FICHE META\_INFORMATION\_PARAMETRES

(à remplir par le responsable du paramètre)

####

### Nom du DATASET / Data SET NAME **SILICON DATA**

*Data set Name (list of the measured parameters):*

**Param code Name Responsible**

Si #1 Orthosilicic acid (SiOH4) Leynaert-Moriceau

Si #2 Biogenic and lithogenic silica (BSi & LSi), Leblanc-Quéguiner-Leynaert-Moriceau

Si #3 Si uptake rate (ρ32Si) Leynaert

Si #4 Si limitation experiment (ρ32Si), Vmax and KSi Leynaert

Si #5 BSi dissolution rate (ΔBSi), Moriceau

Si #6 Specific Si production rate (ρPDMPO), Leblanc-Quéguiner

Si #7 Diatom taxonomy and abundance Leblanc-Quéguiner

Si #8 Si uptake-dissolution rates (ρ30Si, D30Si). Leblanc-Quéguiner

### PROJET-ETUDE / *PROJECT TITLE*

*Campaign NAME* : GreenEdge – AMUNDSEN – 2016 *LEG : 1*

*Date* *begin : 25/06/2016*

*Date end : 10/07/2016*

*Chief Scientist*: Leg 1A : Marcel Babin, Leg1B: Jean Eric Tremblay

*Address :* Université Laval, UMI Takuvik, 1045 avenue de la médecine, Québec, QC, G1V0A6, Canada

### OPERATION *(if Relevant)*

*Sampling method :*

- Water sampling once a day:

 Core parameters on Niskin bottles on CTD up to 12 depths between 0 and 350 m. Production parameters at 3 to 6 depths centered around surface, DCM and bottom of euphotic layer.

-Ice: Ice core sampling at ice stations:

 at 2 depth for silicate and BSi; 0-3 cm and 3-10cm (0,0165 m2)

 at 1 depth for production and dissolution 0-1 cm

- Sediment traps (0,146 m2): long term deployment; sampling for BSi done by Catherine Lalande

*Station number-Cast number :* see excel Bilan silice Amundsen file

### **RESPONSABLE SCIENTIFIQUE du paramètre / *PI of the parameter***

See Table above for detail parameters responsible

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nom /*name* | adresse / *address* | téléphone / *phone number* | fax /*fax number* | adresse mél /*email address* |
| **LEYNAERT****Aude****MORICEAU****Brivaëla** | Laboratoire des sciences de l'environnement marin LEMAR UMR 6539 UBO/CNRS/Ifremer/IRDInstitut Universitaire Européen de la Mer (IUEM)Technopole Brest IroiseRue durmont d'Urville29280 Plouzané | **00 33 (0)2 98 49 86 57** | (0033)(0)29849 8645 | aude.leynaert@univ-brest.frbrivaela.moriceau@univ-brest.fr |
| **LEBLANC****Karine****QUEGUINER Bernard** | MIO UMR 7294 Campus de Luminy, batiment OCEANOMED, 13009 Marseille | **00 33 (0)4 86 09 05 72****00 33 (0)4 86 09 05 68** |  | karine.leblanc@univ-amu.frbernard.queguiner@univ-amu.fr |

### DATASET contact

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nom /*name* | adresse / *address* | téléphone / *phone number* | fax /*fax number* | adresse mél /*email address* |
| **LEYNAERT****Aude** | Laboratoire des sciences de l'environnement marin LEMAR UMR 6539 UBO/CNRS/Ifremer/IRDInstitut Universitaire Européen de la Mer (IUEM)Technopole Brest IroiseRue durmont d'Urville29280 Plouzané | **00 33 (0)2 98 49 86 57** | (0033)(0)29849 8645 | aude.leynaert@univ-brest.frbrivaela.moriceau@univ-brest.fr |
| **LEBLANC****Karine** | MIO UMR 7294 Campus de Luminy, batiment OCEANOMED, 13009 Marseille | **00 33 (0)4 86 09 057 27** |  | karine.leblanc@univ-amu.fr |

### INFORMATION GEOGRAPHIQUES */ GEOGRAPHIC INFORMATION*

*Predefined site (if relevant): See excel Bilan Silice amundsen for location*

*Location:*

*LATITUDE:*

*LONGITUDE*

### DESCRIPTION DES INSTRUMENTS / INSTRUMENTS DESCRIPTION *(if Relevant)*

* **Si #1 (SiOH4), Si #2 (BSi & LSi), Si #5 (ΔBSi)**

*Instrument Type: Autoanalyser technicon Manufacturer: SEAL-BRAN+LUEBBE Model: AA3*

*Instrument Type: Spectrophotometer Manufacturer: Model: Helyos*

*Instrument Type: UV-Spectrofluorometer Manufacturer: Shimadzu Model: RF-5301*

* **Si #3 Si uptake rate (ρ32Si), Si #4 Si limitation experiment (ρ32Si)**

*Instrument Type:*  Scintillation counter, *Manufacturer:* Packard *Model:* Tri-carb 1500 TR

*Instrument Features / Calibration:* 0.5% precision

* **Si #6 Specific Si production rate (ρPDMPO)**

*Instrument Type:* Epifluorescence inverted microscope, *Manufacturer:* Zeiss *Model:* Axiovert *Instrument Type:*  Fluorometer, *Manufacturer:* Turner Design *Model:* Trilogy *Model:* Crude Oil fluorescence module

* **Si #7 Diatom taxonomy and abundance**

*Instrument Type:* Inverted microscope, *Manufacturer:* Nikon *Model:* TE-2000

* **Si #8 Si uptake-dissolution rates (ρ30Si, D30Si)**

*Instrument Type:* HR-ICP-MS, *Manufacturer:* ThermoFisher *Model:* Element XR

### DESCRIPTION DES PARAMETRES */ PARAMETERS DESCRIPTION*

# Ce qui a été collecté, mesuré et comment / *How was the parameter collected and measured (include references for analytical methods)?*

*Sampling:*

**For Si #1, Si #2 and Si #5**

Filtration on PC filters (0.4µm), dried at 60°C and kept at room temperature, filtrate for silicate where kept at 4°C in falcon PC tube.

- Water

- Ice, dilution with filtered seawater to promote melting of the ice and then filtration etc...

two depth in each ice core: 0-3cm and 3-10 cm

- long term sediment traps for BSi and BSi dissolution (Catherine Lalande for details)

**For Si #3, Si #4, Si #6, Si #7 and Si #8**

Samples were incubated 24h with either 32Si, 30Si or PDMPO. Incubations were done in the water at the sampling depth at natural light and temperature. After 24h, filtrations were done and filters were kept at room temperature for Si production and limitation, for PDMPO, samples were centrifuged and resuspended in methanol and kept at 4°C. For Si dissolution, the incubation lasted 48h before filtration.

- Water was collected at 3 to 6 depths around the DCM. see excel file.

*Analytical procedure: (briefly, could be a short recall to a published reference):*

**For Si #1, Si #2 and Si #5**

Samples for biogenic silica and lithogenic silica (BSi-LSi) were filtered onto 0.4-µm polycarbonate filters (Millipore) and dried at 60ºC and stored at room temperature in petri dishes until digestion and analysis. Sequential digestions (NaOH, then HF) were carried out on each filter, with parallel determinations of both Si(OH)4 and dissolved aluminum in order to correct for LSi interference, following Ragueneau et al. (2005).

* **Si #3 Si uptake rate (ρ32Si), Si #4 Si kinetic uptake parameters (ρ32Si)**

 150 ml polycarbonate bottles were carefully filled with sea water collected with Niskin bottles. The radio tracer 32Si was injected just after sampling, and the bottles were placed in a hole outside, each at its sampling depth to maintain natural light and water temperature. The addition of 32Si increased the *in situ* silicic acid concentration by less than 0.1 µM. All the incubations started at 2 pm and lasted 24 h. Incubations were terminated by filtration of the sample through 0.4 µm Nuclepore membrane filters, which were then rinsed with filtered sea water and placed in plastic counting vials. The final counting was carried out 3 months later by Cerenkov measurement, when secular equilibrium had been attained following Tréguer et al. (1991). The Si steady-state uptake rate (ρSi nmol L-l h-1) was calculated from the final activity on the filter, the silicic acid concentration and the initial injected activity. The specific uptake rate, VSi(d-1)*,* was calculated from the equation VSi *=* ρSi/BSi.

* **Si #4 Si limitation experiment (ρ32Si)**

 Following Leynaert et al. (2001), the limitation of the diatom community by silicic acid or one of the other macronutrients (nitrate or phosphate) was assessed at surface depth by measuring Si uptake rates at *in situ* vs increased silicic acid concentrations (40 µM) vs increased nitrate (20 µM), and phosphate (1.5 µM) concentrations. Incubations and samples were processed as described above for Si uptake experiments. The ratio between *in situ* and enriched samples gives an indication of the degree to which silicic acid uptake by phytoplankton is limited by ambient silicic acid concentrations or phosphate+nitrate.

* **Si #5 BSi dissolution rates (ΔBSi)**

Following Moriceau et al. (2009), filters with the BSi sampled were placed in a PC plastic bottle named batch in the following paragraph. Each batch contained 0.7 µm filtered seawater in order to keep natural bacterial community. The volume of water was chosen to reach a final silicate concentration far from the solubility limit. Dissolution batches were then stored in the dark at 0°C, close to the in situ temperature of -1.5°C. To measure the BSi dissolution rate, the increase of the silicate concentration in the water is followed during 15 to 21 days, and different models are used to fit the data. The statistics used to choose between models required a maximum amount of data. Sampling for silicate analysis was taken as regularly as possible, but more frequently in the first days where most of the dissolution occurred. The batch water was sampled every day during 7 days and then every second and third day. pH and O2 were monitored every day to insure that the general parameters did not evolved over the time course of the experiment.

* **Si #6 Specific Si production rate (ρPDMPO)**

Specific Si production rates are quantified using PDMPO labelling following Leblanc and Hutchins (2005) modified by McNair et al (2015). Briefly 170 ml seawater samples are spiked with 0,125 µM PDMPO (final concentration) and incubated in situ for 24 h. A second bottle without any spike is incubated in parallel for fluorescence blank estimation. After incubation, a first 100 ml aliquot of both samples is filtered onto a 0,4 µm PC membrane, digested in 2,5 N HF for 1h, neutralized with H3BO3 and the extracts are read on a Trilogy Fluorometer using a Crude Oil fluorescence module for bulk PDMPO uptake rates (in nmol PDMPO d-1). The rest of the labelled sample (70 ml) is centrifuged down to a 2 ml volume and resuspended with 10 ml methanol and kept at 4°C. This sample will be used to mount permanent slides to be analyzed in epifluorescence microscopy for species specific PDMPO uptake rate measurements. PDMPO labelled cells fluorescence is quantified for each species using a custom-made IMAGE J routine. The rest of the unlabelled sample (70 ml) is fixed with 0,3 ml acidified lugol for diatom identification and counting.

* **Si #7 Diatom taxonomy and abundance**

Diatom taxonomy and abundance will be determined on the subset of the PDMPO samples, by concentrating 70 ml of sample in a sedimentation chamber following Utermöhl (1951) and counting it using an inverted microscope.

* **Si #8 Si uptake-dissolution rates (ρ30Si, D30Si)**

Uptake and dissolution rates are measured using 30Si additions, and by subsequent analyses in HR-ICP-MS following Fripiat et al. 2009 and Corvaisier et al. (2005). Briefly 5 L were collected at each depth (surface, DCM and bottom of euphotic layer). 1 L was immediately filtered and both filter and filtrate were stored for both natural unspiked particulate and dissolved 30Si isotopic ratios. The 1L filtrate is precipated using the MAGIC procedure (14 M NaOH addition), allowing to concentrate all dissolved Si forms in a small volume. 2L are then spiked with 30Si at 10% of initial SiOH4 concentrations for Si uptake measurements ; an aliquot of 1 L is incubated for 24h, while the rest is filtered and treated as the unspiked sample for initial spiked isotopic ratios. The remaining 2L are spiked with 30Si at 100 % of ambiant concentrations ; 1 L is incubated for 48 h in order to increase detection of Si dissolution rates while the rest is filtered and treated as the unspiked sample for initial spiked isotopic ratios.

*Units:*

Si #1 SiOH4 µM

Si #2 BSi & LSi µmol Si L-1

Si #3 ρ32Si nmol Si L-1d-1

Si #4 Si limitation experiment, Vmax and KSi nmol Si L-1d-1, d-1, µmol Si.L-1

Si #5 BSi dissolution rate (ΔBSi), d-1

Si #6 Specific Si production rate (ρPDMPO) nmol PDMPO L-1d-1 and % relative contribution of each species to Si uptake

Si #7 Diatom taxonomy and abundance cells L-1

Si #8 Si uptake-dissolution rates (ρ30Si, D30Si) nmol Si L-1d-1

*Sensor Precision:*

SiOH4 0.1 µM

# Décrire quels types de données sont nécessaires pour vous compléter votre propre jeu de données **avant** envoi à la base de données, et estimer le délai avant la disponibilité de vos données pour la base de données / *Post-cruise data analysis/treatment required, and the time frame for this*

We will need whatever taxonomy and abundance data for diatoms and other siliceous planktonic organisms available for all CTDs and depths where Si parameters were sampled (depths of importance are the depths where production measurements were carried out using 32Si, 30Si or PDMPO).

*Estimated Date of Delivery :*

Si #1 SiOH4 done

Si #2 BSi & LSi Early 2017

Si #3 ρ32Si Early 2017

Si #4 Si limitation experiment, , Vmax and KSi Early 2017

Si #5 BSi dissolution rate (ΔBSi), End 2017

Si #6 Specific Si production rate (ρPDMPO) End of 2017

Si #7 Diatom taxonomy and abundance End of 2017

Si #8 Si uptake-dissolution rates (ρ30Si, D30Si) mid-2017

### REFERENCES BIBLIOGRAPHIQUES

1. Corvaisier, R., Tréguer, P. J., Beucher, C. P. and Elskens, M.: Determination of the rate of production and dissolution of biosilica in marine waters by thermal ionisation mass spectrometry, *Anal. Chim. Acta*, 534(1), 149–155, doi:10.1016/j.aca.2004.11.020, (2005).
2. Fripiat, F., Corvaisier, R., Navez, J., Elskens, M., Schoemann, V., Leblanc, K., André, L. and Cardinal, D.: Measuring production-dissolution rates of marine biogenic silica by 30Si-isotope dilution using a high- resolution sector field inductively coupled plasma mass spectrometer, *Limnol. Oceanogr. Methods*, 7(7), 470– 478, doi:10.4319/lom.2009.7.470 (2009).
3. Leblanc, K. & Hutchins, D. A. New applications of a biogenic silica deposition fluorophore in the study of oceanic diatoms. *Limnol. Oceanogr. Methods* 3, 462–476 (2005).
4. Leynaert, A., Tréguer, P., Lancelot, C. & Rodier, M. Silicon limitation of biogenic silica production in the Equatorial Pacific. *Deep-Sea Res. I* 48, 639–660 (2001).
5. McNair, H. M., Brzezinski, M. A. and Krause, J. W.: Quantifying diatom silicification with the fluorescent dye, PDMPO, *Limnol. Oceanogr. Methods,* 13(10), 587–599, doi:10.1002/lom3.10049, (2015).
6. Moriceau, B. *et al.* Si–C interactions during degradation of the diatom *Skeletonema marinoi*. *Deep-Sea Res. Part II* 56, 1381–1395 (2009).
7. Ragueneau, O. *et al.* Biodeposition by an invasive suspension feeder impacts the biogeochemical cycle of Si in a coastal ecosystem (Bay of Brest, France). *Biogeochemistry,* 25 (5-6), 697-710, doi:10.1007/s10533-004-5677- 3 (2005).
8. Tréguer, P. *et al.* Production of biogenic silica in the Weddell-Scotia Seas measured with 32Si. *Limnol. Oceanogr.* 36, 1217–1227 (1991).
9. Utermöhl, M.: Über das umgekehrte mikroskop, *Arch. für Hydrobiol. und Planktologie*, 22, 643–645, (1931).