

## **AMMONOID EVOLUTION DURING THE CRITICAL INTERVALS BEFORE AND AFTER THE DEVONIAN-CARBONIFEROUS BOUNDARY AND THE MID-CARBONIFEROUS BOUNDARY**

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New calculation of the diversity development of ammonoids during the Carboniferous period have been made possible by using the data stored in the database GONIAT. available in the INTERNET ([www.uni-tuebingen.de](http://www.uni-tuebingen.de), KULLMANN et al. 1998); it is especially designed as a tool for investigations on the systematics of Palaeozoic ammonoids, their palaeogeographic distribution and their biostratigraphic range.

The quantitative and qualitative analysis concentrates on the epochs immediately before and after two fundamental crises in ammonoid evolution: the Devonian-Carboniferous boundary (DCB) and the Mid-Carboniferous boundary (MCB) between the Lower and the Upper Carboniferous subsystems. Both epochs represent critical intervals: several major groups became extinct some time before or at the respective boundary, and some groups were new after the boundary. Only few species crossed the DCB and the MCB.

The changeover at the DCB and MCB are in reality changes in the composition of the faunas. In both cases the morphologic differences concern the configuration of the suture-line and the shell characteristics of their early whorls; significant characters are also the ornamentation and conch shape and size. The general aspect of conch form and suture of the younger faunas (early Tournaisian after the DCB, lower Bashkirian after the MCB) indicates a less advanced degree of the internal characters than the advanced forms of the stratigraphically older faunas (late Famennian before the DCB, Arnsbergian before the MCB).

Both critical intervals had characteristics in common: the older faunas were usually diverse in conch shape and size showing the tendency toward involution of relatively large whorls; many species were strongly ornamented (Clymeniida, partially Tornoceratina before DCB, Girtyoceratidae before MCB). The younger faunas started with smooth and relatively small forms (Prionoceratidae after DCB, Homoceratinae after MCB). The early growth stages were characterised by a wide and low whorl section lacking strong involution of the whorls. The relatively wide conchs gave the young whorls a pachycone or even globular appearance, later growth stages were pachycone or subdiscoidal.

The similarities in ammonoid evolution during the critical intervals under consideration are (1) stepwise decrease in diversity before the boundary from a high diversity phase to a low diversity phase, (2) after the low point the origin of new groups with extremely wide, but small whorls and a low grade of involution, (3) onset of a high diversity phase with complicated conch forms and ornamentation.

The duration of the decrease phase can be estimated at about 3 m.y., but the low diversity phase seems to be very short. The increase phase was apparently shorter than the decrease phase (1 m.y.) with unfavourable life conditions and stressed biota resulting in a graded extinction; possible causes are: sea-level changes due to tectonic activity or glaciation, global cooling caused by decrease of atmospheric CO<sub>2</sub> due to limestone production after uplift and erosion. At present, a fully plausible explanation is not in sight.