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A Middle Carboniferous Conodont Fauna from Blomstrandhalvøya (NW-Spitsbergen): Implications on the Age of Post-Devonian Karstification and the Svalbardian Deformation

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Summary: On Blomstrandhalvøya (NW-Spitsbergen) pre-Devonian basement marbles are unconformably overlain by north-south trending stripes of Old Red clastics. Both were affected by a ± west-directed imbricate faulting. On top of the basement several karst holes and cavities are filled with clastic sediments. Those from one karst fill yielded a Middle Carboniferous conodont fauna. This allows some conclusions with respect to the timing of tectonic events (Tertiary or Upper Devonian „Svalbardian" deformation) and the phases of karstification on Spitsbergen.

Zusammenfassung: Auf der Blomstrandhalvøya in NW-Spitzbergen werden Marmore des prä-devonischen Grundgebirges von nord-süd-streichenden Old Red Klastit-Vorkommen diskordant überlagert. Marmore und Klastite sind von einem ± west-gerichteten Schuppenbau erfaßt worden. Eine Verkarstung der Grundgebirgs-Marmore ist durch verschiedene Schlotten- und Höhlenbildungen dokumentiert, die mit Klastiten gefullt sind. Die Sedimente einer Füllung erbrachten eine mittelkarbone Conodontenfauna. Sie erlaubt Rückschlüsse auf die zeitliche Einstufung der tektonischen Ereignisse (tertiäre oder oberdevonische „svalbardische" Deformation) und der Verkarstungs-Phasen in Spitzbergen.

INTRODUCTION

During the joint Spitsbergen-Expedition of members of the Universities of Münster and Erlangen in 1988 the West Spitsbergen Fold-and-Thrust Belt was studied in the area of Brøggerhalvøya (Fig. 1). Our investigations were focused on deformations of this belt and on microfacies and conodont-biostratigraphy of the Permocarboniferous carbonates. On Blomstrandhalvøya (Fig. 2) a karst pocket or gully in Hecla Hoek marbles, filled with carbonate sand and gravel, yielded a Middle Carboniferous conodont fauna. The finding of this fauna allows some conclusions about the age of the post-Caledonian deformation, the minimum-age of the karstification of the Hecla Hook basement and the onset of transgression of the Permocarboniferous sediments in Blomstrandhalvøya and surrounding areas.

GEOLOGICAL SETTING

The basement (Hecla Hoek) of Svalbard was consolidated during the Caledonian Orogeny and subsequently lifted and stretched. In NW-Spitsbergen (Fig. 1) this extension resulted in the formation of the Raudfjorden-Graben which was filled with coarse-grained sediments of the Red Bay Group (Fig. 3) whilst erosion of basement rocks proceeded at least on the western graben shoulder. After the syntectonic deposition of the Lower Devonian Red Bay Group, which is restricted to narrow north-south striking grabens, extension decreased. In the subsiding Central Devonian Basin of NW-Spitsbergen sediments of the Lower to Middle Devonian Wood Bay, Grey Hoek, and Wijde Bay Groups were deposited (Murascov & Mokin 1979, Piepjohn & Thiedig 1992). Fine-grained redbeds of the Wood Bay Group onlap over the western shoulder of the pre-existing Red Bay graben 15 to 20 km southeast of Blomstrandhalvøya resting immediately on Hecla Hoek micaschists at Colletthøgda and Pretender (Orvin 1940, Friend 1961, Friend & Moody-Stuart 1972, Tessensohn et al. submitted). The Lower Carboniferous Orustdalen Fm. (early rift phase), the Middle Carboniferous Brøggertinden Fm. (main rift phase) and the Lower Nordenskiöldbreen Fm. were deposited only on Brøggerhalvøya southwest of Blornstrandhalvøya (Figs. 3 and 8; Cutbill & Challinor 1965). The platform carbonates and evaporites of the Upper Nordenskiöldbreen Fm. (Tyrrellfjellet Member) cover the carbonates west of Kongsfjorden and both the basement and Devonian Wood Bay Group redbeds in the Pretender/Colletthøgda area east of Kongsfjorden.

The Devonian deposits were partly deformed during the Upper Devonian Svalbardian compressional event (Vogt 1929). Early Carboniferous fault activity (early rift phase) led to the accumulation of coal-bearing sequences in relatively wide basins in a humid fluvial flood basin setting (Johannessen & Steel 1990, 1992). In the course of the following increasing extension (main rift phase) the so-called Central Devonian Graben of NWSpitsbergen was tectonically formed. Coarse-grained fan- and sabkha-deposits interfinger with marine sandstones and carbonates in the subsiding areas (Cutbill & Challinor 1965; Billefjorden Trough: Johannessen & Steel 1990, 1992; Brøggerhalvøya: Ludwig 1988, 1989, 1991) whilst erosion continued in the elevated areas (e.g. „Nordfjorden Block"). During the late- to post-rift phase downwarping was more gentle and platform carbonates (Nordenskiöldbreen Fm.) spread over extended areas.

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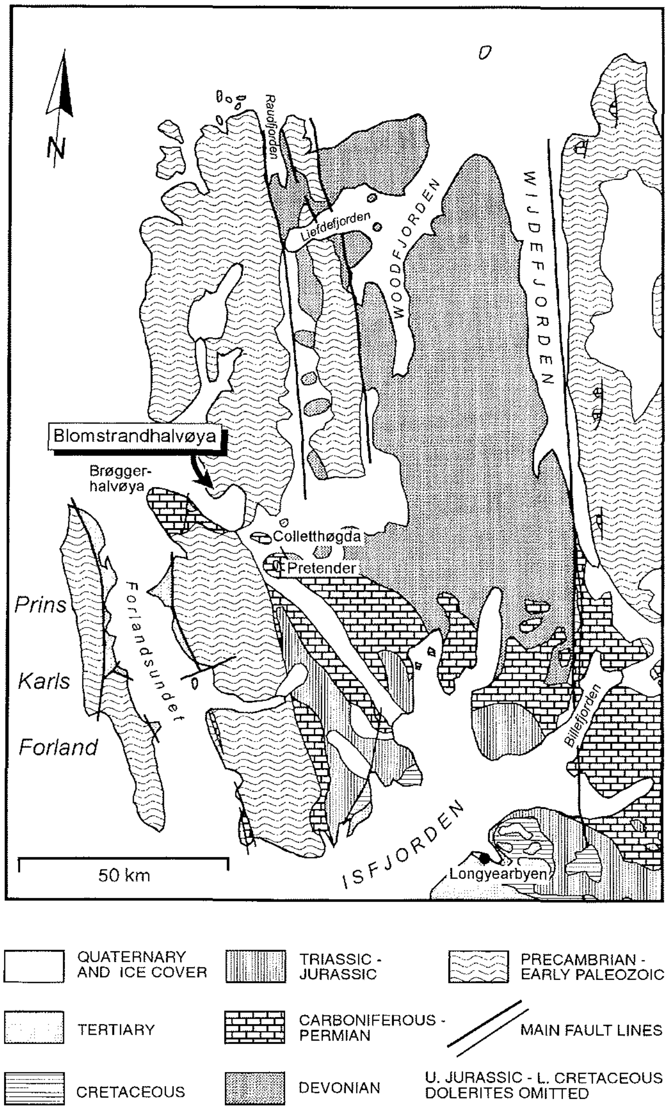


Fig. 1: Simplified geological sketch map of NW-Spitsbergen, compiled and adapted after WINSNES (1988).

Abb. 1: Vereinfachte geologische Kartenskizze von NW-Spitzbergen, nach WINSNES (1988).

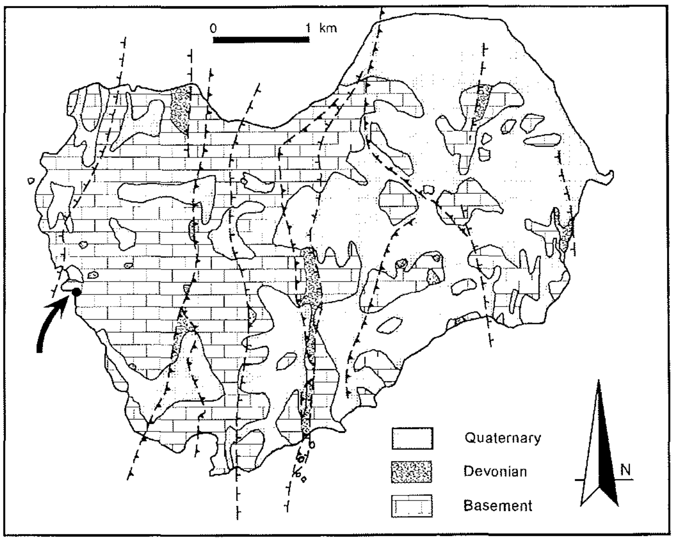


Fig. 2: Simplified geological map of Blomstrandhalvøya (after KEMPE 1989, NIEHOFF 1989, THIEDIG & MANBY 1992). Blomstrandhalvøya was connected up to 1990 with the mainland by the Blomstrandbreen. The peninsula became an island because of the yielding glacier, but the geographical name is still existing. Arrow indicates the position of the paleo-karst pocket and conodont sample.

Abb. 2: Vereinfachte geologische Karte der Blomstrandhalvøya (nach KEMPE 1989, NIEHOFF 1989, THIEDIG & MANBY 1992). Die Blomstrandhalbinsel war bis 1990 durch den Blomstrandbreen mit dem Festland verbunden. Die Halbinsel wurde durch das Zurückweichen des Gletschers zur Insel; der geographische Name besteht vorläufig weiter. Der Pfeil markiert die Position der palao-Karsttaschen und der Conodontenprobe.

		Brøggerhalvøya	East of Kongsfjorden
Lower Triassic	Sassendalen Group	Vardebukta Fm	
Upper Permian	Tempelfjorden Group	Kapp Starostin Fm	
Middle Carboniferous to Lower Permian	Gipsdalen Group	Gipshuken Fm	Gipshuken Fm
		Nordenskiöldbreen Formation: Tyrrellfjellet Mb, Scheteligfjellet Mb, Mørebreen Mb	Tyrrellfjellet Mb
		Brøggertinden Fm	
Lower Carboniferous	Billefjorden Group	Orustdalen Fm	
Middle Devonian	Wijde Bay Group Grey Hoek Bay Group		
Lower Devonian	Wood Bay Group	[Blomstrandhalvøya : Red Bay Group]	Keltiefjellet Fm
? Upper Silurian to Lower Devonian	Red Bay Group Siktefjellet Group		? Wulffberget Fm ? Lilljeborgfjellet Fm
Precambrian to Ordovician	Hecla Hoek	Basement	Basement

Fig. 3: Simplified stratigraphic chart of the area around Kongsfjorden, NW-Spitsbergen (after CUTBILL & CHALLINOR 1965, ORVIN 1940).

Abb. 3: Vereinfachte Tabelle der stratigraphischen Gliederungen in der Region um den Kongsfjord, NW-Spitzbergen (nach CUTBILL & CHALLINOR 1965, ORVIN 1940).

Blomstrandhalvøya

Blomstrandhalvøya is situated 5 km to the North of Brøggerhalvøya at the northeastern coast of Kongsfjorden (Figs. 1 and 2). It mainly consists of marbles of the Generalfjella Fm. (HJELLE 1979) which are part of the pre-Devonian (Caledonian) basement complex. This peninsula is characterized by narrow deposits of redbeds which, according to GJELSVIK (1974), belong to the Lower Devonian Red Bay Group. The basement marbles are cracked and fissured some tens of metres below the conglomerates and sandstones of the Red Bay Group and record an increase in brecciation toward the contact (KEMPE 1989, NIEHOFF 1989, THIEDIG & MANBY 1992) as a result of surface disintegration in pre-Devonian times.

The Conodont Locality

KEMPE (1989) and NIEHOFF (1989) described sandstones and conglomerates in karst-like caves from Blomstrandhalvøya. Most of the caves are small and mainly less than one metre high and some metres long. These cavities were finally filled with clastic sediments and preserved in this way. One of the few bigger caves is situated about 100 m east of the small light-house of Blomstrandhalvøya. Within a cliff of basement marbles the outcrop at the shore is about six metres high and eight metres wide (Fig. 4). On top of the coastal cliff it can be traced for about 20 m. The paleo-environmental situation reminds of a gully on a rocky coast or must have been a bigger cave close to the sea.

The filling consists of medium- to fine-grained, reddish to pink sandstones with intercalations of coarse conglomerates. The latter contain 0.5 cm large clasts of marble and quartzite and some large marble boulders (NIEHOFF 1989). The carbonate matrix of this pocket filling yielded a Middle Carboniferous conodont fauna.

The modal composition and microfacies are shown in Figure 5. In thin section the most common components of the clast-supported conglomerates are cm-sized marbles which derived from the Hecla Hoek basement; mm- to cm-large polycristalline quartz clasts represent the secondary component; feldspar, pyrite, hematite, and heavy minerals (tourmaline) occur accessorily. Some carbonate clasts exhibit micritic envelopes (coated grains). The well-rounded marble clasts are almost unaffected by pressure solution. On the contrast, some of the angular to rounded quartz clasts are intensely corroded by carbonates.

Deformational fabrics are restricted to the marble and quartzite clasts and were not found in the matrix. The latter consists of sparry calcite. Besides micritic envelopes, early cements are not preserved. Diffuse dark relics of micrite indicate that the matrix partly derived from recrystallization. According to conventional classifications, the conodont-bearing conglomerates are extraclastic rudstones. Algae or other fossils of a high energy environment could not be detected. In this respect, the occurrence of conodonts in our sample was very surprising.

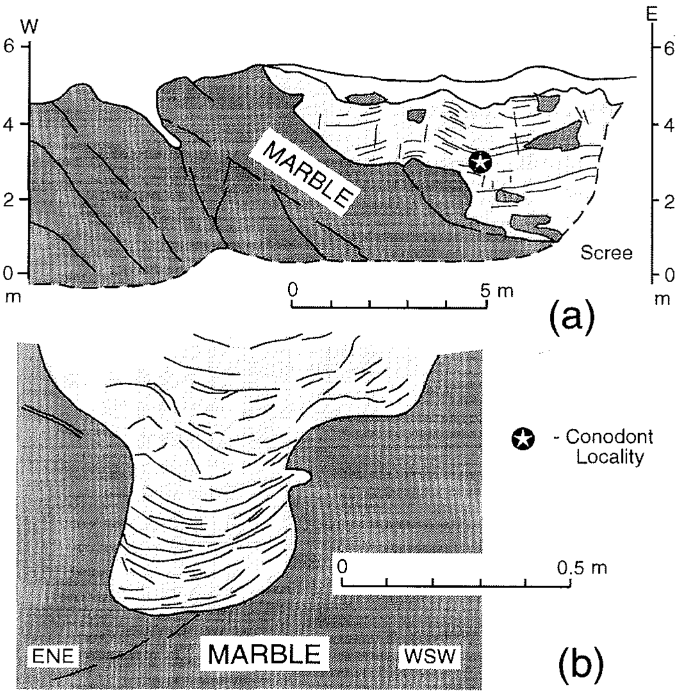


Fig. 4: Karst features on top of the basement marbles at the southwestern coast of Blomstrandhalvøya (for location see Fig. 2). (a) = gully sediments (sandstones, conglomerates) with marble boulders. (b) = karst pocket filled with sandstones on the cliff in front of (a); distance approx. 8 m.

Abb. 4: Karstphänomene am Top der Basement-Marmore an der Südwestküste der Blomstrandhalvøya (Position siehe Fig. 2). (a) = Rinnensedimente (Sandsteine, Konglomerate) mit Marmorblöcken. (b) = Mit Sandsteinen gefüllte Karsttasche im Kliff gegenüber der Rinne in Skizze (a), Entfernung ca. 8 m.

The possibility of resedimentation of the conodonts can be excluded because the uppermost Carboniferous covers already the whole area with marine fossiliferous limestones. The clasts in the carst pockets only consist of basement material, and there is no evidence of reworked sediments in the carstfilling.

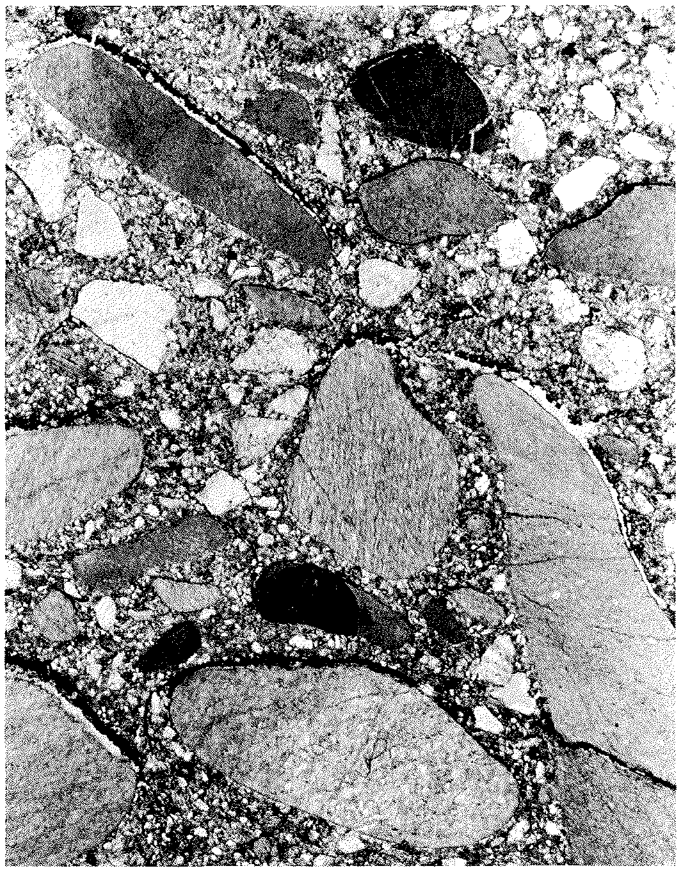


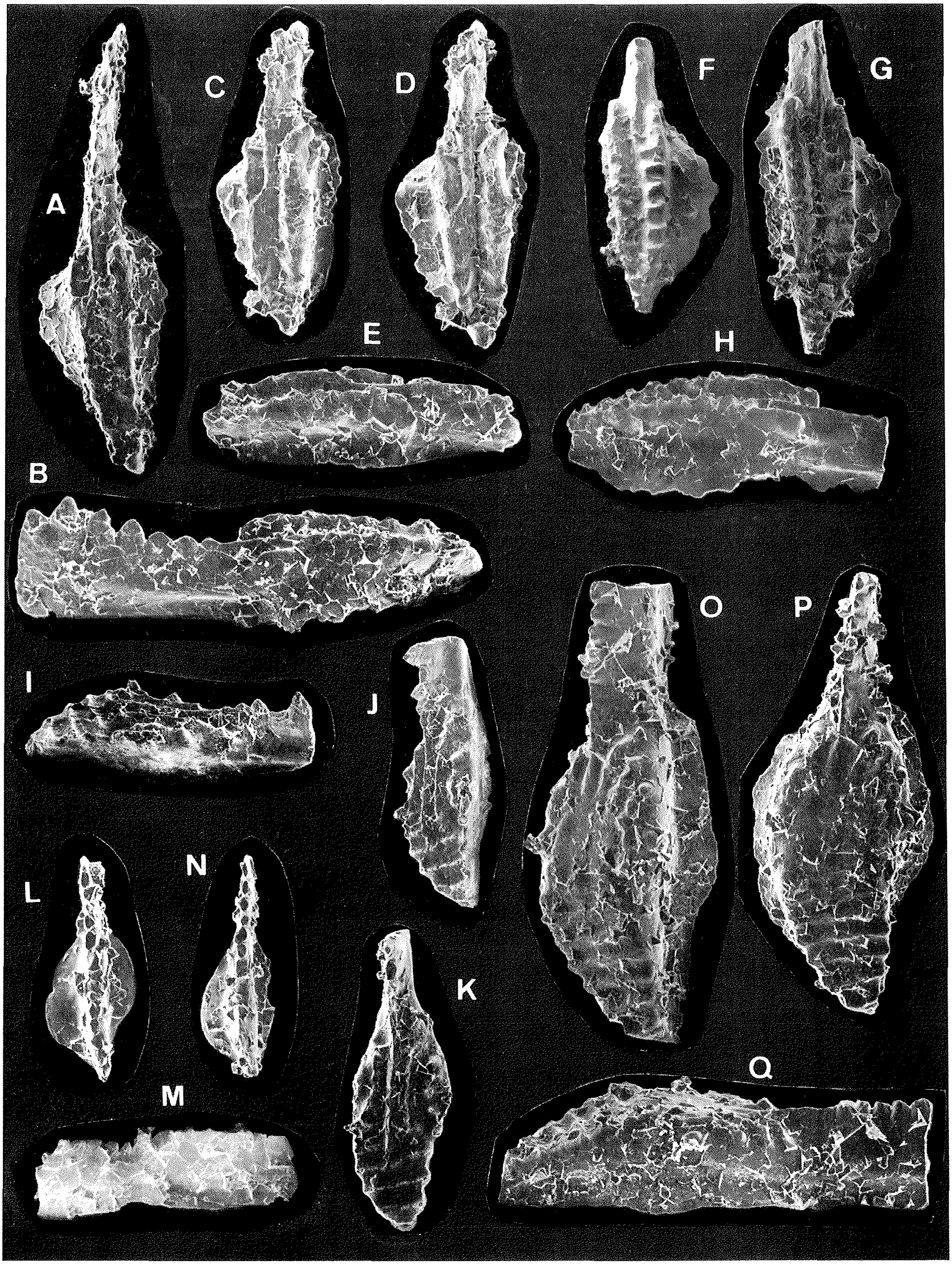
Fig. 5: Photomicrograph (x 3) of karst sediment depicting angular to rounded clasts of (polycristalline) quartz and marble.

Abb. 5: Dünnschliffaufnahme des Karstsedimentes mit eckigen bis gut gerundeten Klasten von (polykristallinem) Quarz und Marmor (Vergrößerung 3-fach).

THE CONODONT FAUNA

One sample (Sp 88-36) contained 11 conodont elements out of which three form-genera could be determined. The assignation to published species is difficult due to the poor preservation of the elements. Therefore, a detailed paleontological description makes no sense. Instead of synonyms, a list of references will be given which were consulted for determination.

Declinognathodus sp. (Fig. 6 A-H)
According to the original description of DUNN (1966) *Declinognathodus is* a genus with lanceolate platform and gnathoidid cup. The laterally compressed blade joins the platform in medial or near medial position. The medial carina is declined to one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side and merges with and continues posteriorly as one of the platform parapets. Two species are assigned to the genus (ZIEGLER 1975): *D. nuduliferous* (ELLISON & GRAVES 1941) and *D. lateralis* (HIGGINS & BOUCKAERT 1968). *Rachistognathodus* has a similar platform and cup but differs in the position of the blade which joins the platform in a lateral position.

In our sample there are five specimens which are in accordance with the description of the genus *Declinognathodus*.

BENDER (1980: 11-12) described five species of „*Idiognathoides*" from Ellesmere Island: „*I. lateralis* is characterized by a short carina terminating against a row of transverse ridges on the outer platform surface whereas in *I. noduliferous* the blade, without continuing into a carina, curves laterally to meet the outer platform margin in a subcentral positionn. According to this description, we assign Figure 6 F-H to *Declinognathodus lateralis* (HIGGINS & BOUCKAERT 1968) and Figure 6 A-E to *Declinognathodus cf. noduliferous* (ELLISON & GRAVES 1941).

Diplognathodus sp. (Fig. 6 L-N)
Two elements of this genus were found which can tentatively be assigned to *D. coloradoensis* (MURRAY & CHRONIC 1965) s.l. or *D.? ellesmerensis* BENDER 1980. *"Diplognathodus* is rare in the Carboniferous... The genus is apparently common only in rocks that were deposited under shallow-water, usually nearshore, relatively high-energy marine conditions" (VON BITTER & MERRILL 1990). According to the original description of KOZUR & MERRILL (in KOZUR 1975) *Diplognathodus* consists of small conodonts in which the platform element has a blade-carina that is sharply differentiated into anterior and posterior regions. After VON BITTER & MERRILL (1990), the genus *Diplognathodus s.s. is* restricted to species with spatulate posterior blades. Species with completely denticulate posterior blades are included in a new genus *Diplognathodus?*. On the other hand, *D. coloradoensis* and *D.? ellesmerensis* may be morphological end members of a single species (for details see VON BITTER & MERRILL 1990).

Our specimens are characterized as follows: The overall size of the elements is 410-430 µm with a length to height ratio of about 3:1. The straight to slightly curved blade is depressed in the center. The anterior and posterior margins of the element are almost vertical. The anterior half of the blade possesses six to eight large erect and laterally compressed denticles with free but mostly broken tips. The posterior half of the blade consists of seven to nine smaller denticles with increased inclination towards the posterior end. Whereas the first and smallest denticles of the posterior blade are isolated, the following denticles may be isolated or fused. The aboral cup, subelliptical but asymmetric in outline, occupies more than half to almost two thirds of the total length.

Discussion: Our specimens correspond in general to the original description of *D. coloradoensis* given by MURRAY & CHRONIC (1965: *Spathognathodus coloradoensis* n. sp.), MERRILL 1973 *(Spathognathodus coloradoensis),* SWEET (in ZIEGLER 1977), LANDING & WARDLAW (1981) or *Diplognathodus ellesmerensis* BENDER1980 (see also VON DER BOOGARD 1983). They differ from the original description in the increased number of anterior denticles, the slight flexure of the blade (Fig. 6 L), and the asymmetry in the outline of the aboral cup. MERRILL's *S. coloradoensis* exhibits also a varying amount of denticles and a slightly bowed unit (1973: Pl. 3, figs. 20-41). LANDING & WARDLAW (1981) stress that the platform element of *D. c.* is highly variable in his collections. *D.? ellesmerensis is* the denticulate end member of *P. coloradoensis.* Despite taxonomic problems, the poor preservation of our specimens does not allow a reasonable discrimination. A similar but broader outline of the aboral cup than observed in our specimens is mentioned in the description of *D. ellipticus* (PERLMUTTER 1975) which bears also less anterior denticles.

Idiognathodus delicatus GUNNELL 1931, s.l. (including *Idiognathodus humerus* DUNN 1966 and *Idiognathodus magnificus* STAUFFER & PLUMMER 1932) [Fig. 6 I-K and O-Q]

Our three robust P elements of *Idiognathodus* are characterized by an almost flat oral surface marked by nearly parallel transverse ridges on the posterior platform. The (broken) free blade extends as a carina only a short distance (Fig. 6 O-Q) or more than midway (Fig. 6 I-K) onto the anterior platform. Nodes on the anterior platform form one to three arched rows which are subparallel to the carina.

Discussion:*I. delicatus* GUNNELL 1931 varies widely (VON BITTER 1972, HIGGINS 1975, ZIEGLER 1975, LANDING & WARDLAW 1981, MANGER et al. 1985, WEYANT & MASSA 1985, ZHIHAO & HIGGINS 1989). Our specimens are in the range of this variation. WEBSTER (1969, after VON BITTER 1972) considered *I. magnificus* to be a gerontic species of *I. delicatus.* Nevertheless, adult forms of both species show distinct differences (VON BITTER 1972). ELLISON (1972) regards also *I. humerus* as synonym of *I. delicatus.* The stratigraphic range of *I. humerus is* Morrow, the range of *I. delicatus* and *magnificus* Late Morrow to Virgil.

Stratigraphic Range of the Conodont Fauna

A simplified stratigraphic correlation of European, North American and Russian subdivisions of Late Carboniferous and the range of conodont genera and species, which are compared with our specimens, is given in Figure 7. The genus *Declinognathodus is* known only from Morrow to early Atokan (DUNN 1970). According to BENDER (1980) the stratigraphic range of *D. lateralis* may continue into the early Atocan. *Rachistognathus mi-*

Fig. 6: Conodonts of Blomstrandhalvøya: A - E = *Declinognathodus cf. noduliferous* (x 75), F - H = *Declinognathodus lateralis* (approx. x 75), I - K and O - Q = *Idiognathodus delicatus* (x 75), L - N = *Diplognathodus coloradoensis vel. ellesmerensis* (x 100).

Abb. 6: Condonten der Blomstrandhalvøya. A - E = *Declinognathodus cf. noduliferous* (x 75), F - H = *Declinognathodus lateralis* (ca. x 75), I - K und O - Q = *Idiognathodus delicatus* (x 75), L - N = *Diplognathodus coloradoensis vel. ellesmerensis* (x 100).

nutus declinatus BAESEMANN & LANE 1985 has about the same age except an unusual occurrence in early Desmoines (BAESEMANN & LANE 1985). Therefore our specimens described as *Declinognathodus sp.* emphasizing a Morrow to early Atokan (Desmoines?) age. *Diplognathodus coloradoensis* and *D. ? ellesmerensis* occur during the same time. *Idiognathodus delicatus* and *I. magnificus* are known from late Morrow to Virgil times. If we include *I. humerus* in the same species „*I. delicatus* s.l", the range is extended to the early Morrow. The affinity of our specimens (Fig. 6 I-K and O-Q) to *I. humerus* may stress that they are early morphotypes of „*Idiognathodus delicatus* s.l.".

Hence, independent on exact taxonomic assignations the conodont fauna from Blomstrandhalvøya is clearly of Morrow to Atokan = late Namurian to early Westphalian = Bashkir to early Moscov - e.g. Middle Carboniferous - age (Fig. 7). Our fauna is almost identical with conodonts described from Ellesmere Island (BENDER1980).

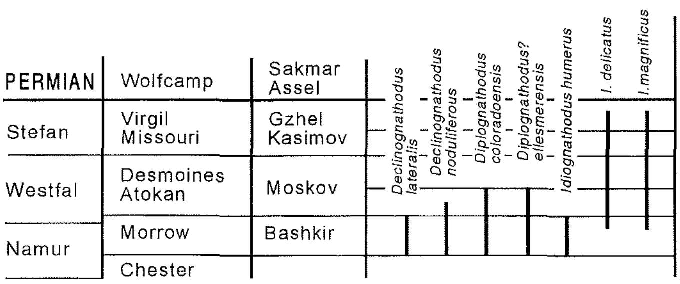

Fig. 7: Simplified stratigraphic correlation chart and range of conodonts (from various sources see text).

Abb. 7: Vereinfachte stratigraphische Korrelationstabelle mit Reichweiten der Conodonten (nach verschiedenen Quellen, siehe Text).

IMPLICATIONS OF THE NEW FINDINGS

Svalbardian Deformation (Upper Devonian)

Along north-south trending and east-dipping imbricate faults the Old Red sediments of Blomstrandhalvøya are imbricated together with the basement marbles (KEMPE 1989, NIEHOFF 1989). The sediments often record west-vergent folds and represent thin tectonic slices within the basement (Figs. 2 and 8). At their footwalls and hanging walls they are displaced against the Hecla Hoek marbles along west-directed thrust faults (THIEDIG & MANBY 1992).

Contrary to the deformed and cleaved Devonian sediments of the imbricates, the fillings of the different pockets and caves are either bent around ± northeast-southwest axes (NIEHOFF 1989) or do not record deformation phenomena (Fig. 5). Some deformed fillings also record small-scale shear planes and thrust faults (see NIEHOFF 1989). Hence, it can be assumed that the internal sediments of a few karst pockets were also deformed. Nevertheless, deformation neither led to intense pressure solution nor to destruction of conodonts. On the other hand, increased temperatures (up to at least 150° C) or the influence of a high fluid flow during diagenesis are shown by the higher conodont alteration (CAI 3 to 4) according to the index of EPSTEIN et al. (1977). In addition, the conodonts record apatite overgrowths (Fig. 6). This contrasts to the normal preservation of Permocarboniferous conodonts from the Billefjorden Trough which record CAIs of about 2.

To our impression, however, the compressional effects cannot be compared with the intense ± west-east shortening of the „Svalbardian" event, leading to the formation of the imbricates, although it cannot be excluded that the more intense compression during imbrication affected only distinct parts of the basement marbles near the thrust faults.

The imbricates on Blomstrandhalvøya are clearly post-Caledonian in age. Up to now it was unclear whether they were created during the Late Devonian „Svalbardian Phase" of deformation (VOGT 1929). As no younger post-Devonian sediments existed on Blomstrandhalvøya it was also impossible to relate the timing of deformation to the (?) Late Cretaceous to Early Tertiary crustal shortening being responsible for the formation of the West Spitsbergen Fold-and-Thrust Belt.

Due to their age the karst sediments suggest that the ± east-west shortening on Blomstrandhalvøya occurred in the Early Devonian to Middle Carboniferous interval. Aside of the west-directed thrust tectonics on Blomstrandhalvøya, which contrasts to the northeast-directed tectonic transports on Brøggerhalvøya to the southwest, this gives an additional indication that the deformation took place during the „Svalbardian" event.

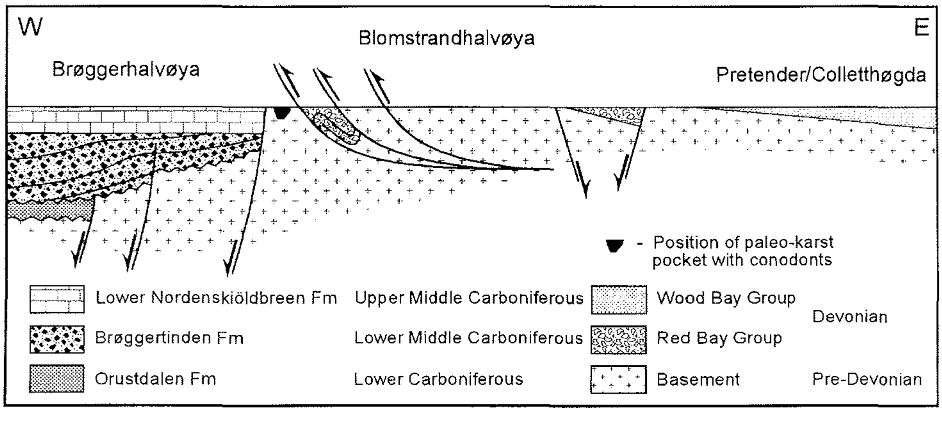

Fig. 8: Schematical east-west cross-section depicting the geologic and tectonic situation in the Kongsfjorden area during Middle Carboniferous times and the position of the paleo-karst pocket with conodonts.

Abb. 8: Geologische und tektonische Situation während des Mittelkarbons in einem schematischen West-Ost-Profil und Position der Paläo-Karsttasche mit Conodonten.

The slight post-Middle Carboniferous deformation of the pokket filling and the conodont alteration could be the expression of the (?) Late Cretaceous to Early Tertiary tectonics on Brøggerhalvøya. This is supported by a few ± north-directed imbricate faults on Blomstrandhalvøya which do not fit with the geometries of the ± west-directed (? „Svalbardian") imbricates affecting the basement marbles plus Devonian clastics.

Furthermore, the age of the cave filling shows that up to Middle Carboniferous times parts of the Blomstrandhalvøya were not covered by post-Caledonian sediments or have been eroded prior to mid-Carboniferous sedimentation. Again this contrasts to parts of the Brøggerhalvøya in the southwest where Early Carboniferous Orustdalen Fm. clastics overlay the basement (Figs. 3 and 8). There, the Middle Carboniferous Brøggertinden Fm. covers the basement and Orustdalen Fm. with different thickness.

Considering the northeast-directed thrust tectonics on Brøggerhalvøya, which took place during the formation of the West Spitsbergen Fold-and-Thrust Belt and led to an intense crustal shortening (MANBY 1988), we can infer an initial position of the Orustdalen and parts of the Brøggertinden clastics far to the southwest. In our schematic section, depicting the Middle Carboniferous situation (Fig. 8), we interpret the deposition of different post-Caledonian strata above different basement units as having been controlled by post-Caledonian to Middle Carboniferous normal faults with a downthrow of the western block.

Age of Karst on Svalbard

The age of karstification of the Hecla Hoek marbles on Blomstrandhaløvya was unclear up to now. At least three main phases are known as follows: The oldest karst is recorded from Sørkapp Land where deformed Ordovician to Silurian limestones of the Sørkapp Land Group are sealed by sediments of the Lower Devonian Marietoppen Fm. (BIRKENMAJER 1964) which can be correlated with the Wood Bay Group of NW Svalbard (DALLMANN et al. 1993). The „Gedinnian" (MURASCOV & MOKIN 1979) Red Bay Group of NW-Spitsbergen is missing on Sørkapp Land. This pre-Siegenian (pre-Pragian) karstification coincides with the erosion after the Red Bay rift and before the sedimentation of the post-rift Wood Bay Group deposits which cover grabens and eroded graben shoulders.

A second phase of karstification is of pre-Middle Carboniferous age. 20 m deep karst caves which are sealed with Lower Carboniferous sediments of the Billefjorden-Group are found north of Ytterdalssata at the western coast of Nordenskiöld Land. South of Van Keulenfjorden, relics of red conglomerates are reported from deep karst pockets in Precambrian dolomites which are overlain by sediments of the Middle Carboniferous Hyrnefjellet Fm. (DALLMANN et al. 1990).

The youngest phase of karst weathering occurs today. SALVIGSEN et al. (1983) and SALVIGSEN & ELGERSMA (1985) described karst phenomena within the Carboniferous Ebbadalen Fm. east of Billefjorden and at Vardeborgsletta, outer Isfjorden. Other areas are found at Sarsøyra (BARBAROUX & BESSET 1968) and in Sørkapp Land (BARANOWSKI 1974, PULINA 1974).

The karst features on Blomstrandhalvøya belong to the pre-Middle Carboniferous erosion which succeeded the compressive Svalbardian Deformation. In this respect, the conodont-bearing cave sediments of Blomstrandhalvøya represent the northeasternmost marine near-shore deposits of the Brøggertinden Formation (LUDWIG 1988) which had its depocenter in the rift structures on Brøggerhalvøya. Erosion continued east of Kongsfjorden from were the coarse-grained fan-sediments of the Brøggertinden Fm. originated until late Carboniferous to Permian platform carbonates covered the whole area.

ACKNOWLEDGEMENTS

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