Theme B. Regional Stratigraphy

Regional Stratigraphy *s. l.*

Lithostratigraphy and lithofacies of siliciclastic Bāqoroq Formation (Middle Triassic), Nakhlak area, Central Iran

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The Triassic succession of the Nakhlak area in Central Iran consists of (1) the Alam Formation, which is a sequence of shallowing- and coarsening-upward marine turbidites deposited on the forearc side of an accretionary prism; (2) the Bāqoroq Formation, a sequence of coarse to fine, polymictic, fluvial conglomerates; and (3) the Ashin Formation, which comprises alternating, distal marine shales and sandstones that have turbiditic characteristics. Geographic locality of Nakhlak group is near to Anarak town in Yazd block, and the studied section from siliciclastic Bāqoroq Formation at 33°33′41″ N and 53°47′49″ E was about 1500 m thick. The Bāqoroq Formation is located between the Alam Formation (down) and the Ashin Formation (top) that divided by disconformity. The study of Bāqoroq Formation is used for petrographic and stratigraphic analysis of this succession, which mainly consists of conglomerate and sandstone. About 40 samples of conglomerate and sandstone were petrographically analysed that 11 samples of those used for point counting analysis. Point counting results plotted in Folk diagram. Litharenite and feldspatic litharenite are common.

Keywords: Bāqoroq Formation, Central Iran, siliciclastic rock, Triassic.

Vertebrate and miospore assemblages from the Famennian of North Timan (Upper Devonian, Russia)

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The Late Devonian vertebrate and miospore assemblages from the Volonga River section of the upper part of Pokayama Formation from North Timan have been described for the first time. The middle Famennian age of the unit has been proved by miospore data. The correlation of some East European sections is discussed.

Keywords: Vertebrates, miospores, Famennian, Devonian, Timan, correlation.

Volcanism, relative sea level change and stratigraphic record: an Oligocene example

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Volcanoes are revealed to be complex and dynamically evolving edifices, characterized both by eruptive activity and episodes of instability, that can periodically cause catastrophic debris avalanches and huge debris flows (MCGUIRE, 1996). The geodynamic context where they are sited, moreover, can interact on the development of

different sedimentary systems (LE FRIANT *et al.*, 2010; SISAVATH *et al.*, 2011) as well as on the emplacement of different processes (WATT *et al.*, 2011; SISAVATH *et al.*, 2012; CRUTCHLEY *et al.*, 2013), dramatically influencing the stratigraphic record of the surrounding basins. By now, the role of climatic changes in depositional processes is still debated (KRASTEL *et al.*, 2001; QUIDELLEUR *et al.*, 2008; SISAVATH *et al.*, 2012). Here we present an example from the Oligocene foredeep of the Alps, now structured in the Northern Apennines, where the interaction between volcanic activity and relative sea level changes has been recorded: Val d'Aveto Formation, 32 – 29 Ma (MUTTI & RICCI LUCCHI, 1972; ELTER *et al.*, 1999; CATANZARITI *et al.*, 2009). The occurrence of two volcanoclastic members (the lowest conglomeratic, containing oligocene andesitic clasts (MATTIOLI, 1997), the uppermost medium to coarse arenitic with polygenic conglomerate lenses in it) above a carbonate to silicoclastic one (pelitic and fine to very fine arenitic, with conglomerate lenses on top), shows how the onset of an active volcanism in the sediments source area interacts with the sediment supply during a regressive stage. Detailed fieldwork and pebbles' counts, that have been performed on 11 conglomerate beds and 2 microconglomerate thin sections, integrated with data present in literature (ELTER *et al.*, 1999) and compared to Oligocene paleoclimate and global sea level curve (HAQ *et al.*, 1987; SISSINGH, 2001; MILLER *et al.*, 2005; PÄLIKE *et al.*, 2006), allowed to recognize an important increase in grain size both of single pebbles and arenitic matrix, from the silicoclastic to the volcanoclastic members, with a high increase of volcanic rock fragments in the latter (ELTER *et al.*, 1999). Moreover, this increase corresponds to a no constant increase of volcanic pebbles. These results seem to emphasize the role of an active, syn – sedimentary volcanism in a source area, even in relation with the first regressive stage:

- increase of sediment production, strongly dependent on grain size
- sediment production independent from the relative sea level changes
- general increase of grain size due to the increase of energy in sediment transport

This work is still in progress; the analysis of the Alpine Oligocene record both in Molassa and foredeep basins, compared with the Jurassic Cañadón Asfalto basin (Patagonia, Argentina) and dataset of modern systems, will allow us to better improve these first, local conclusions on sediment production and depositional processes in volcanic – related basins.

Keywords: active volcanism, depositional processes, sea level changes, sediment production, sediment budget.

Environmental reconstruction of the southwest portion of Maracujá River basin, based on palynological and sedimentary analysis, associated to carbonaceous level radiocarbon dating

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Sedimentary, palynologic and stratigraphic analysis as well as a carbonaceous level absolute dating was performed in quaternary sediments deposited on the southwest portion of Maracujá River basin, which belongs to a geologic province known as Quadrilátero Ferrífero, in Minas Gerais state, Brazil. By means of sedimentary analysis it was possible to define 4 facies and, inside of them, 9 sub-facies which depict energy pulse variation, showing distinct paleo-environmental condition features throughout such stratigraphic sequence formation time. Based on the distinct pollinic assemblages identified along this profile, it was possible verifying climate changes. Radiocarbon dating was performed in the inferior, median and superior stratigraphic sequence portions and had

revealed ages of 4.730±40 A.P., 12.730±50 A.P and 16.260±70 A.P. years, respectively. In this group of data it was observed that older layers are placed on the superior portions, while newer ones on the inferior outcrops, showing a temporal outcrops sequence reversal register, in the area. It happened because they had been raised in flood plains, which were formed in the course of gulling processes seen in the region, and that have left a sequence of alluvial terrace deposit registers on their lateral ramps.

Keywords: dating, climate changes and stratigraphic reversal.

Stratigraphic and sedimentologic characteristics of Jurassic-Lower Cretaceous sediments at Kösrelik- Kösrelikiziği (North of Ankara-Turkey)

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Jurassic- Lower Cretaceous rocks in the northeast of Ankara (Central Turkey) deposited in a tectonically controlled basin which aligned SW-NE. Vertical and lateral lithological variations in the squence were resulted from synsedimentary tectonism. The Jurassic-Lower Cretaceous sequence in the study area lies on the Late Triassic weakly metamorphosed rocks (the Karakaya Complex) with angular unconformity. It begins with interbedded deltaic conglomerate and sandstone (the Çoraklıktepe member) The Sinemurian-Early Pliensbachian sandy limestone overlies the coarse sandstone with lateral and vertical transition. It is red in color and highly fossiliferous. Crinoidal limestone and ammonite bearing marl rest on the sandy limestone following a fast deepening period. It is overlain by red marl having brachiopod and bivalve coquina interbeds. The intermediately bedded pseudonodular limestone with abundant ammonit, crinoid, brachipod and bivalve follows the red marl. Following a synsedimentary tectonism, thick non fossiliferous mudstone was deposited over the ammonite bearing rocks (the Uzundere member). That means that the area was shallowed during Early Pliensbachian.

During Late Pliensbachian- Early Toarcian detritic rocks progressively passes into variegated-red limestone. This typical ammonitico-rosso facies wedges laterally into green mudstone (the Beytepe member). After Bajocian, the area was rapidly shallowed and thick interbedded sandstone and mudstone (the Turnaçeşme member) covered the basin totally.

Due to block faulting formed after Callovian in the area, the base topography of the basin was changed. For that reason, at the northern part of the study area, the pelagic carbonate platform sediments (the Çakırlardere formation) having abundant ammonite and pelagic oolite were deposited directly on the basement rocks. This points that shallow areas were formed off shore as a result of synsedimentary faulting. The pelagic ooid bearing limestone grades laterally and vertically into cherty limestone. During Oxfordian –Early Cretaceous, the area was deepened rapidly and the limestone with Radiolaria (the Soğukçam formation) was deposited.

Keywords: Ankara, Jurassic, Ammonitico rosso, Pelagic oolite, PCP, Hardground.

Stratigraphic features of the Yesilova Ophiolite, Burdur, Southwest Turkey

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The Yesilova ophiolite is located in the Alpine zone as a major part of the Lycian nappes of Western Taurus. It was formed at the Southern branch of Neotethys, and obducted over southern edge of the Menderes Massif in Cenonian by Laramian orogenesis. The ophiolite in the study area starts with tectonite; consisting mainly of harzburgites (37.02 % MgO, 38.77 % SiO_2, 0.42 % Cr_2O_3) a smaller amount dunite and chromite pods, and continues with cumulates; including dunite, wehrlite, clinopyoxenite, layered and non-layered gabbro (45.53 % SiO_2, 11.92 % Al_2O_3, 13.11 % MgO), and plagiogranite (77.41% SiO_2, 0.25% K_2O), from the bottom to top. The

tectonite and cumulates were cut by isolated gabbro and diabase dikes. The altered volcanites took place at the top of ophiolitic sequence, obducted by Upper Cretaceous Kızılcadag Mélange, with limestone, chert- radiolarite blocks and ophiolitic rock fragments. Upper Eocene Varsakyayla Formation rests over the mélange, with abundant nummulites, and is composed of conglomerate sandstone, limestone and conglomerate towards the top. The stratigraphical sequence also continues with Plio-Quaternary Niyazlar formation consisting of terrigeneous conglomerate intercalated with sandstone, and ends with rock talus and alluviums, respectively.

Keywords: Nummulites, Yesilova ophiolite, Salda Lake, Turkey.

Tectonic implications of deep-marine Miocene strata in the western Andean Cordillera of south-central Chile (40º - 42ºS)

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Marine Cenozoic strata crop out in the western flank of the Norht Patagonian Andes at Lago Ranco (40ºS) and Ayacara (42ºS). These deposits, known as the Estratos de Lago Ranco and Ayacara formations, consist of rhythmic successions of sandstone and siltstone. In order to unravel the sedimentary environment, age, and tectonic history of this area during the Neogene, we carried out sedimentological, ichnological, and micropaleontological studies. In addition, we dated detrital zircons by U-Pb (LAICPMS and SHRIMP). Our studies show that these strata were deposited in a deep-marine environment during the early-middle Miocene. Our findings indicate that the uplift of the western flank of the North Patagonian Andes took place after the early-middle Miocene.

Keywords: North Patagonian Andes, southern Chile, U-Pb.

Sedimentation rates in the Late Cretaceous epicontinental basin in the South of the Russian Plate

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This work discusses integrated analysis of sedimentation rates of Late Cretaceous sediments in the south of the Russian Plate. The first map of Late Cretaceous sedimentation rates in this region has been constructed using equal-rate contours; the rates were calculated for ages and epochs at 38 reference sites based on a chronostratigraphic scale and published data and for biostratigraphic zones at 5 sites. The sedimentation rates of pelagic carbonate and siliceous sediments in the Late Cretaceous basin of the Russian Plate ranged from 0.1 to 1n cm/1000 years with a maximum of 2–3 cm/ka in the Caspian Syneclise. The predominantly terrigenous and siliceous–terrigenous sediments could accumulate in the south of the Ulyanovsk–Saratov basin at a rate of 1–3 m/ka.

Keywords: Late Cretaceous, Russian Plate, sedimentation rate.

Lithological–Stratigraphic Characteristics of the Aptian–Cenomanian Sediments of the Abkhazian Zone of the Western Caucasus

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For the first time, a complex lithological–stratigraphic and facial study of the Aptian–Cenomanian sediments of the Abkhazian zone of the Northwestern Caucasus was carried in sections of the Mzymta and Khipsta river valleys. As a result, the areas of distribution of potential oil-source rocks in these sediments, which correspond to the events of the OAE-1 and OAE-2 global paleoecological crises, oil reservoir rocks and rocks-caps were defined.

Keywords: Western Caucasus; Aptian; Albian; Cenomanian; OAE-1; OAE-2.

Stratigraphic schemes for the North Pacific Paleogene and Neogene: geological events, biotic evolution and biogeographic scenarios for the last 65 Ma

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The new Cenozoic stratigraphic schemes for the Kamchatka-Sakhalin region are described. Scenarios of geological events and evolution of biotic assemblages are presented. Five large stages of the North Pacific ecosystem evolution are established.

Keywords: Cenozoic, North Pacific, geological events, paleoclimates.

Pleistocene deposits of the Swiss Northern Alpine Foreland: stratigraphic concept and nomenclature

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The stratigraphic scheme for the Pleistocene deposits in the Northern Alpine Foreland, as defined in southern Germany, cannot be directly adopted in northern Switzerland due to a fundamental difference between the mechanisms that control the regional morphogenesis. Therefore, an independent concept for the stratigraphic procedure, nomenclature and hierarchic structure was developed for the Swiss Pleistocene deposits, which is based on mapping units (in the rank of formations, even if informal in most cases) defined and named according to lithostratigraphic guidelines (and geomorphological criteria in some cases). These basic "building blocks" also provide the flexibility that is needed in case knowledge about the number, extent and hierarchy of glacier advances into the Swiss Northern Alpine Foreland changes as a result of new research, as has been the case a

number of times during the past twenty years. The mapping units are grouped into hierarchically superior units that are based on a genetic interpretation (advance, glaciation, glacial). Despite some deviation from lithostratigraphic rules, we consider this to be a reasonable approach. The stratigraphic concept presented here has been successfully applied in the map sheets of the Geological Atlas of Switzerland 1:25000; furthermore, it provides a robust framework for absolute age determinations.

Keywords: Pleistocene, stratigraphic concept, nomenclature, geological maps, Switzerland, Northern Alpine Foreland.

Distribution and relevance of sand sediments in the lagoons associated with Sefidrud Delta, South-West of the Caspian Sea

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The Sefidrud delta has developed in the south west of Caspian Sea associated with abundant tributary channels and extensive flood plain on which lagoons are common. This delta is characterized by very rapid sedimentations rates in a steep slope setting, which can be used as a model for oil-bearing reservoirs. This study aims to explain the evolution of the Sefidrud delta and a mechanism for delta building will be proposed.
The relationships between the distribution of sediments and the amount of magnetic susceptibility is assessed on short sediment cores taken from two lagoon systems, Amirkola and Zibakenar lagoons, associated with the Sefidrud delta. For this purpose, we have correlated the sediment cores within each basin based on magnetic susceptibility values, particle size of sediments as well as colour change based on visual description. With a chronological framework, this correlation can be used to reconstruct historical changes in sedimentation and consequently, a sediment distribution pattern can be obtained.
In general, the Amirkola lagoon showed a clear-cut change at around the same depth throughout the lagoon, i.e. 40-60 cm, in the magnetic susceptibility values, which is obviously matched with the sand layer. This high amount of magnetic susceptibility can be related to magnetite and ilmenite that are supplied by the Sefidrud. The presence of marine shells in this sand layer in the middle part of lagoon shows that the source should be the sea that either invaded the lagoon as wash over fan or the location was under the sea during a period of higher sea level. Indeed Leroy et al. (2011) have shown in a core taken from the north east of the lagoon, that the sand was marine and dated from the late Little Ice Age, a period of high stand. The present study shows now the horizontal extension of this sand layer. Magnetic susceptibility in mud layers in the southern part of lagoon shows an enhancement, compared with mud layers in the northern part, which can be interpreted as different sources of fine sediment. Large changes in lagoonal morphology were caused by human-induced dredging of channels, in order to use the water for the rice paddies surrounding the lagoon. However, the Zibakenar infill has the typical form of a lagoon in which the thickness of clay reaches to 180 cm with thin layers of silt in between. The sand layer at the bottom of lagoon with high amount of magnetic susceptibility represents the boundary between the lagoon and the delta flood plain. The lack of sand layer in the Zibakenar Lagoon represents a low energy environment in which the lagoon has not been subjected to human impact.

Keywords: sand sediments, lagoons, Caspian Sea.

The "Home-Land" of the Torinosu-type limestone in perspective of the Jurassic accretionary tectonics in SW Japan

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Upper Jurassic - Lower Cretaceous fore-arc basin deposits cover the oceanic-plate sequences (OPS) of the Permian and Jurassic accretionary complexes (AC) in the Outer Zone of SW Japan, facing the Pacific. Special attention is given the Torinosu-type reef limestone blocks in the fore-arc basin deposits, in search for a continental-shelf facies from which to derive them, in relation with the subduction-accretion tectonic evolution of the Asian margin in the segment of Japan. Finding such marginal facies may resolve pending questions about paleogeographic relation and identity of the Kurosegawa Permian accretionary- and South Chichibu Jurassic accretionary terranes. The "in-situ" Torinosu-type reef limestones in the Toyonishi Group (Akiyoshi Terrane in the Inner Zone) as well as those in the Birafu Formation of the Sakashu Group (Kurosegawa Terrane, Outer Zone) of SW Japan suggest such a "home-land" for the Torinosu-type limestone blocks, brought by submarine mass wasting events, some as olistoliths, from the continental-shelf thrust nappe into the fore-arc basins during subduction-accretion.

Keywords: Jurassic, ocean-plate stratigraphy, accretion terrane, fore-arc basin, Torinosu-type limestone, SW Japan.

Constraints on the age of metasediments from western part (Ortaköy, Aksaray) of the Central Anatolian Crystalline Complex, Turkey

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The Central Anatolian Complex (CACC) is the largest metamorphic domain, a ~300*200 km triangular region, exposed in Turkey. The basement is composed usually of migmatites, paragneisses, alternation of marble and paragneiss, and thick metacarbonate sequence. The sequence in the area starts with with graphite bearing paragneiss with interlayers of marble, and metabasics (Tamadag Formation), and continues with marble containing paragneiss, rare metabasics (Bozçaldağ Formation). The basement is overlain by Cretaceous ophiolites, which is cut by voluminious Late Cretaceous-Paleocene granitoids. Neogene formations completed the rock sequence in the area.

The first certain macro fossil, Heliolitinae (Heliolitidae fam.) *Paeckelmannophora* sp., was discovered in the marble of Tamadağ Formation. It has been found out acritarch *Leiosphaeridia* sp and *Lophosphaeriduim* sp., together with possible graptolite fragments-questionably of *Retiolites* sp in the marble residue obtained by treatment of acetic acid. *Paeckelmannophora* sp. and fragments of *Retiolites* sp. have been found pointing to a Silurian-Devonian age. Bozdağ Formation, overlying conformably Tamadag Formation, could hence be Late Paleozoic in age. Based on the age of the metasediments, and geochemistry of the amphibolites in Nigde massif, it has been suggested that CACC could have undergone a Hercynian metamorphism, whose effects may have been destroyed by intensive polyphase Alpine metamorphism. The Tamadag Formation may be correlated with Silurian-Lower Carboniferous Bozdag Formation of Konya Complex (Afyon-Bolkardağ zone), 200 km WSW to the study area.

Keywords: Acritarch, Paleozoic, Massif, Aksaray, Turkey.

Tectono-stratigraphic position of the Kaminnyi Potik Unit in the Ukrainian Carpathians and volcanogenic rocks of the Chyvchyn Mount

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Tectono-stratigraphically the Kaminnyi Potik Unit is the most internal and structurally highest unit of the Fore-Marmarosh units and in many places is directly covered by the Marmarosh nappes of the Central East Carpathians (Marmarosh Massif, Transcarpathian Ukraine). This unit consists of the latest Jurassic/earliest Cretaceous formations composed mainly by thin-bedded limestones, black shales, sandstones and conglomerates with basic effusives (including basaltic pillow lavas) and pyroclastic turbidites. The best places for study of this unit occur both in the Rahiv city vicinity and on the Chyvchyn Mount, the highest peak of the Chyvchynian Mountains. Volcanic-sedimentary complex of the Chyvchyn Mt, does not form a single tectonic unit (cap), but four small tectonic scales with full development of the submarine effusive-pyroclastic debris flows/turbidites complexes.

Keywords: Ukrainian Carpathians, Kaminnyi Potik Unit, tectono-stratigraphy, effusive rocks.

The Devonian stratigraphic succession and evolution of the Baltic sedimentary basin

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Facies analysis, biostratigraphical and taphonomical studies combined with the re-evaluation of signatures of the world-wide events, and a new mathematical model of the BSB enabled better understanding of the development of the Devonian basins in the Baltic area. Four stages of the basin evolution have been established: a) remnant basin stage (Lochkovian); b) shallow epeiric basin stage with mainly siliciclastic sedimentation (Pragian – early Frasnian); c) shallow epeiric basin stage with mainly carbonate sedimentation (Frasnian); d) infilling stage of the progressively narrowing shallow epeiric basin with mixed sedimentation (Famennian).

Keywords: East European Craton, lithostratigraphy, basin modeling, sea-level changes, shallow epeiric sea, siliciclastic and carbonate sedimentation.

Where do the boundaries lie?

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While revising and harmonizing the stratigraphic framework for Swiss geological maps, a number of questions arose as to where to set boundaries when subdividing the vertical succession of strata, how to deal with lateral facies changes and thickness variations or to which extent complications such as metamorphic overprint can be overcome.
The case of Early Jurassic deposits from the main tectonic domains of Switzerland and neighboring regions illustrates the necessity of a rigorous lithostratigraphic approach, despite formal constraints and practical limitations.

Keywords: lithostratigraphy, stratigraphic discontinuity, facies heterogeneity, Early Jurassic, Switzerland.

Cretaceous stratigraphy of outcrop sediments of Ariyalur area, Cauvery Basin, South India

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The pericratonic basin with syn-rift and post rift sedimentation in the Cauvery Basin in southern India is evolved during Late Jurassic. These sediments and associated fauna, flora, are dealt the Cretaceous history in this part of the continent. These sediments are studied to its litho and biostratigraphic architecture and its paleoenvironment.

Keywords: Cauvery Basin, India, Cretaceous stratigraphy, Ariyalur area, litho and biostratigraphy.

Stratigraphical propose to the post-rift sequences of Jatobá Basin, Northeastern Brazil

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The sedimentary infill of Jatobá Basin is not well known, even today, befitting its importance in relations to others interior rift basins of northeastern Brazil.
In its northern portion, more precisely in the middle to the top of Serra Negra and Periquito hills, crop out laminated limestones interbeded within terrigenous sediments, correlated by ROCHA & LEITE (1999) with the aptian laminated limestones of the Crato Formation of Santana Group of the Araripe Basin (NEUMANN & CABRERA, 1999). This sedimentary infill of Jatobá Basin, until this work, had not been studied yet, nor placed in any lithostratigraphical column.
The Crato Formation of Jatobá Basin has the lithology, fossil content, age and depositional environment of the Paracuru (Ceará Basin; NEUMANN *et al*. 2009), Codó (Paranaíba Basin; BRUNI *et al*. 1976) and Crato (Araripe Basin, NEUMANN *et al.* 2009) formations. This aptian lacustrine infill is both generator and oil reservoir in the Atum and Xaréu oilfield at the Ceará Basin.

Due to all these similarities mentioned above, it is important to know the evolution of the geologic knowledge of this stratigraphic post-rift sequence of the Jatobá Basin.
Among the intracratonic basins of northeastern Brazil, the Jatobá Basin presents a succession of lacustrine sediments with pronounced phases of deltaic siliciclastic influence similar to the Aptian lacustrine phase of the Araripe basin (NEUMANN *et al*., 2003).
Therefore, the main objective of this work is the study of the post-rift sequence of Jatobá Basin, focusing on the subdivision in two units: post-rift I (Marizal, Crato and Romualdo formations) and post-rift II (Exu Formation). The results will contribute to a new proposal for the lithostratigraphy of the Jatobá Basin, and with the study of other lacustrine systems of the intracratonic basins of northeastern Brazil.

Keywords: Jatobá Basin, Intracratonic basin, Stratigraphy, Northeastern Brazil.

Cenomanian–Turonian (early Late Cretaceous) facies development and sequence stratigraphy of the Danubian Cretaceous Group (Bavaria, Southern Germany)

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The Cretaceous sediments of the Danubian Cretaceous Group document deposition in a peri-continental setting at the northern margin of the Neotethys, to the southwest of the emergent Bohemian Massif. The Cenomanian–Turonian 2nd-order sea-level rise resulted in a considerable onlap of marine sediments onto formerly emergent Variscan basement and older Mesozoic strata, and in the establishement of a dynamic depositional setting including terrestrial and various neritic environments. Sequence stratigraphic studies document the presence of five sequence boundaries in the Cenomanian (SB Ce 1–5) and five sequence boundaries in the Turonian (SB Tu 1–5) part of the Danubian Cretaceous Group. The stratigraphic positions of the sequence-bounding unconformities correspond to to correlative surfaces in other Cretaceous basin, arguing for a predominant eustatic control of deposition in the Danubian Cretaceous Group. However, increasing tectonic instability related to the onset of inversion at the southwestern margin of the Bohemian Massif can be recognized from the Middle Turonian onwards.

Keywords: Lower Upper Cretaceous, depositional environments, sedimentary unconformities, correlation.

Stratigraphic transect of NW Colombia: a key to understanding the origin of the Panamanian Isthmus

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We present new data on the stratigraphy of the Miocene in NW Colombia, in the Pacific basin. The sedimentological and biostratigraphic study, based on analysis of calcareous nannofossils, foraminifera, palynomorphs and diatoms have enabled a new framework that allows to monitor the closing process of the Isthmus of Panama and its paleoceanographic implications.

Keywords: Miocene, Colombian Pacific basins, Biostratigraphy, Calcareous nannofossils, planktonic Foraminifera, Diatoms, Palynomorphs.

Unique features of interglacial deposits (MIS 11, E Poland): comparison of palaeobotanical and geological data

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The paper describes an unique succession of alluvial deposits from the Holsteinian Interglacial in E Poland. It was studied in terms of sedimentology, palaeobotany and TL geochronology. The interglacial alluvial succession includes two facies of meandering river: point bar and oxbow. TL age of point bar deposits and palaeobotanical analysis of oxbow lake deposits allow to associate them with initial phases (pre-optimum period) of the Holsteinian Interglacial. Specific palaeoenvironmental conditions did not favour the formation of complete interglacial biogenic-clastic succession as it was deposited in the shallow oxbow lake, which underwent quick eutrophication.

Keywords: Holsteinian Interglacial, MIS 11, E Poland, meandering river, palaeobotanical data, sedimentology.

Sequence stratigraphy of the Plänerkalk, Elbtal and Danubian Cretaceous groups (Germany): early Late Cretaceous correlations around the Mid-European Island

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Sequence stratigraphic studies of lower Upper Cretaceous successions (Plänerkalk, Elbtal and Danubian Cretaceous groups) located around the Mid-European Island prove the presence and contemporaneity of five sequence boundaries in the Cenomanian (SB Ce 1–5) and five sequence boundaries in the Turonian (SB Tu 1–5) in different sedimentary basins of Northern Germany, Saxony and Bavaria. The stratigraphic positions of all these sequence-bounding unconformities seem to correspond to correlative surfaces in other Cretaceous basins, although tectonic activity started to influence sedimentation in the Turonian. Furthermore, the sequence

boundaries are also in good agreement with the standard sequence chronostratigraphy of European basins. They thus evidence a predominant eustatic control of early Late Cretaceous deposition by 3rd-order sea-level changes in all three areas.

Keywords: Cenomanian–Turonian, Cretaceous basins, sedimentary unconformities, sea-level changes, correlation.

Sequence stratigraphy of the lower Upper Cretaceous Elbtal Group (Cenomanian–Turonian of Saxony, Germany)

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Sequence stratigraphic analyses of the lower Upper Cretaceous (Cenomanian–Turonian) successions of the Elbtal Group (Saxonian Cretaceous) have been conducted. The repeated stacking patterns of decametre-scale sedimentary units, composed of retrograding marly–calcareous Pläner intervals and progradational sandstone packages separated by sedimentary unconformities, gave important clues for elucidating early Late Cretaceous sea-level changes in the basin. Seven depositional sequences of Middle Cenomanian–Late Turonian age and their bounding unconformities (sequence boundaries SB Ce 4 and 5, SB Tu 1–5) have been identified in the Saxonian Cretaceous. They are also reported from coeval sections around the Mid-European Island (e.g., Münsterland Creatceous Basin, Lower Saxonian and Danubian Cretaceous), suggesting that 3rd-order eustatic sea-level changes were the main causes for the sequence stratigraphic architecture of the Elbtal Group. However, tectonic processes began to affect the global sea-level signal from the (Middle) Turonian onward (onset of inversion at the Lausitz Fault).

Keywords: Cenomanian–Turonian, sedimentary unconformities, sea-level changes, correlation.

Infrazonal subdivision of the Volgian Stage in its type area by ammonites and correlation of the Volgian and Tithonian Stages

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The Volgian Stage of the Russian Platform is subdivided on 3 substages and 9 zones, within which 37 biohorizons are recognized. Only the Lower Volgian is characterized by occurrences of ammonites of the Submediterranean origin, which permits direct correlation with the Tithonian Stage. Rare records of *Haploceras* in the basal Middle Volgian could not be used for correlation, while overlying part of the Volgian stage lacking any Submediterranean or Mediterranean faunal elements in ammonite faunas. Recent advances in magnetostratigraphical studies of the upper part of Volgian Stage in Northern Siberia lead to correlation of uppermost Middle and Upper Volgian of this area with the Tithonian succession. These results could be effectively used also for correlation of the Volgian ammonite zones of the Russian Platform with those of the Tithonian Stage.

Keywords: Volgian Stage, Russian Platform, infrazonal subdivision, ammonites.

Palynomorphs from Pliensbachian -Toarcian transition in Benzerka Section (Traras Mountains, northwestern Algeria): preliminary data

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For the first time in Algeria, the palynological study of the deposits of Upper Pliensbachian – Lower Toarcian in the Benzerka section (Traras Mountains, Northwestern Algeria) identified the sporomorphes (spores and pollen grains) associated with acritarchs and algae. Some spores and pollen taxa of have brought new stratigraphic details on the lower limit of Bayada beds.

Keywords: Palynology, Pliensbachian, Toarcian, Traras Mountains, Benzerka, Algeria.

Early Cretaceous stratigraphy of eastern Asia: non-marine and marine correlation

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There are abundant non-marine Cretaceous deposits which globally exist, and it is difficult to correlate the non-marine strata within the international chronostratigraphic framework chart established based on marine rocks/fossils. Fortunately, there are both alternating non-marine and marine, and complete non-marine sections of Lower Cretaceous in eastern Asia. The approaches to date the non-marine Cretaceous rocks and fossils, and the non-marine and marine correlation of Early Cretaceous strata in eastern Asia were summarized in this short article.

Keywords: Non-marine, marine, correlation, Early Cretaceous, eastern Asia.

Stratigraphical characteristics of the Derinkuyu area, Nevsehir, Turkey

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The study area is located in Derinkuyu area, Central Anatolia. The oldest formation in the area is Cretaceous Karatepe hornblende gabbro, overlied by Upper Miocene Melendizdağı tuffs, Melendizdağı andesites, Gostuk tuff and ignimbrite, and Karakaya formations. These units were followed by Lower Pliocene Selime tuff, Kızılkaya ignimbrite and Ağıllı formation, which were overlied by various Pleistocene ashes, namely, Hasandağı ash formation, Kumtepe ash ve Göllüdağ ash flow tuffs. All of which were overlied by Pleistocene Kızıldag basalts and Holocene basaltic cinder cones. Talus is the youngest unit in the area.
The young volcanics and volcanoclastics in the area may have been originated from volcanism of Mount Hasan, Mount Melendiz and Mount Erciyes.

Keywords: Mount Hasan, volcanism, Derinkuyu, Turkey.

Stratigraphy and Microfacies of the Cretaceous Limestones within the Bornova Flysch Zone (Spil Mountain, Manisa, W Turkey)

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The Spil Mountain (Manisa, W Turkey) is situated in the Bornova Flysh Zone which is bounded by the İzmir-Ankara Suture Zone (northern branch of Neotethys) to the northwest and by the Menderes Massif to the southeast. The purpose of this study is to describe microfacies and microfossil assemblages of the Spil Mountain carbonate sequences. Two carbonate sequences in autochthonous and allochthonous settings are differentiated. Autochthonous sequence begins with inner platform carbonates of the Early Cretaceous age which are represented by algal wackestone, fenestral mudstone, intraclastic packstone with *Praechrysalidina infracretacea*, *Salpingoporella annulata*, charophyte oogonia. The platform succession are disconformably overlained by calciclastic turbidites and pelagic wackestones of the Maastrichtian age, representing platform drowning, and then passes upward into siliciclastic sediments containing large limestone blocks. Allochthonous carbonate sequences range in age from the Cenomanian(?) to Santonian-early Campanian, which were deposited in peritidal to outer shelf paleoenvironments. Lower part of the allochthonous sequence is composed of foraminiferal-intraclastic wackestones-packstones with mainly miliolids and *Cuneolina pavonia*. The middle part consists of peloidal wackestone/packstone with *Aeolisaccus*, *Thaumatoporella*, benthic foraminifers and rudist-shell fragments. The benthic foraminifera are represented by *Pseudocyclammina sphaeroidea, Keramosphaerina tergestina*, *Moncharmontia apenninica*/*compressa*, *Scandonea samnitica*. In the upper part of the allocthonous sequence, pelagic wackestone with *Marginotruncana* and *Dicarinella* is alternated with foraminiferal-peloidal packestone with rudist shell fragments and microbioclastic wackestone.

Keywords: Microfacies, Microfossils, Cretaceous, Spil Mountain, Bornova Flysch Zone, Turkey.

Harmonising the Swiss lithostratigraphic nomenclature

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After more than 80 years of traditional geological map production for the Geological Atlas of Switzerland 1:25000, 143 printed sheets with equivalent legends of this map series exist. During the last decades the Swiss Geological Survey has spent considerable effort to convert the existing map sheets into Geographic Information System (GIS) datasets. By means of an initiative of the Swiss Geological Survey, other federal departments and several cantons, the published Atlas maps were completed with compiled geological GIS maps of lower quality, in order to make GIS maps available for the whole of Switzerland. However, each of the 220 available GIS maps has its individual lithostratigraphic legend. In this work, we present the HARMOS project, which aims to harmonise the multiple existing map legends and to elaborate a lithostratigraphic standard legend, including harmonised descriptions, for Swiss geological maps at a scale of 1:25000. The project involves 40 recognized stratigraphic experts. A close collaboration with and quality control by the Swiss Committee on Stratigraphy assures the required quality for broad acceptance. Preliminary results indicate that the application of the elaborated lithostratigraphic map legend to GIS datasets remarkably increase the value of the geological data. This confirms the idea that the new lithostratigraphic standard legend will provide a fundamental base for a future seamless, semantically harmonised, nationwide geological GIS map of Switzerland.

Keywords: lithostratigraphy, nomenclature, geological maps, GIS, Switzerland.

Lower and Middle Jurassic stratigraphic scheme of the Western Caucasus: problems of correlation and division

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The western part of the official regional stratigraphic schemes of the Lower and Middle Jurassic of the Caucasus are considered in this paper. The completion of this work allows one to make an estimation of the degree of validity of the various stratigraphic units according to the requirements of the Stratigraphic Code of Russia and the opportunity of their association in groups. In the published descriptions of some formations there is not enough information necessary for the establishment of new local stratigraphic units according to requirements of the Stratigraphic Code of Russia. Therefore, there is no full justification for the legality of these stratigraphic units. This review of the stratigraphic division of the Lower and Middle Jurassic of some zones of the Western Caucasus and validity of the establishment of formations and groups illuminates the different degree of development of the stratigraphic schemes for all zones of this considered region. New groups are presented herein and the stratigraphic intervals of several known groups are changed. Some proposals for improving the mentioned scheme are presented and discussed in this paper.

Keywords: Jurassic, stratigraphic scheme, Western Caucasus.

Base and new definition of the Lower Badenian and the age of the Badenian stratotype (Middle Miocene, Central Paratethys)

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A new and precisely defined timing, chronometric and chronostratigraphic subdivision of the Badenian (Middle Miocene, regional stage of Central Paratethys) is presented based on data from the classical Vienna and Styrian basins and the Alpine-Carpathian Foredeep using global events, mainly based on geomagnetic polarity reversals as correlated chronometric boundaries, and climate, and sea level changes,in addition to isotope events and biostratigraphic data. The Karpatian/Badenian boundary is positioned at 16.303 Ma, at the top of chron C5Cn.2n, the Badenian/Sarmatian boundary at 12.829 Ma, at the top of polarity chron C5Ar.2n. The Lower Badenian ranges from 16.303 to 15.032 Ma, the top of polarity chron C5Bn.2n. The orbitally-based time calibration of the Badenian stratotype at the type locality Baden Sooss gave an age of 13.982 Ma to 13.964 Ma (Hohenegger and Wagreich 2012) belonging to middle Badenian.

Keywords: Middle Miocene, Badenian, Lower Badenian, Paratethys, stratotype, Vienna Basin.

Integrated stratigraphy (bio- and sequence stratigraphy) and facies analysis of the Upper Cenomanian–Turonian (lower Upper Cretaceous) in the Eastern Desert, Egypt

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The Cenomanian–Turonian successions of the Eastern Desert of Egypt have been studied in great detail applying facies analysis and an integrated stratigraphic approach. A detailed ammonite biozonation has been elaborated that allows precise correlations. The predominantly shallow-marine successions include the Galala, Maghra El Hadida and Umm Omeiyid formations which represent a shallow-marine, mixed carbonate–siliciclastic open, lagoonal to carbonate ramp setting. Six major sedimentary unconformities (Cenomanian sequence boundaries SB Ce 4 and 5, and Turonian sequence boundaries SB Tu 1–4) have been recognized and laterally tracked across the Eastern Desert. Their stratigraphic positions have been calibrated by means of ammonite-biostratigraphy and they define five 3rd-order depositional sequences (DS ED 1–5). The sequence stratigraphical calibration of the study area with successions from other Cretaceous basins demonstrates the contemporaneity of the unconformities across different tectonic plates, strongly suggesting that their formation resulted from eustatic sea-level changes.

Keywords: Mid-Cretaceous, ammonite biostratigraphy, sedimentary unconformities, correlation, depositional environments.

Integrated stratigraphy and facies analysis of the Upper Albian–Turonian (Cretaceous) Debarsu Formation (Yazd Block, Central Iran)

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The Upper Albian–Turonian Debarsu Formation in its type area around Haftoman, south of Khur (Central Iran), has been investigated using an integrated approach of detailed logging, bio- and sequence stratigraphic dating and facies analysis based on field observations and microfacies studies. The formation has been deposited on a homoclinal carbonate ramp with a basinal area situated towards the north. Numerous shallowing-upward cycles from offshore marl to shallow-water limestones are capped by palaeo-karst surfaces, giving evidence of significant relative sea-level changes. Based on the stratigraphic positions of the sequence-bounding unconformities, a predominantly eustatic control of the sedimentary cyclicity is inferred. The major unconformity at the base of the overlying Coniacian–Campanian Haftoman Formation, however, is of tectonic origin.

Keywords: mid-Cretaceous, biostratigraphy, sequence stratigraphy, homoclinal ramp, geodynamics.

Review of the Jurassic System of Russia: stages, boundaries and perspectives

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Review of the state-of-art of the Jurassic Stages in Russia is given. Jurassic System is represented here mainly by Boreal deposits, and direct correlation of GSSP-based boundaries with stage boundaries of the Boreal succession mainly remains unclear for the Lower and Middle Jurassic, and these Boreal boundaries further could be fixed by choosing of SSSP sections. Callovian and Upper Jurassic stage boundaries are directly traced throughout in the Boreal areas.

Keywords: Jurassic, Russia, stage boundaries, GSSP, SSSP.

Stratigraphic Sequence of Paleogene-Neogene of Tibet Plateau and their Response to the Uplift of the Plateau

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98 remnant basins and 5 stratigraphic realms with 13 stratigraphic subrealms have been recognized on the Tibet Plateau. Through the research of the types of remnant basins, tectonic setting, stratigraphic sequence and sedimentary characteristics, and evolution history of sediments, we divided the uplift process and sedimentary response of the Tibet Plateau into 3 stages and 8 sub-stages, namely, subduction-collision uplift stage (65–34 Ma) with three sub-stages, intercontinental convergence and compressive uplift stage (34–13 Ma) with three sub-stages, and intercontinental isostatic adjustment uplift stage (since 13 Ma) with two sub-stages.

Keywords: Cenozoic, stratigraphic realm, sedimentary evolution, Tibet Plateau.