Analysis of Abundance and Origin Possibility of Planktonic Foraminifera in Sulawesi Sea

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Abstract. Foraminifera is very diverse and adaptive, both in its morphology and biology. It is a potential bioindicator to understand the ecological and physical conditions of the ancient and modern waters based on their distribution. It has been well confirmed that the abundance of foraminifera (as a fossil) in sediment can reflect the ocean conditions above (mixed layer to upper ocean) where it was deposited. Planktonic foraminifera however can be considered as passive particles, their movement is carried by ocean currents. In consequence, the foraminifera abundance may represent more wider ocean condition according to the ocean current pattern. This study aims to examine the role of ocean currents in the distribution of foraminifera in the Sulawesi Sea. Ten gravity core sediment samples from 73-3009 m water depth were retrieved by RV Geomarin III from the Marine Geological Institute, Indonesia. We conducted quantitative analysis, including calculation of abundance and cluster analysis. Two decades (1992-2012) of ocean current simulated data from the Hybrid Coordinate Ocean Model (HYCOM) is used in this analysis, extending from 115˚E-140˚E and 8˚N-2˚S. The result indicates that planktonic foraminifera is abundant in the Sulawesi Sea by 86.3%. There were several predominant planktonic species such as Globigerinoides ruber (22.6%), Globigerina bulloides (15.3%), and Neogloboquadrina dutertrei (10.1%). The ocean current above the sample location is constantly moving eastward as a part of the NECC. The average currents velocity shows that foraminifera in sample site S-03 with depth 2064 m may originated from up to 1035 kilometers away from its recent location.

1. Introduction
Sulawesi Sea is located in the north of Sulawesi and is bordered by the Pacific Ocean and the Sulu Islands. Sulawesi Sea is a more typical open ocean condition, forming a vast basin with a depth of 2500-5500 meters [1]. Sulawesi Sea is the main entrance of the Indonesian Throughflow, which is a branch of the global thermohaline circulation. It carries water masses from the Pacific Ocean to the Indian Ocean through Indonesian Seas [2, 3]. The Indonesian Throughflow transports heat and energy that influence the water mass of the Indian Ocean, hence influence the global temperature and precipitation. Regarding that, it is essential to understand the dynamics of the Sulawesi Sea. One potential proxy commonly used by researchers related to the Indonesian Throughflow is microfauna foraminifera [4-7].
Foraminifera is a single-celled eukaryote; foraminifera possess an agglutinated or secreted solid carbonate skeleton called test. The test is divided into a series of chambers, which increase in number and size during its growth. The ecological sensitivity, complexity, and specific characteristics of the structure of foraminifera are the basis of their geological usefulness in studies of recent and ancient environmental conditions [8, 9]. Foraminifera is separated into two types following their life strategy, including benthic (bottom-dwelling) and planktonic (free-floating within the water column). The differences in their way of life affect the morphology of each category. The benthic form occurs at all depths in the marine zone. It varies in size from less than 100 µm in diameter to a centimetres. Benthic foraminifera have a dominant flat test to make it easier to attach or immerse itself in the substrate. In contrast, the planktonic foraminifera live freely in the open ocean's surface or within the ocean water column. They have a global occurrence, with the size not exceeding 600 µm in diameter. The planktonic foraminifera have unique cellular organelles, which are supplemented by the so-called fibrillar bodies. This foraminiferal type has a relatively globular chamber that provides the buoyancy control. Planktonic foraminifera lose their ability to stay buoyant in the upper ocean at the end of their life, and its test sinks to the ocean floor to contribute the sedimentary geological archive [8, 10-13].

Foraminiferal fossils are abundant in marine sediment, particularly planktonic type is often assumed to represent ocean conditions above its sediment deposit location and surrounding environment. Planktonic foraminifera are considered a passive particle [13], in addition to the fact that it employs a mechanism to control its depth habitat [9, 10]. However, their movement is sensitive to advective processes by ocean currents. This study examines the distribution of foraminifera, identifies the biozone that occurs using Cluster method, and estimates the lateral distance of planktonic foraminiferal distribution during their lifespan in the Sulawesi Sea.

1.1 The current system of the Sulawesi Sea

Sulawesi Sea is the main entrance of the Indonesian throughflow (ITF). The ITF enters the north part of the Sulawesi Sea from the North Pacific Waters at the surface and thermocline layer through the strong Mindanao Current (MC) derived from North Equator Current (NEC) [14, 15]. At the east of the Philippines, the NEC is bifurcated into two branches, the northward flow is Kuroshio, and the other branch is MC that is going southward. MC carries North Pacific thermocline and intermediate water [16]. Part of MC flows westward to the Sulawesi Sea, in contrast, the other part goes eastward to contribute to the North Equatorial Counter Current (NECC), and a minor portion enters the Molucca Sea. From the Sulawesi Sea, the ITF entering the Makassar Strait, then part of them being discharged to the Indian Ocean through Lombok Strait, and the others flowing to the Banda Sea before exiting toward the Indian Ocean through Timor Passage and Ombai Strait (figure 1) [2, 17-19]

![Figure 1. ITF (Source: Modification from [2]).](image-url)
2. Material and method
Ten surface sediment samples (S-1 to S-10) from sediment core in Sulawesi Sea were analyzed (figure 2 and table 1). These samples were obtained using gravity core by the research team from Marine Geological Institute in 2016. Sample preparation was conducted at Marine Geological Institute Laboratory at Cirebon. The sediment is soaked in water to separate the foraminifera test from sediment grains, and then samples were washed while filtered by using a 150 µm sieve. Afterwards, sediment samples larger than 150 µm size were dried in the oven with 40^o-60^oC [8]. About 300 specimens of foraminifera were separated from other materials for quantitative analysis [5, 10]. Foraminifera which has been separated from other materials was then identified using a binocular microscope following several identification [20], [21], [22], and [23].

![Figure 2. Map of sediment samples location (Source: Modification from Sulawesi Sea Team [24]).](image)

| No | Sample | Coordinate X | Coordinate Y | Depth (m) |
|----|--------|--------------|--------------|-----------|
| 1  | S-1    | 125.543428   | 4.405547     | 870       |
| 2  | S-2    | 125.473061   | 3.906394     | 1255      |
| 3  | S-3    | 125.246125   | 2.794339     | 2064      |
| 4  | S-4    | 125.058739   | 2.336606     | 3009      |
| 5  | S-5    | 122.756258   | 1.136400     | 1511      |
| 6  | S-6    | 123.251594   | 1.144544     | 1095      |
| 7  | S-7    | 124.187369   | 1.346592     | 1715      |
| 8  | S-8    | 125.183133   | 2.027986     | 2115      |
| 9  | S-9    | 125.385911   | 1.679933     | 1037      |
| 10 | S-10   | 125.175769   | 1.755242     | 73        |
2.1 Data Analysis

2.1.1. Relative abundance. Relative abundance is the percentage of each species in each sample. It is commonly used as part of the census data of foraminifer that aims to determine ecological or functional types [10]. The calculation is using this following formula:

\[ P_i = \frac{N_i}{N} \]  

Formula description:
P_i = Ratio of the individual species with an overall species in the sample interest
N_i = Number of individual species in the sample interest
N = Total number of individual in the sample interest

2.1.2 Diversity index, evenness index, and dominance index. Following the aims to determine the ecological or functional types of foraminifera, quantification the biodiversity using these three indices is conducted.

A. Diversity index [25]:

\[ H' = -\sum P_i \ln P_i \]  

Formula description:
H’ = Shannon’s Diversity Index
P_i = Ratio of individuals belonging to the ith species in the sample interest

B. Evenness index [26]:

\[ E = \frac{e^H}{S} \]  

Formula description:
E = Buzas and Gibson’s Evenness Index
H = Shannon’s Diversity Index
S = Total number of species

C. Dominance index [25]:

\[ D = \left( \frac{ni}{N} \right)^2 \]  

Formula description:
D = Simpson’s Index
ni = Number of individual species in the sample interest
N = Total number of individual in the sample interest

2.1.3 Biozonation identification. Identification of biozonation carried out using the Cluster Method, which classifies biozones based on the similarity of the constituent species and described by a dendrogram. The Cluster Method is done by using the UPGMA algorithm and the Bray-Curtis Similarity index. The UPGMA algorithm is an algorithm that uses the average value as a measure of distance for grouping objects [27]. The Bray-Curtis index is a statistic used to quantify the differences in species population between two different sites or more. The Bray-Curtis index is always a number between 0 and 1, where 0 means the sites have the same composition (share all the species), and 1 means the sites do not share any species [26]. Biozonation formed from the Cluster Method can be influenced by various...
parameters of environmental conditions. This analysis was processed using PAST3 (Paleontological Statistics Ver.3.23) software by Hammer [28] directly to http://folk.uio.no/ohammer/past.

2.1.4 Estimate the lateral distance of planktonic foraminifera. To estimate the lateral distance of planktonic foraminiferal distribution, we considered the foraminifera traits (depth habitat, lifespan, and post-mortem settling velocity) and their relation to the ocean currents. By using a simple mathematical formula (average velocity equation) to find the average drift distance during lifespan and post-mortem sinking. The calculation using this following equation [29]:

\[ \vec{v} = \frac{\Delta x}{\Delta t} \]  

Formula description:
- \( \vec{v} \) = Average velocity
- \( \Delta t \) = Change in time
- \( \Delta x \) = Displacement

Two decades (1992-2012) of ocean current simulated data from the Hybrid Coordinate Ocean Model (HYCOM) is used to determine the average current velocity at the study site. The study site is extending from 115°E-140°E and 8°N-2°S. The spatial resolution of HYCOM is 1/12° in the horizontal direction and has high vertical resolution by using a combination of isopycnal, sigma-z, and z-level coordinates [30]. Ocean current simulated data from the HYCOM directly to https://www.hycom.org/.

The average drift distance during lifespan is calculated by using the average ocean current velocity at a depth of 50 m and 100 m. Assumption of no significant vertical migration during living time occurs is considered. Uses the average velocity at a depth of 50 and 100 m is related to the predominant foraminifera planktonic species found in sediment samples from Sulawesi Sea, which live mainly at a depth of 50-100 m and can be called surface-dwelling species [31].

Surface-dwelling species appear to have a lifespan that were related to the synodic lunar cycle of 30 days (Hastigerina pelagica, Globigerinoides sacculifer, Globigerina bulloides) or half-synodic lunar cycle, which is 15 days (Globigerinoides ruber) [10, 32]. Therefore, 15 days and 30 days are \( \Delta t \) for the calculation of the average drift distance during lifespan. After 15 and 30 days, the foraminifera was considered dead and begins to sink to the bottom of the water. Then the calculation of the average drift distance during the post-mortem sinking was carried out.

The sinking velocity of planktonic foraminifera depends mainly on the shell size, weight, shape, and presence of spines. In general, large and spineless species are expected to sink at speeds between 500 and 3,000 m/day, while small species or species with spines drowned slower (>200 m/day) [10]. From previous studies, the sinking velocity of Globigerinoides ruber, Globigerinoides sacculifer and Globigerina bulloides which is the surface-dwelling species, tends to be approximate >200 m/day [10]. Therefore, the calculation in this study use a sinking velocity of 200 m/day, following the work of [13]. By dividing the depth of sample location with the sinking distance per day of 200 m, it will obtain the time required for foraminifera to reach the bottom of the water. Thus, those values are \( \Delta t \) to calculate the average drift distance during the post-mortem sinking, shown in the table 2.

When the foraminifera begins to sink, it will still be affected by ocean currents, and the calculation of the average drift distance during the post-mortem sinking is used the average current velocity at a depth of 300 m. Considered a depth of 300 m is the initial depth of the foraminifera to begin sinking (approximately 200 m from the initial habitat), the use of the average current velocity at depth of 300 m also by assumes there is no change in speed during the sinking process.
Table 2. Time required for foraminifera to reach the bottom of the water. By dividing the depth of sample location with the sinking distance per day of 200 m.

| Sample | Depth (m) | Sinking time (days) |
|--------|-----------|---------------------|
| S-1    | 870       | 4                   |
| S-2    | 1255      | 6                   |
| S-3    | 2064      | 10                  |
| S-4    | 3009      | 14                  |
| S-5    | 1511      | 7                   |
| S-6    | 1095      | 5                   |
| S-7    | 1715      | 8                   |
| S-8    | 2115      | 10                  |
| S-9    | 1037      | 4                   |
| S-10   | 73        | 0                   |

3. Result
The result indicates that foraminifera in Sulawesi Sea is composed of 56 species from 54 benthic genera, and 20 species belong to 8 planktonic genera. Planktonic type is dominant, comprised of 86.3%. Several predominant planktonic species are Globigerinoides ruber, Globigerina bulloides, Neoglobuquadrina dutertrei, Puleniatina obliquiloculata, Neoglobuquadrina humerosa, Hastigerina aequilateralis, Globorotalia menardii, and Hastigerina shiponifera (figure 3 and 4). The other planktonic species has a percentage range less than 2%. Benthic foraminifera found in low percentage (in total 13.7%) and dominated particularly by Amphiistegina (in average 2%), Melonis (1.5%), Operculina (0.9%), Eponides (0.8%), and Cibicides (0.8%). The other species, including Heterolepa, Globocassidulina, and Lenticulina, have similar percentages, with each percentage average is 0.6% (figure 5). In contrast to other locations, sample S-10, located in the south-eastern part of the study area, is dominated by benthic foraminifera (72.5%). This sediment sample was collected from middle neritic zone (73 m water depth), relatively shallower than the others, which were obtained from bathyal-abyssal zone with a depth range above >800 m. In this location, the most dominant benthic genera with a percentage 18.6% is Amphiistegina.

Figure 3. The relative abundance of foraminifera in Sulawesi Sea.
Figure 4. Predominant species of planktonic foraminifera in Sulawesi Sea (private collection): 1. *Globigerinoides ruber*, 2. *Globigerinoides trilobus*, 3. *Globigerinoides immaturus*, 4. *Hastigerina siphonifera*, 5. *Hastigerina obesa*, 6. *Neoglobuquadrina dutertrei*, 7-8. *Neoglobuquadrina humerosa*, 9. *Orbulina universa*, 10. *Globigerina bulloides*, 11. *Hastigerina adamsi*, 12. *Hastigerina aequilateralis*, 13. *Pulleniatina obliquiloculata*, 14. *Globigerinoides saculiferus*, 15. *Globorotalia menardi*, 16-17. *Globorotalia unguilata*.

Figure 5. Benthic foraminifera in Sulawesi Sea (private collection): 1. *Dentalina advena*, 2. *Bolivinita quadrilatera*, 3. *Uvigerina peregrina*, 4. *Neouvigerina ampullacea*, 5. *Lagena sp.*, 6. *Ceratobulimina pacifica*, 7. *Globocassidulina subglobosa*, 8. *Cassidulina sp.*, 9. *Ehrenbergina bradyi*, 10. *Spiroloculina sp.*, 11. *Quinqueloculina sp.*, 12. *Fisurina sp.*, 13. *Pyrgo depressa*, 14. *Melonis affinis*. 
3.1. Diversity, Evenness and Dominance Index

Diversity is an indicator of functionality and potential resilience to habitat alteration. Diversity was represented through the Diversity index or Shannon index (H), Buzas and Gibson’s Evenness Index (E), and Simpson’s Dominance Index (D). The aim is to reduce the complexity of assemblage data into a single index evaluated for each sample, which can then be handled statistically. The diversity index values range from 1-3 (H > 3 = High diversity, 1 < H < 3 = Moderate diversity and H < 1 = Low diversity). Evenness (E) and Dominance Index (D) express how evenly the individuals are distributed among the different species. Both Evenness (E) and Dominance Index (D), the values are between 0-1. The value of the dominance index is inversely proportional to the evenness index. When the dominance index is high, the evenness index is low. That condition suggests that foraminiferal abundance is unevenly distributed because one species highly dominates [26, 33, 34].

The diversity index ranged from 1.93-2.91, with an average of 2.43. The evenness index ranged from 0.38-0.68 with an average of 0.48. Both diversity and evenness index are categorized as moderate category, suggest the presence of foraminifera in the Sulawesi Sea was evenly distributed. For dominance index results ranged from 0.08-0.22 with an average of 0.13, categorized as low category, indicating no particular type of foraminifera are dominant. These three indices (figure 6 and table in appendix, A1) suggest that the condition of the Sulawesi Sea is still favourable for the habitat of foraminifera.

![Figure 6](image)

**Figure 6.** Diversity, Evenness and Dominance Index in the Sulawesi Sea. 
Note: E & D is Evenness and Dominance Index. H in Y axis refer to Diversity Index

3.2. Biozonation Analysis

Biozonation analysis is based on calculations using the Cluster Method, as previously described in Methods. Two biozones from the Cluster Method are obtained and described by a dendrogram in figure 7. The first biozone consists of only 1 sample (S-10), and the second biozone which is divided into two groups (group A and group B) consists of nine other samples. The separation of these two biozones was clearly due to the differences in environmental conditions such as water depth.

First biozone (S-10) occur at the middle neritic zone is dominated by genera of benthic foraminifera, mainly *Amphistegina*, *Oerculina*, *Eponides*, and *Lenticulina*. The percentage of planktonic foraminifera in this biozone is only 27.5% consists of *Globigerinoides ruber* (which has the highest percentage of 10.8%), *Neoglobuquadrina humerosa*, *N. dutertrei*, and *Hastigerina siphonifera*. Meanwhile, second biozone (occur at middle bathyal–upper abyssal) is dominated by planktonic foraminifera, particularly *Globigerinoides ruber*, *Globigerina bulloides*, *Neoglobuquadrina dutertrei*, and *Puleniatina oliqueloculata*. As seen from the dendrogram (figure 7), the second biozone was divided into two groups (group A and B). Though almost all the samples contained nearly similar dominated taxa types, this is due to a significant percentage shift of several species.
Group A comprises samples S-1, 2, 3, 5, 6, 7, 8, and 9, located between the middle bathyal–upper bathyal. This group is characterized by high dominance of *Globigerinoides ruber* (average 23.9%), *Globigerina bulloides* (shallow dwelling species, common in high productivity region and moderate to dissolution [10, 35, 36]) with an average of 18.7%, and *Neoglobuquadrina dutertrei* (surface depth habitat with a current active system, warm water, low salinity, and dissolution resistant [10, 30]) with average percentage 11.5%.

Group B consists of only 1 sample (S-4) which was taken from the lower abyssal zone with water depth of 3009m. Group B is also characterized by high dominance of *Globigerinoides ruber* with percentage 23.8%. Other dominant species are *Globorotalia menardii* with percentage 16.8%, and *Puleniatina obliquiloculata* with percentage 15.8%. *G. menardii* is a deeper dwelling species that prefer high SST with normal salinity, resistance to dissolution, and it is abundant in upwelling regions, while *P. obliquiloculata* is a thick-walled tropical species, commonly in warm water associated with high productivity, in subsurface habitat, and dissolution resistant [10, 31, 35].

While group A and group B were highly dominated by *Globigerinoides ruber*, the difference lies in the abundance of other species, such as *Globigerina bulloides* and *Neoglobuquadrina dutertrei*, which have lower percentages in group B (4.0% and 5.9%). In contrast, the two species exhibit relatively higher percentage in group A, which are 18.7% and 11.5% in average. Another difference was reflected by the decrease of *Globorotalia menardii* and *Puleniatina obliquiloculata* percentage in group A (4.3% and 7.4% on average), while it was found more abundant in group B instead (16% and 15.8%). *Globigerinoides ruber* is abundance in all samples from the second biozone, this may be associated with its life cycle that is faster (half synodic lunar cycle) than other species (synodic lunar cycle) [10].

Foraminiferal biozonation derived from Cluster Method separates sample S-10, the only sample collected from the neritic zone as first biozone. Furthermore, it also dissociates S-4, sample from lower abyssal zone as group B. It suggests that bathymetry strongly influence the abundance and the diversity of foraminifera in the Sulawesi Sea.

![Figure 7. Dendrogram of biozonation analysis in Sulawesi Sea by using Cluster Method.](image-url)
3.3. Lateral Distance of Planktonic Foraminifera

The average current direction and velocity in the studied area are influenced by ITF (figure 8). Both depth 50 m and 100 m have the same current direction because this water mass is the ITF itself. The water mass flows from the Pacific Ocean, which is flowing southward at the southern of Mindanao Bay. Then it crosses the center of Sulawesi Sea; at this point, the water mass mostly directed towards the Makassar strait and partly deflected eastward towards the Pacific Ocean as part of the North Equatorial Counter Current (NECC). These currents towards the Pacific Ocean significantly affect the sample locations.

As has been mentioned in Methods that only a depth habitat of 50 and 100 m, a lifespan of 30 and 15 days with a sinking speed of 200 m per day is considered in this study. The estimated average drift distances appear to originate from hundreds of kilometers away from the sample site. Based on the ocean currents velocity map (figure 8), the origin of the foraminifera is from the northern to western parts of the sample site. The average current velocity at a depth of 50 m is 0.36 m/s and at a depth of 100 m is 0.307 m/s. Using these velocity values, the average drift distance during lifespan at 50 m depth habitat for 30 and 15 days of lifespans, respectively are 934 and 467 km. Meanwhile, at a 100 m, the average drift distance during lifespans is 796 and 398 km, respectively for 30 and 15 days of lifespan. The green shaded area on the map is the approximate area traversed by the foraminifera to get to the sample location.

The average distance during post-mortem sinking with a sinking speed of 200 m per day and the current velocity of 0.116 m/s is different for each sample location (table B1). For the sample S-3 with a depth of 2064 m, it takes ten days to get to the seafloor, so the average distance during post-mortem sinking is about 100 km. Here we add up the average drift distance during the lifespan and post-mortem sinking, so the estimated total distance from day one of a lifespan to the sample site (e.g., S-3) is approximately 567 and 498 km for species with a lifespan of 15 days at depth habitat 50 and 100 m, respectively. For species with lifespans of 30 days, the distance were 1034 km and 897 km, respectively at depth habitat of 50 and 100 m (table 3).

| Table 3. Total average drift distance of planktonic foraminifera using the average velocity equation. |
|---------------------------------------------------------------|
| **Depth habitat (m)** | **Total average distance (km)** |
| **Lifespan (days)** | 50 | 30 | 15 | 30 |
| S-1 | 508 | 975 | 439 | 838 |
| S-2 | 527 | 994 | 459 | 857 |
| S-3 | 568 | 1035 | 499 | 897 |
| S-4 | 607 | 1074 | 538 | 936 |
| S-5 | 540 | 1007 | 471 | 870 |
| S-6 | 519 | 986 | 451 | 849 |
| S-7 | 550 | 1017 | 481 | 880 |
| S-8 | 570 | 1037 | 501 | 900 |
| S-9 | 507 | 974 | 438 | 837 |
| S-10 | 467 | 934 | 398 | 797 |
4. Conclusion

Foraminifera that were found in the Sulawesi Sea is abundant, dominated by *Globigerinoides ruber* (22.6%), *Globigerina bulloides* (15.3%), and *Neogloboquadrina dutertrei* (10.1%) from the planktonic type. Benthic type is dominated by *Amphistegina* (2%), *Melonis* (1.5%), and *Operculina* (0.9%). According to biozonation analysis by using the Cluster Method, S-10 and S-04 which were taken from neritic and lower abyssal zone, respectively, were dissociated from the other samples group due to a significant percentage shift of several species. It suggests that the depth factors strongly influence foraminifera in the Sulawesi Sea, even though its distribution is influenced by several factors such as temperature, salinity, light intensity, depth habitat, current velocity, and way of life. Considered as a passive particle, advective processes by ocean currents affect the movement of planktonic foraminifera as well. Based on calculation results, the ocean current that is dominant for the foraminifera movement in the study site is North Equatorial Counter Current (NECC). The estimated average drift distances originated from hundreds of kilometers up to >1000 km away, which is the approximate area traversed by foraminifera is likely from the northern (Mindanao Bay) to the western part (center of Sulawesi Sea) of the sample site.
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Appendix A. Diversity, Evenness and Dominance Index Value

| Sample | Diversity (H) | Evenness (E) | Dominance (D) |
|--------|---------------|--------------|---------------|
| S-1    | 2.80          | 0.42         | 0.09          |
| S-2    | 1.93          | 0.43         | 0.22          |
| S-3    | 2.36          | 0.56         | 0.13          |
| S-4    | 2.27          | 0.60         | 0.14          |
| S-5    | 2.75          | 0.38         | 0.10          |
| S-6    | 2.29          | 0.45         | 0.14          |
| S-7    | 2.07          | 0.44         | 0.18          |
| S-8    | 2.51          | 0.40         | 0.12          |
| S-9    | 2.45          | 0.48         | 0.13          |
| S-10   | 2.91          | 0.68         | 0.08          |

Appendix B. Average Drift Distance During Post-mortem Sinking

| Sample | Depth (m) | Sinking time (days) | Average distance (km) |
|--------|-----------|---------------------|-----------------------|
| S-1    | 870       | 4                   | 41                    |
| S-2    | 1255      | 6                   | 60                    |
| S-3    | 2064      | 10                  | 101                   |
| S-4    | 3009      | 14                  | 140                   |
| S-5    | 1511      | 7                   | 73                    |
| S-6    | 1095      | 5                   | 52                    |
| S-7    | 1715      | 8                   | 83                    |
| S-8    | 2115      | 10                  | 103                   |
| S-9    | 1037      | 4                   | 40                    |
| S-10   | 73        | 0                   | 0                     |

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