

HAUTERIVIAN ALLODAPIC LIMESTONES WITHIN THE SCHRAMBACH FORMATION (KALTENLEUTGEBEN SECTION, LUNZ NAPPE, NORTHERN CALCAREOUS ALPS, LOWER AUSTRIA)

Alexander LUKENEDER¹ & Felix SCHLAGINTWEIT²

¹ Department of Palaeontology, Geozentrum, Althanstrasse 14, A-1090 Vienna, Austria, e-mail: alexander.lukeneder@univie.ac.at

² Lerchenauerstraße 167, D-80935 Munich, Germany, e-mail: EF.Schlagintweit@t-online.de

Allodapic limestone layers (thickness up to 10 cm) are described for the first time from the Lower Cretaceous Schrambach Formation of the Lunz Nappe (Kaltenleutgeben section, Northern Calcareous Alps). They are composed almost exclusively of bioclasts such as echinoids (about 50 %), bryozoans, coralline red algae, foraminifera and remains of stromatoporoids and belemnoids; calcareous green algae are missing. The stratigraphic age of these layers can be indicated as Upper Hauterivian based on the findings of the *Euptychoceras* abundance Zone. The occurring biota, indicate a source area in an upper slope position indicating the transition to real shallow water areas. From the time-interval between the Plassen Formation (up to Early/Middle Berriasian) and the allochthonous Urgonian limestones (from Late-Barremian onwards) no records of a shallow water evolution in the Northern Calcareous Alps were known up to now. A relationship to equivalent biodetritus within the Rossfeld Formation, without biostratigraphic data so far, is possible. Last but not least, due to the occasional occurrence of chrome spinel and the nappe tectonic position of the locality, transportation from southern directions is assumed (Fig. 1).

Lithology and microfacies of the allodapic limestones

The Upper Hauterivian succession of southeast Lower Austria was deposited in an unstable shelf setting characterized by thick stratigraphic units that reflect transgressive histories punctuated by tectonic events, as shown by the deposition of sandstones and allodapic limestones.

At the Kaltenleutgeben section, the Lower Cretaceous is represented by a single formation: the Schrambach Formation (approx. 150 m, Late Valanginian – Early Barremian). The section consists of essentially grey marly limestones, ocher calcareous marls and grey silty marlstones accompanied by sandstones and two allodapic limestone beds. The CaCO₃ (calcium carbonate contents, equivalents calculated from total inorganic carbon) varies between 56 and 89 % within the limestones and marly limestones of the Schrambach Formation. TOC values vary between 0.2 and 7.3 % and the Sulphur contents reach from 0.1 to at 1.5 mg/g.

The intercalated allodapic limestone beds occur in irregularly layers and lenses from 2 –10 cm in thickness and show wavy, not regular boundaries. Lower boundaries are sharp, whereas in contrast the top of the layers is passing more gradually into 'normal limestone beds'. The top of these beds often shows graduation into a finer fraction. These redeposited layers are only visible on broken surfaces, when they show the typical brightness of echinoderm debris.

The following data concerning microfacies and micropalaeontology refers to sample Ka 110 from which 20 thin-sections have been prepared. The material examined is deposited in the palaeontological collection of the Natural History Museum, Vienna, Austria (NHMW).

The allodapic limestones can be classified as (bioclastic) packstones with sparite between the almost exclusively biogenic components (mostly between 0.5 and 1.0 mm in diameter). The latter are dominated by echinoid fragments (about 50 %), bryozoans, mollusc and brachiopod shells, benthic foraminifera, serpulid tubes, calcareous algae (e.g. corallinaceae) and remains of pharetronid sponges and stromatoporoids. Due to the typical orthogonal microstructure

(with dark median line) the stromatoporoid fragments can probably be referred to *Actinostromaria*. In addition there are sections of belemnoids. Comparable frequent are cross-sections of *Carpathiella triangulata* MISIK, SOTAK & ZIEGLER interpreted as serpulid tubes (MISIK et al. 1999).

The microfauna is poorly diversified with textulariids, arenaceous encrusting forms, *Charentia* sp. and calcareous foraminifera most typically *Lenticulina* sp., *Spirillina* sp. and more rarely *Neotrocholina* sp. Amongst the calcareous algae, the absence of green algae such as dasycladales is striking. Instead, there are fragments of coralline red algae (*Sporolithon?* sp.), peysonelliacean red algae with *Polystrata alba* (PFENDER) DENIZOT and scattered remains of *Marinella lugeoni* PFENDER. In addition there are rare fragments of the colonial microorganism incertae sedis *Koskinobullina socialis* CHERCHI & SCHROEDER.

Some echinoid fragments and bryozoans skeletons show impregnation by glauconite that can also occur as single grains. Occasionally, small grains of chrome spinel can be observed.

Stratigraphy

23 genera of Lytoceratina, Phylloceratina, Ammonitina and Ancyloceratina (suborders), comprising 25 different species, were reported in a recent paper by LUKENEDER (2003). The cephalopods can be found in the whole section but are concentrated in certain levels (ammonoid 'abundance zones'; see SALVADOR 1994; STEININGER & PILLER 1999). The following important genera could be detected: *Lytoceras*, *Leptotetragonite*, *Phylloceras*, *Phyllopachyceras*, *Oosterella*, *Olcostephanus*, *Haploceras*, *Kilianella*, *Thurmanniceras*, *Eleniceras*, *Spitidiscus*, *Acanthodiscus*, *Leopoldia*, *Neocomites*, *Barremites*, *Pulchellia*, *Himantoceras*, *Crioceratites*, *Bochianites*, *Karsteniceras*, *Euptychoceras*, *Hamulina* and *Anahamulina*. For a detailed list of the ammonoid species see LUKENEDER (2003). The bigger part of the ammonoid species do not allow to give significant evidence on the stratigraphic age of the encompassing sediments. According to LUKENEDER (2003) the *Euptychoceras*-abundance zone hints to a Late Hauterivian age for the interval around the allodapic limestone layers (see also VAŠÍČEK et al. 1994, '*Euptychoceras* beds'). At the investigated section the *Euptychoceras*-abundance zone is located between the *Olcostephanus* (*J.*) *jeannoti*-abundance zone and the *Crioceratites krenkeli*-abundance zone. *Olcostephanus* (*J.*) *jeannoti* is the index fossil of the *jeannoti* Subzone within the *Crioceratites loryi* Zone (middle Early Hauterivian). *Crioceratites loryi* (SARKAR), the index ammonite for the *loryi* Zone and for the *loryi* Subzone, was also detected. The occurrence of *Crioceratites krenkeli* hints to the *Pseudothurmannia angulicostata* Zone (latest Hauterivian) (HOEDEMAEKER et al. 2003).

Hence, the latter implementations and the intermediate position of the *Euptychoceras*-abundance zone, the intercalated allodapic limestone beds are assumed to be of early Late Hauterivian age.

The microfossils resedimented in the allodapic limestones do not allow a precise dating. Only the occurrence of the corallinaceans give a minimum age of Early Hauterivian being their oldest records so far recorded in the literature (ARIAS et al. 1995).

Discussion and comparisons

In the general palaeogeographic and biostratigraphic framework, the allodapic limestones of the Kaltenleutgeben section necessitate a comparison with the Barmstein limestones, the Rossfeld Formation (see also VAŠÍČEK & FAUPL 1998), and allodapic Urgonian limestones. It is worth mentioning, that from the time interval between the Barmstein limestones (Late Tithonian-Early/Middle Berriasian according to GAWLICK et al. in press; see also LUKENEDER et al. 2003) and the oldest allodapic Urgonian limestones of Late Barremian age (HAGN 1982) there are no records of the existence of a shallow water facies in the Northern Calcareous Alps.

The Barmstein limestones (Late Tithonian-Early/Middle Berriasian) are mass-flow deposits that occur intercalated in the basin facies of the Oberalm Formation (STEIGER 1981; GAWLICK et al. in press). They were deriving from the Trattberg rise at the boundary of the Lower – Upper Tirolic Nappe (for explanation see GAWLICK & FRISCH 2003). The microfacies of the Barmstein limestones is characterized by densely packed lithoclasts and bioclasts predominantly of the Plassen Formation of different facies zones (slope, platform margin, back-reef, closed lagoon). At the type-locality, the Barmsteine near Hallein, extraclasts of older strata of Jurassic and Late Triassic age occur. The Hauterivian allodapic limestones instead are composed of bioclasts and in addition reworked older lithoclasts (due to calpionellid findings of Valanginian age)

Remains of coralline red algae such as *Sporolithon rude* (LEMOINE), bryozoans and echinoids are known as bioclasts in sandstones of the Rossfeld Formation (SCHLAGINTWEIT 1991: p. 54). These could either indicate a shallow water facies south of the depositional area of the Rossfeld Formation or a lateral influx from the 'Urgonian platform' known from the interval Late Barremian-Albian. The latter possibility has been favoured by SCHLAGINTWEIT (1991) since no stratigraphic data were available from these sandstones and a time-equivalent position to the allochthonous Urgonian limestones has been assumed. The allodapic limestones of Kaltenleutgeben, however, are of Hauterivian age and thus, older than the first records of the Urgonian platform known so far as Late Barremian (HAGN 1982). From a micropalaeontological point of view, the latter contain a diverse microfauna of benthic foraminifera (e.g. orbitolinids, lituolids, miliolids and others), calcareous green algae (Dasycladales, Halimedaceae) and remains of corals, thus, being totally different from the allodapic limestones of Kaltenleutgeben. Whereas the biogenic composition of the allodapic layers of the Kaltenleutgeben section can be ascribed to the foramol type sediments, the allodapic Urgonian limestones belong to the chlorozoan type sediments (e.g. CARANNANTE & SIMONE 1987). These differences, however, should not be overestimated, since they can just simply reflect differences of the water depth of the primary depositional area in connection with a variance of siliciclastic influx. Due to the total absence of photophil dasycladalean green algae (up to approx. 20 m water depth), the dominance of echinoids and bryozoans and the abundance of lenticulinid foraminifera, an upper circalittoral source area (= upper slope) is assumed (e.g. MASSE 1992) (Fig. 1). In contrast hereto, the allodapic Urgonian limestones were deriving from outer platform or platform margin position (= external infralittoral).

Last but not least, it should be mentioned, that similar lithologies of sparitic resedimented limestones deriving from the basin margins with abundant crinoid fragments and Lenticulinids impregnated by glauconite are also known from the Early Liassic of the Northern Calcareous Alps (e.g. EHSES & LEINFELDER 1988; EBELI 1997).

Hence we have to face two possibilities for the origin of the allodapic limestones of Kaltenleutgeben, a shallow water facies south of the depositional realm of the Rossfeld Formation or an initial stage of the carbonatic Urgonian platform that could have formed by shallowing upwards as the Upper Jurassic Plassen Formation (SCHLAGINTWEIT et al. 2003). The final solution of this question should be possible to answer with the discovery of Early Barremian carbonatic resediment layers and their micropalaeontological and microfacies analysis.

Conclusions

The new results obtained clearly show that special attention should generally be paid to calcareous intercalations (allodapic limestones, breccias, mass-flows) within basin successions. In some cases, these can be, together with clast occurrences in conglomerates, the only relics of sedimentary successions that have totally eroded away during orogenesis (e.g. Urgonian platform). In other cases, these intercalations can provide useful informations on the platform basin transitions and stratigraphic correlations between both. The new results

show that both, basin and shallow water facies can be expected during the whole Cretaceous and especially in the Lower Cretaceous of the Northern Calcareous Alps. During siliclastic periods, however, the stratigraphic identification will become problematic and especially in carbonate resediments, stratigraphic significant shallow water microfossils can be expected. New aspects for the correlation between Lower Cretaceous ammonoids and microfossils are given and show the enhanced value of ammonoid marker-beds ('abundance zone') for the stratigraphy of geodynamical processes. The cephalopod fauna at the outcrop covers exclusively forms of the Mediterranean Province, which is typical for the Northern Calcareous Alps.

The Upper Hauterivian allodapic limestones of the Kaltenleutgeben are the first evidences for the existence of a shallow water facies in the time interval between the ending of the Plassen Formation (Early/Middle Berriasian) and the beginning of Urgonian type facies dated as Late Barremian.

With respect to formal lithostratigraphic definitions, calcareous turbiditic layers are not known from the Berriasian type-locality of the Schrambach Formation (RASSER et al. 2003). As a consequence of these observations, either the formal lithostratigraphic definition of the Schrambach Formation has to be enlarged or a new formation has to be defined.

Acknowledgements: Thanks are due to the Austrian Science Fund (FWF) for the financial support in the project FWF P16100-N06.

References

- ARIAS, C., MASSE, J.-P. & VILAS, L. (1995): Hauterivian shallow marine calcareous biogenic mounds: S.E. Spain. – *Palaeogeogr., Palaeoclim., Palaeoecol.*, **119**: 3-17.
- CARANNANTE, G. & SIMONE, L. (1987): „Temperate“ versus „Tropical“ Cretaceous carbonate platforms in Italy. – *Rend. Soc. Geol. It.*, **9** (1986): 153-156.
- EBLI, O. (1997): Sedimentation und Biofazies an passiven Kontinentalrändern: Lias und Dogger des Mittelabschnittes der Nördlichen Kalkalpen und des frühen Atlantik (DSDP site 547B, offshore Marokko). – *Münchener Geowiss. Abh.*, **32**: 1-255; München.
- EHSER, H.H. & LEINFELDER, R.R. (1988): Laterale und vertikale Faziesentwicklung der Rhaät/Unterlias-Sedimentation im Wallberg-Blankenstein-Gebiet (Tegernsee, Nördliche Kalkalpen). – *Mainzer geowiss. Mitt.*, **17**: 53-94; Mainz.
- GAWLICK, H.-J., SCHLAGINTWEIT, F. & MISSONI, S. (in press): Die Barmsteinkalke der Typlokalität nordwestlich Hallein (hohes Tithonium bis tieferes Berriasium; Salzburger Kalkalpen, Deutschland, Österreich) - Sedimentologie, Mikrofazies, Stratigraphie und Mikropaläontologie: neue Aspekte zur Entwicklungsgeschichte der Ober-Jura-Karbonatplattform und der tektonischen Interpretation der Hallstätter Zone von Hallein – Bad Dürrenberg. – *N. Jb. Geol. Paläont. Mh.*, Stuttgart.
- HAGN, H. (1982): Neue Beobachtungen in der Unterkreide der Nördlichen Kalkalpen (Thierseer Mulde SE Landl, Kalkalpine Randschuppe SW Bad Wiessee). – *Mitt. Bayer. Staatsslg. Paläont. Hist. Geol.*, **22**: 117-135; München.
- LUKENEDER, A. (2003): Ammonoid stratigraphy of Lower Cretaceous successions within the Vienna Woods (Kaltenleutgeben section, Lunz Nappe, Northern Calcareous Alps, Lower Austria). In: W.E. Piller (Ed.), *Stratigraphia Austriaca*. Österreichische Akademie der Wissenschaften, Schriftenreihe der Erdwissenschaftlichen Kommissionen, **16**, 165-191.
- LUKENEDER A., KRYSZYN L., RASSER M.W., MÄRZENDORFER G. (2003): A unique ammonite fauna from the Upper Jurassic Loser section (Northern Calcareous Alps, Salzkammergut). – In: W.E. Piller. (Ed.), *Stratigraphia Austriaca*, Schriftenreihe der Erdwissenschaftlichen Kommissionen der Österreichischen Akademie der Wissenschaften, **16**, 217-229.
- MISIK, M., SOTAK, J. & ZIEGLER, V. (1999): Serpulid worms *Mercierella* Fauvel, *Durandella* Dragastan and *Carpathiella* nov. gen. from the Jurassic, Cretaceous and Paleogene of the Western Carpathians. – *Geol. Carpath.*, **50/4**: 305-312, Bratislava.
- RASSER, M., VAŠÍČEK, Z., SKUPIEN, P., LOBITZER, H. & BOOROVA, D. (2003): Die Schrambach-Formation an ihrer Typlokalität (Unter-Kreide, Nördliche Kalkalpen, Salzburg): Lithostratigraphische Formalisierung und „historische“ Irrtümer. – In: W.E. PILLER (Ed.), *Stratigraphia Austriaca*, Österr. Akad. Wiss. Schriftenr. Erdwiss. Komm., **16**: 193-216, Wien.
- SCHLAGINTWEIT, F. (1991): Allochthone Urgonkalke im mittleren Abschnitt der Nördlichen Kalkalpen: Fazies, Paläontologie und Paläogeographie. – *Münchener Geowiss. Abh.*, **20**: 1-120, München.

STEIGER, T. (1981): Kalkturbidite im Oberjura der Nördlichen Kalkalpen (Barmstein Kalke, Salzburg, Österreich). - *Facies*, 4: 215-348, Erlangen.

VAŠÍČEK, Z. & FAUPL, P. (1998): Late Valanginian cephalopods in relation to the palaeogeographic position of the Rossfeld and Schrambach Formation of the Reichraming Nappe (Northern Calcareous Alps, Upper Austria). - *Zbl. Geol. Paläont., Teil 1* 11/12: 1421-1432, Stuttgart.

Early Cretaceous (Hauterivian)

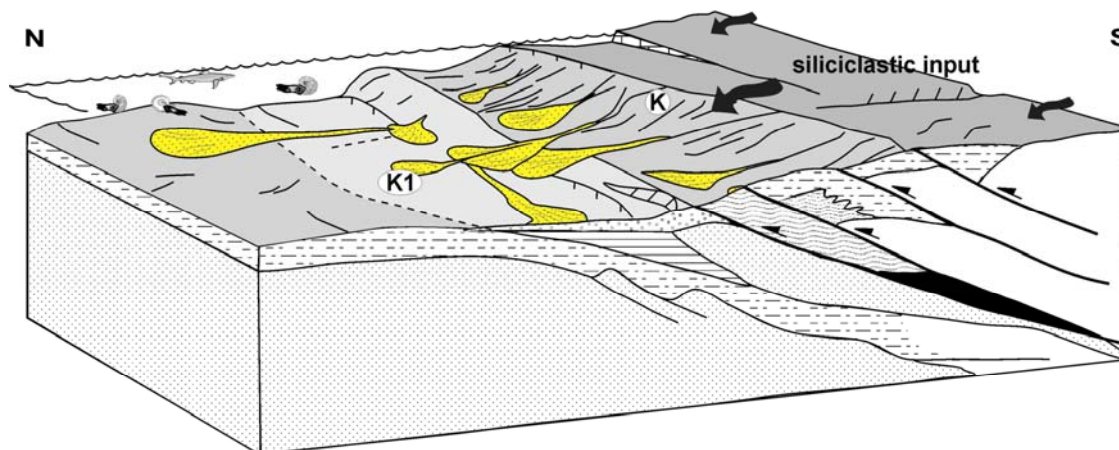


Fig. 1. Model for the palaeogeographic transect and sedimentary origin of the allodapic limestone layers at Kaltenleutgeben during the Hauterivian. K - primary deposition. K1 - final deposition after transport.