



HAL
open science

Carbon and silica megasink in deep-sea sediments of the Congo terminal lobes

Christophe Rabouille, B. Dennielou, François Baudin, Mélanie Raimonet, L. Droz, A. Khripounoff, P. Martinez, L. Mejanelle, P. Michalopoulos, L. Pastor, et al.

► **To cite this version:**

Christophe Rabouille, B. Dennielou, François Baudin, Mélanie Raimonet, L. Droz, et al.. Carbon and silica megasink in deep-sea sediments of the Congo terminal lobes. *Quaternary Science Reviews*, 2019, 222, pp.105854. 10.1016/j.quascirev.2019.07.036 . hal-02429997

HAL Id: hal-02429997

<https://hal.science/hal-02429997>

Submitted on 13 Apr 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NoDerivatives| 4.0 International License

1
2
3 **Carbon and silica megasink in deep-sea sediments**
4 **of the Congo terminal lobes**
5

6 **C. Rabouille^{1*}, B. Dennielou², F. Baudin³, M. Raimonet⁴, L. Droz⁵, A. Khripounoff⁶, P.**
7 **Martinez⁷, L. Mejanelle⁸, P. Michalopoulos⁹, L. Pastor⁶, A. Pruski⁸, O. Ragueneau⁴, J-L.**
8 **Reyss¹, L. Ruffine², J. Schnyder³, E. Stetten³, M. Taillefert¹⁰, J. Tourolle⁶ and K. Olu⁶**
9

10
11 ¹Laboratoire des Sciences du Climat et de l'Environnement, UMR CEA-CNRS-UVSQ 8212 et
12 IPSL, Université Paris-Saclay, Avenue de la Terrasse, 91190 Gif sur Yvette, France

13 ²Unité de Recherche Géosciences Marines, IFREMER, 29280 Plouzané, France

14 ³Institut des Sciences de la Terre de Paris, Sorbonne Université, CNRS, UMR 7193, 4 Place
15 Jussieu, 75005 Paris, France

16 ⁴Laboratoire des sciences de l'Environnement Marin, UMR UBO-CNRS, Institut Universitaire
17 Européen de la Mer, 29280 Plouzané, France

18 ⁵Laboratoire Domaines Océaniques, UMR UBO-CNRS6538, Institut Universitaire Européen de
19 la Mer, 29280 Plouzané, France

20 ⁶IFREMER Centre Bretagne, Unité de Recherche Etude des Ecosystèmes Profonds, (REM-EEP-
21 LEP), 29280 Plouzané, France

22 ⁷Environnements et Paléoenvironnements Océaniques et Continentaux, Université de Bordeaux, UMR
23 5805, Allée Geoffroy St Hilaire, 33615 Pessac Cedex, France

24 ⁸Laboratoire d'Ecogéochimie des Environnements Benthiques, Sorbonne Université, CNRS,
25 UMR 8222, Observatoire Océanologique, 66650 Banyuls-sur-Mer, France

26 ⁹Institute of Oceanography, Hellenic Center for Marine Research, 46.7 km Athens-Sounion An,
27 Anavyssos, 19013, Greece

28 ¹⁰School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Dr., Atlanta,
29 GA 30332, USA

30
31 Corresponding author: Christophe Rabouille (rabouill@lsce.ipsl.fr) Orcid :
32 <https://orcid.org/0000-0003-1211-717X>

33 **Key Points:**

- 34 • Sediments located at the termination of Congo Canyon and channel-levee system are a
35 [large sink of organic carbon \(0.35 TgC/yr\) and amorphous silica \(0.11 TgSi/yr\)](#)
- 36 • These sediments collect and store in the deep-sea (~5 km depth) 18 and 35% of Congo
37 River organic carbon and amorphous silica inputs, respectively
- 38 • Organic carbon burial in these sediments increases OC burial in the entire South Atlantic
39 deep basin (>3000m) by 19% for a surface area <0.01%

- Burial efficiencies in these megasinks are 85% for OC and 73% for aSi

Keywords:

Present; Paleoceanography; South Atlantic; Inorganic geochemistry; Organic geochemistry; Sedimentology-marine cores;

44

45

46

Abstract

Carbon and silicon cycles at the Earth surface are linked to long-term variations of atmospheric CO₂ and oceanic primary production. In these cycles, the river-sea interface is considered a biogeochemical hotspot, and deltas presently receive and preserve a major fraction of riverine particles in shallow water sediments. In contrast, periods of glacial maximum lowstand were characterized by massive exports of sediments to the deep-sea via submarine canyons and accumulation in deep-sea fans. Here, we calculate present-day mass balances for organic carbon (OC) and amorphous silica (aSi) in the terminal lobe complex of the Congo River deep-sea fan as an analog for glacial periods. We show that this lobe complex constitutes a megasink with the current accumulation of 18 and 35% of the OC and aSi river input, respectively. This increases the estimates of organic carbon burial by 19% in the South Atlantic Ocean in a zone representing less than 0.01% of the basin. These megasinks might have played a role in carbon trapping in oceanic sediments during glacial times.

60

1 Introduction

The carbon cycle regulates atmospheric CO₂ concentration, the major driver of climate variations over different timescales (Cox et al., 2000; Frank et al., 2010; Parrenin et al., 2013). Over the last

64 decade, the coastal ocean, and particularly large river estuaries and deltas, have received
65 increased attention as a biogeochemical hotspot at the interface between the oceanic and
66 continental carbon cycles (Battin et al., 2009; Bauer et al., 2013; Bianchi et al., 2014; Regnier et
67 al., 2013). The silicon cycle is tightly linked to the carbon cycle (Tréguer et al., 2018) with
68 diatom production and export largely contributing to the biological carbon pump and the transfer
69 of particulate carbon from the surface to the deep ocean (Ragueneau et al., 2002). The major
70 role of continent-ocean transfer in the marine silicon cycle has also been recognized (Tréguer
71 and De La Rocha, 2013). As these two cycles are largely intertwined, it is of prime importance to
72 investigate their interaction at the continent-ocean interface (Demaster, 2002; Laruelle et al.,
73 2009).

74 Eustatic sea-level change is a major forcing on continent-ocean sediment transfer and submarine
75 deep-sea fan development as it controls the location of sediment deposition on the shelf during
76 highstands or its delivery to the deep ocean during lowstands (Posamentier and Vail, 1988;
77 Shanmugam and Moiola, 1982; Vail et al., 1977). Though a strict lowstand model of submarine
78 fan development is frequently discussed (Allin et al., 2017; Covault and Graham, 2010; Covault
79 and Fildani, 2014), sea level remains the main control in areas characterized by a large
80 continental shelf like for the Amazon fan (Flood and Piper, 1997), Mississippi (Bouma et al.,
81 1989), Rhone fan (Lombo Tombo et al., 2015) or Danube fan (Constantinescu et al., 2015). In
82 the present highstand ocean, terrestrial particulate organic carbon (OC) and amorphous silica
83 (aSi) are mainly buried and recycled in river deltas (Berner, 1989; Bianchi and Allison, 2009;
84 Bianchi et al., 2014; Blair and Aller, 2012; Burdige, 2005; Hedges and Keil, 1995; Lansard et al.,
85 2009) and continental shelves (80-90%; (Rabouille et al., 2001), and a small fraction of riverine
86 OC and aSi is therefore transported away to continental slopes or the abyssal plain (Canals et al.,

87 2006; Rabouille et al., 2009). In contrast, a larger fraction of continental carbon and silicon was
88 transferred into canyons connected to rivers during glacial period lowstands, as rivers discharged
89 closer to shelf breaks and slopes (Schlünz et al., 1999; Tsandev et al., 2010). As a result, the
90 exposed continental shelf of the Amazon (Goni, 1997; Keil et al., 1997) or the Mississippi
91 (Burdige, 2005; Newman et al., 1973) was bypassed, and deep-sea fans acted as main carbon and
92 silicon repository during the glacial period. However, these deep-sea repositories are presently
93 inactive making impossible to understand lowstand source-to-sink processes for OC and aSi.

94 The Congo River is the world's second largest river by its discharge and ranks fifth by its
95 particulate organic carbon input to the ocean (Milliman, 1991; Spencer et al., 2014). It is the only
96 major river directly connected to an active canyon enabling a large amount of its sediment load
97 to bypass the shelf and to be conveyed through the canyon to the deep-sea channel-levees by
98 turbidity current (Babonneau et al., 2002; Dennielou et al., 2017). This direct transfer thereby
99 makes the repository zone named Congo terminal lobes (Mulder and Etienne, 2010; Savoye et
100 al., 2009) excellent analogs to understand the functioning and the significance of river-sea fluxes
101 of carbon and silicon in a lowstand ocean. Indeed, a large and unknown fraction of the 1.9 Tg
102 OC y^{-1} ($1\text{Tg} = 10^{12}\text{ g}$) and 0.33 Tg aSi y^{-1} exported by the Congo River into the Atlantic Ocean is
103 presently transported by turbidity currents over 1000 km along the submarine canyon and deep-
104 sea channel (Azpiroz-Zabala et al., 2017; Khripounoff et al., 2003; Vangriesheim et al., 2009).
105 Previous estimations of the organic carbon and amorphous silica accumulation in the Congo lobe
106 complex (Rabouille et al., 2009; Raimonet et al., 2015; Stetten et al., 2015) lacked a detailed
107 survey of the lobe complex morphology, accurate sedimentation rates, and estimates of the
108 surface area involved to precisely determine the fate of OC and aSi. In this paper, we use a
109 multidisciplinary dataset including detailed remotely operated vehicles (ROV) mapping,

110 sediment characteristics and composition together with sedimentation rates over the last century,
111 *in situ* benthic chamber fluxes, and sediment traps to quantify the fate of deposited OC and aSi in
112 the Congo lobe complex. This leads to the calculation of a mass balance (burial and recycling) of
113 terrestrial OC and aSi for the lobe complex. We further estimate the proportion of terrestrial
114 amorphous silica and organic carbon from the Congo River trapped in the terminal lobes sink
115 and the importance of this previously unknown C and Si sink in the South Atlantic Ocean for the
116 present and extrapolate to the glacial periods.

117 **2. Materials and Methods**

118 2.1. Location and background

119 The present Congo fan lobe complex includes five successive amalgamated lobes developed
120 during the last 4000 years (Denniellou et al., 2017; Picot, 2015). Annual and powerful turbidity
121 currents feeding the lobe complex have been recorded and monitored in the canyon (Heezen et
122 al., 1964) and the deep-sea channel (Azpiroz-Zabala et al., 2017; Khripounoff et al., 2003;
123 Vangriesheim et al., 2009), but the flux of sediment to the lobe complex is difficult to estimate
124 because of the pulsed and unpredictable nature of these turbidity currents. Sediments record the
125 deposition of these currents as exemplified by the counting of turbidites in sediment cores from
126 the lobe complex combined with ^{210}Pb chronology which shows that the recurrence time of
127 deposits by turbidity currents ranges between 6 and 17 years (Denniellou et al., 2017; Picot,
128 2015).

129

130 2.2. Methods for mass balance

131 Two expeditions were carried out in February 2011 (Olu, 2011) and December 2011
132 (Rabouille, 2011). State of the art methods were used for assessing mass balances in the terminal
133 lobes of the Congo deep-sea fan. Most data were already published in several papers (see section
134 3 for references) except sediment trap fluxes, DSi benthic fluxes and aSi sediment content
135 (methods in Supplementary Material). Recycling rates of OC and aSi were calculated from *in*
136 *situ* measurements of total oxygen uptake (TOU) and dissolved silica (DSi) benthic fluxes with a
137 benthic chamber lander (Khripounoff et al., 2006). Uncertainty on TOU values was calculated
138 from variability among 3 chambers during the same deployment (5-10%) and was propagated as
139 relative uncertainty to the DSi flux. In order to recalculate OC mineralization rates, a C/O₂ (C/O₂
140 = 1-2*N/C; Van Cappellen and Wang, 1996) molar ratio of 0.9 was used corresponding to the
141 average observed C/N of 15-20 observed in the area (Stetten et al., 2015). The aSi dissolution
142 rates were assumed similar to measured dissolved silica fluxes. Burial was estimated by
143 multiplying the measured sedimentation rates by porosity and the organic carbon or amorphous
144 silica content (Congolobe group et al., 2017; Stetten et al., 2015; Raimonet et al., 2015) with an
145 uncertainty calculated using 30% variability on sedimentation rates and 5% for the average OC
146 (Baudin et al., 2017a; Baudin et al., 2017b; Stetten et al., 2015) or aSi (Raimonet et al., 2015)
147 concentrations (see Supplementary Material for details) . Vertical fluxes of OC and aSi were
148 measured in 2011 (unpublished data) using sediment traps deployed at 35 m above sea floor for a
149 year at the Congolobe site without any noticeable turbidity current (Supplementary Material).
150 Therefore, sediment traps have measured the ambient “non-turbiditic” vertical flux. Another
151 sediment trap array was deployed in a nearby site in 2003-2004 (site Bio-D, 200 km east of the
152 lobe complex; Rabouille et al., 2009). In addition, a particular effort was made to estimate the

153 lobe complex perimeter and surface areas of the five lobes using multibeam acoustic backscatter
154 and sub-bottom profiler imagery (Denniellou et al., 2017; and Supplementary Materials).

155 In this paper, we used the classical method for calculating the input of OC and aSi to the lobe
156 complex by summing independent estimates of recycling and burial fluxes (Burdige, 2006):

157
$$\text{Input to the lobe complex} = \text{recycling flux} + \text{burial flux} \quad (\text{Eq. 2})$$

158 As sedimentation rates were calculated from ^{210}Pb chronologies, covering a period of time of
159 about a century (Congolobe group, 2017), the burial timescale encompasses several turbidity
160 events (return time of 6-17 years), and is thus a fair estimate of average burial. Furthermore,
161 since turbiditic activity in the lobe zone was absent throughout 2011 as recorded by sediment
162 traps, we can reasonably assume that recycling is not biased by a pulse input of new turbiditic
163 material and fairly reflects recycling between turbidity events. The OC and aSi total input fluxes
164 were thus computed using the sum of recycling and burial fluxes for each lobe multiplied by its
165 surface area. They were summed to determine the total inputs of OC and aSi to the lobe
166 complex.

167

168 **3 Results: cycling and burial fluxes in the terminal lobe system**

169 **3.1 Recycling of OC and aSi derived from benthic chamber measurements**

170 TOU and DSi fluxes ranged between 5.4 and 9.6 mmol O₂ m⁻² d⁻¹ and between 0.6 and 1.9 mmol
171 Si m⁻² d⁻¹ respectively at the different stations along the lobe complex (Table 1; Olu et al., 2017;
172 Raimonet et al., 2015). TOU fluxes were up to one order of magnitude higher than those
173 recorded in the South Atlantic tropical abyssal plain (0.5-1 mmol O₂ m⁻² d⁻¹; Wenzhöfer and

174 Glud, 2002), whereas the DSi fluxes **were** comparable to fluxes measured in the Equatorial
175 Atlantic (Ragueneau et al., 2009).

176 3.2 Burial flux of OC and aSi in terminal lobe complex sediments

177 High sedimentation rates due to the deposition of turbidites (0.5-1 cm y⁻¹; Congolobe group et
178 al., 2017; Rabouille et al., 2009) were recorded over the entire lobe complex. The feeding
179 channel of lobe 5 (the most distal and recent lobe) displayed sedimentation rate of 12 cm y⁻¹
180 (Table 1). The sedimentation rates were on average three to four orders of magnitude higher than
181 those in the surrounding abyssal plain (Congolobe group et al., 2017; Mollenhauer et al., 2004;
182 Stetten et al., 2015). The lobe complex sediments were characterized by large OC concentrations
183 of OC (Stetten et al., 2015; Baudin et al., 2017b), exceeding 3% as compared to 0.5% in the
184 Atlantic sediments of the central basin (Mollenhauer et al., 2004). In turn, aSi concentrations
185 (0.9-1.3% Si dry weight; Raimonet et al., 2015) were **in the same range as those** in the abyssal
186 plain sediments of Eastern Equatorial Atlantic (Ragueneau et al., 2009). As recently proposed by
187 Rahman et al. (2016), aSi concentrations **in lobe sediments** may have been underestimated by a
188 factor of 2-3, because of amorphous silica alteration in the shelf repository (canyon head) **before**
189 **being entrained by** turbidity current. Burial of OC and aSi in terminal lobe sediments showed
190 extremely large fluxes of **38-1560 g C m⁻² y⁻¹ for OC burial and 11-381 g Si m⁻² y⁻¹ for aSi**
191 (Table 1). These fluxes exceeded South Atlantic Basin values at these depths (**>3000m**) by a
192 factor of 2000 for OC (0.06 g C m⁻² y⁻¹; Mollenhauer et al., 2004) and 100 for aSi (maximum 0.4
193 g Si m⁻² y⁻¹; Geibert et al., 2005). OC and aSi burial fluxes were the highest in the feeding
194 channel of lobe 5 (station C, Fig. 1), where sedimentation rates are highest (12 cm y⁻¹;
195 Congolobe group et al., 2017). The OC/aSi molar ratios in buried particles (**average 7.1**) were

196 also consistently high (Table 1), with values that are five times larger than the maximal ratio
197 measured in deep-sea sediments (0.02-1.7; Ragueneau et al., 2002).

198 3.3 Vertical flux of OC and aSi from sediment traps

199 The particulate OC and an aSi rain rate were much lower than the recycling and burial fluxes
200 (Table 1). The OC/aSi molar ratio of the rain rate was 1-2, a much lower value than the measured
201 burial ratio (≈ 7 , Table 1) which was consistent with deep-sea sediment and trap particles OC/aSi
202 ratio (Ragueneau et al., 2002).

203

204 **4 Discussion: Budgets, burial efficiencies and comparison to riverine and marine sources**

205 The striking point of these OC and aSi budgets is the high burial rates (0.35 Tg C y⁻¹ and 0.11 Tg
206 Si y⁻¹) and the large burial efficiencies (70-85%) compared to abyssal plain sediments, where
207 generally only <10% of the OC and aSi rain rates are buried (Burdige, 2007; Ragueneau et al.,
208 2002). In addition, the strong decoupling from the vertical marine flux (1% and 4% of the total
209 OC and aSi input, Table 2) is clear. Previous results have highlighted the terrestrial nature of the
210 lobe complex organic matter (Baudin et al., 2017b; Schnyder et al., 2017; Stetten et al., 2015).

211 The small contribution of marine inputs to the total input corroborates the dominance of canyon
212 inputs to the lobe complex. The comparison of the OC/aSi signature of the buried particulate
213 matter (7.1) to the two possible sources of material (riverine=13 and marine=1.5) also points to
214 the Congo River as the main source of sediments in the lobe complex, with limited decoupling
215 between carbon and silicon during the transfer of particles to the terminal lobes. The OC/aSi
216 decrease of riverine material from 13 to 7 can probably be attributed to preferential recycling of
217 carbon versus silica (Ragueneau et al., 2002) in surficial sediments before burial (Raimonet et

218 al., 2015). Overall, the rapid transfer of Si and C through the canyon leads to an enhanced
219 preservation of Si and C with little decoupling (Raimonet et al., 2015) compared to the strong
220 decoupling occurring during particle settling in the open ocean (Ragueneau et al., 2002). If
221 generalized during glacial periods, this rapid transfer to the deep sea fans through the canyons,
222 may lead to a decrease of biogenic matter deposition and recycling on continental shelves and
223 slopes with the following consequences: long-term decrease of CO₂ production during
224 mineralization of the organic matter, and short term changes of phytoplankton dynamics
225 (diatoms) linked to lower silicic acid recycling from shelves and slopes sediments.

226 The present estimate of OC inputs to the lobe complex (0.42 Tg C y⁻¹) can be compared with
227 recent estimates of canyon particulate export rates (0.5-1.1 Tg C y⁻¹) based on ADCP
228 measurements of canyon turbidity currents at 2000 m water depth, 500 km upstream from the
229 lobe complex (Azpiroz-Zabala et al., 2017). These comparable export rates between two distant
230 sites indicates that the sediment transport along the canyon and deep-sea channel is very efficient
231 and that a significant fraction (up to 50%) of the material transported by turbidity currents may
232 reach the lobe complex located at the far end of the channel-levee system.

233 The Congo lobe complex represents an overlooked sink for organic carbon and amorphous silica
234 in the abyssal Atlantic Ocean. The OC and aSi budgets in the lobe complex are dominated by
235 burial fluxes, 3-4 orders of magnitude larger than those in the surrounding abyssal plain (38-
236 1560 versus 0.06 g C m⁻² y⁻¹ and 11-381 versus 0.15 g Si m⁻² y⁻¹). When compared to the overall
237 burial of OC in the South Atlantic (0-40°S) during the Holocene (Mollenhauer et al., 2004), the
238 accumulation of OC in Congo terminal lobe sediments adds 19% to the estimation of OC burial
239 in this deep ocean basin. This contribution is remarkable given the lobe area represents less than

240 0.01% of the South Atlantic surface area (0-40°S) and indicates that the Congo lobe complex
241 constitutes a megasink of OC in the South Atlantic [which was clearly overlooked in previous](#)
242 [studies due to the lack of knowledge on Congo terminal lobes](#). Although slightly less acute, 3%
243 of the total burial of aSi in the South Atlantic occurs in the lobe complex. This number could be
244 raised to 4-6% if aSi was underestimated as suggested by Rahman et al. (2016). Burial fluxes of
245 this dominantly terrestrial OC (70-90%; Schnyder et al., 2017; Stetten et al., 2015) and aSi, that
246 represent 18% and 35% of the Congo River discharge of POC and aSi, respectively, are in the
247 same range of estimates for deltaic sediments, i.e. 22% of river OC input preserved (Burdige,
248 2005; Hedges and Keil, 1995). The estimated burial of terrigenous OC in the lobe complex (0.3
249 Tg C y⁻¹) represents about 0.7% of the overall terrestrial OC burial in the global abyssal ocean
250 (Schlünz and Schneider, 2000).

251 [The present-day export to the abyssal depth of Congo River sediments through the presently](#)
252 [active connection to its canyon, and therefore of embedded OC and aSi, is similar to the](#)
253 [lowstand functioning of major deep-sea fans \(Vail et al., 1977\), e.g. Amazon fan \(Flood and](#)
254 [Piper, 1997\)](#). It may therefore be a representative glacial analogue for terrestrial OC and aSi
255 [export when rivers discharged at the shelf break and active canyons carried a large proportion of](#)
256 [their load to the continental rise and abyssal plain \(Schlünz et al., 1999\)](#). If, as suggested in
257 previous studies (Burdige, 2005), the same fraction of the carbon load (18%) of other major
258 tropical rivers of the Atlantic such as the Amazon (5 Tg C y⁻¹; Moreira-Turcq et al., 2003) or the
259 Orinoco Rivers (1 Tg C y⁻¹; Mora et al., 2014) was buried in the deep Atlantic basin during
260 glacial times, this burial flux would equal the present-day carbon preservation in the entire South
261 Atlantic basin and significantly increase the global oceanic carbon sink during these low CO₂
262 periods. [The OC burial estimate for the Amazon fan during glacial times \(3.7 Tg C/yr; Schlünz et](#)

263 al., 1999) clearly substantiate this calculation. These megasinks may also contribute to enhance
264 OC storage during glacial by better preservation (burial efficiencies of 85%, Table 2) as
265 proposed by Cartapanis et al. (2016). These findings emphasize the need to better constrain these
266 localized but intense megasinks in order to understand the natural sinks in the carbon and silica
267 cycles during both modern and glacial times.

268 **5 Conclusions**

269 In this paper, we have shown that the terminal lobes of the Congo deep-sea fan constitute a
270 singular point in the South Atlantic Ocean corresponding to a mega burial site for organic carbon
271 and amorphous silica. It represents 19% of the entire burial of the South Atlantic Ocean for OC
272 despite covering less than 0.01‰ of the total surface area. By comparing burial in lobe sediments
273 with the Congo River input, we conclude that 18% of organic carbon inputs and 35% of
274 amorphous silica inputs from the Congo River are buried in sediments, which thus constitutes a
275 major repository for exported riverine material. This is largely due to the present and active
276 connection of the Congo canyon to the River estuary. This situation may represent a fair
277 analogue to glacial period river export when most rivers were closely connected to their canyons
278 due to the low sea level. It is expected that burial of OC and aSi in these terminal lobe regions of
279 other rivers was much larger at this period.

280 **Conflict of interest**

281 The authors state that there are no real or perceived conflicts of interests neither financial nor
282 institutional.

283 **Data**

284 Original data were all published with the original papers (see references in text) or are contained
285 in the Supplementary Material. The entire dataset is currently being deposited in the [SEANOE](#)
286 [data base \(IFREMER\)](#).

287 **Acknowledgments**

288 The authors thank the captains and crews of the RV Pourquoi Pas? And the ROV teams during
289 the WACS and Congolobe cruises. We thank two external reviewers (D. Conley, J.E. Cloern)
290 who kindly provided useful comments to this paper. We acknowledge funding from ANR
291 Congolobe (ANR Blanc SIMI5-6, no.11BS56030), from IFREMER (Project “Biodiversité et
292 dynamique des écosystèmes profonds, impacts”), from CEA through LSCE (to CR) and from the
293 U.S. National Science Foundation Chemical Oceanography Program (OCE-0831156 to MT).

294

295

296 **References**

297

- 298 Allin, J. R., Hunt, J. E., Clare, M. A., & Talling, P. J. (2017). Eustatic sea-level controls on the flushing of a shelf-
299 incising submarine canyon, *GSA Bulletin*, 130, 222-237, doi: <https://doi.org/10.1130/B31658.1>.
- 300 Azpiroz-Zabala, M., Cartigny, M. J. B., Talling, P. J., Parsons, D. R., Summer, E. J., Clare, M. A., Simmons, S. M.,
301 Cooper, C., & Pope, E. L. (2017). Newly recognized turbidity current structure can explain prolonged flushing of
302 submarine canyons, *Sci. Adv.*, 3, e1700200, doi: 10.1126/sciadv.1700200.
- 303 Babonneau, N., Savoye, B., Cremer, M., & Klein, B. (2002). Morphology and architecture of the present canyon and
304 channel system of the Zaire deep-sea fan, *Mar. Petrol. Geol.*, 19, 445-467.
- 305 Battin, T. J., Luyssaert, S., Kaplan, L. A., Aufdenkampe, A. K., Richter, A., & Tranvik, L. J. (2009). The boundless
306 carbon cycle, *Nature Geoscience*, 2, 598-600.
- 307 Baudin, F., Martinez, P., Dennielou, B., Charlier, K., Marsset, T., Droz, L., & Rabouille, C. (2017a). Organic carbon
308 accumulation in modern sediments of the Angola basin influenced by the Congo deep sea fan, *Deep-Sea Res. II:*
309 *Top. Stud. Oceanogr.*, 142, 64-74.
- 310 Baudin, F., Stetten, E., Schnyder, J., Charlier, K., Martinez, P., Dennielou, B., & Droz, L. (2017b). Origin and
311 distribution of the organic matter in the distal lobe of the Congo deep-sea fan – A Rock-Eval survey, *Deep-Sea*
312 *Res. II: Top. Stud. Oceanogr.*, 142, 75-90.
- 313 Bauer, J. E., Cai, W. J., Raymond, P. A., Bianchi, S. T., Hopkinson, C. S., & Regnier, P. A. G. (2013). The changing
314 carbon cycle of the coastal ocean, *Nature*, 504, 61-70.
- 315 Berner, R. A. (1989). Biogeochemical cycles of carbon and sulfur and their effect on atmospheric oxygen over
316 phanerozoic time, *Pal. Pal. Pal.*, 73, 97-122.

317 Bianchi, S. T., & Allison, M. A. (2009). Large-river delta-front estuaries as natural “recorders” of global
318 environmental change, *Proc. Nat. Acad. Sci.*, *106*, 8085–8092.

319 Bianchi, S. T., Allison, M. A., & Cai, W. J. (2014), Biogeochemical dynamics at major river-coastal interfaces:
320 linkages with Global Change, 649 pp., Cambridge University Press, New York.

321 Blair, N. E., & Aller, R. C. (2012). The fate of terrestrial organic carbon in the marine environment, *Ann. Rev. Mar.*
322 *Sci.*, *4*, 401-423, doi: doi.org/10.1146/annurev-marine-120709-142717. .

323 Bouma, A. H., Coleman, J. H., Stelting, C. E., & Kohl, B. (1989). Influence of relative sea level changes on the
324 construction of the Mississippi fan, *Geo-Marine Letters*, *93*, 161-170, doi: https://doi.org/10.1007/BF02431043.

325 Burdige, D. J. (2005). Burial of terrestrial organic matter in marine sediments: A re-assessment, *Glob. Biogeochem.*
326 *Cycles*, *19*, GB4011, doi: doi:10.1029/2004GB002368.

327 Burdige, D. J. (2006), Geochemistry of marine sediments, 609 pp., Princeton University Press, Princeton, USA.

328 Burdige, D. J. (2007). Preservation of Organic Matter in Marine Sediments: Controls, Mechanisms and an
329 Imbalance in Sediment Organic Carbon Budgets?, *Chem. Rev.*, *107*, 467-485, doi:
330 http://dx.doi.org/10.1021/cr050347q.

331 Canals, M., Puig, P., Durrieu de Madron, X., Heussner, S., Palanques, A., & Fabres, J. (2006). Flushing submarine
332 canyons, *Nature*, *444*, doi:10.1038/nature05271.

333 Cartapanis, O., Bianchi, D., Jaccard, S.L. and Galbraith, E.D. (2015) Global pulses of organic carbon burial in deep-
334 sea sediments during glacial maxima. *Nature Comm.* *7*:10796.

335 Congolobe group, et al. (2017). The Congolobe project, a multidisciplinary study of Congo deep-sea fan lobe
336 complex: Overview of methods, strategies, observations and sampling, *Deep-Sea Res. (II) Topic. Stud. in*
337 *Oceanogr.*, *142*(7-24).

338 Constantinescu, A. M., Toucanne, S., Dennielou, B., Jorry, S. J., Mulder, T., & Lericolais, G. (2015). Evolution of
339 the danube deep-sea fan since the last glacial maximum: New insights into Black Sea water-level fluctuations,
340 *Mar. Geol.*, *367*, 50-68, doi: http://dx.doi.org/10.1016/j.margeo.2015.05.007.

341 Covault, J. A., & Graham, S. A. (2010). Submarine fans at all sea-level stands: Tectono-morphologic and climatic
342 controls on terrigenous sediment delivery to the deep sea, *Geology*, *38*, 939-942, doi:
343 https://doi.org/10.1130/G31081.1.

344 Covault, J. A., & Fildani, A. (2014), Continental shelves as sediment capacitors or conveyors: source-to-sink
345 insights from the tectonically active Oceanside shelf, southern California, USA, edited, p. 315, Geological
346 Society of London Memoirs.

347 Cox, P. M., Betts, R. A., Jones, C. D., Spall, S. A., & Totterdell, I. J. (2000). Acceleration of global warming due to
348 carbon-cycle feedbacks in a coupled climate model, *Nature*, *408*, 184-187.

349 Demaster, D. J. (2002). The accumulation and cycling of biogenic silica in the Southern Ocean: revisiting the marine
350 silica budget, *Deep-Sea Research II*, *49*, 3155-3167.

351 Dennielou, B., et al. (2017). Morphology, structure, composition and build-up processes of the active Congo
352 channel-mouth lobe complex with inputs from remotely operated underwater vehicle (ROV) multibeam and
353 video surveys, *Deep-Sea Res. (II): Top. Stud. Oceanogr.*, *142*, 25-49.

354 Flood, R. D., & Piper, D. J. W. (1997). Amazon fan sedimentation: the relationship to equatorial climate change,
355 continental denudation, and sea-level fluctuations, *Proceedings of the Ocean Drilling Program, Scientific*
356 *Results*, *155*, 653-675.

357 Frank, D. C., Esper, J., Raible, C. C., Buntgen, U., Trouet, V., Stocker, B., & Joos, F. (2010). Ensemble
358 reconstruction constraints on the global carbon cycle sensitivity to climate, *Nature*, *463*, 527-230, doi:
359 doi:10.1038/nature08769.

360 Geibert, W., Rutgers van Der Loeff, M. M., Usbeck, R., Gersonde, R., Kuhn, G., & Seeberg-Everfeldt, J. (2005).
361 Quantifying the opal belt in the Atlantic and southeast Pacific sector of the Southern Ocean by means of 230Th
362 normalization, *Glob. Biogeochem. Cycle*, *19*, GB4001, doi: doi:10.1029/2005GB002465.

363 Goni, M. A. (1997), Records of terrestrial organic matter composition in Amazon Fan sediments in Proceedings of
364 the Ocean Drilling Program-Scientific Results, edited by R. D. Flood, D. J. W. Piper and L. C. Peterson, pp. 519-
365 530, Ocean Drill. Program, College Station, Tex.

366 Hedges, J. I., & Keil, R. G. (1995). Sedimentary organic matter preservation: an assessment and speculative
367 synthesis, *Mar. Chem.*, *49*, 81-115.

368 Heezen, B. C., Menzies, R. J., Schneider, E. D., Ewing, W. M., & Granelli, N. C. L. (1964). Congo Submarine
369 Canyon, *AAPG Bulletin*, *48*, 1126–1149.

370 Keil, R. G., Tsamakis, E. C., Wolf, N., Hedges, J. I., & Goni, M. A. (1997), Relationships between organic carbon
371 preservation and mineral surface area in Amazon Fan sediments (Holes 932A and 942A), in Proceedings of the

372 Ocean Drilling Program-Scientific Results, edited by R. D. Flood, D. J. W. Piper and L. C. Peterson, pp. 531-
373 538, Ocean Drill. Program, College Station, Tex.

374 Khripounoff, A., Caprais, J., Crassous, P., & Etoubeau, J. (2006). Geochemical and biological recovery of the
375 disturbed seafloor in polymetallic nodule fields of the Clipperton-Clarion Fracture Zone (CCFZ) at 5,000-m
376 depth, *Limnol. Oceanogr.*, *51*, 2033-2041.

377 Khripounoff, A., Vangriesheim, A., Babonneau, N., Crassous, P., Savoye, B., & Dennielou, B. (2003). Direct
378 observation of intense turbidity current activity in the Zaire submarine valley at 4000 m water depth, *Mar. Geol.*,
379 *194*, 151-158.

380 Lansard, B., Rabouille, C., Denis, L., & Grenz, C. (2009). Benthic remineralization at the land-ocean interface: A
381 case study of the Rhone River (NW Mediterranean Sea), *Estuarine Coastal and Shelf Science*, *81*(4), 544-554,
382 doi: 10.1016/j.ecss.2008.11.025.

383 Laruelle, G. G., et al. (2009). Anthropogenic perturbations of the silicon cycle at the global scale: Key role of the
384 land-ocean transition, *Glob. Biogeochem. Cycle*, *23*, GB4031, doi: doi:10.1029/2008GB003267.

385 Lombo Tombo, S., Dennielou, B., Berné, S., Bassetti, M. A., Toucanne, S., Jorry, S. J., Jouet, G., & Fontanier, C.
386 (2015). Sea-level control on turbidite activity in the Rhone canyon and the upper fan during the Last Glacial
387 Maximum and Early deglacial, *Sediment. Geol.*, *323*, 148-166, doi:
388 <http://dx.doi.org/10.1016/j.sedgeo.2015.04.009>.

389 Milliman, J. D. (1991). Flux and fate of fluvial sediment and water in coastal seas, in Ocean margin processes in
390 global change, edited by R. F. C. Mantoura, J-M. Martin and R. Wollast, pp. 69-91, J. Wiley and sons, Berlin.

391 Mollenhauer, G., Schneider, R. R., Jennerjahn, T., Muller, P. J., & Wefer, G. (2004). Organic carbon accumulation
392 in the South Atlantic Ocean: its modern, mid-Holocene and last glacial distribution, *Glob. Planet. Change*, *40*,
393 249-266.

394 Mora, A., Laraque, A., Moreira-Turcq, P., & Alfonso, J. A. (2014). Temporal variation and fluxes of dissolved and
395 particulate organic carbon in the Apure, Caura and Orinoco rivers, Venezuela, *South Amer. J. Earth Sci.*, *54*, 47-
396 56, doi: <http://dx.doi.org/10.1016/j.jsames.2014.04.010>.

397 Moreira-Turcq, P., Seyler, P., Guyot, J. L., & Etcheber, H. (2003). Exportation of organic carbon from the Amazon
398 River and its main tributaries, *Hydrol. Process.*, *17*, 1329-1344, doi: DOI: 10.1002/hyp.1287.

399 Mulder, T., & Etienne, S. (2010). Lobes in deep-sea turbidite systems: State of the art, *Sediment. Geol.*, *229*, 75-80,
400 doi: 10.1016/j.sedgeo.2010.06.011.

401 Newman, J. W., Parker, P. L., & Behrens, E. W. (1973). Organic carbon ratios in Quaternary cores from the Gulf of
402 Mexico, *Geochim. Cosmochim. Acta*, *37*, 225- 238.

403 Olu, K. (2011). WACS cruise, R/V Pourquoi Pas?, doi: <http://dx.doi.org/10.17600/11030010>.

404 Olu, K., Decker, C., Pastor, L., Caprais, J. C., Khripounoff, A., Morineaux, M., Ain Baziz, M., Menot, L., &
405 Rabouille, C. (2017). Cold-seep-like macrofaunal communities in organic- and sulfide-rich sediments of the
406 Congo deep-sea fan, *Deep-Sea Res. (II) Topic. Stud. in Oceanogr.*, *142*, 180-196.

407 Parenin, F., Masson-Delmotte, V., Kohler, P., Raynaud, D., Paillard, D., Schwander, J., Barbante, C., Landais, A.,
408 Wegner, A., & Jouzel, J. (2013). Synchronous change of atmospheric CO₂ and antarctic temperature during the
409 last deglacial warming, *Science*, *339*, 1060-1063, doi: DOI: 10.1126/science.1226368.

410 Picot, M. (2015). Cycles sédimentaires dans le système turbiditique du Congo: nature et origine (Doctorat Thesis).
411 Université de Bretagne Occidentale, Brest, 368., 368 p pp, Université de Bretagne Occidentale, Brest.

412 Posamentier, H. W., & Vail, P. R. (1988), Eustatic Controls on Clastic Deposition II—Sequence and Systems Tract
413 Models, in Sea-Level Changes: An Integrated Approach, edited by C. K. W. e. al., SEPM Society for
414 Sedimentary Geology,.

415 Rabouille, C. (2011). CONGOLOBE cruise, R/V Pourquoi Pas? , doi: <http://dx.doi.org/10.17600/11030170>.

416 Rabouille, C., Mackenzie, F., & Ver, L. M. (2001). Influence of the human perturbation on carbon, nitrogen and
417 oxygen biogeochemical cycles in the global coastal ocean, *Geochim. Cosmochim. Acta*, *65*, 3615-3639.

418 Rabouille, C., Caprais, J. C., Lansard, B., Crassous, P., Dedieu, K., Reyss, J. L., & Khripounoff, A. (2009). Organic
419 matter budget in the Southeast Atlantic continental margin close to the Congo Canyon: In situ measurements of
420 sediment oxygen consumption, *Deep-Sea Research Part II-Topical Studies in Oceanography*, *56*(23), 2223-
421 2238, doi: 10.1016/j.dsr2.2009.04.005.

422 Ragueneau, O., Dittert, N., Pondaven, P., Treguer, P., & Corrin, L. (2002). Si/C decoupling in the world ocean : is
423 the Southern Ocean different?, *Deep-Sea Res. II*, *49*, 3127-3154.

424 Ragueneau, O., Regaudie-de-Gioux, A., Moriceau, B., Gallinari, M., Vangriesheim, A., Baurand, F., & Khripounoff,
425 A. (2009). A benthic Si mass balance on the Congo margin: Origin of the 4000 m DSi anomaly and implications
426 for the transfer of Si from land to ocean, *Deep Sea Research Part II: Topical Studies in Oceanography*, *56*(23),
427 2197.

428 Raimonet, M., Ragueneau, O., Jacques, V., Corvaisier, R., Moriceau, B., Khripounoff, A., Pozzato, L., & Rabouille,
429 C. (2015). Rapid transport and high accumulation of amorphous silica in the Congo deep-sea fan: a preliminary
430 budget, *J. Mar. Sys.*, *141*, 71-79.

431 Regnier, P. A. G., et al. (2013). Anthropogenic perturbation of the carbon fluxes from land to ocean, *Nat. Geosc.*, *6*,
432 597-607, doi: DOI: 10.1038/NGEO1830.

433 Savoye, B., Babonneau, N., Dennielou, B., & Bez, M. (2009). Geological overview of the Angola-Congo margin,
434 the Congo deep-sea fan and its submarine valleys, *Deep Sea Research Part II: Topical Studies in Oceanography*,
435 *56*(23), 2169.

436 Schlünz, B., & Schneider, R. R. (2000). Transport and terrestrial organic carbon to the oceans by rivers: re-
437 estimating flux and burial rates, *Int. J. Earth Sci.*, *88*, 599-606.

438 Schlünz, B., Schneider, E. D., Muller, P. J., Showers, W. J., & Wefer, G. (1999). Terrestrial organic carbon
439 accumulation on the Amazon deep sea fan during the last glacial sea level low stand, *Chem. Geol.*, *159*, 263-
440 281.

441 Schnyder, J., Stetten, E., Baudin, F., Pruski, A., & Martinez, P. (2017). Palynofacies reveal fresh terrestrial organic
442 matter inputs in the terminal lobes of the Congo deep-sea fan, *Deep-Sea Res. (II) Topical Stud. in Oceanogr.*, *142*,
443 91-108.

444 Shanmugam, G., & Moiola, R. J. (1982). Eustatic control of turbidites and winnowed turbidites, *Geology*, *10*, 231-
445 235, doi: [https://doi.org/10.1130/0091-7613\(1982\)10<231:ECOTAW>2.0.CO;2](https://doi.org/10.1130/0091-7613(1982)10<231:ECOTAW>2.0.CO;2).

446 Spencer, R. G. M., Stubbins, A., & Gaillardet, J. (2014). Geochemistry of the Congo River, estuary and plume, in
447 Biogeochemical dynamics at the major river-coastal interfaces, edited by S. T. Bianchi, M. A. Allison and W. J.
448 Cai, pp. 554-606, Cambridge Univ. Press, New York.

449 Stetten, E., Baudin, F., Reyss, J. L., Martinez, P., Charlier, K., Schnyder, J., Rabouille, C., Dennielou, B., Coston-
450 Guarini, J., & Pruski, A. (2015). Organic matter characterization and distribution in sediments of the terminal
451 lobes of the Congo deep-sea fan: evidence for the direct influence of the Congo River, *Mar. Geol.*, *369*, 182-195.

452 Tréguer, P., & De La Rocha, C. L. (2013). The world ocean silica cycle, *Ann. Rev. Mar. Sci.*, *5*, 477-501, doi:
453 10.1146/annurev-marine-121211-172346.

454 Tréguer, P., et al. (2018). Influence of diatom diversity on the ocean biological carbon pump, *Nat. Geosc.*, *11*, 27-
455 37, doi: doi/10.1038/s41561-017-0028-x.

456 Tsandev, I., Rabouille, C., Slomp, C. P., & Van Cappellen, P. (2010). Shelf erosion and submarine river canyons:
457 implications for deep-sea oxygenation and ocean productivity during glaciation, *Biogeosciences*, *7*(6), 1973-
458 1982, doi: 10.5194/bg-7-1973-2010.

459 Vail, P. R., Mitchum, R. M., Todd, R. G., Widmier, J. M., Thompson III, S., Sangree, J. B., Bubbs, J. N., & Hatelid,
460 W. G. (1977). Seismic stratigraphy and global changes of sea level, in *Seismic stratigraphy—Applications to*
461 *hydrocarbon exploration*, edited by C. E. Payton, pp. 49-212, American Association of Petroleum Geologists
462 Memoir.

463 Van Cappellen, P., & Wang, Y. (1996). Cycling of iron and manganese in surface sediments: a general theory for
464 the coupled transport and reaction of carbon, oxygen, nitrogen, sulfur, iron and manganese, *Amer. J. Sci.*, *296*,
465 197-243.

466 Vangriesheim, A., Khripounoff, A., & Crassous, P. (2009). Turbidity events observed in situ along the Congo
467 submarine channel, *Deep-Sea Res. II*, doi:10.1016/j.dsr1012.2009.1004.1004

468 Wenzhöfer, F., & Glud, R. N. (2002). Benthic carbon mineralization in the Atlantic: A synthesis based on in situ
469 data from the last decade, *Deep-Sea Res. (I)*, *49*, 1255-1279.

470

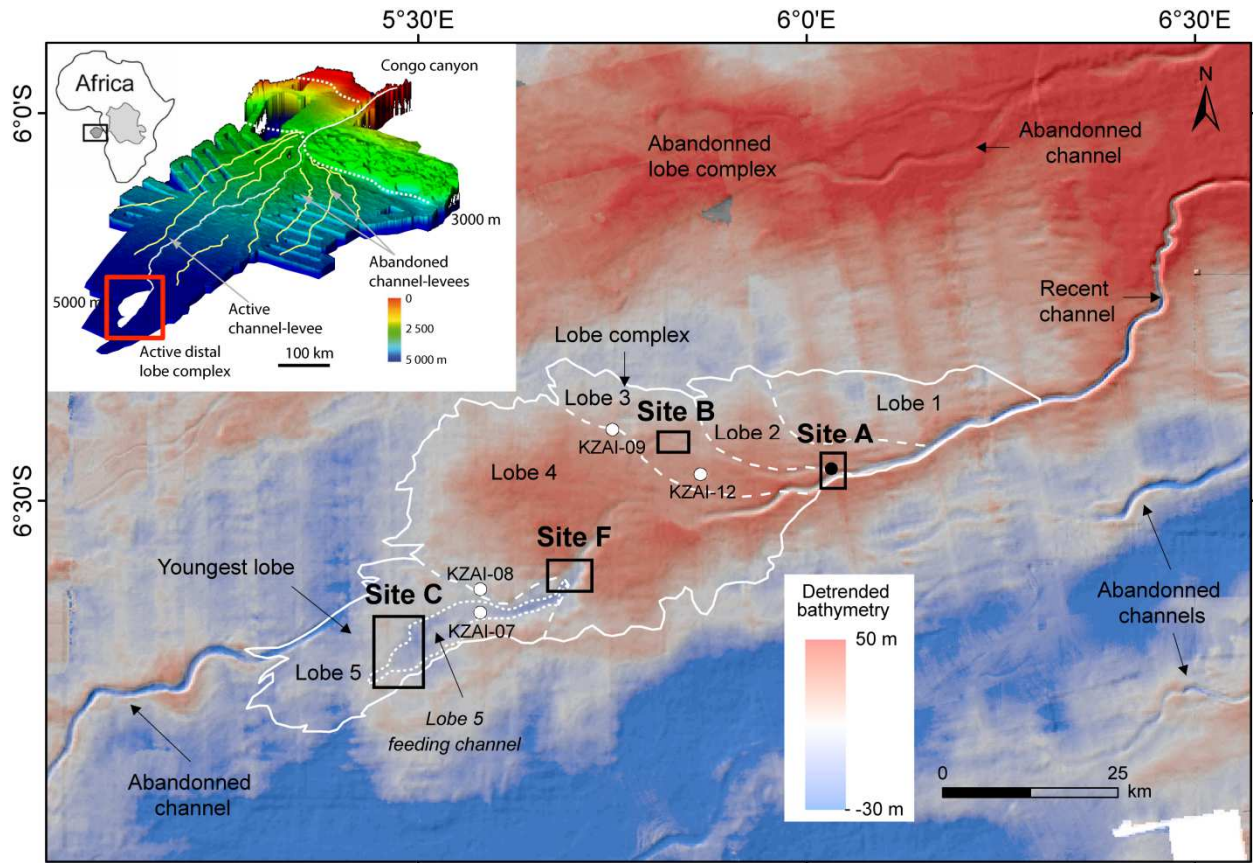


Fig.1: Map and high resolution detrended bathymetry of the terminal lobes of the Congo deep-sea fan showing the contours of lobes numbered from 1 to 5 according to their distance from the entrance of the lobe complex (=recent channel). Average depth is 4800m (Congolobe group, 2017). Stations were located at four representative sites along the lobes (A=Lobe 1+Lobe 2, B=Lobe 3, F=Lobe 4, C=Lobe 5). The dotted line contour outlines the lobe 5 feeding channel that shows the highest sedimentation rates. White dots show the location of sediment cores used for additional sedimentation rate calculation. The black dot on Site A shows the location of sediment traps deployed in 2011.

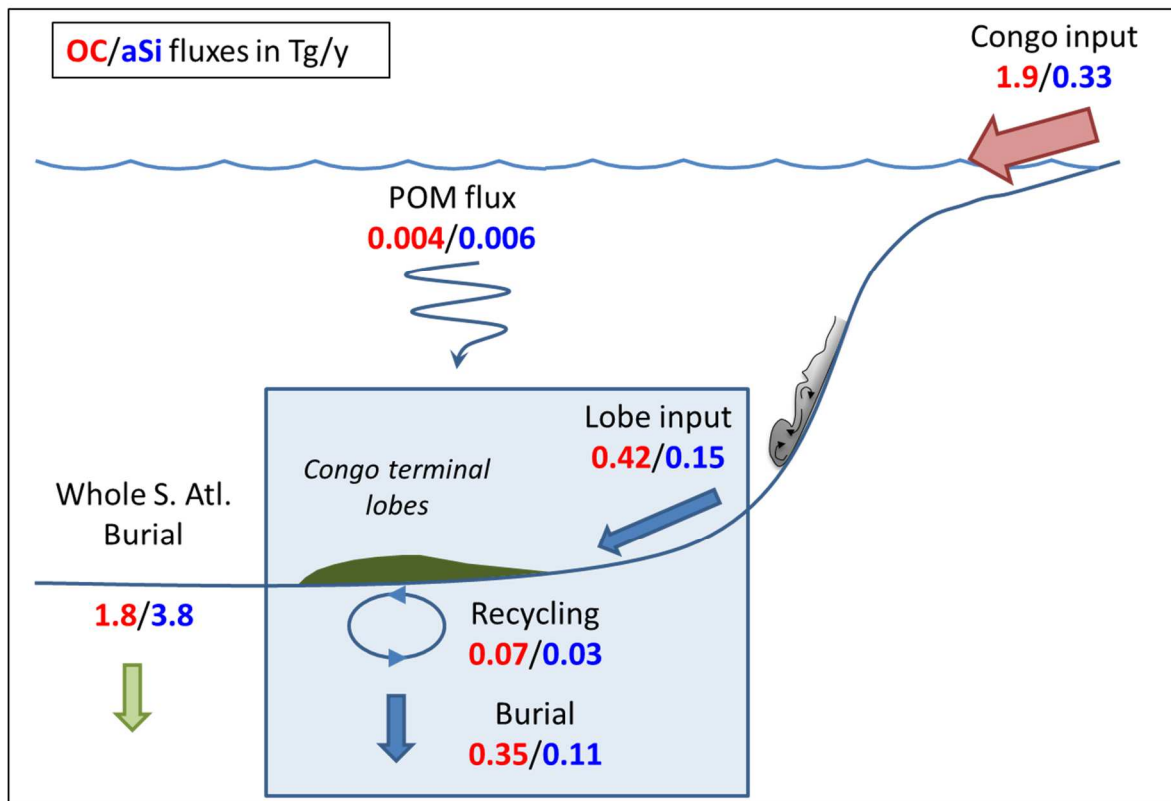


Figure 2: Mass balance for the Congo terminal lobe complex for organic carbon (OC in Tg C y^{-1} ; 1 Tg = 10^{12} g) and amorphous silica (aSi in Tg Si y^{-1}). Input from the Congo River, from the marine rain and burial rates in the South Atlantic basin (0-40°S) are also displayed. Red numbers are for OC and blue for aSi.

Table 1: Recycling, burial and vertical fluxes for OC and aSi in Congo lobe sediments. Recycling fluxes of OC (mineralization) and aSi (dissolution) was calculated from TOU (total oxygen uptake) and DSi flux (dissolved silica flux). Conversion of TOU to OC mineralization was made using a molar ratio C/O₂ of 0.9 (see text). Burial fluxes were calculated from measured sedimentation rates, porosity and average OC and aSi content of surface sediments (0-20cm). For recycling and burial, a weighted average for the entire lobe complex was calculated using the proportion of surface area of each lobe (see below). The measured porosity values were averaged for depth in core between 10 and 40 cm. Vertical fluxes are from station A (unpublished when unmarked). The mark (*) values are from Rabouille et al. (2009) and Ragueneau et al. (2009) measured at site Bio-D 200km East of the Lobe zone at 400m above seafloor.

	Site A (Lobes1&2)	Site B (Lobe 3)	Site F (Lobe 4)	Site C levee (Lobe 5)	Site C channel (Lobe 5 feeding channel)	Weighted average
Recycling						
Surface area (km ²)	533	283	1203	424	82	
TOU (mmol O ₂ m ⁻² d ⁻¹)	5.4±0.5	7±0.9	6.5±0.7	7.8±0.4	9.6±0.8	
OC miner (g C m ⁻² y ⁻¹)	21±2	28±4	26±3	31±2	38±4	26±4
DSi flux (mmol Si m ⁻² d ⁻¹)	1.1±0.1	-	1.9±0.2	0.6±0.1	0.6±0.1	
aSi dissol. (g Si m ⁻² y ⁻¹)	7.7±0.7	-	19±2	6.2±0.6	5.9±0.6	13±2
Burial						
Sedim. rate (cm y ⁻¹)	1±0.3	0.3±0.1	0.7±0.2	0.7±0.2	12±6	
Porosity	0.84	0.84	0.85	0.85	0.87	
OC (% dw)	3.25±0.2	3.2±0.2	3.3±0.2	3.4±0.2	4.0±0.2	
aSi (%Si dw)	1.3±0.1	0.9±0.1	1.2±0.1	1.2±0.1	1.0±0.1	
OC Burial (g C m ⁻² y ⁻¹)	130±40	38±12	87±30	89±32	1560±540	139±42
aSi Burial (g Si m ⁻² y ⁻¹)	53±11	11±4	32±8	31±9	381±125	45±11
OC/aSi burial (mol/mol)	5.8	8.0	6.3	6.7	9.6	7.1
Vertical flux						
F-aSi (g Si m ⁻² y ⁻¹)	1.5-2.5*					
F-OC (g C m ⁻² y ⁻¹)	1.1-1.7*					

Table 2: Mass balance for the terminal lobes of the Congo deep-sea fan and comparison to the marine particulate fluxes, Congo discharge and burial in the South Atlantic (1 Tg = 10¹² g). *aSi burial in the South Atlantic is calculated from the regional organic carbon burial and OC/aSi ratio or downscaling global fluxes (see supplementary material). OC/aSi is calculated as molar ratio compared to mass fluxes for OC and aSi.

	OC (Tg C y ⁻¹)	aSi (Tg Si y ⁻¹)	OC/aSi (mol/mol)
Burial	0.35 ± 0.12	0.11 ± 0.05	7.1
Mineralization/dissolution	0.07 ± 0.01	0.03 ± 0.01	
Lobe input based on mass balance	0.42 ± 0.14	0.15 ± 0.05	8.0
Burial efficiency (BE)	84%	73%	
Marine input	0.004	0.006	1.5
% marine in total input	1%	4%	
River discharge (Coynel et al., 2005; Hugues et al., 2011; Seylers et al., 2005)	1.9	0.33	13
% burial of Congo River export	18%	35%	
Burial in deep South Atlantic (0-40°S; >3000m; (Mollenhauer et al., 2004)	1.8	3.8*	1
% burial in Congo lobes relative to deep South Atlantic	19%	3%	