Cyanobacterial 'whiting' origin of Devonian-Mississippian carbonate mud mounds?

Riding, R.

Department of Earth and Planetary Sciences, University of Tennessee, Knoxville TN 37996, USA (rriding@utk.edu)

Carbonate mud mounds are unusually abundant in the Late Devonian-Early Mississippian. A sediment baffling origin has been suggested, but a suitable source of off-mound carbonate mud has been difficult to identify. Late Devonian changes in atmospheric composition, particularly pCO_2 reduction and pO_2 increase, may have been sufficiently large to induce CO_2 concentrating mechanisms (CCM) in phytoplankton. CCM act to maintain photosynthesis, and include active transport of HCO^{3-} into the cells that can lead to extracellular pH rise and precipitation of fine-grained carbonate ('whitings') in the water column when carbonate saturation state is sufficiently elevated. It is proposed that Late Devonian-Early Mississippian whitings promoted mound development by generating mud off-mound whose import substantially augmented any on-mound carbonate production. Coeval increase in benthic calcified cyanobacteria supports elevated carbonate saturation state and CCM induction, and potential increase in primary productivity stimulated by CCM induction is consistent with organic carbon rich anoxic sediments and large positive δ^{13}CPDB excursions at this time.

A number of the sedimentary features commonly associated with Late Devonian-Early Mississippian mud mounds are consistent with current-driven accumulation of fine-grained carbonate. These include: (i) formation in a wide range of water depths; (ii) orientation, asymmetry, lateral progradation and amalgamation, (iii) grainstone haloes; (iv) presence of current-reliant filter feeders (bryozoans, crinoids, sponges); (v) layered structure; (vi) collapse structures (stromatactis and slumps). Carbonate mud derived from phytoplanktic whitings can be rich in organic matter. This could have promoted microbial lithification (e.g., by bacterial sulfate reduction) that contributed to the formation of clotted-peloidal microfabric. Thus, whiting processes could have been the primary mud source and also have created conditions favoring syndepositional on-mound early lithification. In this view, on- and off-mound microbial processes were mutually related, with off-mound mud production being mediated by cyanobacterial oxygenic photosynthesis and on-mound lithification mediated by heterotrophic mineralization of whiting organic matter.

Peritidal cyclical sequences of Kimmeridgian-Berriasian-?Valanginian limestones from Piatra Craiului Massif (Romania); the role of microbialites and rivulariacean-type cyanobacteria

Sasaran, E., Ples, G., Mircescu, C. & Bucur, I.I.

Department of Geology, Faculty of Biology and Geology, Babes-Bolyai University, M. Kogalniceanu 1, 400084 Cluj-Napoca, Romania
(emanoil.sasaran@ubbcluj.ro; george.ples@ubbcluj.ro; ioan.bucur@ubbcluj.ro)

The Kimmeridgian-Berriasian-?Valanginian limestones from Piatra Craiului Massif are part of the sedimentary cover of the Getic Nappe from Southern Carpathians. Within the Piatra Craiului carbonate succession, three major types of depositional systems have been separated which can be followed from base to the top: (1) slope and shelf margin system; (2) open shelf system (offshore) and (3) coastal and shoreline system.

The carbonate deposits belonging to the slope and shelf margin system are represented by reef breccias and bioconstructions. The bioconstuctions associated with gravity flows indicate a shelf slope environment related to the external flanks of the carbonate platform. Within the bioconstructions microbialites and encrusting organisms played an important role.

The middle and upper part of the succession is composed of normal and restrictive marine subtidal limestones. The vertical distribution of subtidal facies, reflects cyclic changes in wather depth. The first record in these deposits is marked by a fluctuation of the environmental deepening (from shallow to deeper domains) and/or ecological changes in the depositional environment (from restrictive to open marine conditions and returning to restrictive conditions).

In the upper part of the succession the peritidal limestones are dominant. The typical facies and facies associations for the peritidal environment are separated in three depositional subtypes: subtidal, intertidal and supratidal. The vertical stacking of the identified facies reflects cyclical changes in water depth. The deposits contain marine and marine restrictive facies acumulated in high or low energy environments. The facies evolution of individual beds or bed sets, indicates a transition between the three depositional zones, represented by lagoons, ponds, beaches, tidal bars, algal-microbial mats and swamps. Rivulariacean-type cyanobacteria played an important role in the carbonate accumulation.

The vertical succession of the carbonate deposits from Piatra Craiului indicate the existence of a gradual transition from slope and shelf margin to subtidal and shoreline facies. This fact indicates the progradation of the carbonate platform during the Lower Cretaceous. In the same time, due to the radical reduction of the accomodation space on the carbonate platform, the main carbonate sedimentary production was generated by cyanobacteria.

Acknowledgments: This work is a contribution to the research project financed through PN-II-ID-PCE-2011-3-0025 grant.

A coastal paradise for Aptian microbialites (Early Cretaceous, N Spain)

Suarez-Gonzalez, P.[1], Quijada, I.E.[1], Benito, M.I.[1], Mas, R.[1] & Riding, R.[2]

[1] Dpto. Estratigrafia, Facultad de Ciencias Geologicas, Universidad Complutense de Madrid - IGEO (CSIC-UCM), c/Jose Antonio Novais 12, 28040 Madrid, Spain (pablosuarez@geo.ucm.es)

[2] Dept. Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996, USA

Microbial carbonates are remarkably diverse and abundant in the early Aptian (~120 Myr) coastal carbonates of the Leza Fm (La Rioja, N Spain). They show a great variety of macro- and microfabrics, associated with differing sedimentary environments. This provides a unique opportunity to study the factors underlying development of microbial fabrics and structures.

The Leza Fm is part of the Early Cretaceous Cameros rift basin. Sedimentological analysis reveals that it was deposited in a system of carbonate coastal-wetlands with variable fresh- and seawater influence, composed of: a) carbonate water-bodies with charophytes and dasyclads; b) palustrine plains with common paleosols; c) siliciclastic alluvial environments; d) oncoid channels; e) carbonate water-bodies with ostracodes and miliolids; f) tidally-influenced water-bodies; and g) restricted carbonate-evaporite water-bodies. These environments interfinger throughout the unit, but also show a general retrogradational trend.

Most of the sedimentary environments of the Leza Fm are rich in microbial carbonates: (1) *Oncoids* are common in small channels and facies with strong freshwater influence, and have microfabrics dominated by calcified filaments. (2) *Skeletal stromatolites* occur in the western outcrops associated with cross-bedded sandy grainstones with charophytes and rare dasyclads. They have domical morphologies and well-calcified filamentous microfabrics. (3) *Fragments of dendrolites* are common throughout the coastal-lake facies with charophytes and dasyclads, showing microstructures of delicate branching calcified filaments. (4) *Thrombolites* occur in dasyclad-dominated coastal-lake carbonates of the western outcrops. Their microfabrics are commonly diagenetically altered, but show relict peloidal micrite and calcified filaments. (5) *Fenestral laminites* are common in facies with ostracodes and miliolids in the western outcrops. They show undulose lamination marked by elongate fenestrae. Vertical cracks and vadose calcite cements are common. Their