

Linking sediment biodegradability with its origin in shallow coastal environments

Justine Louis^{1,3}, Annet M. Laverman¹, Emilie Jardé², Alexandrine Pannard¹, Marine Liotaud², Françoise Andrieux-Loyer³, Gérard Gruau², Florian Caradec³, Emilie Rabiller³, Nathalie Lebris¹, Laurent Jeanneau³.

1: Centre National de la Recherche Scientifique (CNRS), ECOBIO – UMR 6553, Université de Rennes 1, 35042 Rennes, France

2: Centre National de la Recherche Scientifique (CNRS), Géosciences Rennes – UMR 6118, Université de Rennes 1, 35042 Rennes, France

3: Ifremer, DYNECO PELAGOS, ZI Pointe du Diable, 29280 Plouzané, France

Correspondence to: Justine Louis (justine.louis@ifremer.fr)

Supplementary Material

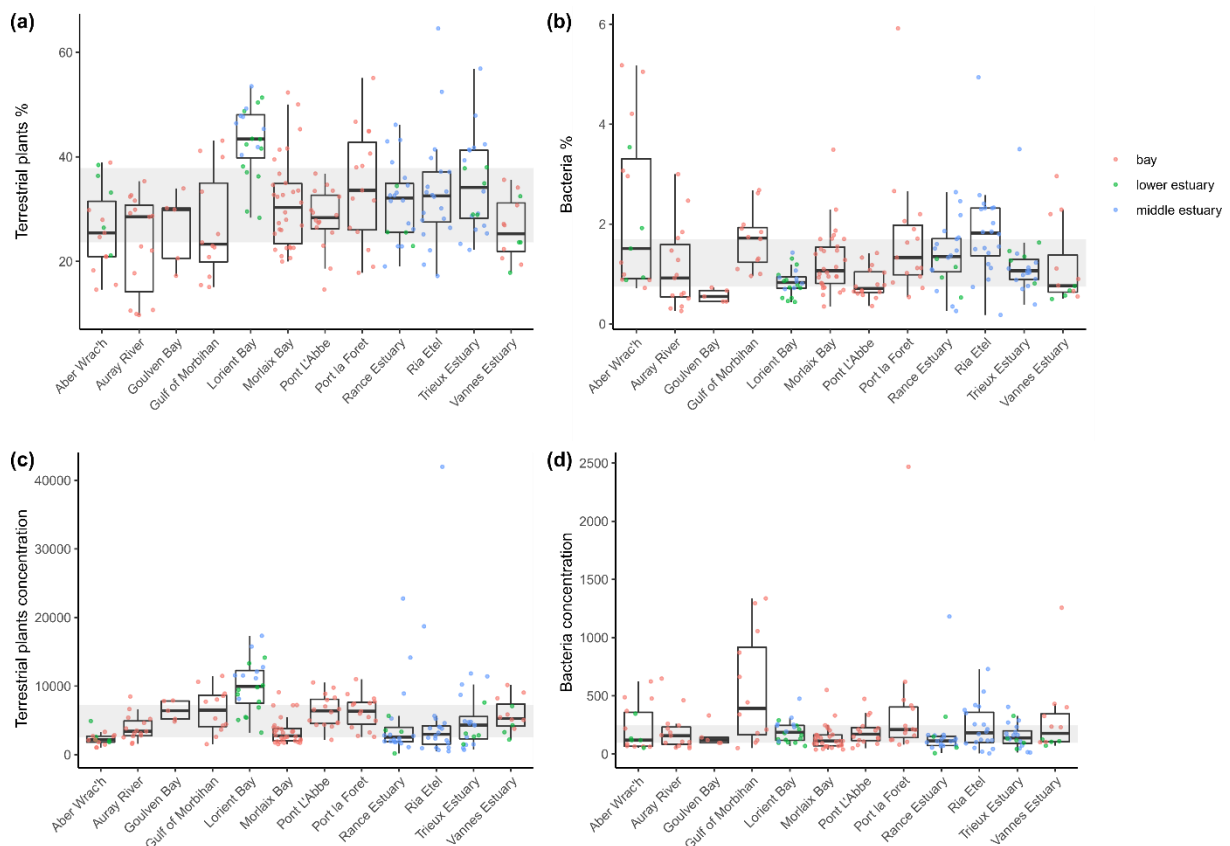


Figure S1. Boxplot of the biomarkers proportion (%) and concentration (ng.g^{-1} of dry sediment) specific to terrestrial plants (A and C) and bacterial matter (B and D) in the lipid pool of sediment samples collected on the 12 studied mudflats. The grey area represents the values between the first and third quartiles calculated overall data.

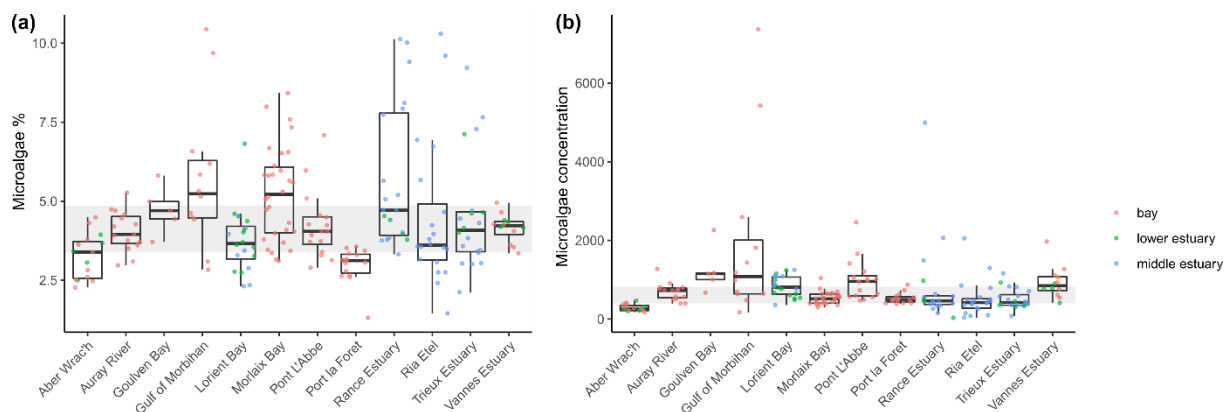


Figure S2. Boxplot of the biomarkers proportion (%) (A) and concentration ($\text{ng}\cdot\text{g}^{-1}$ of dry sediment) (B) specific to microalgae (sum of biomarkers of phytoplankton and n-alkanes microalgae) (A and C) in the lipid pool of sediment samples collected on the 12 studied mudflats. The grey area represents the values between the first and third quartiles calculated overall data.

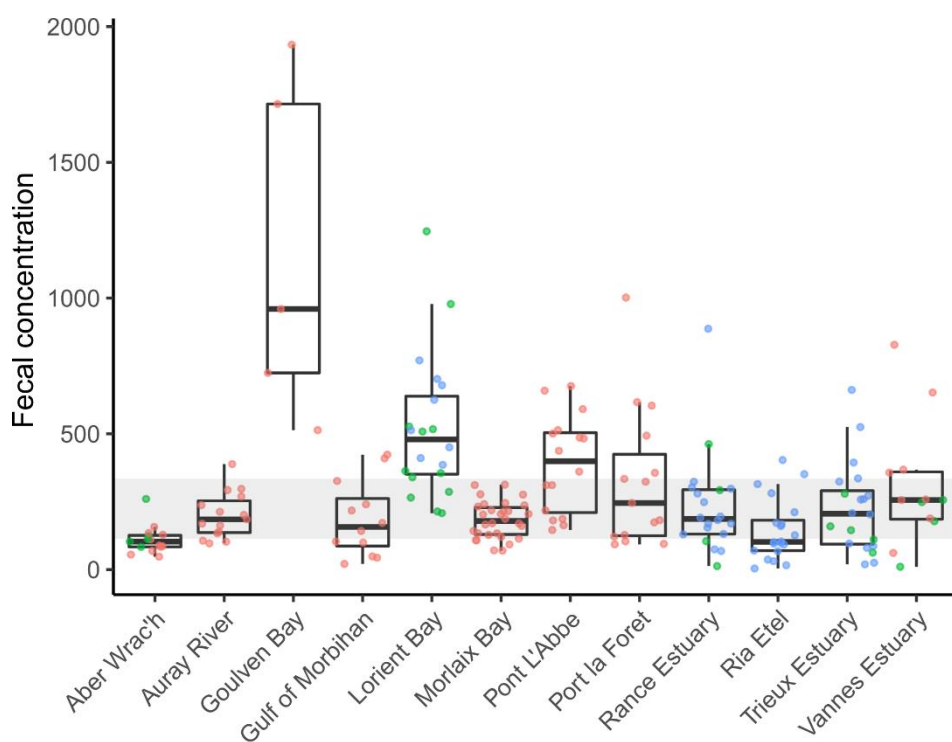


Figure S3. Boxplot of the markers concentration ($\text{ng}\cdot\text{g}^{-1}$ of dry sediment) specific to fecal matter in the lipid pool of sediment samples collected on the 12 studied mudflats. The grey area represents the values between the first and third quartiles calculated overall data.

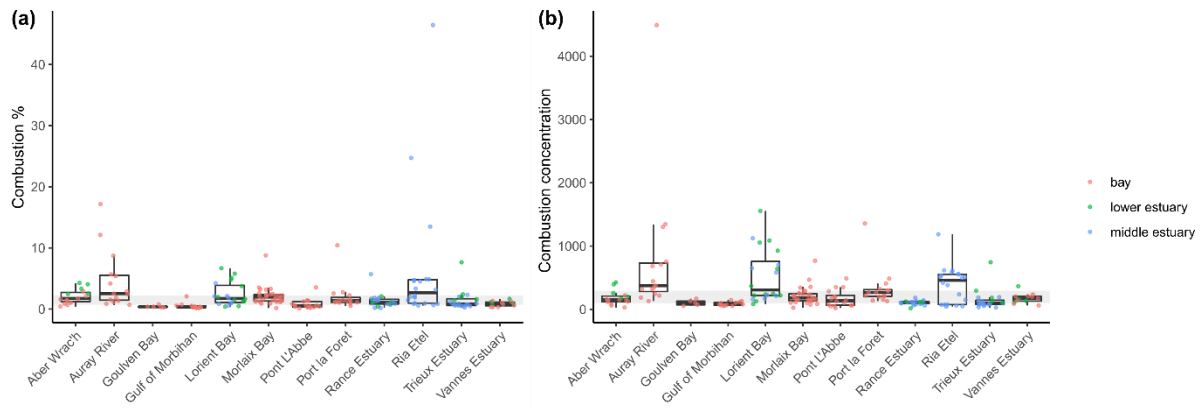


Figure S4. Boxplot of the markers proportion (%) (A) and concentration (ng.g^{-1} of dry sediment) (B) specific to combustion products in the lipid pool of sediment samples collected on the 12 studied mudflats. The grey area represents the values between the first and third quartiles calculated overall data.

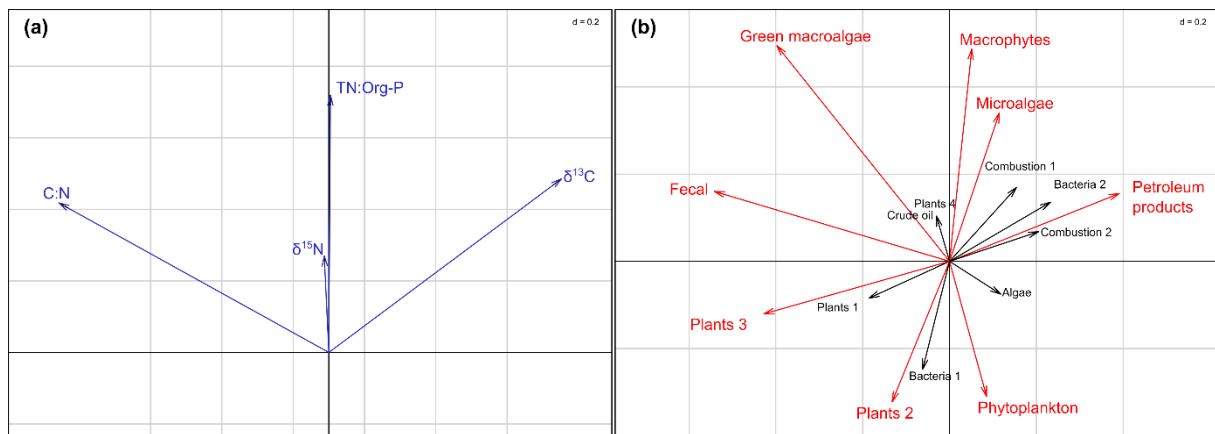


Figure S5. Representation in the common space of the co-inertia analysis of the two data matrices: elemental and isotopic ratios (A), and proportions of lipid marker groups (B). The marker groups which contributed most to the two first axis ($> 10\%$) are represented in red.

Table S1. List of all lipid markers identified in our sediment samples.

Source Groupe	Fecal matter	Combustion products		Oil and by-products		Bacterial matter		Macrophytes	
	"Fecal"	"Combustion 1"	"Combustion 2"	"Petroleum product"	"Crude oil"	"Bacteria 1"	"Bacteria 2"	"Macrophytes"	
Lipid markers	Coprostanol	Phénanthrène	Benzo[b]naphtho[2,3-d]thiophene	n-C11	pristane	acide gras C17 iso	acide gras C15 iso	nC20-nC23	
	Epicoprostanol	Anthracène	Benzo(a)anthracène	n-C12	phytane	acide gras C17 anteiso	acide gras C15 anteiso	nC24+nC25+nC26	
	24-Ethylcoprostanol	C1-178	Chrysène	n-C13	nC20-nC23				
	24-Ethylepicoprostanol	C2-178	C1-228	n-C14	nC24+nC25+nC26				
		C3-178	C2-228	bicyclohexane	nC27-nC34				
		Fluoranthène	Benzo(b,j,k)fluoranthène		C20 TT				
		Pyrène	Benzo(e)pyrène		C21 TT				
		C1-202	Benzo(a)pyrène		C22 TT				
		C2-202	Perylène		C23 TT				
				C1-252		C24 TT			
			Dibenz[a,h]anthracene		C25 TT				
			Indeno[1,2,3-cd]pyrene		18a-trisnorhopane				
			Benzo[ghi]perylene		17b-trisnorhopane				
		C1-276		17a,21b-30norhopane					
			17a, 21b-hopane						
			22S-17a(H)-, 21b(H)-30-homohopane (C31)						
			22R-17a(H)-, 21b(H)-30-homohopane (C31)						
			22S-17a(H)-, 21b(H)-30-bishomohopane (C32)						
			22R-17a(H)-, 21b(H)-30-bishomohopane (C32)						
			22S-17a(H)-, 21b(H)-30-trishomohopane (C33)						
			22R-17a(H)-, 21b(H)-30-trishomohopane (C33)						

Table S1 (continued)

Source Groupe	Terrestrial plants				Phytoplankton	Pelagic and benthic microalgae	Algal matter (micro and macro)	Green macroalgae
	"Plants 1"	"Plants 2"	"Plants 3"	"Plants 4"	"Phytoplankton"	"Microalgae"	"Algae"	"Green macroalage"
Lipid markers	nC24+nC25+nC26	Campestérol	alcool-C20	wOHC16:0	Cholesta-5,22(E)-dien-3b-ol	n-C15	néophytadiène 01	Fucostérol
	nC27-nC34	Stigmastérol	alcool-C21	a,wC16:0	Brassicasterol	n-C16	néophytadiène 02	D5-avenasterol (=isofucosterol)
	n-C35		alcool-C22	ac C20		n-C17	néophytadiène 03	
			alcool-C23	wOHC18:0		n-C18		
			alcool-C24	ac C21		n-C19		
			alcool-C25	a,w C18:0				
			alcool-C26	ac C22				
			alcool-C27	wOHC20:0				
			alcool-C28	ac C23				
			alcool-C29	a,w C20:0				
			alcool-C30	ac C24				
				wOHC22:0				
				ac C25				
				a,w C22:0				
				ac C26				
				wOHC24:0				
			ac C27					
			a,w C24:0					
			ac C28					
			ac C29					
			a,w C26:0					
			ac C30					

Table S2. Results of the hierarchical cluster analysis on the canonical ordination.

Sample	Site	Mudflat	Cluster
1_1	#1	Trieux Estuary	"III"
1_2	#1	Trieux Estuary	"III"
1_3	#1	Trieux Estuary	"III"
1_4	#1	Trieux Estuary	"II"
1_5	#1	Trieux Estuary	"II"
2_1	#2	Trieux Estuary	"III"
2_2	#2	Trieux Estuary	"I"
2_3	#2	Trieux Estuary	"III"
2_4	#2	Trieux Estuary	"III"
2_5	#2	Trieux Estuary	"III"
3_1	#3	Trieux Estuary	"II"
3_2	#3	Trieux Estuary	"II"
3_3	#3	Trieux Estuary	"II"
3_4	#3	Trieux Estuary	"II"
3_5	#3	Trieux Estuary	"II"
4_1	#4	Trieux Estuary	"II"
4_2	#4	Trieux Estuary	"II"
4_3	#4	Trieux Estuary	"II"
4_4	#4	Trieux Estuary	"II"
4_5	#4	Trieux Estuary	"II"
5_1	#5	Ria Etel	"II"
5_2	#5	Ria Etel	"II"
5_3	#5	Ria Etel	"II"
5_4	#5	Ria Etel	"II"
6_1	#6	Ria Etel	"II"
6_2	#6	Ria Etel	"II"
6_3	#6	Ria Etel	"II"
6_4	#6	Ria Etel	"II"
7_1	#7	Ria Etel	"II"
7_2	#7	Ria Etel	"II"
7_3	#7	Ria Etel	"II"
7_4	#7	Ria Etel	"II"
8_1	#8	Ria Etel	"II"
8_2	#8	Ria Etel	"II"
8_3	#8	Ria Etel	"II"
8_4	#8	Ria Etel	"II"
9_1	#9	Ria Etel	"II"
9_2	#9	Ria Etel	"II"
9_3	#9	Ria Etel	"II"
9_4	#9	Ria Etel	"II"

Table S2 (continued)

10_1	#10	Lorient Bay	"IV"
10_2	#10	Lorient Bay	"IV"
10_3	#10	Lorient Bay	"III"
10_4	#10	Lorient Bay	"IV"
11_1	#11	Lorient Bay	"III"
11_2	#11	Lorient Bay	"III"
11_3	#11	Lorient Bay	"III"
12_1	#12	Lorient Bay	"II"
12_2	#12	Lorient Bay	"II"
12_3	#12	Lorient Bay	"II"
12_4	#12	Lorient Bay	"II"
13_1	#13	Lorient Bay	"III"
13_2	#13	Lorient Bay	"III"
13_3	#13	Lorient Bay	"III"
13_4	#13	Lorient Bay	"III"
14_1	#14	Lorient Bay	"III"
14_2	#14	Lorient Bay	"III"
14_3	#14	Lorient Bay	"I"
14_4	#14	Lorient Bay	"III"
15_1	#15	Morlaix Bay	"II"
15_2	#15	Morlaix Bay	"II"
15_4	#15	Morlaix Bay	"II"
15_5	#15	Morlaix Bay	"II"
16_1	#16	Morlaix Bay	"II"
16_2	#16	Morlaix Bay	"II"
16_3	#16	Morlaix Bay	"III"
16_4	#16	Morlaix Bay	"II"
16_5	#16	Morlaix Bay	"II"
17_1	#17	Morlaix Bay	"II"
17_2	#17	Morlaix Bay	"II"
17_3	#17	Morlaix Bay	"II"
17_4	#17	Morlaix Bay	"II"
17_5	#17	Morlaix Bay	"II"
18_1	#18	Morlaix Bay	"II"
18_2	#18	Morlaix Bay	"II"
18_3	#18	Morlaix Bay	"II"
18_4	#18	Morlaix Bay	"II"
18_5	#18	Morlaix Bay	"II"
19_1	#19	Morlaix Bay	"II"
19_2	#19	Morlaix Bay	"II"
19_3	#19	Morlaix Bay	"II"
19_4	#19	Morlaix Bay	"II"
19_5	#19	Morlaix Bay	"II"
20_1	#20	Morlaix Bay	"III"
20_2	#20	Morlaix Bay	"II"
20_3	#20	Morlaix Bay	"II"
20_4	#20	Morlaix Bay	"II"
20_5	#20	Morlaix Bay	"II"
21_1	#21	Goulven Bay	"III"
21_2	#21	Goulven Bay	"III"
21_3	#21	Goulven Bay	"I"
21_4	#21	Goulven Bay	"I"
21_5	#21	Goulven Bay	"III"

Table S2 (continued)

22_1	#22	Aber Wrac'h	"II"
22_2	#22	Aber Wrac'h	"II"
22_3	#22	Aber Wrac'h	"II"
22_4	#22	Aber Wrac'h	"II"
22_5	#22	Aber Wrac'h	"II"
23_1	#23	Aber Wrac'h	"II"
23_2	#23	Aber Wrac'h	"II"
23_3	#23	Aber Wrac'h	"II"
23_4	#23	Aber Wrac'h	"II"
23_5	#23	Aber Wrac'h	"I"
24_1	#24	Aber Wrac'h	"II"
24_2	#24	Aber Wrac'h	"II"
24_3	#24	Aber Wrac'h	"II"
24_4	#24	Aber Wrac'h	"II"
24_5	#24	Aber Wrac'h	"II"
25_1	#25	Pont L'Abbe	"III"
25_2	#25	Pont L'Abbe	"III"
25_3	#25	Pont L'Abbe	"III"
25_4	#25	Pont L'Abbe	"III"
26_1	#26	Pont L'Abbe	"I"
26_2	#26	Pont L'Abbe	"I"
26_3	#26	Pont L'Abbe	"I"
26_4	#26	Pont L'Abbe	"I"
27_1	#27	Pont L'Abbe	"III"
27_2	#27	Pont L'Abbe	"III"
27_3	#27	Pont L'Abbe	"I"
27_4	#27	Pont L'Abbe	"III"
28_1	#28	Pont L'Abbe	"I"
28_2	#28	Pont L'Abbe	"III"
28_3	#28	Pont L'Abbe	"I"
28_4	#28	Pont L'Abbe	"I"
29_1	#29	Port la Foret	"II"
29_2	#29	Port la Foret	"II"
29_3	#29	Port la Foret	"II"
29_4	#29	Port la Foret	"II"
29_5	#29	Port la Foret	"II"
30_1	#30	Port la Foret	"II"
30_2	#30	Port la Foret	"II"
30_3	#30	Port la Foret	"I"
30_4	#30	Port la Foret	"III"
30_5	#30	Port la Foret	"I"
31_1	#31	Port la Foret	"I"
31_2	#31	Port la Foret	"I"
31_3	#31	Port la Foret	"III"
31_4	#31	Port la Foret	"I"
31_5	#31	Port la Foret	"I"
32_1	#32	Rance Estuary	"III"
32_2	#32	Rance Estuary	"III"
32_3	#32	Rance Estuary	"III"
32_4	#32	Rance Estuary	"III"
33_1	#33	Rance Estuary	"III"
33_2	#33	Rance Estuary	"III"
33_3	#33	Rance Estuary	"III"
33_4	#33	Rance Estuary	"III"

Table S2 (continued)

34_1	#34	Rance Estuary	"III"
34_2	#34	Rance Estuary	"III"
34_3	#34	Rance Estuary	"III"
34_4	#34	Rance Estuary	"III"
35_1	#35	Rance Estuary	"III"
35_2	#35	Rance Estuary	"III"
35_3	#35	Rance Estuary	"III"
35_4	#35	Rance Estuary	"III"
36_1	#36	Rance Estuary	"II"
36_2	#36	Rance Estuary	"II"
36_3	#36	Rance Estuary	"II"
36_4	#36	Rance Estuary	"II"
37_1	#37	Auray River	"II"
37_2	#37	Auray River	"III"
37_3	#37	Auray River	"III"
37_4	#37	Auray River	"III"
37_5	#37	Auray River	"II"
38_1	#38	Auray River	"II"
38_2	#38	Auray River	"II"
38_3	#38	Auray River	"III"
38_4	#38	Auray River	"II"
38_5	#38	Auray River	"III"
39_1	#39	Auray River	"II"
39_2	#39	Auray River	"II"
39_3	#39	Auray River	"II"
39_4	#39	Auray River	"II"
39_5	#39	Auray River	"II"
40_1	#40	Vannes Estuary	"II"
40_2	#40	Vannes Estuary	"II"
40_3	#40	Vannes Estuary	"II"
40_4	#40	Vannes Estuary	"IV"
41_1	#41	Vannes Estuary	"IV"
41_2	#41	Vannes Estuary	"IV"
41_3	#41	Vannes Estuary	"IV"
41_4	#41	Vannes Estuary	"IV"
42_1	#42	Vannes Estuary	"II"
42_2	#42	Vannes Estuary	"I"
42_3	#42	Vannes Estuary	"II"
42_4	#42	Vannes Estuary	"II"
43_1	#43	Gulf of Morbihan	"II"
43_2	#43	Gulf of Morbihan	"II"
43_3	#43	Gulf of Morbihan	"IV"
43_4	#43	Gulf of Morbihan	"IV"
44_1	#44	Gulf of Morbihan	"II"
44_2	#44	Gulf of Morbihan	"II"
44_3	#44	Gulf of Morbihan	"IV"
44_4	#44	Gulf of Morbihan	"IV"
45_1	#45	Gulf of Morbihan	"II"
45_2	#45	Gulf of Morbihan	"II"
45_3	#45	Gulf of Morbihan	"II"
45_4	#45	Gulf of Morbihan	"II"