McNeill & al., Earth and Planetary Science Letters, Volume 475, p.134-142*

Mots-Clés : Education, Education Officer, classroom activity, erosion, Bengal Fan, turbidity cur- rents, high school, Himalaya moutains

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”Embark” students on geosciences expeditions, across the oceans …

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As science teachers we can live and share a fabulous experience of science and research on the scientific drilling vessels and platforms of IODP-ECORD and JAMSTEC consortiums. ECORD recently offered to three of us the opportunity to embark on the IODP 359, 360 and 362 expeditions as Education Officers. Our task was to communicate about science with the general public and students from 7 to 25 years-old. In this presentation, we will focus on the 360 expedition, South West Indian Ridge-lower crust and Moho. We explain the three steps of the "teacher at sea" experience from the very first idea to the real pedagogical work during and after the expedition. -Apply, get ready and leave. . . for two months: From the difficulties you may encounter to the most efficient ways to prepare the pedagogical tasks. -Work, live onboard and get back: We will describe the main activities of the Education officers among the Science party and the way all this can become a highly changing-life experience. -Use data, share and inspire: We will detail some strategies we used to catch the attention of the students. They could participate to "live" science and have a better idea of the job of researcher. Now, we have to inspire others teachers to use our data and pedagogical documents, or to get the opportunity to embark ! What gets out of these crossed experiences is that the quality of the human relationships, and the way the students can get closer to the scientists during the interactions, are the keys to motivate students and give them a new vision of the scientific research.

Mots-Clés : Moho quest, ocean crust, gabbros, Education and Outreach, Participative Science, scientific drilling and data as education for STEM, women in science

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Reconstructing air-seawater carbon dioxide exchange during the penultimate deglaciation in sites of deep-water formation: new insight from the coccolith record

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The role of the deep ocean in the regulation of atmospheric CO2 concentrations is the object of ongoing research in the fields of both past and future climate change. In the case of glacial-interglacial change, it has been put forward as a means of storing and releasing the 170 gigatons of carbon needed to reproduce the 80 ppm fluctuations in pCO2 observed in the Vostok ice cores over 100 kyr timescales. In this respect, it appears essential to constrain the fluxes of carbon between the ocean and the atmosphere in places where deep waters are in contact with the atmosphere.
Here, the use of coccolith geochemistry as a proxy for oceanic CO2 outgassing during deglaciations is presented. Contrary to most other organisms calcifying in the surface ocean, coccolithophores form their calcite biominerals, coccoliths, from within a cellular compartment from a CO2 substrate. Previous studies from fossilized and cultured material have shown that the oxygen and carbon isotopic compositions of coccoliths are sensitive to the availability of CO2 in the environment, and are thus expected to vary with surface ocean [CO2].
We test this proxy on different size fractions of coccoliths retrieved from the deep-sea cores ODP 1089 in the South Atlantic and MD95-2037 in the North Atlantic, both regions of deep water formation. Preliminary results from Termination II at both sites show that the coccolith oxy- gen isotope signal cannot be fully accounted for by temperature, salinity and seawater d18O changes, and that the remaining component may indeed correlate to changes in the carbon content of the ocean. The extent of this signal remains however to be defined, and may benefit from comparisons with culture studies.

Mots-Clés : coccolith derived proxy, [CO2] reconstruction, glacial interglacial cycles, carbon cycle

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The first results of late Miocene surface hydrological variability obtained from IODP Site U1443 (Expedition 353): Indian monsoon and global climate interactions

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The Indian monsoon and associated hydrological changes directly affects the livelihoods of over a billion of people on the Asian continent although its variability and climate feedback processes are still to be clarified. The Late Miocene (11.6-5.3 Ma) is particularly interesting to investigate natural variability of monsoon since the period is characterized by warm and possibly high pCO2 conditions.
Here, we present new records of surface ocean hydrology from IODP Site U1443 (Expedition 353) in the equatorial Indian Ocean (5° N, 90° E). The obtained records resolve for the first time tectonic to orbital variability over the interval 9-5 Ma. Planktonic foraminiferal Mg/Ca thermometer and d18O measurements were carried out on mixed layer-dwelling planktonic foraminiferal species *Trilobatus trilobus* at CEREGE. Benthic foraminiferal stable isotopes were analysed for stratigraphy framework and bulk high-resolution elementary composition was obtained by X-ray fluorescence (XRF) scanning.

The Mg/Ca sea surface temperature (SST) indicates a long-term cooling trend of 3-4°C from 8 to 5.7 Ma, supporting the hypothesis that the Late Miocene cooling is global. Surface water d18O (d18Osw) estimated from *T. trilobus* Mg/Ca and d18O showed a decrease of 1.5‰ from 8 to 6 Ma, and a subsequent increase between 6 and 5 Ma. It could reflect long-term changes in the hydrological cycle and/or surface circulation related to the Indian monsoon and tectonic evolution (e.g. Indonesian Throughflow). On orbital timescales, SST and d18Osw minima are correlated to maxima of export productivity based on excess Ba content relative to detrital fraction derived from XRF. Vertical mixing of surface/subsurface layers are expected to have modulated water temperature, salinity and nutrient supply. Preliminary spectral analyses of these upper water column proxy records indicate dominant precession band, suggesting changes in Indian monsoon wind strength in relation to local insolation.

This work has been realized in the framework of C. Martinot PhD thesis in collaboration with W. Kuhnt, A. Holbourn, J. Lubbers, N. Andersen, E.J. Rohling, K. Grant, G. Marino. It is financed by ANR JCJC iMonsoon (coordination by C. Bolton)

Mots-Clés : late Miocene, Indian monsoon, surface hydrological variability, IODP Site U1443, Expedition 353

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Résultats préliminaires du forçage orbital des sédiments paléocènes du forage M0077, golfe du Mexique, Yucatán

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En 2016, l'Expédition ICDP-IODP 364 (Chicxulub Impact Crater, Yucatán, Mexique) a permis de récupérer 112 m de sédiments hémi-pélagiques et pélagiques du Paléogène, accumulés sur le haut topographique formant le " peak-ring " du cratère d'impact de Chicxulub (505,7 à 618 mbsf; Morgan et al., 2016).
Des travaux récents menés sur les sédiments d'âge Paléocène inférieur (-66 à -62 Ma) de ce forage ont permis de mettre en évidence un changement climatique majeur autour de -65.0 +/- 0.3 Ma qui coïncide avec un changement des stratégies trophiques des foraminifères planctoniques, passant d'eutrophique à oligotrophique (Jones et al., 2019 ; Lowery soumis). Ceci se manifeste par une augmentation de palygorskite et des épisodes éoliens marqueurs d'un climat plus aride, contribuant à une diminution des apports d'eau douce et de nutriments dans le bassin sédimen taire (voir présentation Chenot et al.). La compilation de données minéralogiques du golfe du Mexique tend à montrer que ce changement climatique a lieu sur la marge nord (autour de 30°N) et sur la marge sud (autour de 22°N) du golfe du Mexique, qui se situe pourtant dans des ceintures climatiques différentes.
L'objectif de ce travail est de comprendre la cause de ce changement climatique. Est-il ou non relié aux événements hyperthermaux du Paléocène ? Est-il contrôlé par les paramètres orbitaux ?
Pour répondre à cette question, une analyse spectrale a été réalisée sur la base de données de la luminosité du sédiment (L*), acquis à haute résolution au cours de l'Expédition ICDP-ICDP 364. Les premiers résultats tendent à montrer que la grande excentricité de 405 ka semble moins bien s'exprimer dans les sédiments pour le proxy lithologique de la lumière, entre 64.3 et 63.0 Ma, c'est-à-dire au cours de la mise en place du climat aride. Ce motif semble aussi s'exprimer au même moment dans les sédiments du forage IODP 1262 en Atlantique Sud, d'après l'analyse spectrale de la mesure du fer à la fluorescence X (XRF ; Westerhold et al., 2008). En conséquence, il semblerait que les "noeuds" du cycle d'excentricité de 2,4 Ma se marquent par la mise en place de conditions plus arides au début du Paléogène dans notre domaine d'étude.

Références :
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Morgan, J., et al., 2016, *Science*.
Jones, H., et al., 2019, *Geology.*
Lowery, C., et al., soumis, *Paleoceanography-Paleoclimatology.*

Mots-Clés : Danian, forçage orbital, Chicxulub

*Intervenant

A 400-m long Plio-Quaternary succession in the Ionian Sea (central Mediterranean) as a key to reconstruct past climate change and timing of large earthquakes/tsunamis

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The IODP Proposal 857C Full (Bertoni et al., 2019) aims to recover the Messinian record from several locations in the Mediterranean, including the proposed sites ION-01 in the Ionian Sea, at the same location of the DSDP 374 borehole (leg3) at 4078 m water depth (Shipboard Scientific Party, 1978). The objective of an APL (Ancillary Proposal Letter) to the drilling proposal IODP-385C would be to recover a continuous drill core record through the upper ca. 400 m of Pliocene and Quaternary.
Within the Plio-Quaternary section of proposed site ION-01, the low reflectivity layer at the base of Unit PQa, well imaged in new seismic data, represents the megaturbidite TTL (> 35m-thick Thick Transparent Layer dated at 650 ka; Hieke et al., 2003). Unit PQa correlates with lithostratigraphic Unit Ia in DSDP Site 374 (nannofossil marl with graded sands end silts). Unit PQb, correlates well with DSDP Site 374 Unit Ib (nannofossil marl and mud; Shipboard Scientific Party, 1978).

The full recovery of the upper 400 m in the proposed borehole ION-01 would allow to: 1) refine the Plio-Quaternary stratigraphy of the Mediterranean region (see e.g., Lirer et al., 2019); 2) obtain a crucial record of past events including organic rich layers (sapropel), and tephra layers; 3) recover entirely the megaturbidite layers known in the literature (AT, DTL, TTL, Hiecke et al., 2003) that present a relevant interest for paleoseismological reconstructions (e.g., Polonia et al., 2013).

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Mots-Clés : Mediterranean, Plio, Quaternary, Megaturbidite, Geohazards, Sapropel, DSDP 374

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Evolution de l'altération continentale de la marge sud-Américaine au cours du Crétacé supérieur : un nouveau regard sur les liens tectonique-climat

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L'altération continentale joue un rôle majeur dans l'évolution du climat sur de longues échelles de temps (> 1 Ma) à travers la consommation de CO2 atmosphérique lors de l'altération chimique des minéraux silicatés. La nature des liens entre altération continentale et climat reste très débattue en particulier en contexte d'orogenèse. L'objectif de cette étude est d'apporter de nouvelles contraintes quant aux liens entre tectonique, altération et climat en se focalisant sur le Crétacé supérieur, période marquée par un épisode de refroidissement climatique majeur et un épisode de surrection des continents Africain et Amérique du Sud. La fraction argileuse (< 2μm) extraite d'échantillons du forage DSDP 356 (marge brésilienne) a été analysée pour sa composition isotopique de l'hafnium et du néodyme pour approcher l'évolution de l'intensité de l'altération chimique du continent adjacent. Des analyses complémentaires de la composition minéralogique des argiles ont été réalisées, pouvant dans certains contextes tectoniques très actifs tels que celui choisi ici renseigner sur l'intensité de l'érosion mécanique. Nos résultats mettent en évidence une diminution des apports en illite et chlorite au profit d'une augmentation de la smectite, traduisant un épisode de transition entre une période d'érosion mécanique, marquée par l'apport de minéraux argileux primaires issus des roches cristallines et une phase de plus forte altération chimique suggérée par l'enrichissement en smectites pédogénétiques. De plus, la diminution progressive des proportions de palygorskite (argile fibreuse formée en contexte évaporitique) tout au long du Crétacé supérieur, témoigne vraisemblablement de conditions de plus en plus hydrolysantes dans cette région jusqu'au Maastrichtien. Les résultats des analyses géochimiques montrent une diminution marque de l'Nd traduisant un changement de sources dans les roches érodées du continent sud-américain. Ce changement pourrait s'expliquer par une contribution plus importante au milieu du Crétacé de roches volcaniques radiogéniques du trapp du Parana-Etendeka dans les sédiments apportés jusqu'au site 356, qui diminuerait progressivement pendant le Crétacé supérieur. Le ΔHf, qui représente la déviation de l'Hf des échantillons par rapport à la droite des argiles et qui reflète l'intensité de l'altération des roches sur le continent, en regard du site 356, montre une augmentation marquée au passage Santonien/Campanien. Cette augmentation, qui traduirait altération chimique plus intense de la marge continentale adjacente, est cohérente avec les données des cortèges argileux montrant conjointement une augmentation de l'hydrolyse. Ce changement semble concorder avec la période de soulèvement tectonique du Crétacé supérieur, qui pourrait donc être un facteur de l'intensification des pluies et donc de l'altération continentale.

Mots-Clés : altération, climat, géochimie isotopique, Crétacé

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Hydrological investigation of the Japan Trench using pressure while drilling data of expedition IODP 343 (J-FAST)

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A key element of the hydro-mechanical behavior of an active fault is the hydrogeological characteristics in both fault core and in the damage zone around it. Pore pressure weakens the rock and fault and increases the probability of fault rupture. Also, an earthquake will change pore pressure and permeability in the fault zone. In this study, the focus is on the scientific borehole drilled within the Japan Trench plate boundary shortly after the huge Tohoku-Oku earthquake, a huge M9 earthquake which struck north-eastern Japan on March 2011. This earthquake had an unexpected large slip at the toe of the accretionary prism, in contradiction with previous model of subduction seismicity. A possible explanation is overpressure within the fault zone.

The new approach of this work is the combining of wellbore logs including resistivity logs and, and drilling data to estimate the fluid properties of the fault zone. Downhole annulus pressure (DHAP) is modeled to extract the fluid influx/outflux from the formation during drilling. Resistivity logs provides insight on the invasion of the formation by drilling fluid, and hence on permeability. Furthermore, drilling data have been used as inputs for corrected d-exponent method in order to estimate pore pressure in this study. The results show a weak but robust signal from the fault. The décollement itself is impermeable, but secondary faults act as permeable conduits.

Mots-Clés : IODP 343

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