

# Assessing New Zealand Deep Water Ages Using Radiocarbon Dating of Deep Corals

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## Introduction

Currently only general knowledge exists regarding the circulation of deep water in the New Zealand area. In the past it has been assumed that the ages of New Zealand waters match with what has been observed regionally in the South Pacific. By determining radiocarbon ages of modern deep water corals of varying depths, the specific data regarding the area around New Zealand will be better understood.

## The <sup>14</sup>C Ocean System

The formation of <sup>14</sup>C takes place in the atmosphere and is then incorporated into CO<sub>2</sub>, which is transferred to the ocean by gas exchange at the surface. Water located above the thermocline maintains a constant age because of the continuous input of new radiocarbon. Water below the thermocline is cut off from the atmosphere and begins the aging process as <sup>14</sup>C decays.

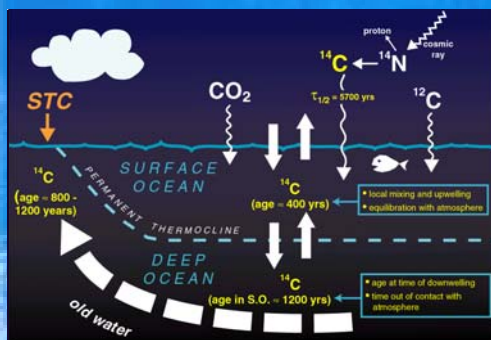


Figure 1: The <sup>14</sup>C system as described above.

Via global thermohaline circulation, water travels below the thermocline and ages as it travels. The vertical distributions of radiocarbon in the ocean can be used to show patterns of ocean circulation and horizontal movement. The results of this study will provide a more accurate picture of the circulation in New Zealand waters.

## Why Deep Corals?

The radiocarbon ages of the carbonate that makes up the coral skeleton will provide ages that are the same as that of the water mass in which the corals grow. The corals were alive when acquired, and therefore indicate the age of the water at the time of sampling. By having corals from a range of depths, modern age estimates can be made for multiple areas of the water column.



Figure 2: This solitary deep water coral, *Goniocorella dumosa*, was sampled from the South Chatham Rise at 395m.

## Study Area – New Zealand

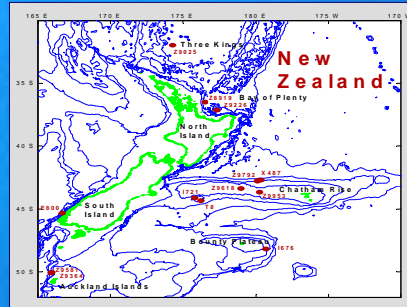


Figure 3: Map of New Zealand including sample locations.

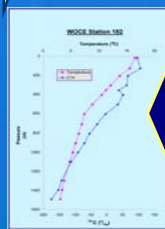


Figure 4: This figure illustrates how bomb radiocarbon (any <sup>14</sup>C value above zero) penetrates below the thermocline. The thermocline in the plot is at about 200m and we see bomb radiocarbon as deep as 600m.

## Results and Discussion

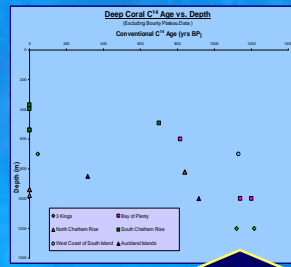
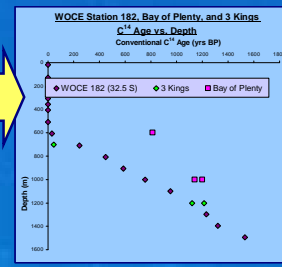


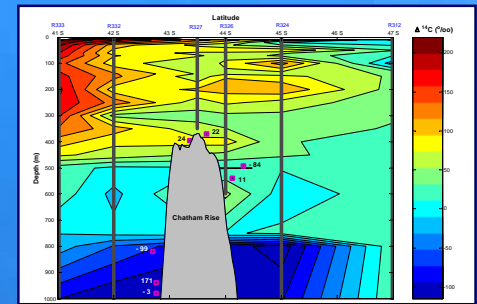
Figure 5: The <sup>14</sup>C ages of our corals plotted against the depth of sampling. Not included is one sample assumed to be dead upon sampling because the radiocarbon age was 6830 <sup>14</sup>C yr BP.

Figure 6: Our <sup>14</sup>C data from 2 regions plotted with WOCE sta. 182 data. The 3 Kings ages match up with the WOCE data indicating the expected trends at similar depths. The Bay of Plenty ages are much older at shallower depths.



There are several possible explanations for the old shallow water at this location: (listed in decreasing order of plausibility)

- The water travels a different path through the ocean and ages below the thermocline for an extended amount of time.
- There may be a "basin effect" in the Bay of Plenty, and there is limited circulation causing local aging.
- There could be a local source of dead carbon from a deep sea vent or outgassing of CO<sub>2</sub> from volcanoes.



## The Chatham Rise

Figure 7: In this location, significant turbulence due to strong currents associated with the subtropical front (STF) and the shallow bathymetric profile formed by the Chatham Rise cause water from the surface to mix down. This brings modern carbon to deep depths.

## Summary

By obtaining the radiocarbon ages of living deep water corals from various locations around New Zealand, we now have a more detailed view of the local circulation of water masses.

- The <sup>14</sup>C ages of the corals from many locations match with WOCE data indicating that circulation is what was expected regionally.
- Other locations show old water at shallow depths. This is most likely because the water taking an alternate path around the ocean and has the opportunity to get older.
- At the Chatham Rise there are very modern ages for the water at greater depths due to turbulent mixing associated with the STF and the bathymetric high.

## Acknowledgements

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