Volvo Ocean Race

Science programme

Preliminary results Leg 9 – Newport to Cardiff
Preliminary results Leg 9

Compiled using data provided by Dr Toste Tanhua & Dr-ing. Sören Gutekunst, GEOMAR Helmholtz Centre for Ocean Research Kiel with the support of Cluster of Excellence Future Ocean. With contributions from Shaun Dolk, National Oceanic & Atmospheric Administration.

The microplastic results reported here have been revised November 2018 to include updated data – measurements were previously reported differently but further analysis confirmed the values presented here.

Particular thanks to the Turn the Tide on Plastic and Team AkzoNobel race teams, and notably Liz Wardley and Nicolai Sehested of those teams respectively, for facilitating and conducting the data collection.

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This report forms part of a suite of reports summarising the progress of data collection and preliminary analysis. Refer also to previous reports available to download at https://www.volvoceanrace.com/en/sustainability/legacy.html
Executive Summary

Over the last nine months the Volvo Ocean Race Science Programme has contributed considerable amounts of data to extend scientific knowledge of microplastics distribution and other parameters that indicate overall ocean health.

The arrival into Cardiff marked a significant milestone for this scientific research as it completed the world circumnavigation back to Europe. The dataset generated by the race provides for the first time an internally consistent picture of microplastic concentrations around the world.

This leg of the race from Newport, U.S.A to Cardiff, Wales provided an opportunity to sample a west-east transect of the North Atlantic. Scientific drifter buoys were also deployed in areas typically difficult to seed with these data-transmitting devices.

Samples were collected along this leg by two racing boats as both Turn the Tide on Plastic and Team AkzoNobel carried sampling units.

Based on the preliminary results of analysis microplastics were recorded in all samples from this transatlantic route. Remarkably the microplastic concentrations measured in the mid-Atlantic were comparable to levels measured from more inshore samples. Relatively consistent microplastics levels in the mid-Atlantic may correspond to the northern edge of the North Atlantic Gyre or ‘Garbage Patch’.

Oceanographic measurements reflected high summer productivity in places with phytoplankton sequestering carbon dioxide from the ocean and providing an opportunity for absorption of excess atmospheric carbon dioxide.

Collaboration, Funding and Support

The onboard sampling component of the science programme is a collaboration between Volvo Cars, Cluster of Excellence - The Future Ocean, GEOMAR Helmholtz Centre for Ocean Research Kiel, SubCtech GmbH, bbe Moldaenke, Turn the Tide on Plastic and Team AkzoNobel crews. Volvo Cars has funded the onboard equipment through profits from the sale of their Cross Country Volvo V90 Ocean Race edition cars.

The scientific drifter buoys are part of the National Oceanic and Atmospheric Administration's (NOAA) drifter programme.

The sharing of meteorological data measured from the boats is part of a pilot project developed by JCOMM (Joint technical Commission for Oceanography and Marine Meteorology, WMO – IOC1) partners.

These organisations are brought together by the Volvo Ocean Race Sustainability Programme, in order to increase ocean knowledge, pioneer a new area of data collection and advance the technology of instrumentation in order to contribute to create a global map of standardised data, specifically in the area of microplastic concentration.
Onboard sampling
Preliminary results

Provided by Dr Toste Tanhua and Dr-Ing. Sören Gutekunst, GEOMAR Helmholtz Centre for Ocean Research Kiel with the support of Cluster of Excellence Future Oceans

Leg 9: Newport to Cardiff

Note: The microplastic results reported here have been revised November 2018 to include updated data – some measurements were previously reported differently but further analysis confirmed the values presented here.

Atlantic Transect

Leg 9 from Newport to Cardiff provided the opportunity to sample a transect of the northern mid-Atlantic from east to west over a very short period of time.

The preliminary results presented here are those from Turn the Tide on Plastic sampling effort only. To maintain continuity of the existing dataset analyses of Turn the Tide on Plastic samples were prioritised and Team AkzoNobel sample results will be presented at a later stage. Significantly, Liz Wardley of the Turn the Tide on Plastic crew, increased the sampling effort on this leg by changing the microplastics filters daily. This provided a higher resolution dataset of microplastic concentrations along the north Atlantic route. The Turn the Tide on Plastic sampling effort rendered eight filter sets for analysis.

It is important as always to remember the preliminary nature of these results and also to view them with consideration of ocean currents and the ‘averages’ that the numbers represent due to the potential geographical range of a single sample.

The most notable feature of the preliminary dataset from this Atlantic transect is the relative uniformity of concentrations through the mid-Atlantic possibly coinciding with the North Atlantic Gyre or ‘Garbage Patch’.

Mid-Atlantic microplastics

The first sample taken closest to Newport contained a microplastic concentration similar to that measured on the inbound leg – 38 particles/m³ at an average distance of 293 km from Newport at the start of the east-bound leg, compared to 36 particles/m³ on the approach to Newport.

A decrease to 13 particles/m³ was observed further offshore but remarkably concentrations in the mid-Atlantic increased again to between 32 and 37 particles/m³. This may coincide with the northern edge of the North Atlantic Gyre or ‘North Atlantic Garbage Patch’. What’s striking is that microplastics concentrations in this mid-ocean segment of the route were comparable to concentrations recorded further inshore – 35 particles/m³ at an average distance of 413 km from Cardiff and 38 particles/m³ at an average distance of 293 km from Newport.
**Microplastics Data / Turn the Tide on Plastic preliminary results**

1. **North Atlantic Ocean and Mediterranean Sea**: High microplastics levels may be attributed to the proximity to the coast, strong ocean currents and busy shipping routes.

2. **Atlantic Ocean**: Progressing south, levels decreased with distance from land, with a relative increase closer to South America, an area with strong surface currents.

3. **South African coast**: Microplastic pollution near Cape Town may partly originate further north due to the strong Agulhas current, which flows from the northern Indian Ocean.

4. **Indian Ocean**: Relatively high microplastic content in these remote areas is likely due to currents originating further north.

5. **South of Great Australian Bight**: One of the only three Turn the Tide on Plastic sample areas where no microplastics were recorded.

6. **Australian coast**: Microplastic concentrations will be affected by currents coming from the southern Indian Ocean & Indonesian archipelago.

7. **From Melbourne to Hong Kong**: Recorded levels were low in the open water of the Equatorial Pacific.

8. **Philippine Sea**: The measurement of 75 particles/l is due in part to patchiness of plastic distribution as highest levels were recorded in a more inshore sample from this area.

9. **South China and North Philippine Sea**: High levels were measured in an area coinciding with the Kuroshio current which feeds into the North Pacific Subtropical Gyre.

10. **Equatorial Pacific**: Average levels in this region were higher than recorded on the previous leg. Prevailing currents have a significant impact on microplastic distribution in this area.

11. **Approach to New Zealand**: Progressing south through the Coral Sea the concentration increased slightly to a level of 50 particles/l in the sample closest to Auckland.

12. **Remote Pacific near Point Nemo**: Microplastic levels of 3-25 particles/l in an area further from land then anywhere else on Earth. A total of 57 particles/l off Cape Horn.

13. **South America east coast**: One of only three Turn the Tide on Plastic sample areas where no microplastics were recorded.

14. **Brazilian coast**: Levels were highest in the samples closest to land.

15. **Caribbean Sea**: A low measurement in this area may have been due partly to filter blooming by sargassum seaweed.

16. **East of the USA**: Measurements were between 15 and 43 particles/l.

17. **North Mid-Atlantic Ocean**: Levels were very consistent and comparable to more inshore concentrations, likely corresponding to the North Atlantic Gyre.

18. **West of Ireland**: One of the few samples containing no microplastics, out of a total of 75 Turn the Tide on Plastic samples.

19. **Skagerrak area**: Relatively high levels in the busy shipping area were the Baltic and North sea mix.
Measurements of oceanographic variables reflected the time of year. The start of the northern hemisphere summer results in an increase in phytoplankton productivity thereby using dissolved carbon dioxide. Consequently, dissolved carbon levels observed during this leg dipped below 360 ppm. This was similar to the pattern observed in the South Indian (‘Southern’) Ocean during the southern hemisphere summer transect through that area.

The occurrence of the northern hemisphere ‘spring bloom’ was also illustrated by increased chlorophyll a levels. This indicator of phytoplankton productivity was particularly elevated west of and over the Irish continental shelf. It is important to remember that other variables will affect chlorophyll a concentrations, most notably the availability of daylight for phytoplankton photosynthesis.

pH levels were closely related to CO₂ measurements. In correspondence with low dissolved carbon dioxide ocean pH was relatively basic i.e. relatively high pH value. Once again this very clearly shows the relationship between dissolved carbon dioxide and potential ocean acidification.
The temperature observations recorded during this leg appeared to correspond to ocean current patterns in the North Atlantic. Warm current input from the south affected temperatures closest to the American mainland. A considerably lower temperature offshore would seem to correspond to input from the colder Labrador current. Relatively consistent temperatures progressing across the Atlantic might have coincided with the Gulf Stream, with higher values recorded over the continental shelf.

The pattern relating to salinity along the Atlantic ‘transect’ was related to temperature, with more saline warm water and low salinity observed in samples potentially influenced by cold water currents.

Volvo Ocean Race data is now available open source on the National Oceanic and Atmospheric Administration website: https://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:0170967

The contribution of Volvo Ocean Race data to understanding and protecting our ocean and climate was highlighted in the World Meteorological Organisation’s World Oceans Day statement: https://public.wmo.int/en/media/news/world-oceans-day-campaign-cleaner-healthier-seas

Maps © Sören Gutekunst, GEOMAR Helmholtz Centre for Ocean Research Kiel
Drifter Buoys
Drifter buoy deployments during Leg 9 were chosen to fill gaps within the north Atlantic. Many drifter deployment opportunities in the Atlantic basin are south of the proposed race route, so these Volvo Ocean Race deployments aimed to seed gaps that otherwise rely on buoys fed by the Gulf Stream.

One drifter buoy was deployed by each of the seven boats as listed below.

View the track of any of the Volvo Ocean Race Leg 9 drifter buoys at: http://osmc.noaa.gov/Monitor/OSMC/OSMC.html
See more

Watch:


Previous reports:


Legs 1-4 | Alicante – Lisbon – Cape Town – Melbourne – Hong Kong
'Volvo Ocean Race Science Programme – Preliminary Results Leg 1, 2, 3 & 4'

Leg 6 | Hong Kong – Auckland
'Volvo Ocean Race Science Programme – Leg 6 preliminary results_FINAL'

Leg 7 | Auckland - Itajaí
'Volvo Ocean Race Science Programme – Auckland to Itajaí – Preliminary Data'

Leg 8 | Itajaí - Newport
'Volvo Ocean Race Science Programme – Itajaí to Newport – Preliminary Data'

Interesting links:
https://www.nasa.gov/topics/earth/features/perpetual-ocean.html

https://www.esa.int/SPECIALS/Eduspace_Weather_EN/SEM1HYK1YHH_1.html

View the Volvo Ocean Race Drifter buoys:

• Search for the Volvo Ocean Race drifter buoys in the list at:
  http://www.aoml.noaa.gov/phod/dac/deployed.html

• Insert the WMO# of one of the buoys at http://osmc.noaa.gov/Monitor/OSMC/OSMC.html, change the time range, display ‘All Positions’ and refresh the map to see the track line from where each buoy has been transmitting.

• Alternatively, access the ‘Platform Info’ to view the raw near real-time data.
Volvo Ocean Race
Scientific Consortium

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