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THE *KARSTENICERAS* LEVEL: DYSOXIC AMMONOID BEDS WITHIN THE EARLY CRETACEOUS (BARREMIAN, NORTHERN CALCAREOUS ALPS, AUSTRIA)

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An Early Cretaceous mass-occurrence of ammonites in the Ternberg Nappe of the Northern Calcareous Alps (Upper Austria) is described for the first time. The mass-occurrence (section KB1-B = Klausrieglerbach 1, section B) dominated by *Karsteniceras ternbergense* Lukeneder is of Early Barremian age (*Moutoniceras moutonianum* Zone). The *Karsteniceras* mass-occurrence comprises eight different genera, each apparently represented by a single species, of which four are identified to species level. About 300 specimens of *K. ternbergense* between 5 and 37 mm in diameter were investigated. Two groups showing thick main ribs but different maximum size are distinguishable. The latter parameters are suggested to reflect sexual dimorphism within *K. ternbergense*, a condition that is most probably applicable to the whole leptoceratoid group. The geochemical results indicate that the *Karsteniceras* mass-occurrence within the described Lower Cretaceous succession was deposited under intermittent oxygen-depleted conditions associated with stable, salinity-stratified water masses. The rhythmicity of laminated black-marly limestone layers and light-grey bioturbated, organic-poor limestones suggests that the oxic and dysoxic conditions underwent highly dynamic changes. The deposition of the limestones in this interval occurred in an unstable environment and was controlled by short- and long-term fluctuations in oxygen levels. *Karsteniceras* inhabited areas of stagnant water with low dissolved oxygen; it showed peak abundance during times of oxygen depletion, which partially hindered other invertebrates from settling in such environments. The autochthonous *Karsteniceras* mass-occurrence can be assigned to the deposition-type of 'Konservat Lagerstätte', which is indicated by the preservation of phosphatic siphuncle structures and proved by the *in situ* preservation of aptychi within *Karsteniceras ternbergense*. Based on lithological and geochemical analysis combined with investigations of trace fossils, microfossils and macrofossils, an invasion of an opportunistic (r-strategist) *Karsteniceras* biocoenosis during unfavourable conditions over the sea bed during the Lower Barremian is proposed for the KB1-B section.

The proposed *Karsteniceras* Level currently has only local biostratigraphic value. Its potential status as a stratigraphic horizon or sub-zone depends on its potential for correlation and its extension toThe geochemical results indicate that the assemblage was deposited under conditions of intermittent oxygen-depletion associated with stable water masses. The rhythmicity of laminated black shale layers and light-grey bioturbated, organic-depleted limestones suggests that the oxic and dysoxic conditions episodically changed. A highly dynamic environment, controlled by short- and long-

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term fluctuations in oxygen levels, and poor circulation of bottom-water currents within an isolated, basin-like region led to the accumulation of the *Karsteniceras* Level. The lamination generally indicates a very quiet depositional environment, which was not disturbed by currents.

Within the Schrambach Formation, dysaerobic (not anaerobic) conditions prevailed, allowing endobenthic colonization of the incompletely bioturbated sediment by *Chondrites* (accompanied by *Planolites* in some beds). Increasing levels of dissolved oxygen in bottom waters over time are suggested by well bioturbated, pale grey limestone beds, whereas dysaerobic conditions are expressed through thin, black, laminated limestones ('black shales'). The *Karsteniceras* mass-occurrence is situated in the laminated horizons. The following features are observable: (1) high TOC, (2) high sulphur content, (3) concentrations of pyrite, (4) phosphatic siphuncle structures, (5) indistinct lamination, (6) almost monospecific trace fossil community (e.g. *Chondrites*), (7) fish remains, (8) extremely rare benthos (e.g. inoceramids, 'paper pectens'), (9) rare microfauna, (10) 'mass-mortality' of *Karsteniceras*, very abundant and small in size, (11) nearly 'monospecific' faunal spectrum and (12) *in situ* aptychi.

It is assumed that, based on the described features from KB1-B and literature data, *Karsteniceras* most probably had an opportunistic (r-strategist) mode of life and was adapted to dysaerobic sea-water. These ancyloceratids most likely inhabited regions reaching from the sea floor to at least a few tens of meters into the overlying water-column, based on the *in situ* aptychi and the nearly monospecific faunal assemblage of small heteromorphs. Most of the associated other ammonites (e.g. *Barremites* cf. *difficilis*) show different overgrowth stages (serpulids); these can be explained as a reflection of life in the upper, oxygenated water-column, with subsequent sinking to the sea floor or drifting after death. *Karsteniceras* probably inhabited areas of water stagnation with low dissolved oxygen, showing abundance peaks during times of oxygen depletion, which hindered other invertebrates from colonising such environments. The described autochthonous *Karsteniceras* mass-occurrence features fit well into the scheme of a 'Konservat Lagerstätte'.

The evidence for an oxygen-depleted formation of the *Karsteniceras* mass-occurrence needs to be supplemented by additional analysis of the micropalaeontological record (e.g. benthic foraminifera, nannofossils) and further investigations on the organic carbon material (e.g. type and producers). Further work has to be done on the influence of oxygen-depleted benthic environments on pelagic organisms, and to this end biomarker analyses are planned. Information on syngenetic or diagenetic formation of pyrite will be provided by TOS/S plots.

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