

19. *BOLBOFORMA* FROM NORTH ATLANTIC SITES, DEEP SEA DRILLING PROJECT LEG 94¹

John W. Murray, Department of Geology, University of Exeter, Devon, United Kingdom²

ABSTRACT

Eight species of *Bolboforma* occur in the middle Miocene to lower Pliocene carbonate oozes and chalks of Sites 400 and 606 to 611. Although they have some biostratigraphic value, this is limited because most species are long-ranging. Also, the data show clearly that *Bolboforma* is most diverse in high latitudes, which in turn affects the biostratigraphic value of these forms.

INTRODUCTION

Bolboforma von Daniels and Spiegler, 1974, is a problematic microfossil first recorded from the Tertiary of Germany. It is now known to be widespread in European Tertiary shelf sediments (Willems, 1976; Odrzywolska-Bienkova, 1976; Szczechura, 1982; King, 1983) and in deep-sea sediments from the Mediterranean (Bizon et al., 1977), North Atlantic (L. Molinsky, in Rögl and Hochuli, 1976; Murray, 1979, 1984), and off Antarctica (Rögl and Hochuli, 1976). In this chapter, the occurrence of *Bolboforma* is reported from Sites 606 through 611 of Leg 94 and also from Hole 400A of Leg 48 (Table 1, Fig. 1). The biostratigraphy is based on the site reports in the respective volumes.

MATERIALS AND METHODS

Core-catcher samples were studied from Sites 606 to 611 (Table 1). Those from Sites 606, 607, and 608 had already been processed by Dr. P. Weaver. Samples from Hole 400A were supplied from the DSDP core repository. Each sample was dried at 60°C, soaked in a dilute solution of calgon (sodium hexametaphosphate), and then washed on a 63- μm (230 mesh) sieve. The residue was dried at 60°C and then split on a 125- μm (125 mesh) sieve. Only the fraction >125 μm was examined. The age range of the samples is from early Miocene (NN2) to early Pliocene (NN16). Altogether 107 samples were examined, of which 31 contained *Bolboforma*. All the species recorded here are illustrated in Murray (1984).

DATA

Those samples that yielded *Bolboforma* are listed in Table 2; those that are barren are listed in Table 3. The biostratigraphic distribution is shown in Table 4, which also shows the ranges recorded at Sites 552 to 555 off Rockall Plateau. For *B. aculeata*, *B. costata*, *B. danielsi*, *B. intermedia*, and *B. reticulata*, the ranges recorded here are consistent with those from Rockall, but generally incomplete. For *B. clodiusi* and *B. laevis*, the range is extended down to Zone NN5, compared with Zone NN6 at Sites 552 through 555. At Rockall, *B. metzmacheri* was found in Zones NN1 and NN6 through 16, so the record at Sites 609 to 611 and 400 in Zone NN5 is consistent with this.

Table 1. Position of holes at Sites 606 to 611 and 400.

Site/hole	Latitude (N)	Longitude (W)	Depth (m)
606	37°20.32'	35°29.99'	3007
607A	41°00.07'	32°57.44'	3427
608	42°50.21'	23°05.25'	3526
609B	49°52.67'	24°14.29'	3884
610, 610A	53°13.30'	18°53.21'	2417
610E	53°13.47'	18°53.69'	2445
611C	52°50.15'	30°19.10'	3230
400A	47°22.9'	09°11.9'	4399

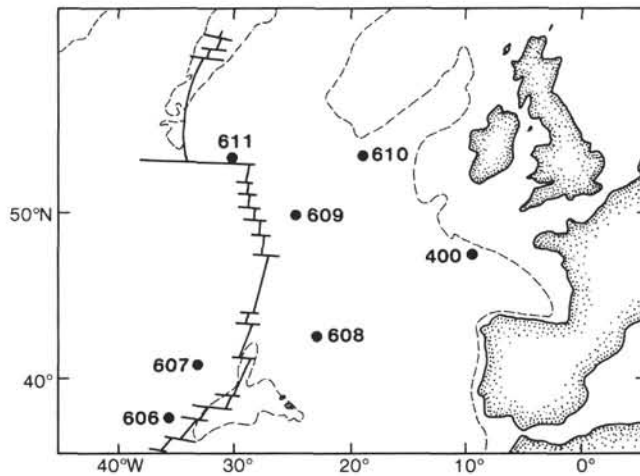


Figure 1. Map showing the position of the sites. (Dashed line = 2000-m isobath.)

The significance of the biostratigraphic distribution has to be judged in the light of ecological controls on the distribution of *Bolboforma*. In Table 5 a comparison is made of the number of species present in each zone at sites arranged in a north-south sequence from Sites 552 to 555, at latitudes of 56 to 57°, to Sites 607 and 606 at latitudes of 37 to 41°N. A clear pattern is evident. In Zones NN6 to NN11 the Rockall Sites 552 through 555 are more diverse, with 5 to 7 species, than those to the south, with 0 to 3 species. Furthermore, those levels where *Bolboforma* is common (rather than present or rare) are mainly confined to the Rockall area and Sites 611 and 610, which are closest to it.

¹ Ruddiman, W. F., Kidd, R. B., Thomas, E., et al., *Init. Repts. DSDP, 94*; Washington (U.S. Govt. Printing Office).

² Address: Dept. of Geology, University of Exeter, Devon, EX4 4QE United Kingdom.

Table 2. Occurrence of *Bolboforma* in Leg 94 samples and Hole 400A.

Sample (core-section, interval in cm)	<i>B. aculeata</i>	<i>B. clodiusi</i>	<i>B. costata</i>	<i>B. danielsi</i>	<i>B. intermedia</i>	<i>B. laevis</i>	<i>B. metzmacheri</i>	<i>B. reticulata</i>	Abundance		Zone
									P = present	C = common	
608-18,CC	—	—	—	—	✓	—	—	—	P		NN11
608-19,CC	—	—	—	—	—	—	—	—	P		NN11
608-20,CC	—	—	—	—	—	—	—	—	P		NN11
608-21,CC	—	—	—	—	—	—	—	—	P		NN11
608-22,CC	—	—	—	—	—	—	—	—	P		NN11
608-23,CC	—	—	—	—	—	—	—	—	P		NN9
608-25,CC	—	—	—	—	—	—	—	—	C		NN7
609B-30,CC	—	—	—	—	—	—	—	—	P		NN13
609B-36,CC	—	—	—	—	—	—	—	—	C		NN11
610-11,CC	—	—	—	—	—	—	—	—	P		NN11
610-12,CC	—	—	—	—	—	—	—	—	P		NN10-7
610-13,CC	—	—	—	—	—	—	—	—	C		NN10-7
610-14,CC	—	—	—	—	—	—	—	—	C		NN10-7
610-15,CC	—	—	—	—	—	—	—	—	C		NN8-7
610-16,CC	—	—	—	—	—	—	—	—	C		NN6
610-17,CC	—	—	—	—	—	—	—	—	C		NN5
610E-2,CC	—	—	—	—	—	—	—	—	P		NN11
610E-6,CC	—	—	—	—	—	—	—	—	P		NN11
610E-7,CC	—	—	—	—	—	—	—	—	C		NN10
611C-22,CC	—	—	—	—	—	—	—	—	P		NN15
611C-35,CC	—	—	—	—	—	—	—	—	P		NN11
611C-43,CC	—	—	—	—	—	—	—	—	P		NN11
611C-44,CC	—	—	—	—	—	—	—	—	C		NN10
611C-45,CC	—	—	—	—	—	—	—	—	C		NN10
611C-46,CC	—	—	—	—	—	—	—	—	C		NN10
611C-47,CC	—	—	—	—	—	—	—	—	C		NN10
400A-20-5, 53-55	—	—	—	—	—	—	—	—	P		NN11
400A-27-1, 130-132	—	—	—	—	—	—	—	—	P		NN8
400A-29-1, 138-140	—	—	—	—	—	—	—	—	P		NN7
400A-35-3, 119-121	—	—	—	—	—	—	—	—	P		NN5
400A-36-2, 20-22	—	—	—	—	—	—	—	—	P		NN5

Note: ✓ = present; — = absent.

Table 3. List of samples in which *Bolboforma* was not found in the >125- μ m fraction (based on the examination of a split containing at least 1000 planktonic foraminifers).

Hole 606	Hole 607A	Hole 608	Hole 609B	Hole 610	Hole 610A	Hole 611C	Hole 400A
8,CC	19,CC	5,CC	19,CC	6,CC	21,CC	15,CC	4-5, 92-94
through	through	through	20,CC	7,CC		17,CC	6-3, 105-106
18,CC	26,CC	17,CC	21,CC	8,CC		19,CC	8-6, 36-38
		24,CC	23,CC	9,CC		21,CC	11-2, 22-24
			25,CC	10,CC		24,CC	14-2, 22-24
			26,CC	18,CC		26,CC	15-4, 22-24
			27,CC	19,CC		28,CC	17-3, 106-108
			28,CC	20,CC		30,CC	18-4, 106-108
			32,CC	22,CC		32,CC	37-4, 114-116
			33,CC	23,CC		39,CC	
			34,CC	24,CC			
				25,CC			

DISCUSSION

Although Daniels and Spiegler (1974) established that *Bolboforma* has some stratigraphic value in the European Tertiary, it is clear that most species are long-ranging and of limited value. The extension of the range from the Miocene into the lower Pliocene recorded by Murray (1984) is confirmed by this study.

The Leg 94 material strongly supports the speculation by Murray (1984) that *Bolboforma* might be most diverse and most abundant in high latitudes. The highest numbers of individuals occur in drift deposits (probably because of their fine grain size), but the diversity values are clearly independent of this influence. The diversity is moderate in the drift deposits of Sites 610 and 611 even though the abundance of individuals is high.

Table 4. Biostratigraphic distribution of *Bolboforma*.

Age	Zone	<i>B. aculeata</i>	<i>B. clodiusi</i>	<i>B. costata</i>	<i>B. danielsi</i>	<i>B. intermedia</i>	<i>B. laevis</i>	<i>B. metzmacheri</i>	<i>B. reticulata</i>
early Pliocene	NN16							o	
	NN15		o	o x					o
	NN14		o						
	NN13		x						
late Miocene	NN12		o				o	o	o
	NN11	o	o x			o x	o x	o x	o x
	NN10	o	o x			o	o x	o x	o
	NN9	o	o x		o		o x	o	o
middle Miocene	NN8	o	o x		o	o x	o x	o	o
	NN7	o x	o x		o	o x	o x	o	o
	NN6		o x		o x		o	o	o
	NN5		x				x	x	

Note: x = range recorded in this chapter; o = range recorded by Murray (1984) for Sites 552 through 556.

Table 5. Number of *Bolboforma* species at North-east Atlantic sites.

Sites	NN11	NN10	NN9	NN8	NN7	NN6
552-555	6	6 ^x	7 ^x	7 ^x	7 ^x	5 ^x
611, 610	3	3 ^x	—	3 ^x	3 ^x	2 ^x
609	3 ^x	—	—	—	—	—
400, 119	2	—	—	2	2	—
608	3	—	1	0	3 ^x	—
607, 606	0	—	—	—	—	—

Note: — = not sampled or not represented. Data for Sites 552 through 555 and 119, from Murray (1984). ^x = common (i.e., several per 10-cm² picking tray); all figures that are not so marked are present to rare.

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