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https://www.sedimentologists.org/society/correspondents

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EDITORIAL

Newsletter 274 is the last of my mandate as IAS General Secretary. I would like to thanks all IAS members for the support given to me in the past 8 years.

This Newsletter mostly collects the Postgraduate Grant Scheme, 1st and 2nd Sessions 2017.

In the central part of the Newsletter the Announcement of the 34th IAS Meeting. The Meeting of Sedimentology will take place in Rome (Italy) on 10-13 September 2019. Make sure to block these dates already now, so that you do not have to miss this event!

The 1st Circular and the Conference will be distributed during the ISC in Quebec City. Website will be active from August 15 2018.

On behalf of the work carried by Early Career Scientists Committee IAS is on Facebook.

Student Grant applications guidelines close the Newsletter.

IAS has restyled the webpage (www.sedimentologists.org): please have a look at it, log in and fill the spaces under your profile, and renew your membership for 2018.

You can renew your membership quickly and safely on the IAS website (after log in).

Basic membership fees for 2018 remain at 25 Euro for full members (or 20 Euro if you renew for 5 years at once) and 10 Euro for student members. Please check our Membership Benefits page to find out what your membership buys you.

Remember that being an IAS member gives you the following benefits:

- access to the online versions of Sedimentology and Basin Research, including all issues ever published;
- access to the printed versions of Sedimentology and Basin Research at very favourable rates;
- access to the IAS Member Directory;
- the Friendship Scheme which gives free membership to people in less-developed countries;
- the electronic Newsletter;

- a network of National Correspondents, which report on the activities in their countries;
- International Sedimentological Congress every four years at reduced fees;
- annual Regional Meeting and meetings sponsored by the IAS at reduced fees;
- special lecturer tours allowing sedimentology groups to invite a well-known teacher to give talks and short courses in their country;
- travel grants for PhD student members to attend IAS sponsored meetings;
- research grants for PhD student members (maximum 1.000 Euros);
- institutional grants for capacity building in 'Least Developed Countries' (LDC), (maximum 10.000 Euros)
- biannual Summer Schools focused on cutting edge topics for PhD student members.

The 20th International Sedimentological Congress will take place in Quebec City (Canada) on 13-17 August 2018. Following previous gatherings on four different continents (Africa, Asia, South America and Europe), the congress will now return to North America... 36 years after Hamilton in 1982. For the first time, the congress will also be co-sponsored by IAS's privileged partner organization SEPM (Society for Sedimentary Geology).

All information and updates about the 20th ISC can be found on the Conference Website and on Twitter.

Travel grants for IAS Student Members

- 6th Conjugate Margins Conference "Celebrating 10 years of the CMC: Pushing the Boundaries of Knowledge" (Halifax, Canada; 19-22 August 2018)
- 1st School on Sandstone Diagenesis Workshop (Erlangen, Germany; 27-29 August 2018)
- FOSI 3rd Regional Seminar "Past and Present Sedimentation in Tropical Region: (Yogyakarta, Indonesia; 5-6 September 2018)
- Turkish Sedimentological Working Group - SÇG 2018 Workshop (Sakarya, Turkey; 6-9 September 2018)
- VII Argentinean Meeting on Quaternary and Geomorphology (Puerto Madryn, Argentina; 8-21 September 2018)
- 8th Sedimentary Provenance Analysis (SPA) Short Course (Göttingen, Germany; 24-28 September 2018)
- Conference on Seismic Characterisation of Carbonate Platforms and Reservoirs (London, UK; 10-11 October 2018)
- International Meeting around the Jurassic-Cretaceous Boundary (Geneva, Switzerland; 5-7 December 2018)
- BSRG Annual General Meeting 2018 (Edinburgh, UK; 17-22 December 2018)
- All meetings with IAS support are also listed on the website in the members-only Events Timeline. The listings include the option for downloading the event period in your calendar.

All travel grants are also listed on the website in the members-only Events Timeline. The listings include the option for downloading the deadline in your calendar.

IMPORTANT: The application rules and eligibility criteria for IAS Student Travel Grants have been updated:

- Applicants must be active IAS Student Members;
- Applicants can apply for a travel grant twice per calendar year: once for an IAS meeting (IMS or ISC) and once for any other IAS-sponsored meeting;
- Applicants must have an active and approved (oral or poster) presentation at the meeting.

Meetings with IAS support

- 7th International Maar Conference (Olot, Spain; 21-25 May 2018)
- International Conference Resources for Future Generations 2018 (Vancouver, Canada; 16-21 June 2018)
- 4th Meeting of the Working Group on Sediment Generation (Dublin, Ireland; 27-29 June 2018)
- Cyclostratigraphy Intercomparison Project Workshop (Brussels, Belgium; 30 July - 1 August 2018)
- 20th International Sedimentological Congress (Quebec, Canada; 13-17 August 2018)
- VII Argentinean Meeting on Quaternary and Geomorphology (Puerto Madryn, Argentina; 8-21 September 2018)

All meetings with IAS support are also listed on the website in the members-only Events Timeline. The listings include the option for downloading the event period in your calendar.

I would like to remind all IAS members that:

- the IAS Newsletter 273 is published on-line and is available at: http://www.sedimentologists.org/publications/newsletter

The Electronic Newsletter (ENIAS), started in November 2011, continues to bring monthly information to members. For information on ENIAS contact ias-office@ugent.be

Check the new Announcements and Calendar. Meetings and events shown in CAPITAL LETTERS and/or with * are fully or partially sponsored by IAS. For all of these meetings, IAS Student Member travel grants are available. Students can apply through the IAS web site. To receive the travel grant, potential candidates must present the abstract of the sedimentological research they will present at the conference. More info @ www.sedimentologists.org

Vincenzo Pascucci
(IAS General Secretary)

IAS POSTGRADUATE GRANT SCHEME REPORT - 1ST SESSION 2017

The Kimmeridge Clay Formation of Yorkshire: A petrographic study

Elizabeth Atar

Introduction

The Kimmeridge Clay Formation (KCF) is a laterally extensive Upper Jurassic sedimentary deposit that occurs throughout the North Sea and onshore UK. The KCF is generally enriched in organic carbon and is the main source rock in petroleum exploration on the UK and Norwegian continental shelves. Its lateral equivalent formations in the Norwegian and Danish sectors are the Draupne and Mandal Formations, for this reason is it of great importance to the petroleum industry. Additionally, it is of great interest to palaeoclimatologists because its sedimentary 'completeness' enables us to investigate the climatic, tectonic and geographic controls on sediment deposition, oceanic and atmospheric processes, environmental perturbations, and the evolution of flora and fauna through the time of deposition. This information can enhance our understanding of the palaeoclimate and facilitate our predictions of future climate change.

In the modern world, pervasive organic enrichment is usually attributed to a basin restriction setting, e.g. the Black Sea, where the tectonic setting of the water leads to hypersaline anoxic conditions thus falling at the preservation end of the scale, or an upwelling scenario, e.g. modern day Gulf of Mexico, where high levels of primary productivity give way to oxygen depleted bottoms waters, so that high productivity creates good preservation conditions for organic matter. However, the Kimmeridge Clay Formation (KCF) was deposited in the Late Jurassic, when the palaeogeography was very different to that of today (Bradshaw et al., 1992). The KCF was deposited in a relatively shallow, c. 100's m deep, epicontinental seaway between the Tethys and Boreal oceans (Powell, 2010). Palaeogeography exerts a

Figure 1: Location map. Yellow star = studied core. Pink star = type section

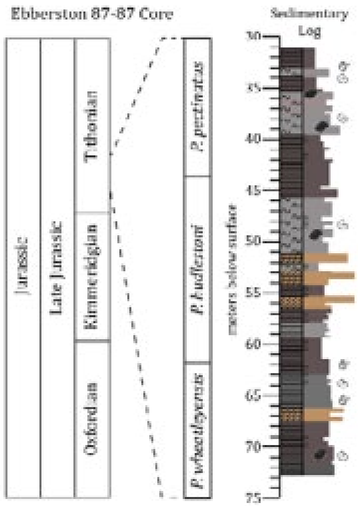

Figure 2: Litholog of the studied interval

strong control on the deposition of source rocks so the fact that it was so different to now means we cannot use uniformitarianism to reconstruct the depositional environment. This raises the question: what controls deposition of the Kimmeridge Clay Formation? To investigate this, a high resolution petrographic study has been conducted and preliminary results are reported here.

Methods

Polished thin sections were prepared to a thickness of 30 µm by a laboratory that specializes in mudstone sections. Thin sections were scanned on a flatbed scanner and examined under plain polarised and cross polarized light on a Leica DM750P microscope fitted with a Leica ICC50 HD. Further examination was conducted under backscattered electron microscopy on a Hitachi SE-70 High Resolution Analytical Scanning Electron Microscope. Optical characteristics, backscattered coefficients and SEM-EDX were used to identify components. The scanning electron microscope was operated at 15 kV and at a working distance of 15 mm.

Results and synthesis

Preliminary petrographic results indicate substantial temporal and spatial heterogeneities within the student section, including variations in microfossils and sedimentary component proportions. Four facies have been identified:

1. Clay-rich, silt-bearing mudstone

This facies is homogenized through bioturbation and has occasional erosional surfaces preserved indicating a component of sediment transport. Framework grains comprise silt-size quartz and feldspar along with macro shell fragments and are set within an illitic matrix. The matrix also contains minor amounts of pyrite and disarticulated coccolith debris and equant particles of organic material. This facies is interpreted to represent background sedimentation where sedimentation rate was slow, the sea floor was colonized and sediment was brought in and reworked by bottom currents.

2. Coccolith-dominated mudstone

This facies comprises normally-graded laminae with erosional bases indicating sediment transport and reworking may be involved in the deposition of these sediments. Coccolith material is organized into millimeter-scale fecal pellets as well as being a dominant component of the matrix. Clay minerals, ‘wispy’ algalderived organic material and pyrite make up the remainder of the matrix. This is interpreted to represent the time of peak carbonate production in the studied interval. Pristine preservation

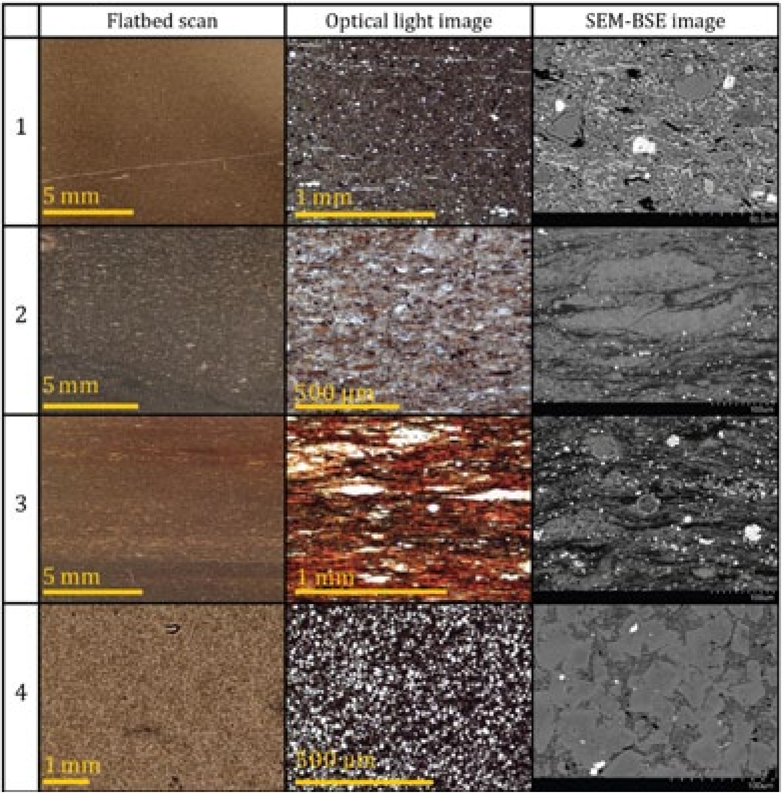

Figure 3: Flatbed scan, optical light image and SEM-BSE images of each of the four identified facies.

of coccoliths suggests limited lateral transport. The co-occurrence of coccoliths and organic material is somewhat paradoxical as coccoliths are generally considered to thrive in nutrient-poor waters, whereas high levels of organic matter production occur in nutrient-rich waters. However, it has been suggested that some coccoliths are ecologically selected to thrive in nutrient-rich waters (Lees et al., 2006).

3. Organic matter and calcareous pellet-rich mudstone

This facies is dominated by the presence of algal-derived organic material and coccolith-rich fecal pellets; clay minerals, framboidal pyrite and calcareous nanofossils are also present. These components are organised into submillimeter-scale laminae that alternate between red algal maceral dominated and clay mineral dominated layers. The laminae have sharp erosional bases and are normally graded. The sedimentary components are compacted around calcareous pellets that are concentrated in the clay-rich laminae. We interpret this facies to represent deposition under peak primary productivity.

4. Carbonate cemented siltstone

This is a medium to coarse, angular digenetic carbonate grain-dominated sediment with an argillaceous matrix. The carbonate grains are microcrystalline zoned non-ferroan calcite and non-ferroan dolomite crystals. Relict matrix, comprising of coccolith debris, illitic clay and fine quartz grains, can be seen between the diagenetic components. Minor pyrite is present throughout the matrix and carbonate crystals as small (>10 μm) framboids. This facies is a diagenetic overprint so cannot be used in palaeoenvironmental reconstruction; however it will be used to investigate the burial history of the section.

Conclusions and further work

The Kimmeridge Clay Formation is very heterogeneous, with four distinct facies indicative of a range of oceanographic and depositional conditions which resulted in the highly differential preservation of organic carbon. The petrographic work enabled by the IAS grant and reported here is being used to underpin and contextualize extensive geochemical work and forms part of a wider PhD project investigating the depositional controls on the Kimmeridge Clay Formation. Questions being addressed include: (a) how does the type and nature of organic material change through the section; (b) what are the origins of the sediment components; (c) what were the main controls on deposition of the Kimmeridge Clay Formation; (d) what controls the organic matter richness of the sequence?

Acknowledgments

The IAS Postgraduate Award Scheme for making this study possible through a grant for the thin sections. Wagner Petrographic Ltd are acknowledged for making the thin sections and Leon Bowen is thanked for SEM training and support.

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Miocene mixed heterozoan-photozoan ramp systems in tropical settings: Developing predictive sequence stratigraphic and sedimentologic models for reservoir characterization.

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Introduction

Shallow-water, low-latitude (tropical) carbonate systems typically consist of abundant photosynthetic organisms (e.g. corals and green algae), submarine cement and carbonate mud (Photozoan Association of James, 1997) and form rimmed reefal platforms, such as the Bahamas platform today. However environmental conditions, such as excess nutrients, turbid water, and cooler water in the photic zone (typically due to land runoff or upwelling) can result in the typical Photozoan Association being absent, and the shallow water areas instead being occupied by filter, suspension, and deposit feeders, (e.g. molluscs, bryozoans, echinoderms; Heterozoan Association of James, 1997) and only photozoan components tolerant of the adverse photic zone conditions; usually large-benthic-foraminifera (e.g. amphisteginids, soritids, peneroplids) and some corals (e.g. Porites sp. and Montastraea sp.) (Edinger and Risk, 1994; Wilson and Vesci, 2005). These “hybrid” photic zone tropical systems are typically grainy, lack abundant framework building organisms, mud, and submarine cement, and form ramp, non-rimmed platforms, and deep-water systems dominated by transport (Westphal et al., 2010; Ortega-Ariza, 2016). The understanding of the controls on deposition, stratigraphic architecture, and reservoir character are lacking compared to typical photozoan-dominated tropical systems. Depositional and stratigraphic models for hybrid tropical systems need to include additional controls on carbonate production (e.g. currents and location of nutrients) and physical processes that cause reworking and transport. Because these systems are typically composed of loose grains, paleotopography (substrate slope) is also an important control for what type of system is formed (e.g. ramps, deep water systems dominated by sediment gravity flows; Franseen et al., 1997; Franseen et al., 1998; Johnson et al., 2005). Understanding the “hybrid” tropical systems is also important because they form important reservoirs in the rock record, including the

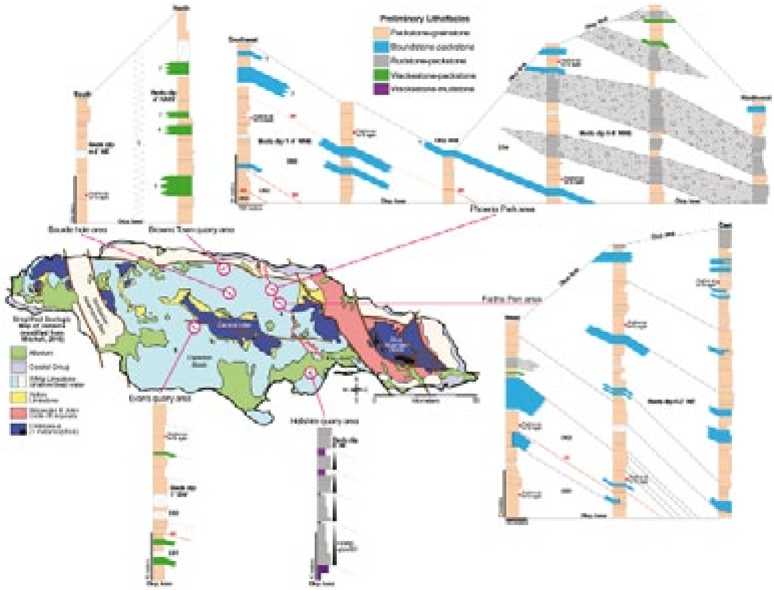

Figure 1. Jamaica generalized geologic map (modified from Mitchell, 2016) showing location of study areas, stratigraphic sections with generalized facies, and correlations for each area "work in progress".

Cenozoic in the Caribbean and Indo-Pacific (Wilson, 2002; Pomar et al., 2015).

My study will provide sea level, sedimentologic, paleotopographic, paleogeographic, oceanographic, and reservoir character data to develop models that can be applied to similar systems in the rock record. The requested IAS Grant funds have been used to partially cover expenses associated with field work conducted in Jamaica during the summer of 2017 as part of this project.

Methods

Field work was conducted on Oligocene-Miocene White Limestone Group strata exposed along Jamaican North-South Highway (JNSH) and in adjacent quarries in eastern and central Jamaica from May 12 to August 19, 2017. Field work focused on: 1) measuring 13 stratigraphic sections; 2) physically tracing strata (stratal geometries, stacking patterns) and surfaces (e.g. sequence boundaries) and marking them on photographs; 3) documenting facies, sedimentary structures, and diagenetic features to determine environments of formation, and surfaces indicative of ancient sea-level positions; 4) collecting structural data and way-up indicators (e.g. gravity geopetals, light seeking corals) for paleotopographic reconstruction; and 5) collecting samples for petrographic analysis and Strontium isotope dating to supplement and refine chronostratigraphic data. Generalized stratigraphic sections and facies are shown in a preliminary schematic cross section (Figure 1), which is briefly explained in the next section.

Preliminary Results

The following represents initial results from summer study in six selected areas in Jamaica; additional field work, and analysis of data for refinement of paleotopography, facies, correlations, depositional environments and sea-level history are currently in progress.

The Faiths Pen (FP) area shows two major sequences (DS1 and DS2). DS1 (approx. 18 m thick) consists of mollusk, echinoid, red algae, coral fragments and large benthic foraminifera (LBF) packstone-grainstone facies with in-place Kuphus sp. bivalves and is capped by a sharp, subaerial exposure surface that is interpreted as a sequence boundary (SB). Facies show intense bioturbation, local trough crossbedding, mixtures of abraded and non-abraded bioclasts, and inplace Kuphus sp. indicating a shallow open-marine, subtidal environment. DS2 (approx. 30 m thick) basal deposits consist of mollusk and LBF dominated packstone-grainstone facies with inplace Kuphus sp. bivalves indicating a shallow open-marine, subtidal environment and is directly overlain by coral-dominated boundstone facies that occur as isolated corals and that changes vertically to debris flow deposits characterized by megaclasts floating in a fine-grain skeletal packstone matrix at the top of DS2.

The Phoenix Park (PP) area shows four major sequences (DS1, DS2, DS3 and DS4). DS1 (approx. 3 m thick) consists of mollusk and LBF packstone-grainstone facies interpreted as shallow open-marine, subtidal deposits and is capped by a sharp, erosional subaerial exposure surface (SB). DS2 (0.5-2 m thick) consists of mollusk and LBF packstone-grainstone facies interpreted as shallow open-marine, subtidal deposits and is capped by a sharp, erosional subaerial exposure surface (SB). DS3 (approx. 15 m thick) consist of beds of in-place Kuphus sp. and LBFdominated packstone-grainstone facies indicating a shallow open-marine, subtidal environment and is followed by coral-dominated boundstone facies that occur as isolated corals at the top of the sequence. DS3 is capped by an irregular erosional surface and local paleosol (SB). DS4 (approx. 22 m thick) is composed of mollusk, coral fragment and LBF packstone-grainstone facies interpreted as shallow open-marine, subtidal environment alternating with mollusk, red algae and LBF rudstone-packstone facies interpreted as sediment gravity flows deposits because they show normally graded bedding and scoured surfaces.

The Bauxite Hole (BH) area shows a 26-meter thick partial sequence (DS1?) consists of mollusk and LBF-dominated packstone-grainstone with bioturbation and local crossbedding, and in-place Kuphus sp. bivalves indicating a shallow open-marine, subtidal environment.

The Browns Town Quarry (BTQ) area consists of a 44-meter thick partial sequence (DS1?) composed of mollusk, whole echinoids (i.e. Clypeaster sp.) and LBF packstone-grainstone alternating with wackestone-packstone facies. The presence of unabraded to slightly abraded skeletal grains and low-angle trough cross bedding suggest low intermittent energy, shallow openmarine, possibly seagrass environment indicated by the well-preserved echinoids.

The Evan's Quarry (EQ) area shows two major depositional sequences (DS1 and DS2). DS1 consists of mollusk, red algae and LBF packstone-grainstone facies throughout the sequences interpreted as shallow open-marine, subtidal deposits and is capped by a sharp, erosional subaerial exposure surface (SB). DS2 consists of mollusk, red algae and LBF packstone-grainstone facies. DS2 upper boundary (SB) is not exposed. The presence of moderately abraded skeletal grains and low-angle trough cross bedding suggest a low-medium energy, shallow open-marine, subtidal deposits.

The Hellshire Quarry (HQ) area consists of a 31-meter thick partial sequence (DS1?) that shows five finning upward cycles composed of mollusk, red algae (i.e. rhodoliths) LBF rudstonepackstone and fine-grained wackestone-mudstone facies. Soft sediment deformation, normally graded beds and scoured surfaces indicate that these are sedimentary gravity flow deposits.

Post-depositional m-scale faults occur throughout the field area. A variety of diagnostic wayup indicators (e.g. Kuphus sp. bivalves; Montastraea sp. corals in growth position; and gravity geopetals), and other useful way-up indicators (e.g. whole echinoderms oriented along surfaces) occur throughout the study area and allow reconstruction of paleotopography and indicate that the Eocene substrate upon which Oligocene-Miocene carbonates were deposited had variable paleotopography with highs and lows. The carbonates that are the focus of this study were deposited on the flanks of substrate highs. They show primary dips of 0-8 degrees, dipping in different directions away from substrate highs. Facies deposited on slopes >5 degrees are dominated by sediment gravity flows, and facies deposited on slopes <5 degrees reflect original depositional environment. Ongoing petrographic facies analysis are helping define details of vertical and lateral changes in facies.

Future work

Ongoing work includes further analysis of field data, petrography, and processing samples for Strontium isotope data will be used to help determine correlations between separated areas. Additional field work will be conducted in Jamaica to finalize data collection for reconstruction of paleotopography, relative sea-level histories, and other controls on the carbonate-dominated systems.

Acknowledgments

I am very thankful for funding received from the International Association of Sedimentologists (IAS) to achieve a successful 2017 field work season in Jamaica.

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"Geochemistry of carbonates and shales of Pilmatué Member, Agrio Formation, Neuquén Basin, western Argentina"

Introduction and goals

One of the most significant progress made in petroleum geology in the last years has been the attainment of a satisfactory understanding of the processes of oil and gas generation and trapping in fine-grained sedimentary rocks. For this reason sedimentological studies focused on the analysis of heterogeneities in these deposits. Detailed field surveys combined with geochemical and micro-textural observations now make it possible to comprehend many formerly obscure aspects of the genesis and stratigraphic distribution of petroleum source beds.

The offshore deposits of Pilmatué Member (Lower Agrio Formation, Neuquén Basin), which comprises mudstones, claystones, marlstones and siltstones, with variations both in TOC and carbonate/siliciclastic content, present an excellent opportunity to carry on this kind of studies due to its lithological variability and its excellent outcrops (Spalletti et al., 2011)

The main goal of this report is to analyze the inorganic geochemistry and to evaluate proximal-distal compositional variations in late Valanginian – early Hauterivian offshore fine-grained deposits of a mixed (siliciclastic-carbonate) marine ramp (Neuquén Basin, Argentina), in order to distinguish different geochemichal features during mudrocks deposition.

Geological setting

The Pilmatué Member (Leanza et al., 2001) corresponds to the Lower Member of Agrio Formation (Weaver, 1931) in the Neuquén Basin (western Argentina) and comprises black shale sequences deposited in a marine ramp setting during transgressive and high sea level periods (Legarreta & Gulisano, 1989; Legarreta & Uliana, 1991). Several previous studies indicated that in the central sector of the basin its composition is predominantly siliciclastic, while to the north, the content of carbonates is higher (Sagasti, 2002; Spalletti et al., 2011). In addition, it has been suggested that there is an increase in the total organic content to the north (Tyson et al., 2005). To explain these variations, a detailed analysis of the processes involved is required. This study is focused on the offshore deposits of the Member (Fig. 1b).

Methods

Three stratigraphic sections (550-650 m thick) of the Pilmatué Member (Agrio Formation) were logged in a north-south transect of 17 km (Fig. 1a). A total of 120 samples were processed for geochemical analysis using a handheld X-ray fluorescence equipment (Nitton XL3 Analyzer Thermo Scientific). Then, data was calibrated with ICPMS

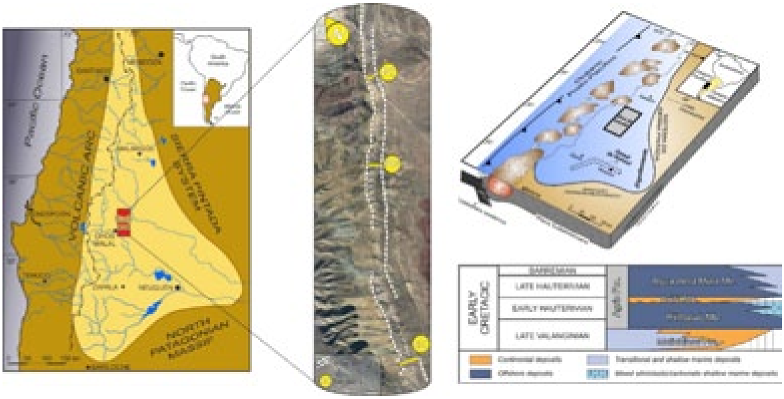

Figure 1. (a) Location of Neuquén Basin, western Argentina. EC: Escuela de Curaco, PQ: Puesto Quintero, PC: Puerta de Curaco. (b) Neuquén basin reconstruction for Valanginian-Hauterivian age (after Howell et al., 2005). (c) Stratigraphic chart of the Late Valanginian-Barremian interval in the studied area of Neuquén Basin (after Spalletti et al., 2011)

data (Fig. 2). The elements used for this characterization were: SiO_2, TiO_2, Al_2O_3, Th and Zr, as detrital supply proxies; CaO and Sr as proxies of carbonate productivity; and V, Cr, Co, Cu, Mo, U and Ni as redox proxies (Tribovillard et al., 2006; among others).

Results

The obtained results show significant compositional variations both in lateral and vertical direction. The southern (proximal) section is enriched in elements with detrital affinity (Fig. 3a), while those sensitive of carbonate productivity are more abundant in the northern (distal) sector. Analysis of temporal evolution of the record shows an increase in siliciclastic components towards the top of the succession, which is attributed to progressive raise in terrigenous contributions during the progradation of the ramp system

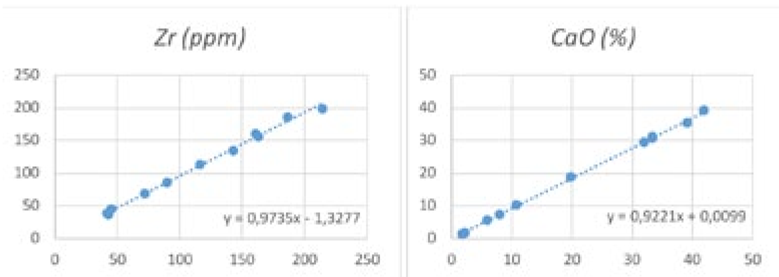

Figure 2. Comparison of results obtained with Handheld XRF and ICP-MS for different elements and concentrations. In X-axis, the results correspond to ICP-MS analyzes and in Y-axis, to Handeld XRF.

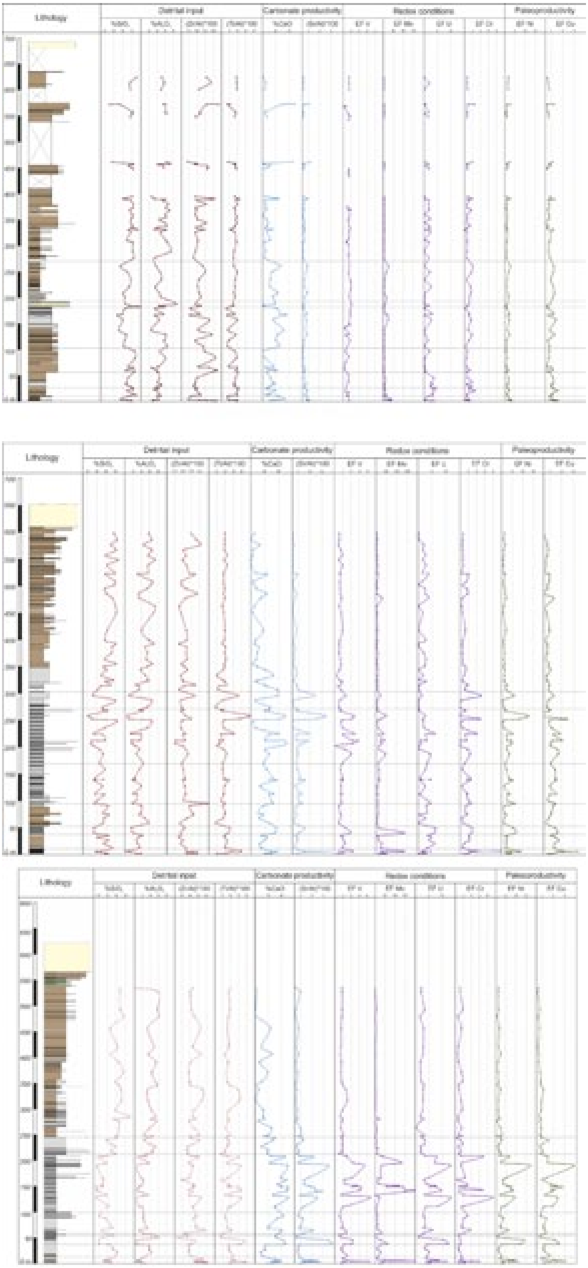

Figure 3. (a) Escuela de Curaco location (south). (b). Puesto Quintero location (c) Puerta de Curaco location (north)

in a highstand stage. The analysis of carbonate proxies revealed the presence of favourable conditions for carbonate productivity in distal (north) sectors (Fig. 3c) as well as in the mid-lower section, associated with the transgressive stages of the system. The redox proxies indicate that low levels of oxygenation prevailed in the distal sectors (north) and in the lower and middle sections of the unit, coincident with the maximum productivity of carbonates. Thus, during the transgressive stage, the input of oxygenated water and terrigenous supply was remarkably deficient. In contrast, the subsequent highstand conditions favoured the activity of marine currents which allowed redistribution offshore of terrigenous components, an increase in the oxygenation of waters (low concentrations of redox sensitive elements), and a significant decrease in carbonate productivity.

Conclusions

- Temporal evolution of the record shows an increase in siliciclastic components towards the top of the succession, which is atributted to progressive raise in terrigenous contributions during the progradation of the ramp system in a highstand stage. - Carbonate proxies revealed the presence of favourable conditions for productivity in distal (north) sectors as well as in the mid-lower section, and are associate with transgresive stages.
- Redox proxies indicate that low levels of oxygenation prevailed in the distal (north) and in the lower and middle sections of the unit, coincident with the highest productivity of carbonates. Furthermore, productivity could consume oxygen through organic-matter decay and helped anoxia to install close to SWI.
- During the transgressive stage, input of oxygenated water and terrigenous supply was deficient. In contrast, highstand conditions favoured the activity of marine currents which allowed redistribution offshore of terrigenous components, an increase in the oxygenation of the waters and a decrease in carbonate productivity.

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Origin of iron formations within the Cryogenian glacial deposits of Death Valley, California

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Introduction & Background

The Cryogenian Period (~720-635 Ma) experienced some of the most severe glaciations in all Earth history (Hoffman et al. 1998). Cryogenian glacial deposits are often associated with iron formations (Cox et al. 2013): enigmatic iron-rich chemical precipitates for which there no clear modern analogue. The Kingston Peak Formation, Death Valley, California records glacial sedimentation during the Cryogenian Period and contains iron formation horizons. Similar deposits are found globally in Cryogenian glacial successions, and a comprehensive study of broadly correlative deposits in South Australia and Namibia has been conducted (Lechte & Wallace 2015; Lechte & Wallace 2016). These iron formations represent the first global deposition of iron formation following a one billion year absence (Bekker et al. 2014). The genesis of these glacially associated iron formations remains contentious. Preliminary sedimentological results strongly suggest that these deposits are hydrogenous marine sediments. As the availability of dissolved iron in the oceans is strongly controlled by the marine redox, these iron formations have profound implications for our understanding of the changes in atmospheric oxygen content and ocean redox chemistry during the Precambrian.

Methods

Funding from the IAS helped to facilitate extensive geochemical analysis of these iron formations. 59 samples from the Kingston Peak Formation were selected for geochemical analysis following petrographic screening. Following bulk digest, trace elements were measured on a Thermo Scientific Finnigan Element XR inductively coupled plasma - mass spectrometer (ICP-MS) at Yale University. Iron was purification by ion exchange chromatography and iron isotopes were measured on a Thermo Finnigan Neptune Plus multicollector ICP-MS at the Yale Metal Geochemistry Center.

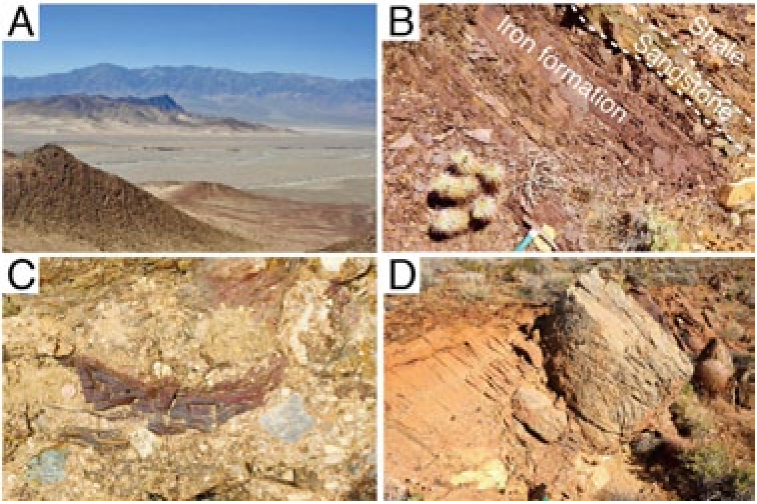

Figure 1. (A) The iron formation-bearing glacioturbidite succession of the Kingston Peak Formation at Sperry Wash, southeastern Death Valley. (B) Laminated iron formation overlain by sandstone and shale, Kingston Range Wilderness. (C) Iron formation intraclast within conglomerate of the Kingston Peak Formation. (D) Boulder-sized clast within diamictite in the Kingston Range.

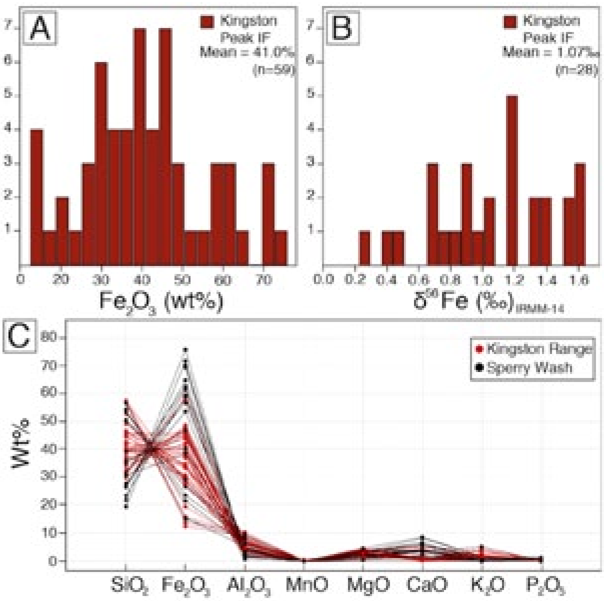

Figure 2. (A) Histogram showing the bulk Fe2O3 content of the Kingston Peak iron formations. (B) Histogram showing the iron isotope composition of the Kingston peak iron formations. (C) Major element geochemistry of the Kingston Peak iron formations.

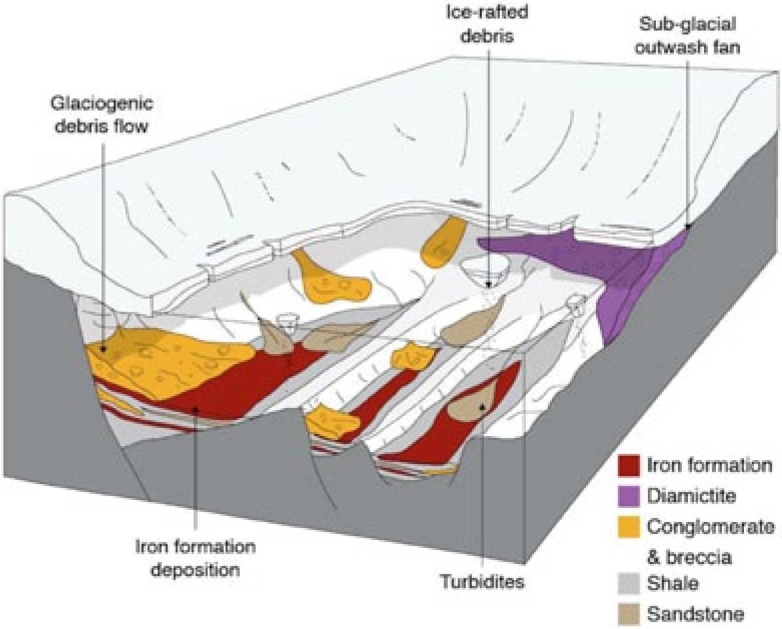

Figure 3. Interpreted deposition environment of the Kingston Peak Formation, showing iron formation deposition in synsedimentary rift basins. Iron formation sedimentation, controlled by the supply of oxygenated glacial fluids, is periodically interrupted by mass flows, turbidites and glacial diamictite deposition.

Results

The Kingston Peak iron formations are mineralogically and sedimentologically simple, consisting of finely laminated hematitic siltstones that contain up to 50 wt% Fe. These iron formations are hosted within a heterogeneous sedimentary succession of glaciogenic diamictites, mass flow breccias, conglomerates, sandstones and siltstones (Figure 1). The sedimentology of these iron formations and associated iron formation intraclasts provide are evidence of a synsedimentary origin for these iron formations. The iron isotopic signature is consistently positive, with 56Fe values reaching up to 1.65. High 56Fe values are typically linked to partial ferrous iron oxidation (Dauphas et al. 2004), implying a very low oxidizing potential of the basinal seawater (e.g. Li et al. 2013) and for varying degrees of partial oxygenation of a dissolved iron reservoir (e.g. Busigny et al. 2014) by fluctuating oxygen supply.

The iron formations of the Kingston Peak Formation are interpreted to have been deposited in a range of glaciomarine environments as the product of mixing of ferruginous seawater with oxygenated glacial meltwater. Glaciation provided a supply of oxidants to the anoxic oceans in the Cryogenian, facilitating iron formation deposition (Lechte et al. In press).

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“Sequence stratigraphy and architecture of syn-rift sediments, Eastern margin of the Gulf of Suez, Egypt”

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Introduction

The Cenozoic Gulf of Suez basin is a world-class example of a continental rift with excellent exposures. Much concern was given to the rift history and the overall characteristics of the stratigraphy, the structural styles, and fault-propagation folding (e.g. Moustafa, 1993, Sharp et al., 2000; Jackson et al., 2006). The well exposed outcrops in the eastern margin of the Gulf of Suez provides an opportunity to tackle an important unresolved issue in sedimentary geology and tectonics, which is how sea-level change and deformation work together to control patterns of sedimentation.

A widely held view in this field is that sea-level change controls the timing of sequence development, and the deformation works mainly to provide space for sediment accumulation and to influence the character of boundaries. However, relevant previous studies at the New Jersey continental margin (Pekar et al., 2003) and the Cretaceous of western Colorado (Madof et al., 2015) indicate that timing is influenced by factors other than sea-level change, and the brittle deformation controls both the timing and geometry of stratigraphic intervals representing spans as short as hundreds of thousands of years. So we hypothesize that both eustasy and deformation may play a role in the development of sedimentary cyclicity in the Gulf of Suez, though perhaps in different places within a single half-graben. Given that basin-bounding faults are associated with growth folds that propagate laterally and vertically, it is also possible that the timing of specific laterally traceable surfaces varies from one place to another, though whether such diachroneity can be resolved remains to be evaluated.

Among the keys to the research project are:

1- The interval of interest (Early Miocene) has a well-established record of sea-level change from deep-sea oxygen isotopes and New Jersey shallow shelf drilling (e.g. Browning et al., 2013).
2- Early Miocene syn-rift sediments at the eastern margin of the Gulf of Suez were deposited close to the shoreline, so shell beds are abundant and

can provide material to sample for Sr isotopes (Figs. 1C&1D).
3- Secular changes in Sr isotopes are relatively rapid providing an appropriate dating approach.

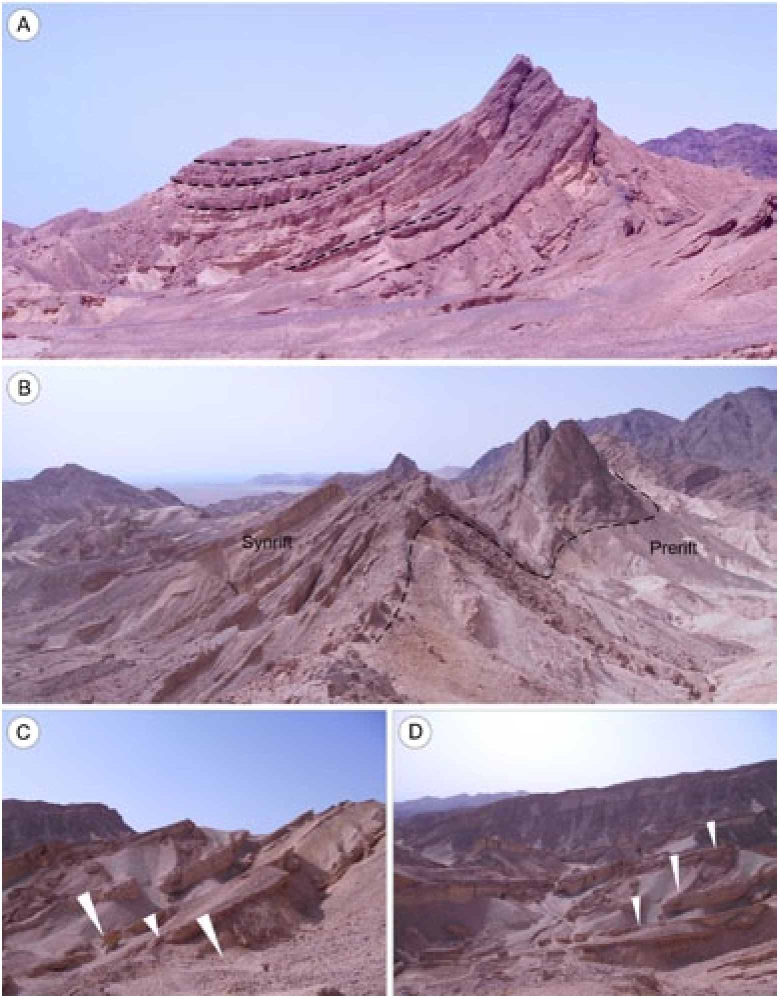

Fig. 1. Field photographs showing: (A) Panoramic view of tilted synrift strata in the hanging wall of the rift border fault. Note the complex stratal geometries including both updip and downdip pinchout and their onlap, downlap and truncation bounding surfaces, (B) Panoramic view showing the prerift/synrift contact and some details of the synrift stratal architecture, (C) & (D) High frequency of cyclic shell beds that provide material to sample for Sr-isotope dating.

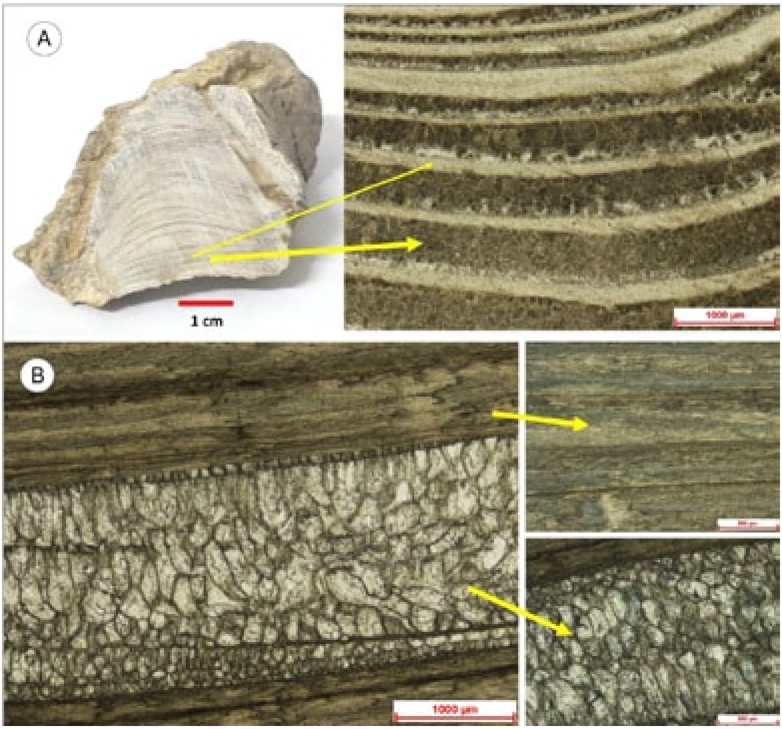

Fig. 2. (A) Slabbed oyster shell for thin sectioning and its photomicrograph on the right showing details of the layers' microstructures and mineralogy, (B) Thin section photomicrographs showing multilayered structure of a thick-walled oyster shell that retains its original internal foliated and prismatic microstructures. The foliated layers are originally calcitic in composition. Tangential and cross sections in the prismatic layers show pentahedral, hexahedral or more irregular end faces of the prisms. The good preservation of these prisms suggests their original calcitic composition.

We are not interested in fitting the standard sequence stratigraphic ideas, systems tracts and so forth. What we wish to do instead is to figure it out from first principles, and then to ask questions about how sequence stratigraphic principles need to be modified in a tectonically active setting.

Methodology

1. Constructing GIS Database which includes pertinent studies from the literature, geologic and topographic maps, satellite images, DEMs etc., and preparation of an integrated basemap.
2. Field work:

The main task is carefully mapping the key surfaces through laterally changing facies and detailed documentation of the stratal geometries and cyclicity. Mapping the most prominent stratigraphic discontinuities, folds and faults to provide a framework. Documenting how the geometry and character of specific discontinuities varies transverse and parallel to geological structures, and how facies relate to that geometry. Such documentation will take two forms: a map of physical surfaces, and carefully measured stratigraphic sections keyed to those surfaces. Sampling of shell beds for Sr-isotope dating will be undertaken in that geometrical context.

3. Laboratory work which includes Sr-isotope dating, and petrographic examinations.

Preliminary findings

Our first field reconnaissance was in Summer 2017. The main objective was to get acquainted with the entire area accessibility, the stratigraphy, structural framework, facies types, etc., and to walk and verify the previous published geologic maps of the study area (e.g. Moustafa, 1987, 2004; and Sharp et al., 2000), and stand on the points of controversy.

Our observations were focused on the synrift stratal architecture and key surfaces, the rift border fault zone and its related folds, and the pre-rift/syn-rift contact (e.g. Figs.1A&B). We selected candidate locations for future measuring of key sedimentary sections; and collected spot samples of oysters and fine-grained sediments suitable for petrographic and biostratigraphic investigations respectively. The collected oyster samples were thin sectioned and examined to test their preservation status and types of mineralogical alteration, if any, and hence their suitability for the Sr isotope analyses (e.g. Fig.2). Marine microfossils recovered from the fine-grained intervals were identified as well.

Among our observations are the high abundance of cyclic shell beds which may provide a potential for high resolution age dating (Figs.1C&D), a pronounced facies changes from non-marine to shallow and deep marine suites, different stratal geometries including onlap, downlap, both updip and downdip pinching out.

Acknowledgment

I would like to thank the International Association of Sedimentologists for funding part of my research that made this fieldwork possible.

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Spatial and temporal variations in grounding line proximal sedimentation in the Anvers Palaeo-Ice Stream Trough, western Antarctic Peninsula

Zoë Roseby

In the modern day, we are seeing the retreat and thinning of the majority of Antarctic Peninsula Ice Sheet glaciers (Cook et al., 2016). The mechanisms that drive these changes and the future behaviour of marine terminating glaciers and ice streams remain difficult to understand, due to the short timescales over which we have recorded observational and satellite data. Investigating past Antarctic Ice Sheet dynamics allows us to extend the temporal and spatial scales over which we can understand the behaviour of these systems. This can be achieved through the recovery and analysis of sedimentary sequences deposited during the Last Glacial Maximum (25-19 ka BP) and the subsequent deglaciation on polar continental shelves (Ó Cofaigh et al., 2014). These sediments typically fall into three broad facies associated with the following depositional environments; subglacial, transitional and open marine (Fig. 1) (Domack and Harris, 1998; Ó Cofaigh et al., 2014; Smith et al., 2011). The sedimentary processes that occur near the grounding line deposit transitional sediment facies. These sediments provide an insight into the cause and style of ice stream retreat. My PhD study uses a multi-proxy approach on marine sediment cores recovered from the Anvers-Hugo Palaeo-Ice Stream Trough (AHT), western

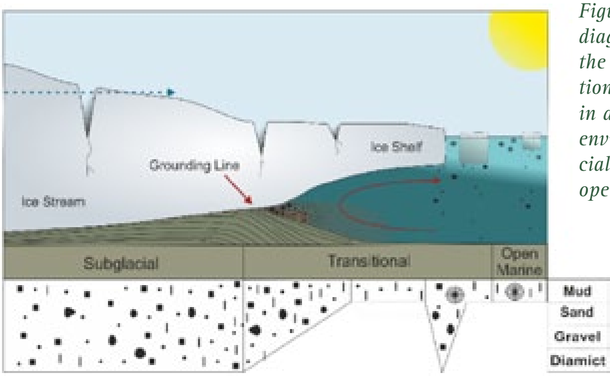

Figure 1: Schematic diagram illustrating the three key depositional environments in a glacial-marine environment: subglacial, transitional and open marine.

Antarctic Peninsula shelf (RRS James Clark Ross cruise JR284), to identify variability in transitional sediment facies deposited along and across the trough. The data reveal systematic variability in the types and volume of transitional sediments, relating to retreat rate, bathymetry, thermal regime, grounding line oscillations and the evolving nature of the ice margin over deglaciation.

Previous studies have collected and dated sediments deposited during the retreat of the Anvers-Hugo Ice Stream (AHIS) following the LGM (e.g. Pudsey et al., 1994). Despite this, the timing of ice stream retreat within the AHT remains poorly constrained. Without a detailed retreat chronology, it remains difficult to relate the variability in depositional processes to regional and global forcing mechanisms, such as increases in atmospheric and/or ocean temperatures and sea-level rise. Robust core chronologies can also help constrain the timescales and processes that form depositional features such as grounding zone wedges. Producing a dependable retreat chronology remains challenging in the Antarctic, due to a scarcity of preserved biogenic calcium carbonate within sediments. 14C dating of calcareous shells and foraminifera is considered the most reliable method for dating sediments deposited during the last 40 ka (Bentley et al., 2014). Without this method, past studies have often relied on dating the acid insoluble fraction of the organic matter (AIOM) of the sediments; this involves the combustion and dating of all of the acid-insoluble organic matter within the sediments (Andrews et al., 1999). Dates obtained from AIOM dating can have considerable error bars and, in some sectors, are thousands of years older than the corresponding 14C ages of calcareous microfossils dated from the same sediment samples (Andrews et al., 1999). Ultimately, AIOM dating is unable to remove the entire contamination effect caused by the supply of reworked, fossil organic carbon, which was produced much earlier than the time of sediment deposition (Andrews et al., 1999).

This summer I visited the University of South Florida, where I utilised a novel method developed by Professor Brad Rosenheim, to date sediments sampled from the JR284 sediment cores. Ramped Pyrolysis (RP) 14C dating minimises the effect of contamination by fossil carbon on the 14C dates from organic matter, thus overcoming the error introduced during AIOM dating. This is achieved through combusting sediments at gradually increasing temperatures to thermally break down the bulk organic matter. The gradual temperature increase allows for the separation of the more thermochemically reactive younger constituents, which are preferably combusted under lower temperatures, from the reworked more stable older constituents, so that these separate components can be dated independently (Rosenheim et al., 2008; Rosenheim et al., 2013). During my visit, I learnt how to carry out RP 14C analysis; this involved splitting the CO2 gas at intervals of ~10-25 µmol as the sediment was gradually heated and CO2 was produced. The CO2 was separated from other gases using a series of liquid nitrogen and liquid nitrogen–cooled isopropanol traps and was sealed into pre-combusted, evacuated Pyrex tubes (Rosenheim et al., 2008; Subt et al., 2016). These Pyrex tubes contain pre-combusted copper oxide and granulated silver; this allowed the CO2 gas to be graphitised at the National Ocean

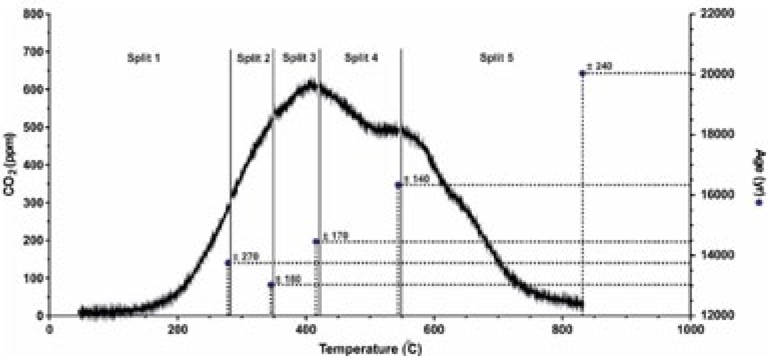

Figure 2: Thermograph from GC690 (313-314 cmbsf) ramped pyrolysis run. The black line illustrates CO2 (photometric) produced (ppm; left axis) as temperature increases (°C). The bars represent the temperature range over which a sample was split. The age of each split (yr; right axis) is shown by blue circles and includes the error in these ages.

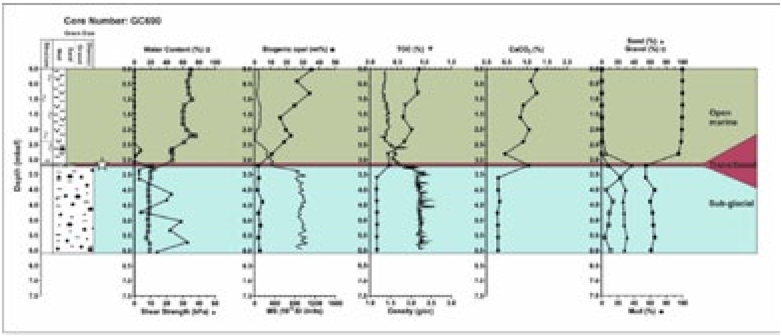

Figure 3: Core logs and core data plots for JR284 sediment core GC690. Data are water content (open squares), shear strength (closed triangles), Magnetic Susceptibility (MS), content of biogenic opal (closed squares), TOC (open triangles), CaCO3 (closed circles), density, contents of mud (<63µm, closed squares), sand (63 µm- 2mm, closed triangles) and gravel (>2 mm, open squares). Sedimentary structure was identified using X-radiographs. Based on these properties, sediment facies are interpreted as open marine (green), transitional (pink) and sub-glacial (blue). The white star indica-tes the horizon at which sediment was sampled for RP dating.

Sciences Accelerator Mass Spectrometry Facility (NOSAMS) at the Woods Hole Oceanographic Institution (WHOI). I spent one week in NOSAMS learning about this graphitisation process.

Figure 2 shows an example of a thermograph produced during my visit, and the temperature intervals at which the CO2 was split, using the RP method. It additionally shows the corresponding age of the CO2 splits. This sample was recovered from sediment core GC690; the stratigraphic position of this sample is shown as a star in Figure 3. Figure 3 shows that this sample was recovered from the top of the sub-glacial sediment facies and so the age received from Split 1 for this sample, ~ 13,700 yr, is considered to be the date at which the AHIS grounding line passed over the core site. Initial results indicate that grounded ice within the Anvers-Hugo Trough retreated rapidly across the mid to inner shelf. One implication of this is that grounding zone wedges, depositional features that are indicative of still stands during ice stream retreat, developed over limited time-scales.

Overall, this was an excellent experience, allowing me to learn a technique that is at the cutting edge of radiocarbon dating and spend time working internationally with scientists in world class research institutes. Through the grant application process and this research visit, I have gained important skills and connections that have been advantageous for my personal development and future career.

Acknowledgements:

I would like to thank the International Association of Sedimentologists for supporting this data acquisition and institute visit, through the Postgraduate Grant Scheme. This study was additionally funded by The British Sedimentological Research Group, Quaternary Research Association and the Trans-Antarctic Association.

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IAS POSTGRADUATE GRANT SCHEME REPORT - 2ND SESSION 2017

Stratigraphy, Facies Analysis and Paleo-drainage Evolution of the Late-Mesozoic Continental Succession of the Central High Atlas (Morocco): the area of the High Atlas of Marrakech.

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1.Introduction

The sedimentary record of paleo-drainages in active tectonic settings stores important information about mode and timing of crustal deformation (Howard, 1967; Cox, 1989; Clark, 2004). Such record may be investigated through different methods ranging from petrographic and quantitative provenance analyses of sedimentary sequences (Vezzoli and Garzanti, 2009), to morphological drainage pattern analyses (Clark, 2004) and facies to paleo-current analyses (Ielpi and Ghinassi, 2014). In this project, we use facies analysis of fluvial deposits and paleo-current patterns, together with structural observations, for reconstructing the tectono-stratigraphic evolution of the Late-Mesozoic continental successions of the Central High Atlas (Morocco).

These successions, regionally known as Couches Rouges, are largely exposed at the cores of synclines at the northern front of the Central High Atlas (Fig.1a, Jenny et al., 1981; Sohuel, 1987, 1996; Haddoumi et al., 2002, 2008, 2010; Charrière and Haddoumi, 2016, 2017). These red beds attest to a Middle Jurassic-Early Cretaceous regressive phase debated in the frame of the tectono-sedimentary evolution of the Central High Atlas. Indeed, the significance of this long phase of continental deposition is relevant to the discussion about the stages of build-up of the Atlas Mountains. According to some authors these continental successions record localized (Monbaron, 1982; Laville, 1985; Piqué et al., 1998; Cavallina et al., 2017) to widespread (Benvenuti et al., 2017; Moratti et al., 2018) early compressive-transpressive stages of deformations. Other authors refer them to a period of tectonic quiescence, during which the sedimentation was mainly controlled by sea-level variations (Beauchamp et al., 1999; Teixell et al., 2003; Tesón and Teixell, 2008; Frizon de Lamotte et al., 2000, 2008, 2009).

The main aims of this PhD project are: 1) revise the stratigraphic framework of the Central High Atlas LateMesozoic continental successions,

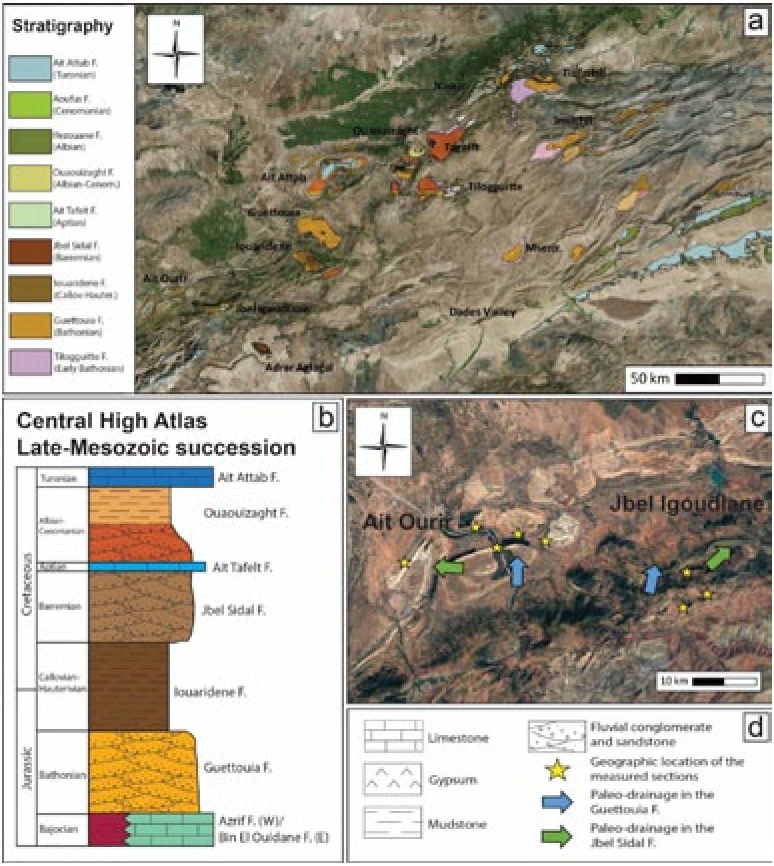

Fig. 1: a) Geological map of the Late Mesozoic successions in the Central High Atlas. b) Simplified stratigraphic section of the Late Mesozoic succession of the Central High Atlas. c) The study area, reporting the localization of the measured sections and the direction of the paleo-drainage. d) Symbology.

based on standard sedimentary facies analysis method and recognition of Unconformity Bounded Stratigraphic Units (UBSU, ISSC, 1994); 2) reconstruct the evolution of the paleodrainage through time in order to understand if there is a tectonic forcing in the organization of the fluvial systems.

2. Geological Setting

The Moroccan High Atlas chain records a complex tectono-sedimetary history related to the Early-Mesozoic opening of the Atlantic Ocean (Pre-Orogenic period) and, then, to the Cenozoic convergence between the African and European plates which led to a tectonic inversion (Orogenic

Period; Mattauer et al., 1977; Frizon de Lamotte et al., 2008, 2009). Its structural limits are the North Atlas Fault to the north and the South Atlas Fault to the south, that were active as normal faults during the Preo-Orogenic period, as the shoulders of the rift system, and then have been reactivated in inversion during the Orogenic period. Starting from the Late Permian, crustal extension affected the NW African craton, giving rise to several rifted basins, filled during the Triassic-Early Jurassic by continental clastic sediments, evaporites and basalts. During the Early Jurassic a regional marine ingression led to the development of syn-rift carbonate platforms (Frizon de Lamotte et al., 2000, 2008, 2009) replaced, in the Middle Jurassic, by post-rift fluvial and lacustrine environments (Haddoumi et al., 2002, 2008, 2010; Charrière et al., 2005; Charrière and Haddoumi 2016, 2017). Continental deposition lasted up to the Late Cretaceous, except for the Aptian marine transgression, testified by shelfal carbonates exposed only on the northern front of the Central High Atlas (Cavin et al., 2010).

This long phase characterized by mainly continental deposition is recorded by several successions throughout the Central High Atlas (Fig. 1b). These successions rest unconformably over the Middle Jurassic (Bajocian) limestone units of the Bin El Ouidane-Tanant formation and, locally, over its continental equivalent, the Azrif formation (Jenny et al., 1981). Up to the Aptian transgression these continental deposits have been subdivided into three clastic sedimentary units, regionally known as Couches Rouges (Haddoumi et al., 2002, 2008, 2010; Charrière et al., 2005; Charrière and Haddoumi, 2016, 2017):

- Guettouia Formation: fluvial reddish fine-grained conglomerates, sandstones and mudstones ascribed to the late Bathonian (Charrière et al., 2005). Calcareous clast composition of the conglomerates reflects the denudation of Early and Middle Jurassic marine limestones forming the basin shoulders.
- Iouaridene Formation: several hundred-meter-thick lacustrine reddish mudstones with subordinate marls and evaporites. Ostracod and charophyte assemblages (Mojon et al., 2009) suggest a timetransgressive onset of this deposition (from the Bathonian-Callovian in the southernmost outcrops, to the Hauterivian in the northernmost basins).
- Jbel Sidal Formation: fluvial reddish sandstones and mudstones resting unconformably over the previous formation and referred to the Barremian-early Aptian (Andreu et al., 2003; Mojon et al., 2009)

At the northern Central High Atlas front, the Aptian interval is recorded by limestones and marls of the Ait Tafelt Formation (Haddoumi et al., 2002, 2008, 2010; Charrière et al., 2005) which documents a marine ingression. The reestablishment of continental conditions during the Albian-Cenomanian is recorded by continental deposits at both fronts of the Central High Atlas: on the northern front, the Ouaouizaght Formation is composed by fluvial sandstones grading upward to sabhka gypsum and mudstones (Monbaron, 1985; Sohuel 1987); at the southern front, the Cenomanian fluvial complex regionally known as Kem Kem beds (Sereno et al., 1996; Ettachfini and Andreu, 2004; Cavin et al., 2010) includes the Ifezouane Formation (fluvial sandstones) and the Aoufous Formation (mudstones and gypsum). All over the Central High Atlas deposition continued during the Late Cenomanian-Turonian in coastal settings and shallow carbonate ramps represented by the Akrabou Formation, hinting to a new transgressive stage (Ettachfini and Andreu, 2004; Ettachfini et al., 2005).

3. Background research:

During the first years of my PhD, high and low-resolution datasets were collected in the field throughout the Central High Atlas (Fig. 1a). Our preliminary results are quite consistent in pointing out early tectonic stages of deformation, occurring during the deposition. We detected: 1) growth folding geometries and angular unconformities in the studied successions, suggesting a sinsedimentary tectonics; and 2) a paleo-drainage directed transversal to the chain and towards the North Atlas Fault in the High Atlas of Marrakech. The latter finding suggests the presence of a progressively growing topographic high in the axial part of the system at least from the Bathonian, that could be better explained in a framework of early compressive-transpressive stages of deformation rather than as resulting from a tectonically quiescent post-rift stage.

From a sedimentological point of view the studied deposits show features that escape the classical fluvial models (braided and meandering systems). Instead of traditional bar forms, the channel infill is characterized by very low angle-to aggradational accretion sets. Instead of traditional cross-stratification, accretion sets are characterized by supercritical-flow and high-deposition-rate sedimentary structures. These characteristics are common in the variable discharge fluvial systems described in Plink-Björklund (2015).

Our preliminary results point out unique geological issues. Unraveling the tectonic history of the Central High Atlas, would provide a new perspective on the transition from the pre-orogenic period to the orogenic period in the build-up of this intra-cratonic orogenic system. Deciphering the paleo-environment of the couches rouges would provide a case study on variable discharge fluvial systems.

4. Methods and study areas

The High Atlas of Marrakech (Ait Ourir and Jbel Igoudlane areas) has been recognized as a key area to understand the tectono-stratigraphic evolution of the Late-Mesozoic continental succession (Fig. 1c). Indeed, in these areas, the two fluvial units of the Couches Rouges (Guettouia F., Jbel Sidal F.), focus of our research, are well exposed; furthermore, the paleo-drainage patterns, together with structural observations, point to the presence of a topographic high at least from the Bathonian, suggesting a syn-sedimentary tectonics forcing the paleo-drainage (Cavallina et al., 2017). Therefore, we decided to improve the resolution of the datasets in these areas of the High Atlas chain.

For this purpose, we carried out a geological fieldwork in the areas of Jbel Igoudlane and Ait Ourir from April 7th to April 17th, 2018. During this period, 8 geological sections has been measured on the Late-Mesozoic continental successions outcropping in these areas. The continental deposits have been described in terms of standard sedimentary facies analysis (Bosellini et al., 1989; Nichols, 2009).

The succession has been subdivided in stratigraphic units that could be correlated whit the Late-Mesozoic continental formations exposed throughout the chain (Guettouia F., Iouaridene F., Jbel Sidal F., Ouaouizaght F.). Paleo-current analysis, aimed at reconstructing the evolution of the paleo-drainage through time, has been carried out on the fluvial deposits. Measures have been taken on the lee side of fluvial sedimentary structures as dunes and ripples. The axes of paleo-channels and paleo-valleys, eventually detected in the field, have been also measured

5. Preliminary findings:

During the geological fieldwork new data on the Late Mesozoic Continental Succession in the High Atlas of Marrakech have been collected, in order to: 1) revise the stratigraphy of the study areas, 2) reconstruct the paleo-drainage pattern of the fluvial systems 3) verify the variable discharge character of the fluvial systems represented by the studied successions. The achieved results are summarized below:

- Stratigraphic review of the Late-Mesozoic continental succession in the High Atlas of Marrakech:

In the Jbel Igoudlane area our data confirm the stratigraphic subdivision proposed by Jenny et al. (1981), who recognized in the succession the classical subdivision of the Couches Rouges in three continental formations: two fluvial (Guettouia F. and Jbel Sidal f.) interrupted by a lacustrine one (Iouaridene F.).

In the Ait Ourir area we subdivide the continental succession, generically known as Dogger (Ferrandini et al., 1982; Haddach et al, 2015), in three stratigraphic units possibly represent local equivalents of the Couches Rouges (Cavallina et al., 2017).

- The paleo-drainage evolution of the Couches Rouges of the High Atlas of Marrakech:

The Guettouia F. shows, in both the study areas, a paleo-drainage directed to the north, towards the North Atlas fault, testifying the presence of a Topographic High in the axial part of the chain that forces the fluvial systems to flow towards the shoulders of the paleo-rift (Cavallina et al., 2017; Fig. 1c). The Jbel Sidal F. shows paleo-current directions still towards the north in the Jbel Igoudlane area, while in the Ait Ourir area it testifies a west-directed paleo-drainage (Fig. 1c). This discover could be related to the presence of a watershed between the two areas during the Barremian, that could be linked to a syn-sedimentary tectonics.

- The seasonal character of the fluvial systems represented by the Couches Rouges in the High Atlas of Marrakech:

From a sedimentological point of view the two fluvial Formations (Guettouia F. and Jbel Sidal F.) seam to unfit the facies models established for braided and meandering fluvial systems (Miall 1978, 2010). The facies architecture of the studied deposits includes high amount of muddy floodplain deposits, whilst braided systems are normally characterized by thick amalgamated sandstone bodies. Differently from braided and meandering fluvial systems, where different-scale bar-forms are common in-channel structures, in our cases the channel fill is characterized by very low angle-to aggradational accretion sets, without well-developed bar-forms. Together with the traditional crossstratification, accretion sets are characterized by trans to supercritical-flow or Upper flow regime sedimentary structures (UFR) and high-deposition-rate sedimentary structures (HDR). Furthermore, the studied deposits commonly present in-channel mud layers and heterolytic infill, thick soft sediment clast conglomerates (mud clasts), soft sediment deformation (in UMc5) and in-channel paleo-soils and bioturbation. These features are common in the fluvial systems dominated by variable discharge as presently represented by a wide range of seasonal rivers (Plink-Björklund, 2015). These are ephemeral rivers, active only during the wet periods in which the sedimentation is dominated by big flood events, causing UFR and HDR sedimentary structures. During the dry periods these rivers only transmit a low base flow with limited or null sediment transport and, eventually, the full deactivation of the system favors pedogenetic processes inside the dry channels.

In conclusion, the geological fieldwork carried out in the High Atlas of Marrakech confirms the previous results: the Late-Mesozoic fluvial red beds of the Central High Atlas seam to record the activity of ephemeral rivers affected by syn-sedimentary tectonics.

6. Budget justification

The present research has benefited from the grant allocated to this project by the IAS, to support the costs related with the field work activity. The money has been used to cover the rental of a 4X4 car and to pay a local car-driver, both expenses necessary to carry out geological fieldwork in the Central High Atlas. Part of the grant has been also used to cover part of the costs of food and accommodation.

Car rental (Transport touristique Bakbou): 9.900 DH = 872,29

Accommodation (3 night, half pension, Complex Ouiskdou): 1350 DH = 118, 95

Food (1 lunch, aires de repos du sud Al Baraka): 289 DH = 25,46

Tot: DH 11539 = 1016,7

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Neogene Volcaniclastic Infill Analysis Of The Collón Curá Basin: Implications For The North Patagonian Foreland System During The Last Andean Orogenic Episode

INTRODUCTION

The origin, infill and evolution of foreland basins are topics widely analysed in the last decades. Even though the processes that govern the accommodation space in foreland basins (DeCelles and Giles, 1996) and the processes that control the transfer of sediments from and through them (Allen, 2008; Romans et al., 2016) have been analysed and determined for specific basins. Nowadays there is still an ongoing debate and a lack of understanding of the subject due to the generalization and the overlapping of these processes in different foreland basins around the world.

The North Patagonian foreland region is characterized by isolated depocentres which are infilled by hundreds to a few thousand metres of volcaniclastic to epiclastic sediments (Fig. 1) (Bilmes, 2012; Ramos et al., 2014). It is not possible to explain the characteristics of this little known foreland system by conventional models of accommodation space

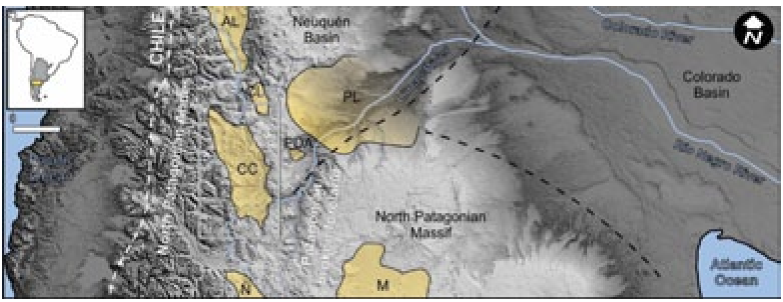

Figure 1.- Schematic distribution of Neogene depocentres located in the North Patagonian foreland region. CC: Collón Cura Basin

creation and preservation of sediments. Furthermore, this is an exceptional case study as its evolution coincided with the mid Miocene Climate Optimum and the period of greatest volcanic activity and volcaniclastic sediment generation registered in the North Patagonian Andes.

In this context, the Collón Cura basin is one of the main depocentres located in the North Patagonian foreland region. So, the characteristics of the volcaniclastic and epiclastic infill and of the structures that bound the basin makes it an exceptional case study to understand the processes that control the origin, infill and evolution of this foreland system at the foot of the Andes (Fig. 2). The main goal of this PhD project consists in the analysis of the Neogene volcano-sedimentary infill of one of the most important basins in the North Patagonian foreland system, i.e., the Collón Curá basin (south of Neuquén and north of Río Negro). The objective is to define sedimentary accumulation models that would allow us to interpret the changes through time in the routing systems forced by the main controls, such as volcanism, tectonism and climate change. The general results will have palaeoenvironmental and tectonic implications for the Neogene evolution in this Andean region.

METHODS

So far, we have analyzed more than 1000 m of total log profiles (scale 1:100), as well as architectural panels, obtained from strategic locations and we have also taken samples for

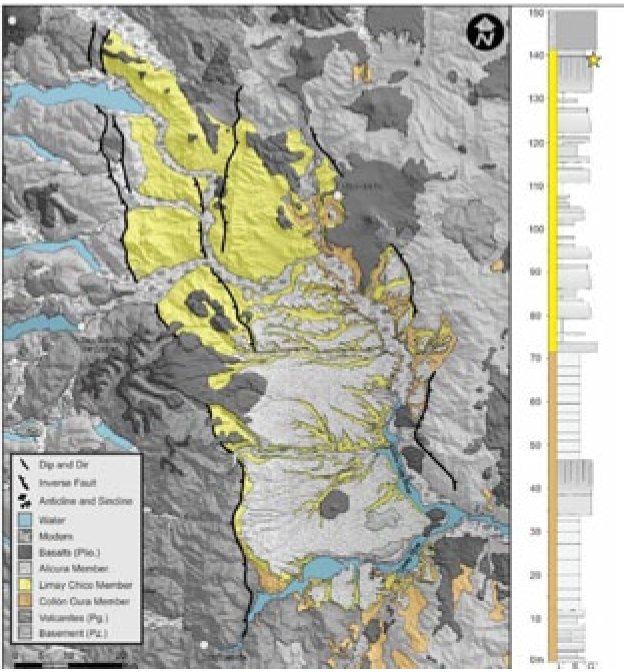

Figure 2.- Geologic map and general stratigraphic log of the Collón Cura Basin. Yellow star indicates the ignimbrite analyzed by radiometric dating.

petrographic and magnetostratigraphic analysis. Besides, we have made a detailed geological map with a 6-m elevation error of the surfaces between the main units. With all that information, we have modelled the basin with the Midland Valley Move Software in order to estimate the volume of each unit. We have also obtained the composition of each unit through composition maps in thin sections and clast counts in the field.

Nowadays we are analyzing the magnetic memory of samples from specific profiles in order to construct magnetostratigraphic profiles. This is being measured in a cryogenic magnetometer with an attached degausser (2G Enterprises, Model 755R [DC squids]). With this magnetic memory, we are analyzing the results with specific software (Anisoft and PaleoMag 3.1 by AGICO) for data visualization and interpretation. As is generally known, at least one radiometric dating is fundamental because it allows us to know the reversion cycle of the dated unit. With this reliable data acquired, we will link sedimentary logs with the chronostratigraphic magnetic chart and so reconstruct the evolution of the basin through time. Due the high price of this radiometric dating analysis, this grant was a great help in this postgraduate research project.

ZIRCONS SEPARATION, SELECTION AND U - PB ANALYSIS

The sample to be analyzed was taken from the field, and the unit was interpreted as a primary volcaniclastic density current with less than 5% in lithics. The preparation of the sample was done by crushed and milled of 2 kg of sample trough a specific protocol in order to separate the minerals from the rock sample. After that, the sieve of interest fraction and the separation of heavy minerals through hydraulic methods (using water and a separation pan) was done. Then, magnetic minerals were taken out using a neodymium magnet.

Figure 3.- Sample preparation and hand picking at the Centro de Investigaciones Geológicas.

Finally, we did the hand picking with binocular magnifying glass. According to determine the cristalization age, volcanic zircons with euhedral developed and clean faces, prismatic habit and without fractures or strange shapes were selected. As a result, 300 zircons were separated and sent to the Radiogenic Isotope and Geochronology Lab (RIGL) located in Washington State University, United State of America.

At the Radiogenic Isotope and Geochronology Lab (RIGL) zircons were analyzed for their U-Pb using the data reduction protocol described in detail by Chang et al. (2006). Each analysis consists of a 30 second gas blank followed 35 seconds of ablation. Analyses were conducted using a New Wave 213nm solid state (Nd:YAG) laser ablation system couple to a ThermoFinnigan Element2 ICPMS. Laser ablation parameters used for this study employed laser spot size diameters of 30μm, with a repetition rate of 10Hz, and a few of ~5-7 J/cm2.

For each analysis, the first ~6 seconds of data produced, as the sample signal reaches maximum signal intensity, are not considered.

Analyses of unknown zircons and quality control zircons are interspersed with analyses of external calibration standards, typically with 10-12 unknowns bracketed by multiple analyses of two different zircon standards (Plešovice and FC-1). Plešovice (337 Ma; Sláma et al., 2008) was used to calibrate the 206Pb/238U and 207Pb/235U ages, and FC-1 (1099 Ma; Paces and Miller, 1993) was used for calibration of 207Pb/206Pb, owing to much higher count rates for 207Pb (~24 times higher than Plešovice). Final ages were determined using a standard-sample bracketing approach. Common lead was corrected using 207 Method. The concentrations of U, Th, Pb are estimated by interspersing analyses of NIST610 glass which has well characterized concentrations of these elements.

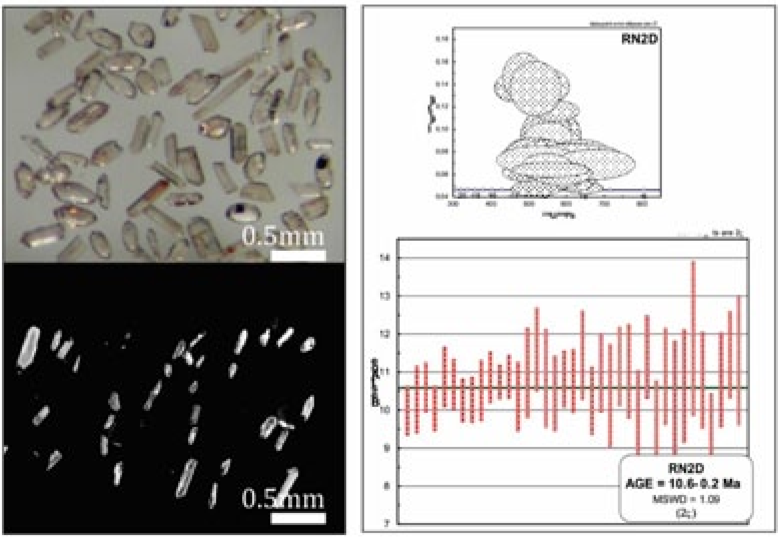

Figure 4.- Resultsfrom the U-Pb analyses.

RESULTS

61 zircon crystals were analyzed. As a result, a very consistent U – Pb age was constrained. The maximum frequency was between 10 and 11Ma, therefore the crystallization age of the ignimbrite was determined to 10,06 ± 0,2 Ma (Fig. 4). Just one zircon show a 280Ma age, and it was interpreted as inherited from a lithic that could be associated to the basement that surround the basin.

With this new age constrained, we are allowed to link the sedimentary infill of the basin with the Global Magnetic Polarity Log. Magnetostratigraphic analyses is being carried out at the Daniel A. Valencio Palaeomagnetism Laboratory of the Instituto de Geociencias Básicas, Aplicadas y Ambientales de Buenos Aires (IGEBA) at the Ciudad Universitaria, Autonomous City of Buenos Aires, Argentina.

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Sedimentology

to face societal challenges
on risk, resources
and record of the past

SAPIENZA
UNIVERSITÀ DI ROMA

34th International Meeting of Sedimentology

Venue

The Meeting will be held at the Sapienza University of Rome. The campus (Città Universitaria) lecture rooms offer all the facilities needed for a such large conference. It is located in centre of Rome, a few hundreds metres far from the main railway stations where shuttle trains and buses from international airports arrive. Countless hotels and tourist facilities are present nearby, as well as along the subway lines, whose stations are located at walking distance from the campus.

Key dates

15 August 2018 1st circular and call for sessions
31 October 2018 deadline for call for sessions
31 December 2018 2nd circular and early bird registration
30 March 2019 deadline for abstract submission
30 May 2019 regular registration
15 June 2019 3rd circular (program)
15 August 2019 deadline for regular registration

Meeting Calendar

6-9 September pre-meeting field trips and short courses
9 September ice breaker
10-11 September scientific sessions
12 September one day field trips, workshops and short courses
13 September scientific sessions
14-18 September post-meeting field trips

Field trips

8 pre-, 8 post- and several intra-meeting field trips

Organizing Committee

Francesco Chiocci (Rome), Marco Brandano (Rome).
Daniele Casalbore (Rome), Simonetta Cirilli (Perugia), Vincenzo Pascucci (Sassari), Luisa Sabato (Bari), Marcello Tropeano (Bari).
Sivano Agostini, Sergio Cappucci, Stefano Catalano, Domenico Cosentino, Chiara D'Ambrogi, Giancarlo Davoli, Farbizio Galadini, Maria Cristina Giovagnoli, Fabrizio Lirer, Lucia Marinangeli, Massimiliano Moscatelli, Paola Petrosino, Michele Rebesco, Andrea Sposato.

IAS
INTERNATIONAL ASSOCIATION OF SEDIMENTOLOGISTS

The International Association
of Sedimentologists
and
Sapienza University
invite you to Rome
for the 34th IAS Meeting
10th – 13th September, 2019

Website (available from 20th August)
www.iasroma2019.org

Correspondence
iasroma2019@uniroma1.it

IAS
INTERNATIONAL ASSOCIATION OF SEDIMENTOLOGISTS

34th International Meeting of Sedimentology 2019
10-13 September, Rome ITALY

SAPIENZA
UNIVERSITÀ DI ROMA


TURKISH SEDIMENTOLOGY WORKING GROUP
SÇG
2018 WORKSHOP
Sedimentary Records of Colluvial, Coastal and Fluvial Depositional Processes
2018
6-9
SEPTEMBER
SAKARYA
- Sedimentary Structures & Depositional Environments
- Dating & Sampling Methods
- Facies Properties
- Geomorphological Processes
- Sedimentary Petrography
- Diagenesis
- Quaternary Depositional Environments
Sessions
6-7 September
Sakarya University, Faculty of Law
Prof. Dr. Sebahattin Zaim Conference Hall
Field Trip
8 Sep: Sakarya & Mudurnu River Terraces
9 Sep: Kefken Coastal Cliffs & Karasu Delta and Dunes
Abstract Submission
Deadline: 01 June 2018
Contact
scg2018@sakarya.edu.tr
(M. Korhan ERTURAÇ / Ozan ERDAL)
IAS
SAKARYA ÜNİVERSİTESİ
scg2018.sakarya.edu.tr

EARLY CAREER SCIENTISTS RESEARCH GRANTS

Post-Doctoral Research Grants are intended as a seed to assist early-career post-doctoral researchers in either establishing a proof of concept, in order to support applications to national research funding bodies, or to fund areas of a project that were not included in the original project scope.

Up to 4 grants, each to a maximum of 2,500, are awarded twice per year to Early Career IAS members – those that have secured their Ph.D. within the previous 7 years.

Applicants should apply for a Post-Doctoral Research Grant via the IAS website. The application requires submission of a research proposal with budget and CV (template provided on the submission webpage), and a letter of support from the researcher's supervisor, line manager or Head of School.

Eligibility:

- Applicants must be full members of the IAS.
- Applicants must have secured their Ph.D. within the previous 7 years.
- Applicants can only benefit from a Post-Doctoral grant on one occasion.

Proposals will be ranked on the following criteria:

- Scientific quality of research, novelty and timeliness, likely output.
- Feasibility.
- Cost effectiveness.
- The scientific and publication track record of the investigator.
- Demonstration that the proposed work cannot be conducted without a grant.
- Researchers that are not supported by substantial funding.
- Preference is given to applications for a single purpose (rather than top-ups of other grant applications).

Application requirements:

Applications must be made via the IAS web site.

- Research Proposal, maximum 3 pages A4, including:
- Rationale and scientific hypothesis to be addressed
- Specific objectives of the research
- Anticipated achievements and outputs
- Methodology and approach
- Research plan

- A list of pending and previous applications for funds to support this or related research.
- CV of the applicant, maximum 2 pages A4.
- Justification of the proposed expenditure, up to 1 page of A4. If other individuals are to be involved with the project, this document must include a clear explanation of their role and costs.

Examples of funding

- Direct costs of fieldwork.
- Laboratory analysis.
- Specialist equipment (not computers).

Funding exclusions

The IAS does not offer funding for the following costs:

- Investigator's salary costs.
- Travel to attend a scientific conference, workshop or exhibition.
- Core funding or overheads for institutions.
- Student tuition fees and summer research bursaries.

Deliverables

- The IAS should be acknowledged in all reports, presentations and publications produced as a result of the awarded grant.
- A report should be submitted to the IAS detailing the outcomes of the research.
- Where a publication is produced then this may be submitted in lieu of a report.

INSTITUTIONAL IAS GRANT SCHEME (IIGS)

IIGS Guidelines

Special IAS Grants or Institutional IAS Grants are meant for capacity building in third world countries. There exists a list of 'Least Developed Countries' (LDC) by the UN. This list categorizes countries according to income per capita and is yearly updated.

Grants are allocated to allow Geology Departments in LDC to acquire durable sedimentological equipment for teaching and research (like sieves, calcimeters, auger drilling tools, etc.) or tools that can be used by all geology students (like general geology/sedimentology textbooks, IAS Special Publications (SP), memory sticks with back issues of Sedimentology or SP, etc). Therefore, the grant application should clearly demonstrate to increase the recipient's capacity to teach sedimentology at the undergraduate level (Bachelor) in a durable way. It should also indicate in what way it would enable to support sedimentological research at the graduate level (Master).

Applicants should have a permanent position at their University and should be IAS Full Members. Applications should be submitted by email to the Office of the Treasurer (ias-office@ugent.be) and contain the following information (not exhaustive list):

- the mission statement of the University/Geology Department
- the approval of the University Authorities to accept the grant
- a list of permanent teaching and technical staff members of the Geology Department (with indication of their area of research)
- the structure of the geology undergraduate and graduate courses (Bachelor/Master programme with indication of courses and theoretical and practical lecture hours)
- the number of geology students
- the actual facilities for geology/sedimentology students
- a motivation of application
- a budget with justification
- the CV of the applicant, including a sedimentology research plan

The institutional grant scheme consists each year of 2 sessions of 1 grant of 10.000 Euro. Applications run in parallel with the PhD research grant scheme (same deadline for application and recipient notification). The IAS Grant Committee will seek recommendations from relevant National Correspondents and Council Members (eventually including visitation) before advising the IAS Bureau for final decision. Additional funds made available by the recipient's University are considered as a plus.

Items listed in the application will be bought through the Office of the IAS Treasurer and shipped to the successful applicant. By no means money will be transferred to the grant recipient.

POSTGRADUATE GRANT SCHEME (PGS)

PG Guidelines

IAS has established a grant scheme designed to help PhD students with their studies by offering financial support for fieldwork, data acquisition and analysis, visits to other institutes to use specialized facilities, or participation in field excursions directly related to the PhD research subject.

Up to 10 grants, each of about 1,000 Euro are awarded, twice a year. These grants are available for IAS Student Members only. Students enrolled in MSc programs are not eligible for funding and research grants are not given for travel to attend a scientific conference, nor for the acquisition of equipment.

Applicants should apply for a postgraduate grant via the IAS website. The application requires submitting a research proposal with budget and CV (template provided on the submission webpage) and a letter of support from the student's supervisor. After the deadline has passed, the IAS Bureau evaluates the submitted applications and makes a final selection. Applicants are personally informed by the Office of the Treasurer about their grant. The grants are transferred to the applicants' bank account upon submission of a short scientific and financial report.

Eligibility and selection criteria:

- Applicants must be enrolled as a PhD student;
- Applicants can only benefit from a postgraduate grant once during their PhD;
- In the evaluation process preference will be given to those applications that i) can convincingly demonstrate that the proposed work cannot be conducted without the grant, and ii) are not supported by substantial industry funding.

Application

The application should be concise and informative, and contains the following information (limit your application to 1250 words max.):

- Research proposal (including Introduction, Proposal, Motivation and Methods, Facilities) – max. 750 words
- Bibliography – max. 125 words
- Budget – max. 125 words
- Curriculum Vitae – max. 250 words

Your research proposal must be submitted via the Postgraduate Grant Scheme application form on the IAS website before the application deadline. The form contains additional assistance details for completing the request. Please read carefully all instructions before completing and submitting your application. Prepare your application in 'Word' and use 'Word count' before pasting your application in the appropriate fields.

A recommendation letter from the PhD supervisor supporting the applicant is mandatory, as well as a recommendation letter from the Head of Department/Laboratory of guest institution in case of laboratory visit. The letter needs to be uploaded by the candidate, when submitting his/her application, and not be sent separately to the Office of the Treasurer.

Please make sure to adequately answer all questions.

Deadlines and notifications

Application deadline 1st session: 31 March.

Application deadline 2nd session: 30 September.

Recipient notification 1st session: before 30 June.

Recipient notification 2nd session: before 31 December.

NOTE: Students who got a grant in a past session need to wait 2 sessions (1 year) before submitting a Postgraduate Grant Scheme grant application again.

Students whose application was rejected in one session can apply again after the notification deadline of the rejected grant application

Application Form

- Research Proposal (max. 750 words)
- Title: ....
- Introduction (max. 250 words): .....

Introduce briefly the subject of your PhD and provide relevant background information; summarise previous work by you or others (provide max. 5 relevant references, to be detailed in the 'Bibliography' field). Provide the context for your PhD study in terms of geography, geology, and/or scientific discipline.

- Proposal (max. 250 words): ...

Describe clearly your research proposal and indicate in what way your proposal will contribute to the successful achievement of your PhD. Your application should have a clearly written hypothesis or a well-explained research problem of geologic significance. It should explain why it is important. Simply collecting data without an objective is not considered wise use of resources.

- Methods (max. 125 words): ....

Outline the research strategy (methods) that you plan to use to solve the problem in the field and/or in the laboratory. Please include information on data collection, data analyses, and data interpretation. Justify why you need to undertake this research.

- Facilities (max. 125 words): ....

Briefly list research and study facilities available to you, such as field and laboratory equipment, computers, library.

- Bibliography (max. 125 words)

Provide a list of 5 key publications that are relevant to your proposed research, listed in your 'Introduction'. The list should show that you have done adequate background research on your project and are assured that your methodology is solid and the project has not been done already. Limit your bibliography to the essential references. Each publication should be preceded by a '*'-character (e.g. *Surlyk et al., Sedimentology 42, 323-354, 1995).

- Budget (max. 125 words)

Provide a brief summary of the total cost of the research. Clearly indicate the amount (in Euro) being requested. State specifically what the IAS grant funds will be used for. Please list only expenses to be covered by the IAS grant. The IAS will support field activities (to collect data and samples, etc.) and laboratory activities/analyses. Laboratory activities/analyses that consist of training by performing the activities/analyses yourself will be considered a plus for your application as they will contribute to your formation and to the capacity building of your home institution. In this case, the agreement of the Head of your Guest Department/Laboratory will be solicited by automated e-mail.

- Curriculum Vitae (max. 250 words)

Name, postal address, e-mail address, university education (degrees & dates), work experience, awards and scholarships (max. 5, considered to be representative), independent research projects, citations of your abstracts and publications (max. 5, considered to be representative).

- Advise of Supervisor and Head of Guest Department/Laboratory

The recommendation letter from the supervisor should provide an evaluation of the capability of the applicant to carry out the proposed research, the significance and necessity of the research, and reasonableness of the budget request. The recommendation letter must be uploaded by the applicant together with the rest of the application content. Applications without letter of support will be rejected. It will be considered as a plus for your application if your PhD supervisor is also a member of IAS.

If you apply for laboratory analyses/activities, please carefully check analysis prices and compare charges of various academic and private laboratories as prices per unit might differ considerably. Please first check whether analyses can be performed within your own University. If your University is not in a position to provide you with the adequate analysis tools, visiting another lab to conduct the analyses yourself strengthens your application considerably as it contributes to your formation and to capacity building of your home University. Please check with the Head of Department/ Laboratory of your guest lab to assure its assistance during your visit. You should add a letter of support from him/her with your application.

Finally, before submitting your application, you will be asked to answer a few informative questions by ticking the appropriate boxes.

- is your supervisor a member of IAS
- was this application your own initiative
- did you discuss your application with your Supervisor
- did you already have contact in the past with the Head of the Guest Department/Laboratory (if appropriate)

CALENDAR

*The Indonesian Sedimentologists Forum (FOSI)

5th-6th September 2018
Yogyakarta, Central Java, Indonesia,

www.iagi.or.id/fosi

*Sedimentary Records of Slope, Beach and Fluvial Processes

6th-9th September 2018
Sakarya, Turkey

Ezher Toker Tagliasacchi
egulbas@pau.edu.tr

*VII Argentinean Meeting on Quaternary and Geomorphology

8th-21st September 2018
Puerto Madryn, Argentina

http://www.cacg2018.cenpat-conicet.gob.ar/

*8th Sedimentary Provenance Analysis (SPA) Short Course

24th-28th September 2018
Göttingen, Germany

http://www.sediment.uni-goettingen.de/spa2018/home.html

Seismic Characterisation of Carbonate Platforms and Reservoirs

10th-11th October 2018
London, United Kingdom

https://www.geolsoc.org.uk/carbonateplatforms18

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*International Meeting around the Jurassic-Cretaceous Boundary

5th-7th December 2018
Geneva, Switzerland

https://php5.univ-brest.fr/conference/ocs/index.php/JK2018/JK2018

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*BSRG Annual General Meeting 2018

17th-22th December 2018
Edinburgh, UK

http://lyellcentre.ac.uk/news/bsrg.html

34th IAS Meeting of Sedimentology

10th-13th September 2019
Rome, Italy

http://iasroma2019.org

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