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AUXILIARY STRATOTYPE SECTIONS FOR THE GLOBAL STRATOTYPE SECTION AND POINT (GSSP) FOR THE DEVONIAN-CARBONIFEROUS BOUNDARY : HASSELBACHTAL

by

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(1 figure)

INTRODUCTION

The GSSP at La Serre in the Montagne Noire, southern France, is far from being an ideal GSSP - that would be an ideal representation of time by rock (Paproth *et al.*, 1991). It seems, however, to be a GSSP that excludes misinterpretations and ambiguity. As the GSSP lacks some important stratigraphic guides, as cephalopodes (to a large extent), spores and ash layers for radiometric dating, the appropriate Working Group was induced to support the GSSP by the Auxiliary Stratotype Sections of Hasselbachtal and Nanbiancun. As has been demonstrated in the proposition of the GSSP to the International Stratigraphical Commission, these two meticulously described sections confirm and guarantee without any reasonable doubt the right position of the Devonian-Carboniferous boundary at the base of Bed 89 in La Serre (Becker *et al.*, 1984; Flajs & Feist, 1988; Yu, 1988).

HASSELBACHTAL

Following earlier work by Schmidt (1924) and Groos-Uffenorde & Uffenorde (1974), the section, its position and locality, has been described in detail by Becker *et al.* (1984). It is located at the northern border of the Rhenish Massif, north of the town Hohenlimburg, 150 km NE of Köln/Cologne (1:25000 sheet 4611 Hagen-Hohenlimburg). After the 1984 description, fossils and age determinations have been worked out by Higgs & Streel (1984), Becker (1985, 1988, 1993 in prep.), Bless & Uffenorde (1984), Brauckmann & Hahn (1984) and Claoué-Long *et al.* (1992). The most recent descriptions may be found in this volume (Kürschner *et al.*, 1993; Bless *et al.*, 1993; Higgs *et al.*, 1993; Winter, 1993).

Main advantages of the Hasselbachtal section are :

- the abundance of cephalopods, at least in certain intervals and close to the boundary;
- the presence of spores near the Devonian-Carboniferous boundary level;
- the presence of a thin bed of volcanic ash (metabentonite), bearing datable zircons near the boundary level;
- the presence of numerous other fossil groups such as trilobites, ostracodes, brachiopods, pelecypods, gastropods, rugose corals etc.;
- its position in an area where several fossil bearing sections of the Devonian-Carboniferous boundary beds have been studied since long in papers that belong to the "classic" publications of stratigraphical and palaeontological literature (H. Schmidt, 1924; O.H. Schindewolf, 1937; Vöhringer, 1960; Wedekind, 1913); this makes palaeogeographical reconstruction for the latest Devonian and earliest Carboniferous times quite sure and detailed.

Main disadvantages of the Hasselbachtal section are :

- the sparsity of conodont faunas, their absence in beds immediately below the boundary;

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lithostratigraphy	beds	index species	zonation			
	N-section		ammonoids	conodonts	trilobites	miospores
Hangenberg Limestone	958	*Siphonodella carinthiaca*	Gattendorfia crassa	late duplicata	Liobolina submonstrans	
	55	*Eocanites ?spiratissimus*	?	?		
	57	*"Acutimitoceras" intermedium*		early duplicata		
	67	*Pseudopolygnathus fusiformis*		?	?	
	69	*Liobolina cf. submonstrans*				
	72	*Siphonodella duplicata*	Gattendorfia subinvoluta			
	73	*Gattendorfia sp.*				
	78	*"Acutimitoceras" cf. antecedens* *Siphonodella praesulcata*		sulcata		
equivalents of Stockum Limestone	79	(Metabentonit, 353 ma)	"Acutimitoceras" prorsum	upper Protognathodus	Semi. (Waribole) drewerensis	
	81	*"Spiriferina" tarpata* *Polygnathus purus purus* *Semi. (Waribole) drewerensis*				
	83	*Belgibole abruptirhachis*			Belgibole abruptirhachis ?	
	84	*Siphonodella sulcata* *Protognathodus kuehni*				
Hangenberg Shale	85	*"Acutimitoceras" cf. prorsum* *(last) Retispora lepidophyta*		(?late praesulcata)		VI
		Verrucosporites nitidus	Cymaclymenia evoluta			LN
	S-section					
Wocklum Shale (= HBS)	115	*Cymaclymenia cf. evoluta*		middle praesulcata		?
Wocklum Limestone	114 (N-sect.)	*Wocklumeria sphaeroides* *(Wocklumeria plana)* *(Hymenozonotriletes explanatus)*	Wocklumeria sphaeroides			LE
			?			
			Parawocklumeria paradoxa			
	64	*Parawocklumeria paradoxa*				
	48	*Kalloclymenia pessoides*	Kalloclymenia subarmata/ Sphenoclymenia brevispina	early praesulcata	Chaunoproetus palensis	
	33–43	*Balvia n.sp.*				
	27	*?Kamptoclymenia n. sp.*				
	18	*Siphonodella praesulcata*				
	2	*Mimimitoceras geminum* *Kalloclymenia pessoides*		late expansa		
	0	*"Finiclymenia" pachydisca gp.*				

Fig. 1.- The succession of index species in the Hasselbachtal section and their dating with different chronologies. Note new records taken from Becker (1993, in prep.) such as *Balvia* n. sp. (Beds 33 and 43), *Cymaclymenia* (leg. D. Korn) in the Wocklum Shale (*sensu* Krebs, 1979 = Hangenberg Black Shale, HBS) and *Gattendorfia* (in Bed 73).

- the erosive (turbiditic?) nature of the oldest bed that contains *Siphonodella sulcata* (upper part of Bed 84 - here taken as the base of the Carboniferous).

The Hasselbachtal section provides firm evidence that the chosen boundary level postdates briefly the LN/VI boundary of the miospore zonation (in the upper part of Bed 85) and that it is placed **within** the *"Acutimitoceras" prorsum* Zone but below the Stockum Limestone level with the upper *Protognathodus* fauna (present in Beds 83 to 81 at Hasselbachtal).

The cyclicity of events near the Devonian-Carboniferous boundary is well reflected in the Hasselbachtal successions (Bless *et al.*, 1993). Its correlation with neighbouring profiles is exact, particularly in regard of the palaeozoic age of the rocks. This precision is certainly due to the "right" sedimentation rate : it was low enough to avoid undue "dilution" of guide fossils and volcanic ashes by erosional detritus; and it was high enough to prevent too many and too long depositional gaps. This again may be explained by the peculiar palaeogeographic situation of the area that now forms the northern belt of the Rhenish Massif (Bless *et al.*, 1993; Paproth, 1991). The present belt of outcrops ran near the shore line of a shallow sea in the north, covering parts of the Devonian Old Red Continent where mainly early Devonian erosion had left a morphologically balanced plain.

The shallow sea bordered a shallow, but rising island formed by the Rhenish Massif in statu ascendi. There was the NNE/SSW directed soft ridge of the Remscheid High (Paproth, 1991) from where two rivers may have originated, the "Seiler river" and the "Stockum river". Both rivers flowed into the shallow sea to the north and deposited their sedimentary load in detritus fans which spread in spaces between submarine shoals (formed by dead Givetian-Frasnian reef complexes). The Seiler river left the erosive Seiler conglomerat and the Hangenberg Sandstone while the Stockum fan spread just a little parallel to the shore line.

The present Velbert area, bordering the mid Netherland-Krefeld High to the SE, was characterised by a very low sedimentation rate in the early Carboniferous which followed a particularly high sedimentation rate in the Famennian. The northern border of the Velbert area to the shallow open sea was marked by an oolite wall, in the times of the Devonian-Carboniferous boundary. South of the wall, a shallow area with extraordinary and peculiar marine sedimentation conditions left rich and unusual faunas and floras (Thomas, 1992).

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