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## Dissolved rare earth elements distribution in the Solomon Sea

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### Abstract :

Trace Elements and Isotopes (TEIs) were measured as part of the GEOTRACES PANDORA cruise (July–August 2012, R/V L'Atalante), among them Rare Earth Elements (REEs) as pertinent tracers of land-ocean inputs and water mass transformations. This work discusses results of 19 dissolved REE (dREE) profiles measured using a trispike method in the Coral Sea and inside and at the exits of the Solomon Sea, a semi-enclosed sea with complex topography and straits. Overall, dREEs –except the insoluble Ce– show nutrient like profiles, i.e. depleted at the surface and enriched at depth. Illustrative Nd concentrations range from ~5 pmol/kg at the surface to >25 pmol/kg at 5000 m depth. However, local dREE enrichments are observed, mostly in the Straits (Indispensable, Solomon and Vitiaz Straits) and along the island coasts. A box model allows calculating and discussing the fate of the dREEs in the different water layers flowing through the Solomon Sea. Finally, subtle variations revealed by La, Ce, Eu anomalies and the normalized light versus heavy REE ratio (expressed as Nd<sub>n</sub>/Ybn) allows the identification of specific mechanisms affecting the distribution of the different dREEs. The positive Eu anomaly observed in the surface layers reflects the basaltic origin of external inputs, consistent with the intensive weathering and/or volcanic activity affecting the surrounding islands. These data also confirm that the distributions of heavy dREEs (like Yb) are better correlated to the dSi concentrations than that of the other REEs.

**Keywords :** Solomon Sea, Coral Sea, Dissolved rare Earth Element distribution, Lithogenic inputs, GEOTRACES

## 36 1 Introduction

37 [1] In the southwest Pacific Ocean, the northern branch of the westward South Equatorial  
38 Current is conveyed equatorward by the low-latitude western boundary currents (LLWBCs).  
39 These currents are flowing through the semi-enclosed Solomon Sea as final pathway  
40 between the subtropical Pacific and the Equator (Fine et al., 1994; Grenier et al., 2014;  
41 Johnson and McPhaden, 1999). The LLWBCs are joining the equatorial current system, in  
42 particular the eastward Equatorial Undercurrent feeding the “cold equatorial tongue” in the  
43 eastern equatorial Pacific. The properties of the water masses they transport have thus the  
44 potential to impact the equatorial thermocline stratification as well as native ecosystems of  
45 the western Pacific with potential downstream effects on the eastern Pacific ones (Figure1,  
46 Germaineaud et al., 2016). Hence, the Solomon Sea is a hot spot to study the water  
47 modifications when flowing from the Subtropical to the Equatorial region.

48 [2] The Solomon Sea is surrounded by high and intensively weathered islands (Milliman et  
49 al 1999). Together with its complex topography and hydrography, these characteristics make  
50 this area a potential source of trace elements to the waters flowing through it. Preceding  
51 studies aimed at characterizing the chemistry of the LLWBCs upstream and downstream of  
52 the Solomon Sea (i.e: Grenier et al., 2014; Grenier et al., 2013; Slemons et al., 2010; Mackey  
53 et al., 2002; Zhang and Nozaki, 1996). However, the Solomon Sea itself was never  
54 documented so far, becoming with time a sort of “missing piece” of the geochemical map of  
55 this area.

56 [3] Two exploratory oceanographic cruises were undertaken in the framework of the SPICE  
57 (Southwest Pacific Ocean Circulation and Climate Experiment) and GEOTRACES  
58 ([www.geotraces.org](http://www.geotraces.org)) programs (Ganachaud et al., 2014; Ganachaud et al., 2017). The  
59 Pandora cruise (July 2012) documented a large number of hydrographic and biogeochemical  
60 parameters in the Coral and Solomon Seas while two years later the MoorSPICE cruise  
61 (March 2014) repeated the hydrographic measurements.

62 [4] Dissolved chemical elements and their isotopes (so called as geochemical tracers)  
63 provide a better understanding and quantification of water mass histories and characterize  
64 the sources of key nutrient species to the oceans (Crusius et al., 1996; Elrod et al., 2004;  
65 Haley et al., 2004; Johnson et al., 2003; Nozaki, 1986). Among the “tracer world”, the rare  
66 earth elements (REE) and isotopic composition of neodymium are used to quantify any  
67 lithogenic enrichment, scavenging processes and/or water mass transport when occurring in  
68 a given area (Goldstein and Hemming, 2003; Jeandel et al., 2013; Lacan and Jeandel, 2001;  
69 Tachikawa et al., 2003). Rare earth element (REE) is a group of 14 elements displaying  
70 extreme coherent characteristics from lanthanum (La) to lutetium (Lu). The light REE (LREE)  
71 refers to the lower atomic number REEs from 57 (La) to 61 (Nd); Samarium (Sm) Europium  
72 (Eu) and Gadolinium (Gd) stand for medium REE (MREE), while Dysprosium (Dy) to Lutetium  
73 are heavy REEs (HREE). Within this group, the atomic weight increases while the atomic size  
74 decreases which yields chemical fractionation processes to occur during geochemical  
75 processes by means of an ordered response through the group as a function of atomic  
76 number. In the oceanic environment, most of the previous studies concluded that not only  
77 the internal processes (i.e: Akagi, 2013; Akagi et al., 2011; De Baar et al., 1985a; Jong Hyeon

78 and Byrne, 1993; Tachikawa et al., 1999) but also the external ones (i.e: Nozaki and Alibo,  
79 2003a; Nozaki and Alibo, 2003b; Sholkovitz et al., 1994; Rousseau et al., 2015; Wang and  
80 Yamada., 2007) could fractionate the REE distribution. The internal processes occurring all  
81 along the water column can be resumed as dissolved-particulate exchanges which result  
82 from biological uptake-remineralization and/or adsorption-desorption onto reactive particle  
83 coatings and/or (co)precipitation-dissolution. In addition, dREE could be released to the open  
84 ocean from river discharge, atmospheric dust, hydrothermal plume or exchange at the land-  
85 ocean interface, considered as external inputs. Understanding the fate of these important  
86 tracers in the modern ocean is therefore a key issue.

87 [5] This work characterizes the dREE concentrations along the whole water column at 21  
88 stations collected between the entrance of the Coral Sea and the exiting straits of the  
89 Solomon Sea. The geochemical data are coupled with the associated hydrological parameters  
90 and the water mass transports, providing an essential view on water mass pathways. This  
91 strategy allows us to describe and quantify the modification of geochemical parameters  
92 during south-north transit of the waters through the Solomon Sea. Our results are also  
93 compared with other geochemical parameters (e.g: Al, Mn) which are concurring to validate  
94 the enrichment of lithogenic origin observed in the Solomon Sea. Relationships between  
95 dREE, dissolved Ba and nutrient data are also discussed in order to reveal the influence of the  
96 biological activity REE fractionation.

97 [6] Section 2 describes the sampling procedure, sample preservation and analytical  
98 protocol while section 3 presents the hydrological context. Section 4 presents the resulting  
99 dREE profiles and their PAAS-normalized patterns. Section 5 is the discussion: it presents a  
100 simple box model to estimate the dREE Solomon Sea budgets in different density layers, the  
101 enrichment of the waters along their pathways, and provides a discussion around the  
102 fractionation observed in the REE patterns (La, Ce, Eu anomalies), the presumed associated  
103 mechanisms and the control of the HREE fate by the dissolved silica.

## 104 2 Material and Methods

### 105 2.1. Sample collection

106 [7] 143 seawater samples were collected at 21 stations during the PANDORA cruise (July-  
107 August 2012, onboard R/V *Atalante*). The sampling locations are reported in Figure 1b. Nine  
108 stations (stations 04, 10, 13, 20, 21, 29, 34, 36 and 82) were located in the Coral Sea and at  
109 the southern entrance of the Solomon Sea in order to characterize the water masses entering  
110 the Solomon Sea. Stations 04 and 10 were sampled to characterize the North Vanuatu Jet  
111 (NVJ) and North Caledonia Jet (NCJ), respectively. Stations 13, 20 and 21 were collected  
112 before and after the Indispensable Strait in order to identify any modification of the waters  
113 when flowing through this strait. Stations 29, 34 and 36 tried to catch the complex  
114 hydrological features at the entrance of the Solomon Sea (Cravatte et al., 2011; Davis et al.,  
115 2012; Germineaud et al., 2016). The remaining 12 stations are located in the “body” of the  
116 Solomon Sea as well as in the 3 straits through which waters are flowing out (i.e: Vitiaz Strait,  
117 St George’s Channel and Solomon Strait).

118 [8] Salinity (S), potential temperature ( $\theta$ ) and dissolved oxygen ( $dO_2$ ) were measured on  
119 board using sensors mounted at the base of the rosette. Salinity and oxygen sensors were  
120 calibrated and adjusted after the cruise using the chemical measurements of these  
121 parameters on discrete samples (Ganachaud et al., 2017). Shipboard and Lowered Acoustic  
122 Doppler Current Profiler (ADCP) data and other samples for various chemical analyses were  
123 also acquired during the cruise for the seawater characterization in trace metals, nutrients  
124 and other biological and chemical parameters. The online cruise report ([http://www.obs-  
126 vlf.fr/proof/php/pandora/xdat\\_alist1.php?xxop=pandora&xxcamp=pandora](http://www.obs-<br/>125 vlf.fr/proof/php/pandora/xdat_alist1.php?xxop=pandora&xxcamp=pandora)) and the  
127 synthesis article of Ganachaud et al. (2017) provide more details on the numerous operations  
conducted in the framework of PANDORA.

128 [9] Seawater samples dedicated to dREE analysis were collected using 22 12 L Niskin  
129 bottles mounted on a rosette. Aliquots of 500 mL were rapidly filtered through 0.4  $\mu$ M pore  
130 size, 47 mm diameter SUPOR membranes in the R/V *Atalante* humid laboratory. Filtered  
131 water was transferred into pre-cleaned low density polyethylene (LDPE) bottles and  
132 immediately acidified to  $pH \leq 2$  by addition of suprapur HCl 30%. All consumable material was  
133 acid-cleaned before the cruise. Note that samples from station 82 and some duplicates from  
134 station 73 and 77 were not filtered. Replicate samples were also taken at some stations in  
135 order to validate the data, identify particle/dissolved interaction and control the blank of the  
136 filtration system (e.g. at station 73).

## 137 2.2. Analytical procedure

138 [10] dREE concentrations were determined using the LEGOS protocol (Lacan and Jeandel,  
139 2001; Tachikawa et al., 1999). Briefly, dREE were extracted from the seawater aliquot by a  
140 co-precipitation with iron hydroxides, followed by purification through ion-exchange column  
141 and measured with a High Resolution Inductively Coupled Plasma Mass Spectrometer (HR-  
142 ICP-MS). In details, a trispik solution containing  $^{150}\text{Nd}$  (97.84%),  $^{153}\text{Eu}$  (97.84%), and  $^{174}\text{Yb}$   
143 (94.9%) was added to the acidified seawater aliquots of 250 mL or 500 mL. Approximately 2.5  
144 mg of purified  $\text{FeCl}_3$  diluted in 0.1M HCl was then added to the samples. The homogenization  
145 was ensured by a continuous shaking of the sample during 24h and a subsequent 24h resting  
146 state before performing the co-precipitation. Then, the pH was increased to  $8 \pm 0.5$  by adding  
147 suprapur  $\text{NH}_4\text{OH}$  yielding the iron hydroxides to co-precipitate the dREE. The dREE-Fe  
148 precipitate was then rinsed and separated from the seawater by successive centrifugations.  
149 This rinsing step was repeated between 5 to 7 times and the precipitate was later dissolved in  
150 1 mL of 6M HCl and then loaded on an anion exchange column packed with 2 mL of AG1-X8  
151 resin, in order to purify the dREE fraction from Fe. dREEs were then eluted from the column  
152 using 4 mL of 6M HCl and evaporated to dryness. Finally, the residue was dissolved again with  
153 5 mL  $\text{HNO}_3$  0.32M spiked with an internal standard (In-Re, 100 ppt), which is the appropriate  
154 solution to measure the concentrations on a sector field Inductively Coupled Plasma Mass  
155 Spectrometer (THERMO ELEMENT XR™ ICP-MS).

156 [11] Recoveries of the whole experiment (including sensitivity variations during the ICPMS  
157 sequence) were precisely determined by comparing the Nd, Eu and Yb concentrations  
158 calculated by Isotopic Dilution (ID-CONC) with that measured by external calibration (EXT-  
159 CONC). The ratio  $(\text{EXT-CONC})/(\text{ID-CONC})$  for these 3 elements were then linearly

160 (interpolated and extrapolated to be applied to the remaining dREE concentrations,  
161 measured by external calibration only. On the average, recoveries of more than 80% were  
162 obtained for the light REE, and around 77% for the middle and heavy REE. Our method based  
163 on 2 or 3 spikes followed by an (inter/extra)polation was validated by comparing results  
164 obtained using 10 spikes on the same seawater samples, either in the framework of T.  
165 Rousseau thesis (Rousseau et al., 2013) or in the recent work of M. Behrens (Behrens et al.,  
166 2016). During the ICP-MS analysis, the use of a desolvating nebulizer system (ARIDUS II)  
167 considerably minimized the oxide interference formation (Chung et al., 2009; Grenier et al.,  
168 2013; Pahnke et al., 2012). This is notably effective for the barium oxide formation reduction,  
169 which subsequently improves the analytical accuracy for  $^{151}\text{Eu}$  and  $^{153}\text{Eu}$ .

[12] Replicate measurements were conducted on filtered (4 replicates, station 73, 1650  
170 m) and non-filtered samples (3 replicates at 1650 m of station 73 and 4 replicates at 1200 m  
171 of station 82). Filtered light REE (dLREE) concentrations agree within 8% for La, 14% for Ce  
172 and 4% for Pr and Nd; filtered middle (dMREE) and heavy (dHREE) concentrations agree  
173 within 8% for Sm, 11% for Eu and less than 4% for the remaining REE. Non-filtered  
174 concentrations are agreeing within less than 4% for all the LREE (including Ce) and 7% for  
175 MREE and HREE.

[13] The average chemical blank values were established on 20 measurements. Blank  
176 levels represent less than 2% of the LREE signals and less than 0.7% for MREE and HREE ones.  
177 Due to the very low Ce concentration in our samples, the dCe blanks represent  $14\pm 9\%$  of the  
178 sample signal. In addition, the blank of our on-board filtration system was checked by filtering  
179 twice the same samples. No noticeable variation of concentration was observed, assessing  
180 the cleanliness of our systems. Finally, our full dREE analytical procedure was validated by our  
181 successful participation to two GEOTRACES intercalibration exercises (Behrens et al., 2016;  
182 van de Fliedert et al., 2012).

[14] Together with REE analysis, the dissolved Ba were also measured follow this protocol:  
183 fifteen mL of unfiltered seawater were collected in pre-cleaned polypropylene bottles (rinsed  
184 three times with the same seawater sample), acidified with 15  $\mu\text{L}$  of HCl (10 M, Optima  
185 grade) and kept at room temperature for later analysis. Dissolved Ba concentrations were  
186 measured using an isotope dilution (ID) method (Freydier et al., 1995; Klinkhammer and  
187 Chan, 1990) by high resolution -inductively coupled plasma- mass spectrometry (HR-ICP-MS).  
188 This method was adapted to a Thermo Finnigan Element XR instrument (MIO, Marseille). The  
189 dissolved Ba measurements presented here are the sum of dissolved Ba and a very small  
190 fraction (generally  $<1\%$  of total Ba) that is generated from the particulate Ba pool as a result  
191 of the acidification. For the sake of simplicity, we use the term of dissolved Ba. Samples (0.5  
192 mL) were spiked with 300  $\mu\text{L}$  of a  $^{135}\text{Ba}$ -enriched solution (93 %  $^{135}\text{Ba}$ ; 95  $\text{nmol.kg}^{-1}$ ) and  
193 diluted with 15 mL of acidified (2 %  $\text{HNO}_3$ , 14 M, Optima grade) Milli-Q grade water  
194 (Millipore). The amounts of sample, spike and dilution water were assessed by weighing.  
195 Reproducibility of this method is 1.5 % (1 RSD) as tested on repeated preparations of the  
196 reference solution SLRS-5 (NRC-CNRC river water reference material for trace metals;  $101.9 \pm$   
197  $3.6 \text{ nmol kg}^{-1}$ ). The limit of detection, calculated as three times the standard deviation of the  
198 procedural blank, is  $0.09 \text{ nmol.kg}^{-1}$ .

### 203 3 Hydrological context

1  
2 204 [15] Coral and Solomon sea hydrological properties have been the subject of several  
3  
4 205 surveys since the 60s. Water mass properties were discussed in miscellaneous works since  
5 206 then (e.g. Tsuchiya, 1981; Tsuchiya et al., 1989; Qu and Lindstrom, 2002; Grenier et al., 2013;  
6 207 Kessler and Cravatte, 2013; Ganachaud et al., 2014). Recently, Germaineaud et al. (2016)  
8 208 presented a detailed description of the currents and water masses in the Solomon Sea based  
9 209 on the PANDORA (2012) and MoorSPICE (2014) cruise data. The description proposed here is  
10 210 mostly based on this last work together with the thorough description of the Southwest  
11 211 Pacific currents conducted by Grenier et al. (2011; 2013, 2014). The water mass  
12 212 nomenclatures are varying among authors; the names used in this study are following those  
13 213 proposed by Grenier et al. (2013), Tomczak and Godfrey (2003), and Tomczak and Hao (1989)  
14 214 in order to avoid any confusion when describing the water masses, especially in the layers  
15 215 characterizing the thermocline.

16 216 [16] The general circulation scheme, current names and sampling details of the different  
17 217 stations used in this study are given in Figure 1. Figure 2 proposes a compilation of the  
18 218 property plots observed at the different stations, together with the identification of the main  
19 219 water masses sampled during the cruise. The last column of Table 1 also recalls the water  
20 220 masses corresponding to the collected seawater samples.

21 221 [17] Water properties in the Southwest Pacific can be traced from the Coral Sea to the  
22 222 Solomon Sea, in part through the Low Latitude Western Boundary Currents (LLWBCs) flowing  
23 223 toward the Equator (Figure 1). The LLWBCs are initially fed by the westward South Equatorial  
24 224 Current (SEC) (Qu and Lindstrom, 2002; Tsuchiya et al., 1989), dividing into several zonal  
25 225 currents when encountering islands in the Coral Sea. These zonal currents, some of them  
26 226 extending deep, transport several water masses that we choose to present here following  
27 227 increasing density.

#### 228 3.1. Thermocline Waters

##### 229 3.1.1. Upper thermocline: Tropical and Equatorial Waters

230 [18] In the Coral and Solomon Seas, the salty South Pacific Tropical Waters (SPTW) are  
231 232 flowing in the upper thermocline ( $\sim\sigma_\theta = 24.3\text{-}25.3 \text{ kg.m}^{-3}$ ). This tropical water can be divided  
233 in two main branches.

234 [19] The northern branch of the SPTW is called the South Pacific Equatorial Water (SPEW)  
235 and enters the Coral Sea north of the Vanuatu Archipelago, transported by the North  
236 Vanuatu Jet (NVJ) (Kessler and Cravatte, 2013; Tomczak and Godfrey, 2003; Tomczak and  
237 Hao, 1989; Tsuchiya et al., 1989). The SPEW originates from the subtropical central South  
238 Pacific ( $\sim 20^\circ\text{S}$ ,  $110^\circ\text{W}$ ), subducts in the high surface evaporation zone (HSEA), characterized  
239 by a maximum in sea surface salinity (see Figure 1 of Grenier et al., 2013). The SPEW is thus  
240 marked by a maximum in salinity ( $\sim S=36.0$ ) at  $\sim\sigma_\theta=24.5 \text{ kg.m}^{-3}$  (Kessler, 1999; Qu and  
241 Lindstrom, 2002) and relative high oxygen ( $\sim 135 \mu\text{mol.kg}^{-1}$ ; Grenier et al., 2013). After  
242 entering in the Coral Sea, the SPEW follows two pathways to reach the Solomon Sea: the first  
one is directly entering by the southern entrance of the Solomon Sea while the second is

243 conveyed by the Gulf of Papua Current (GPC) before entering the Solomon Sea at its  
244 southwestern end (see Figure 3 and Figure 5 of Cravatte et al., 2011; Ganachaud et al., 2014).  
245 During Pandora, SPEW was well identified at station 10 (Figure 2).

[20] The southern branch of the SPTW enters the Coral Sea mainly south of the Vanuatu  
246 Archipelago, conveyed by the North Caledonian Jet (NCJ) (Ganachaud et al., 2014; Gasparin  
247 et al., 2011; Germineaud et al., 2016; Grenier et al., 2013). This tropical water is then  
248 transported westward to the Australian coast where it bifurcates equatorward and poleward.  
249 The equatorward branch is carried by the GPC, and enters the Solomon Sea where it mixes  
250 with the SPEW described above to form the New Guinea Coastal Undercurrent (NGCU)  
251 flowing equatorward (Cravatte et al., 2011). At the entrance of the Coral Sea, this water mass  
252 is slightly denser ( $\sim\sigma_\theta=24.8 \text{ kg.m}^{-3}$ ), less saline ( $S\sim35.6$ ) and richer in oxygen ( $\sim165 \text{ }\mu\text{mol.kg}^{-1}$ )  
253 than those of the northern branch (see station 4, Figure 2).  
254

[21] Inside the Solomon Sea, the NGCU splits south of Woodlark Island and then reemerges  
255 at its northern side, to finally bifurcate again into two branches south of New Britain Island.  
256 The first branch flows westward towards the Bismarck Sea through the Vitiaz Strait while the  
257 second one is conveyed eastward by the New Britain Coastal Undercurrent. It exits the  
258 Solomon Sea northward by the St George's Undercurrent (SGU) and the New Ireland Coastal  
259 Undercurrent (NICU) through St George's Channel and Solomon Strait, respectively (Cravatte  
260 et al., 2011; Ganachaud et al., 2014; Ganachaud et al., 2017; Germineaud et al., 2016). Since  
261 the SPTW in the Solomon Sea results from the mixing between two water masses of minor  
262 differences which are referred above, its characteristics are fairly high oxygen content (140-  
263  $145 \text{ }\mu\text{mol.kg}^{-1}$ ), and high salinity ( $\sim S=35.7$ , see station 34, 36, 42, 43, 57, 60, 71, 73 and 77 in  
264 figure 2).  
265

### 3.1.2. Lower thermocline: Central Water and Mode Water

[22] Lying just underneath the upper thermocline water and considered as the lower  
267 thermocline water, the Western South Pacific Central Water (WSPCW) is identified in our  
268 research area, displaying thermostad characteristics (Grenier et al., 2014; Qu et al., 2008;  
269 Tsuchiya, 1981) and a very loose stratification at about 300 m depth. WSPCW is described by  
270 potential density centered at  $26.4 \text{ kg.m}^{-3}$  and high salinity due to its origin, north of New  
271 Zealand (Tomczak and Hao, 1989). High oxygen content WSPCW (mean  $\text{O}_2=160 \text{ kg.m}^{-3}$ ) is  
272 conveyed into the Coral Sea in its southern part, through the deep NCJ (Sokolov and Rintoul,  
273 2000; Tomczak and Godfrey, 2003; Tsuchiya et al., 1989). During its transportation through  
274 the Coral Sea, the Gulf of Papua and inside the Solomon Sea (Kessler and Cravatte, 2013), this  
275 water mass loses its oxygen as a result of mixing. Near the straits, it mixes with older,  
276 deoxygenated water originating from the southeastern Pacific Ocean and entering the  
277 Solomon Sea through Solomon Strait. A drop of dissolved oxygen values from  $\sim160 \text{ kg.m}^{-3}$  at  
278 the southern entrance of the Solomon Sea to  $\sim130 \text{ kg.m}^{-3}$  in its northeastern part is observed.  
279

[23] Below the WSPCW, another mode water, with no salinity or oxygen extremum, is  
280 identified. It is named the Subantarctic Mode Water SAMW ( $\sim\sigma_\theta = 26.5\text{-}27 \text{ kg.m}^{-3}$ ) and enters  
281 the Coral and Solomon Seas from the south, (Grenier et al., 2013; McCartney, 1977). It  
282 originates from the southeastern Southern Ocean by subduction north of the Antarctic  
283

284 Circumpolar Current (Hanawa, 2001). This water mass is centered on  $\sim\sigma_\theta=27 \text{ kg.m}^{-3}$  and is  
285 characterized by a low salinity ( $\sim 34.5$ ) and high oxygen content ( $\sim 175 \text{ kg.m}^{-3}$ ) because of its  
286 origin (Qu et al., 2009). In the Coral and Solomon Seas, SAMW keeps its original  
287 characteristics and contributes to the formation of  $13^\circ\text{C}$  Water (Qu et al., 2009).

### 288 3.2. Intermediate Waters

289 [24] The Antarctic Intermediate Water (AAIW;  $\sigma^\theta \sim 27.2 \text{ kg.m}^{-3}$ ) is identified in the southern  
290 part of the studied region by a salinity minimum ( $\sim S=34.3-34.5$ ) and an oxygen maximum  
291 ( $\sim O_2=200-300 \mu\text{mol.kg}^{-1}$ , Qu and Lindstrom, 2004). The AAIW circulation in the South Pacific  
292 follows the wind-driven subtropical gyre circulation and flows equatorward through the Coral  
293 Sea. It enters the Solomon Sea through the LLWBCs (Bostock et al., 2010; Germaineaud et al.,  
294 2016; Qu and Lindstrom, 2004; Tomczak and Godfrey, 2003). From the Coral Sea to the  
295 equator, the AAIW becomes slightly denser and less oxygenated ( $\sim\sigma_\theta=27.26 \text{ kg.m}^{-3}$ ;  $O_2=160-$   
296  $190 \mu\text{mol.kg}^{-1}$ ) due to remineralization of organic material settling from the surface and  
297 diapycnal mixing with lower oxygenated waters.

298 [25] Another intermediate water identified in our study area is the Equatorial Pacific  
299 Intermediate Water (EqPIW ;  $\sim\sigma_\theta=27.3 \text{ kg.m}^{-3}$ ), which is originally formed from a combination  
300 of AAIW and upwelled Pacific Deep Water (Bostock et al., 2010). In our study, it is suggested  
301 that part of this water mass enters the Solomon Sea from the north-east through Solomon  
302 Strait (Germaineaud et al., 2016) and mixes then with AAIW as proposed in Figure 1 of Bostock  
303 et al. (2010). The distinct characteristics of this water mass is a salinity higher than that of  
304 AAIW ( $\sim S=34.5-34.6$ ) and a significantly lower oxygen concentration ( $\sim O_2=75-125 \mu\text{mol.kg}^{-1}$ ). It  
305 is found at a density of  $27 \text{ kg.m}^{-3}$  at station 43 and 46. Moreover, the oxygen plot of station  
306 43 show that EqPIW and AAIW are interleaving near 700 m depth.

### 307 3.3. Deep and Bottom Waters

308 [26] The deep and bottom waters within the Coral and Solomon Seas have been poorly  
309 documented since the first observations summarized in Reid (1986, 1997) and their pathways  
310 and fates are not clearly understood. They are strongly constrained by the topography  
311 (Johnson and Toole, 1993; Kawabe and Fujio, 2010; Roemmich et al., 1996; Tsimplis et al.,  
312 1998). Their pathways, origins and properties are described in Germaineaud et al. (in  
313 preparation).

314 [27] The Upper Circumpolar Deep Water (UCDW) is observed between 1000 m and 3500  
315 m in the studied area. This water mass has been depleted in oxygen since its origin in the  
316 Antarctic Circumpolar Current (ACC) (Reid, 1986; Talley, 2007; Wijffels et al., 2001). In this  
317 study, UCDW is characterized by relatively high salinity and low oxygen content with a  
318 pronounced minimum ( $\sim S=34.6$ ,  $\sim O_2=140 \mu\text{mol.kg}^{-1}$ ) at  $\sim\sigma_\theta=27.65 \text{ kg.m}^{-3}$  at almost all of our  
319 stations (Figure 2). Germaineaud et al. (2016) suggests that the UCDW can be divided into two  
320 sublayers which are the upper extent and lower extent UCDW, with potential density  
321 anomaly ( $\sigma_\theta$ ) ranges of  $\sim 27.4-27.65$  and  $27.65-27.76$ , respectively.

322 [28] Just beneath the UCDW, the Lower Circumpolar Deep Water (LCDW; Kawabe and  
323 Fujio, 2010; Reid, 1997; Tsimplis et al., 1998) is identified by a salinity maximum reaching  
324  $34.72-34.73$  and a decrease of its silicate content when compared to the UCDW (Orsi et al.,



1999). The LCDW transport is supposed to be limited from the Tasman Sea to the Coral and Solomon Seas because this last one is so far considered as a sealed area below 3500 m, separated from the outer world by islands and sills (Germineaud, 2016; Sokolov and Rintoul, 2000). Curiously, we clearly identified the LCDW imprint in our profiles, and an unexpected oxygen concentration increase with depth, which underlines that the topography, and the possible pathways and fate of this water mass are still unclear (Germineaud et al., in preparation).

## 4 Results

### 4.1. Dissolved REE concentrations

[29] The dissolved concentrations measured for the 14 REEs at the different stations are compiled in Table 2. For simplicity, only the vertical distributions of dissolved Lanthanum (dLa), Neodymium (dNd), Europium (dEu) and Ytterbium (dYb) are shown in Figure 3. dLa and dNd represent the dissolved LREE while dEu and dYb represent the dMREE and dHREE, respectively.

[30] The dREE concentrations display low values at the surface and increase with depth, showing a vertical profile shape similar to that of nutrients although not completely depleted in the surface waters (Figure 3). The dLa concentrations are increasing from  $\sim 4 \text{ pmol.kg}^{-1}$  in the surface water to  $\sim 15 \text{ pmol.kg}^{-1}$  at  $\sim 1000 \text{ m}$ ; dNd profiles are varying from  $\sim 5 \text{ pmol.kg}^{-1}$  in the euphotic zone to  $\sim 10 \text{ pmol.kg}^{-1}$  at intermediate layer followed by an  $\sim 2.5$ -fold increase towards the bottom. Typical dEu and dYb profiles show the same kind of gradients as dLa and dNd but with lower concentrations ( $< 1 \text{ pmol.kg}^{-1}$  for dEu and  $< 10 \text{ pmol.kg}^{-1}$  for dYb).

[31] The surface depletion and enrichment at depth are consistent with the surface-scavenging and depth-dissolution hypothesis characterizing the fate of these trivalent elements onto particulate carrier phases (oxides, hydroxides, organic matter) along the water column (De Baar et al., 1985a; Elderfield, 1988; Garcia-Solsona et al., 2014; Sholkovitz et al., 1994; Takebe, 2005). The concentration ratio between the deepest samples (deeper than 3000 m) and shallowest samples is larger than 4, indicating a significant release of the REE from the particles in the deepest layers. Beyond the observed general concentration increase, the vertical shape of the profiles show subtle but interesting variations:

- Down to 3000 m, all the concentrations linearly increase, although the dYb profile is always slightly more convex than the 3 other dREE ones.
- In the southern part of our study (Coral Sea and Solomon Sea entrance, Figure 3a), a break is observed in the linearity at 3000 m, with dREE concentration values slightly lower between 3000 and 4000 m.
- Station 60 profiles, in the northern part of the Solomon Sea, show a local maximum between 4000 and 5000 m, dREE concentrations being maximal in this layer and then decreasing toward the bottom. The convex shape of dYb is the most pronounced at this station (Figure 3c).
- On the average, dREE concentrations are slightly enriched within the Solomon Sea compared with the sites located outside of it. For example, dNd average value is of  $\sim 3.5 \text{ pmol.kg}^{-1}$  in the Solomon Sea for the isopycnal layer  $24 \text{ kg.m}^{-3} < \sigma_\theta < 26 \text{ kg.m}^{-3}$

366 while of  $2.5 \text{ pmol.kg}^{-1}$  for the same density layer in the Coral Sea and in the east of  
1 367 the Solomon archipelago (see station 04, 10, 34 and 71, Figure 3).

- 3 368 • Figure 3e shows a slight maximum at station 21, suggesting an input of Solomon  
4 369 Archipelago material into seawater passing through Indispensable strait

5 370 [32] In addition to these features affecting the profiles, local enrichments are observed at  
6 371 specific stations and depths as at the surface of stations 36, 57 and 77, very likely reflecting  
7 372 the proximity between these stations and the coast. Within the thermocline some layers  
8 373 show enriched dREE concentrations [e.g: around 500 m at station 42, 46, 57, 77, in the  
9 374 intermediate waters (~700 m) at station 13, 21, 34 and at 980 m at station 29].

10 375 [33] Dissolved cerium (dCe) concentrations are reported in Table 1 and some data will be  
11 376 shown later as part of the discussion. As often observed in seawater where the oxidized  
12 377 Ce(IV) is poorly soluble and then behaves differently to the remaining trivalent REEs, dCe  
13 378 shows a reverse behavior compared to the other dREEs, with high concentrations at the top  
14 379 of the water column, which decreasing at intermediate levels before increasing again in the  
15 380 deep and bottom waters due to its preference for scavenging (see station 29, 42, 71 and 73,  
16 381 Table 1) (De Baar et al., 1983; De Baar et al., 1985a; Elderfield, 1988; Goldberg et al., 1963;  
17 382 Liu et al., 1988; Piegras and Jacobsen, 1992; Sholkovitz et al., 1994; Tachikawa et al., 1999).  
18 383 However, consistently with the other dREEs, dCe maxima are observed at some specific  
19 384 locations: surface layers at station 36 and 77, close to the surface and at 735 m at station 34  
20 385 and slightly deeper (934 m) at station 29 (Table 1).

## 21 386 4.2. Comparison with previous studies

22 387 [34] Two previous studies analyzed samples at the entrance of the Solomon Sea and in the  
23 388 Coral Sea (Grenier et al., 2013; Zhang and Nozaki, 1996), allowing us to compare our data  
24 389 with published values. Figure 4 shows the locations of these stations and the dissolved REE  
25 390 concentrations as a function of potential density in order to compare the dREE values in the  
26 391 same isopycnal layers. This figure also highlights the excellent agreement between our data  
27 392 and these previous results. The minor difference observed between the surface dLa  
28 393 concentrations at SA-7 and at station 82 of our study likely reflects the dissimilarity in our  
29 394 sampling locations and times of the year, in this region of high eddy variability (Keppler et al.,  
30 395 2018).

31 396 [35] In Vitiaz strait, a striking similarity between our results (station 077) and Grenier et al.  
32 397 (2013) one (EUC-30) is also observed, despite the difference in sampling times (Figure 4) in  
33 398 this highly variable and turbulent region. Station 077 is located in Vitiaz strait which is narrow  
34 399 and relatively shallow (1200 m deep) in comparison with Solomon Sea average depth. The  
35 400 continental influence is therefore suggested to be high and dominant over the influence on  
36 401 dissolve concentration of internal oceanic processes variability. This suggests that the REEs  
37 402 concentrations are “buffered” by interplay of different processes.

## 38 403 4.3. Dissolved REE patterns

39 404 [36] Fractionation of the dREE from each other while submitted to oceanic processes  
40 405 (uptake, remineralization, freshly weathered from the continent or not...) could be identified  
41 406 using the normalization of dREE concentrations in seawater to those contained in shale, a  
42 407 material representing the average crustal geochemical composition. Here we used the Post-

408 Archean Australian Shale or “PAAS” (McLennan, 1989). The PAAS-normalized REE patterns  
409 are presented in Figure 5.

410 [37] The main characteristics of the dREE patterns observed in the Coral and Solomon Seas  
411 are consistent with those found in the literature: the obvious negative dCe anomalies reflect  
412 the impact of the poor solubility and preferential scavenging of this element. The  $(dNd_n/dYb_n)$   
413 ratio, which gives information about the dLREE versus dHREE slope evolution, is maximum in  
414 surface, decreasing from ~0.3 to approximately 0.1 at intermediate level (~1000 m), from  
415 where it increases again in the deep and bottom waters. These observations agree with  
416 previously published results (Bertram and Elderfield, 1993; De Baar et al., 1985a; Tachikawa  
417 et al., 1999; Garcia-Solsona et al., 2014; Grenier et al., submitted; Grenier et al., 2013; Zhang  
418 and Nozaki, 1996).

419 [38] dREE patterns are relatively flat in surface waters, which seems to indicate that recent  
420 lithogenic inputs are affecting these upper layers. The evolution of the pattern shape with  
421 depth reflects the differential scavenging along the water column. A slight local maximum is  
422 often observed for the dMREE, as already noticed by Grenier (Grenier et al., 2013) in the  
423 same area.

## 424 5 Discussion

### 425 5.1. Nd and dREE enrichments within the Solomon Sea

426 [39] A simple box model was built for the Solomon Sea, allowing us to estimate the dREE  
427 budget for different isopycnal layers between its southern entrance (southern section) and  
428 its northern exits (Vitiaz Strait, St George’s Channel and Solomon Strait). The box model  
429 proposed here aims at identifying whether dREE (but more specifically dNd) concentrations  
430 get enriched, depleted, or stay constant while crossing the Solomon Sea and determining the  
431 related input (or output) net fluxes. This is a preliminary step to further developments that  
432 will include the on-going measurements of Nd isotopic compositions, allowing us a better  
433 quantification of exchange processes, if any. The scheme of the box model is proposed in  
434 Figure 6. This box model is applied to the upper thermocline layer ( $\sigma_{\theta} 24\text{-}25.3 \text{ kg.m}^{-3}$ ), the  
435 lower thermocline layer ( $\sigma_{\theta} 25.3\text{-}26.9 \text{ kg.m}^{-3}$ ), the intermediate waters ( $\sigma_{\theta} 26.9\text{-}27.4$   
436  $\text{kg.m}^{-3}$ ), and the deeper UCWD waters ( $\sigma_{\theta} 27.4\text{-}27.65$  and  $27.65\text{-}27.76 \text{ kg.m}^{-3}$ ).

437 [40] Owing to the complexity of the Solomon Sea currents (see section 3), we  
438 hypothesized a slightly simplified circulation scheme. Our box model considers the Solomon  
439 Sea as a closed area at steady state and assumes that incoming and exiting water fluxes are  
440 balanced (Figure 6a). Two upstream sources (incoming NGCU and direct NVJ) are feeding the  
441 Solomon Sea across the southern entrance and three downstream fluxes (SGU, NICU and  
442 NGCU) are exiting from it through the different straits (NGCU through Vitiaz Strait, SGU  
443 through St George’s Channel, NICU through Solomon Strait). The required parameters to  
444 achieve the model calculation are the water mass transports and the Nd concentrations of  
445 each layer. Water flowing equatorward into the Solomon Sea includes the transports of the  
446 NGCU ( $W_E$ ), and of the direct inflow ( $W_N$ ). Meanwhile, water leaving the Solomon Sea gathers  
447 the fluxes exiting at the Solomon Strait ( $W_S$ ), the St. George’s Strait ( $W_G$ ) and Vitiaz Strait  
448 ( $W_V$ ). Respective dissolved Nd concentrations considered here are  $Nd_E$ ,  $Nd_N$  at the southern

449 entrance and  $Nd_S$ ,  $Nd_G$  and  $Nd_V$  at the northern exits (Figure 6a and b). Under the hypothesis  
450 that diapycnal mixing is weak in this area, we obtain in each density layer the equation:

451

$$W_E \cdot [Nd]_E + W_N \cdot [Nd]_N + F_{\text{tot PANDORA}} = W_S \cdot [Nd]_S + W_G \cdot [Nd]_G + W_V \cdot [Nd]_V \quad (1)$$

452 Where:

453  $F_{\text{tot PANDORA}}$  is the total net flux into seawater from the surrounding coasts.

454 [41] The transports are computed in each density layer using the PANDORA cruise data  
455 (Ganachaud et al., 2016; Germaineaud et al., 2016; Germaineaud et al., in prep). Currents were  
456 recorded along the ship track with Shipboard Acoustic Doppler Current Profilers (S-ADCPs)  
457 with a vertical extent of around 1000-1300 m. S-ADCPs were rotated to estimate the current  
458 perpendicular to each of the box model section (Germaineaud et al., 2016). At depths below  
459 1000 m, they are combined with geostrophic velocities estimated with CTD station pairs, and  
referenced to 3000 m depth, or to the deepest common level of the station pairs.

460 [42] Transports computed across the southern entrance do not balance the summed  
461 transports at the exits, as they were estimated during instantaneous transects. For the  
462 purpose of this study, relying on a steady state hypothesis, velocities are adjusted with an  
463 inverse model to allow the mass, salt and heat conservation (Germaineaud et al., 2016;  
464 Germaineaud et al., in prep). All water transports in distinct layers associated with their  
465 uncertainties are given in Table 4.

466 [43] The calculation is reported in Figure 6c for Nd in the lower thermocline layer, and  
467 budgets of the other layers are reported in Table 4. The only missing dREE concentration data  
468 was for the upper thermocline at station 29. We therefore estimated these values using its  
469 neighbor stations due to their similarity in dREE concentrations (stations 04, 34 and 36). The  
470 sign of  $F_{\text{tot PANDORA}}$  indicates whether external input (when positive) or subtraction by  
471 scavenging process (when negative) is dominating the Nd fate along the pathway of the  
472 different water layers. A Monte Carlo statistic method was used to estimate uncertainties of  
473 the fluxes.

474 [44] A significant positive net flux ( $F_{\text{total PANDORA}} = 145.1 \pm 45.8 \text{ t(Nd).yr}^{-1}$ ; Figure 6c) is  
475 observed in the Lower Thermocline Layer, suggesting that waters transported equatorward  
476 through the Solomon Sea are enriched in dNd. This is consistent with Grenier et al. (2014)  
477 who found enrichment in the lower thermocline layer downstream the Solomon Sea and  
478 suggested that this enrichment occurred inside the sea itself. Enrichments are also observed  
479 in the other layers, except for IW. However, the large uncertainties affecting the calculated  
480 fluxes prevent us to draw firm conclusions for these layers (Table 4). Our flux estimations are  
481 approximately 50 times those of Grenier et al. (2014). This difference likely reflects that the  
482 whole region is considered here whereas Grenier et al. (2014) only focused on inputs into  
483 specific current veins.

484 [45] Surprisingly, in the upper thermocline, our results do not show a clear and strong  
485 enrichment in Nd content. Our hypothesis is that the dNd (dREE) external inputs, likely  
486 weathered from the surrounding islands and discharged into the Solomon Sea, are balanced

487 by the dNd (dREE) removal by scavenging, consistent with the productivity of the area  
488 (Radenac et al., 2013; Bonnet et al., 2015). This will be confirmed or disproved with the  
489 isotopic Nd signatures.

## 490 5.2. Interesting features in the dREE profiles

491 [46] This section discusses more specifically the dREE PAAS-normalized patterns and  
492 anomalies. Calculated dREE anomalies allow identifying if, after normalization to the PAAS  
493 values, an element is enriched or depleted relatively to its neighbors. Thus, they can bring  
494 information about the dominant mechanisms affecting the local marine REE pool. Anomalies  
495 are calculated following the equations below (Bau et al., 2004; Bau et al., 1996; Friend et al.,  
496 2008; Garcia-Solsona et al., 2014). In the following, we will discuss more specifically the La,  
497 Ce, Eu and Yb anomalies.

$$498 \frac{\text{La}}{\text{La}^*} = \frac{[\text{La}]_n}{3[\text{Pr}]_n - 2[\text{Nd}]_n} \quad (1) \quad \frac{\text{Ce}}{\text{Ce}^*} = \frac{[\text{Ce}]_n}{2[\text{Pr}]_n - [\text{Nd}]_n} \quad (2)$$

$$499 \frac{\text{Eu}}{\text{Eu}^*} = \frac{4 \times [\text{Eu}]_n}{3[\text{Sm}]_n + [\text{Dy}]_n} \quad (3) \quad \frac{\text{Yb}}{\text{Yb}^*} = \frac{[\text{Yb}]_n}{2[\text{Er}]_n + [\text{Dy}]_n} \quad (4)$$

500 [47] A complementary parameter to the anomalies is the ratio between normalized LREE  
501 and HREE, expressed as  $\text{Nd}_n/\text{Yb}_n$ , which provides information about the slope of the  
502 normalized dREE pattern. Figure 7 shows the vertical profiles for the La, Eu, Yb anomalies and  
503 the  $\text{Nd}_n/\text{Yb}_n$  slope. Normalization of the dREE to PAAS implies that without any fractionation  
504 between the dREE within the water column, the dREE pattern would be flat -  $\text{Nd}_n/\text{Yb}_n$  close  
505 to 1- and no anomaly would be observed. The full data set is reported in Table 1. The  
506 REE/REE\* ratio reveals an enrichment relatively to its neighbors when its value is larger than  
507 one, and a depletion in the opposite case.

### 508 5.2.1. Dissolved Lanthanum anomaly

509 [48] All the dissolved Solomon Sea samples collected during Pandora are characterized by  
510 positive La anomalies, with values ranging from 3-6 (Figure 7). Such positive values have been  
511 observed elsewhere in the ocean and are believed to result from a differential La behavior  
512 due to the lacking electron in the 4f shell of the La atom, suspected to increase its stability in  
513 seawater, so called the “tetrad” or “double-double” effect (Byrne and Kim, 1990; Byrne and  
514 Sholkovitz, 1996; De Baar et al., 1985b; Elderfield, 1988; Garcia-Solsona et al., 2014; Grenier  
515 et al., submitted; Jong Hyeon and Byrne, 1993; McLennan, 1994). In particular, while dLa is  
516 released from riverine particles when freshwaters are discharged into the ocean, more  
517 efficient releasing than scavenging rate could cause local positive dLa anomalies (Lawrence  
518 and Kamber, 2006). Nevertheless, the positive dLa anomalies in the Solomon Sea are  
519 observed at all the monitored stations even that located far from the coastline. Knowing that  
520 the oceanic dREE pattern mostly results from dissolved-particle exchange also occurring in  
521 the open ocean (Tachikawa et al. 1999), we are seeking if another factor than the « Tetrad  
522 effect » only could govern the La behavior in the Coral and Solomon Seas.

523 [49] Due to the similar atomic size and close chemical properties of barium and  
524 lanthanum, they are suspected to display coupled behavior in seawater (Garcia-Solsona et al.,  
525 2014; Haley et al., 2014; Grenier et al., submitted). Bishop (1988) and Dehairs et al. (1980)  
526 demonstrated that oceanic dBa distribution is governed by the surface biologically driven  
527 formation of barite crystal ( $\text{BaSO}_4$ ) followed by its dissolution at depth. Coupling between the  
528 two elements could therefore occur if dLa is associated to the dBa/barite cycle within the  
529 water column (Dehairs et al., 1980; Garcia-Solsona et al., 2014; Grenier et al., Submitted in  
530 2017; Guichard et al., 1979).

531 [50] Figure 8 displays strong correlations between dissolved dLa and dBa measured on the  
532 same samples at all the stations, with  $R^2_{\text{coefficient}} = 0.95 \pm 0.04$ . These results support the idea  
533 that dLa marine behavior is to some extent coupled to the dBa one. The marked enrichment  
534 of dLa over dBa at the « coastal » stations 71, 73 and 77 could reflect the efficient release of  
535 dLa from the lithogenic material discussed in Lawrence and Kamber (2006). Nonetheless, the  
536 lack of particulate barium data so called as barium excess ( $\text{Ba}_{\text{xs}}$ ) prevents us to go farther in  
537 discussing the dLa anomaly in the Solomon Sea.

### 538 5.2.2. Dissolved Europium anomaly

539 [51] A positive dEu anomaly is characterized for all normalized dREE patterns whatever the  
540 water mass type and location of the sample. Such positive dEu anomalies were observed in  
541 previous studies (Amakawa et al., 2000; Nozaki et al., 1999) but were not discussed till the  
542 work of Zhang et al. (2008) and the more recent observations of Grenier et al. (2013;  
543 Submitted in 2017). Either on the Kerguelen plateau (Grenier et al., Submitted in 2017; Zhang  
544 et al., 2008) or in the Equatorial Pacific (Grenier et al., 2013) these authors invoke a  
545 remaining signature of lithogenic inputs of basaltic origin, local basalts being characterized by  
546 a positive Eu anomaly. In our studied area, the conspicuous feature of dEu anomaly shows  
547 maxima in the surface water, reach a minimum at intermediate depths (~500 m) and then  
548 slightly increase again toward bottom except in the Coral Sea profiles characterized by fairly  
549 constant dEu anomalies at depths below 1000 m (Figure 7).

550 [52] The higher dEu anomalies (~1.3) at the surface likely reflect relatively recent  
551 enrichment of lithogenic origin, which could be of coastal or atmospheric source. Indeed, the  
552 Solomon Sea is surrounded by volcanic islands whose basaltic material is enriched in Eu  
553 (Grenier et al., 2013). Besides, some volcanoes such as Rabaul, Ulawun and Bagana, are still  
554 very active (Lefèvre et al., 2008; Slemmons et al., 2010).

555 [53] Deeper than 1000 m, the increase of the positive dEu anomaly could result from two  
556 non-exclusive processes: i) the release of dREE in intermediate and deep layers caused by the  
557 dissolution of basaltic sediments deposited on the margins by submarine weathering  
558 followed by the advection of the enriched waters (Grenier et al., 2013; Jeandel et al., 2011;  
559 Zhang et al., 2008). As already underlined by Grenier et al. (2013), the preservation of this  
560 dEu anomaly is made possible by the fact that the residence time of dEu (320-820 yrs; Alibo  
561 and Nozaki, 1999) is larger than that of the thermocline waters across the studied area (10-  
562 15 yrs, Fukumori et al., 2004) ; ii) Grenier et al. (Submitted) suggested that the deep positive  
563 dEu anomaly could also result from LREE/MREE preferential scavenging onto surface coating  
564 of organic particles in surface water followed by their release at depth (Sholkovitz et al.,

1994). Ongoing measurements of the filtered particles might help to identify the importance of such processes in the Solomon Sea.

### 5.2.3. Dissolved Ce anomalies

[54] Contrastingly to dLa and dEu, the marked depletion of dCe is observed at all the studied stations although less pronounced in the surface and subsurface waters above 500 m ( $dCe/dCe^* \geq 0.4$ ). Consistent with the higher dEu anomalies discussed above, these less pronounced dCe anomalies might reflect recent lithogenic inputs, which are more affecting the upper layers. Higher dCe anomalies ( $dCe/dCe^* \geq 0.5$ ) were found mostly in the surface water of stations located around the Solomon archipelago (e.g. stations 42, 43, 60), indicating more recent inputs. Specifically, one upper thermocline sample at station 71 (160 m) shows a significantly high dCe anomaly ( $\sim 1.4$ ). However, this station is very close to the coast and was located here to identify any margin input to the waters conveyed by NGCU through the slit between New Britain and Woodlark islands; the existence of strong inputs is thus confirmed by the high positive Ce anomaly observed at this station.

### 5.2.4. HREE behavior

[55] The vertical dHREE profiles show more convex shapes than that of the other dREE (Figure 3). In addition, the  $Nd_n/Yb_n$  slopes are increasing below intermediate depths at a rate of two up to the seafloor (Figure 7). Such rapid increase was already observed although not always discussed (Grenier et al., Submitted; Haley et al., 2014; Jeandel et al., 2013; Molina-Kescher et al., 2014). Bertram and Elderfield (1993) noticed that coupling between dREE and dSi cycle could be more significant for the dHREE than for the dLREE and recent works of Akagi (2013) and Grenier et al. (Submitted in 2017) seem to confirm this observation. Here we propose to explore the link between dHREE (represented by dYb) and the dSi cycle in Figure 9. The high values of the correlation coefficients ( $\sim R^2 = 0.9$ ) support this hypothesis again. However, a break of the slope is observed at around 700 m, the dYb rate of increase diminishing by a factor of 2 below this depth. Although this observation is consistent with that of Grenier et al. (Submitted in 2017), the  $\Delta dYb/\Delta dSi$  slope observed in Figure 9 for dSi concentrations less than  $40 \mu\text{mol.kg}^{-1}$  (samples  $< 700$  m,  $\Delta dYb/\Delta dSi \approx 0.09$ ) is larger than that of these authors ( $\Delta dYb/\Delta dSi \approx 0.01$ ). This difference could reflect the impact on both tracer cycles of the different ecosystems characterizing the two areas: the huge diatom bloom on the Kerguelen plateau leads to a dramatic increase of particulate biogenic silica and a subsequent major dSi depletion in the upper layers. Although this scavenging is expected to also deplete dYb, the relative rates of the scavenging processes are likely favoring the dSi subtraction in the Southern Ocean. It is more complex in the Solomon Sea which is known as a hot spot for  $N_2$  fixation due to diazotroph blooms (Ganachaud et al., 2017). Interestingly, roughly 10% of the nitrogen fixed by the diazotroph species was found to be transferred into diatoms leading to a growth of diatom abundance (Bonnet et al., 2016). This moderate diatom growth compared to the Kerguelen diatom bloom is consistent with the higher  $\Delta dYb/\Delta dSi$  ratio observed here. In the deep layers, the observed slope  $\Delta \text{HREE}/\Delta dSi \approx 0.04$  is consistent with that found in Grenier et al. (submitted) and in the work of Bertram and Elderfield in the intermediate, deep and bottom waters of the Pacific Ocean (See figure 8 of Bertram and Elderfield, 1993).

### 607 5.3. Origin of the dREE enrichments in the Solomon Sea

1  
2 608 [56] The preceding two sections underlined several common features indicating that the  
3 609 dNd (dREE) enrichment calculated with our box model (section 5.1) results from the release  
4 610 of dNd (dREE) from the surface and submarine weathering of the surrounding islands. Several  
5 611 complementary parameters allowed us to confirm the nature of this external dNd source and  
6 612 its signature in the dissolved phase. Surface dEu enrichments, larger dCe values are  
7 613 consistent with similar high concentrations observed in the dAl and dMn profiles (Michael et  
8 614 al., 2017). In addition, consistent maxima of dREE, dAl and dMn are also observed at some  
9 615 specific points in the thermocline and intermediate layers (i.e: stations 04-1000m; 10-350m;  
10 616 20-700m; 42-700 m; 71-300 m; 77-500 m). Such consistencies underline that submarine  
11 617 weathering took place along the island margins since these enrichments could not result  
12 618 from any surface or bottom external inputs. The Solomon Sea is an area of strong internal  
13 619 wave activity and associated mixing (Alberty et al., 2017). It has been suggested that when  
14 620 the continental slope is close to a critical angle, the strong bottom shear velocities enhance  
15 621 sediment resuspension and potential release of chemical elements (Cacchione et al., 2002).  
16 622 Nepheloid layers might result from these processes and be advected further from the slope,  
17 623 contributing to the observed enrichments. The exact location of such resuspension events  
18 624 could be an interesting investigation for future studies.

## 26 625 6 Conclusion

27  
28  
29 626 [57] This study presented vertical profiles of dREE concentrations for 143 samples and 21  
30 627 stations collected in the Coral and Solomon Seas as part of the PANDORA cruise (boreal  
31 628 summer 2012). Although the profile shapes display common dREE features -i.e surface  
32 629 depleted and enriched at depth- the dREE patterns and anomalies could be discussed and  
33 630 lead to interesting results.

34  
35 631 [58] A first striking result is that, despite the very high dynamic variability of the Solomon  
36 632 Sea, with strong variables currents and recirculations, eddies, internal waves, the REE  
37 633 concentrations are very close to those previously measured at the same locations, confirming  
38 634 the robustness of this chemical family as tracers of continental/ocean exchanges.

39 635 [59] A pronounced dissolved dLa positive anomaly is estimated ( $dLa^*/dLa$  varying between  
40 636 3 and 6). The classical interpretation relates to the “tetrad” effect. However, our data show  
41 637 an excellent correlation between dLa and dBa which could suggest a coupling between both  
42 638 elements, lanthanum being associated with the dissolved barium/barite cycle. The particulate  
43 639 La and  $Ba_{xs}$  data will likely help to dig this hypothesis farther.

44  
45 640 [60] An europium positive anomaly is also found in all of our patterns with higher  
46 641  $dEu^*/dEu$  values in the upper layers. This striking feature agrees with previous observations  
47 642 (Grenier et al., submitted; Grenier et al., 2013; Zhang et al., 2008) and suggests that the  
48 643 enrichment calculated with the box model is lithogenic and of basaltic origin, consistent with  
49 644 the geology of the surrounding islands. The lithogenic source is later confirm by dCe anomaly

50  
51 645 [61] dHREE behaviour seem to be the most influenced by the Si cycle as suggested by  
52 646 Akagi (2013) and also observed by Grenier et al. (submitted).



647 [62] A box model allowed us to establish the net dNd(dREE) fluxes of the waters flowing  
648 equatorward through the Solomon Sea. Significant enrichment is observed ( $F_{\text{total PANDORA}} =$   
649  $145.1 \pm 45.8 \text{ t(Nd).yr}^{-1}$ ) for the Lower Thermocline Layer (between 200-500 m). This  
650 enrichment is of main interest, as these waters will eventually be advected till the equatorial  
651 eastern Pacific through the lower part of the EUC (Slemons et al., 2010; Grenier et al., 2013).  
652 By contrast, the lack of clear net enrichment in the upper thermocline is surprising in this  
653 area bounded by continental margins and with many potential sources. This points to the  
654 complexity of boundary exchange processes, and to the need of better understanding the  
655 removal processes of the oceanic dissolved material. The ongoing analysis of the associated  
656 particles and Nd isotopic composition will help to refine and conclude about the robustness  
657 of these net exchange fluxes.

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## 50 932 **9 Tables and Figures**

### 51 933 **Table Captions**

52 934 **Table 1:** Location, Depths, Hydrological properties, Ce anomalies, Nd concentration of the  
53 935 analyzed sample in this study and the corresponding water masses identified.

54 936 **Table 2:** Dissolved REE concentrations ( $\text{pmol.kg}^{-1}$ ). Data are reported with daily confidence  
55 937 interval ( $2\sigma$ ).

938 **Table 3** Average dNd concentrations in the different layers of the box model

939 **Table 4:** Water masses and associated volume transport (Sv) at different layer during Pandora  
940 (July-August 2012). The water transports were calculated based on S-ADCPs data couple with  
941 geostrophic velocities database

### 942 **Figure Captions**

943 **Figure 1.** General map of the studied area (a) and zoom panel in the Coral and Solomon Sea  
944 allowing the identification of the sampling locations (b). The sampling locations are  
945 represented by circles and different colors associated with distinct regions. The red circles  
946 correspond the Coral Sea and Southern entrance of the Solomon Sea. Samples collected in  
947 waters flowing through four straits (Indispensable, Vitiaz, St George's and Solomon), are  
948 colorized with dark violet, black, green and dark blue, respectively. These color criteria will be  
949 kept all along this work. The main currents flowing in the South Western Pacific Ocean are  
950 shown by solid arrow (Grenier et al., 2011, 2013). SEC: South Equatorial Current, NVJ: New  
951 Vanuatu Jet, NCJ: New Caledonia Jet, GPC: eastward Gulf of Papua Current, NQC: polarward  
952 New Queensland Current, NGCU: New Guinea Coastal Undercurrent, NBCU: New Britain  
953 Coastal Undercurrent, NICU: New Ireland Coastal Undercurrent, SSCC: South Subsurface  
954 Countercurrent, EUC: Equatorial Undercurrent. The main archipelago and islands are also  
955 reported in the map. Along with this, straits are identified by a character covered by red  
956 circle: Indispensable, Vitiaz, St.George and Solomon Strait also highlighted in the map as V, G  
957 and S, correspondingly.

958 **Figure 2.** Potential temperature ( $\theta$ ) versus salinity (S) (right) and potential temperature ( $\theta$ )  
959 versus dissolved oxygen (O<sub>2</sub>) (left) plots for the stations. The curve colors correspond to the  
960 different locations denoted in figure 1. The grey curves are representing the same properties  
961 at all the hydrographic stations sampled as part of PANDORA. In the left plots, potential  
962 density anomaly contours are shown as solid grey lines. Each depth sampled for dissolved  
963 REE measurement is identified by a rectangle and its value (m). All the data characterizing the  
964 stations represented here are provided in Table 1. The water masses at the sampling depth  
965 are also highlighted by their notation: TSW: Tropical Surface Water, SPTW: South Pacific  
966 Tropical Water, SPEW: South Pacific Equatorial Water, WSPCW: Western South Pacific  
967 Central Water, SAMW: Subantarctic Mode Water, AAIW: Antarctic Intermediate Water,  
968 EqPIW: Equatorial Pacific Intermediate Water, UCDW and LCDW: Upper and Lower  
969 Circumpolar Deep Water.

970 **Figure 3.** Profiles of dissolved REE concentrations for La, Nd, Eu and Yb. Stations are gathered  
971 into five groups with the color codes consistent with their geographical location as proposed  
972 in Figure 1.

973 **Figure 4.** Comparison of our data with those measured in the framework of preceding  
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975 1992) located in the middle of the Coral Sea and measured by Zhang and Nozaki (1996). Aqua  
976 square, triangle and dot represent data measured at the entrance of Solomon (FLUSEC 22),  
977 Coral sea (FLUSEC 43) and at exiting Vitiaz Strait respectively, measured by Grenier et al.

978 (2013). It is noted that all sample using in study of Grenier was sampled in August-  
979 September, 2006. Sampling date of our samples are reported in table 1.

980 **Figure 5.** dREE patterns normalized to PAAS ( $\times 10^6$ ) at different depths for 8 stations sampled  
981 in the Coral Sea and at the entrance of Solomon Sea and for 12 stations located in the  
982 Solomon Sea and in the different straits The light colors indicate shallow samples while  
983 darker colors represent the deeper ones.

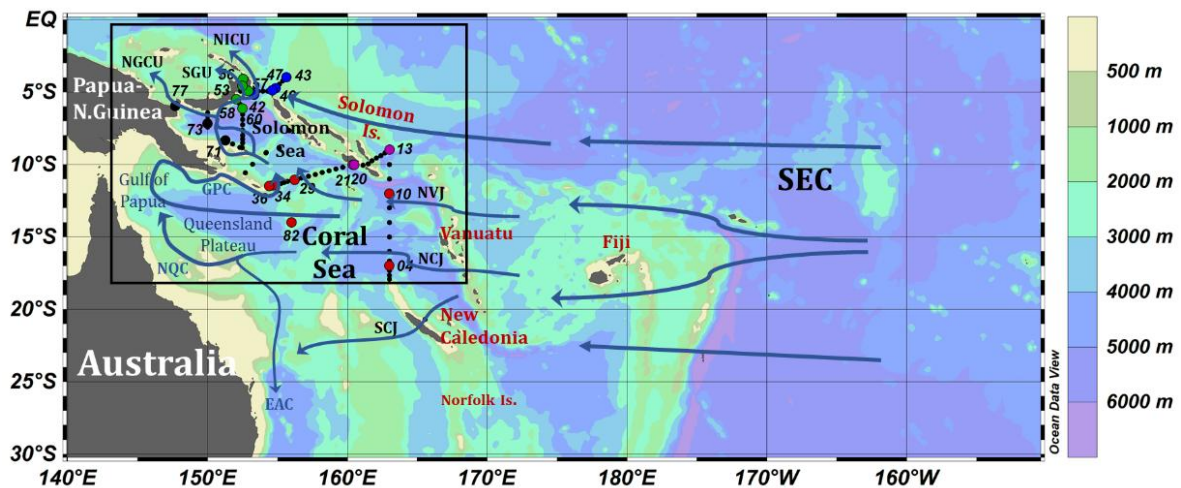
984 **Figure 6.** a) Schematic description of the Pandora box (red rectangular). The water layer is  
985 defined in the table 4. Yellow arrows signify southern input while red arrows characterize  
986 output flow through three straits. Meanwhile, colored letters coupled with number indicate  
987 different stations together with their transport. E: NGCU transport, N: direct NVJ transport, V,  
988 G and S: Vitiaz Strait, St George's Channel and Solomon Strait transports, respectively. b)  
989 Enrichment visualizing by simple Pandora box with 2 southern inputs and 3 northern outputs  
990 as presented in figure 6a. The Nd concentrations were taken into account here are NdE, NdN  
991 in the south and NdS, NdG and NdV in the north. c) Significant enrichment is observed at  
992 Lower Thermocline Water, all fluxes are reported in Table 4.

993 **Figure 7.** Vertical profiles of the anomalies of La ( $La/La^*$ ), Eu ( $Eu/Eu^*$ ), Yb ( $Yb/Yb^*$ ) and of  
994 ratio  $(Nd/Yb)_n$ , calculated following Bau et al. (2004); Bau et al. (1996); Friend et al. (2008);  
995 Garcia-Solsona et al. (2014). The color of markers follow color rule as described in Figure 1.  
996 High value was found at the surface water characterize at almost all parameter, except  
997  $Yb/Yb^*$ . Profile of ratio  $Ndn/Ybn$  indicate the recent lithogenic enrichment at the top of  
998 water, then disappear by marine scavenging and later redissolution and or remineralization  
999 at depth. Error bars are also plotted together with anomaly value.

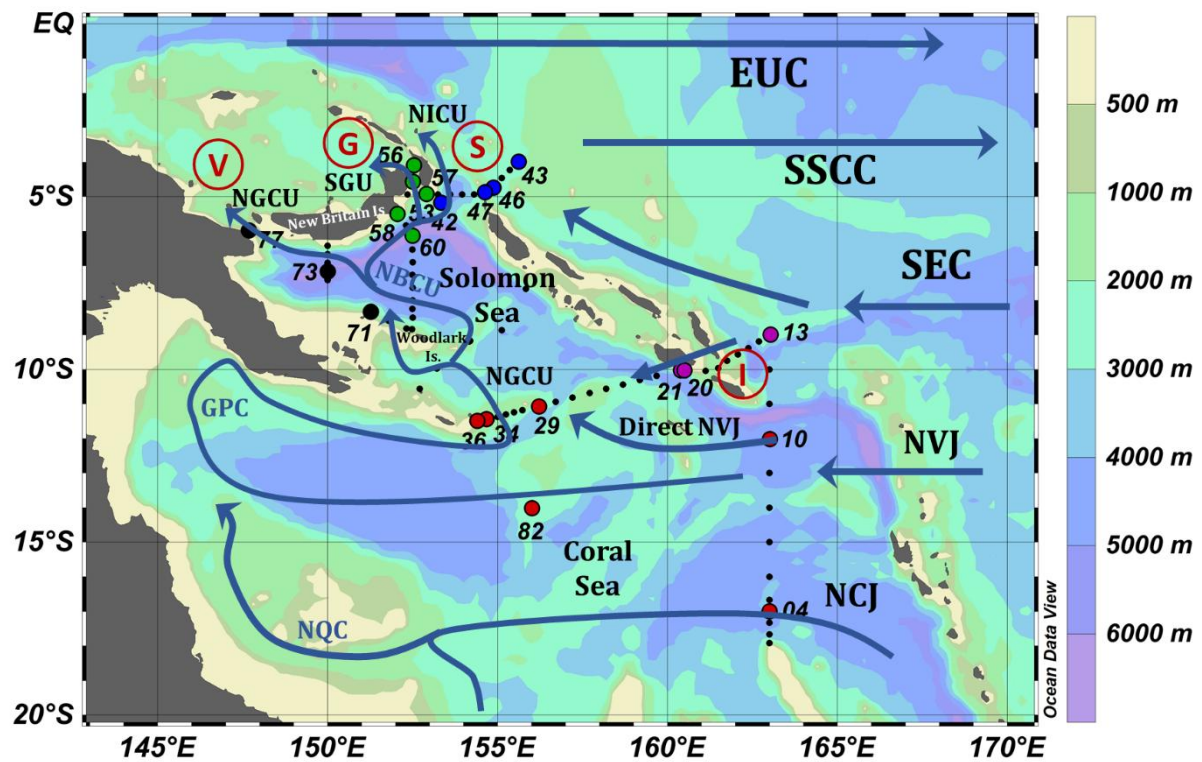
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1001 relationship confirms the hypothesis that a part of La enrichment comes from the barium  
1002 cycle in oceanic water (Garcia-Solona et al., 2014; Grenier et al. Submitted in 2017). The  
1003 slope reflects different rates between Barite formation and lithogenic dissolution in the  
1004 water column.

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1006 regression point out the strong relation between HREE and Si cycle as suggested by Akagi et  
1007 al. (2011, 2013) and Grenier et al. (submitted in 2017). The break slope at around 700m  
1008 suggests the strength of different internal and or external oceanic process on REE  
1009 distribution.



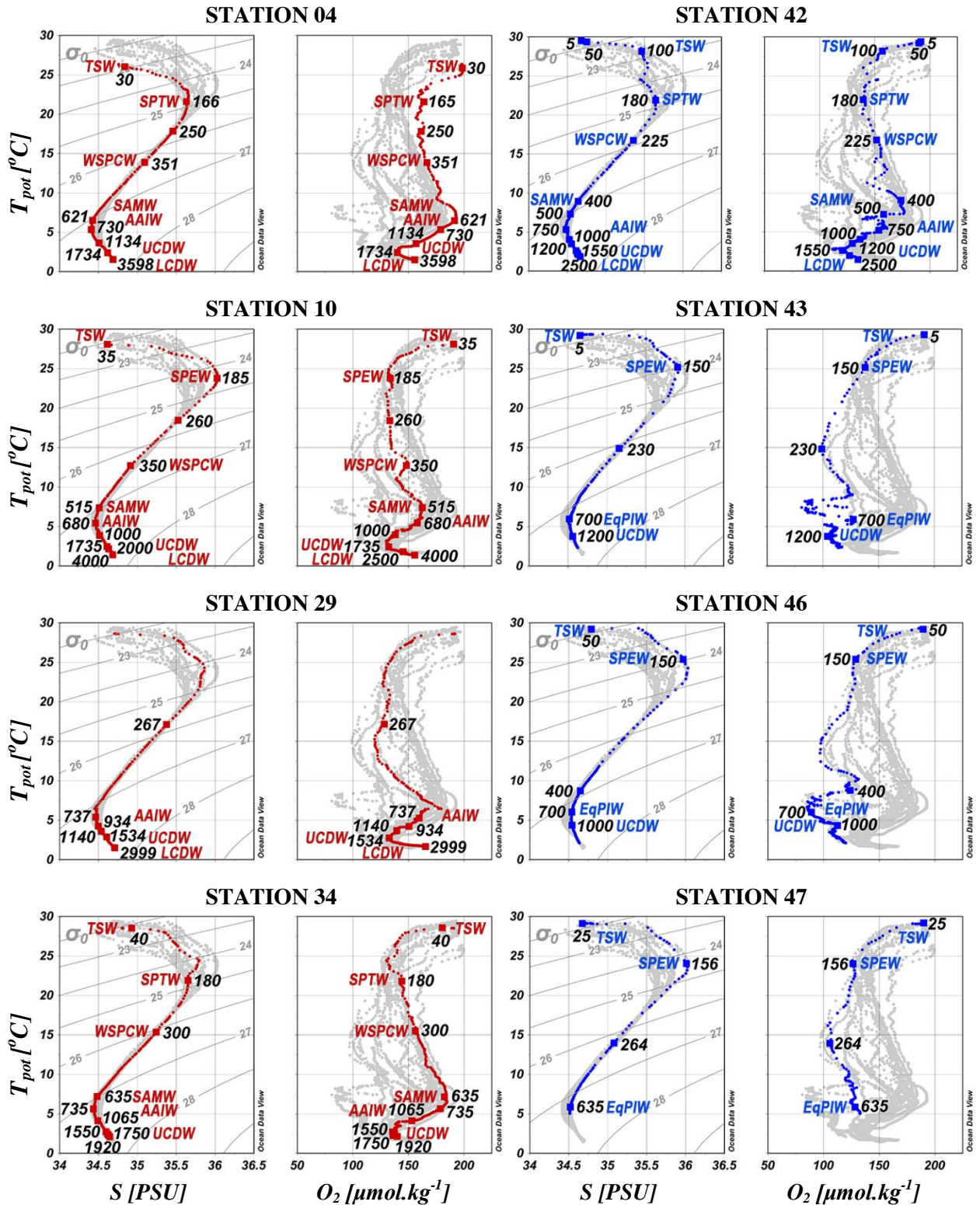


(a)



(b)

**Figure 1.** General map of the studied area (a) and zoom panel in the Coral and Solomon Sea allowing the identification of the sampling locations (b). The sampling locations are represented by circles and different colors associated with distinct regions. The red circles correspond the Coral Sea and Southern entrance of the Solomon Sea. Samples collected in waters flowing through four straits (Indispensable, Vitiiaz, St George's and Solomon), are colorized with dark violet, black, green and dark blue, respectively. These color criteria will be kept all along this work. The main currents flowing in the South Western Pacific Ocean are shown by solid arrow (Grenier et al., 2011, 2013). SEC: South Equatorial Current, NVJ: New Vanuatu Jet, NCJ: New Caledonia Jet, GPC: eastward Gulf of Papua Current, NQC: polarward New Queensland Current, NGCU: New Guinea Coastal Undercurrent, NBCU: New Britain Coastal Undercurrent, NICU: New Ireland Coastal Undercurrent, SSCC: South Subsurface Countercurrent, EUC: Equatorial Undercurrent. The main archipelago and islands are also reported in the map. Along with this, straits are identified by a character covered by red circle: Indispensable, Vitiiaz, St. George and Solomon Strait also highlighted in the map as V, G and S, correspondingly.



**Figure 2.** Potential temperature ( $\theta$ ) versus salinity ( $S$ ) (right) and potential temperature ( $\theta$ ) versus dissolved oxygen ( $O_2$ ) (left) plots for the stations. The curve colors correspond to the different locations denoted in figure 1. The grey curves are representing the same properties at all the hydrographic stations sampled as part of PANDORA. In the left plots, potential density anomaly contours are shown as solid grey lines. Each depth sampled for dissolved REE measurement is identified by a rectangle and its value (m). All the data characterizing the stations represented here are provided in Table 1. The water masses at the sampling depth are also highlighted by their notation: TSW: Tropical Surface Water, SPTW: South Pacific Tropical Water, SPEW: South Pacific Equatorial Water, WSPCW: Western South Pacific Central Water, SAMW: Subantarctic Mode Water, AAIW: Antarctic Intermediate Water, EqPIW: Equatorial Pacific Intermediate Water, UCDW and LCDW: Upper and Lower Circumpolar Deep Water.

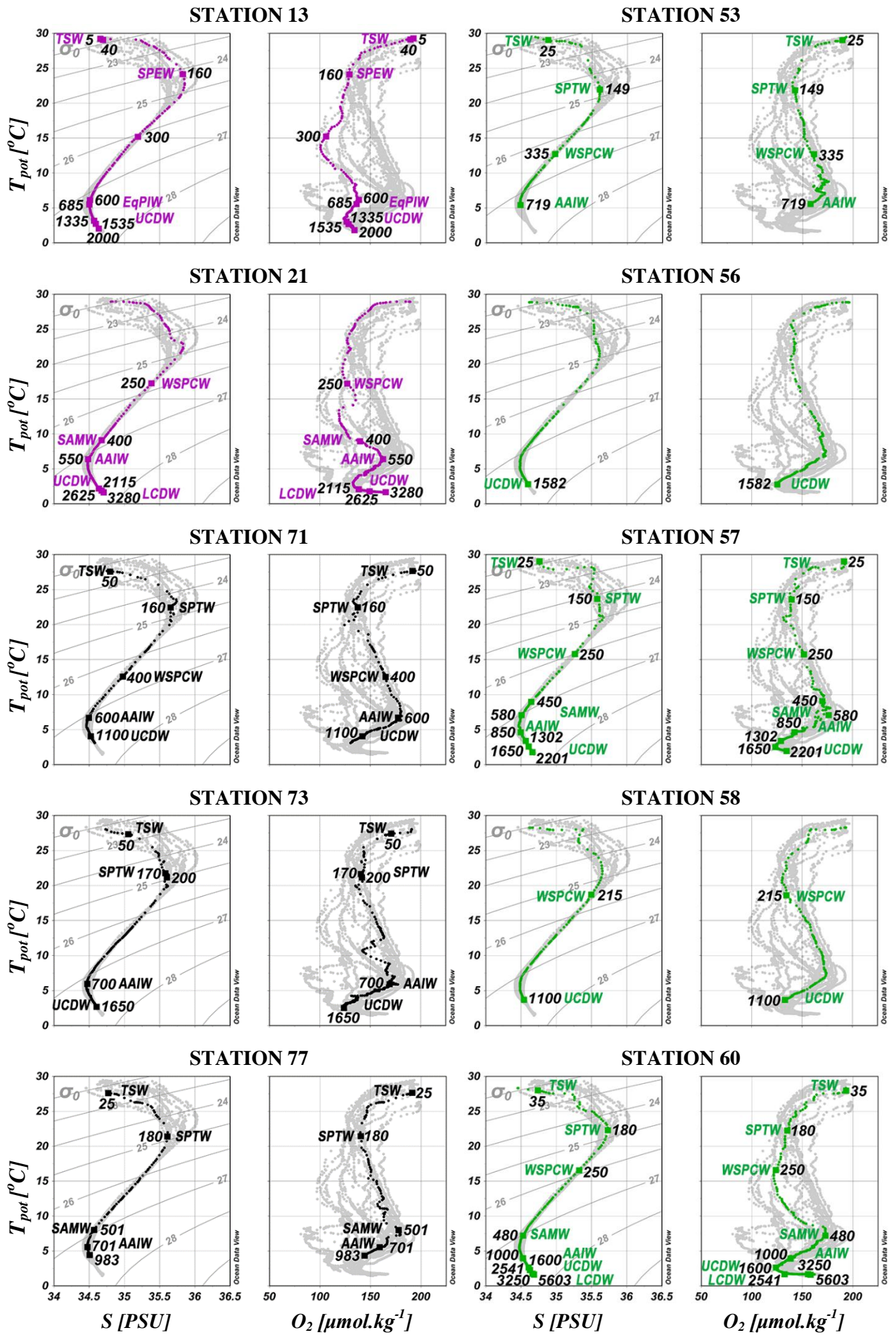
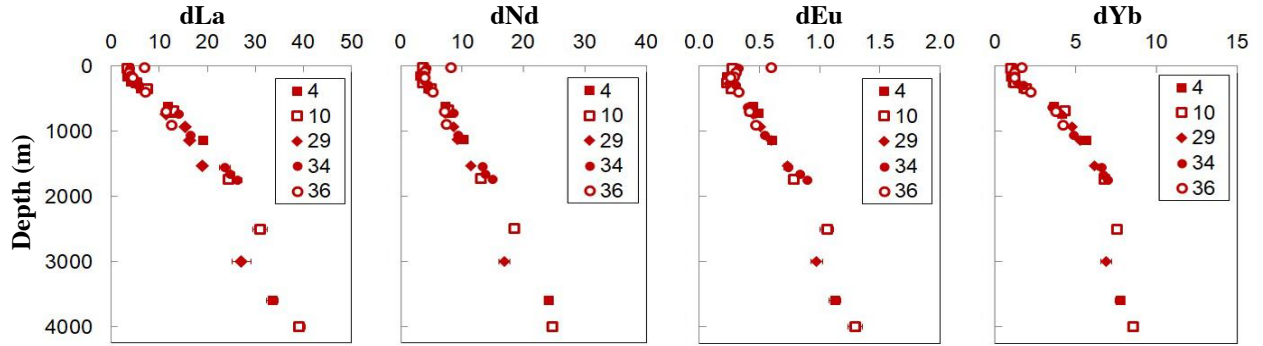
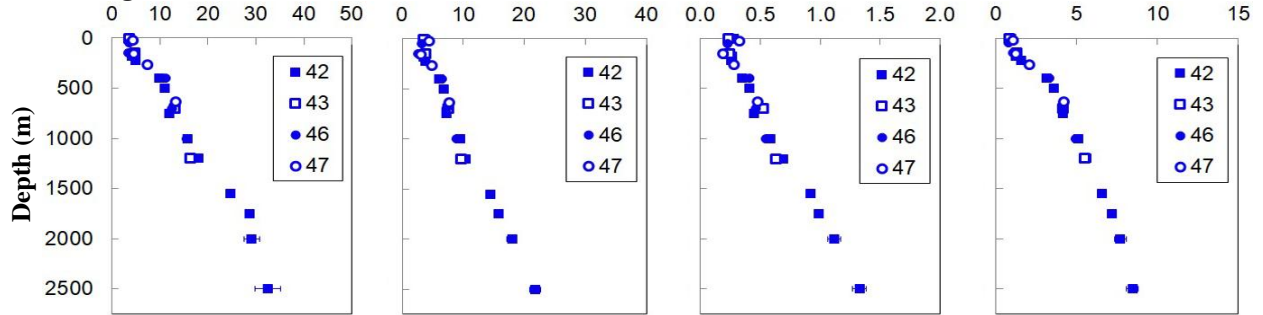


Figure 2. (continued)

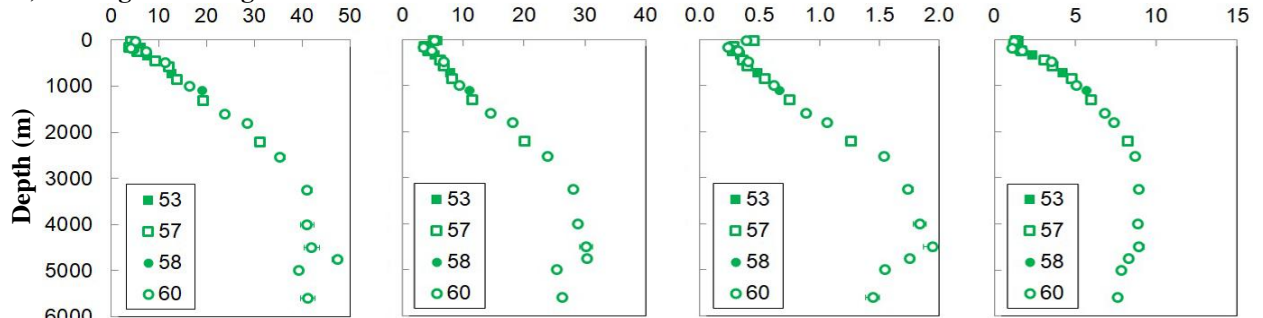
**3a) In the Coral Sea, southern entrance of Solomon Sea**



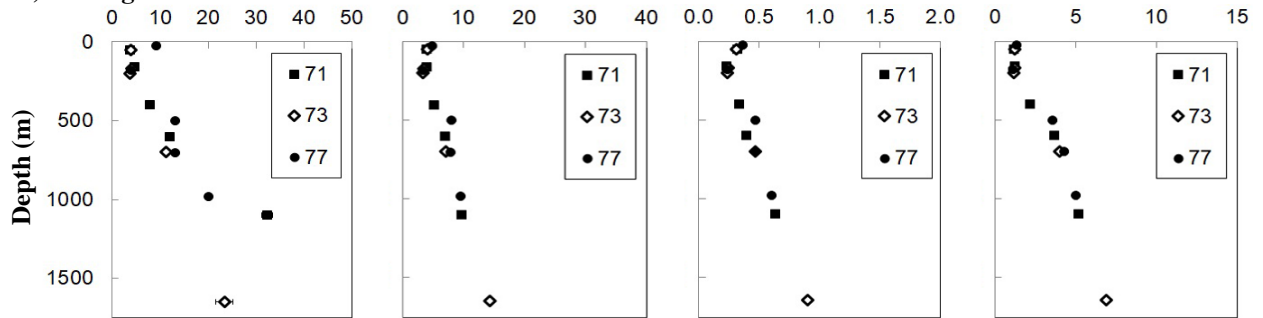
**3b) Through Solomon Strait**



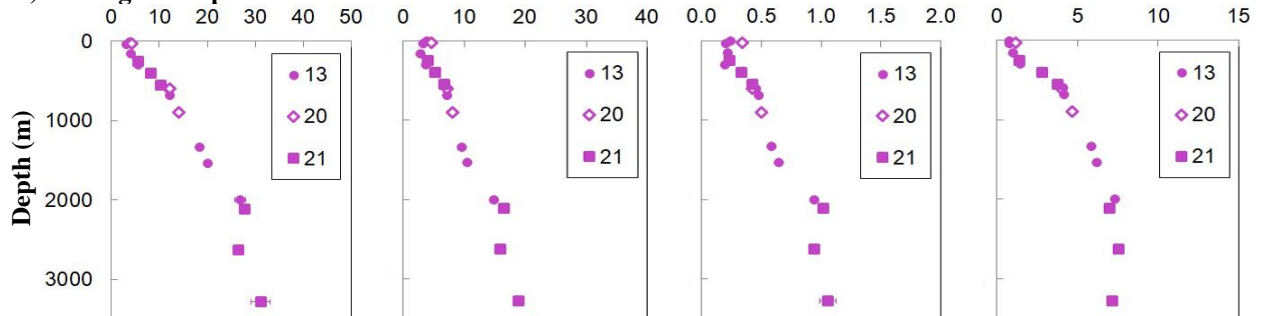
**3c) Through St George's Strait**



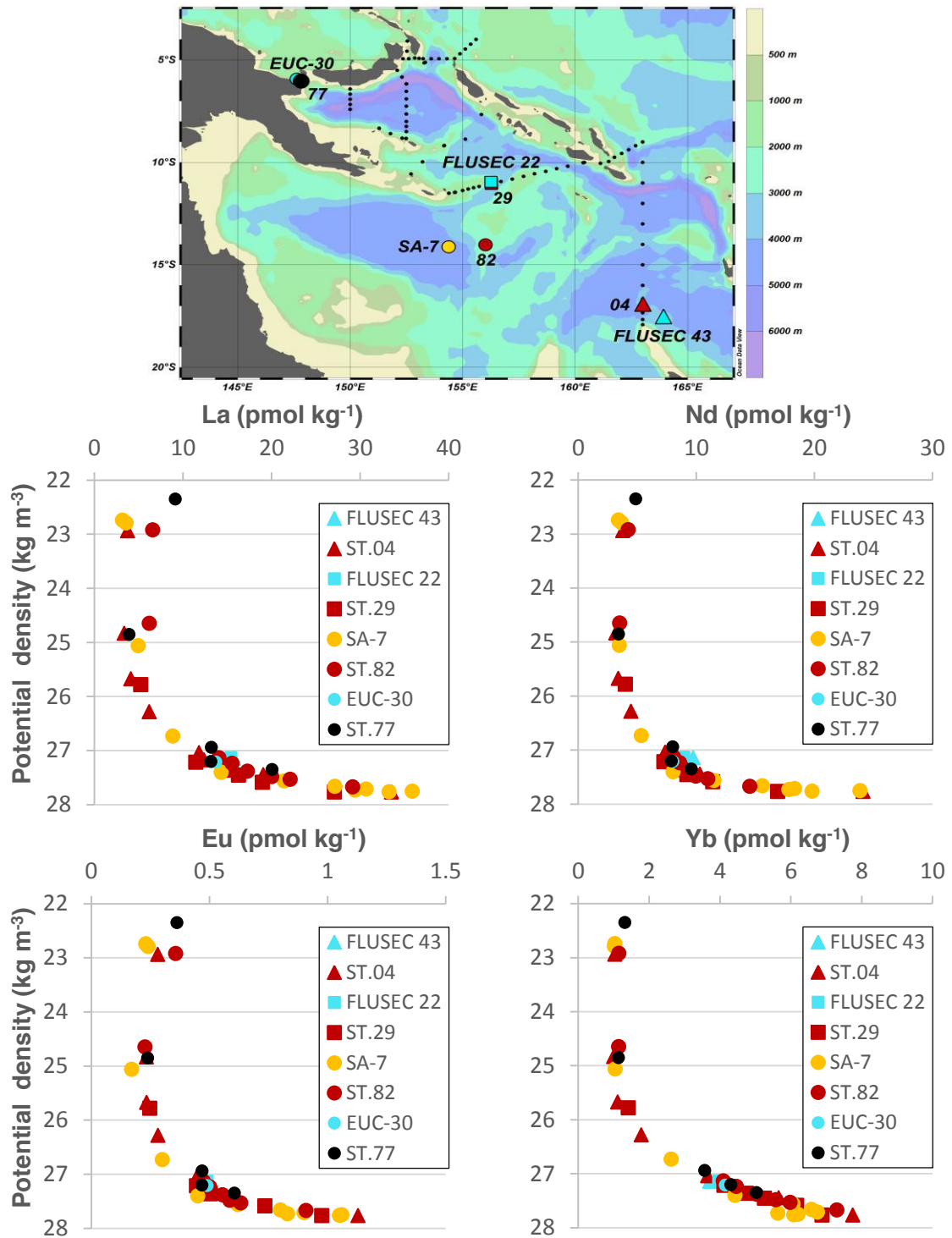
**3d) Through Vitiaz Strait**



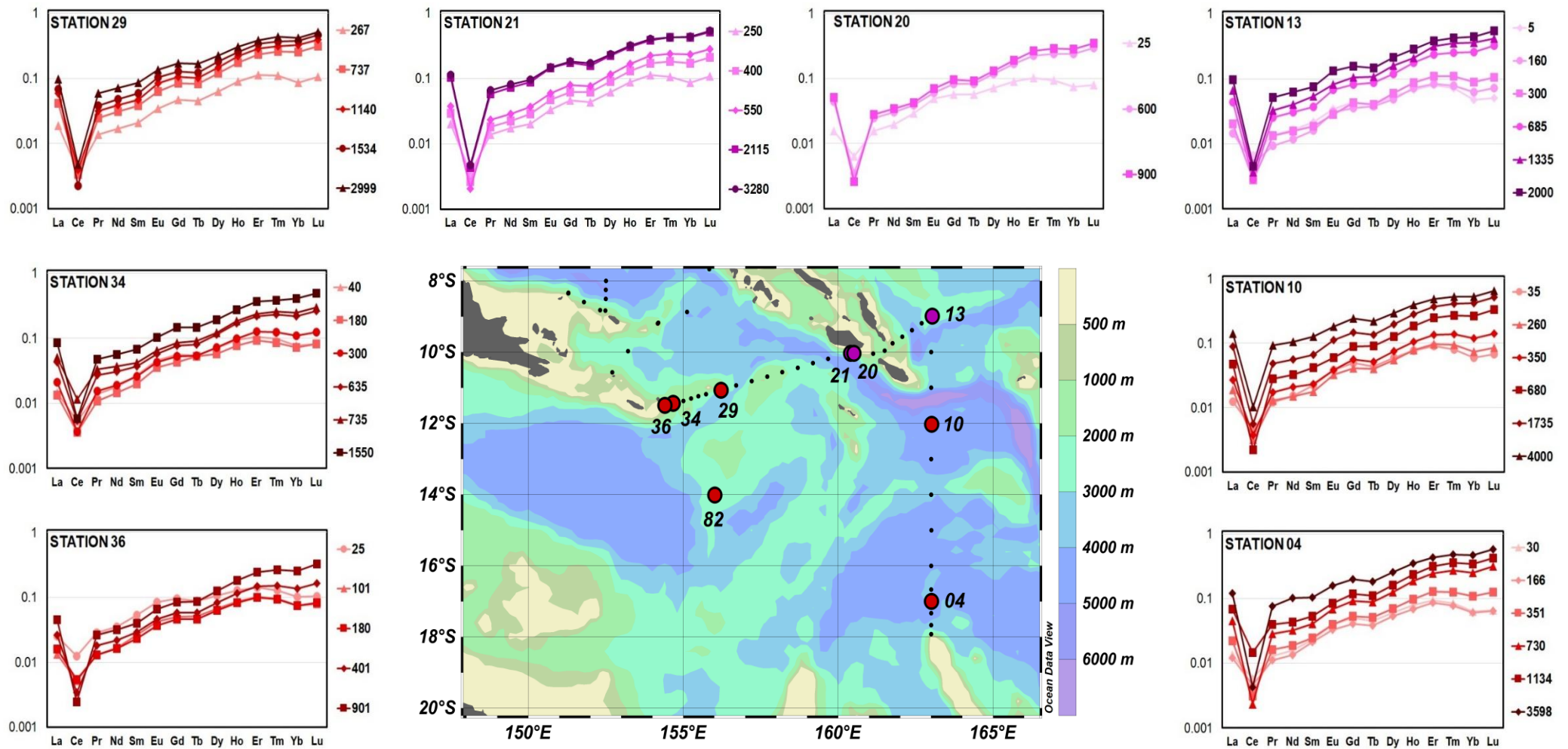
**3e) Through Indispensable Strait**



**Figure 3.** Profiles of dissolved REE concentrations for La, Nd, Eu and Yb. Stations are gathered into five groups with the color codes consistent with their geographical location as proposed in Figure 1.



**Figure 4.** Comparison of our data with those measured in the framework of preceding studies. Yellow points represent data from station SA-7 (sampled during September-October, 1992) located in the middle of the Coral Sea and measured by Zhang and Nozaki (1996). Aqua square, triangle and dot represent data measured at the entrance of Solomon (FLUSEC 22), Coral sea (FLUSEC 43) and at exiting Vitiaz Strait respectively, measured by Grenier et al. (2013). It is noted that all sample using in study of Grenier was sampled in August-September, 2006. Sampling date of our samples are reported in table 1.



**Figure 5.** dREE patterns normalized to PAAS ( $\times 10^6$ ) at different depths for 8 stations sampled in the Coral Sea and at the entrance of Solomon Sea and for 12 stations located in the Solomon Sea and in the different straits. The light colors indicate shallow samples while darker colors represent the deeper ones.

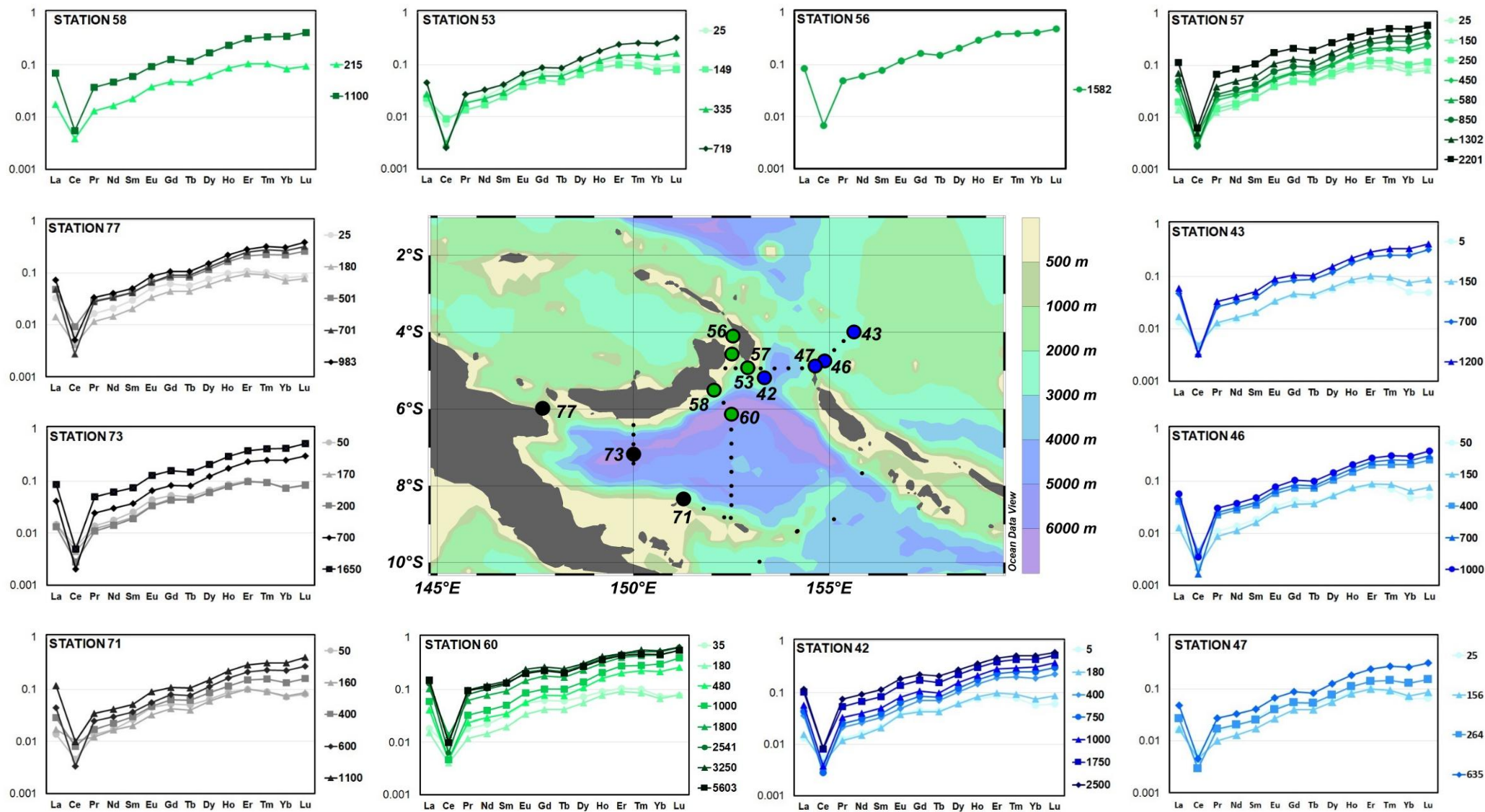
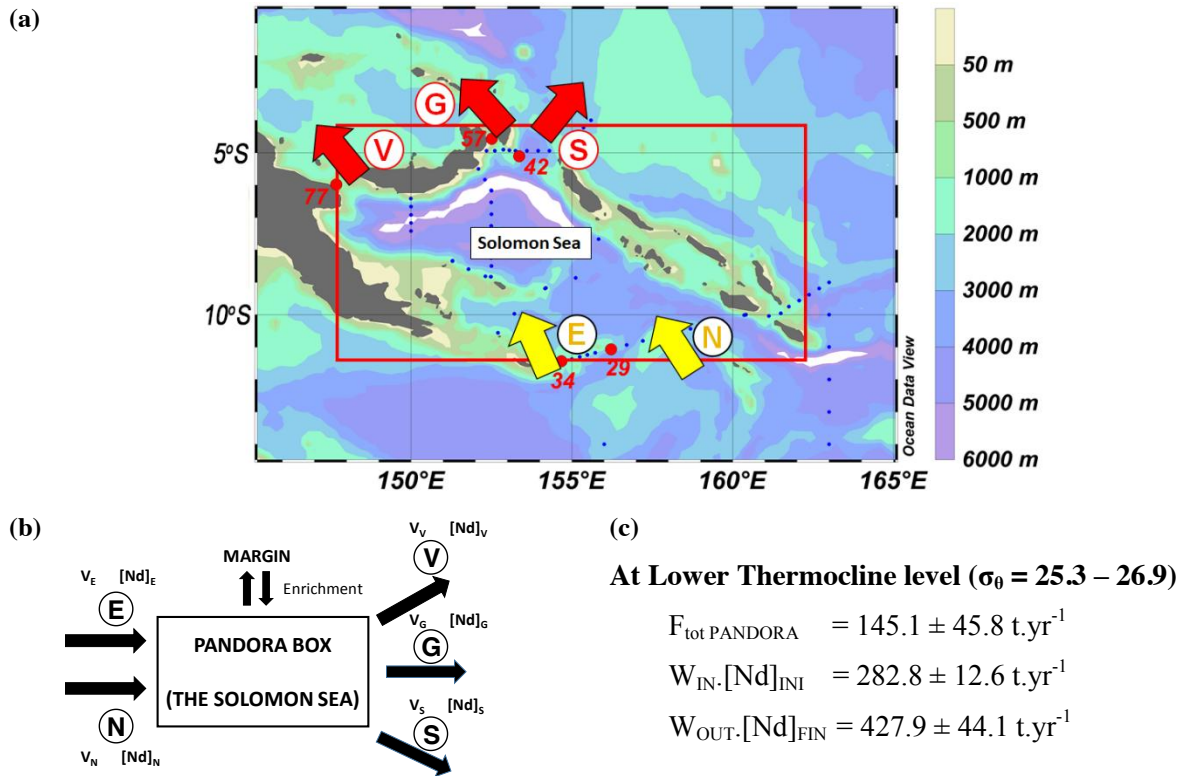
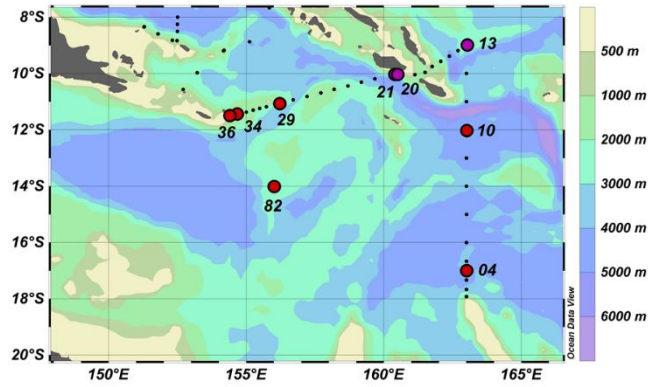


Figure 5. (continued)

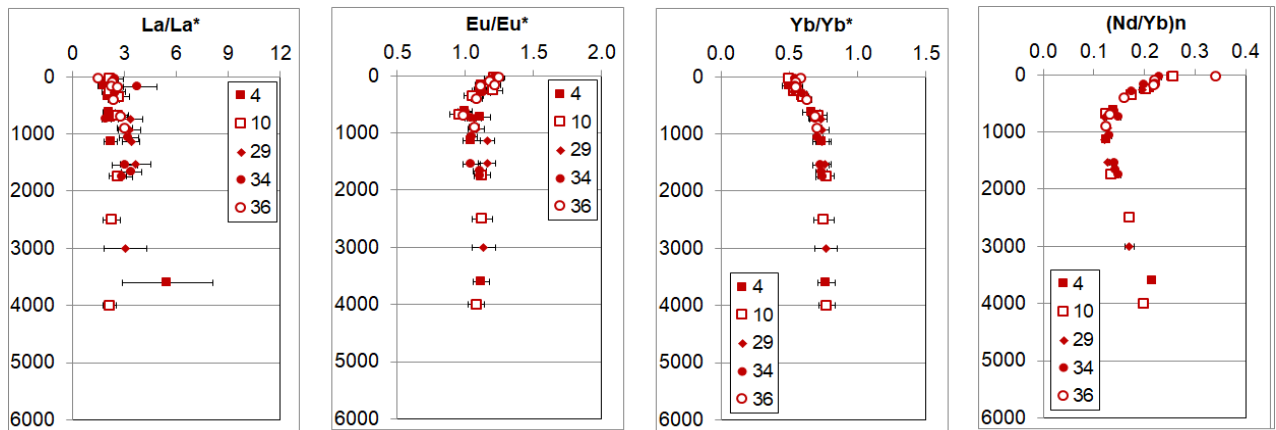


**Figure 6.** a) Schematic description of the Pandora box (red rectangular). The water layer is defined in the table 3. Yellow arrows signify southern input while red arrows characterize output flow through three straits. Meanwhile, colored letters coupled with number indicate different stations together with their transport. E: NGCU transport, N: direct NVJ transport, V, G and S: Vitiaz Strait, St George’s Channel and Solomon Strait transports, respectively. b) Enrichment visualizing by simple Pandora box with 2 southern inputs and 3 northern outputs as presented in figure 6a. The Nd concentrations were taken into account here are  $Nd_E$ ,  $Nd_N$  in the south and  $Nd_S$ ,  $Nd_G$  and  $Nd_V$  in the north. c) Significant enrichment is observed at Lower Thermocline Water, all fluxes are reported in Table 3.

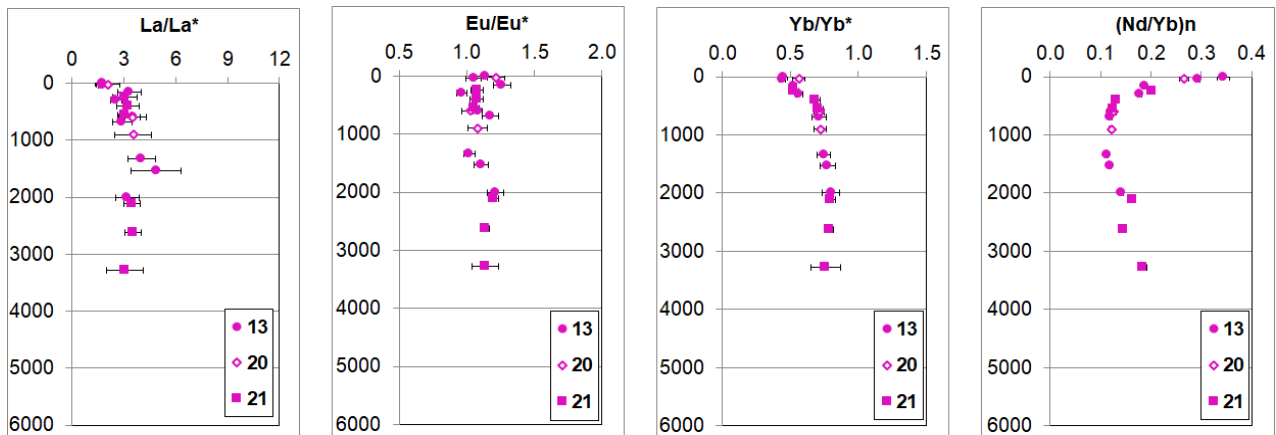




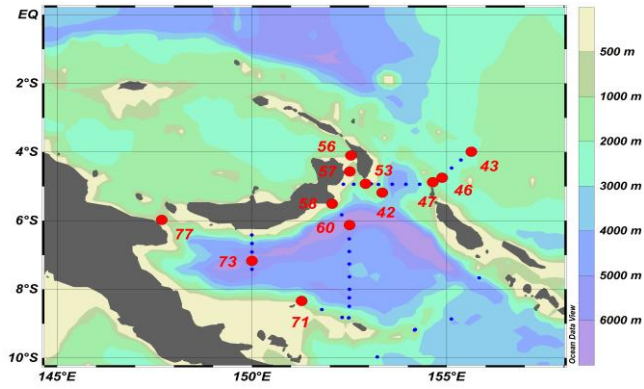
**The Coral Sea, southern entrance of Solomon Sea**



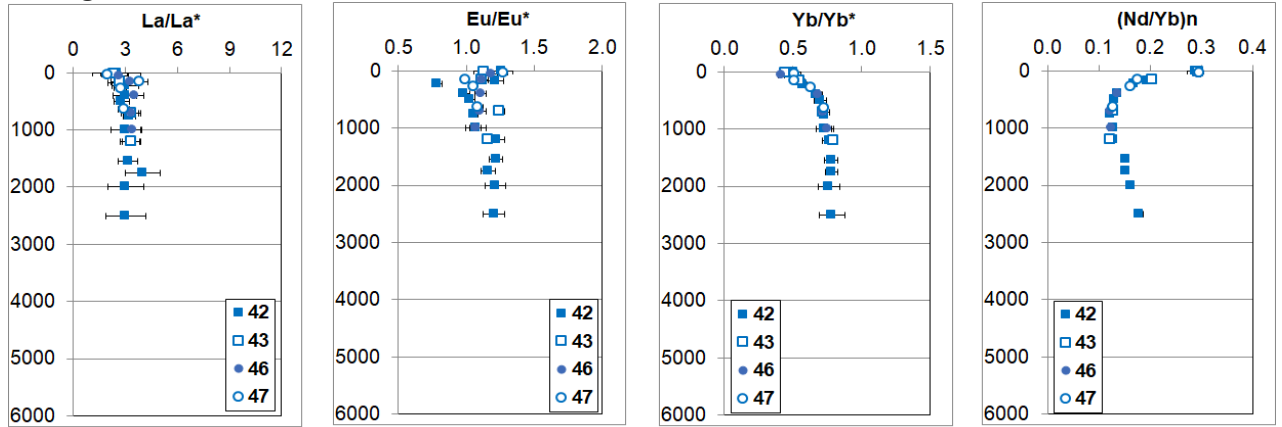
**Through Indispensable Strait**



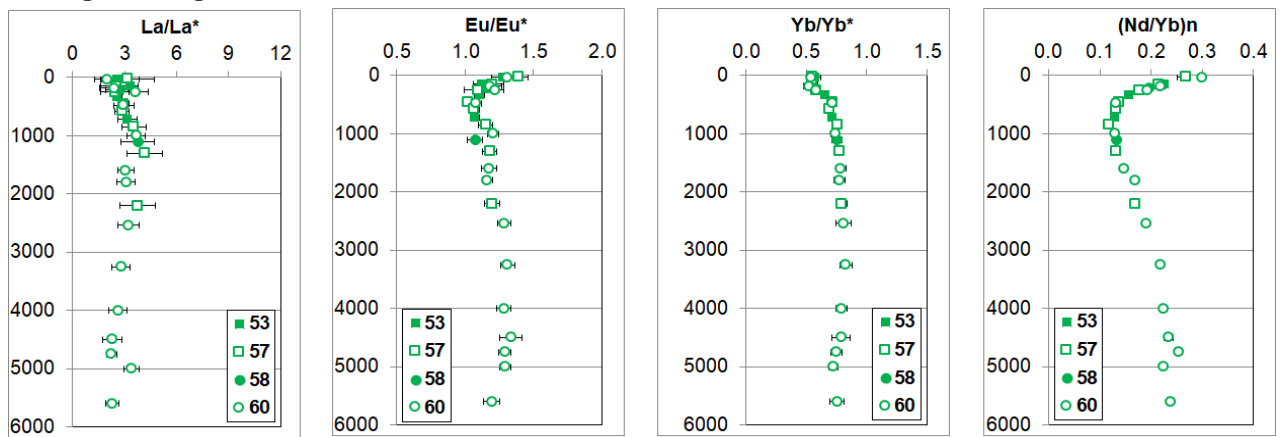
**Figure 7.** Vertical profiles of the anomalies of La ( $La/La^*$ ), Eu ( $Eu/Eu^*$ ), Yb ( $Yb/Yb^*$ ) and of ratio  $(Nd/Yb)_n$ , calculated following Bau et al. (2004); Bau et al. (1996); Friend et al. (2008); Garcia-Solsona et al. (2014). The color of markers follow color rule as described in Figure 1. High value was found at the surface water characterize at almost all parameter, except  $Yb/Yb^*$ . Profile of ratio  $(Nd/Yb)_n$  indicate the recent lithogenic enrichment at the top of water, then disappear by marine scavenging and later redissolution and or remineralization at depth. Error bars are also plotted together with anomaly value.



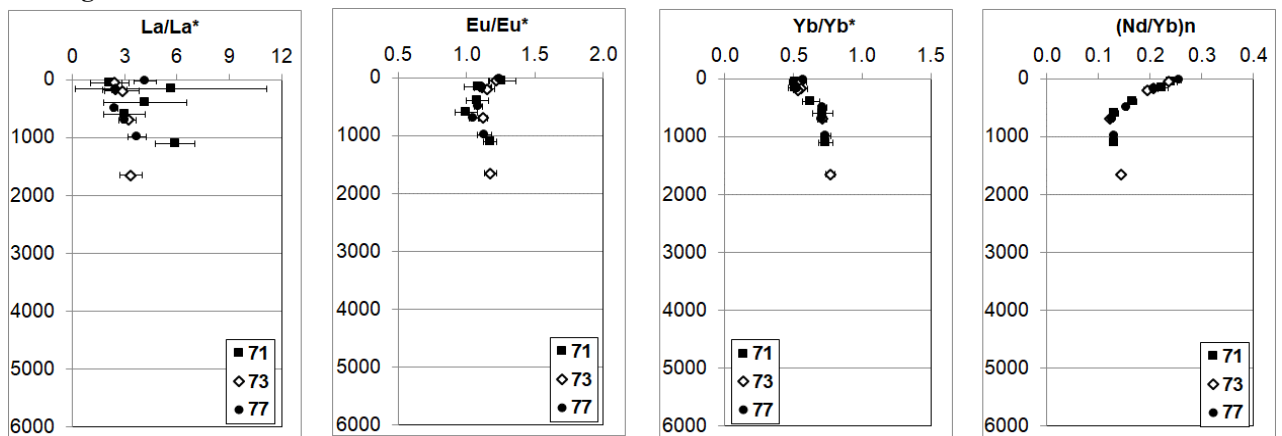
**Through Solomon Strait**



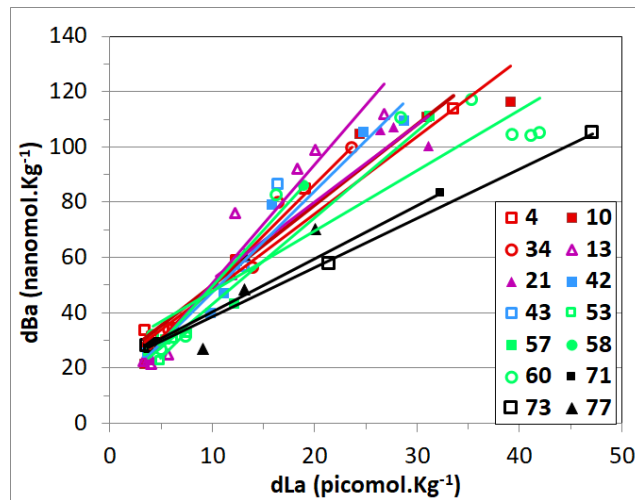
**Through St. George Strait**



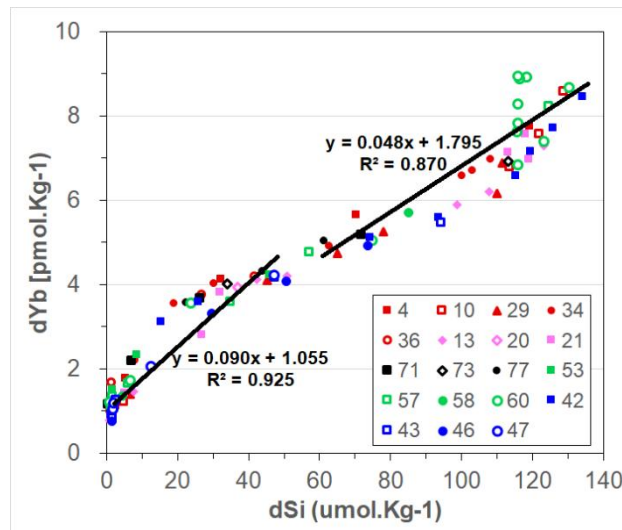
**Through Vitiaz Strait**



**Figure 7 (continued)**



**Figure 8.** Linear correlations between dLa (in  $\text{pmol.kg}^{-1}$ ) and dBa of all Pandora stations. The relationship confirms the hypothesis that a part of La enrichment comes from the barium cycle in oceanic water (Garcia-Solona et al., 2014; Grenier et al. Submitted in 2017). The slope reflects different rates between Barite formation and lithogenic dissolution in the water column.



**Figure 9.** Relationship between dYb (in  $\text{pmol.kg}^{-1}$ ) and dSi (in  $\mu\text{mol.kg}^{-1}$ ). Two linear regression point out the strong relation between HREE and Si cycle as suggested by Akagi et al. (2011, 2013) and Grenier et al. (submitted in 2017). The break slope at around 700m suggests the strength of different internal and or external oceanic process on REE distribution.

**Table 1.** Location, Depths, Hydrological properties, Ce anomalies, Nd concentration of the analyzed sample in this study and the corresponding water masses identified

Depth (m)	Salinity (PSU)	Pot. Temp [°C]	O <sub>2</sub> (μmol kg <sup>-1</sup> )	Pot. Dens (σ <sub>θ</sub> ) (kg m <sup>-3</sup> )	La/La*	Ce/Ce*	Eu/Eu*	Yb/Yb*	(Nd/Yb) <sub>n</sub>	Water Mass
Station 004 (July 01, 2012; 17° 0' 10.8" S; 162° 59' 45.6" E; depth: 4680m)										
30	34.840	25.931	199	22.94	2.08	0.60	1.21	0.50	0.25	TSW
166	35.631	21.533	164	24.83	1.81	0.51	1.12	0.50	0.22	SPTW
250	35.462	17.831	161	25.67	2.31	0.46	1.11	0.55	0.21	WSPCW
351	35.095	13.923	167	26.28	2.04	0.23	1.09	0.59	0.17	SAMW
621	34.426	6.496	192	27.04	2.11	0.12	1.00	0.66	0.14	AAIW
730	34.415	5.375	179	27.17	2.21	0.10	1.11	0.70	0.13	UCDW
1134	34.510	3.573	157	27.44	2.20	0.41	1.05	0.74	0.13	LCDW
1734	34.620	2.410	140	27.64	-	-	-	-	-	
3598	34.687	1.546	156	27.76	5.48	0.09	1.12	0.77	0.22	
Station 010 (July 03, 2012; 12° 0' 0" S; 162° 59' 56.4" E; depth : 5092m)										
35	34.616	28.053	191	22.09	2.13	0.51	1.21	0.50	0.26	TSW
185	36.029	24.496	134	24.50	-	-	-	-	-	SPEW
260	35.523	18.403	133	25.58	2.12	0.29	1.21	0.54	0.20	WSPCW
350	34.918	12.675	148	26.40	2.68	0.27	1.05	0.60	0.18	SAMW
515	34.510	7.400	163	26.98	-	-	-	-	-	AAIW
680	34.458	5.395	158	27.20	2.61	0.10	0.95	0.72	0.12	UCDW
1000	34.520	3.960	139	27.41	-	-	-	-	-	LCDW
1735	34.613	2.435	133	27.63	2.62	0.14	1.12	0.77	0.13	
2500	34.669	1.777	145	27.73	2.26	0.07	1.13	0.75	0.17	
4000	34.685	1.443	153	27.77	2.14	0.13	1.08	0.77	0.20	
Station 013 (July 04, 2012; 9° 0' 10.8" S; 162° 59' 56.4" E; depth : 3853m)										
5	34.651	29.182	191	21.74	1.74	0.61	1.14	0.45	0.34	TSW
40	34.675	29.157	191	21.77	1.77	0.54	1.05	0.44	0.29	SPEW
160	35.830	24.121	129	24.24	3.32	0.74	1.26	0.53	0.19	-
300	35.188	15.244	106	26.07	2.54	0.26	0.96	0.57	0.18	EqPIW
600	34.515	6.128	138	27.16	3.52	0.10	1.08	0.72	0.12	
685	34.503	5.528	138	27.22	2.89	0.14	1.18	0.71	0.12	UCDW
1335	34.574	3.108	126	27.54	4.01	0.15	1.02	0.75	0.11	
1535	34.595	2.709	129	27.60	4.86	0.10	1.11	0.78	0.12	
2000	34.640	2.023	133	27.69	3.19	0.11	1.21	0.80	0.14	
Station 020 (July 06, 2012; 9° 59' 56.4" S; 160° 25' 1.2" E; depth : 2910m)										
25	34.832	28.896	189	21.97	2.09	0.56	1.21	0.56	0.27	TSW
190	35.822	22.620	127	24.67	-	-	-	-	-	SPEW
600	34.485	6.223	162	27.12	3.49	0.19	1.02	0.71	0.13	AAIW
900	34.490	4.787	151	27.30	3.53	0.12	1.08	0.72	0.12	UCDW
1600	34.599	2.720	133	27.60	-	-	-	-	-	
Station 021 (July 07, 2012; 10° 0' 46.8" S; 160° 21' 25.2" E; depth : 3342m)										
250	35.388	17.226	127	25.76	3.05	0.35	1.08	0.53	0.20	WSPCW
400	34.675	9.036	140	26.86	3.24	0.19	1.07	0.69	0.13	SAMW
550	34.491	6.382	163	27.10	3.06	0.11	1.06	0.71	0.12	AAIW
2115	34.644	2.075	139	27.69	3.48	0.10	1.20	0.80	0.16	UCDW
2625	34.677	1.787	150	27.74	3.52	0.09	1.14	0.79	0.15	LCDW
3280	34.700	1.614	165	27.77	3.07	0.09	1.14	0.76	0.18	
Station 029 (July 09, 2012; 11° 3' 39.6" S; 156° 12' 54" E; depth : 3856m)										
267	35.378	17.122	128	25.78	2.49	0.35	1.10	0.53	0.20	-
737	34.465	5.346	160	27.21	3.32	0.18	1.07	0.73	0.12	AAIW
934	34.497	4.281	150	27.36	3.29	0.28	1.08	0.74	0.13	UCDW
1140	34.535	3.704	139	27.45	3.37	0.16	1.16	0.74	0.12	LCDW
1534	34.593	2.817	133	27.59	3.65	0.08	1.16	0.76	0.13	
2999	34.699	1.687	166	27.77	3.02	0.10	1.14	0.77	0.17	
Station 034 (July 10, 2012; 11° 27' 7.2" S; 154° 39' 54" E; depth : 2005m)										

40	34.932	28.522	181	22.17	2.47	0.54	1.21	0.55	0.23	TSW
180	35.656	21.834	144	24.77	3.76	0.50	1.21	0.57	0.20	SPTW
300	35.247	15.416	156	26.08	2.46	0.30	1.14	0.60	0.18	WSPCW
635	34.485	7.121	183	27.00	2.19	0.23	1.01	0.67	0.14	SAMW
735	34.439	5.649	179	27.16	1.94	0.39	1.04	0.69	0.15	AAIW
1065	34.493	4.140	154	27.37	3.23	0.24	1.05	0.71	0.13	
1550	34.600	2.730	136	27.60	3.02	0.15	1.05	0.73	0.14	
1665	34.613	2.558	137	27.62	3.42	0.09	1.11	0.74	0.14	UCDW
1750	34.625	2.385	136	27.65	2.88	0.10	1.11	0.74	0.15	
1920	34.645	2.140	140	27.69	-	-	-	-	-	
Station 036 (July 11, 2012; 11° 30' 7.2" S; 154° 23' 24" E; depth : 1168m)										
24	34.489	27.756	195	22.09	1.52	0.54	1.25	0.59	0.34	TSW
101	35.431	24.271	163	23.89	2.31	0.56	1.18	0.55	0.22	
159	35.609	22.290	141	24.60	2.28	0.50	1.22	0.54	0.22	SPTW
180	35.639	21.074	144	24.96	2.60	0.56	1.11	0.55	0.22	
401	34.943	12.203	167	26.51	2.37	0.23	1.08	0.63	0.16	WSPCW
699	34.460	6.285	182	27.09	2.75	0.12	0.98	0.69	0.13	AAIW
901	34.458	5.126	170	27.24	3.03	0.12	1.07	0.71	0.12	
Station 042 (July 15, 2012; 5° 8' 42" S; 153° 17' 24" E; depth : 3081m)										
5	34.691	29.381	192	21.71	2.50	0.61	1.26	0.50	0.29	
50	34.753	29.380	192	21.75	-	-	-	-	-	TSW
100	35.464	28.210	157	22.68	-	-	-	-	-	
180	35.648	21.971	140	24.72	2.62	0.50	1.21	0.55	0.20	SPTW
225	35.353	16.762	152	25.85	2.99	0.26	0.79	0.57	0.17	WSPCW
400	34.644	9.024	174	26.84	2.99	0.19	0.98	0.67	0.14	
500	34.538	7.266	158	27.02	2.79	0.16	1.03	0.70	0.13	SAMW
750	34.484	5.316	154	27.23	3.24	0.15	1.06	0.73	0.12	
1000	34.526	4.032	137	27.41	3.01	0.14	1.07	0.73	0.13	AAIW
1200	34.557	3.501	130	27.49	3.31	0.18	1.22	0.77	0.13	
1550	34.610	2.607	123	27.62	3.15	0.22	1.22	0.78	0.15	
1750	34.621	2.419	124	27.64	3.99	0.20	1.16	0.78	0.15	UCDW
2000	34.639	2.132	126	27.68	3.03	0.13	1.22	0.76	0.16	
2500	34.660	1.782	133	27.73	3.02	0.15	1.20	0.78	0.18	LCDW
Station 043 (July 17, 2012; 3° 59' 52.8" S; 155° 35' 38.4" E; depth : 1925m)										
5	34.659	29.274	191	21.72	2.34	0.57	1.13	0.44	0.29	TSW
150	35.914	25.138	138	23.99	2.65	0.49	1.12	0.55	0.20	SPEW
230	35.161	14.819	99	26.14	[6.85]	[1.32]	[1.19]	[0.64]	[0.17]	-
700	34.513	5.914	128	27.18	3.35	0.16	1.24	0.72	0.13	EqPIW
1200	34.564	3.737	105	27.47	3.31	0.13	1.15	0.79	0.12	UCDW
Station 046 (July 18, 2012; 4° 42' 0" S; 154° 52' 48" E; depth : 3117m)										
50	34.794	29.190	190	21.85	2.67	0.49	1.19	0.42	0.30	TSW
150	35.974	25.365	129	23.97	3.29	0.36	1.11	0.52	0.18	SPEW
400	34.649	8.724	124	26.89	3.52	0.26	1.11	0.68	0.14	-
700	34.542	6.028	89	27.19	3.34	0.09	1.10	0.72	0.12	EqPIW
1000	34.540	4.326	112	27.39	3.43	0.15	1.07	0.75	0.13	UCDW
Station 047 (July 18, 2012; 4° 56' 2.4" S; 154° 38' 52.8" E; depth : 1004m)										
25	34.670	29.108	190	21.78	1.99	0.50	1.27	0.51	0.30	TSW
156	36.017	24.025	126	24.41	3.80	0.63	0.99	0.51	0.18	SPEW
264	35.082	13.952	106	26.27	2.71	0.22	1.05	0.63	0.16	-
635	34.522	5.856	129	27.20	2.92	0.21	1.09	0.72	0.13	EqPIW
Station 053 (July 19, 2012; 4° 54' 18" S; 152° 52' 12" E; depth : 733m)										
25	34.879	28.959	189	21.99	2.55	0.57	1.27	0.57	0.26	TSW
149	35.610	21.864	142	24.72	3.30	0.89	1.12	0.55	0.23	SPTW
335	34.977	12.632	161	26.45	2.57	0.21	1.10	0.65	0.16	WSPCW
719	34.480	5.424	158	27.22	3.17	0.12	1.07	0.71	0.13	AAIW
Station 056 (July 20, 2012; 4° 4' 37.2" S; 152° 32' 20.4" E; depth : 1580m)										

1582	34.599	2.818	125	27.59	3.20	0.18	1.08	0.72	0.15	UCDW
Station 057 (July 20, 2012; 4° 34' 12" S; 152° 31' 22.8" E; depth : 2552m)										
25	34.767	28.952	192	21.91	3.16	0.59	1.39	0.55	0.27	TSW
150	35.583	23.624	139	24.20	2.52	0.52	1.19	0.55	0.21	SPTW
250	35.268	15.802	152	26.00	2.45	0.32	1.09	0.58	0.18	WSPCW
450	34.650	8.974	171	26.85	2.94	0.16	1.02	0.71	0.14	
580	34.509	7.083	177	27.02	2.85	0.22	1.06	0.69	0.13	SAMW
850	34.503	4.623	143	27.33	3.53	0.14	1.15	0.76	0.12	AAIW
1302	34.565	3.374	129	27.51	4.17	0.18	1.18	0.77	0.13	UCDW
1650	34.611	2.610	124	27.62	-	-	-	-	-	
2201	34.654	1.992	135	27.71	3.77	0.13	1.20	0.79	0.17	LCDW
Station 058 (July 21, 2012; 5° 30' 10.8" S; 152° 5' 52.8" E; depth : 1142m)										
215	35.500	18.602	135	25.51	2.74	0.40	1.16	0.56	0.20	WSPCW
1100	34.547	3.675	133	27.47	3.77	0.20	1.07	0.76	0.13	UCDW
Station 060 (July 22, 2012; 6° 10' 1.2" S; 152° 29' 49.2" E; depth : 5609m)										
35	34.737	28.022	193	22.19	2.03	0.59	1.30	0.54	0.30	TSW
180	35.733	22.267	135	24.70	2.40	0.44	1.18	0.52	0.22	SPTW
250	35.325	16.605	124	25.86	3.65	0.55	1.22	0.58	0.19	WSPCW
480	34.531	7.193	173	27.03	2.97	0.25	1.08	0.72	0.13	SAMW
1000	34.530	3.930	138	27.43	3.68	0.19	1.20	0.74	0.13	AAIW
1600	34.611	2.604	124	27.62	3.08	0.22	1.18	0.79	0.15	UCDW
1800	34.631	2.263	125	27.67	3.11	0.29	1.16	0.77	0.17	
2541	34.661	1.724	132	27.73	3.21	0.10	1.28	0.81	0.19	
3250	34.692	1.673	155	27.76	2.81	0.14	1.31	0.83	0.22	
4000	34.696	1.665	158	27.77	2.62	0.13	1.28	0.81	0.23	
4500	34.696	1.660	160	27.77	2.31	0.16	1.34	0.79	0.23	LCDW
4750	34.697	1.656	160	27.77	2.26	0.27	1.29	0.75	0.25	
5000	34.697	1.653	161	27.77	3.43	0.15	1.29	0.72	0.22	
5603	34.697	1.649	162	27.77	2.30	0.12	1.19	0.75	0.24	
Station 071 (July 25, 2012; 8° 19' 55.2" S; 151° 17' 27.6" E; depth : 1563m)										
50	34.797	27.552	192	22.39	2.14	0.46	1.26	0.52	0.24	TSW
160	35.659	22.424	138	24.60	5.68	1.37	1.09	0.52	0.22	SPTW
400	34.977	12.552	165	26.47	4.17	0.67	1.08	0.63	0.17	WSPCW
600	34.493	6.699	178	27.06	3.00	0.17	1.00	0.71	0.13	AAIW
1100	34.522	4.051	143	27.41	5.89	0.36	1.17	0.74	0.13	UCDW
Station 073 (July 26, 2012; 7° 9' 57.6" S; 149° 59' 56.4" E; depth : 5253m)										
50	35.058	27.325	171	22.66	2.40	0.55	1.22	0.55	0.24	TSW
170	35.586	21.658	141	24.76	2.40	0.44	1.33	0.55	0.21	SPTW
200	35.602	21.191	140	24.90	2.85	0.36	1.15	0.53	0.19	
700	34.474	5.882	169	27.16	3.24	0.11	1.12	0.71	0.12	AAIW
1650	34.609	2.604	123	27.62	3.35	0.13	1.18	0.77	0.14	UCDW
Station 077 (July 28, 2012; 5° 57' 3.6" S; 147° 39' 36" E; depth : 1045m)										
25	34.767	27.606	191	22.35	4.19	0.53	1.24	0.57	0.26	TSW
180	35.609	21.401	140	24.85	2.52	0.48	1.12	0.53	0.21	SPTW
501	34.572	8.016	178	26.94	2.43	0.37	1.09	0.71	0.16	SAMW
701	34.477	5.536	159	27.20	3.00	0.13	1.05	0.71	0.13	AAIW
983	34.505	4.473	145	27.35	3.73	0.19	1.13	0.74	0.13	
Station 082- Non-filtrated (August 03, 2012; 13° 59' 49.2" S; 156° 0' 25.2" E; depth : 2586m)										
25	34.927	26.195	197	22.92	2.68	0.72	1.40	0.53	0.26	TSW
180	35.789	22.612	129	24.65	3.06	0.82	1.04	0.53	0.21	SPTW
700	34.469	6.035	165	27.13	2.55	0.32	1.00	0.67	0.14	
800	34.451	5.083	163	27.23	2.65	0.29	1.02	0.68	0.13	AAIW
1000	34.498	4.114	151	27.38	3.14	0.92	1.04	0.71	0.13	
1200	34.539	3.454	145	27.48	3.60	0.44	1.05	0.74	0.12	
1350	34.565	3.159	140	27.53	3.45	0.17	0.98	0.73	0.13	UCDW
2000	34.636	2.226	141	27.67	2.29	0.37	1.18	0.77	0.14	

**Table 2:** Dissolved REE concentrations (pmol.kg<sup>-1</sup>). Data are reported with daily confidence interval (2σ).

Depth (m)	Salinity (PSU)	O <sub>2</sub> (μmol.kg <sup>-1</sup> )	σ <sub>θ</sub> (kg m <sup>-3</sup> )	(pmol.kg <sup>-1</sup> )													
				La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Station 004 (July 01, 2012; 17° 0' 10.8" S; 162° 59' 45.6" E ; depth: 4680m)																	
30	34.84	199	22.94	3.7±0.1	3.3±0.1	0.8±0	3.8±0.1	0.9±0	0.3±0	1.5±0.1	0.2±0	1.8±0.1	0.5±0	1.6±0.1	0.2±0	1±0	0.2±0
166	35.63	164	24.83	3.3±0.1	2.6±0.1	0.7±0	3.2±0.1	0.8±0	0.2±0	1.2±0.1	0.2±0	1.5±0.1	0.4±0	1.5±0.1	0.2±0	1±0	0.2±0
250	35.46	161	25.67	4.1±0.2	2.4±0.1	0.7±0	3.4±0.1	0.8±0	0.2±0	1.2±0	0.2±0	1.6±0.1	0.4±0	1.5±0.1	0.2±0	1.1±0	0.2±0
351	35.10	167	26.28	6.2±0.2	1.8±0	1±0	4.5±0.1	0.9±0	0.3±0	1.6±0.1	0.2±0	2±0.1	0.6±0	2.2±0.1	0.3±0	1.8±0	0.3±0
621	34.43	192	27.04	11.8±0.5	1.6±0.1	1.7±0.1	7.3±0.2	1.7±0.1	0.4±0	2.5±0.1	0.4±0	3.4±0.1	1±0	3.9±0.3	0.6±0	3.7±0.1	0.7±0
730	34.42	179	27.17	12.3±0.6	1.3±0.1	1.8±0.1	7.7±0.4	1.5±0.1	0.5±0	2.8±0.1	0.4±0	3.6±0.2	1.1±0.1	4.2±0.2	0.7±0	4.1±0.1	0.8±0
1134	34.51	157	27.44	19±0.7	8.3±0.3	2.5±0.1	10.3±0.3	2±0.1	0.6±0	3.5±0.2	0.5±0	4.7±0.3	1.4±0.1	5.4±0.3	0.9±0	5.7±0.2	1.1±0
1734	34.62	140	27.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3598	34.69	156	27.76	33.5±1.3	2.4±0.1	4.8±0.2	24.1±0.7	3.8±0.2	1.1±0	6±0.3	0.9±0	7.4±0.3	2.1±0.1	7.4±0.4	1.2±0.1	7.7±0.3	1.4±0.1
Station 010 (July 03, 2012; 12° 0' 0" S; 162° 59' 56.4" E; depth : 5092m)																	
35	34.62	191	22.09	3.4±0.1	2.6±0.1	0.8±0	3.6±0.1	0.8±0	0.3±0	1.5±0.1	0.2±0	1.7±0.1	0.5±0	1.5±0.1	0.2±0	1±0	0.2±0
185	36.03	134	24.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
260	35.52	133	25.58	5.2±0.2	1.8±0.1	0.8±0	3.6±0.1	0.7±0	0.2±0	1.2±0.1	0.2±0	1.6±0.1	0.5±0	1.6±0.1	0.2±0	1.2±0	0.2±0
350	34.92	148	26.40	7.4±0.3	2.1±0.1	1.1±0	4.9±0.2	0.9±0	0.3±0	1.7±0.1	0.3±0	2.2±0.1	0.6±0	2.3±0.1	0.3±0	1.9±0.1	0.3±0
515	34.51	163	26.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-
680	34.46	158	27.20	13±0.5	[1.3±0.1]	1.7±0.1	7.7±0.2	1.5±0.1	0.4±0	2.6±0.1	0.4±0	3.7±0.2	1.1±0.1	4.2±0.2	0.7±0	4.3±0.1	0.8±0.1
1000	34.52	139	27.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1735	34.61	133	27.63	24.4±1	3.2±0.1	3±0.1	13.1±0.3	2.4±0.1	0.8±0	4.3±0.2	0.7±0	5.7±0.3	1.7±0.1	6.3±0.3	1±0	6.8±0.2	1.3±0.1
2500	34.67	145	27.73	31±1.5	2.2±0.1	4.3±0.2	18.5±0.6	3.5±0.2	1.1±0.1	5.6±0.3	0.9±0	7.1±0.4	2.1±0.1	7.3±0.4	1.1±0.1	7.6±0.3	1.4±0.1
4000	34.69	153	27.77	39.1±1.3	5.9±0.2	5.8±0.2	24.6±0.7	4.7±0.2	1.3±0.1	7.2±0.3	1.1±0	8.5±0.4	2.4±0.1	8.3±0.4	1.3±0	8.6±0.3	1.6±0.1
Station 013 (July 04, 2012; 9° 0' 10.8" S; 162° 59' 56.4" E; depth : 3853m)																	
5	34.65	191	21.74	4±0.1	3.8±0.1	0.9±0	3.9±0.1	0.8±0.1	0.2±0	1.3±0.1	0.2±0	1.6±0.1	0.4±0	1.4±0	0.2±0	0.8±0	0.1±0
40	34.68	191	21.77	3.3±0.1	2.8±0.1	0.7±0	3.3±0	0.7±0	0.2±0	1.2±0	0.2±0	1.5±0	0.4±0	1.4±0	0.2±0	0.8±0	0.1±0
160	35.83	129	24.24	4±0.1	2.9±0.1	0.6±0	2.8±0.1	0.6±0	0.2±0	1.1±0	0.2±0	1.4±0.1	0.4±0	1.4±0	0.2±0	1±0	0.2±0
300	35.19	106	26.07	5.6±0.1	[1.6±0]	0.8±0	3.7±0.1	0.7±0	0.2±0	1.3±0	0.2±0	1.7±0.1	0.5±0	1.9±0.1	0.3±0	1.5±0	0.3±0
600	34.52	138	27.16	11.8±0.2	[1±0]	1.5±0	7.2±0.1	1.4±0	0.5±0	2.5±0.1	0.4±0	3.5±0.1	1.1±0	4±0.1	0.6±0	4.1±0.1	0.8±0
685	34.50	138	27.22	12.2±0.5	1.6±0.1	1.6±0	7.2±0.2	1.4±0.1	0.5±0	2.4±0.1	0.4±0	3.4±0.2	1.1±0	4.1±0.2	0.6±0	4.2±0.1	0.8±0
1335	34.57	126	27.54	18.3±0.5	2.1±0.1	2±0.1	9.6±0.2	2±0.1	0.6±0	3.1±0.1	0.5±0	4.7±0.2	1.3±0	5.5±0.2	0.8±0	5.9±0.1	1±0
1535	34.60	129	27.60	20±0.7	1.4±0.1	2.2±0.1	10.6±0.3	1.9±0.1	0.6±0	3.5±0.2	0.5±0	4.9±0.2	1.4±0.1	5.6±0.2	0.9±0	6.2±0.2	1.2±0.1
2000	34.64	133	27.69	26.8±1.1	2.6±0.1	3.3±0.1	14.8±0.4	2.8±0.1	0.9±0	4.7±0.2	0.7±0	6.1±0.4	1.7±0.1	6.6±0.3	1±0	7.3±0.2	1.4±0.1
Station 020 (July 06, 2012; 9° 59' 56.4" S; 160° 25' 1.2" E; depth : 2910m)																	

25	34.83	189	21.97	4.3±0.2	3.7±0.1	1±0	4.7±0.2	1.1±0.1	0.3±0	1.7±0.1	0.3±0	2.1±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
190	35.82	127	24.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
600	34.49	162	27.12	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0
900	34.49	151	27.30	14.1±0.6	1.5±0.1	1.8±0.1	8.2±0.3	1.6±0.1	0.5±0	2.8±0.2	0.4±0	3.8±0.2	1.2±0	4.5±0.2	0.7±0	4.7±0.2	0.9±0
1600	34.60	133	27.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Station 021 (July 07, 2012; 10° 0' 46.8" S; 160° 21' 25.2" E; depth : 3342m)																	
250	35.39	127	25.76	5.6±0.2	2±0.1	0.9±0	4.1±0.1	0.7±0	0.2±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.9±0.1	0.3±0	1.4±0	0.3±0
400	34.68	140	26.86	8.2±0.2	1.5±0	1.1±0	5.3±0.1	1.1±0	0.3±0	1.8±0.1	0.3±0	2.6±0.1	0.8±0	2.9±0.1	0.4±0	2.8±0.1	0.5±0
550	34.49	163	27.10	10.3±0.2	1.2±0	1.5±0	6.8±0.1	1.4±0	0.4±0	2.4±0.1	0.4±0	3.4±0.1	1±0	3.8±0.1	0.6±0	3.8±0.1	0.7±0
2115	34.64	139	27.69	27.7±0.6	2.4±0.1	3.5±0.1	16.5±0.3	3.1±0.1	1±0	5.1±0.2	0.8±0	6.4±0.2	1.8±0	6.5±0.2	1±0	7±0.1	1.3±0
2625	34.68	150	27.74	26.4±0.4	2.1±0.1	3.4±0.1	15.9±0.2	2.9±0.1	0.9±0	5.1±0.2	0.8±0	6.6±0.2	1.9±0	6.9±0.2	1.1±0	7.6±0.1	1.4±0
3280	34.70	165	27.77	31.1±2	2.7±0.2	4.1±0.2	19±0.7	3.5±0.2	1.1±0.1	5.5±0.4	0.8±0.1	6.8±0.6	1.9±0.1	6.9±0.6	1±0.1	7.1±0.3	1.3±0.1
Station 029 (July 09, 2012; 11° 3' 39.6" S; 156° 12' 54" E; depth : 3856m)																	
267	35.38	128	25.78	5.2±0.2	2.2±0.1	0.9±0	4±0.1	0.8±0	0.2±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.9±0.1	0.3±0	1.4±0	0.3±0
737	34.47	160	27.21	11.4±0.4	1.9±0.1	1.6±0	7.2±0.2	1.4±0.1	0.4±0	2.5±0.1	0.4±0	3.5±0.1	1±0	4±0.2	0.6±0	4.1±0.1	0.8±0
934	34.50	150	27.36	15.3±0.6	3.8±0.1	1.9±0.1	8.6±0.2	1.6±0.1	0.5±0	2.8±0.1	0.5±0	3.9±0.2	1.1±0	4.5±0.2	0.7±0	4.7±0.1	0.9±0
1140	34.54	139	27.45	16.2±0.5	2.2±0	2±0	9.2±0.2	1.8±0.1	0.6±0	3.2±0.1	0.5±0	4.2±0.2	1.3±0	4.9±0.2	0.8±0	5.3±0.1	1±0
1534	34.59	133	27.59	18.9±0.7	1.3±0.1	2.4±0.1	11.4±0.3	2.2±0.1	0.7±0	3.8±0.2	0.6±0	5.2±0.3	1.5±0.1	5.8±0.2	0.9±0	6.2±0.2	1.2±0.1
2999	34.70	166	27.77	27.1±2	2.7±0.2	3.7±0.2	16.9±0.9	3.2±0.3	1±0.1	5.1±0.4	0.8±0	6.5±0.4	1.8±0.1	6.6±0.4	1±0.1	6.9±0.4	1.3±0.1
Station 034 (July 10, 2012; 11° 27' 7.2" S; 154° 39' 54" E; depth : 2005m)																	
40	34.93	181	22.17	4±0.1	3±0.1	0.9±0	4.2±0.1	1±0	0.3±0	1.7±0	0.3±0	2±0	0.6±0	1.8±0	0.2±0	1.3±0	0.2±0
180	35.66	144	24.77	3.7±0.1	2.1±0	0.7±0	3.4±0	0.7±0	0.3±0	1.3±0	0.3±0	1.7±0	0.5±0	1.6±0.1	0.2±0	1.2±0	0.2±0
300	35.25	156	26.08	5.8±0.1	2.1±0.1	1±0	4.5±0.1	1±0	0.3±0	1.6±0	0.3±0	2.1±0.1	0.6±0	2.2±0.1	0.3±0	1.8±0	0.3±0
635	34.49	183	27.00	11.8±0.5	3.1±0.1	1.7±0	7.2±0.1	1.4±0.1	0.4±0	2.3±0.1	0.4±0	3.3±0.1	1±0	3.7±0.1	0.6±0	3.5±0.1	0.7±0
735	34.44	179	27.16	14±0.6	6.5±0.2	2.1±0.1	8.6±0.2	1.5±0.1	0.5±0	2.5±0.1	0.4±0	3.5±0.1	1.1±0	4.1±0.1	0.6±0	4±0.1	0.7±0
1065	34.49	154	27.37	16.5±0.6	3.5±0.1	2±0.1	9.3±0.2	1.8±0.1	0.5±0	3.2±0.1	0.5±0	4.3±0.1	1.3±0	4.9±0.2	0.7±0	4.9±0.1	0.9±0
1550	34.60	136	27.60	23.6±1.1	3.3±0.2	3±0.1	13.3±0.5	2.5±0.1	0.7±0	4.3±0.2	0.7±0	5.5±0.3	1.6±0.1	6.3±0.3	0.9±0	6.6±0.3	1.2±0.1
1665	34.61	137	27.62	24.8±0.9	[1.9±0.1]	3±0.1	13.8±0.3	2.7±0.1	0.8±0	4.4±0.2	0.7±0	5.9±0.2	1.8±0.1	6.5±0.2	1±0	6.7±0.2	1.3±0
1750	34.63	136	27.65	26.3±0.9	2.5±0.1	3.4±0.1	15±0.4	3±0.1	0.9±0	4.7±0.2	0.8±0	6.1±0.2	1.9±0.1	6.7±0.3	1±0	7±0.2	1.3±0
1920	34.65	140	27.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Station 036 (July 11, 2012; 11° 30' 7.2" S; 154° 23' 24" E; depth : 1168m)																	
25	34.49	195	22.09	7±0.1	7.1±0.1	1.8±0	8.2±0.1	2±0.1	0.6±0	2.8±0.1	0.4±0	3.1±0.1	0.8±0	2.4±0.1	0.3±0	1.7±0	0.3±0
100	35.43	163	23.89	3.7±0.1	3±0	0.8±0	3.9±0	1±0	0.3±0	1.5±0.1	0.2±0	1.9±0	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
160	35.61	141	24.60	4.1±0.1	2.8±0.1	0.8±0	3.8±0	0.9±0	0.3±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
180	35.64	144	24.96	4.4±0.1	3.1±0	0.8±0	3.8±0	0.9±0	0.3±0	1.4±0	0.2±0	1.8±0.1	0.5±0	1.7±0	0.2±0	1.2±0	0.2±0
400	34.94	167	26.51	7.2±0.2	1.9±0.1	1.1±0	5.2±0.1	1.1±0	0.3±0	1.7±0.1	0.3±0	2.4±0.1	0.7±0	2.5±0.1	0.4±0	2.2±0	0.4±0
700	34.46	182	27.09	11.4±0.4	[1.4±0]	1.6±0	7.2±0.1	1.5±0.1	0.4±0	2.4±0.1	0.4±0	3.4±0.1	1±0	3.8±0.1	0.6±0	3.7±0.1	0.7±0



900	34.46	170	27.24	12.6±0.4	1.4±0	1.6±0	7.5±0.1	1.5±0.1	0.5±0	2.5±0.1	0.4±0	3.6±0.1	1.1±0	4.1±0.1	0.6±0	4.2±0.1	0.8±0
Station 042 (July 15, 2012; 5° 8' 42" S; 153° 17' 24" E; depth : 3081m)																	
5	34.69	192	21.71	3.6±0.2	3.1±0.2	0.8±0	3.9±0.2	0.8±0	0.3±0	1.4±0.1	0.2±0	1.7±0.1	0.5±0	1.5±0.1	0.2±0	0.9±0	0.2±0
50	34.75	192	21.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	35.46	157	22.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	35.65	140	24.72	4.2±0.2	2.5±0.1	0.7±0	3.4±0.1	0.8±0	0.3±0	1.3±0.1	0.2±0	1.7±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
225	35.35	152	25.85	4.9±0.2	[1.4±0]	0.8±0	3.8±0.1	1.5±0.1	0.3±0	1.4±0.1	0.2±0	2±0.1	0.5±0	2±0.1	0.3±0	1.6±0	0.3±0
400	34.64	174	26.84	9.8±0.2	[1.8±0]	1.3±0.1	6.1±0.1	1.2±0.1	0.4±0	2.1±0.1	0.3±0	3±0.1	0.9±0	3.3±0.1	0.5±0	3.1±0.1	0.6±0
500	34.54	158	27.02	11±0.3	1.7±0	1.5±0	6.8±0.1	1.4±0	0.4±0	2.3±0.1	0.4±0	3.2±0.1	1±0	3.6±0.2	0.6±0	3.6±0.1	0.7±0
750	34.48	154	27.23	11.9±0.3	[1.6±0.1]	1.6±0	7.3±0.1	1.5±0	0.4±0	2.5±0.1	0.4±0	3.5±0.1	1.1±0	4±0.1	0.6±0	4.1±0	0.8±0
1000	34.53	137	27.41	15.8±0.8	2.1±0.1	2.1±0.1	9.4±0.3	1.9±0.1	0.6±0	3.2±0.2	0.5±0	4.5±0.3	1.3±0.1	5±0.3	0.7±0	5.1±0.2	1±0.1
1200	34.56	130	27.49	17.9±0.6	2.8±0.1	2.3±0.1	10.4±0.2	2±0.1	0.7±0	3.5±0.2	0.6±0	4.6±0.2	1.4±0.1	5.1±0.2	0.8±0	5.6±0.1	1.1±0
1550	34.61	123	27.62	24.8±0.7	5.1±0.1	3.2±0.1	14.5±0.3	2.8±0.1	0.9±0	4.4±0.2	0.7±0	5.7±0.2	1.7±0.1	6.1±0.3	1±0	6.6±0.2	1.2±0
1750	34.62	124	27.64	28.6±0.9	4.6±0.2	3.3±0.1	15.8±0.5	3.1±0.1	1±0	5.2±0.2	0.8±0	6.5±0.2	1.8±0.1	6.7±0.2	1.1±0	7.2±0.2	1.3±0
2000	34.64	126	27.68	29.1±1.6	3.6±0.2	3.9±0.2	18±0.8	3.4±0.2	1.1±0.1	5.7±0.3	0.9±0	6.8±0.4	1.9±0.1	7.3±0.5	1.1±0.1	7.7±0.4	1.4±0.1
2500	34.66	133	27.73	32.5±2.6	4.8±0.2	4.7±0.3	21.8±0.9	4.2±0.3	1.3±0.1	6.7±0.4	1±0.1	7.9±0.6	2.2±0.2	8±0.6	1.3±0.1	8.5±0.4	1.5±0.1
Station 043 (July 17, 2012; 3° 59' 52.8" S; 155° 35' 38.4" E; depth : 1925m)																	
5	34.66	191	21.72	3.6±0.2	2.8±0.2	0.7±0	3.5±0.1	0.7±0	0.2±0	1.3±0.1	0.2±0	1.6±0.1	0.5±0	1.4±0.1	0.2±0	0.8±0	0.1±0
150	35.91	138	23.99	4.5±0.1	2.6±0.1	0.8±0	3.7±0.1	0.7±0	0.2±0	1.3±0.1	0.2±0	1.7±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
230	35.16	99	26.14	[25.5±0.8]	[12.3±0.3]	[1.2±0]	[5.2±0.1]	[0.9±0]	[0.3±0]	[1.6±0.1]	[0.3±0]	[2.2±0.1]	[0.6±0]	[2.3±0.1]	[0.3±0]	[2.1±0]	[0.4±0]
700	34.51	128	27.18	13.1±0.3	1.8±0	1.7±0	7.6±0.1	1.5±0	0.5±0	2.5±0.1	0.4±0	3.4±0.1	1.1±0	4±0.1	0.6±0	4.2±0.1	0.8±0
1200	34.56	105	27.47	16.4±0.5	1.9±0	2.1±0	9.6±0.2	1.9±0.1	0.6±0	3.2±0.1	0.5±0	4.4±0.1	1.3±0	4.9±0.2	0.8±0	5.5±0.1	1±0
Station 046 (July 18, 2012; 4° 42' 0" S; 154° 52' 48" E; depth : 3117m)																	
50	34.79	190	21.85	3.6±0.1	2.2±0.1	0.7±0	3.3±0	0.7±0	0.2±0	1.3±0	0.2±0	1.5±0	0.4±0	1.4±0	0.2±0	0.8±0	0.1±0
150	35.97	129	23.97	3.5±0.1	1.3±0	0.6±0	2.6±0	0.6±0	0.2±0	1.1±0	0.2±0	1.5±0	0.4±0	1.5±0	0.2±0	1±0	0.2±0
400	34.65	124	26.89	11.3±0.3	2.5±0.1	1.4±0	6.5±0.1	1.3±0.1	0.4±0	2.1±0.1	0.4±0	3±0.1	0.9±0	3.4±0.1	0.5±0	3.3±0.1	0.6±0
700	34.54	89	27.19	12.5±0.3	0.9±0	1.6±0	7.2±0.2	1.4±0.1	0.5±0	2.5±0.1	0.4±0	3.5±0.1	1±0	4±0.1	0.6±0	4.1±0.1	0.8±0
1000	34.54	112	27.39	15.6±0.5	2±0.1	1.9±0	8.9±0.2	1.8±0.1	0.5±0	3.1±0.1	0.5±0	4.2±0.1	1.2±0	4.7±0.1	0.7±0	4.9±0.1	0.9±0
Station 047 (July 18, 2012; 4° 56' 2.4" S; 154° 38' 52.8" E; depth : 1004m)																	
25	34.67	190	21.78	4.4±0.1	3.3±0.1	1±0	4.4±0.1	1±0	0.3±0	1.6±0	0.2±0	1.9±0.1	0.5±0	1.6±0	0.2±0	1±0	0.2±0
156	36.02	126	24.41	4.6±0.1	2.6±0	0.6±0	3±0	0.6±0	0.2±0	1.2±0	0.2±0	1.6±0	0.5±0	1.7±0	0.2±0	1.2±0	0.2±0
264	35.08	106	26.27	[7.4±0.1]	1.7±0	1.1±0	4.8±0.1	0.9±0	0.3±0	1.6±0.1	0.3±0	2.2±0.1	0.7±0	2.4±0.1	0.3±0	2.1±0	0.4±0
635	34.52	129	27.20	13.3±0.3	2.6±0.2	1.7±0	7.7±0.1	1.5±0	0.5±0	2.6±0.1	0.4±0	3.6±0.2	1.1±0	4.1±0.1	0.7±0	4.2±0.1	0.8±0
Station 053 (July 19, 2012; 4° 54' 18" S; 152° 52' 12" E; depth : 733m)																	
25	34.88	189	21.99	4.9±0.2	4.1±0.2	1.2±0.1	5.7±0.3	1.4±0.1	0.5±0	2.1±0.1	0.3±0	2.5±0.1	0.7±0	2.1±0.1	0.3±0	1.5±0.1	0.2±0
149	35.61	142	24.72	6.3±0.2	5.2±0.1	0.9±0	4±0.1	0.9±0	0.3±0	1.5±0.1	0.2±0	1.8±0.1	0.5±0	1.7±0	0.2±0	1.2±0	0.2±0
335	34.98	161	26.45	[7.6±0.1]	1.8±0	1.2±0	5.3±0.1	1.1±0	0.3±0	1.8±0.1	0.3±0	2.5±0.1	0.7±0	2.6±0.1	0.4±0	2.3±0	0.4±0

719	34.48	158	27.22	[12.6±0.5]	1.5±0	1.7±0	7.8±0.1	1.5±0	0.5±0	2.6±0.1	0.4±0	3.7±0.1	1.1±0	4.2±0.1	0.6±0	4.2±0.1	0.8±0
Station 056 (July 20, 2012; 4° 4' 37.2" S; 152° 32' 20.4" E; depth : 1580m)																	
1582	34.60	125	27.59	23.4±0	3.8±0	3.1±0	14.3±0	2.8±0	0.8±0	4.8±0	0.7±0	5.9±0	1.8±0	6.6±0	0.9±0	6.7±0	1.2±0
Station 057 (July 20, 2012; 4° 34' 12" S; 152° 31' 22.8" E; depth : 2552m)																	
25	34.77	192	21.91	4.1±0.1	3.5±0.1	1±0	5.2±0.1	1.3±0.1	0.5±0	2.1±0.1	0.3±0	2.3±0.1	0.6±0	2±0.1	0.3±0	1.3±0	0.2±0
150	35.58	139	24.20	3.8±0.2	2.6±0.1	0.8±0	3.7±0.1	0.9±0.1	0.3±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
250	35.27	152	26.00	5.4±0.2	2.1±0.1	0.9±0.1	4.2±0.1	0.9±0.1	0.3±0	1.5±0.1	0.2±0	2±0.1	0.6±0	2.1±0.1	0.3±0	1.7±0	0.3±0
450	34.65	171	26.85	9.3±0.2	1.5±0	1.3±0	6.2±0.1	1.2±0.1	0.4±0	2.1±0.1	0.3±0	2.9±0.1	0.9±0	3.1±0.1	0.5±0	3.1±0	0.6±0
580	34.51	177	27.02	12.1±0.3	2.5±0.1	1.5±0	6.8±0.1	1.3±0	0.4±0	2.2±0.1	0.4±0	3.1±0.1	0.9±0	3.6±0.1	0.5±0	3.6±0.1	0.7±0
850	34.50	143	27.33	13.7±0.4	1.6±0	1.7±0	8.1±0.2	1.6±0.1	0.5±0	2.9±0.1	0.5±0	3.9±0.1	1.2±0	4.4±0.1	0.7±0	4.8±0.1	0.9±0
1302	34.57	129	27.51	19.2±0.5	2.8±0.1	2.4±0.1	11.5±0.3	2.2±0.1	0.7±0	3.9±0.2	0.6±0	5.1±0.2	1.5±0	5.5±0.2	0.9±0	6±0.1	1.1±0
1650	34.61	124	27.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2201	34.65	135	27.71	31.2±0.9	3.5±0.1	4.2±0.1	20±0.5	3.9±0.2	1.3±0	6.3±0.3	1±0	7.9±0.3	2.1±0	7.7±0.2	1.2±0	8.2±0.2	1.5±0
Station 058 (July 21, 2012; 5° 30' 10.8" S; 152° 5' 52.8" E; depth : 1142m)																	
215	35.50	135	25.51	4.8±0.2	2.2±0.1	0.8±0	3.9±0.1	0.8±0	0.3±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.8±0.1	0.3±0	1.4±0	0.2±0
1100	34.55	133	27.47	18.9±0.7	3.1±0.1	2.3±0.1	11±0.3	2.2±0.1	0.7±0	3.7±0.2	0.6±0	4.9±0.2	1.4±0.1	5.4±0.2	0.8±0	5.7±0.2	1±0
Station 060 (July 22, 2012; 6° 10' 1.2" S; 152° 29' 49.2" E; depth : 5609m)																	
35	34.74	193	22.19	5±0.1	4.5±0.1	1.1±0	5.3±0.1	1.2±0	0.4±0	1.8±0.1	0.3±0	2.1±0.1	0.6±0	1.8±0.1	0.2±0	1.2±0	0.2±0
180	35.73	135	24.70	4.2±0.2	2.3±0.1	0.7±0	3.4±0.1	0.7±0	0.2±0	1.2±0.1	0.2±0	1.6±0.1	0.5±0	1.6±0.1	0.2±0	1.1±0	0.2±0
250	35.33	124	25.86	7.4±0.1	3.7±0.1	1±0	4.9±0.1	1±0	0.3±0	1.6±0.1	0.2±0	2±0.1	0.6±0	2.2±0.1	0.3±0	1.7±0	0.3±0
480	34.53	173	27.03	11.2±0.3	2.6±0.1	1.5±0.1	6.8±0.1	1.3±0.1	0.4±0	2.3±0.1	0.4±0	3.1±0.1	1±0	3.5±0.1	0.6±0	3.6±0.1	0.7±0
1000	34.53	138	27.43	16.3±0.3	2.7±0.1	2±0	9.4±0.1	1.8±0.1	0.6±0	3±0.1	0.5±0	4±0.1	1.3±0	4.8±0.2	0.7±0	5±0.1	1±0
1600	34.61	124	27.62	23.9±0.9	5±0.2	3.2±0.1	14.5±0.3	2.8±0.1	0.9±0	4.6±0.2	0.7±0	5.8±0.2	1.8±0	6.2±0.2	1±0	6.8±0.1	1.3±0
1800	34.63	125	27.67	28.4±0.6	7.8±0.2	3.9±0.1	18.1±0.3	3.4±0.1	1.1±0	5.4±0.2	0.8±0	6.8±0.3	1.9±0.1	7±0.2	1.1±0	7.4±0.2	1.4±0
2541	34.66	132	27.73	35.4±1	3.5±0.1	5.1±0.1	23.8±0.5	4.6±0.2	1.5±0	7±0.3	1.1±0	8.6±0.4	2.3±0.1	8.1±0.4	1.3±0.1	8.7±0.2	1.6±0.1
3250	34.69	155	27.76	41.1±1.1	5.8±0.2	6.1±0.2	28.1±0.6	5.3±0.2	1.7±0	8±0.3	1.2±0	9.1±0.4	2.6±0.1	8.3±0.3	1.4±0	8.9±0.2	1.6±0.1
4000	34.70	158	27.77	41±1.4	5.6±0.2	6.3±0.2	28.8±0.8	5.9±0.2	1.8±0.1	8.2±0.3	1.2±0	9.5±0.3	2.5±0.1	8.7±0.3	1.3±0	8.9±0.2	1.6±0.1
4500	34.70	160	27.77	41.9±1.6	8±0.3	6.8±0.3	30.2±1	6±0.3	1.9±0.1	8.4±0.5	1.3±0.1	9.6±0.6	2.6±0.1	8.8±0.5	1.4±0.1	8.9±0.3	1.6±0.1
4750	34.70	160	27.77	47.3±1	14.6±0.3	7±0.2	30.4±0.4	5.6±0.2	1.8±0	7.8±0.3	1.2±0	8.9±0.4	2.4±0.1	8.4±0.3	1.2±0	8.3±0.1	1.6±0
5000	34.70	161	27.77	39.3±0.9	5.3±0.1	5.4±0.1	25.4±0.3	4.8±0.2	1.5±0	7±0.2	1.1±0	8.1±0.3	2.3±0.1	8±0.3	1.2±0	7.8±0.1	1.5±0
5603	34.70	162	27.77	41.2±1.5	5.6±0.2	6±0.2	26.3±0.7	4.9±0.2	1.4±0.1	6.8±0.4	1±0.1	8±0.4	2.2±0.1	7.6±0.4	1.1±0.1	7.6±0.2	1.4±0
Station 071 (July 25, 2012; 8° 19' 55.2" S; 151° 17' 27.6" E; depth : 1563m)																	
50	34.80	192	22.39	3.8±0.3	[2.6±0.2]	0.8±0.1	4±0.2	1±0.1	0.3±0	1.5±0.1	0.2±0	1.8±0.1	0.5±0	1.7±0.1	0.2±0	1.1±0	0.2±0
160	35.66	138	24.60	4.6±0.3	5.9±0.4	0.8±0	3.9±0.2	0.7±0.1	0.2±0	1.3±0.1	0.2±0	1.7±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0.1	0.2±0
400	34.98	165	26.47	7.9±0.6	4.6±0.2	1.1±0.1	5.2±0.2	1.1±0.1	0.3±0	1.8±0.1	0.3±0	2.5±0.2	0.7±0	2.5±0.1	0.4±0	2.2±0.1	0.4±0
600	34.49	178	27.06	12±0.9	[1.9±0.2]	1.5±0.1	6.9±0.4	1.3±0.1	0.4±0	2.3±0.2	0.4±0	3.3±0.3	1±0.1	3.7±0.2	0.6±0	3.7±0.2	0.7±0.1
1100	34.52	143	27.41	32.3±1.2	5.6±0.2	2.1±0.1	9.7±0.2	1.9±0.1	0.6±0	3.2±0.1	0.5±0	4.3±0.2	1.3±0	4.9±0.2	0.8±0	5.2±0.1	1±0

Station 073 - Filtrated (July 26, 2012; 7° 9' 57.6" S; 149° 59' 56.4" E; depth: 5253m)

50	35.06	171	22.66	4±0.1	3.1±0.1	0.9±0	4.1±0.1	0.9±0	0.3±0	1.5±0.1	0.2±0	1.9±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
170	35.59	141	24.76	4±0.2	2.5±0.1	0.8±0	3.6±0.1	0.7±0	0.2±0	1.4±0.1	0.2±0	1.8±0.1	0.5±0	1.6±0.1	0.2±0	1.2±0	0.2±0
200	35.60	140	24.90	3.6±0.1	[1.6±0.1]	0.7±0	3.3±0.1	0.7±0	0.2±0	1.3±0.1	0.2±0	1.7±0.1	0.5±0	1.7±0.1	0.2±0	1.2±0	0.2±0
700	34.47	169	27.16	11.2±0.2	1.2±0	1.5±0	7.1±0.1	1.4±0	0.5±0	2.4±0.1	0.4±0	3.5±0.1	1±0	4±0.1	0.6±0	4±0.1	0.7±0
1650 <sup>a</sup>	<i>34.61</i>	<i>123</i>	<i>27.62</i>	<i>19.6±0.9</i>	<i>2.2±0.2</i>	<i>2.5±0</i>	<i>11.7±0.2</i>	<i>2.3±0.1</i>	<i>0.7±0</i>	<i>3.8±0</i>	<i>0.6±0</i>	<i>4.8±0.1</i>	<i>1.4±0</i>	<i>5.2±0</i>	<i>0.8±0</i>	<i>5.6±0.1</i>	<i>1.1±0</i>

Station 077 (July 28, 2012; 5° 57' 3.6" S; 147° 39' 36" E; depth : 1045m)

25	34.77	191	22.35	9.1±0.2	3.7±0.1	1±0	4.9±0.1	1.1±0	0.4±0	1.8±0.1	0.3±0	2.2±0.1	0.6±0	1.8±0	0.2±0	1.3±0	0.2±0
180	35.61	140	24.85	3.9±0.1	2.3±0	0.7±0	3.4±0	0.8±0	0.2±0	1.3±0	0.2±0	1.7±0	0.5±0	1.6±0	0.2±0	1.1±0	0.2±0
501	34.57	178	26.94	13.2±0.2	5.2±0.5	1.8±0	8±0.1	1.6±0	0.5±0	2.4±0.1	0.4±0	3.3±0.1	1±0	3.6±0.1	0.5±0	3.6±0.1	0.6±0
701	34.48	159	27.20	13.1±0.2	[1.6±0]	1.7±0	7.9±0.1	1.5±0	0.5±0	2.7±0.1	0.4±0	3.7±0.1	1.1±0	4.3±0.1	0.7±0	4.3±0.1	0.8±0
983	34.51	145	27.35	20±0.7	2.9±0.1	2.1±0	9.6±0.2	1.9±0.1	0.6±0	3.1±0.1	0.5±0	4.3±0.2	1.3±0	4.8±0.1	0.8±0	5±0.1	1±0

Station 082- Non-filtrated (August 03, 2012; 13° 59' 49.2" S; 156° 0' 25.2" E; depth : 2586m)

25	34.93	197	22.92	6.6±0.2	4.9±0.1	0.9±0	4.2±0.1	0.9±0.1	0.4±0	1.7±0.1	0.2±0	1.9±0.1	0.5±0	1.7±0.1	0.2±0	1.1±0	0.2±0
180	35.79	129	24.65	6.2±0.3	4.6±0.2	0.8±0	3.5±0.1	0.8±0	0.2±0	1.3±0.1	0.2±0	1.6±0.1	0.5±0	1.6±0.1	0.2±0	1.1±0	0.2±0
700	34.47	165	27.13	14±0.6	4.5±0.2	1.9±0.1	8.1±0.2	1.6±0.1	0.5±0	2.9±0.1	0.4±0	3.8±0.2	1.1±0	4.3±0.2	0.7±0	4.1±0.1	0.7±0
800	34.45	163	27.23	15.5±0.7	4.4±0.2	2±0.1	8.6±0.3	1.7±0.1	0.5±0	2.9±0.1	0.5±0	3.9±0.2	1.2±0.1	4.6±0.2	0.7±0	4.5±0.1	0.8±0
1000	34.50	151	27.38	17.3±0.7	14±0.3	2.1±0.1	9.5±0.2	1.8±0.1	0.6±0	3.3±0.1	0.5±0	4.2±0.1	1.3±0.1	4.9±0.2	0.8±0	5±0.1	0.9±0
1200 <sup>a</sup>	<i>34.54</i>	<i>145</i>	<i>27.48</i>	<i>20±1.7</i>	<i>6.9±3</i>	<i>2.2±0</i>	<i>10±0.2</i>	<i>1.9±0.1</i>	<i>0.6±0</i>	<i>3.3±0</i>	<i>0.5±0</i>	<i>4.6±0.1</i>	<i>1.4±0</i>	<i>5.3±0.1</i>	<i>0.8±0</i>	<i>5.6±0.1</i>	<i>1.1±0</i>
1350	34.57	140	27.53	22.1±1.2	3±0.1	2.4±0.1	11±0.4	2.3±0.1	0.6±0	3.7±0.2	0.6±0	5.1±0.3	1.5±0.1	5.8±0.3	0.9±0	6±0.2	1.2±0.1
2000	34.64	141	27.67	29.1±1.1	10.7±0.4	3.6±0.1	14.5±0.4	2.7±0.2	0.9±0.1	4.7±0.2	0.7±0	6.1±0.2	1.8±0.1	6.8±0.3	1±0	7.3±0.2	1.5±0.1

<sup>a</sup>Italic values of dREE refer to data with its statistical error bar.

Square brackets indicate data with low recoveries

**Table 3:** Average dNd concentrations in the different layers of the box model

Water Mass	Upper $\sigma_\theta$ ( $\text{kg.m}^{-3}$ )	Station 34	Station 29	Station 77	Station 57	Station 42
Upper thermocline water (UTW)	24-25.3	$0.49 \pm 0.01$	$0.51 \pm 0.05$	$0.49 \pm 0.01$	$0.54 \pm 0.02$	$0.50 \pm 0.01$
Lower thermocline water (LTW)	25.3-26.9	$0.65 \pm 0.01$	$0.57 \pm 0.02$	$1.15 \pm 0.01$	$0.75 \pm 0.20$	$0.72 \pm 0.24$
Intermediate water (IW)	26.9-27.4	$1.21 \pm 0.16$	$1.15 \pm 0.14$	$1.22 \pm 0.14$	$1.08 \pm 0.13$	$1.13 \pm 0.20$
Upper Circumpolar Deep Water (UCDW) - Upper extent	27.4-26.65	$2.02 \pm 0.12$	$1.48 \pm 0.22$	-	$1.65 \pm 0.04$	$1.96 \pm 0.40$
Upper Circumpolar Deep Water (UCDW) - Lower extent	27.65-27.76	-	$2.44 \pm 0.12$	-	$2.89 \pm 0.08$	$2.87 \pm 0.38$

**Table 4:** Water masses and associated volume transport (Sv) at different layer during Pandora (July-August 2012). The dNd fluxes were estimated from dNd values compiled in table 3 and water transports entering and leaving the Solomon Sea.

Water Mass	Upper $\sigma_\theta$ ( $\text{kg.m}^{-3}$ )	Lower $\sigma_\theta$ ( $\text{kg.m}^{-3}$ )	Incoming NGCU ( $W_E$ )	Direct NVJ ( $W_N$ )	Vitiaz ( $W_V$ )	St-Georges ( $W_G$ )	Solomon ( $W_S$ )	dNd flux ( $\text{t.yr}^{-1}$ )
UTW	24	25.3	$1.5 \pm 0.5$	$3.5 \pm 0.5$	$1.5 \pm 0.5$	$1.5 \pm 0.5$	$2.0 \pm 0.5$	$0.5 \pm 15.9$
LTW	25.3	26.9	$9.2 \pm 0.5$	$7.8 \pm 0.5$	$8.0 \pm 0.5$	4.0	$5 \pm 0.5$	$145.1 \pm 45.8$
IW	26.9	27.4	$7.2 \pm 1.0$	$1.2 \pm 1.0$	4.5	1.4	$2.5 \pm 1.0$	$-6.0 \pm 52.3$
UCDW - Upper extent	27.4	27.65	$1.0 \pm 0.5$	$4.5 \pm 1.5$	-	$1.5 \pm 0.5$	$4.0 \pm 0.5$	$46.2 \pm 101.1$
UCDW - Lower extent	27.65	27.76	-	$3.0 \pm 2.0$	-	0.5	$2.5 \pm 2.0$	$28.7 \pm 131.5$