**Subject: Bob Scholes cabin 5B - The Roaring Forties**

**14:22 11 Dec 2009 39.1584 S 10.7003 E**

Dear Stirling,

As we approach the magical line of 40 degrees south, the waves are beginning to pile up and the skies are grey and low. Water is regularly sloshing over the decks now, and the gentle rolling of the ship has become a distinct cork-screwing pitch, especially in my lab at the aft of the SA Agulhas. These latitudes in the Southern ocean were both feared and courted by sailors on sailing ships - the steady strong winds would blow them across to Australia in record time, but the huge swells and gales could also tear their wooden ships apart. They called them the 'Roaring Forties'.

What is happening in ocean and atmosphere terms is a convergence of wind systems. The same thing happens at about forty degrees north as well, but in the southern hemisphere, which is dominated by oceans, there are fewer land masses to get in the way. So the winds are uninterrupted and the waves build higher and higher.

Because it is a zone of such turbulence, we are seeing distinct changes in the water. The upper layer mixes to much deeper - about 150 m at the moment. This is both good and bad for the phytoplankton, the tiny algae responsible for most photosynthesis in the ocean. On the one hand, more water volume means more nutrients, so this is an area of high productivity. But no sooner have the little cells started to photosynthesise than they are tumbled back into the inky darkness.

Thanks to the turbulence there is also lots of chance for gas exchange with the atmosphere, both in and out. Oxygen gets churned in, allowing the decomposer organisms (mostly bacteria) to do their job of turning dead cells back into carbon dioxide. But carbon dioxide can also be incorporated if the photosynthesising phytoplankton have used up what was in the sunlit layers. So it can go both ways, and the Roaring Forties are an area of great variability for the carbon cycle.

The rough seas tore the sample tubes out of the 'fish' (actually, it looks like a torpedo) that we dangle on a giant fishing rod off the starboard of the ship, to sample water uncontaminated by the ship. Fortunately we have a wonderful team of engineers and mechanics on board, on their way to the SANAE base, who sorted it out brilliantly.

Love,

Dad