specific decision consequences, recorded by the confusion matrices of different λ values. Although our experiments are restricted to a specific geochemical data set, we believe that the application of such modern learning methods is a promising approach and deserves further attention.

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Drilling predation from the Early and Middle Miocene marine fossil record of the Central Paratethys

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Drilling predation is among the most studied biotic interactions in the fossil record, and its overall patterns are well established on Cenozoic molluscs from North America. Few studies have examined such predation in Europe. This study aims to evaluate molluscan drilling intensities from the Burdigalian, Langhian and Serravallian of the Central Paratethys. Using drill frequency (DF) and prey effectiveness (PE), a measure of prey's ability to survive predatory attacks, we examine taxonomic and environmental effects on drilling predation, evaluate local and regional spatial variation, and compare Central Paratethys values to other contemporaneous basins using >38500 whole shells from 162 Karpatian (Upper Burdigalian) and Badenian (Langhian and Lower Serravallian) bulk samples from Austria and Slovakia.

DF and PE were slightly higher in bivalves than gastropods, and DF could vary drastically within single environments at single localities (maximum at Immendorf: mean = 10.9 %, standard deviation = 12.9 %). Both DF and PE were more variable in the Karpatian than Badenian. Higher overall DFs, but lower PEs were seen in the Badenian than in the Karpatian. A similar pattern was observed between intertidal and sublittoral deposits.

We interpret the increase in predation from the Lower to Middle Miocene to reflect environmental shifts from restricted estuarine to deeper, normal marine conditions. Regional predation intensities from the Central Paratethys are distinctly lower than those of other Miocene seas, potentially due to lower predator abundance, differences in faunal composition, and/or fluctuating salinities typical of inland seas.

The Zottachkopf Formation: A new formation in the Lower Permian Rattendorf Group (Carnic Alps, Austria)

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Sedimentological study of the Lower Permian succession at Zweikofel, Trogkofel and Zottachkopf in the Carnic Alps showed that a well-bedded succession underlying the unbedded Trogkofel Limestone of Trogkofel and Zottachkopf differs significantly from the Zweikofel Formation at Zweikofel and Garnitzenbach (as defined by KRAINER 1995). The bedded succession was originally termed „Oberer Schwagerinenkalk" by KAHLER & KAHLER (1937); it is characterized by dark gray, thin- to medium-bedded limestone rich in small oncoids and, in its lower part, by siltite intercalations and reddish limestones rich in crinoid fragments. In addition, algal mounds are present, particularly along the southern flank of Trogkofel.

This bedded facies is not an equivalent of the Zweikofel Fm, but is younger and differs significantly in facies. We herein introduce the term Zottachkopf Formation (of the Rattendorf Group), as the section along the northern slope of Zottachkopf was originally regarded as the type section for the „Oberer Schwagerinenkalk" by KAHLER & KAHLER (1937).

The new type section of the Zottachkopf Fm is located in the basal part of the northern cliff of Trogkofel, and may be up to approximately 120 meters in thickness; there, the basal part of the Zottachkopf Fm starts with a bed of reddish to grey, karstified limestone, overlain by a package of well-bedded, red-coloured limestones and two intervals of calcareous siltstone are intercalated. Sedimentary structures, such as festooned cross-lamination, ripple drift cross-lamination, cross-bedding, parallel-laminated siltites with interspersed quartz grains up to 2 cm in size are common, and record deposition in shoreface environment. These intervals are overlain by wavy- to evenly-bedded packstones to rudstones rich in echinoderms, fusulinids and/or oncoids. Thick-bedded oncolithic pack- to wackestones represent the top of this package. The described package is separated by an E-W trending, south-dipping fault from grey well-bedded limestones of the remainder of the Zottachkopf Fm in the lower part of the northern Trogkofel cliff. The section on the northern side of Trogkofel attains 90 m in thickness, and is characterized by alternating thin- to thick-bedded limestones, locally showing cross-bedding. Five small, laterally arrayed mounds with thin-bedded intermound facies are intercalated. Oncolithic floatstones are overlain by bioclastic pack- to grainstones and oncolithic packstones. Our preliminary biostratigraphic data from fusulinids of the north-facing Trogkofel cliff indicate an Artinskian age for the Zottachkopf Fm. From reddish limestones exposed at Rudnigsattel east of the Trogkofel massif, FORKE (1995) and SCHÖNLAUB & FORKE (2007) described a conodont fauna of Late Sakmarian to Early Artinskian age; these limestones may correlate in age with the lower part of the Zottachkopf Fm in the northern cliff.

Reference sections are located on the southern side of Trogkofel and the northern slope of Zottachkopf. On its southern side, the base of the Trogkofel massif shows a succession about 40 m in thickness of thin- to thick-bedded limestones (oncolithic floatstone, fusulinid floatstone, bioclastic wackestone) with wavy bedding surface intercalated by algal mounds which consist of phylloid algal limestone and *Tubiphytes*-algal-boundstone. At Zottachkopf, the succession is 40 m in thickness and consists of dark grey, well-bedded limestones. Grainstones rich in echinoderm fragments and/or fusulinids alternate with well-bedded oncolithic limestone. At the southern side of Zottachkopf, algal mounds (mainly of *Neoanchicodium*) up to a few meters in thickness are present. Lithoclastic packstones at the top of the Zottachkopf Fm. mark the transition to the Trogkofel Limestone (*Tubiphytes* boundstones and bioclastic grainstones).
Compared to the Zweikofel Fm, the Zottachkopf Fm does not show clear-cut cyclicity, and is devoid of intervals of oolites. At all locations, the Zottachkopf Fm is sharply overlain by the Trogkofel Limestone; in the field, this vertical transition is obvious by disappearance of bedding from the well-bedded succession of the Zottachkopf Fm into the overall unbedded Trogkofel Limestone.

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Diagenetic evolution of the Lower Permian Trogkofel Limestone (Carnic Alps, Austria)

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The Trogkofel massif in the Carnic Alps represents a succession 400 m in thickness of limestones deposited along a platform margin (Trogkofel Limestone, Artinskian). The Trogkofel Limestone is overlain along a truncation surface of differentiated meso-scale relief by the Tarvis Breccia, a package of carbonate-lithic breccias with a matrix of former lime mudstone; at Trogkofel, the Tarvis Breccia is dolomitized, and probably accumulated from hillslope-colluvial processes.
The Trogkofel Limestone, in turn, consists of shallow-water bioclastic limestones, intercalated with intervals composed of: (a) phylloid algae, *Tubiphytes*, bryozoans and *Archaeolithoporella*, and (b) a three-dimensional network of stromatactoid cavities that are filled by botryoids and thick fringes of fibrous cements (calcitized aragonite, radiaxial calcite). Intrinsic framework pores are filled with microbialite (micropeloidal thrombolites), and/or with lime mudstone to bioclastic wackestone. Shallow-water bioclastic grainstones are cemented by isopachous fringes of fibrous calcite or by sparry calcite. Palaeokarst vugs, dykes and caverns are mainly filled by micaceous, red, geopetally-laminated, dolomitized lime mudstone to bio-lithoclastic wackestone. The geopetal lamination of the palaeokarstic infillings locally is convoluted to more-or-less homogenized. Locally, infillings with convolute lamination are overlain by successive infillings with undistorted geopetal lamination, indicative of distinct 'generations' of infill. Rarely, palaeokarstic cavities are entirely or partly filled with coarsely crystalline fibrous calcite spar.
In the Trogkofel Limestone, most of the karstic cavities filled by red dolomitized lime mudstone are surrounded by a halo of dolomitized Trogkofel Limestone. Up-section, dolomitization overall becomes more widespread, and the topmost part of the Trogkofel Limestone as well as the overlying Tarvis Breccia are completely dolomitized. Replacement dolomites show a wide range of shapes and fabrics, including: (a) fine-crystalline anhedral xenotopic fabric, (b) coarse-crystalline subhedral to euhedral, hypidiotopic to idiotopic fabric of turbid to optically zoned crystals and (c) saddle dolomite as replacement and filling of fractures. Various types of cement (isopachous, botryoidal, microbialite, calcite spar), karstic cavity fills (internal sediments, cements), and replacement dolomites of the Trogkofel section and of the Tarvis Breccia were analysed for their stable isotope composition (Vienna-PDB). $\delta^{18}O$ and $\delta^{13}C$ data allow to discriminate replacement dolomite and saddle dolomite. Saddle dolomite shows the most negative $\delta^{18}O$ values, suggesting formation at elevated temperatures. Carbon isotope values are invariably positive in all dolomite types; this indicates that the alkalinity of deep-burial pore waters was not influenced by organic diagenesis. Both, the replacement dolomites of the uppermost Trogkofel Limestone, and lithoclasts and matrix of the Tarvis Breccia, show slightly positive $\delta^{18}O$ values. The isotopic composition of the dolomitized red karstic infillings indicates a marine origin of the precursor lime mudstone.
Calcite cements show a wide range of $\delta^{18}O$ values (ca. -1 to -7 per mil), which overlaps the composition of unaltered brachiopod shells from Artinskian carbonates elsewhere reported by other authors. Within individual samples, from early diagenetic cements (calcitized aragonite) to late diagenetic calcite cements in remnant pores and fractures, oxygen isotope values become more negative; this trend most likely reflects increasing temperature with progressive burial. Calcite cements from dolomitized lime mudstone in karstic cavities display carbon isotopes values from -1 to -7 per mil; this is suggestive of an influence of soil bicarbonate on the composition of the pore water.