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THE SEDIMENT FLUX OF THE NILE

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Since the sixties, after the building of the Aswan High Dam in Upper Egypt, the Roseires Dam on the Blue Nile and Kashm el Girba Dam on the Atbara river, the sediment load of the Nile River has been reduced to almost zero (0,19-1,74 Mt/yr, Abedl-Fattah et al., 2004), causing the destruction phase of the delta (Stanley and Warne, 1998). Today the Nile sediment yield has to be recalculated from the amount of sediments deposited in natural sinks (East African lakes, Sudd and Machar marshes of southern Sudan) and reservoirs (Lake Nasser, Roseires, Sennar, Kashm el Girba, Jebel Aulia) occurring along the Nile system. The amount of sediment progressively stored within reservoirs in the last forty years, though the information is often heterogeneous and incomplete, provides a useful base to asses the Nile sediment load with greater accuracy than in the past. Moreover, high-resolution bulk-petrography and dense-mineral analysis of sediment carried through the Nile system, from the Ethiopian Plateaux across the Sudan Plain and Egyptian Deserts to the Mediterranean Sea provides the key to asses the relative contributions of the main branches (White Nile, Blue Nile and Atbara). Because of practical difficulties that prevent actual measurement of sediment transport rate in the field, bedload sediment flux can be assessed by applying theoretical equations based both on bed-shear stress (Meyer-Peter and Muller, 1948; Van Rijn, 1984) and energy expenditure concepts (Engelund and Hansen, 1967; R.A. Bagnold, 1980). Sediment flux can be reckoned by a simple, general equation correlating stream power and bedload transport rate derived by Martin (2003) using literature data of sand-gravel bed rivers. A more detailed knowledge of sediment transport rate, beside the needs of a correct management of water and land resources, is fundamental for a better understanding of tectonic and climate effects, and specifically of strongly seasonal rainfall on the Ethiopian Highlands which controls the hydrology of large areas along the River Nile where the Egyptian Civilization developed 5000 years ago and where today more than 170 million people live.

PETROGRAPHY AND GEOCHEMISTRY OF WESTERN TETHYS MESOZOIC SEDIMENTARY COVERS: FROM SOURCE AREAS TO MARGINS CONFIGURATION

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Provenance studies most commonly apply the classical methodological approach based on petrographic modal analysis of arenites. In this work a multidisciplinary approach is used, that matches modal analysis of arenites to both petrographic study on conglomerate clasts and to geochemical investigation on major and trace elements of pelites (via XRF and ICP-MS analysis, respectively). This work is aimed to: i) understand the nature of the source areas of the Mesozoic sedimentary covers of the Ligure-Piemontese oceanic basin, a branch of Western Tethys opened during the Middle Jurassic; these sedimentary successions are preserved as tectonic units in the Alpine-Apennine belt (Balagne Nappe in Alpine Corsica and Internal and External Ligurian units in Northern Apennines); ii) to provide further constraints to the understanding of the rifting process. The overall first order petrographic and geochemical homogeneity of the samples is overcome by a more detailed investigation, indicating prominent differences between Corsica and Internal Ligurian units against External Ligurian units. Petrographic analysis of pebbles from rudites and lithic fragments from arenites shows that Corsica and Internal Ligurian units are composed by a debris made up by low-grade metamorphic rocks and carbonate platform rock fragments, while the External Ligurian units are represented by low-, medium- and high-grade metamorphic rock types even by mm-sized cromiferous spinel that probably derived from a mantle-rock source; additionally, both carbonate platform and pelagic siliceous/carbonatic rock fragments have been found. Geochemical data on pelites show that samples from External Ligurian units suggest a more mafic/ultramafic character, compared to samples from Corsica and Internal Ligurian units. Also, samples from External Ligurian units are the most enriched in elements such as Cr, Co, Ni (the main rock-forming minerals of mafic-ultramafic rocks), and the Th/Sc/Cr/V/Ni relationships show for External Ligurian samples a systematic shift towards ultramafic contribution. On the whole, petrographic and chemical data collected in this paper indicate that the source for the sedimentary covers of Corsica and Internal Ligurian units were similar, and made up by the upper part of a continental basement and by its carbonatic sedimentary cover (the Europe continental margin). On the other hand, the sedimentary cover of the External Ligurian units was supplied by a source area where a complete lithospheric section was exposed, from the upper mantle up to the deep sea sedimentary cover (the Adria continental margin). These findings are useful to unravel the processes related to the opening mechanisms of the Ligure-Piemontese oceanic basin: among the different rifting models existing, our data support an asymmetric mechanism for the western Tethys opening, with the Adria margin acting as the lower plate during the rifting processes, dominated by a west-dipping detachment fault.

GLAUCONY AND SEQUENCE STRATIGRAPHY: NEW INSIGHTS FROM THE CENOMANIAN DEPOSITS OF NORMANDY (NORTHERN FRANCE)

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The Lower to Middle Cenomanian deposits of Normandy, cropping out along a spectacularly exposed cliff at St. Jouin, are represented by the St. Jouin Formation and the overlying Rouen Formation. These units include an alternations of chalks, chert layers, and hardgrounds. Each hardground is overlain by a glaucony-bearing horizon, interpreted by previous work as either a transgressive surface or a maximum flooding surface of a specific 3rd-order depositional sequence. Sedimentological, mineralogical and geochemical characterization of glaucony from the basal Cenomanian deposits and nine hardgrounds (St. Jouin, Bruneval 1-3, Rouen 1-2, and Antifer 1-3) of Early-Middle Cenomanian age shows remarkable differences in terms of abundance and maturity of the green grains, and reveals additional information on the possible use of glaucony as a key to the sequence-stratigraphic interpretation of glaucony-bearing deposits. The glaucony-rich deposits at the very base of the Cenomanian stage are approximately 1.5 m thick and include 40% to 60% evolved (7.2-7.5% K2O) glaucony. Upsection, the Lower to Middle Cenomanian glaucony-bearing horizons are just tens of cm thick, and generally contain less than 20% slightly evolved to evolved (5.8-6.3% K2O) glaucony. These major differences in amount and potassium content of glaucony are laterally persistent across four different sections, 40 km apart (Cap de la Hève, Octeville, Cauville and Fecamp), providing the basis for basinwide correlations. X-ray diffraction analyses of glaucony from the basal Cenomanian deposits further document the higher maturity of glaucony from this condensed section, revealing patterns characteristic of well-ordered, mature glauconite. These include sharper and narrower (001) reflections, with comparatively lower distances between peaks (001) and (020). An increase in glaucony maturity in all the study samples is invariably accompanied by a parallel decrease in calcium content, reflecting the progressive dissolution of the substrate for glauconitization with increasing evolution of the green grains. SEM investigations of glaucony from the basal condensed section document the presence of lamellar nanostructures, characteristic of mature glaucony, which contrast markedly with the characteristic rosette structures observed in the overlying horizons, typical of comparatively less evolved glaucony. Similarly to what recently documented at more northern locations in the Paris Basin (Cap Blanc Nez section), the thick deposits hosting high amounts of highly mature glaucony at the base of Cenomanian are interpreted to represent a complex, laterally extensive condensed section that span an interval of time in the same order of magnitude as an entire third-order depositional sequence (106 years). For this reason, this condensed horizon should not simply be interpreted as a transgressive surface. On the other hand, the lower concentration of less mature glaucony recorded in the overlying glaucony-bearing horizons implies local breaks in sedimentation of relatively short duration (105 years), taking place at sites of condensation within younger depositional sequences. The results of this study thus demonstrate that glaucony may occur at multiple, qualitatively distinct stratigraphic intervals within a sedimentary succession, allowing identification of a hierarchy of depositional units in terms of glaucony abundance and maturity. Detailed glaucony characterization, thus, is needed for a correct sequence stratigraphic interpretation of glaucony-bearing deposits.

DEVELOPMENT AND SIGNIFICANCE OF RHODOLITH-BEARING DEPOSITS IN TRANSGRESSIVE SETTINGS: SOME FOSSIL AND MODERN EXAMPLES FROM NORTH ISLAND, NEW ZEALAND

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Rhodoliths are nodular structures mainly composed of superimposed thalli of red coralline algae. Since their development is controlled by an array of ecological parameters, rhodoliths are a valuable source of paleoenvironmental information. However, despite their common use in paleoecological reconstructions, the stratigraphic significance of rhodolith accumulations has seldom been specifically addressed. In a study of Neogene rhodolith-bearing deposits from New Zealand North Island, rhodolithic units, usually of limited lateral extent, are systematically found above major unconformities at the base of deepening upwards successions. Two types of transgressive rhodolith-bearing deposits may be distinguished on the basis of texture and rhodolith internal structure. Type A deposits are clast supported rhodolithic rudstones containing abundant pebbles and cobbles reworked from the substrate, and are characterized by rhodoliths with dense concentric to columnar internal structure and a high nucleus to algal cover ratio. Type B deposits are rhodolithic floatstones with a matrix usually consisting of bryozoan fragments, large benthic foraminifera, and echinoid fragments or terrigenous silty fine sand. The algal nodules of type B units have usually a loose internal framework with leafy to branched crusts. The units are interpreted as a characteristic facies of TST deposits, analogous to shell concentrations forming in conditions of low net sedimentation. Type A deposits are interpreted as forming in high energy shoreface settings or in narrow submerged paleotopographic lows, and are likened to onlap shellbeds. Type B deposits are likened to backlap or compound (mixed onlap-backlap) shellbeds, forming at the basinward termination of a backstepping sediment body in lower energy settings. The association between transgression and development of rhodolithic facies is also observed in the modern rhodolith production site of the Whangaparaoa Peninsula (New Zealand North Island), where algal nodules grow above a ravinement surface cut during the Holocene sea level rise, and is confirmed by a review of published fossil examples that show stratigraphic and compositional attributes analogue to those of New Zealand North Island. It is suggested that a combination of factors, such as net sedimentary input, nature of the substrate, sea level rise, inherited physiography, and the Heterozoan composition of the association, contribute to determine the relationship between rhodolith-bearing deposits and transgressive settings.

NANNOFOSSIL BIOSTRATIGRAPHY OF THE ANTOLA UNIT SUCCESSION (NORTHERN APENNINES, ITALY): NEW AGE CONSTRAINTS FOR THE UPPER CRETACEOUS HELMINTHOID FLYSCH

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In the Northern Apennines, the Antola Unit occurs at the top of the nappe pile cropping out in the area regarded as the boundary between Alps and Apennine. This unit, overlain both the Internal and the External Ligurian Units, is interpreted as representative of the Ligure-Piemontese oceanic basin and its transition to the Adria continental margin. Despite its key role in understanding the Northern Apennine evolution the geological data are scarce or published more than 30 years ago. The new data collected during the 1:50.000 CARG Project (Foglio 196 "Cabella Ligure") are here presented in order to propose a new litho- and bio-stratigraphic picture of this unit able to provide new constraints for the geodynamic recostruction of the Alps-Apennine orogenic system. Based on the geological survay a new lithostratigraphy has been proposed, moreover the whole stratigraphic succession of the Antola Unit has been dated through the analysis of the nannofossil assemblages. The Antola Unit succession can be roughly subdivided in three main parts: the lower "basal complex" (Montoggio Shale and Gorreto Sandstone), the middle carbonatic turbiditic deposits (Antola Flysch) and the upper mixed siliciclastic-carbonatic turbiditic deposits (Bruggi-Selvapiana Formation and Pagliaro Shale). The lower part is represented by the so called "basal complex" represented by the Montoggio Shale, made by black manganesiferous carbonate-free hemipelagic shales interlayered with fine-grained turbiditic sandstones and capped by varicoloured hemipelagic shales. Follow the turbiditic succession of the Gorreto Sandstone, characterized by thin bedded turbidites showing a mixed siliciclastic/carbonatic composition. The basal complex grades upward to the Mt. Antola Flysch, consisting of calcareous turbidites and megaturbidites interlayered with rare silicilastic beds and thin hemipelagic carbonate-free shales. The Mt. Antola Flysch is overlain by the carbonatic megaturbidite sequence of Bruggi/Selvapiana Formation, partly corresponding to the Bruggi and Selvapiana members of Abbate and Sagri (1967). This formation is characterized by alternating of turbiditic marly mega-beds with thin bedded siliciclastic turbidites and shales. The top of the Antola Unit succession is represented by the Pagliaro Shale mainly consisting of thick shaly beds alternating with siliciclastic thin bedded turbidites and minor calcareous turbidites (cfr. Cabella Member of Abbate and Sagri, 1967). The biostratigraphic results indicate that the Antola Unit succession is characterized by the Montoggio Shale (late Cenomanian-middle Turonian; CC10-CC11 Zones), the Gorreto Sandstone (early-middle Campanian; CC18/19-CC20 Zones), the Mt. Antola Flysch (middle-late Campanian; CC20-CC22/23 Zones), the Bruggi-Selvapiana Formation (late Campanian-late Maastrichtian; CC24-CC25a Zones) and the Pagliaro Shale (late Maastrichtian-late Paleocene; CC25b-NP5 Zones). These data, compared with those of other Helminthoid Flysch units, suggest a possible correlation with the Cassio Unit succession outcropping in the outern side of the Northern Apennines (cfr. Vescovi et al.1999). The produced data confirm the hypothesis proposed by Pertusati and Elter (1973) suggesting that the Antola succession could be located in the External Ligurian Helminthoid Flysch basin. Moreover, the close similarities between both the basal complexes and the flysch successions indicate that the Antola and Cassio units successions were located in the same basin. The proposed paleogeographic setting implies that to reach its actual structural position at the top of the Northern Apennines nappe pile, the Antola Unit must have suffered an early Europe-verging tectonic phase

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MIDDLE TRIASSIC TECTONICS CONTROLLING THE SEDIMENTARY EVOLUTION AND THE POST-DEPOSITIONAL HISTORY OF THE LATEMAR PLATFORM (ITALIAN DOLOMITES)

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The Anisian-Ladinian carbonate platform of the Latemàr spectacularly outcrops in the western Dolomites. Since the Seventies, the buildup has attracted sizable attention, for its good exposure, comparatively reduced late diagenetic overprinting and apparently reduced tectonic deformation. The whole of these features prompted detailed studies on the sedimentary facies distribution, high frequency sedimentary cyclicity and Triassic dolomitization processes, by international research teams. Our study is however suggesting that the present-day geometric framework of the platform is significantly affected by brittle deformation, mainly Middle Triassic in age and synvolcanic in nature. The work is aimed at making a more realistic reconstruction of the 3D depositional geometry, platform facies architecture and accumulation rate evaluation, through the reconstruction and retrodeformation of the tectonic structures affecting the massif. The study was largely based on mobile GIS, GPS assisted geological mapping, integrated by classical facies analysis techniques. Stratigraphic data were analyzed within the available accurate chronological framework, derived from the integration of biostratigraphic and isotopic data. The platform records a large upper Anisian aggradation, forced by a short-lived but very fast tectonically-induced subsidence. A stratigraphic thickness of about 750 m accumulated over just about 4 millions of years, with subsidence speed possibly climaxing at more than 300 m/myr, during the deposition of the lower subtidal portion of the succession. An Anisian paleofault possibly controlled the northern margin location, but no direct structural control on the buildup geometry is documented. The relative sea-level increase then decelerated considerably. The subsidence reduction was associated with a fast regional carbonate platform progradation, leading to the onset of the volcanism. This phase is poorly recorded by the Latemàr, also because of Triassic and Quaternary erosive episodes. The analysis of pelagic-filled neptunian dykes would suggest that a drowning event terminated the carbonate platform growth before the shoshonitic volcanism starting. The late Ladinian synmagmatic deformation significantly altered the geometric framework of the dead platform. Vertical movements exceeding one kilometer in magnitude were produced by normal faulting and calderic collapsing, associated with the Predazzo volcano and its shallow epicrustal magma-chamber. The carbonate edifice was mutilated by large rotational sliding and by platform margin scalloping, and then buried beneath thick bodies of volcanites, volcanoclastites and chaotic megabreccia. The buildup was densely cross cut by "extension breccia dikes", filled by older platform carbonate clasts. These dykes are often associated with sea-water hydrothermal dolomitization and karstification, followed by the intrusion of slightly younger basaltic dykes. Breccia dykes are particularly common at the junction between platform-top and slope units, a line of clear mechanical weakness. These Triassic structures were partially reactivated by the Alpine tectonic stresses, particularly in the western side of the massif. The platform margin bodies are therefore often disturbed by breccification and tectonics to the extent to make any sedimentological reconstruction impossible, just a few reef bodies remaining well preserved in situ, at scattered spots. Each "sedimentary dyke" was normally associated with a lateral extension of just a few meters, but the cumulative platform-wide spreading was quite significant. The Ladinian tectono-magmatic event therefore affected the buildup to the extent to destroy large portions of the platform body, making the complete reconstruction of it impossible. Alpine reactivation is also locally important. The Triassic and Alpine deformation has therefore to be carefully evaluated while estimating the platform volume, depositional rates and sedimentary geometry.

THE SEARCH FOR SUBMARINE RELIC SANDS ON THE LIGURIAN CONTINENTAL SHELF

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Almost the entire Ligurian continental shelf is a sedimentary construction shelf in which, over the past 2-3 million years, sedimentary layers have accumulated on a substratum that dips extensionally from the margin. Its genesis and development occurred entirely within the Plio-Quaternary, even if phases of precocious erosive reworking in some areas have been dated to the Late Miocene. The transgressive-regressive cycles related to Quaternary glacio-eustasy have given the shelf its present structure, with aggradation and/or progradation processes occurring during high stands and erosive surfaces and progradant deposits occurring beyond the shelf break during low stands. Due to these processes the evolution and structural features of the Ligurian continental shelf are very variable: Apennine shelf linked to the Tyrrhenian evolution of the Alpine shelf linked to the Provençal-Ligurian Basin. The continental shelf of the Apennine sector is generally a sedimentary construction shelf in which subsidence, the sedimentary supply and transgressive-regressive cycles have played a decisive role in defining the features of the margin. Instead, the western Ligurian continental shelf is of limited width and subdivided by morphological and tectonic signatures. It is primarily a rocky shelf with limited sedimentary deposits near the coast and Plio-Quaternary sediments off shore. Our study of the deposition process during the transgressive-regressive cycles associated with glacio-eustasy has identified a number of relic deposits on the shelf. In fact, during the low stand that occurred at the acme of the LGM (18,000-20,000 yrBP), the continental shelf was exposed, the sea level was 110-120 m lower than at present, and watercourses deposited their solid load on the front itself, forming progradant bodies (Low Standing System Tract). During the Versilian Transgression the coastline migrated from what is now the shelf-break to its present position. This migration was not continuous and sediments associated with littoral or deltaic systems were deposited at intermediate points on the shelf during periods of stasis. The results of seismostratigraphic studies and an oceanographic campaign we conducted in collaboration with the Ligurian Region, and funded by the E.U. Beachmed Interreg IIIb Project, have enabled us to distinguish littoral and deltaic deposits that may be suitable for beach nourishment at depths of 20-40 m near the coast and 60-80 m on the outer shelf, in areas with only a thin Holocene pelitic mud cover (of high stand origin). The calibration cores of the sedimentary bodies identified with seismic lines that were taken from the areas between Ospedaletti and the Taggia Canyon and between Albenga and Loano permitted us to distinguish, in the first case, sandy and sandy-pebbly sediments of deltaic and littoral origin under a thin pelitic cover and, in the second, sandy, gravely sand and sandy gravel deposits of beach origin under a Holocene pelitic cover.

THE CAPRERA TURBIDITE SYSTEM (EAST SARDINIA MARGIN): MORPHOLOGY AND PROCESSES OF A SMALL SUBMARINE FAN IN A PARTIALLY CONFINED INTRASLOPE BASIN

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New high resolution bathymetric Multibeam data collected by ISMAR in 1999 have been invistigated, to describe the morphology and the main architectural elements of the turbidite systems of the eastern Sardina margin. The present study is focused on the Caprera Turbidite System (CTS), the nothermost turbiditic system of the margin, located between Corsica and Sardinia, in the Olbia Basin. We present a detailed description of the morphology of this turbidite system. Moreover, an intepretation of the possible evolution of the CTSis presented, coupling the new bathymetric data, with the seismic profile acquired in the late 70's. The Multibeam data reveal that the Caprera System is partially confined between the upper continental slope and the Etruschi Seamount. In the upper slope, it consists of two tributaries canyon, around 15 km long that join in a single, around 1 km wide canyon at depth of 1000 m. The two tributaries show different morphology: the southern one (C1) is around 1 km wide, slightly sinuous, with a V-shaped thalweg, in correspondence to a steep slope sector, followed, downslope by a U-shaped thalweg along a more gentle slope tract. The nothern canyon (C2) is very narrow (150 m), with a V-shaped thalweg and a well developed internal levee around 4 km long and with a relief of 100 m. At around 950 m depth the canyon shows a strong bend sector with a well developed meander bar. The main canyon (Caprera Canyon), initially show a straight NE trending, 1 km large segment with a terrace on the left side. At 1100 m depth the canyon show a 65° turn form NE to SE, with a steep scarps on the external side (300 m high), and with a 2 km long meander bar on the internal scarp. At the base of the slope the canyon evolves into a leveed channel with a width of around 2 km. The channel has a lenght of around 16 km, with an initially NW-SE direction and a subsequent NS direction in the distal sector, after a gentle bending sector. The levee show a remarkable asimmetry, with the left levee that is around 12 kmwide and reaches the base of the Etruschi Seamount. The right levee is less developed, being only 7 km wide, and to the west is confined by the base of the continental slope. The surface of the left levee is characterized by few rectilinear chutes likely originated by channel overbank flow, and by many small slump scars. At 1400 m water depth the Caprera channel gives way to a sector, around 7 km long, characterized by a very low steepness (less than 0.3°), with large, small relief scours (less than 10 m). Subsequently, in correspondence to a moderate break-in-slope (from 0.3° to 1.5°), the Caprera System show a re-channalized sector, with small, low relief, rectilinear channel and associated levee-shaped feature that span the flat plain of the Olbia Basin in a E-W direction. The morphologic data over CTS show therefore that channelized and non-channalized portion alternate along the Olbia basin fan in response to subtle variation of the gradient of the receiving basin. These data furnish evidence that topography is a fundamental control on the depositional style and fan development in small sized, partially confined basins.

A SIMPLE STATISTICAL ANALYSIS OF FACIES CHANGES AT THE ONLAP TERMINATIONS OF A TURBIDITIC SANDSTONE BODY

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The turbiditic sand-lobes represent one of the most interesting type among the deep-sea clastic repositories of hydrocarbons. Their terminations and onlaps, both along and across palaeoflow directions, may be accompanied by changes of stratal patterns and sand/shale ratio. These parameters affect the petrophysical properties (porosity and permeability) which must be modelled to obtain reservoir characterizations. The quantitative study of outcrop analogues of pinching-out turbiditic lobes may provide constraints to the geological, geophysical and geostatistical methods of subsurface interpretation and reconstruction. At this purpose we studied a sandstone body belonging to a well-known turbidite system of the Tertiary Piedmont Basin, the Cengio Turbidite System (Oligocene - Early Miocene; Gelati & Gnaccolini, 1980; Cazzola et al., 1985; Mutti, 1992), which provides good exposures of pinching-out sandstone lobes. The entire turbidite system fills a structural depression and laps out against slope marlstones, both to the NE (i.e. down-current) and to the W and NW (i.e. parallel to the average palaeoflow trends). It is formed by several stacked amalgamated sandstone bodies which invariably develop above stratified units of alternating turbiditic sands and shales (Cazzola et al., 1985; Mutti, 1992). We selected two coupled lithosomes, a lower sand-shale stratified unit that is followed upsection by an amalgamated sandstone body (total maximum thickness about 25 m, length of exposure about 1200 m in N-S down-current direction and 1500 m in E-W direction) that should correspond to lobes I and II of Cazzola et al. (1985) and Mutti (1992). The simple descriptive statistical approach was applied to two cross-sections that we obtained after bed-by-bed measurement and field correlation of 20 stratigraphic sections. Univariate and multivariate statistical analyses were performed both in the vertical and horizontal directions. We considered the variables which are most influent on reservoir heterogeneity: number and thickness of sand divisions of beds, sand/shale ratio and facies. This enabled us to make quantitative comparisons between the depocentral area and two different pinch-out zones (abrupt pinch-outs against palaeo-high structures to the NE and gradual terminations, parallel to palaeo-flows, to the W and NW). The most gradual onlap terminations are characterised by enhancement of bed separation, low sand/shale ratios, high abundance of laminated bed-sets, high frequency of water-escape structures in sand beds and high diffusion of mud-chips. Differently, the abrupt onlaps show dominant bed amalgamation, high sand/shale and thickness/number of beds ratios and prevalence of massive sandstone facies. In the lower stratified lithosome a positive statistical correlation has been observed, moving down-current (i.e. from SW to NE), between decreasing thickness of the sand divisions of turbidite beds and increasing number of beds. This trend is accompanied by the statistical tendency to a down-current change from massive sandstone, to fluidised flow sandstones and then to classical Bouma sequence turbidites. Differently the upper amalgamated sandstone lithosome shows no regular statistical trends of modifications and only minor changes of thickness, number of beds and facies occur, both down current and towards the onlap terminations.

TOPOGRAPHICALLY COMPLEX SLOPE AND DEEP SEA DEPOSITIONAL SYSTEM IN THE TYRRHENIAN SEA

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The present-day morphosedimentary features and the character and distribution of depositional systems within the Tyrrhenian Sea reflect the recent geological evolution of the area consisting of distinct, eastward migrating episodes of extensional tectonics and backarc basin opening. Numerous intraslope basins, bounded seaward by fault blocks, are located along the rifted Latium-Campanian, Calabrian, Sicilian and Sardinian margins that surround the two abyssal plains of Vavilov and Marsili, where extension has progressed up to back-arc basin formation. Due to the variability in age and style of the tectonics that have shaped the different margins and to the present-day geodynamic setting of the adjacent emerged areas, contrasting sedimentary processes are active and responsible for the distinct depositional settings of the intraslope basins. A striking difference emerges between the depositional architecture of the Sardinian passive margin and that of the Cefalu and Gioia Basins located along the Sicilian active margin. The Sardinian intraslope basins (Olbia, Baronie, Ogliastra and Ichnusa-Sarrabus) are in fact characterized by the development of small fans with circular or elongated planform and dimensions up to 15 km developed at the mouth of the main canyons. In the Cefalu and in the Gioia basins, on the contrary, canyons pass downslope to leveed channels that at the base-of slope build a prograding wedge of channel-levee deposits forming a constructional depositional apron. Some of the intraslope basins such as the Cefalu and the Olbia basins are completely confined by their seaward bounding structures and represent therefore isolated depositional systems. Other intraslope basins, on the contrary, develop submarine drainage networks resulting in sea valleys that cross the whole margin and are throughoing sedimentary fairways connecting the coastal areas to the the ultimate base level for the sedimentary processes active in the Tyrrhenian region, the deep abyssal plains of the Vavilov and Marsili basins that represent. The obstacle effect of tectonic and volcanic features control the general course of the sea valleys. This is particularly evident in the Latium-Campanian margin where, due to the recent age of the tectonics that has shaped the margin, a connected tortuous corridor develops. The control of volcanic features is displayed by the Stromboli valley that in the Gioia basin runs toward the NE parallel to the Aeolian arc and then turns to an E-W direction in correspondence of a breach in the Aeolian arc between the Stromboli and the Lametini volcanic edifices. Tectonic features also promote changes in the sedimentary dynamics within the sea valleys. The Ischia-Magnaghi and Dhorn valleys, that have a depositional character in the Ventotene and Capri basins, become highly erosive in the crossing of the Sirene and the Sartori lineaments. Also the distal portion of the Sardinia valley undergoes a change from depositional to erosional character in the crossing of the Selli line. In the Calabrian margin and in the Gioia Basin slope deposits have almost completely mantled the basement highs and as a consequence the Gioia-Mesima and the Angitola slope channels follow a more direct downslope route. However, the downslope evolution of the Angitola and the Mesima-Gioia slope channels, from meandering segments running through a wider depositional channel belt to linear mainly erosional segments, likely reflect changes in slope gradients in turn controlled by basement structures.

INTEGRATED BIOSTRATIGRAPHY AS A TOOL TO DATE THE SUB-MARINE VOLCANIC ACTIVITY OF PALMAROLA ISLAND (PONTINE ISLAND, TYRRHENIAN SEA)

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In the framework of a wider project, implying a detailed field survey and geological investigation for the new geological map of the Palmarola Island, this paper presents the major results of the dating of the marine sediment of the Palmarola shoreline, obtained from the integrated stratigraphy (calcareous plankton biostratigraphy, paleobathymetric environment based on benthonic analysis and volcanologic evidences). The main aim of this work is to define the timing of the rise of San Silverio dome, cropping out at Palmarola Island, and to link the age of this sub-marine volcanic activity to the volcanic framework of the Western Pontine Archipelago. The Palmarola beach section, cropping out in the west coast of the Palmarola Island, south of the S. Silverio high, is 5.30 meter thick, consists of a cyclic organization of deep marine sediment characterised by marls and calcareous marls, beige in color, and capped upwards by conglomeratic Quaternary deposits. The geological field survey allowed us to reconstruct the relationship between the clay layers of the Palmarola beach section and the San Silverio dome. According to the model here proposed, the dome uprising would have occurred in a deep sea environment and the pelitic sedimentation would have lasted along the whole time of the rising of the dome. The lowermost layers of the clay section, in consequence, mark the beginning of the uprising, whereas the topmost represent the end of the pelitic sedimentation. Evidences from planktonic foraminifer biostratigraphy in the investigated sequence, allow us to constrain the volcanic event between an interval comprised among the LO of Sphaereodinellopsis seminulina (dated at 3.19 Ma, Lourens et al. in press) and the LO of Globorotalia bononiensis (dated at 2.41 Ma, Lourens et al. in press) and before the FCO of Neogloboquadrina spp. left coiling (dated at 1.806 Ma, Lourens et al. in press). Calcareous nannofossil data suggest a time interval between the LO of Discoaster broweri and the FO of medium-sized Gephyrocapsa, which are dated 1.95 Ma (Lourens et al. in press) and 1.70 Ma (Raffi 2002) respectively. Therefore the most probable time interval of the volcanic dome rise is between 3.19-2.41 Ma and not younger than 1.806 Ma and in a paleobathymetric environment indicative of an epibathyal habitat with a range depth of about 300-1300 meters. Afterwards, in response to the same tectonic phase causing the uprising of ryolithic magmas, as hypothesized by Bellucci et al. (1999) for the Ponza Island, the Palmarola island was brought in a subaerial environment. The K/Ar age of 1.58+/-0.02 Ma recently determined for the S. Silverio neck by Cadoux et al. (2005) seems, however, somewhat younger of the ages deduced through the present multidisciplinary research, and this comparison makes our results worth of further investigations.

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COMBINING GEOLOGICAL AND GEO-ELECTRICAL METHODS TO CONSTRAIN CORRELATIONS AND MODELLING OF SEDIMENT CHANGES IN FLUVIAL AQUIFERS

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The reconstruction and characterisation of alluvial aquifer stratigraphy is based on correlation of water-well and borehole point-data, with the aid of geophysical investigations (georadar, shallow seismic, geo-electrical profiling). Nevertheless, georadar can be used only under specific conditions (absence of shale layers, non-saturated sediments) and shallow multi-channel seismic is too expensive for usage in routine hydrogeological studies. Therefore, the data-sets we use to constrain models of hydrostratigraphy are still not sufficient to minimize uncertainty that affects the correlation between the scattered data points. Outstanding problems are: 1) how can we fill the gap between the available wells, at the hydrostratigraphic scale (aquifer units), to constrain the reconstruction of aquifer geometry? 2) how can we obtain a horizontal stratigraphic resolution, comparable to the scale of sediment variations in alluvial depositional systems (sand to shale transitions), to constrain the models of aquifer architecture? 3) is it possible to achieve these two goals by an eligible routine methodology? We tried to address these problems studying the shallow fluvial aquifers of Late Pleistocene age (LGM sediments) of the southern Lambro catchement, close to the town of Lodi (Lombardy). These units were deposited by the Sillaro palaeo-river, an extinct mixed-load meandering river that flew within a valley sculptured into the pre-LGM sediments. Our method is based on the combination of all the available geomorphological, geological, stratigraphic, sedimentological data with the conceptual constraints provided by knowledge of regional vs. local control on fluvial architecture and with the results of the friendly and cheap geoelectrical techniques: vertical electrical soundings (VES) and electrical resistivity tomography (ERT). We studied the first 20 m below the topographic surface over a 4 km2 wide area, by geological/geomorphological mapping and correlation of 29 boreholes and water-well logs. The geological reconstruction provided a preliminary image of the subsurface, showing two (gravel)sand-shale fining-upwards sequences (channel-point bar system) grading downstream (southwards) to a shale-rich succession (flood plain and oxbow lake). Based on this reconstruction we located 12 VES with Schlumberger arrays, which were calibrated to well-data and interpreted, enabling us to draw apparent resistivity maps of the subsurface. The latter were compared with the sand/shale maps obtained by the geological correlation. In this way the horizontal transition between sand units and the correlative shale successions was constrained, but looked still like a vertical (unrealistic) facies change. To refine the reconstruction of this transition we surveyed some 1570 m long ERT, that showed where and how the expected transition occurred, over a distance of some tens of m. These results show that the use of the geoelectrical surveys provides hints to fill in the gap between the sparse borehole data, provided that the plan of geophysical investigation is driven by the formerly elaborated geological model. The horizontal scale at which the sand-shale transition has been portrayed is that of tens of meters, the detail is that of the characterisation of the internal architecture of (hydro)stratigraphic units.

ALLUVIAL-PLAIN DEPOSITS IN THE PIACENZIAN OF THE VALDELSA BASIN (CENTRAL ITALY): FACIES ANALYSIS AND COMMENTS ON THEIR CYCLOTHEMIC STACKING PATTERN

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The Valdelsa Basin, is a NW-SE trending post-collisional basin located in central Tuscany and filled with 2,000 m thick Neogene-Quaternary terrigenous deposits. About 1,000 m of these deposits form a Pliocene succession largely exposed in the basin and made of continental to shallow marine gravel, sand and mud. Basin-wide unconformities and lithofacies analysis allowed to distinguish seven main unconformity-bounded stratigraphic units (synthems) deposited between the uppermost Messinian and the Middle Pliocene (Piacenzian). Each synthem shows a composite stratigraphic architecture made of small-scale (15-30 m thick) depositional sequences developed within major phases of relative sea-level rise. The latter is indicated by overall fining and deepening upward trends characterizing each synthem. Depositional systems punctuating such evolution were alluvial plains respectively represented by gravel-bed rivers, fed mostly from the north-eastern margin, and mud-rich floodbasin. In the central portion of the basin such alluvial systems fed river deltas, lagoons and shorelines facing a inner shelf. Alluvial deposits in the Piacenzian Ponte a Elsa and S.Miniato synthems are described in terms of facies analysis from relatively continuous outcrops related to abandoned quarries. These deposits are arranged in a cyclic fashion outlined by gravely and subordinately sandy bedsets up to 10 m thick, separated by muddy bedsets up to 20 m thick. Coarse-grained facies are characterized by varying bedding, texture and sedimentary structures, on the whole pointing to high-magnitude discharges in flood-dominated gravel-bed rivers. These rivers had variable planforms, from braiding to low-sinuosity channels, in relation to the balance between sediment and water discharge. Relatively large flood bars represent a sedimentological peculiarity in these deposits. Such bars, making the most part of the gravely units, resulted from both lateral and frontal accretion of sediment-laden flood flows escaping the grain-by-grain mode of channel bar construction typical of low-concentration streamflows. A further singularity in these facies is represented by recurring secondary channels found on the uppermost portion of the gravely units. These channels are filled with pebbly sands pointing to a drastic change of sediment supply in the late aggradation of the main river channel. This response is referred to a deficit of coarse-grained material rather than to decreasing water discharge, thus, reflecting a dynamic of cyclic sediment production in the upper catchments on the north-eastern basin's margin. Transition to mud-dominated bedsets is always sharp pointing to a more dramatic change of sediment supply. Muds are generally massive, locally planar laminated, bearing terrestrial mollusc and vegetal remains and weakly developed soil horizons. Lenticular beds made of fine-grained sand referred to as scattered, small scale, channels, occur within the dominant fine-grained deposits. These sedimentological and palaeontological features suggest deposition in a floodplain although the available outcrops apparently indicate the deactivation of major river systems during the vertical accretion of fines in this environment. The latter is interpreted as a floodbasin dominated by sediment settling from overland flows during phases of rising base level and locally drained by small-scale channels. The cyclic development of the two basic lithofacies associations will be discussed balancing the role of climate, testified by heavy rainfall regime generating high-magnitude flood-flows, tectonism, triggering relief rejuvenation and basin subsidence, and glacio-eustatic fluctuations controlling the grading of these river systems to the sea-level.

HOLOCENE EVOLUTION OF THE TERNI BASIN, CENTRAL ITALY: AN INTEGRATED APPROACH

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A multidisciplinary study in collaboration with: Soprint. Archeol. of Umbria and "G. Nicoli" Center Bologna, has been conducted on the archaeological site of Maratta Bassa (VII-VI century B.C.) located to west of the town of Terni, which has enabled an integrated interpretation of the paleoenvironmental and paleoclimatic evolution of the Terni basin from the Middle Holocene to the present time. The Terni basin represents the western elongation of an intramontane depression, the Tiberino basin, which originated during the extension phases of the Apennine orogeny and gradually filled with continental deposits from the Upper Pliocene. The evolution of the archaeological site of Maratta Bassa was influenced by the water level oscillations of a lake subject to repeated climatically controlled expansion and contraction in an overall regressive-transgressive cycle. The lake occupied the Terni basin up to historical time with an evolution, which can be correlated with that of other lakes of Central Italy. A stratigraphical sequence a few meters thick has been studied with a multidisciplinary approach based on geological, mineralogical-petrographical and paleontological evidence with pollen and archaeological data. The succession has been informally subdivided into several units (from A to G, A being the lowest) made of alternating lacustrine, fluvial and fluvio-lacustrine deposits. Unit A is formed of carbonaceous clay mud typical of a relatively shallow lake below the wave base. Ostracods dominated by Candona lacustris are present and the pollen assemblage shows an open landscape covered by a vegetation of prairie type with wide swamp areas and abundant aquatic plants. Unit B is a lacustrine facies. It is composed of carbonaceous clay mud faintly laminated with Ostracods, fragments of Molluscs and remnants of algal plants. Unit C presents a fluvio-lacustrine character. It is made of carbonaceous silty-clay mud and records a progressive enhancement of the siliciclastic content due to an increasing influx of fluvial floodwaters. Pollen data in the units C and D show traces of herbaceous and cultivated plants related to human activity testifying human presence in the Terni basin during the Late Bronze age (2000-1500 BP) in land areas adjacent to the site of Maratta. Unit D marks a return to marginal lacustrine conditions with the presence of a gently sloping ramp-type lake margin below wave influx. The unit is formed of laminated carbonaceous sandy mud with cyanobacterial oncoids, Molluscs and encrusted charophytes. A regression of the lacustrine conditions and related humid-temperate forest is recorded at the top of unit D. The lake is probably reduced to a shallow pond and the environment is dominated by fluvial activity. Pollen concentration shows a pronounced reduction in all main arboreal taxa. The temporary subaerial conditions of unit E favoured the development of a human settlement between the end of the VII and the beginning of the VI century B.C. Pedogenetical figures, roots traces and terrigenous detritus characterize this paleosurface. A new oscillation of the hydrological regime marked by more humid climatic conditions is responsible for a new expansion of the lake with consequent flooding of the previous human settlement, associated with an increase of arboreal plants and a reduction of herbs and cultivated plants. Unit F is formed of oolitic-pisolitic carbonaceous sandy-silty mud with Mollusc fragments, aquatic plants and low terrigenous input, which testify the presence of a wave influenced shallow lake. The following regressive fluctuation stopped the lake history and caused the exposure to the atmosphere of the sediments and the formation of a paleosurface (unit G) on which a settlement dated V century B.C. developed overlapping the oldest one. The progressive filling of the lake with alluvial sediments in a basin where fluvial conditions dominated marked the beginning of the evolution of the present-day Terni plain.

LATE PLIOCENE - EARLY PLEISTOCENE LACUSTRINE FACIES ASSOCIATIONS IN THE ARQUATA QUARRY (VALLE UMBRA, CENTRAL ITALY)

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Arquata quarry, eastern from Bevagna town (Umbria, Central Italy), represents an interesting observation point for Plio - Pleistocene paleoenvironmental characterization of the "Valle Umbra". A total of about 50 meters stratigraphical log has been studied , and facies analysis, leading to processes identification and paleoenvironmental characterization, has been carried on. Several facies associations, mainly referable to a shallow lacustrine environment, with a persistent wave motion, have been described. Massive to thin-laminated clay or silty-clay deposits, interbedded to bioclastic levels (mollusk fragments) and/or rhythmical, wave- or current-rippled silty sand, represent the prevailing facies association. Wave-rippled fine to medium sand, showing hardened, sub-aerial surfaces, as well as mud cracks and paleosoils, alternates to clay. Post-depositional structures, as convolute laminations, and sin-depositional collapse features usually occur. Rhythmicity, recurrent both in a single facies association and in the vertical facies alternation, allows the hypothesis of lake level variations during time, related both to short time fluctuation (seasonality, sedimentation rate, processes on the shoreline, etc.) and to long time climatic changes. Lignite levels, with prevailing woody remains and roots, commonly occur in the upper succession, often over paleosoils or interbedded to massive or thin-laminated clay. Both lignite levels and paleosoils are referable to a marsh, highly reducing environment bordering the lake, allowing the organic matter preservation. Moreover, lignite and paleosoils cyclically alternate to thick, roughly arranged sandy bodies, interpreted as coastal dunes re-elaboration or distal flooding events. Paleontological content confirms sedimentological data and paleoenvironmental context. Finally, several facies association characters underline analogies with Western Tiberino Basin evolution, especially with lacustrine Fosso Bianco lithostratigraphic Unit (Ambrosetti *et al.*, 1995; Basilici, 1997).

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SEDIMENTARY AND BIOSTRATIGRAPHIC FEATURES OF THE PLIO-PLEISTOCENE SUCCESSIONS OF THE PELORITANI MTS (SICILY, SOUTHERN ITALY)

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In NE Sicily (southern Italy), the Peloritani Mts. represents the southernmost flank of the Calabria-Peloritani Arc. In this area, the Kabilo-Calabride Chain crystalline units widely outcrop, forming the innermost sector of the Apenninian-Maghrebian Chain. The Kabilo-Calabride units are covered by several terrigenous sequences, starting from latest Eocene, each indicating a stage in the polyphasic tectonic evolution of the area. This study represents a first step of a more large research project, which have the aim to reconstruct the vertical/lateral relationship between the Plio-Pleistocene deposits, discontinuously cropping out along the Tyrrhenian and Ionian coasts of Peloritani Mountains. These sediments represents the present remnants of pery-coastal small basins and semi-enclosed gulfs or embayments, partly dissected by the active and recent structures of the belt, and recording the relative sea-level changes during the Plio-Pleistocene age, when important geodynamic events occur in the central Mediterranean, as the opening of the Tyrrhenian Basin. Furthermore, the understanding of the sequential identity of these successions can help to reconstruct the different structural evolution of the Peloritani Mts, characterized by various uplift rates and structural styles. A multi-disciplinary study carried on the spectacular sections located near the town of Rometta, have offered the possibility to detect the sedimentary characters of the Plio-Pleistocene sequences, and to recognize the relationship between tectonics and eustatism in the control of sedimentary record. The Rometta section shows three main stratal units, distinguished on the base of their lithological and biogenic features; the characters of the bounding surfaces and the abrupt facies vertical changes refer this sequence to a fall-to-rise cycle of relative sea-level fluctuation, occurred during the Plio-Pleistocene. The physical correlation with other similar succession along the Peloritani Mountains, permits to reconstruct the sequential order of deposition up to the late Pleistocene, highlighting the role of the local tectonics in the control of depositional systems development.

THE RECOGNITION OF THE TRIGGER AGENTS OF SOFT-SEDIMENT DEFORMATION: THE CASE HISTORY OF THE PLEISTOCENE SAN LORENZO LACUSTRINE DEPOSITS OF THE SANT'ARCANGELO BASIN (SOUTHERN ITALY)

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The soft-sediment deformation structures induced by seismic liquefaction and/or fluidization (seismites) have been analysed by many authors in sedimentological and palaeoseismic studies. Seismites have been reported in all sedimentary environments, but they seem to be very common in lacustrine successions. Moreover, even without clear deformation of strata, homogeneous silty beds in lacustrine environments have been interpreted as seismites. The relative abundance of seismites in lacustrine successions is explained in literature in this way: 1) presence of water-saturated sediments; 2) presence of sediments with high susceptibility to liquefaction; 3) absence of hydrodynamic and sedimentary processes able to obliterate the seismically-induced deformations. Most of soft-sediment deformation processes are related with the loss and/or the drastic decrease in shear resistance in water-saturated and unconsolidated sediments and liquefaction and/or fluidization are the main agents which allow a temporary change from a solid-like to a liquid-like behaviour in sand and silt. But liquefaction and fluidization can be induced by a lot of natural processes (overloading, unequal loading, wave-induced cyclical and/or impulsive stresses, sudden changes in groundwater level, and earthquakes). In this work we analyse many deformed beds in the lower Pleistocene part of the lower to middle lacustrine succession of the Sant'Arcangelo Basin (Southern Italy). Our analyses were focused on: - the detailed description of the morphological features of different kinds of soft-sediment deformation structures; - the interpretation of time and mechanism of deformation; - the interpretation of trigger mechanisms. The studied lacustrine deposits of the San Lorenzo Cycle belong to the infill-succession of the Sant'Arcangelo Basin, a Pliocene to Pleistocene satellite basin, located back to the front of the south-Apennines thrust belt. The lower to middle Pleistocene lacustrine succession is made up of siltstone, claystone, and, secondly of sandstone beds and carbonate and volcaniclastic interbeds, arranged into fining upward sequences. The upper-middle part (about 50 m thick) of the entire succession (about 200 m thick), has been investigated in detail in the depocentral sector of the lacustrine basin. Here, soft-sediment deformation structures have been observed. They occur in fine-grained sandstone and claystone alternations and show a wide morphological variability (deformed laminations, slumps, load-structures, large vertical water escape structures and neptunian dykes). Their formation occurred at different times (during and after sedimentation) and with different mechanisms of deformation: some structures are related with liquefaction and fluidization processes (viscous fluid behaviour) while other ones occurred when sediment was already diagenized and its behaviour was plastic and/or fragil. The facies analysis carried out on the succession and the detailed morphologic study of the soft-sediment deformation structures allow us to suppose that the main trigger agents for deformation were seismic shocks and overloading induced by sudden supplies of coarser deposits on clayey sediments due to the arrival of low-density turbiditic currents: therefore, we can demonstrate that not all deformed beds are related with a seismic trigger mechanism. The general interest of the work is related with the role of sedimentology in palaeoseismic studies, in particular in to establish general criteria to distinguish seismic and not-seismic soft-sediment deformation structures.

SEQUENCE STRATIGRAPHIC ANATOMY OF DIVERSITY PATTERNS: LATE QUATERNARY BENTHIC MOLLUSKS OF PO PLAIN, ITALY

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The influence of sequence stratigraphic (sea-level driven processes) on patterns derived from the fossil record has received an increasing attention. This study explores stratigraphic anatomy of diversity patterns across two late Quaternary 4th-order sequences deposited on the Po Plain (Italy) over the last 150 k.y. (i.e., the two most recent glacial-interglacial cycles). The rich mollusk fauna, dominated by extant forms, preserved as a part of well-understood eustatic cycles, offers a testing ground for exploring how climate-driven sea level changes influence sample diversity, diversity turnover, and higher-order diversity patterns within and across systems tracts and sequences. These two 4th-order depositional sequences were densely sampled along 3 cores. The analyzed data (150 species and 22776 specimens) included 29 Holocene and 19 Pleistocene samples, were analyzed using single-sample and multi-sample rarefaction techniques. In all three cores and for both cycles, sample-level diversity decreased upward within sequences: the late-Transgressive Systems Tract (l-TST) samples displayed the highest equitability and richness and the Highstand Systems Tract (HST) samples displayed the lowest diversity (the trend primarily reflects the increase in the dominance of most common species in HST samples). This pattern is likely due to a combination of ecological, environmental, and taphonomic processes. Multi-sample rarefaction indicates that species turnover is more limited in transgressive phases of both depositional cycles. This trend may reflect increasing environmental heterogeneity of marginal habitats averaged within shallowing-upward successions and/or decreasing time averaging, which should be more pronounced during HST phases of the cycles when sedimentation rates tend to be higher. The sequence and multi-sequence diversity levels are lower than those observed within individual l-TST systems tracts, indicating that species turnover was minimal both within as well as across the last two interglacial cycles. The study shows that species richness and equitability patterns of the most common mollusk species track closely the sequence stratigraphic architecture of late Quaternary successions of Po Plain.

ROCKY COASTS, SAND AND GRAVEL BEACHES FROM LATE PLIOCENE AND EARLY PLEISTOCENE OF THE ORVIETO AREA (WESTERN UMBRIA, CENTRAL ITALY) (poster)

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Several Late Pliocene to Early Pleistocene successions outcropping in the Orvieto area (Western Umbria, Central Italy), are referable to a coastal marine environment and reveal considerable differences in shoreline palaeomorphologies. Basing on facies description and sedimentological analysis, it was possible to discriminate the various coastal subenvironments, ranging from offshore to shoreface, to beachface. Various coastal morphologies, and consequently differences on depositional systems, have been noted. The main variations are related to beachface and shoreface subenvironments: deposits are alternatively represented by cliff talus, rounded to flattened cobbles and pebbles (organized as gravel beaches), clinostratified sandy and/or calcarenitic bodies, storm events showing swaley cross stratification, distributory mouth bars of alluvial origin, and even small build-ups of *Cladocora caespitosa* coral. On the other hand, offshore deposits are always represented by massive to roughly laminated clay and silty clay. Coastal paleomorphologies varied from rocky coasts to sand and gravelly beaches fed by small rivers (fan deltas). Differences may depend on lateral subenvironmental variations, inherited from of previous subaerial evolution of landscape, testifying for a complex articulation of shoreline in headlands, in which large amount of wave's erosion took place, and protected bays, with a lower paleoenvironmental energy and even little fluvial mouths. On the other hand new data, recently collected, reveal a minimal age gap, the main cliffs' systems being a little holder respect to fluvial-related coasts. Both progradation and retreat trends on coastal systems have been documented, so cyclicity, recognized in almost every outcrop, seems to be a recurrent feature. Although global sea level changes seem to have played the main role in determining regressive and transgressive trends in coastal systems during Pliocene and Pleistocene, local tectonics and variations in sediment supply look adequate to explain minor coastal variations at least. Paleoenvironmental restoration appears more complicated than previously supposed (Ambrosetti *et al.*, 1987; Conti *et al.*, 1983). Studies are still in progress, but our data seem to put a new light in the reconstruction of the evolution of Orvieto area, during Late Pliocene and Early Pleistocene at least.

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STRATIGRAPHIC ARRANGEMENT AND SEDIMENTOLOGIC FEATURES OF THE REGRESSIVE LOWER PLEISTOCENE DEPOSITS IN THE CENTRAL BRADANIC TROUGH AREA: GEODYNAMIC IMPLICATIONS (poster)

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The Bradanic Trough is the uplifting and today-exposed foreland basin of the South Apennines chain (southern Italy). The evolutionary history of this basin is characterized during the Pliocene by a progressive subsidence which was partially compensated by sedimentation of deep marine deposits; from the Emilian, this sector of the Apennines foredeep underwent a drastic "shallowing" that caused its complete filling beginning from its central sector (Genzano di Lucania and Banzi area) to the Metaponto plain. The outcropping upper part of the in-fill successions (up to about 600 m in thickness) is mainly characterized by silty clay hemipelagites (the Argille subappennine Formation), which are either in transitional or in erosional contact with the overlying regressive coarse-grained deposits represented by shallow marine deposits sometimes passing upward to continental ones. The stratigraphic and sedimentologic study performed in the central sector of the Bradanic Trough allowed to reconstruct stratigraphic successions that record the first regressive phases of the basin filling, represented by lower Pleistocene coastal to alluvial conglomeratic and sandy deposits characterized by a cyclic repetition of facies and depositional systems. Detailed facies analyses and physical correlations of several logged sections demonstrate the oldest reconstructed stratigraphic successions (i.e. Genzano di Lucania) are of aggradational type and the cyclicity is strictly related to high-frequency relative sea-level changes during a long-term and slow relative sea-level rise; sedimentation rates compensated or exeeded this relative sea-level rises. On the contrary, in the rest of the central basin (i.e. Irsina and Grassano), the stratigraphic architecture of the deposits show a downward-shifting configuration, indicating deposition induced by high-frequency relative sea-level changes during a long-term relative sea-level fall. Therefore, studied deposits of the central area of the Bradanic Trough record the geodynamic change from a "normal" subsident foreland basin to an "anomal" uplifting one; this change was well known in southern Italy but generally was dated middle-late Pleistocene, that is after the deposition of the studied successions.

GEOMETRIES, BIOTA ASSOCIATIONS AND EVOLUTION OF PROGRADING CARBONATE SYSTEM (MIOCENE, NW SARDINIA, ITALY) (poster)

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This contribution presents data on facies, biota associations and depositional environment of a Serravallian-Tortonian carbonate system outcropping in the north-western sector of Sardinia, in the Logudoro basin (Martini et al., 1992; Funedda et al. 2003). The studied system is characterized by two distinct sediment associations: a) rhodalgal sediments and b) chlorozoan-type sediments reflecting two different phase in the evolution of the system. Four major lithostratigraphic units were identified that are deposited in different depositional environments. Time constrains derive from 87Sr/86Sr ratios calculated on bulk carbonate and their relative comparison with Hodell's curve (Hodell et al. 1991). Unit 1 (isotopically dated 13 Ma) is represented by clinoforms dipping with 20-25° whose main components are ellipsoidal rhodoliths and subordinately bivalve, echinoid skeletal debris, benthic foraminifera. Red-algae assemblage include: melobesioids, mastophoroids, lithophylloids and sporolithaceans.The lower boundary of this unit is represented by a bioturbated downlap surface. An erosional unconformity marks the base of Unit 2 that is composed of 8 meters of reefal rudstone and reef framework mainly composed of Tarbellastraea and Porites. Secondary components are: rhodoliths, encrusting red algae, benthic and encrusting foraminifera and bryozoans. Strontium isotope data point out approximately 9 Ma. The coral framework interfingers basinward with skeletal packstone and floatstone rich in rhodoliths, coral fragments and benthic foraminifera (Amphistegina). The coral facies pass upward to ten meters of rhodalgal packstone to rudstone bounded on top by a bioturbated fllooding surface. The overlying Unit 3 is represented again by large-scale prograding clinoforms. Clinobeds are made of skeletal packstones with red-algae fragments, benthic foraminifera, bivalves, echinoids, coral fragments and with rhodolith-rich levels. Basinward they grade into and interfinger with skeletal packstones rich in planktonic foraminifera and with intense bioturbation. The uppermost Unit 4, overlying a second erosive surface, is composed of bioclastic packstone-rudstone with balanids, benthic foraminifera and bryozoan colonies. Biota components of the four units (particularly red-algae and coral communities) indicate tropical conditions to persist in the studied time interval. The evolution of the investigated carbonate system may be summarized in four major steps: a first regressive phase consisting of a rhodalgal downlapping progradational system, followed by the down stepping of the reef facies which directly downlapped on to the rhodalgal units, and successively by the drowning of the coral unit. Finally a new phase of progradation of the rhodalgal clinobeds occurred. The last phase is marked by e new regression of the facies belt. An evaluation of the timing of the first down stepping corresponding to the development of the reefal limestones indicates an interval between 12 Ma and 9 Ma. It could be related to a sea-level fall which, in turn, should coincide with the sea-level lowstand dated 10,5 Ma on the curve after Haq et al.(1987).

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STRATIGRAPHIC REVIEW OF THE PLIOCENE DEPOSITS IN THE SOUTH-EASTERN VALDELSA BASIN (TUSCANY, CENTRAL ITALY): TECTONIC AND EUSTATIC CONTROL ON FLUVIO-DELTAIC DEPOSITIONAL SYSTEMS (poster)

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Pliocene terrigenous deposits exposed in the south-eastern Valdelsa Basin have been studied through high-resolution geological mapping and facies analysis. The stratigraphic architecture of fluvial, deltaic and shallow marine gravelly to muddy deposits, suggests interaction between tectonic and eustatic signals that control the infill of this portion of the basin between the Zanclean and the Piacenzian. The Borro Strolla Synthem (BS)(uppermost Messinian-lower Zanclean) consists of alluvial grading into deltaic deposits. The alluvial deposits represent the filling of a valley incised in Messinian deposits. Three subsynthems are distinguished: the lower two are referred to uppermost Messinian; the upper (lower Zanclean) is represented by gravels and subordinate sands with horizontal and trough cross-stratification. These are abruptly overlain by shallow marine silty clays. The deltaic deposits, exposed in the Colle Valdelsa area, consist in fine to medium gravelly sands, in horizontal or planar inclined beds, internally massive or normally graded, with a locally rich molluscan fauna. The Certaldo Synthem (CS)(latest Zanclean-early Piacenzian) is made of two vertically stacked lithofacies assemblages. The lower assemblage is represented by gravels, pebbles, and coarse medium sands alternating with massive silty clays abundant with marine molluscs, referred to a delta front-inner shelf environment. The upper lithofacies assemblage consists of silty clays with abundant marine molluscs, referred to an inner shelf depositional environment. The Pietrafitta Synthem (PS)(uppermost Zanclean-Piacenzian) consists of two subsynthems. The lower one is made up of massive silty clays with abundant marine molluscs and fine to medium sands, massive or with planar or inclined stratification. The former indicates an inner shelf depositional environment, the latter is interpretable as resulting from hyperpicnal flows. This subsynthem is unconformably overlain by a subsynthem consisting of thin alluvial deposits at the base, then medium to fine massive delta-front sands in tabular bodies with abundant molluscan fauna. The Ponte a Elsa Synthem (PE)(Piacenzian) consists of fluvial gravel, sand and clay on the eastern side of the basin that shifts gradually to deltaic and shallow marine sand and clay in the central-western portion of the basin. The facies architecture and paleocurrent data suggests the following depositional evolution: 1)During the lower Zanclean,in the south-eastern Valdelsa Basin a deltaic system fed by a river coming from the NW developed in a basin that was probably connected to the sea by an opening in the southern part of the Mid Tuscan Ridge, which had probably started the uplifting during the Zanclean, mildly deforming the deltaic system of the BS Synthem. 2)In the latest Zanclean-early Piacenzian the southern connection with the sea must have still been present but the delta fronts show that they are not coming from the eastern margin anymore, but from S. This could be explained by the development of an axial supply correlated to a period of stasis in the uplifting of both western and eastern margins. An alternative hypothesis would be that the paleovalley of the BS was reactivated and had to deviate towards the N because the deltaic sands of the BS constituted a structural height. 3)During the uppermost Zanclean-Piacenzian the deposits of the PS fill some valleys, which are preliminarily interpretable as the result of migrating upstream knickpoints, forming a new drainage systems on the previously submerged shelf, when the sea-level fell, compounded by subsiding of the Valdelsa Basin, probably related to reactivation of uplifting of the western and eastern sides. The delta fronts were fed from the northwest zone as well as from the southern zone. 4)During Piacenzian there was a major reorganization of the drainage network as a consequence of uplift and denudation of the north-eastern basin shoulders.

UNCONFORMITY-BOUNDED STRATIGRAPHIC UNITS MAPPING THE TERRACED MARINE DEPOSITS OF THE IONIAN COAST. THE CASE STUDY OF THE F. 408 "POLICORO", SCALE 1:50.000 (SOUTHERN ITALY) (poster)

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The adoption of the unconformity-bounded stratigraphic units rather than the classic lithostratigraphic ones mapping Quaternary deposits having lithological similarities but belonging to different sedimentary cycles, of a short geochronological span, is one of the discussed problems during the work for the new italian geological cartography (CARG project). In literature these kind of sedimentary bodies have been generally grouped by informal stratigraphic units, subdivided into units of lower rank on the bases of morphological elements. This latter is the case of the terraced marine deposits widely cropping out along the Ionian coast (Southern Italy). These deposits characterize the top of the Pleistocene Bradanic Trough succession and consist of shallow marine and continental deposits which generally lie unconformably on the Argille subappennine Fm. and are showed up by terraced surfaces located between 6 and 450 m a.s.l. These sedimentary wedges have been referred to an informal lithostratigraphic unit named "Terrazzi Marini" (F° 212 "Montalbano Jonico", scale 1:100.000) or "Depositi marini in terrazzi di varie quote" (F° 201 "Matera", scale 1:100.000), and have been subdivided into different orders on the basis of their altitudes and scarps edges bounding terraces. According to the classic interpretation each marine terraced deposit, corresponding to a different order, is the response of Quaternary glacio-eustatic oscillations, while the different heights of each marine terraced deposit are related to the tectonic uplift occurring during the middle-late Pleistocene. A more recent interpretation suggests that the terraced deposits could be referred to a single sedimentary body displaced by faults. The stratigraphic and sedimentologic studies carried out for the new geological survey of the F° 408 "Policoro", scale 1:50.000, located in the Metaponto plain, confirmed that the marine terraced deposits are bounded at the bottom by stratigraphic discontinuities or their correlative conformities and pointed out that each of them is generally represented by a sedimentary succession testifying a transgressive-regressive cycle; the transgressive part is poorly developed and generally consists of lag or gravelly coastal deposits; the regressive part, instead, is represented by a well developed coarsening upward succession, consisting of transitional facies association (beach and delta systems) passing upward to continental ones. It was also pointed out that the stratigraphic discontinuities at the bottom of each marine terraced deposits have regional extent both toward the north (in the Puglia region) and toward the south (in the Calabria region). These evidences and the lack of faults having the same strike of the terraces scarps let us to rule out a tectonic genesis for the marine terraced deposits. According to these data, each terraced marine deposit, bounded at the bottom by a significant unconformity surface, can be defined as an unconformity-bounded stratigraphic unit. In particular, in the F° 408 "Policoro", seven synthems have been identified; six of them represent marine terraced deposits (Sistema di Tinchi 160-120 m a.s.l.; Sintema di Marconia, 116-80 m a.s.l.; Sintema di San Basilio, 85-50 m a.s.l.; Sintema di San Teodoro 45-30 m a.s.l.; Sintema di Terzo Cavone 28-14- m a.s.l.; Sintema di Mass. Ricotta 12-5 m a.s.l.); the seventh synthem (Sintema della Piana costiera metapontina) corresponds to the actual coastal plain. These synthems have been grouped in a supersynthem (Supersintema dei Depositi Regressivi) which includes all the Quaternary regressive deposits which lie unconformably on the upper part of the Bradanic succession. The adoption of unconformity-bounded stratigraphic units allowed us, using stratigraphic elements (a different way with respect to the literature), to separate geological bodies having the same lithology but belonging to unlikely distinguishable chronostratigraphically sedimentary cycles.

THE PALAEOCENE PALUSTRINE CARBONATES IN SOUTHWESTERN SARDINIA (ITALY) : PALAEOENVIRONMENTAL SIGNIFICANCE (poster)

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The long continental phase, which began in the Late Maastrichtian and ended with the extensive early Ypresian marine transgression, the beginnings of which date to the Late Thanetian, is represented chiefly by palaeosoils and by pseudobreccia containing microcodium. Carbonate sediments from palustrine environments containing freshwater algae, referred to the Middle-Late Palaeocene, have only been observed in the Piolanas valley in SW Sardinia. Here, the 10 m thick, chiefly carbonate, Palaeocene succession rests on the Palaeozoic basement. At the base is present a clayey-marly deposit, passing to unfossiliferous yellowish calcareous-dolomite one with mud cracks and ramified cavities infilled by vadose silt and microcrystalline quartz grains, that may be indicative of repeated phases of subaerial diagenesis in a low energy continental environment. These essentially terrigenous sediments may well have deposited in a swampy area under anoxic conditions, given the absence of any biological evidence. These sediments are overlain by unfossiliferous, structureless, grey microsparite limestone again with no traces of biological activity; the widespread micrite concretions rimmed by curved sparite fractures and chiefly micrite filled elongated fenestrae are evidence of subaerial diagenesis. These characteristics are very likely the product of recrystallization during emergence periods of the micrites; their genesis may well be comparable with the marls currently being deposited in the sloughs within the Everglades. These fine-grained primary carbonate sediments are precipitated by cyanobacteria in bicarbonate-rich water in depressions where evaporation prevails for long periods. This favours their precipitation, inhibiting plant growth or promoting the oxidation of any organic matter in hot semi-arid climatic conditions. The microsparites passe upwards into fossiliferous micrite limestones with charophytes, which often dominate and are complete with stems and verticils. Charophytes stems are delicate structures and the abundance of intact stems indicates episodes of deposition in freshwater low-energy environments with no significant transport. Charophytes proliferate at depths of 0 to 1 m and meadows grow chiefly on a muddy substrate at depths of less than 2 m. Organosedimentary deposits are also common; these consist essentially of cauliflower stromatolites and algal mats which actually accumulate at depths of less than 1 m in the Everglades prairies. Microcodium occur throughout the limestones both as crystalline aggregates and debris. The single prisms or fragments can account for up to 50% of sediment volume, their presence suggests reworking of peripalustrine facies with microcodium proliferation. These carbonate sediments are also characterised by the presence of fenestral cavities with partial geopetal filling and glaebules coated with a dark micritic ring. Both these structure and microcodium may suggest subaerial exposure of the carbonate sediments in a peripalustrine environment with water level fluctuations, probably in a hot semi-arid climate. The topmost part of the carbonate succession consists of grey-yellowish, microcrystalline, brecciated dolomitic limestones with neomorphic dolomitic euhedral rhombohedra embedded in a microsparite matrix. These may well have been produced by recrystallization of pure micrite during emergence periods of variable length, in environmental conditions similar to those of the unfossiliferous limestones. The depositional conditions of the Piolanas succession well reflect the climatic events known to have taken place in Europe. In the Early Palaeocene a temperate climate existed at the high latitudes while in SW Europe the climate was tropical. In the Middle-Late Palaeocene there was a general warming but especially an abrupt global warming that occurred at the Palaeocene-Eocene boundary.

THE BAS-OSTRICONI UNIT OF NORTHERN BALAGNE, CORSICA: PALEOGEOGRAPHIC IMPLICATION FROM NEW STRATIGRAPHIC AND STRUCTURAL DATA (poster)

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The Balagne area (northern Corsica) is characterized by a complex stack of tectonic units belonging to Alpine Corsica. In the western side of the Balagne area, this tectonic stack is thrust westwards onto the Hercinian basement and its "middle" Eocene sedimentary cover. The uppermost units are represented by the Oceanic Balagne Nappe (in the South), that crops out in the area between Novella and the Asco Valley and by the Bas-Ostriconi Unit (in the North), that crops out in the area between the Lozari Village and the Ostriconi Valley. The aim of this work is the study of both stratigraphy and structural evolution of the Bas-Ostriconi unit that still represent an open problem in the geology of the Alpine Corsica. The Bas-Ostriconi unit can be divided into three sub-units bounded by N-S west-vergent thrusts. In each sub-units, a polyphasic deformation history, consisting of four distinct folding phases, has been recognized in the whole Bas-Ostriconi unit. The D1 phase is characterized by a penetrative and continuous foliation (S1) mainly developed inside the fine-grained beds, and everywhere recognized at low-angle to the sedimentary stratification (S0); along the S1 foliation, pressure shadows with asymmetric geometry give a top to the W shear sense. The D2 structures, that are the most widespread in the field, are mainly characterized by meso-scale close to tight F2 folds. An axial-plane crenulation cleavage (S2) is associated to these folds. The PA2 axial-planes are folded by a third deformation phase (D3); this phase doesn't develop an axial-plane foliation, associated to the F3 folds. At the regional scale, the whole tectonic units stack, cropping out in the north Balagne area are deformed during the D4 phase in a large scale syncline. The structural evolution of the Bas-Ostriconi unit can be compared with that recognized in the Balagne Nappe. From the stratigraphic point of view the Bas-Ostriconi unit is represented by a succession that includes Late Cretaceous carbonatic turbidites (Narbinco Flysch Auctt.) associated to coarse-grained polymict conglomerates. The basement of this unit has never been recognized. The Narbinco Flysch (cfr. Flysch Calcareo) is characterized by medium- to coarse-grained arenites up to fine-grained rudites capped by thick marly and calcareous-marly levels. The conglomerates are characterized by a clast-supported texture derived from a deposition by poorly evoluted turbidites. Both the arenites from Narbinco Flysch and the conglomerates are characterized by a mixed siliciclastic-carbonatic composition mainly composed by acidic volcanics, extrabasinal platform carbonates, granitoids and low grade metamorphic rock fragments and point to a source area located in the uppermost part of a continental lithosphere. This composition can be compared with the debris composition recognized in the Lydienne Flysch, Toccone Breccia and Novella Sandstone belonging to the lower Cretaceous turbiditic cover of the Balagne Nappe. In this work we propose a correlation between the Bas-Ostriconi Unit succession and the turbidite sedimentary cover of the Balagne Nappe based on theirs common source areas, structural evolution and geometric position. Particularly, we consider the Narbinco Flysch and the associated conglomerates as the uppermost part of the Balagne turbiditic sequence supplied by the near Corsica-Europe margin. Moreover, the association of intrabasinal carbonatic ooze with mixed siliciclastic-carbonatic coarse-grained debris recognized in the Bas-Ostriconi unit succession, represent a common features of several turbidite deposits supplied by the European Margin during the Late Cretaceous (eg. Monte Verzi Marls, Internal Ligurian Units; Marina di Campo Flysch, Elba Island). We also propose the correlation between the Narbinco Flysch and these deposits all characterized by a composition derived from an extrabasinal siliciclastic-carbonatic debris mixed with intrabasinal carbonatic ooze.

UNDERGROUNG CHARACTERIZATION OF THE CAMPANIA PLAIN BETWEEN CAPUA AND CASERTA (poster)

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Within the framework of natural resource management and conservation it is often required a proper knowledge of the subsoil as it is undoubtedly one of the most important factor regulating environmental quality, expecially in lowland areas. Implementation of knowledge concerning the geological setting in the northeast of Piana Campana, nearby Capua (CE), has been carried out through the analysis of many stratigraphic data acquired from probes and wells (stratigraphies and geotechnical and hydrogeological data). Despite the considerable lack of standardisation in the descriptions given by different technical staff and for different purposes and competence, it was possible to homogenise the data. We identified the main lithological properties of the deposits, at times their geotechnical characteristics and sometimes even their depositional environment. The description of sediments obtained from the wells and probes have also been compared with data from the literature By means of construction and comparison of variously trending geological sections we have further outlined the lateral-vertical arrangement of the sedimentary bodies. Formations were then detected that define deposits with the same lithological features or that group different facies of the same deposit or products of the same depositional environment. Chronostratigraphic correlations and interpretations among the various formations were made by using markers such as palaeosoil and well-known extensive volcanic formations. All the information acquired was then inserted in a GIS data base. Insertion of the underground data into a computerised database is firstly useful for creating computerised geological sections so as to construct a three-dimensional geological model of the subsoil. The latter is produced by fitting the data from wells, and using a multilayer grid that integrates the surfaces (top and bottom) of the various geological formations (DSM - Digital Surface Model). A project of this type constitutes not only a powerful tool for analysing the subsoil stratigraphy of urban areas but also has interesting repercussions in applicative terms. The possibility of characterising the subsoil in geological terms allows us to detect not only the nature of the soils but also their physical and mechanical properties and the presence of cavities or potential fracturing.

RUDIST LITHOSOMES RELATED TO CURRENT PATHWAYS IN UPPER CRETACEOUS TEMPERATE-TYPE, INNER SHELVES: A CASE STUDY FROM THE CILENTO AREA, SOUTHERN ITALY (poster)

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Shallow-water foramol limestones have been studied from a locality in the southern Apennines in which outcrop conditions show an excellent overview of the lateral and vertical evolution of rudist bodies and allow their geometry and the dynamic aspects to be reconstructed. The lithofacies suggest open depositional settings characterized by peloidal silty-muddy sediments. Rudists inhabited well-defined sectors of these shelves, giving rise to wide biostromal bodies, and supplied most of the skeletal debris via bioerosion and minor physical breakdown. In particular, the characteristics of rudist lithosomes document the existence of a complex network of channel-like depressions. In such a depositional context, the evolution of rudist lithosomes seems to have been strongly controlled by the hydrodynamic conditions of the environment. The resulting composite rudist assemblages are characterized by individuals quite often found toppled and oriented parallel to bedding, suggesting continuous sediment movement and/or removal between the organisms. The good preservation of the shells and the common articulation of the valves, however, point to an absence of sustained transport but rather a slight sediment destabilization. The gross lenticular geometry of the shell beds could be related to the above-mentioned patterns of weak, maybe channelized, currents and/or pathways. In most cases, lithosomes may be considered as a multistorey growth in channel-like systems in a persistently subtidal setting. The depositional setting may be considered as a low-energy system with low tidal range, such that facies transition is very gradual and facies belts are broad, while distinct shoal/barrier deposits are absent. Such a depositional system implies a very low bathymetric slope on which wave energy was minimal, dampened by friction along a broad expanse of shallow water hundreds of kilometres wide. The resulting sea bottoms, dominated by biogenic carbonate sedimentation, were separated by troughs and/or tidal passes. In such a depositional context, rudist colonization on channel margins assumes particular importance as it documents the rudist ability to exploit a wide array of environments, comparable to that of oysters in Recent seas, and reflecting the probable opportunistic nature of rudists.

STRATIGRAPHIC AND DEPOSITIONAL EVOLUTION OF THE QUATERNARY MARINE TERRACED AND ALLUVIAL COASTAL DEPOSITS BETWEEN BASENTO AND CAVONE RIVERS (METAPONTO PLAIN, SOUTHERN ITALY) (poster)

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The studied area is located in the Metaponto plain, along the coastal zone of the Taranto Gulf (Southern Italy), corresponding to the outcropping southern part of the Bradanic Trough. This latter represents the south-Apennines foredeep filled by a few kilometers thick succession mainly characterized by buried turbidites, and by outcropping shallow marine deposits passing upward to continental ones. This sedimentary record corresponds to the evolutionary history of the basin: during the Pliocene, it was characterized by a progressive subsidence which was partially compensated by sedimentation of deep marine deposits; from the Emilian, the south-Apennines foredeep underwent a drastic "shallowing" due to uplift that caused its complete filling beginning from its central sector. This "shallowing" is testified by the sedimentation of silty-clays offshore deposits (Argille subappennine Formation), and by the progressive sedimentation of sandy and gravelly units of coastal and continental environments. These regressive deposits shift during time, gradually moving to the present-day Metaponto coastal area, and recording the uplift. They include both upper Pleistocene marine terraced deposits outcropping in the Metaponto area and other deposits buried below Holocene ones. These latter represent also the present-day coastal area and are composed of sandy beaches, dunes and backshore lagoons. In more internal areas, upper Pleistocene-Holocene alluvial terraced deposits crop out; they formed owing to climatic and relative base-level changes, so they complete the upper Quaternary stratigraphic setting. In particular, in the studied area, five orders of terraced marine deposits are distinguished. The most complete observed succession, some meters thick, overlies the Argille subappennine Formation, and is made up of transgressive gravelly to sandy beaches wedges passing upward to regressive sandy to gravelly prograding beaches or deltas. Finally, the upper part of the succession is represented by an erosionally based unit, made up of sandy and gravelly reddish deposits, alluvial in origin.

A GIS ASSISTED INTERDISCIPLINARY APPROACH TO THE ENVIRONMENTAL EVOLUTION AND STRATIGRAPHIC ARCHITECTURE OF THE SOUTHERN PORTION OF THE MODERN PO DELTA (poster)

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The Holocene sedimentary history of the Po Delta is recorded within a complex depositional architecture, affecting the present-day evolution of the fragile coastal area. Reconstruction of the surface and subsurface stratigraphy derived from the integration, within a geographic information system, of remote sensing techniques, and sedimentological, stratigraphic, paleontological, and geotechnical investigation. These research were mainly supported by the Regione Emilia Romagna, within the CARG geological mapping project. Local research on the Goro area was founded by the Provincia di Ferrara. The coastal plain stretching between Chioggia and Ravenna was generated by the diachronous progradation of several highstand Po delta lobes, through the last 5,000 years. The depositional evolution of the delta was influenced by the fast natural subsidence, by the changing climatic framework, and by a growing degree of human alteration, significant since Roman times. The present-day Po Delta lobe was artificially induced, just four centuries ago (1604), to prevent the silting up of the Venice Lagoon. A canal cutting by the Venice Republic forced the Po main distributary channel to flow into a shallow-water interdistributary bay. This artificial forcing triggered a very fast delta progradation, of about 20 Km over less than 300 years, into marine water even 20 m deep. The progradation therefore generated a very large sedimentary body, over a short period of time. This fast progradation was supported by a cool and moist climatic pulse, characterising the XVII-XVIII Centuries, increasing the water and sediment discharge to the coastal systems. During the early growth phase of the delta, progradation was so fast that outspeeded the fluid expulsion from the delta front muds, thus delaying the compaction subsidence starting. Subsidence then became important, reducing the progradation speed, by increasing the accommodation space creation. During the last century, strong subsidence associated with water and methane pumping from the shallow subsurface and a massive artificial reduction of the river sediment load stopped the delta progradation and forced coastal erosion. The development of the modern delta lobe framed the evolution of the Goro coastal Lagoon (Sacca), at the north-eastern edge of the Ferrara Province. This semi-enclosed shallow-water area brings a major economic relevance, mainly because of the mollusc exploitation. The Sacca di Goro area evolved from an open interdistributary bay to a semi-enclosed shallow coastal lagoon, during the last two centuries, whereas the adjacent terminal distributary channels largely prograded. The fast lateral growth of arcuate coastal spits progressively enclosed the bay, which evolved from prodelta to low-energy peritidal conditions without any high-energy beach system passing through the area. The depositional architecture largely affects the water circulation and thus the lagoon ecological framework. These waters show highly seasonally variable salinity, temperature and redox potential gradients. The coastal lagoon is subject to great environmental hazards, of eutrophication, anoxia and erosion and therefore need an accurate environmental management. Only large artificial embankment and massive water scooping prevent the adjacent delta-top area from be rapidly submerged. The preservation of the coastal spit from the marine erosion is therefore fundamental for both the conservation of the ecological framework and for preventing the marine storm waters from flooding the adjacent widespread coastal area. The evolution of the area will be also strongly influenced by the compaction subsidence. The reconstruction of the depositional architecture has therefore to be carefully integrated in any sensible forecasting of the environmental evolution and in the sustainable management of these beautiful but fragile coastal environments.

THE MIDDLE TRIASSIC CARBONATE PINACLE OF THE CERNERA PLATFORM: AN OUTCROPPING MODEL FOR HYDROCARBON RESERVOIR (poster)

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The Cernera Massif shows several superposed generation of Middle Triassic carbonate platforms, developed in the hinge belt between the western and eastern Dolomites. The less subsiding western region is characterized by upper Anisian carbonates almost directly lying on a single sequence bounding unconformity, deeply cut into the Lower Triassic and older units; these carbonates were followed by thick Anisian-Ladinian platforms and by Ladinian volcanic event. The eastern and northern area is typified by various generations of Anisian carbonate platforms, separated by gently-eroded boundaries, followed by long-lasting, terrigenously-influenced basinal deposits; the Ladinian volcanism did not directly affect the area. The Cernera area shows the good preservation of three superposed Anisian platform generations and depositional sequences. The area spectacularly records the evolution of an isolated carbonate pinnacle "fighting for survival" against fast subsidence during younger Anisian and earliest Ladinian times, but eventually giving up to retrogradation, deepening, and eventual drowning. The fast aggradational evolution of the pinnacle is recorded by more than 600 m of succession, accumulated in a very short time span, probably in the order of one million of years, as suggested by the correlation with the most recent geochronometric data. The Cernera platform-top consists mainly of oncoidal calcrudites and calcarenites, associated with abundant dasycladaceans and gastropods, deposited in high hydrodynamic energy subtidal conditions. The platform-margin and slope geometry of the Cernera Platform is very different on its various sides: the eastern flank records a backstepping evolution of the margin, with very thin slope deposits, whereas the western side developed an aggrading breccia slope, retrograding only at a later stage. The sharp difference between the two sides of the platform could be connected to: (i) differential subsidence between two margins, associated with a platform tilting; (ii) windward versus leeward effect (Blendinger & Blendinger 1989); (iii) nutrient supply difference between open-marine areas and semi-enclosed basins. During the aggradational evolution of the platform, while the flanks were dramatically lengthening, the euphotic platform top area was shrinking, further reducing the carbonate factory potential. The imbalance between carbonate production, and the fast creation of accommodation space, eventually forced the platform to die, probably during the Crassus Sbz (sensu Mietto & Manfrin 1995a). During the deepening last phase of the platform, encrinitic shoals accumulated, eventually giving up to ammonoid and pelagic pelecypods-rich limestones, slowly accumulating onto the dead platform, through Ladinian times. Thick terrigenous turbidites (Zoppè Sandstones) then onlapped and fossilized the lower part of the slope; sedimentation was particularly fast on the eastern side of the drowned platform, facing the incoming turbiditic fluxes. Sand accumulation was followed by a temporary return to hemipelagic sedimentation (Acquatona Fm), which was in turn interrupted by the appearance of basic volcanoclastics, and by catastrophic gravitation-driven megabreccia deposits (Caotico Eterogeneo Fm), associated with an erosive, deeply-channelized base. During the late Ladinian magmatic event, the platform body was affected by hydrothermal dolomitization, sulfite precipitation and deep karstification processes. These diagenetic modification generally largely increazed the platform permeability. The massif provides an outcropping example of a potential hydrocarbon carbonate reservoir , sealed by low permeability volcanic and volcanoclastic deposits, and sourced by Anisian black shales. Actual hydrocarbon impregnations are locally visible, as well as a widespread permeability-enhancing hydrothermal karstification. Middle Triassic lead sulphide and fluorite mineralizations are also visible.

SEQUENCE STRATIGRAPHY IN HALF-GRABEN BASINS: EXAMPLES FROM THE PLIOCENE SUCCESSION OF CROTONE BASIN (SOUTHERN ITALY) (poster)

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The Crotone Basin is located in the Ionian side of the Calabrian Arc, and is interpreted as a forearc basin. The basin is laterally bounded by two NW-trending sinistral shear zones, and its opening started between Serravallian and Tortonian time. The depositional history of the Crotone Basin was characterized by a dominant extensional tectonic regime that was periodically interrupted by short compressional or transpressional phases. The sedimentary succession consists of Serravallian to middle Pleistocene continental to slope deposits. Field examples from the Pliocene succession of the Crotone Basin document the variability of stratal architecture in normal fault-bounded basins. Relatively thick trangressive intervals are common within these successions, as shown in the lower Pliocene Zinga 2 and Zinga 3 stratal units, and in the middle Pliocene Spartizzo and Scandale formations. Transgressive packages are formed by lagoonal mudstones that are abruptly overlain by shoreface sandstones. Thickness depends on the interplay between the rate of creation of accomodation and the rate of sediment supply, and is maximum if the rates approximate the balance. Aggradational highstand shallow-marine packages form the upper part of Zinga 2 and Zinga 3 stratal units in half-graben basins. These deposits resulted from balanced conditions between the rate of sediment supply and the rate of creation of accomodation. The impossibility to distinguish a maximum flooding surface in both Zinga 2 and Zinga 3 stratal units, and the lack of a marked progradational component in the aggradational packages evidence important deviations from the basic sequence-stratigraphic model. A complex stratal architecture may be the consequence of the alternation between tectonic subsidence and uplift (e.g. the Serra Piani stratal unit). Such variations are thought to be related to the onset of an earliest middle Pliocene transpressional tectonic phase. The studied deposits, therefore, show a marked tectonic control that strongly influenced their stratal architecture. These examples represent interesting cases of sequence-stratigraphic analysis in growth-faulted contexts.

THE TRANSGRESSIVE SUBMARINE DEPOSITS OF THE WESTERN SECTOR OF THE LIGURIAN CONTINENTAL SHELF: THE CASE OF SAN REMO (poster)

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In this article we present the results of an oceanographic campaign conducted by the Ligurian Region and the University of Genoa to discover, characterise and evaluate the volume of submarine sources of sand and gravel on the continental shelf that are suitable for beach nourishment. The research program, financed by the European Union Interreg IIIb Medocc Project, involved collecting high-resolution seismic reliefs and a series of vibracores from the continental shelf of western Liguria, between Ospedaletti in the west and the head of the Taggia Canyon in the east. In this sector the continental shelf is very varied and the slope generally steep, with a very marked shelf break characterised by a progradant sedimentary body, defined in the literature as a "frontal accumulation", consisting of sediments that are transparent to a high-frequency seismic signal (3.5 kHz) and lying above an LSST (Low Standing System Tract) sedimentary body that accumulated during the low stand following the last glacio-eustatic regression of 18,000-20,000 yrBP. The continental shelf is of limited width in this zone, but in the most developed areas it is possible to distinguish an inner sector, consisting of an erosion platform with a dislocated sub-outcropping substratum where post-glacial sediments have accumulated, and an outer sector with a very reduced substratum, due to tectonic activity, where a sedimentary construction prism of limited proportions has developed. Progradant sedimentary bodies have not been able to develop in this sector as they are subject to gravitative instability. However, even in this area there are accumulations of sedimentary bodies of a certain importance related to littoral and deltaic systems associated with moments of stasis or the slowing down of the transgression during the post-glacial sea-level rise. The existence of transgressive littoral sedimentary deposits was established by recent geophysical and sedimentological studies conducted to produce Maps 258 and 271 of the Carta Geologica d'Italia on a scale of 1:50,000 (CARG - Liguria), financed by the Ligurian Region and the E.U., which involved a high-resolution geophysical survey of 157 km of seismic lines on a scale between 1:30,000 and 1:12,500 and the collection of 23 vibracores. The study of the seismic lines (Sub Bottom Profiler 3.5 kHz and Boomer 200-400 J) enabled us to distinguish transgressive sedimentary bodies covered with by a thin muddy Holocene cover. Taking vibration cores to a depth of 6 m allowed us to establish the sedimentary characteristics of the deposits, which lie at two different depths, at 20-40 m on the inner shelf and 50-70 m on the outer shelf. In these sectors the depocentres of the sedimentary bodies have a strike direction to the coast and can probably be linked to the structure of the substratum and fluvial and deltaic apparatuses of watercourses that cut through a coastal plain of limited width during low stands or periods of stasis during the sea level rise.

HIGH RESOLUTION SEISMIC, SIDE SCAN SONAR AND MULTIBEAM SURVEYS IN THE ASINARA GULF (NORTH-WEST SARDINIA, ITALY): PRELIMINARY RESULTS (poster)

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The Asinara Gulf (North-West Sardinia) represents the offshore expression of the Porto Torres-Lugodoro basin, a half graben formed during extensional tectonic which was active from the Burdigalian to late Tortonian. The sedimentary fill of the Asinara Gulf is represented by three Neogene-Quaternary depositional sequences ranging from Burdigalian to Quaternary, onlapping the metamorphic Ercinian basement. Many studies have been focused on the Neogene evolution of the Gulf, whereas its recentmost history (Quaternary) is still poor known. The aim of this study is the analysis of the Holocene deposits at the NW boundary of the Gulf, in order to define the relationship between the inland geology of the Asinara Island and the recentmost depositional environment and to identify the main sediment dispersal pattern. Here we present the preliminary results of two surveys carried out in the study area. The first campaign has been performed by the University of Sassari in 2003, when high resolution 3.5 kHz seismic, side scan sonar and multibeam data have been acquired. A multidisciplinary survey has been conducted also by OGS in 2000, in which 3.5 kHz seismic data together with sea bed sonograms have been acquired off the eastern coast of the Asinara Island. This survey has been conducted in the frame of a project aimed to monitoring the quality of the coastal waters in the northern Sardinia, sponsored by the Province of Sassari. The acquired data highlight the complex history of the Asinara Gulf during its recentmost (late Quaternary) evolution, being strongly influenced by sea-level fluctuations. This is well constrained by the formation and filling of fluvial valleys, known as "rias", and by the presence at various depth of several submerged beaches. Five main acoustic facies and sea bed morphologies have been identified. These are related to : 1) medium to coarse sand, mainly deposited within confined basins between the relieves of the basement; 2) fine sand/silt, characterizing an almost flat sea floor topography, as shown in the southeastern sector of the study area; 3) medium sand with bedforms, mainly represented by ripple marks and dunes; they have been identified overall within the Cala Reale, showing a dominant NW-SE crest orientation; 4) channels incised in a medium to coarse sand sea floor, filled with fine sand/silt; 5) basement outcrops, characterized by a very irregular superficial topography overall in the northernmost part of the study area. Here, a system of NW-SE oriented faults has been identified and it would be related to the so called "Posada-Asinara line" which represents the boundary between the migmatitic and metamorphic complexes, both Ercinian in age. The 2003 survey investigated also the Cala dei Fornelli area, separating the Sardinia northernmost tip from the Asinara Island, where is located the so called "La Pelosa" beach. It has a great ecologic and touristic value as it lies between the National Park of Asinara and one of the most popular Italian holiday centre, Stintino. La Pelosa is constituted by well sorted, medium sand, deposited above the Cambrian micascists, which underwent strong erosional processes in the last 30 years. The analysis of the data acquired in this area together with hystorical meteorological data would suggest that the sand dispersal of La Pelosa beach is mainly directed toward SE, following the dominant wind path, i.e the Mistral.

A HOLOCENIC HIGHSTAND CARBONATE-TERRIGENOUS CONTINENTAL SHELF IN THE GULF OF CAGLIARI, SARDINIA (poster)

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By means of 11 new echographic lines and 100 surface sediment samples it has been possible to individualize on the continental shelf of Cagliari Gulf several depositional facies associations between foreshore and shelf edge. These associations document a suite of peculiar environments that diversified and stabilized during the Holocene eustatic rise. From shore to shelfbreak we first encounter a shoreface, gently sloped and distally sea-grass covered which ends in a trough parallel to the coast. Toward the open shelf is a relief, topping at -12-15 meters, site of the *Posidonia oceanica* main bank, followed by a wide foreslope. At a depth of 30 m the vegetation becomes rare, and starting from -35-40 m a large belt of sand waves appears. At the depth of 50 m a flat bottom prevails, followed by submerged shoreline relieves at -55 m. Externally to such structures a narrow outer shelf occurs and the shelf edge is observed at a depth of 115-125 m. The inner shelf trough can be interpreted as a paleo-river valley during the MIS 4-2 and previous lowstands, combined with terrigenous inputs insufficient to fill the accommodation space produced by the Holocene sea-level rise. Towards the middle shelf the trough is bounded by paleo-reliefs where the *Posidonia oceanica* bank at present overgrows, weakly aggrading and prograding landward and seaward. Compositional and grain-size analysis of samples allowed us to identify eight depositional facies related to present day environments. Shoreface sediments are represented by terrigenous coarse to medium sands in the eastern sector of the gulf, and mixed terrigenous-bioclastic medium to fine sands on the western sector. Two distinct groups of lithic facies are present near Cape S.Elia and near Zavorra Point, due to sediment dispersion from the limestone and andesite outcrops along the cliffed coast. The western inner-shelf trough is characterized by mixed quartzose-bioclastic sandy muds with bivalves and peloidal grains. Mixed facies of biogenic production and relict terrigenous sediments are present on the Posidonia bank, while through the sand wave belt a transition is observed to bioclastic, poorly sorted gravely sands with red algae and foraminifers. Rare breakthroughs of mixed sediments are present in proximity of the -55 m paleo-shores. Starting from depths of 75 m, sediments are represented by fine bioclastic-quartzose sands with bivalves and foraminifers. The depositional facies described document this sedimentation as of a mid-latitude mixed carbonate-terrigenous shelf. The present day sedimentation is highly siliciclastic in the inner shelf from fluvial-continental feeding, and bioclastic in the rest of the shelf with a maximum productivity along the middle-shelf Posidonia bank and its foreslope. In the middle and outer shelf the siliciclastic component is related to previous eustatic phases. The sequential analysis of 3.5 kHz lines show the Holocenic trasgressive systems tract blanking over a maximum flooding surface, or over a trasgressive ravinement surface or lowstand erosional truncations. The Holocenic TST, except for the siliciclastic shoreface, is mostly carbonatic, owing to the highstand-related terrigenous starvation and to a good bioclastic productivity of molluscs, red algae, briozoans, foraminifers and echinoids. Analogous depositional contexts should be attributed to the preceding highstand phases of the Middle-Upper Pleistocene. Otherwise, during glacio-eustatic phases of falling, lowstand and rising sea-level, the shelf has been mostly interested by terrigenous continental or shoreface deposits that are currently resedimented in the middle and outer shelf. In summary, the depositional model of this shelf is characterised by alternated phases of carbonate-terrigenous mid-latitude sedimentation with poorly rainy, warm Mediterranean climate during highstand conditions, and terrigenous phases during lowstands with rainy, cold Mediterranean climate.

THE USE OF SEDIMENTOLOGICAL STUDIES TO DETERMINE THE MECHANISMS CAUSING SILTING UP OF A PORT AND THE PLANNING OF APPROPRIATE EXPERIMENTAL STRUCTURES TO HALT THE PHENOMENON (poster)

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This work presents the results of a sedimentological study of the marina of Genoa Nervi prior to planning new defence works to halt the silting up of the port area. The purpose of the study was to characterise the seafloor of the port and adjacent waters and define the sedimentary dynamics of the area in order to understand the mechanisms that have caused the silting up and to propose solutions that take into consideration the notable environmental and scenic value of the area. Our bathymetric and sedimentological studies of the area permitted us to establish that the most significant sedimentary accumulations inside the port area were of marine origin and, due to the particular conformation of the structure, the morphology of the site and the direction of the current, had accumulated in areas now protected from littoral drift. The silting up could only be partly attributable to the Nervi Torrent, a watercourse that empties inside the port itself. We established that the sediments were discretely sorted (mean diameter 0.25 mm) and that their transport was essentially along the seafloor. The sector of the mobile seafloor less than 9 m below sea level was affected by this textural class. We were also able to establish that the port area is subject to relatively intense wave action on the basis of the textural characteristics of the sediments. In fact, any fraction finer than 0.25 mm is unstable and so carried off shore, above all in a S-W direction. On the basis of these findings, it has been proposed to construct two submerged groins (articulated prefabricated concrete structures) to the sides of the port entrance instead of a classical structure, such as a mole, that would have a serious environmental impact on a stretch of the coast of inestimable scenic value. The use of such structures for this purpose would presumably be a first as they are usually used to defend the littoral, where the submerged extension of transversal works intercepts the littoral drift and, thereby, increases the stability of the submerged beach. In this specific case these structures, positioned to the sides of the port entrance should intercept the sediments with a mean grain size of 0.25 mm or greater and stop the silting up of the port. The finer fraction, transported in suspension, that could pass around the defence works and enter the port is unstable in these waters, as revealed by our sedimentological study, and is carried off shore.

A MULTIDISCIPLINARY APPROACH TO TERRITORY KNOWLEDGE AND EXPLOITATION: THE EXAMPLE OF BEVAGNA COUNTY (UMBRIA, CENTRAL ITALY)

(poster)

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The project "Geo-Paleontological and Archaeological study of Bevagna area", coordinated by Prof. M. R. Trabalza and Prof. R. Colacicchi, was seriously promoted by the Municipality of Bevagna (Perugia, Umbria central Italy). It is a first example of multidisciplinary approach: geo-paleontological, naturalistic, historical and archaeological studies are aimed to the knowledge, exploitation, protection and tourist - cultural enjoy of the territorial heritage. The geo-paleontological studies pointed out some important sites for the Plio-Quaternary paleoenvironmental evolution of the Bevagna zone (Arquata quarry, Cantalupo, Castelbuono and Terraia basins) and its geo - naturalistic peculiarity like Aiso and Aisillo resurgences. Moreover, Bevagna area had an important role for the anthropological - cultural interaction between man and territory since Palaeolithic age and it got its apex during Roman age. The most important architectonic works of Bevagna have been studied by archaeometrical point of view to define the lithic materials employed and to find the old source area. The Bevagna area has an important role for the cultural heritage and it should be used for touristical didactical and scientifical porpouse. In fact a scientific - didactic and tourist - cultural route should promote some geo - sites and a documentation centre.

RECONSTRUCTION OF HOLOCENE PALAEO-ENVIRONMENT AND SEDIMENTATION HISTORY OF THE DIACCIA BOTRONA AREA (SOUTH TUSCANY, ITALY): PRELIMINARY DATA (poster)

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The palynological study of lacustrine sediments from Diaccia Botrona bog has provided a palaeoenvironmental record for the last interglacial. The chronology of the sequence is based on three new radiocarbon dates collected from two boreholes drilled in this area. The pollen record, starting during Late Pleistocene, shows that remarkable changes occurred in the floristic composition, vegetation's structures and in the sedimentary environments, which changed from continental to marine-transitional environments. Pollen spectra, which have been divided in four different zones, shows a vegetational oscillation (ZDB-3/ZDB-4) during Late Holocene. Local environmental conditions around the site changed from a brackish-marine environment to a temporarily fresh-water conditions. A renewed marine influence led to the development of salt marsh conditions. There is evidence for a temporary cessation of sea-level rise shortly, which may be linked to cooler, wetter climatic conditions and a decline of solar activity. Thermal contraction of ocean water during the early Subatlantic may have played a role.

RECONSTRUCTION OF LATE HOLOCENE PALAEO-ENVIRONMENT AND SEDIMENTATION EVOLUTION OF "LAGUNA DI BURANO" AREA (SOUTH TUSCANY-ITALY) (poster)

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The late Holocene sedimentological and palaeoecological evolution of the "Laguna di Burano" area was studied. The lithology of the upper 400 cm was analyzed and a reconstruction of environmental changes was undertaken based on palaeoecological macro- and microfossil analysis. Four pollen assemblage zones (LdB1-4), indicating peculiar vegetation features, have been distinguished and interpreted as a vegetation response to regional climatic changes and five different lithofacies have been recognized as well in the borehole which have been interpreted as consequence of environmental and depositional changes. LdB1 zone is characterized by an extremely poor percentage of pollen grains, it is assigned, for sedimentological and palynological affinity with sediments collected in Grosseto alluvial plain, to a Lateglacial (Late Pleistocene) alluvial plain (BISERNI, 2004; BISERNI & VAN GEEL, 2005; BISERNI ET AL,2005). Sedimentological and palynological radical changes between LdB1 and LdB2 occur. From the bottom of LdB2, assigned, using new AMS data, to middle Holocene, the sedimentary environment change from sub-aerial to aquatic, sedimentological changes and a continuos increasing of pollen concentration have been distinguished. LdB 2 is characterized by a good pollen concentration where the percentage of NAP (no arboreal pollen) is higher than AP (arboreal pollen). In LdB 3, where AP concentration is higher than NAP, forest expansion occur and beginning of human activities have been distinguished. LdB4 is characterized by peculiar vegetation features which are related to the installation of the Mediterranean climate. Presence of elements referred to human activities as breeding and farming, recognized from zone LdB3, become higher in LdB4. Locally between LdB 2 and LdB 3 environmental conditions changed from a brackish-marine environment to a temporarily fresh-water conditions. In the top of the core (LdB 4) a renewed marine influence led to the development of salt marsh conditions. AMS data allow to presume that between sub-aerial (Late Pleistocene) and aquatic environments (middle Holocene) a big depositional hiatus occur. AMS data suggest also that in this area the Holocene transgression started around 5286-5588 cal yr BP.

HOLOCENE COASTAL SYSTEMS OF THE EASTERN SICILY AND THEIR RELATIONSHIP WITH THE ONSHORE GEOLOGY (poster)

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We present the preliminary results about geological and morphological observations conducted along the Ionian coast of Sicily, southern Italy. In particular, the relationships existing between the geology of the onshore areas and their respective coastal systems were analyzed, in order to explain the characters of all the beach models developing along this coast. Sicily occupies a complex tectonic setting at the boundary of the European and African plates, a condition reflected by active patterns of differential uplift and subsidence. In particular, the eastern coast of Sicily runs perpendicularly to three main regional-scale structural domains: (i) a chain, (ii) a foredeep and (iii) a foreland domain. Several examples of beach models have been studied along this coast; the Holocene shores show the record of regional, well-documented local geological setting and represent the result of the combined control of structural elements, sea-level changes and uplift rates. The chain domain (i) is represented by the Kabilo-Calabride Chain units, forming the innermost sector of the Apenninian-Maghrebian Chain and consisting of nappes of Hercynian crystalline basements with remnants of the Meso-Cenozoic sedimentary covers. Recent studies have demonstrated that the coastal sectors of this domain are characterized by high uplift rates, ranging from 0.4 and 0.8 mm . y-1. This feature give rise to highlands very close to the sea, narrow coastal areas and steep, coarse-grained beaches. The continental platform is represented by a narrow ramp-type shelf. Southwards, the N30° trend of coastline is abruptly modified by the occurrence of Holocene Etnean lava deltas, emplaced during last 500.000 years, and that produced a quite articulate cliffed coast and pocket beaches. The foredeep domain (ii) is presently occupied by the largest alluvial plain of the island; the Catania Plain represents the Holocene upper sequences of the Plio-Quaternary foredeep basin infill. The main tectonic structures are represented by blind thrusts, covered by some hundreds of metres of marine sediments and by several normal fault systems, EW and NE-SW-trending, bounding respectively the northern and southern margins of the Catania Plain basin. Nevertheless this area was characterized by subsidence in the past, today the Catania Plain is affected by a moderate uplift, more recently estimated on 0.56 mm . y-1. During the Holocene time, the geological setting of the plain have favoured the progradation of a large coastal area, formed by extended aeolian dunes and fine-grained low-gradient NS-trending beaches, fed by important regional rivers (Simeto and S. Leonardo Rivers); the continental shelf here shows its maximum extension of the entire coast, forming a low-gradient, dissipative sea-bottom profile. The foredeep domain (iii) is represented by the Hyblean Plateau; it forms part of the orogenic foreland deformed by extensional and strike-slip faults. The sediments consists of Miocene shallow water carbonates with volcanic rocks. They rest upon carbonates of upper Cretaceous-Paleogene age and volcanic rocks of seamount sequences. The onshore geology and the uplift rate of about 0.7 mm . y-1 of this coast have produced a quite articulated shoreline, forming a series of promontories and gulfs, with isolated cliffed and low-gradient beaches. The coastal areas are occupied by small systems, comprised by tectonic constrains and slightly prograding seaward. The continental shelf geometry is here controlled by the strike-slip fault systems, related to the recent activity of the Malta Escarpment structural complex. All these beach systems have been involved in the development of anthropogenic coastal activities, during last fifty years; their present aspect represents the result of a quick adaptation also to these modifications, that have strongly changed the original characters of the coast.

GLACIAL-INTERGLACIAL SIGNALS IN FLUVIAL SAND COMPOSITION FROM THE MODENA ALLUVIAL PLAIN: PRELIMINARY INVESTIGATIONS (poster)

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Sand composition studies carry a particular significance in areas such as the Late Peistocene-Holocene Modena plain, where fluvial sediments buried a spectacular number of Neolithic, Iron Age, Bronze Age, Etruscan, Roman and Longobardian archaeological sites. The good chronological control available for the stratigraphy of the area allow us to investigate in detail the sediment compositional variability through time extending our knowledge of the sedimentary supply back in time to test possible glacial-interglacial compositional cycles. Modal analyses of modern sands from the Modena plain streams indicate that the compositional field of modern sands from each stream depends, in order of importance, on the extent of the watershed, the recycling of older fluvial sediments and, subordinately, on the sediment input from tributary streams. Our data indicate that sand composition of major rivers (Panaro and Secchia) has not varied since the last ~7 kyr, stage characterized by colluvial aggradation with dense vegetation cover. The direct implication is that provenance of sediments buried in the floodplain can be determined by a simple comparison with modern sand composition, suggesting that we have a powerful tool to reconstruct the evolution of the main drainage system in the Holocene. Ancient sands from fluvial deposits that are attributed to the last glacial event (Vignola Unit, Late Pleistocene, age>15-18 kyr) have an higher content in quartz and feldspar compared to both, modern and Holocene sands. The higher feldspar content in Late Pleistocene fluvial sands may reflect a high-frequency signal in sediment supply rate due to secular variations of weathering processes. Climate changes related to glacial-interglacial phases appear to be the most important factor that modified sediment composition by changing bedrock weathering rate and removal of weathering products. The change in composition suggests that sediments are today subjected to more prolonged chemical weathering during storage in the source area. Thus, the sediment supply shift could reflect changes from a stage of marked denudation, such as during the last glacial maximum to a stage of colluvial aggradation and soil formation with dense vegetation cover (since ~7 kyr). For these reasons, sand composition studies may represent a new key to investigate the glacial-interglacial climatic influence on sediment supply and deposition in the northern Apennines floodplain.

PALEODRAINAGES OF FRIULIAN RIVERS INFERRED BY PETROGRAPHIC AND SEDIMENTOLOGIC ANALYSES OF THE CONTINENTAL SUCCESSIONS OF THE OSOPPO HILLS (FRIULI, NE ITALY) (poster)

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The Osoppo Hills are four main relieves made up of conglomerates referred to late Messinian - early Pliocene, on the base of mammalian trackways (Dalla Vecchia and Rustioni, 1996; Venturini; 2000). The age seems confirmed by structural analysis in the pressure-solution tracks made by Caputo et alii (2002) and in the present work. New sedimentologic and petrographic analysis, carried out on arenites levels, revealed a complex whole of sedimentary bodies in the four hills. At the bottom of the succession there is an angular unconformity between the conglomeratic bodies and quartz rich arenites of lower Miocene age, that outcrop at the base of the eastern cliff of San Rocco hill and of the western rock face of Osoppo hill. The main unit of the hills is conglomeratic with Gilbert-type deposits, about 80 m thick and two heteropic bodies characterize it. For both the foreset beds are well recognizable, often accompanied by many backset beds; the toeset beds are observable only at Vergnal hill and are bed sorted; the bottomset beds have not been seen yet. No wave-influenced structures have been evidenced, in agreement with the hypothesis of Venturini (1991) of a lake delta system. The presence of faults seems to have warped the sedimentary structures only in the central portion of the Osoppo hill, where the fluvial conglomerates were tilted. The first body is well exposed in the western sides of the hills. The foreset beds are accompanied by a big slump that closes the top of the delta sequence on Osoppo hill. The paleocurrent analyses show that this fan came from N-NW to S-SE. Its clast composition is characterized by 70 to 85% of carbonate lithic clasts and less than 10% of quartz; this points to a provenance from Tagliamento river basin. This watercourse probably flew down westwards the Cavazzo lake valley during late Messinian - early Pliocene, while the present-day Tagliamento valley was crossed by Fella river. The contribution of this latter seems suggested by the change of the directions of the foreset beds, from NNW-SSE to NNE-SSW, in the northern side of Osoppo hill, and an increasing abundance of carbonate lithic clasts (more than 80%). The second delta evidences a progradation from E to W; it is rich of slump structures, 10 to 20 m thick, inside the foreset beds. This body is clearly heteropic with the other; this relationship is perceptible in the western side of San Rocco hill, where a mixing zone is present. This delta has a clast composition richer in quartz (between 20-30%) and weaker in carbonates (between 40-60%) than the other has. Its petrographic composition is similar to the actual small river basins made of Paleocene-Miocene cropping out successions; it is probably that the sedimentary body came from a E-W drainage nowadays extinct, whose source area might be the foothills of the Julian Prealps. At the top of Osoppo hill, for the last 20 m, fluvial deposits outcrop; they are made by sorted conglomerates with common and thin lenses of sandstone. They indicate a main southward direction of the flow and the petrography shows a Tagliamento dominate drainage, maybe the river from the east had been already disconnected. It is not clear if the horizontal fluvial conglomerates are the topset beds of the delta complex; an angular unconformity is visible between the two bodies at the bottom of the outcrop with the mammalian trackways.

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USING OPTICALLY STIMULATED LUMINESCENCE (OSL) TO UNRAVEL THE CHRONOLOGY AND DEFORMATION HISTORY OF MARINE TERRACES: AN EXAMPLE FROM THE CROTONE PENINSULA (SOUTHERN ITALY) (poster)

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Marine terraces are generated from the interplay of tectonics and sea level change. They therefore represent a potential archive of information on the uplift history of a specific area and have been used to tune the intensity of late Quaternary eustatic oscillations. However, any reconstruction based on marine terraces is dependent upon the establishment of a precise chronology of the terrace deposits. This task is usually accomplished through dating of ash layers or corals embedded in the sedimentary cover of a terrace, but may prove to be very difficult in the absence of material suitable for radiometric analysis. A well developed flight of marine terraces, whose chronology is rather poor, is preserved on the coast of the Crotone Peninsula. The disruption of the original terrace surfaces due to intense neotectonic activity, and the discontinuity of exposures combined with high lateral facies variability make the correlation of terraces very complex. In order to address this complexity and to provide new chronological data for the Crotone terraces, ten samples were selected and analyzed with the Optically Stimulated Luminescence (OSL) technique applied on feldspar grains. The obtained ages show stratigraphic consistency, with samples taken from terraces at higher elevation systematically older than those at lower elevation. Samples taken from the uppermost terrace are very close to saturation and indicate a minimum age corresponding to MIS 7. Consequently, the OSL method in the Crotone Peninsula has an apparent upper limit of applicability of around 200 ka. Samples from the lower terraces give ages that generally agree with the Upper Pleistocene interglacial and interstadial eustatic peaks. OSL dating has also allowed clarifying the significance of a small terrace occurring just above the present sea level. The obtained age indicates that this terrace results from tectonic displacement of an older one rather than being a newly cut abrasion platform. Uplift rates of the Crotone Peninsula, calculated with the new OSL ages, are apparently slightly decreasing, from MIS 7 (1 mm/yr) to MIS 3 (0.7 mm/yr). This study confirms that OSL is a valuable method for unraveling both chronology and stratigraphy of deposits where traditional radiometric dating can not be applied.