

Spatial distribution and lability of sedimented organic matter in the surface sediments of Admiralty Bay (King George Island, Antarctic Peninsula)

Bruno Deflandre^{1,*}, Adriana Galindo Dalto², Olivier Maire¹, Sabine Schmidt¹, Sabrina Bichon¹, Laurence Costes¹, Dominique Poirier¹, Karine Charlier¹, Andre Monnerat Lanna², Lúcia de Siqueira Campos², Helena Passeri Lavrado², Eduardo de Almeida Xavier², Antoine Grémare¹ and Yocie Yoneshigue-Valentin²

MOTIVATION

The French Brazilian cooperation between INCT-APA/UFRJ (Brasil) and UMR 5805 EPOC/UB (France) consists in investigating the role of biodiversity on the mineralization of organic matter (OM) in Admiralty Bay sediments (King George Island, Antarctic Peninsula). The characterization of relationships between (1) the diversity of benthic fauna, (2) sediment bioturbation processes, and (3) biogeochemical fluxes at the sediment-water interface is essential to better understand the consequences of a change in benthic biodiversity resulting from global changes on the ecological and biogeochemical functioning of Antarctic coastal ecosystems.

STRATEGY - APPROACH

The link between the diversity of benthic fauna, bioturbation processes and biogeochemical fluxes is investigated by using a hierarchical approach, which considers that the intensity of OM mineralization results from the superposition of the effects of different types of factors (Figure 1).

The first stage of this work aims at assessing the spatial variability of the main characteristics of sedimentary OM and its lability.

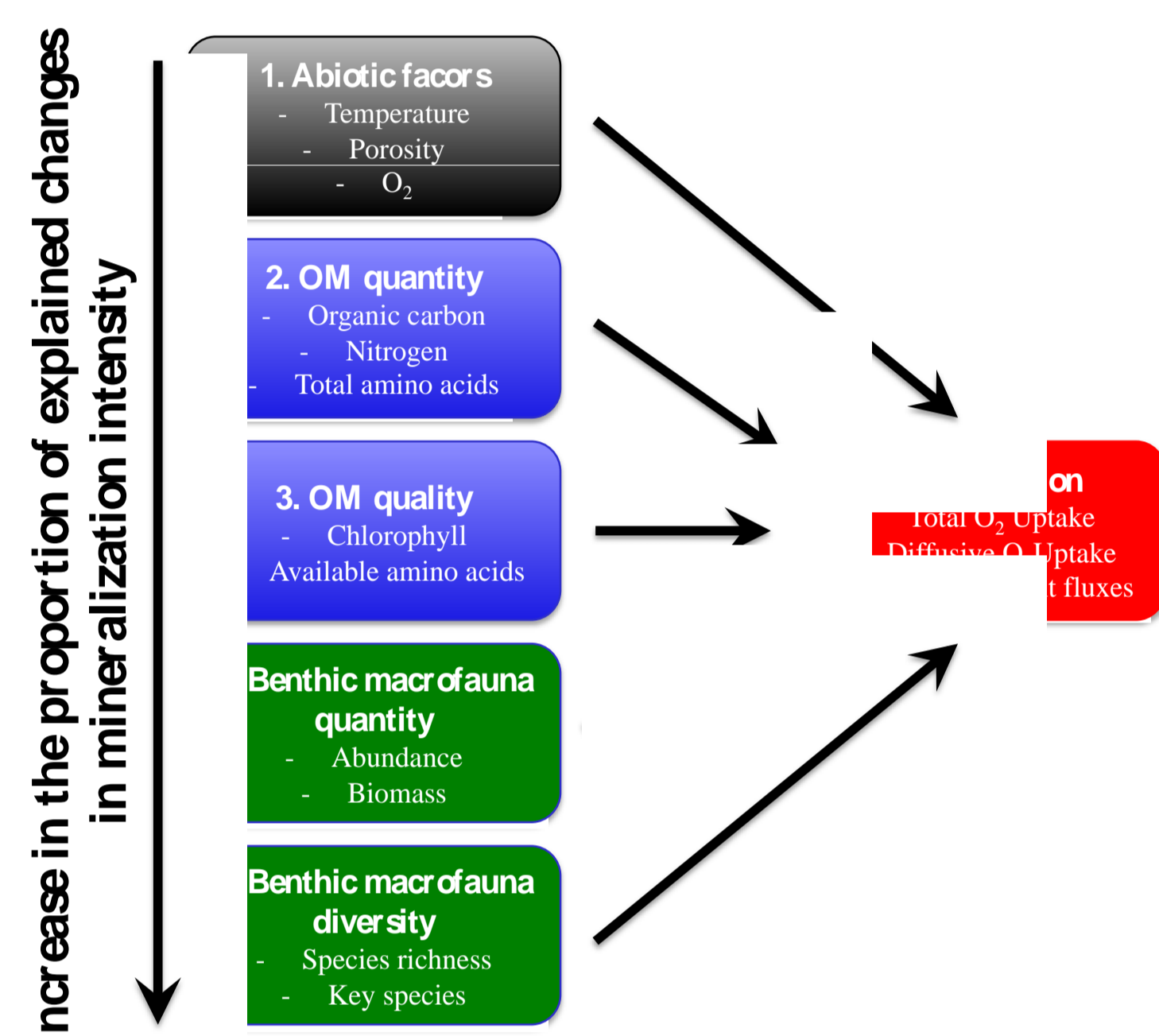


Figure 1: Description of the hierarchical approach used in this work to investigate the relative importance of the main potential factors controlling OM mineralization processes

STUDY SITE – SAMPLING

The Admiralty Bay is located on the southern coastline of King George Island (South Shetland Islands) close to the northern tip of the Antarctic Peninsula (Figure 2).

Sediments cores were collected during the 2012 austral summer. Organic carbon (OC) and total nitrogen (N), total and enzymatically hydrolysable amino acids (THAA, EHA), chloropigments (and their degradation products) and $\delta^{13}C_{OC}$ were measured in the top sediment layer (~0-1 cm) at 53 stations located within the three inlets of Admiralty Bay. These samples are the only ones that escaped the destruction of the Brazilian Station, *Comandante Ferraz*, in February 2012.

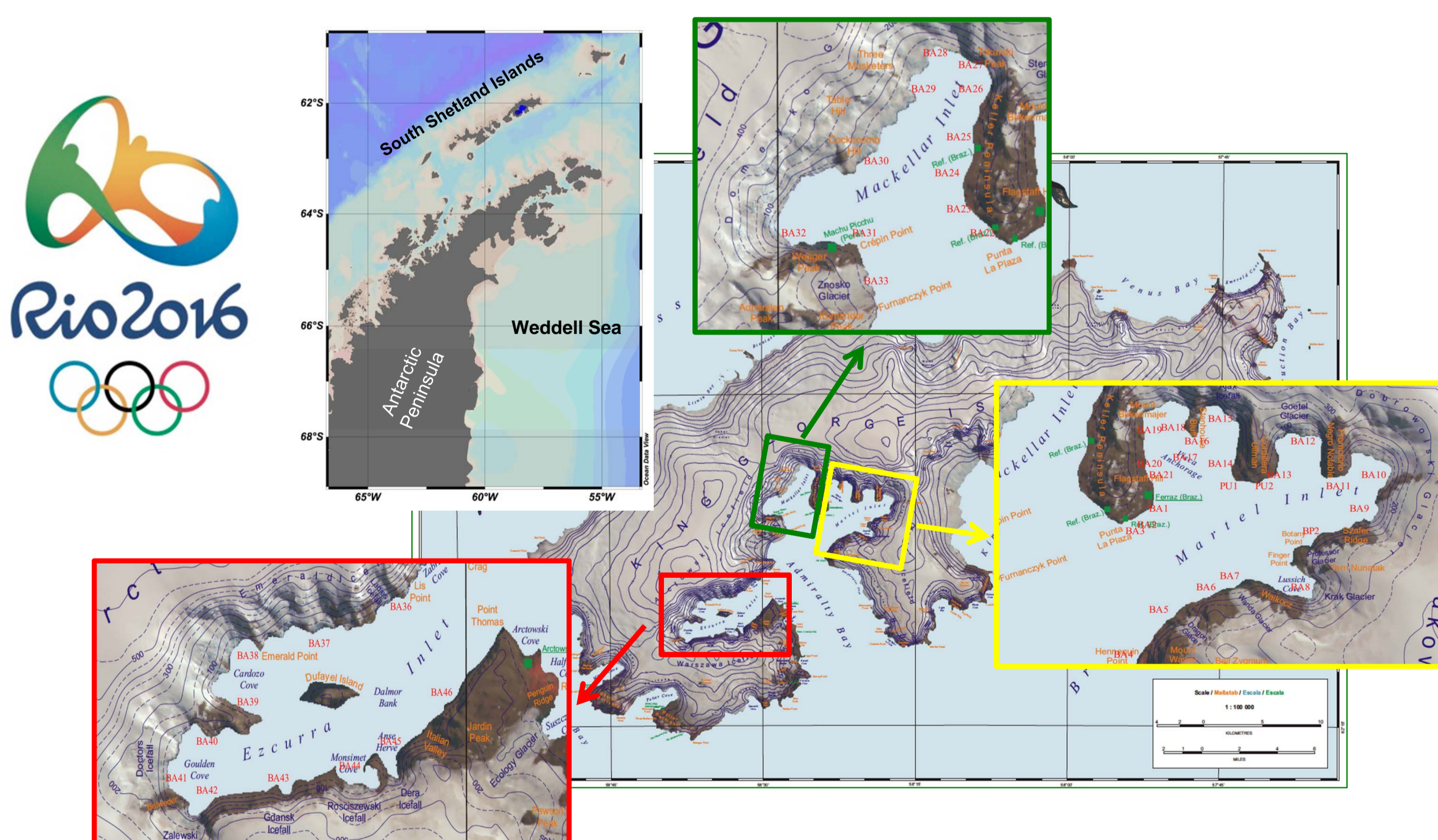


Figure 2: Map of the Admiralty Bay showing the position of study sites within the three main inlets of the bay: Mackellar inlet, Martel inlet and Ezcurra Inlet (adapted from IPG & LAPAG, nov. 2001).

RESULTS

Results clearly show an important spatial variability of OM descriptors throughout the Admiralty Bay. Based on the main characteristics of sedimentary organics, the inlets are significantly different (ANOSIM, Global $r=0.24$, $p<0.001$). Organic C contents were quite low in the different inlets of Admiralty Bay as observed in other Antarctic areas although the highest contents were measured in areas enriched in macroalgae and close to the Brazilian Scientific Station (Table 1). Total N had a similar pattern with levels 3 times higher close to the Brazilian Station. The sediments consisted mainly of silty muds but fine sands have also been found in some areas in the vicinity of glaciers or at the entrance of inlets. However, the observed differences in OM descriptors cannot be only explained by sediment grain size.

Table 1: Main characteristics of sedimented organics in the surface sediments of Admiralty Bay (PRI= pigment ratio index = chl a / (chl a + phaeo a)).

	Median grain size	OC	N	C/N	$\delta^{13}C_{OC}$	Chl a	Pheo a	PRI	Chl a / Phe a	THAA	EHA	EHA/THAA
	μm	%	%	molar	(‰)	$\mu g/g DW$	$\mu g/g DW$	%		nmol/mg	nmol/mg	%
Martel inlet (18 sites)	20	0,32	0,05	7,0	-23,1	11,3	9,2	54	1,43	14,0	4,4	33
Botany Point	9	0,24	0,04	6,7	-23,9	1,4	18,0	7	0,08	10,7	4,1	38
Comandante Ferraz	10	0,86	0,15	6,7	-21,3	3,2	47,2	6	0,07	47,2	13,8	30
Punta Ulmann	13	0,55	0,08	8,1	-22,4	1,5	23,0	6	0,06	25,8	9,9	37
Mackellar inlet (12 sites)	29	0,28	0,04	7,9	-23,1	6,2	13,0	32	1,08	13,8	4,4	33
Ezcurra inlet (11 sites)	26	0,26	0,04	7,6	-21,7	1,0	10,4	8	0,09	14,7	4,9	32

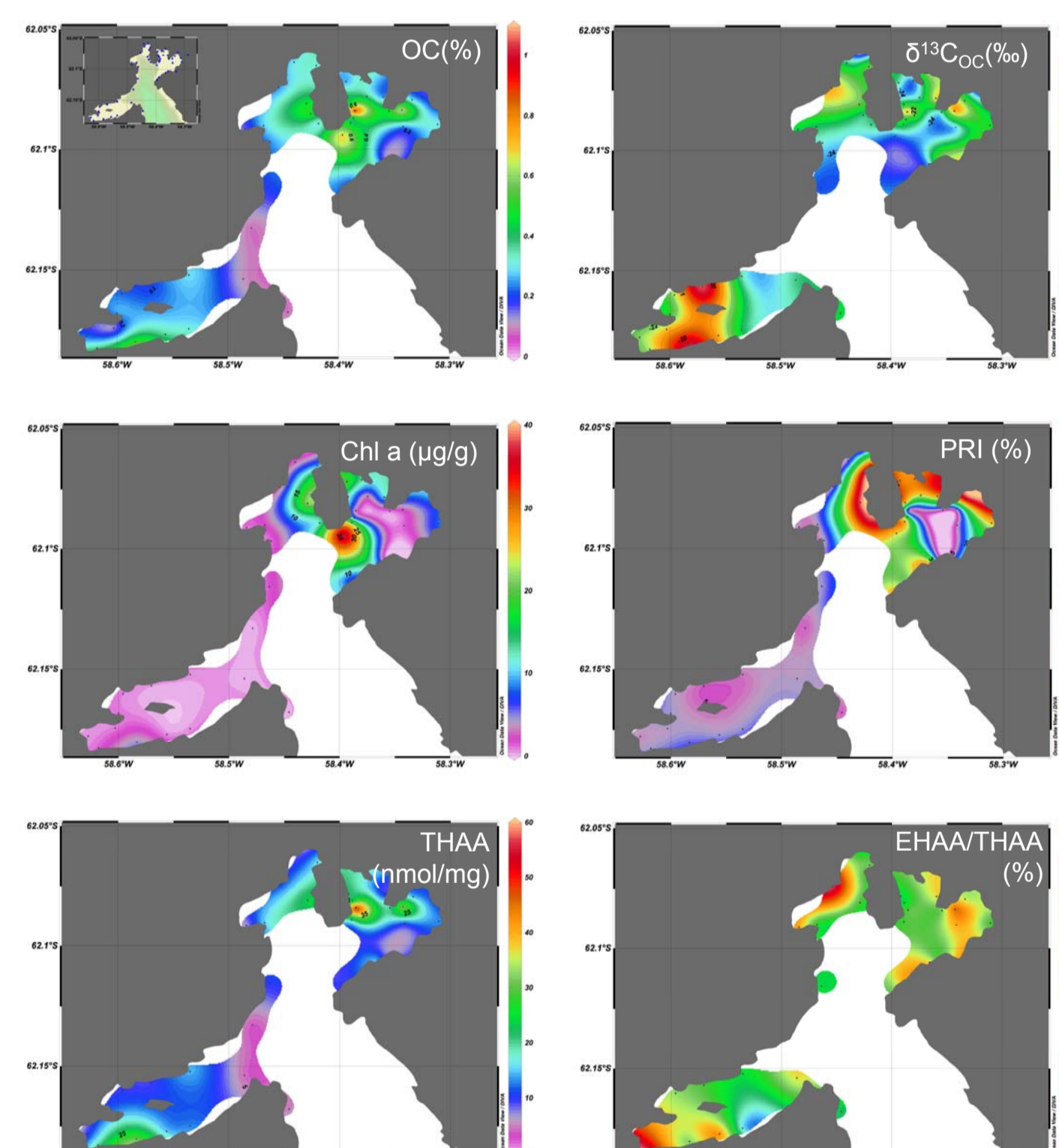


Figure 3: Spatial distributions of main OM descriptors in the surface sediments of Admiralty Bay

The C/N ratios and $\delta^{13}C_{OC}$ values suggest the occurrence of marine OM although a contribution of continental inputs and/or degraded material can be locally observed, as for instance in front of the Glacier Tokarski in the Mackellar inlet. This is coherent with the high values of qualitative descriptors (PRI and EHA/THAA), which indicate a high (1) lability of sedimentary OM, and (2) spatial variability associated to its origin.

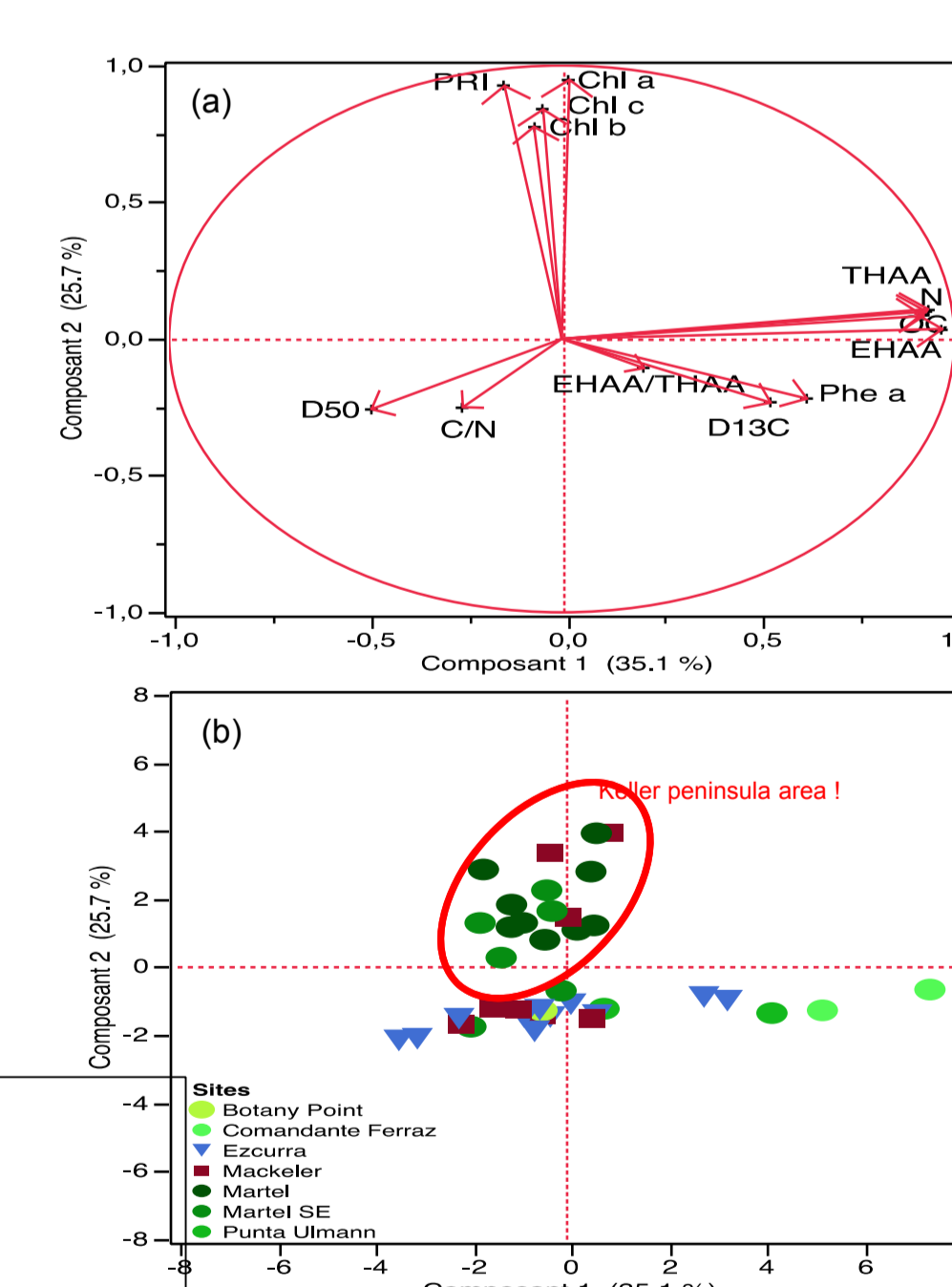


Figure 4: Plot of variables (a) and stations (b) of a Principal Component Analysis used to test the potential link between the origin and the lability of sedimentary OM.

CONCLUSION

Ours results show (1) a low OC content in the surface sediments of Admiralty Bay as observed in other Antarctic zones, (2) a strong spatial heterogeneity of main descriptors of sedimentary OM, (3) the occurrence of labile sedimentary organics with a major contribution of marine OM, and (4) that the fresh and labile plant material was mainly located around the Keller peninsula (Mackellar and Martel inlets). This preliminary work was essential to refine the sampling strategy for the field trip scheduled in Jan. 2016. Our next field work is scheduled in the upwelling region of Cabo Frio (Brasil) in January & July 2015.

French partners were funded by Europe (FEDER-OSQUAR, I3-JERICO), INSU (EC2CO-PNEC, LEFE-CYBER), CNRS, University of Bordeaux 1 (BQRs) and Région Aquitaine (OSQUAR, FEBBA). Brazilian partners were funded by Brazilian Antarctic Program (PROANTAR), Federal University of Rio de Janeiro (UFRJ), National Council for Scientific and Technological Development (CNPq), National Institutes of Science and Technology, Program (INCT), Carlos Chagas Filho Research Support Foundation (FAPERJ).