Student 3: Low Merit

NZQA Intended for teacher use only

Method Summary:

Too much carbon dioxide!

Purpose:

A/ To see how altering the amount of CO_2 dissolved in sea water alters the pH of the sea water solution.

B/ To see how this acidified sea water dissolves calcium carbonate rich mollusc shells using cockle shells (Austrovenus stutchburyi) from the Aromoana Estuary.

Method:

(Students followed a valid method that allowed for the production of valid data.)

Results:

Sea water plus Dry ice pH

250 mLs sea water + 0g Dry ice	8.06 +- 0.02
250 mLs sea water + 1g Dry ice	8.03 +- 0.02
250 mLs sea water + 2g Dry ice	7.99 +- 0.02
250 mLs sea water + 3g Dry ice	7.94 +- 0.02
250 mLs sea water + 4g Dry ice	7.79 +- 0.02

Average loss of mass in cockle shells in different solutions pH solutions

Sea water pH mass loss as a percentage (7 days)

8.06	1.01%
8.03	1.92%
7.99	2.13%
7.94	2.35%
7.79	2.51%

Conclusion:

The results show that the more carbon dioxide that ends up dissolved in sea water the lower the pH. This lower pH is the main cause of ocean acidification. Sea water is slightly basic and excess carbon dioxide dissolved in the sea water makes it more acidic. The change may be small but a change of 0.1 pH units is a 30 fold increase of the hydrogen ion.

Sea shells made of calcium carbonate lose mass faster in a lower pH. This is because the -carbonate ion CO_3^{2-} is being converted to the hydrogen carbonate ion HCO_3^- and shellfish cannot use the hydrogen carbonate ion for building their shells. They need to have the carbonate ion. (1)

Reasons why these results are reliable and valid.

My results are reliable and valid because I made sure the fair test was repeatable. Weighing the dry ice was a problem to start with as it was hard to get the required amount. I solved the problem by cutting excess dry-ice and sitting it on filter paper and letting it sublimate until the required mass was achieved. This mass was then dropped into the 250 mL flask into 100mLs sea water and sealed.

The cockles were washed, cleaned and dried at 70^0C for 20 minutes and allowed to come to room temperature. The mass was accurately measured and shells placed into each flask at the measured pH. The shells were left in the solution for 2 days, dried, heated to 70^0C and allowed to come to room temperature. 2

The significance of these results related to Earth and Space Science knowledge.

As more carbon dioxide dissolve in sea water the pH of the sea water lowers and the carbonate ion is converted to the hydrogen carbonate ion and this lowers the amount of carbonate ion available for plants and animals to be used for life processes and shell formation for bottom dwelling organisms.

Equation:

$$CO_2 + H_2O + CO_3^- \leftrightarrow 2HCO_3^-$$

This reaction is a buffer reaction and when more carbon dioxide is added more carbonate is converted to hydrogen carbonate. In today's oceans about 89 percent of the carbon dioxide dissolved in seawater takes the form of hydrogen carbonate ion, about 10 percent as carbonate ion, and 1 percent as dissolved gas. At 4000m in the deep oceans it is possible to get all the carbon dioxide converted to hydrogen carbonate and there is no carbonate ion left for the few animals that live in this zone. This depth level will rise as more carbon dioxide is dissolved in sea water and the levels of the carbonate ion will also fall. A change in pH towards an acid environment is going to affect all life forms that depend on the carbonate ion for their existence. 3