Geometry and facies heterogenities across an Upper Jurassic sand-shoal complex (Iberian Basin, NE Spain)

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The Kimmeridgian (Upper Jurassic) outcrops of Ricla (Iberian Ranges, NE Spain) expose the shallow areas of a mixed siliciclastic-carbonate (i.e., oolitic) platform in different dip to strike-oriented sections. Extensive fieldwork on these outcrops has resulted in a precise facies reconstruction of an oolitic-siliciclastic sand-shoal complex and its heterogeneities, across a 4 x 1 km (downdip x strike) square area. Lithofacies, building blocks and master bedding surfaces have been mapped and accurately delimited using high-resolution continuous photomosaics on selected panoramic outcrops. Paleocurrent measurements, characterizing the vertical and lateral variations of bedforms migration, and logging and sampling for a detailed lithofacies reconstruction have completed the obtained data.

The oolitic-siliciclastic sand-shoal complex is up to 22 m-thick in proximal (Northern) areas and phinches out basinward (to the South), down to 5 m-thick in distal localities. A number of facies types dominated by different cross-bedded structures have been mapped across the down-dip and strike sections, which are arranged in two vertically stacked shallowing-upward sequences in proximal localities.

Large-scale planar cross-bedded lithofacies (sets 1–3 m in thickness) and smaller-scale planar cross-bedded lithofacies (sets <1 m in thickness) compose the larger volume of the sand body. How these facies are inter-related within individual building blocks and how they are pilled along the whole sedimentary body is an issue discussed in this work. Southeast to southwest oriented paleocurrents, measured on the planar cross-bedded units, indicate a dominant offshore migration of large-scale bedforms due to unidirectional storm-induced return currents. The upper part of the two shallowing-upward sequences show more dispersed palaeocurrents, indicating a significant contribution of the inshore and alongshore currents in shallower parts of the oolitic-siliciclastic sand-shoal complex. The observed facies architecture was the result of a rapid sand-shoal progradation, which has been related to the stage of stillstand of sea level observed across the Iberian basin at the onset of the Late Kimmeridgian (i.e., late regressive stage of the third-order Kim-1 Sequence).

Sedimentary evolution within the studied sand-shoal complex was controlled by the interaction between sedimentary production (i.e., ooid generation and terrigenous input), hydrodynamic energy (mainly storm-induced return currents) and relative sea-level changes.

Seismic or aseismic turbidites? – new insights from X-ray computed tomography

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One of the main challenges in turbidite paleoseismology is proving that the turbidites are indeed triggered by earthquakes, both in marine and lacustrine environments. It is generally accepted that when underwater landslides occur simultaneously on different (types of) slopes and in different (sub)basins, they must be earthquake-triggered. The same logic holds for turbidites, as long as they are not originating from river-discharge events. However, single turbidites are often too thin to be distinguished on reflection-seismic profiles, which are commonly used to determine simultaneous triggering of landslides. Therefore, many sediment cores are needed to prove this simultaneous turbidite triggering. We studied sediment cores containing recent earthquake-triggered turbidites in a Chilean fjord (Aysén), and in lakes in Chile (Panguipulli and Pellaifa), Alaska (Skilak and Kenai) and Switzerland (Lucerne), using medical X-ray computed tomography (CT) scanning. CT scans can be used to determine relative flow directions in turbidites by studying orientations of sedimentary structures (e.g. convolute lamination) and fabrics (e.g. imbrication). We show that most of the earthquake-triggered turbidites are not single but rather stacked turbidites, resulting from simultaneous triggering of turbidity currents in different source areas. Alternating flow directions from these different turbidite sources are seen in Bouma Ta-Td divisions. Apart from grain-size independent variations in mineralogy within a turbidite (Nakajima and Kanai, 2000; Gutierrez-Pastor et al., 2013), this is up to now the only method to show stacking of turbidites, thereby suggesting their earthquake origin.

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Improving the interpretation of event deposits using X-ray CT scans

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It is not always straightforward to determine the triggering processes responsible for the formation of event deposits such as turbidites in marine and lacustrine environments. Especially when studying sediment cores, which have typically diameters of only 5 to 11 cm, only a small spatial window is available to study the deposits. We have performed medical X-ray CT scans (Siemens SOMATOM Definition Flash) at the Ghent University Hospital on sediment cores from Chilean and Alaskan lakes and a Chilean fjord. Even though we only used rather low-resolution CT scans (0.6 mm voxel size), many sedimentary structures and fabrics that are not visible by eye, became obvious. For example, the CT scans allowed to distinguish between tephra layers that are deposited by fall-out, those that reached the basin by river transport or mud flows, and tephra layers that have been reworked and re-deposited by turbidity currents. Moreover, the 3D environment of the CT scans also allowed to examine relative orientations of sedimentary structures (e.g. convolute lamination) and fabrics (e.g. imbricated mud clasts), which can be used to reconstruct flow directions. Such relative flow directions can be used to determine whether a deposit (e.g. a turbidite) had one or several source areas. When the sediment core can be oriented (e.g. using paleomagnetic properties), the absolute flow directions can be reconstructed. All this extra information can help determining whether an ash layer was deposited as fall out from an ash cloud, or fluvially washed into the lake, or whether a turbidite is earthquake triggered, or not.

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Dolomitization of the Jurassic open-marine Sargelu Formation, NE Kurdistan (Iraq)

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The Sargelu Formation is one of the main hydrocarbon reservoir rocks in Kurdistan (North-East Iraq). The thickness of the formation decreases from about 485 m west of the Tigris River in the Mosul area toward north where it is 30-40 m thick. In the area studied, the formation is 80-120 m thick. This study was performed on the core samples from exploration wells located in area of NE region of Kurdistan (Iraq).

The formation consists of black, hydrocarbon impregnated, tight, thin-bedded marl and limestone, which are often partly dolomitized. Black thin chert streak occasionally appears. The sedimentary features and the fauna content (radiolarians, planktonic bivalves) indicate pelagic, open marine depositional environment. Deposition within the basin occurred in a low-energy, relatively deep water. On the bases of the fauna and the stratigraphic position the age of the formation is Middle-Late Jurassic.

The main interest in the formation is the presence of dolomite. The majority of the medium-sized (*ca* 100–150 μm) dolomite crystals have subhedral and euhedral shape. The dolomite partially replaced the micrite matrix. In the rocks, dissolution seams are common, which are usually surrounded the dolomite crystals. Dolomite crystals in some beds possess irregular and uneven surface that point to corrosion of the crystals. The observation that calcite spars surround the dolomite crystals suggests calcitization of the dolomite. Hairline calcite veins cut across the rocks. The dolomitization probable took place in intermediate burial depth likely just before the onset of chemical compaction. Dolomite dissolution and calcite precipitation, or calcite replacement occurred in a successive diagenetic stage. The next step of the study aims the geochemical analyses that will likely help to understand the dolomitization and diagenetic processes.

Experimental and Natural Dolomite Precipitation under Earth Surface Conditions: Insights on Nucleation and Crystallization Processes

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The plentiful abundance of sedimentary dolomite in the geologic rock record has remained an egnimatic problem for carbonate sedimentologists for more than 100 years. Questions surrounding its frequent occurrence in the geologic record versus its rare appearance in modern sediments have long focused on the thermodynamics and kinetic principles promoting its formation, either by direct preciptiation or so-called replacement dolomitization. With the advent of modern crystallographic techniques, additional controvery has surrounded the naming of the generally non-stoichiometric ("non-ideal") sedimentary dolomite and how it relates to the well-defined 50:50 Ca:Mg composition of stoichiometric "(ideal") dolomite. With the addition of a biological/organic factor promoting the precipitation of low-temperature (<50^{o}C), it is now possible to study dolomite formation in the laboratory and relate these experimental conditions to those measured in the rare modern environments where dolomite precipitates. The aim of this correlation between laboratory experiments and natural ennvironments is to better understand the initial mineralogy of the Ca-Mg-carbonate precipitate and how it evolves during very early diagenesis from disordered/non-stoichiometric to ordered/stoichiometric dolomite.

However, laboratory microbial experiments performed to simulate biomineralization processes under Earth surface conditions remain contentious due to the fact that natural settings are dynamic systems, and "in vitro" duplication of natural processes is quite challenging. Thus, this experimental methodology has been approached from diverse perspectives including studies of nucleation processes, crystallization and crystal ordering, as well as quantification of the role that metabolisms contribute to the mineral formation. Previous mineralogical and SEM investigations have shown that, in some natural environments, initial crystallization occurred in association with organic compounds (EPS), with a subsequent transformation from an initial amorphous precipitate into well-crystallized carbonate phases. In contrast, under laboratory conditions these processes were not observed, and the mass transfer of a solute from the liquid solution to a dolomite crystal is apparently related to the metabolic rate and temperature. Indeed, at 25°C, a mixture of high Mg-calcite and poorly ordered non-stoichiometric Ca-dolomite precipitated, whereas, in contrast, at 45°C, the mineral product recovered was 100% fully ordered stoichiometric dolomite.

Here, we present a study designed to understand low-temperature experimental and natural processes, which lead to the crystallization of fully ordered dolomite. We hypothesis that, in the temperature controlled laboratory experiments, we are replicating the mineralogic transtion that may occur with a reordering of the mineral composition from the intial highly disorderd, non-stoichiometric dolomite to a more stoichometric dolomite during early stage diagenesis and burial, i.e., reflecting the naturally increasing temperature changes occurring with the transition from dolomitic mud to dolomite rock. Finally, we propose that our comparative study of natural and experimental dolomite can help to clarify the processes involved during dolomite formation and furnish important insight to better understand low-temperature dolomite occurrences in the geological record.

A peculiar wave-dominated siliciclastic system in the Fezouata and Zini formations, Lower Ordovician, Morocco: a possible tide influence?

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In the central Anti-Atlas (Zagora, Morocco), the Lower Ordovician (Tremadocian to Floian) consists in ca. 1000m of fossiliferous siltstones and sandstones. It is represented by the Fezouata and Zini formations. One of the most important radiation of the Phanerozoic, the Great Ordovician Biodiversification Event (GOBE), is recorded in the Lower Fezouata Formation with many layers containing exceptionally preserved soft tissues of animals. More than 1,500 soft-bodied specimens have been collected.

In order to constrain the paleoenvironmental conditions favouring exceptional preservation of fossils, a model of deposition for the Fezouata and Zini formations was achieved. These two formations were deposited during a long-term transgressive cycle on a siliciclastic platform at the periphery of the Gondawana at high paleolatitude (ca. 60°S).

Fifteen sections have been logged and correlated using facies analysis, thin section description and available biostratigraphic data (graptolites, chitinozoans, trilobites). Generally, the sedimentary environment is a wave-dominated siliciclastic system with numerous small- and large-scale ripples pointing to a dominant storm- and wave-influence on sedimentation. The Fezouata and Zini formations record sedimentary environments from proximal offshore to foreshore. Our model suggests that the layers containing exceptional preservation of fossils are located in the proximal offshore to distal lower shoreface.

Peculiar sedimentary organization and sedimentary structures are observed in the wave-dominated system of the Fezouata and Zini formations. These suggest a second influence on sedimentation: (1) at any scale of observation (from one storm event to groups of storm events), the sediments are deposited in lobes, and sometimes channel-lobes; (2) internal erosion in storm deposits is very common; (3) multiple changes in the size of wave-oscillation structures within a single storm event point to a modulation of oscillation intensity during the storms; (4) aggrading-prograding wave-ripples are commonly observed; and (5) the foreshore environment is characterized by alternating phases of deposition of parallel stratifications, large-scale ripples, small-scale ripples, and frequent beach cusps. These various characteristics of deposition suggest that wave intensity during storms or during fair weather is continuously modulated by another controlling factor of the sedimentation. We suggest an indirect tide influence on the deposition of the Fezouata and Zini formations, and propose a model of deposition for this mixed, wave-dominated, tide-influenced sedimentary context.

Development of a new methodology for the estimation of beach vulnerability to sea level rise - an application to the Aegean Sea

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Beach erosion, which is already significant along the global coastline, is likely to be exacerbated due to mean sea level rise (SLR) and changes in the wind/wave regimes and coastal sediment supply. The aim of the present contribution is the development of a methodology that can estimate the range of beach retreat for morphologically different beaches, under various scenarios of long- and short-term sea level rise and different conditions/forcing. This methodology was applied to assess the vulnerability of all Aegean Sea island beaches in Greece.
A database of the spatial (length, width, orientation) and -where such information is available- of the geological and hydrodynamic characteristics of all the Aegean island beaches has been assembled (Aegean Island Beach Inventory-AIBI). Beach spatial characteristics were recorded/analysed using widely available remote sensing information (Google Earth Pro) and web-GIS tools.
Six analytical and numerical morphodynamic models were used to form suitable model ensembles in order to simulate (long- and short-term) beach retreats and assess their range under different morphological (beach slopes), sedimentological (grain size), wave conditions and different scenarios of mean sea level changes. These ranges were then compared to the beach width maxima of the Aegean island beaches recorded at the AIBI, to project potential retreats and assess their vulnerability.
The Aegean Archipelago beaches were found to consist of medium-grained sediments and to be limited in size, (> 64% and 94% of all beaches showed maximum widths < 20 and < 50 m, respectively). Statistical analysis of the spatial and geological characteristics of the beaches did not show significant correlations, except between the presence of river mouths and the area of the beaches (Pearson correlation value of $r = 0.15$ (on the $p = 0.01$ level, 2-tailed). Comparison between beach maximum widths and the beach retreat projections from the morphodynamic model ensemble showed that sea level rise may have devastating impacts: almost 20% of all beaches will be inundated to about 50% of their maximum width under a 0.6 m SLR, whereas in the case of a 1.0 m SLR, ~90% of all beaches may retreat/lose more than 50% of their maximum width and ~68% will be entirely lost.

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Morphodynamics of supercritical-flow bedforms using a depth-resolved computational fluid dynamics model

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Unidirectional, supercritical, free-surface flows over sediment beds often lead to the formation of supercritical-flow bedforms. These bedforms include cyclic steps (associated with trains of hydraulic jumps) and antidunes (associated with free-surface waves), and have been observed in open-channel flows in both natural and experimental settings, as well as in depth-averaged numerical simulations. The morphodynamics of these supercritical-flow bedforms are, however, still poorly understood, especially due to a lack of measurements of flow processes occurring within the flow. This study aims to gain insight into the processes associated to both the formation of these bedforms as well as their temporal evolution, by simulating a turbulent, supercritical, sediment-laden flow over an erodible bed, using the commercial code MassFLOW-3D. MassFLOW-3D and the kernel FLOW-3D code use a multiphase Reynolds-Averaging Navier-Stokes model in combination with built-in scour model, RNG k-epsilon turbulence model and fractional area/volume obstacle representation (FAVOR) which allows rendering of intra-cell geometries for deposition, transport and erosion of sediments.

The influence of sediment grain size, specific discharge and initial sediment concentration on the supercritical-flow bedforms are investigated. The simulations have successfully shown to be able to simulate upstream migrating cyclic steps, other bedforms observed in the simulations do not appear to fall into the classification scheme of supercritical-flow bedforms. It could either be that those bedforms cannot be classified as discretely as previously thought, or, that the model is unable to capture the dynamics of the complete range of supercritical-flow bedforms. A parameter which is able to predict when cyclic steps are formed has been determined. A novelty in this study are the depth-resolved flow-properties, which give more insights in the dynamic interaction between the flow and the sediment bed over the bedforms on an intra-bedform-scale. Flow-velocity-distribution affects shear-stresses and hence, dominates sediment transport, resultant sediment concentrations and depositional/erosional patterns on their turn affect the velocity structure again.

Giant supercritical-flow bedforms on a Carboniferous delta front (Pennine Basin, UK): record of long-lived paleotropical flood on early Pangea

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Recent developments in fluvial sedimentology suggest that rivers in tropical monsoonal settings are subject to prolonged hydrological inactivity alternating to (inter)annual pluvial phases of flood-prone behavior with occasional extreme discharges. This regime is recognizable by sedimentological traits such as great volumes of supercritical-flow bedforms, vegetation-induced sedimentary structures within channel fills, and coarse overbank facies. Distally linked deltas might feature unusual facies and architectures, but this hypothesis remains poorly explored.

Late Carboniferous sandstones of the Lower Kinderscout Grit (Millstone Grit Group, Pennine Basin) in northern England were deposited in fluvio-deltaic to shallow-marine settings at paleoequatorial latitudes in a back-arc basin north of the Variscan orogenic belt, during early assemblage of the Pangean megacontinent. Several outcrops comprise large undulating bedforms and singular facies architectures traditionally interpreted as river flood deposits or migrating channel confluences. Insights from flume experiments and submarine observations have extended our knowledge of sediment-bed configurations under supercritical currents, including the identification of a new bedform category, 'cyclic steps', developed at maximum Froude numbers. The geometry of such bedforms provides a close match for the complex stratal configuration at the Derby Delph Quarry (near the Booth Wood Reservoir, Rishworth, West Yorkshire), a classical exposure for sedimentological analyses of the Millstone Grit. The main quarry rockwall shows sets of large-scale (12 m high, 10s of meters in wavelength), undulating, massive sandstone beds with down- and upcurrent dip and fully aggradational, conformable geometry within sets; adjacent sets are separated by erosive surfaces uniformly dipping downcurrent. Individual sandstone beds are laterally continuous, commonly massive, poorly to very poorly sorted, generally ungraded, with only local evidence of smaller (decimeter scale), superposed tractive bedforms, mostly of supercritical-flow origin. A similar geometry is observable in 3D at a lower stratigraphic level along the opposite bank of the Booth Wood Reservoir, although vegetation and the quarry pavement do not consent to ascertain whether the two exposures belong to the same depositional event.

Reinterpretation of sandstone strata at Derby Delph as aggraded under migrating cyclic-steps provides a parsimonious, all-encompassing depositional model accounting for the unusual scale and architecture of these sedimentary structures, and for the virtual absence of fine-grained partings, erosive surfaces, subcritical-flow structures and reworked horizons. The large volume of gravelly sand was probably deposited by a protracted, sediment-laden hyperpycnal current along a proximal delta slope; sedimentological evidence is strongly suggestive of a single depositional event. Paleogeographic reconstructions of the Late-Carboniferous Pennine Basin imply that the region was subject to a tropical climate with elevated seasonality and enhanced monsoonal circulation along the eastern, windward margin of the early Pangean landmass. Combined with the paleoclimatic context, the interpreted nature of the sedimentary structures described here suggests a possible additional criterion to recognize exceptional hydrological events in ancient fluviodeltaic settings subject to flood-prone regimes.

3D Palinspastic Reconstructions of the Phanerozoic *versus* Sea-Level and Sr-ratio Variations

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A full global geodynamical model over 600 million years (Ma) has been developed at the University of Lausanne during the past 20 years. We show how the 2D maps can be converted in 3D (*i.e.* full hypsometry and bathymetry), using a heuristic-based approach. Although the synthetic topography may be viewed as relatively crude, it has the advantage of being applicable anywhere on the globe and at any geological time. The model allows estimating the sea-level changes throughout the Phanerozoic, with the possibility, for the first time, to flood continental areas accordingly. One of the most striking results is the good correlation with 'measured' sea-level changes, implying that long-term variations are predominantly tectonically-driven. Volume of mountain reliefs are also estimated through time and compared with strontium isotopic ratio, commonly thought to reflect mountain belt erosion. The tectonic impact upon the general Sr-ratio trend is shown for the first time, although such influence has long been inferred.

Geodynamic evolution of the Earth over the Phanerozoic: Plate tectonic activity and palæo-climatic indicators

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During the last decades numerous local reconstructions based on field geology were developed at the University of Lausanne. They participated to the elaboration of a 600 Ma to present-day global plate tectonic model deeply rooted in geological data, controlled by geometric and kinematic constraints and coherent with forces acting at plate boundaries.

We have compared values derived from the tectonic model (age of oceanic floor, production and subduction rates, tectonic activity) with a combination of chemical proxies (namely CO_2, $^{87}Sr/^{86}Sr$, glaciations evidence, and sea-level variations) known to be strongly influenced by tectonics. One of the outstanding results is the observation of an overall decreasing trend in the evolution of the global tectonic activity, oceanic mean ages and plate velocities over the whole Phanerozoic. We speculate that it reflects the global cooling of the Earth system. Additionally, the parallel between the tectonic activity and CO_2 together with the extension of glaciations confirms the generally accepted idea of a primary control of CO_2 on climate and highlights the link between plate tectonics and CO_2 in a time scale greater than 10^7 yr. Lastly, the wide variations observed in the reconstructed sea-floor production rates are in contradiction with the steady-state model hypothesized by some.

Comparing Mediterranean and NE Atlantic cold-water coral mounds: spatial and temporal distribution of benthic carbonate associations

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Cold-water coral (CWC) mounds located along the Atlantic and Mediterranean margins have been subject of intensive research during the last 15 years. Data collected in over a hundred of oceanographic cruises have highly increased our knowledge on CWC mound typologies, settings and on the environmental factors controlling their evolution. Nevertheless, there is still a poor knowledge about calcifying benthic organisms characterizing CWC communities, though their skeletal accumulation represents the dominant component of most mound facies and can provide important insights on the mound evolutionary stages.
This study focuses on benthic carbonate associations (BCA) collected, through box- and gravity cores, from selected CWC mounds located in four key regions: 1. Santa Maria di Leuca CWC Province, Ionian Sea, Central Mediterranean; 2. Melilla Mound Field, Alboran Sea, Western Mediterranean; 3. Pen Duick Escarpment, Gulf of Cadiz, NE Atlantic; 4. Moira Mounds, Porcupine Seabight, NE Atlantic. The main goals of this work are (1) to characterize modern BCA (bio- and thanatocoenoses) from the examined sites and to relate their spatial distribution to patterns in environmental variables and (2) to identify and interpret BCA variations through time in order to better understand the mound evolutionary processes.
Our preliminary results show that the modern BCA from the four analyzed regions share major common taxonomic components. Their spatial distribution, either within a single region or a single mound, is mostly influenced by local environmental variables such as the seafloor topography, the substrate composition and the intensity of bottom currents. However, NE Atlantic and Mediterranean coral-dominated BCA can be easily distinguished due to the presence of characteristic taxa, among which the solitary scleractinian *Carophyllia sarsiae* and the gastropod *Amphissa acutecostata*, common to abundant in the NE Atlantic CWC sites and absent (or rarely present as fossil) in the Mediterranean ones. Moreover, modern coral-dominated BCA from the Pen Duick Escarpment (Gulf of Cadiz), with a prevalent presence of dendrophylliid corals and a peculiar associated fauna, are clearly distinct from the Mediterranean and the Porcupine Seabight fields, dominated by *Madrepora oculata* and *Lophelia pertusa* respectively. Interestingly, although the modern NE Atlantic communities are known to be more diversified than the Mediterranean ones, the BCA from the Moira Mounds (NE Atlantic) show the lowest number of taxa among the examined sites. On the contrary, the benthic calcifying organisms (in particular molluscs) from the Alboran Sea mounds seem to be the most diversified and larger in size.
Regarding the temporal distribution of the examined BCA from CWC mounds, several variations observed along the gravity cores seem to be related to environmental changes at a local scale. However the appearance/disappearance of specific taxa and/or morphotypes (e.g. thick-walled *Lophelia pertusa*) as well as striking variations in the relative abundance of taxonomic groups hints at larger-scale oceanographic and sedimentary variations, probably related to climatic oscillations.

The USLE model applied to theVolturno River basin (Southern Italy) using GIS

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Assessing of the solid contribution provided by streams to a coastal setting plays a key role for the coastal equilibrium, as almost all coastal states in the world are to some extent affected by coastal erosion due to anthropogenic disturbances.
The intensity of denudation are influenced by many factors such as climate, soil type, morphology, hydrology, vegetation, as well as processing systems and cultivation.
This study aims at estimate the potential erosion and to calculate the sediment budget of the Volturno River basin, a 5,560 km² wide catchment located in the southern Appennines (Southern Italy), where there are no gauging stations to estimate soil loss, through the application of the Universal Soil Loss Equation (USLE) model using GIS. The USLE, proposed by Wischemeier and Smith (1978), represents a good compromise between applicability (availability of necessary input data such as climatic, topographic, soil and crop) and reliability (estimated soil loss) for the evaluation of the annual surface erosion of a single agricultural parcel.
The erosion map obtained highlights the most vulnerable areas interested by soil erosion and also gives an estimate of the maximum soil erosion. The latter is equal to 337350 t/ha/year; taking into account that the basin area is 565,344 ha, it is possible to define the average soil eroded for the entire basin as about 190×10^9 t/year. Annual soil loss ranged from 0 to 1,15 t/ha/year. The mean soil erosion amount in study area is 28 t/ha/year.
From the above it comes that about 53% of the catchment is affected by very low or null erosion, 7.5 % by low erosion, 10.6 % by moderate erosion, about 7 % by high erosion, 21.8 % by very high erosion. The erosion is almost absent (3.3%) in flat areas, in the urban and in the rocky areas.
On the whole, we can say that:
✓ in the mountain areas, the erosion process is highly influenced both by topographic features and by high values of rainfall erosivity (highest in these areas). Nevertheless, these factors are effectively limited by the calcareous lithology (usually poorly pedogenised) and the vegetative soil covering consisting in coniferous, broad leaved and mixed woods that greatly limit the spreading of the erosion phenomena;
✓ in the hilly areas, although both the topographical factor and the rainfall erosivity are slightly lower than in the mountain areas, the vegetative soil cover is thin, and consequently insufficient to oppose the spreading of erosion. The hilly areas are, therefore, more exposed to the erosion phenomena;
✓ in the flat area the erosion processes are highly influenced both by lithology and by land uses. In fact, the clay and volcanic soils, characterised by not irrigated arable land and systems of particles with permanent cultivations, are particularly vulnerable to erosion process.
Sensitivity analysis clearly show the significant relationship among land use and erosion process entities. Whereby, in particularly, here was required implementation of effective soil conservation measures to reduce soil erosion risk by implementing different soil conservation techniques especially on steep slopes.
The USLE map produced can be considered as a relevant document supporting all the activities related to land use planning and sustainable exploitation of soil resources. The above methodology provides also useful indications of mitigating intervention planning on erosion processes.

Pre-Salt South Atlantic carbonates, why are they so unconventional?

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Since several years the Pre-Salt carbonate reservoirs have been a main focus point in the petroleum industry. The unconventional location (200 km from the coast) of this game changer, in deeply buried conditions (up to 5500m) with excellent porosity index (up to 30%), is sufficient to open a new hydrocarbon province close to the continental/oceanic boundary.

Based on studies of several wells and 3D seismic data, we can now argue that the Pre-Salt carbonate reservoirs are characterized by a combination of lacustrine and hydrothermal carbonate-rich systems. The presence and development of such continental carbonates in an active rift context are very unconventional. Their location close to exhumed mantle could explain why travertine and coquina deposits can occur in this very special tectonic context.

The development of these different provinces is clearly linked to the tectonic evolution of the margin. The rheological behavior of the crust could control the shape of the lacustrine basins and their facies belts. Using in-house rift evolution nomenclature, 5 domains were described, from early (stretching) to late (spreading) evolution of the rift. Four coastal carbonate domains can be distinguished: (1) classical proximal coquina wedges, (2) isolated stromatolite-dominated platform, (3) travertine fissures ridges and (4) mixed coquina/travertine mounds.

Source rocks and coquina systems occur mainly during the stretching stage in small confined basins, while the stromatolite-dominated lacustrine system mainly developed during the thinning phase, in more extended basins. The occurrence of travertine is tectonically controlled (mainly close to the wrench zones) during the exhumation phase, associated with hydrothermal fluid circulations and serpentinization processes. This can explain the high volume of Ca and CO_2-rich water necessary to construct travertine edifices. Furthermore, the alteration of magmatic-rich rocks may have produced lare amount of Mg-clays that are observed in several places. The break-up event is contemporaneous with the salt deposits.

The presence of carbonate mainly controlled by CO_2 is very unconventional and their proximity to the mantle needs to be investigate in much more detail. The discoveries of several carbonate chimneys (“white smokers”) in normal marine conditions (Lost city, North Atlantic Ocean) and all the “chimneys” in normal lacustrine conditions (such as Abhe lake, Djibouti Republic) are very useful in deciphering the extreme complexity of this new carbonate province!

Mineral precipitation potential in hypersaline microbial mats: What we can learn from metabolic rates

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The precipitation potential of calcium carbonate in microbial mats depends on the balance of all of the metabolic processes as well as the properties of the extracellular organic matter (EOM). Microbial metabolism can alter the carbonate equilibrium, thereby changing the saturation index of calcium carbonate. The production of EOM (including exopolymeric substances (EPS) and low molecular weight organic carbon (LMWOC)) is the indirect result of microbial metabolism. This organic matrix plays a pivotal role in calcium carbonate precipitation as well. Lastly, the community metabolism is coordinated through chemical communication (or quorum sensing) between microbes in the mat.

We present an overview of metabolic rates of key functional groups of microbes measured at different salinities. These rates typically decrease with increasing salinity. Both EPS and LMWOC are important carbon sources that support heterotrophic activity of the microbial community. When the rate of EOM turnover is considered, there is a shift in the relative contribution of LMWOC: with increasing salinity from ~30 PSU to ~200 PSU, the relative turnover rate of EOM decreases more rapidly than the turnover rate of EPS. At salinities >200 PSU, the consumption of EPS virtually stops and the heterotrophic activity of the community is supported by LMWOC, notably that of C_1-compounds. When considering aerobic respiration and sulfate reduction, the relative contribution of the latter metabolism increases with increasing salinity. Interestingly, 3-5% of carbon in EPS supports relatively rapid microbial respiration at salinities lower than 200 PSU. The potential of EPS consumption is important with respect to calcium carbonate precipitation.

The majority of organic carbon production and consumption is found in the surface of the microbial mats: typically >90% of the inorganic carbon that is fixed through autotrophic processes is consumed within the oxic zone of the mat. This appears counterintuitive as consumption of organic carbon includes aerobic and anaerobic processes. The presence of supersaturated oxygen concentrations creates a challenge for anaerobic organisms; preliminary results indicate that chemical communication may play a role in resolving the physiological dilemma.

Paleoenvironments, Evolution, and Geomicrobiology in a Tropical Pacific Lake: The Lake Towuti Drilling Project

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Lake Towuti (2.5°S, 121°E) is a, 560 km^2, 200-m deep tectonic lake at the downstream end of the Malili lake system, a set of five, ancient (1-2 MYr) tectonic lakes in central Sulawesi, Indonesia. Lake Towuti's location in central Indonesia provides a unique opportunity to reconstruct long-term paleoclimate change in a crucially important yet understudied region- the Indo-Pacific warm pool (IPWP), heart of the El Niño-Southern Oscillation. The Malili Lakes have extraordinarily high rates of floral and faunal endemism, and the lakes are surrounded by one of the most diverse tropical forests on Earth. Drilling in Lake Towuti will identify the age and origin of the lake and the environmental and climatic context that shaped the evolution of this unique lacustrine and terrestrial ecosystem. The ultramafic (ophiolitic) rocks and lateritic soils surrounding Lake Towuti provide metal substrates that feed a diverse, exotic microbial community, analogous to the microbial ecosystems that operated in the Archean Oceans. Drill core will provide unique insight into long-term changes in this ecosystem, as well as microbial processes operating at depth in the sediment column.

High-resolution seismic reflection data (CHIRP and airgun) combined with numerous long sediment piston cores collected from 2007-2013 demonstrate the enormous promise of Lake Towuti for an ICDP drilling campaign. Well-stratified sequences of up to 150 m thickness, uninterrupted by unconformities or erosional truncation, are present in multiple sub-basins within Towuti, providing ideal sites for long-term environmental, climatic, and limnological reconstructions. Multiproxy analyses of piston cores document a continuous and detailed record of moisture balance variations in Lake Towuti during the past 60 kyr BP. In detail our datasets show that wet conditions and rainforest ecosystems in central Indonesia persisted during Marine Isotope Stage 3 (MIS3) and the Holocene, and were interrupted by severe drying between ~33,000 and 16,000 yr BP when high-latitude ice sheets expanded and global temperatures cooled. This in combination with the observed little direct influence of precessional orbital forcing and exposure of the Sunda Shelf implies that central Indonesian hydroclimate varies strongly in response to high-latitude climate forcing: a hypothesis we aim to test across multiple glacial-interglacial cycles through scientific drilling. Indeed, numerous high-amplitude reflectors in the upper 150 m of lacustrine fill suggest repeated cycles of moisture-balance variations in the tropical Pacific.

Important milestones concerning the operational and logistical preparation of a deep drilling at Lake Towuti have been achieved by the PI team in close collaboration with DOSECC Exploration Services, local authorities and businesses in Indonesia, and ICDP. Proposals requesting financial and logistical support for scientific drilling and research have recently been funded through the ICDP and national funding agencies. Drilling operations are planned to commence in early 2015.

Orbitally forced moisture supply and pedogenesis in Miocene mudflat deposits of southeastern Kazakhstan, Central Asia

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Continental settings of Central Asia witnessed increased desertification and the establishment of monsoonal climate conditions during the Cenozoic. These continental-scale climate shifts are considered to be mainly connected to the uplift of the Tibetan-Himalaya complex. Oscillations in the extent of the Paratethys and its final retreat further contributed to the intensification of the Asian monsoonal system. The intensity of westerly and monsoonal wind systems played an important role in transporting moisture into Asia´s continental interior. However, proxy data from terrestrial archives that document these processes are yet rare.

This study presents first results from an Oligocene–Miocene succession in the Aktau Hills (Ili Basin, northern Tien Shan, southeastern Kazakhstan), which was studied for its potential as a terrestrial paleoclimatic archive because of its excellent exposure. Sediments of the Aktau Hills were deposited close to the basin centre and consist of reddish-coloured floodplain and fluvial deposits that grade into grey lacustrine and mudflat deposits with locally intercalated thin coal seams. The age of the succession is constrained by occurrences of vertebrate remains, which are of late Oligocene age based on the occurrence of *Schizotherium*, and of early Miocene age (MN 4-5) based on different even- and odd-toed ungulates. The 80-m-thick middle Miocene part of the succession (Bastau Fm) comprises a cyclically bedded alternation of sheet floods, detrital mudflats and semi-arid soils.

We generated high-resolution records based on bulk-rock sediment geochemistry (e.g., element geochemistry, $CaCO_3$, $CaSO_4$) and sediment color scans. Time-series analysis of high-resolution color scanning show a cycle-to-frequency ratio typical for Milankovitch cyclicity, with a dominant cycle interpreted to represent obliquity, and evidence of short and long eccentricity. Bulk-sediment geochemistry is used to determine changes in the intensity of weathering and pedogenesis. The molar Chemical Index of Alteration (CIAm) describes the enrichment of Al over Ca, K and Na during chemical weathering. The Mg/Al ratio of the silicate fraction records pedogenic processes. The enrichment of Mg^{2+} in paleosols indicates the retention of Mg^{2+} in the solid phase by the formation of smectite and illite. The lack of smectite and illite in less weathered horizons, together with low CIA-K values and the presence of sand-size grains, suggests that smectite and illite were formed *in situ* as a result of pedogenic alteration. Furthermore, the covariance of CIAm und Mg/Al indicates that most of the clay minerals were formed by pedogenesis instead of detrital transport. The Ti/Al ratio in the silicate fraction can be interpreted as an indicator of precipitation in the hinterland because of unchanged sedimentary provenance. Ti is readily removed by physical weathering and deposited as Ti-rich coatings in mudflats. Combined time-series analyses of the different proxy data provide evidence that the main periods of soil formation are related to phases of elevated moisture supply and are paced by long eccentricity forcing. We suggest that these wet phases are related to long eccentricity minima when intensified westerlies provided more year-round precipitation.

Microfacies and sedimentary environment of the lacustrine Island Pag Basin (Early Miocene, S Croatia)

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The Island Pag Miocene succession represents the infill of the northwestern-most basin of the Neogene Dinaride Lake System (DLS). In the beginning of the Early Miocene, a series of extensional depressions were formed on the uplifted Dinaride mountain range. Faulting triggered erosion of the nearby uplifted Mesozoic-Paleogene carbonates and the formation of numerous, synchronous, carbonate-rich, shallow lacustrine basins in these depressions.

The Island Pag Miocene Basin infill was logged in detail along Crnika beach. The section is located on the SW shore of Pag Bay, where outcrops over a lateral distance of nearly one kilometer are present. Paleomagnetic measurements of the Crnika section combined with biostratigraphic constraints based on mollusks and the pollen record indicate that the Pag succession was deposited between 17.1 and 16.7 Ma (Burdigalian stage of the Mediterranean; Karpatian stage of the Central Paratethys), i.e. in the period of the Miocene Climatic Optimum (MCO; ~17 to ~15 Ma). The Crnika section represents about a 140-meter-thick record of lacustrine deposits. The rest of the exposure contains Quaternary breccias, sandstones and clays.

Sedimentological analysis and petrography of the Miocene lacustrine carbonates distinguishes five microfacies described as follows (A) Micritic mudstones comprised of very fine-grained, degraded, and/or carbonized plant remains randomly distributed throughout. (B) Charophyte biomicrite composed of micritic packstone-wackestones containing complete or silt-sized fragmented plant material (mostly stems of submerged vegetation) encrusted with carbonate with finely dispersed siliciclastic quartz grains. (C) Sandy micrite comprised of 65% micrite with 35% fine sand-sized quartz and carbonate grains dispersed randomly throughout the micrite. (D) Calcisiltite containing quartz grains in a calcitic-clayey matrix. (E) Cyanoid grainstone containing oncolites up to a few mm in diameter within a carbonate mud supported fabric with dispersed microsparite.

Microfacies analysis reveals that sediment deposition in the Miocene Pag lake was dominantly in the form of authigenic lime mud induced by the photosynthetic activity of floating and submerged macrophytes as well as charophytes, algae, and possible microbes. Rooted submerged macrophytes indicate a vegetated littoral zone. Vertical microfacies patterns point to carbonate sedimentation on broad shallow, low-energy bench lake margin in one progradational regressive cycle. Lacustrine carbonates are interbedded with penecontaporaneous carbonate and siliciclastic material and coal, suggesting an overfilled lacustrine system. Tectonics and climate worked in tandem having controlled the subsidence along with the sediment and water input.

Isotope stratigraphy, organic geochemistry and crush-leach analysis of the Late Triassic Raibl group (Julians Alps, NW Slovenia)

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We investigated a Late Carnian shallow-water succession (Slovenian Tamar formation as part of the Raibl Group) in the Julian Alps (NW Slovenia). The studied section is located in the foothills of Mt. Mangart, east of Cave del Predil. The outcrop is the main scarp of a landslide, which happenend in November, 2000. We present the correlation of the changing microfacies characteristics triggered by sea-level changes with high resolution isotope stratigraphy and crush-leach data of the sequence boundaries.
The Carnian stage was dominated mainly by carbonate sedimentation interrupted by the deposition of siliciclastics in the Middle-Late Carnian. After the demise of the Wetterstein platforms (Late Ladinian-Early Carnian) deposition of siliclastic-carbonatic-evaporitic Raibl Group started in the Middle Carnian (Julian) - known as the Carnian Pluvial Event - and continued until the Late Carnian. The deposition of the shallow-marine Raibl Group is controlled by sea-level changes. With the Late Carnian Dolomia Principale the next next carbonate platform cycle started.
The studied section represents the middle and upper part of the Raibl Group. By microfacies analysis we determine at least four different cycles, starting with bioclastic rudstones, which are slightly dolomitized. A significant increase of the Br, Li and SO4 ionic concentration in these tempestites is probably related to erosional products of older volcanics or a Tuvalian volcanism. The second cycle starts with shales with layers of thin-bedded bioclastic tempestites (TST), followed by the deposition of marls and marly limestones with intercalated bioclastic packstones and two hardgrounds near the top (SB). In the second cycle organic rich marls and clays with TOC values between 0.5% in 0.6% were deposited. The biomarker analysis indicates a considerable terrestrial input from higher plants. Noteworthy is the substantial amount of polycyclic aromatic hydrocarbons present in the clays. The kerogene type is between type II and III. The cycle is topped by a massive coarse-grained recrystallized limestone (SB). The third cycle starts again with thin-bedded bioclastic floatstones with bivalves, crinoids and encrusting organisms, which is interpreted as the next TST. The succession continues with deposition of micritic limestones (partly dolomitized) and marls with layers of tempestites. The cycle is topped by bioclastic floatstones, mudstones and marls. Increasing abundance in ostracods documents probably an increase in the salinity. This level has no indications of any volcanism. The fourth cycle is represented by deposition of a sabkha dolomite corresponding to the lowermost part of the Dolomia Principale. All cycles mentioned above are reflected in the oxygen and carbon isotope curves. Sequence boundaries are characterized by a major drop in the oxygen isotope values; evident also in the microfacies characteristics.

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