DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 1997/8

Biostratigraphy of wells 10/8-1 and 9/11-1

Lea Holstein

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GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

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Contents

INTRODUCTION

The biostratigraphic work was carried out in order to map the thickness and distribution of the Late Paleocene deposits and to evaluate the palaeobathymetry and depositional environment of wells 9/11-1 and 10/8-1 from the Norwegian sector, North Sea.

The sample material of the wells was kindly provided by Oljedirektoratet (Norwegian Petroleum Directorate) following conversations with Robert Williams. Last samples from well 10/8-1 arrived at GEUS on July 11th 1996.

WELL DESCRIPTIONS

10/8-1

The depth scale was in 10/8-1 given in metres and has been converted to feet to match the 9/11-1. 10/8-1 covers the interval late Paleocene to early Paleocene (Fiskebank Formation to Ekofisk Formation) at depths 520 m (1706 ft.) to 760 m (2493 ft.).

STRATIGRAPHIC SUMMARY

Depth (m) (Depth ft.)	Age	Formation	Zone	Event
520m (1706')	Late Paleocene	Fiskebank Fm. (Sele Fm.)	PM6	*Coscinodiscus* sp.13
530m (1706')	Late Paleocene	Fiskebank Fm. (Sele Fm.)	PM5	barren of microfossils
560m (1837')	Late Paleocene	Fiskebank Fm. (Lista Fm., part)	PM4	*Bulimina trigonalis.*
590m (1936')	Laté Paleocene	Våle Fm. (Maureen Fm.)	PM3	*S. beccariformis* and *B. midwayensis*
690 (2464')	Early Paleocene	Våle Fm. ?"N. Sea Marl"	PM2	Limited planktic assemblage
750 (2460')	Early Paleocene	Ekofisk Fm.	PM1	*Prinsius dimorphosus. Chiasmolithus danicus*

Last sample examined at 760m (2493')

See fig. 1

NOTE:

Samples 750m (2460') and 760m (2493') were examined for nannofossils because microfossil recovery was poor.

9/11-1

Well 9/11-1 covers the interval late Paleocene to Late Cretaceous at depths 4380' to 5460' (1335-1664m).

STRATIGRAPHIC SUMMARY

Depth (ft.) (Depth ~m)	Age	Formation	Zone	Event
4380' (1335m)	Basal early. Eocene	Balder Fm.	PM 7	*Coscinodiscus* sp.1
4430' (1350m)	Basal ey. Eoc/ Lt. Paleocene	Fiskebank Fm. (Sele Fm.)	PM6	*Coscinodiscus* sp. 13
4840' (1475m)	Basal ey. Eoc/ Lt. Paleocene	Fiskebank Fm. (Sele Fm.)	PM5	Base *Coscinodiscus* spp.
4910' (1497m)	Late Paleocene	Lista Fm.	PM4	*T. ruthvenmurrayi* and influx of aggluts.
5080' (1548m)	Late Paleocene	Våle Fm. (Maureen Fm.)	PM3	*S. beccariformis.* *C. succedens*
5370' (1637m)	Early Paleocene	Ekofisk Fm.	PM1	abund. and diverse planktics incl. *G. compressa* and *G. planocompressa*
5460' (1664m)	Late Cretaceous			*Micula deccusata*

Last sample examined at 5460' (1664m)

See fig. 2

NOTE: samples 5320' to 5460' was examined for nannofossils because microfossil recovery was poor.

PALAEOENVIRONMENT AND PALAEO-BATHYMETRY

The late Paleocene microfauna consists almost exclusively of non-calcareous agglutinated foraminifera, dominated by simple structured forms e.g. *Bathysiphon* spp., *Ammodiscus* spp. and *Glomospira* spp. This type of fauna was described by Brouwer, 1965 as "Rhabdammina type" fauna. The non-calcareous agglutinated foraminifera are known to replace calcareous benthic foraminifera with the onset of clastic depositional regime and is often indicative of flysch type deposits. The late Paleocene formations of the North Sea are considered to represent palaeoenvironments as follows:

Balder Formation

The microfossil content of this Formation is dominated by a diatomaceous flora recognised in many North Sea wells. The lithology of the formation are varicoloured claystones and tuffs. The environment is interpreted low energy marine with restrichted circulation and dysoxic bottom water conditions. The diatom flora suggest an elevated freshwater input with resulting lowered salinity of surface waters. The impoverished non-calcareous agglutinated fauna suggest dysoxic bottomwater conditions probably due to restricted bottom water circulation. The Balder Formation is interpreted as deposited in a bathyal environment.

Fiskebank Formation

The Fiskebank Formation consists of fine to very fine grained, well sorted micromicaceous sandstone, occasionally with calcareous cement. The planktic assemblage found in this interval is dominated by diatoms; the flora is in the upper part of the formation more divers than the assemblage typical of the overlying Balder Formation. The foraminiferal fauna are dominated by non-calcareous agglutinated foraminifera which is indicative of a bathyal setting, possibly with water depths of more than 200 m. The palaeoenvironment is thus, as above, interpreted as being a bathyal setting of restrichted bottom water conditions possibly with lowered salinity of surface waters. Occassional calcareous benthic foraminifera occurs e.g. *Nodosaria* spp. The upper and most part of Fiskebank Formation is equivalent to the Sele Formation of central North Sea. The lower part of Fiskebank Formation is equivalent to the uppermost part of Lista Formation of the central North Sea.

Lista Formation

The Lista Formation is represented by grey to greenish grey claystones. Sandbodies in the Formation have been recognised and may be time equivalent to Andrew Member of lower Lista Formation in the Moray Firth basin.
In 9/11-1 the sand is micaceous, fine to very fine grained, subangular to subrounded and well sorted, and has a low content of glaucony. The size of the individual glaucony grains seem to be uniformly fine to very fine throughout the section.
The palaeoenvironment of the Lista Formation is, on the basis of its foraminiferal content, which is a diverse and abundant assemblage of mainly simple structured agglutinated forms but also *Spiroplectammina spectabilis*, suggested to be bathyal. The Formation probably represents a wide range of marine environments, the sand having been deposited in shallower water but redeposited as submarine fans. The assumption is based on the varied lithology i.e. the glacoconitic sand and claystones and the diversity of foraminifera i.e. groups that represent different environments. The dominating tubular *Rhabdammina* species have been observed to occur in large numbers at the top of flysch type deposits and the accumulation is probably due to the hydrodynamics of a tubular test i.e. large surface/-weight ratio.

Maureen Formation

The Maureen Formation is not clearly lithological separable from the overlying Lista Formation. The Formation is a reworked interval of claystones, sandstones and marl, the percentage of the latter increasing down well. As the claystone becomes more calcareous downsection, calcareous benthic foraminifera reoccur and the lowermost part (informally named the "North Sea Marl") contain reworked Danian planktic foraminifera.

"North Sea marl" (Maureen Formation Part)

The lowermost part of Maureen Formation with the informal name North Sea Marl comprises the calcareous part of Maureen Formation with Danian planktic foraminifera.

Ekofisk Formation (Danian limestone)

The Ekofisk Formation consist of mainly white chalk, commonly a milky white to bluish grey chert is observed in the chalk. Horizons with chert contain poorly preserved microfossils probably because of the recrystalization/replacement of calciumcarbonate.

COMMENTS ON LITHOLOGY

The 9/11-1 sand is a light yellowish brown, micromicaceous sand, with a cotinual low amount of very fine grained glaucony. The unit is interbedded by varicoloured claystones. Occasional fragments of calcareous cemented sandstone has been observed in a non-recognisable pattern. Grain sizes range from 125-63 µ (fine to very fine sand), individual grains subangular to subrounded. The stratigraphic coverage of the ~ 500 ft. (~150m) unit is basal early Eocene to latest Paleocene (Fiskebank Formation which is time equivalent to basal Sele Formation and Lista Formation).

In well 10/8-1 Lista-Maureen formations (the samples from 590-750m) differs markedly in that the lithology of the top 160 m consists of marly silica rich biomicrite with abundant sponge spicules and molds of these. The benthic foraminiferal fauna is poor as well as the planktic foraminifera, in the lower part of the interval, does not occur as abundantly as seen in most Danian deposits in the North Sea.
Mounds build by sponge spicules are described from Conacian chalk deposits, Bornholm, Denmark (Noe-Nyegaard and Surlyk, 1985). These Mounds are believed to be formed by baffling spongemats. The lithology, density of spicules and molds and the low abundance of calcareous microfossils in 10/8-1 lead to the assumption that a similar facies developed in this area. The distribution of sponges is wide, but are more common in nearshore environments (de Laubenfels, 1955).

REFERENCES

Brouwer, J. (1965) Agglutinated foraminifera faunas from some turbiditic sequences. I, II. Proceedings Konenklijke Nederlanse Akademie van Wettenshappen series b, vol. **68**, pp. 309-334.

de Laubenfels, M. W. (1955) Porifera. In: Moore, R. C. (Ed.)Treatise on Invertebrae Paleontology (E)Archaeocyata, Porifera. Geological Society of America, University of Kansas, pp. 21-112.

Noe-Nygaard, N. and Surlyk, F. (1985) Mound bedding in a sponge-rich Coniacian chalk, Bornholm, Denmark. Bull. Geol. Soc. Denmark. Vol. **34**, pp. 237-249.

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BIOSTRATIGRAPHIC SUMMARY SHEET

2

MDRT

Well: *10/8-1*
Operator: *ELF AQUITAINE NORWAY*
Country: *Offshore Norway*
Analyst(s): *L. I. Holstein* **Date:** *Sept. 1996*

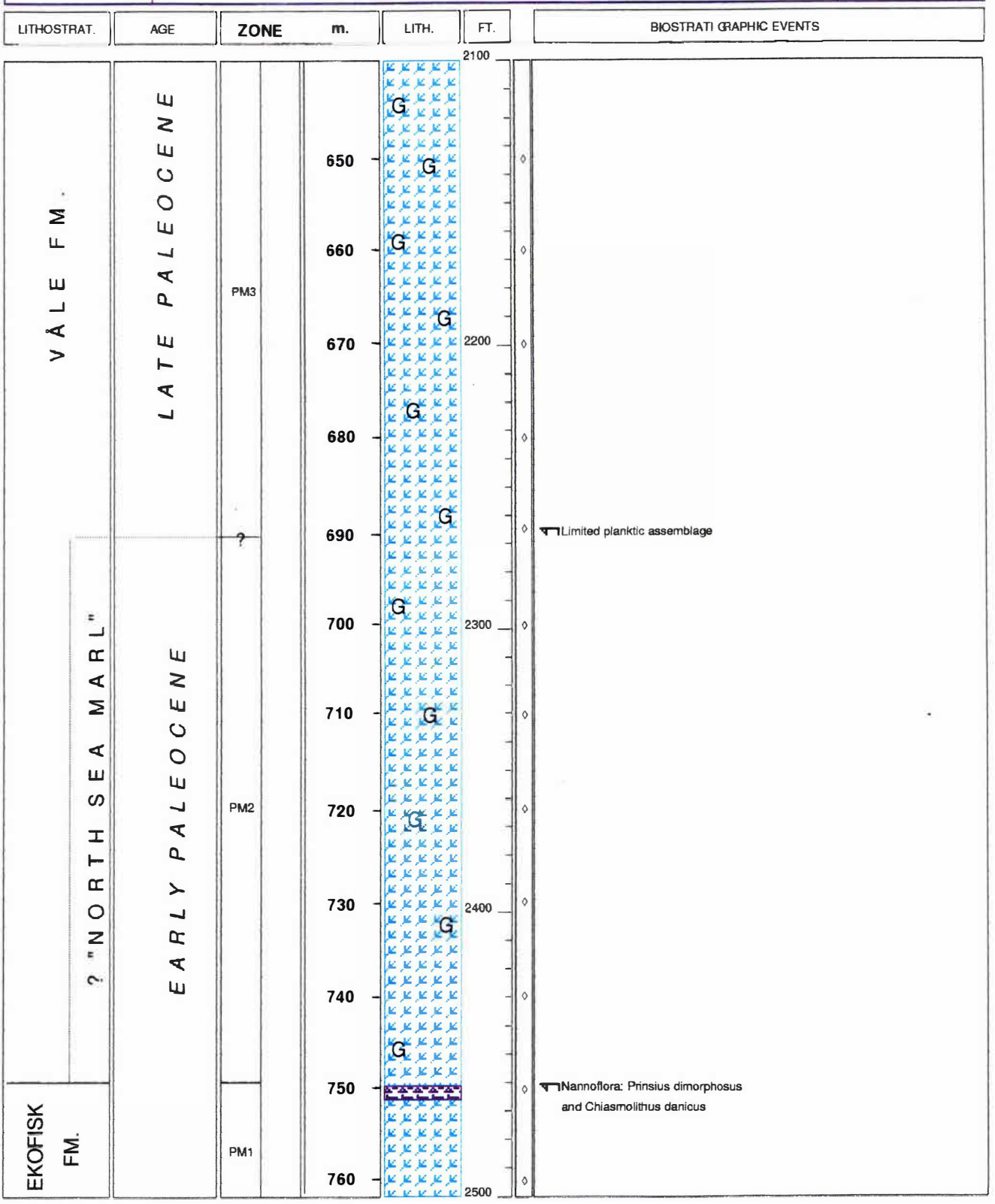

Fig. 1 (part): 10/8-1 biostratigraphy

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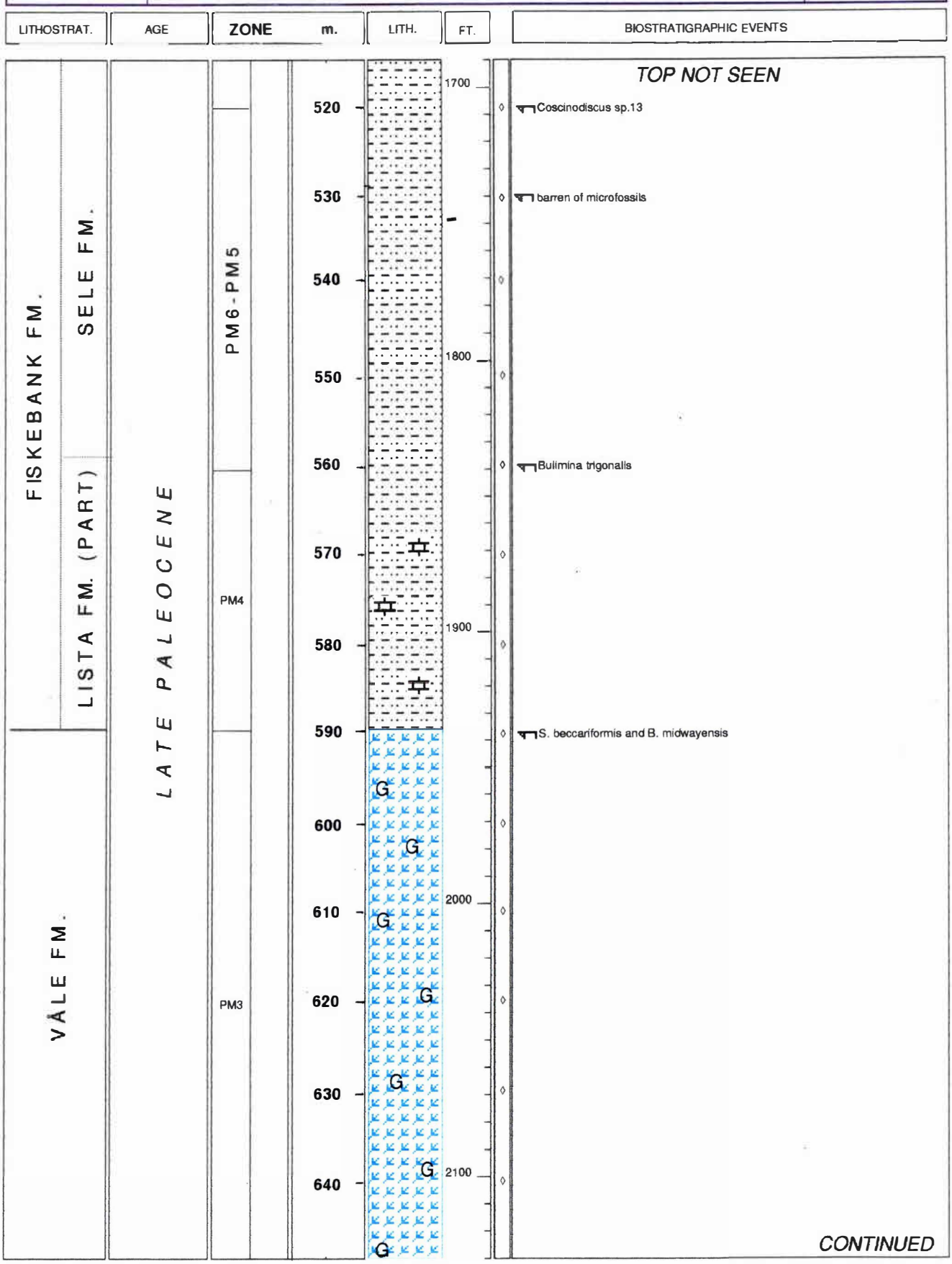
BIOSTRATIGRAPHIC SUMMARY SHEET

1

MDRT

Well: *10/8-1*
Operator: *ELF AQUITAINE NORWAY*
Country: *Offshore Norway*
Analyst(s): *L. I. Holstein* **Date:** *Sept. 1996*



G=GLAUCONY

Fig. 1 (part): 10/8-1 biostratigraphy

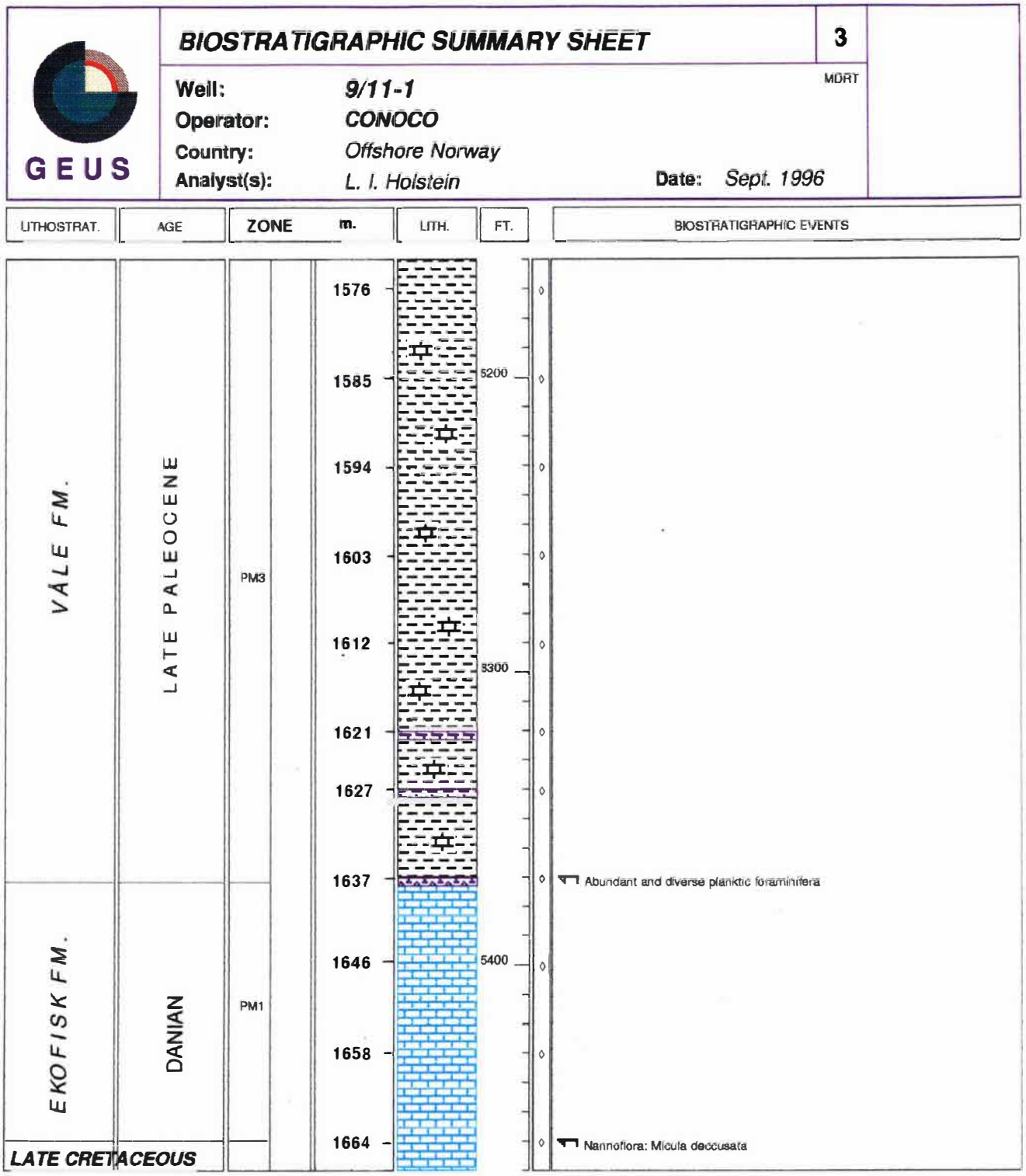


Fig. 2 (part): 9/11-1 biostratigraphy

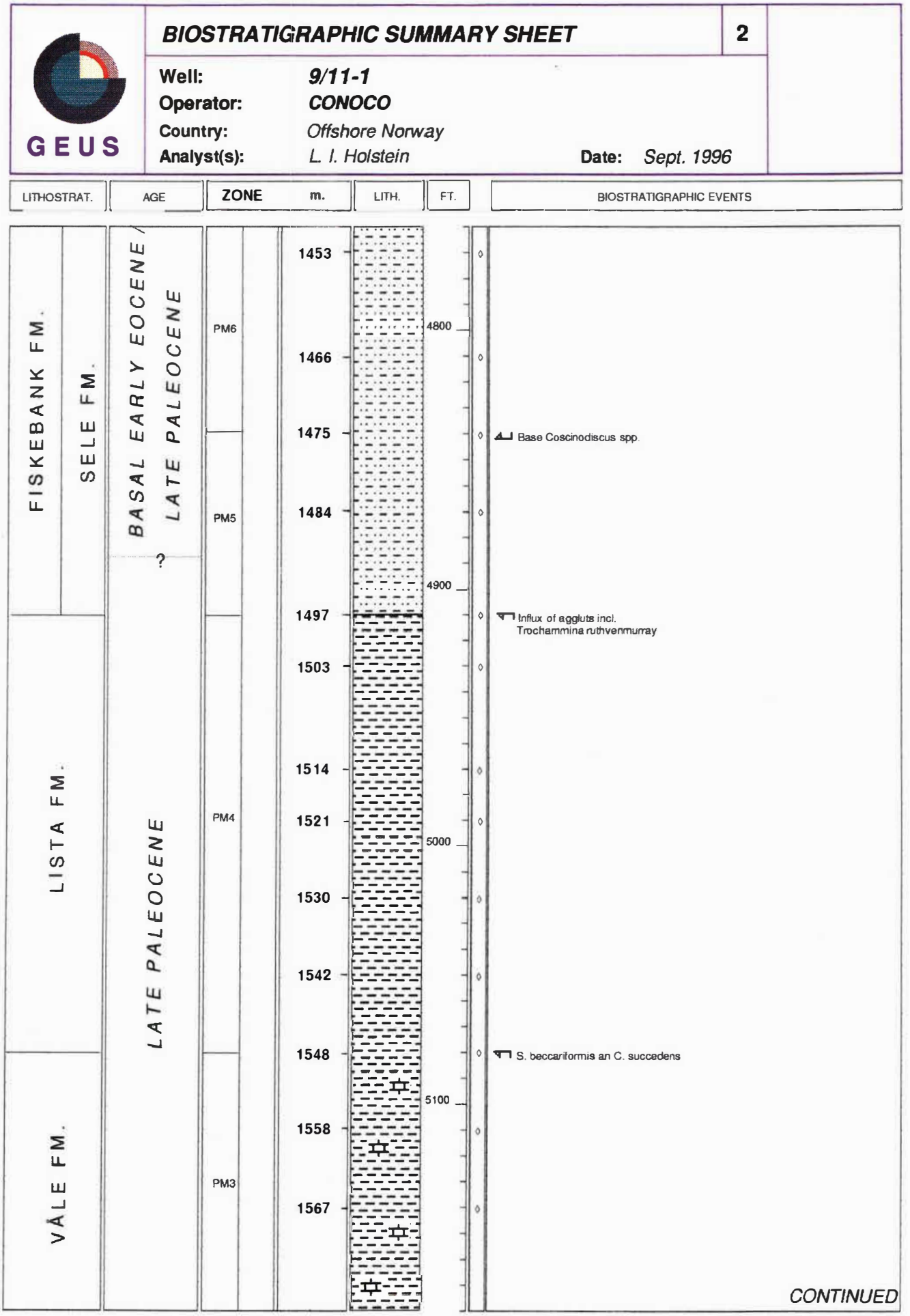


Fig. 2 (part): 9/11-1 biostratigraphy

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BIOSTRATIGRAPHIC SUMMARY SHEET

1

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Operator: *CONOCO*
Country: *Offshore Norway*
Analyst(s): *L. I. Holstein* **Date:** *Sept. 1996*

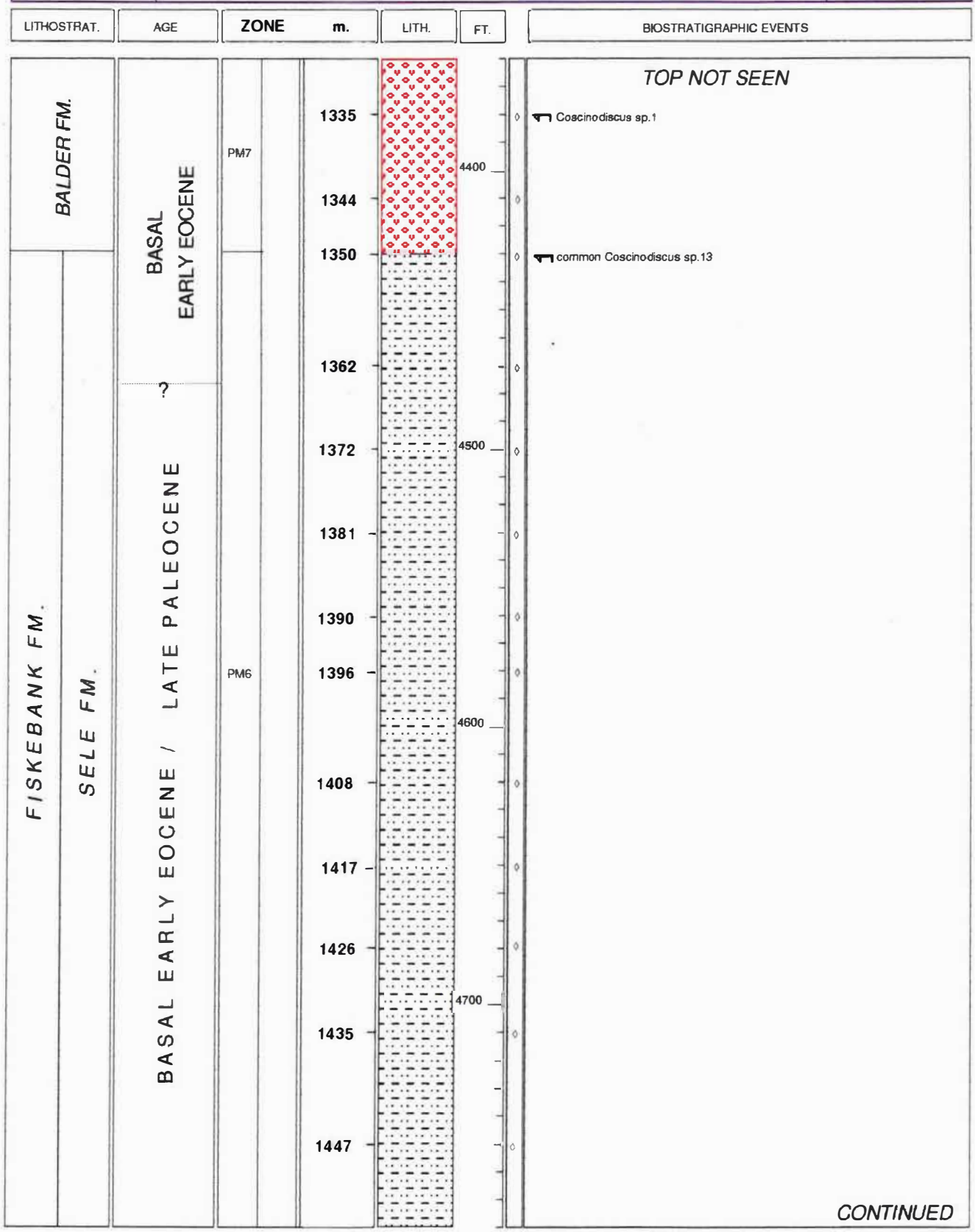


Fig. 2 (part): 9/11-1 biostratigraphy

EARLY TERTIARY

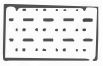
LITHOLOGY LEGEND

CLAYSTONE

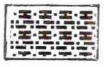
BALDER TUFF

MICROLAMINATED CLAYSTONE

SPHEROIDS



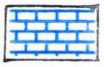
SANDSTONE/CLAYSTONE



MARLY CLAYSTONE

BIOSPARITIC SILT/CLAYSTONE (10/8-1)

FLINT



CHALK (EKOFISK FORMATION)

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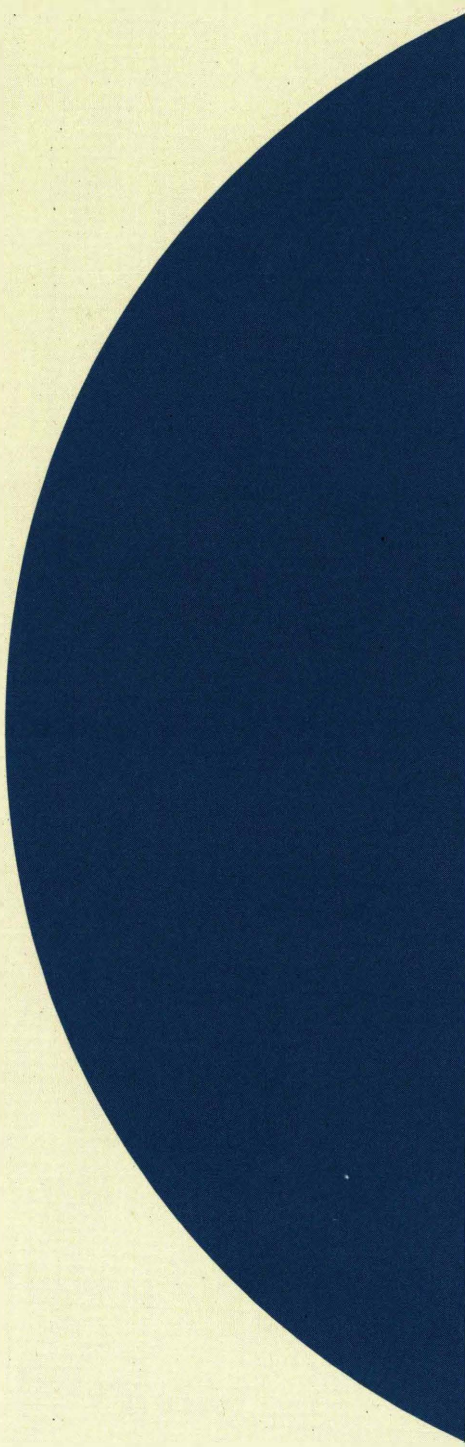

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