Question: समुद्र का पानी खारा क्यों होता है?

Answer by Rudrashis Chakravorty

Well, the simplest form of the answer to this question is that it's because sea water contains salt.

Most estimates say that about 3.5 percent of the weight of sea water is due to salts dissolved in it.To put in another way, if we collect 100 grams of sea water in a bowl and keep it in the sun till the water evaporates completely, then we will find 3.5 grams of salt sitting at the bottom of the bowl.

So now the obvious next question is: Where does all this salt in sea water come from?

It will be interesting to find out the answer by considering what the situation was like with the water in Earth's seas and oceans millions of years ago, because in the beginning, our seas and oceans were not salty!

You see, the Earth formed around 4.5 billion – or 450 crore – years ago. By around 3.8 billion – or 380 crore – years ago, the surface of our planet had cooled enough to allow the water vapour already contained in the Earth's atmosphere to collect into clouds and rain down on land. This is how our seas and oceans gradually got created. As this rain water had come from clouds that were basically condensed water vapour, there was no salt present in it (just dissolve some salt in water, take it in a vessel and heat it, and put a cold plate on the top to cover the vessel – after a sufficient amount of water vapour collects on the bottom surface of the plate as water droplets, taste it and see if it is salty or not). So those primitive seas and oceans were not salty to begin with.

But the land on top of which those water bodies started forming already contained minerals in the form of rocks. These rocks were actually magma that had come out from the depths of massive volcanoes on the Earth's surface during eruptions, which had slowly cooled down and solidified. There were lots

of sodium, potassium and chlorine in them (capable of forming the two salts sodium chloride and potassium chloride under the right conditions).

Eventually a process had begun that had kick-startedthe salinification event, a process which continues till date, and is the biggest factor keeping our seas and oceans salty. It is erosion.

You see, all those billions of years ago, Earth's atmosphere was dominated by gases like nitrogen and carbon dioxide (while nitrogen still dominates the present-day atmosphere by contributing to about 78% of its volume, carbon dioxide concentration has decreased dramatically and stands at only 0.04% of the total volume at this point). When mixed with water, carbon dioxide can form carbonic acid, a weak but corrosive acid. So when it rained back then, as well as when it does today, carbonic acid in the water slowly reacted with the salt in the rocks and released the trapped chemicals in the rain water in the form of ions. The runoff carried that salt away, and finally dumped it into the seas. Although the amount deposited by any one such outlet was small, the contribution of millions of outlets over millions of years steadily raised the salinity of the seas. The process has been continuing all over the planet since then.

Many of the dissolved ions being deposited by land runoff are used by organisms in the oceans and are removed from the water. Others are not used up and are left for long periods of time, where their concentrations keep increasing. Two of the most prevalent ions in sea water are chloride and sodium, and together they make up over 90 percent of all dissolved ions in the oceans.

However, this isn't the only way the seas are fed with salt. Like those times billions of years ago, ongoing volcanism has kept playing an important role. Hydrothermal vents – cracks or openings on the floor of the seas from where water heated by Earth's hot internal core comes out – allow sea water that has seeped through the rock of the oceanic crust to return to the surface. The water is superheated from magma below, and as it travels up it dissolves minerals locked in the crust, erupting as mineral-rich steam.

Many of the islands on Earth were formed in this way, releasing thousands of tons of salt in the process.

It should be noted here that the oceans and seas are not uniformly salty; generally the closer you get to the poles the less saline the water becomes, because fresh water released from the ice of the frozen poles dilutes the concentration of the salt.

Interestingly, rain water and the resulting runoff don't make rivers anywhere near as salty as the seas and oceans. This is mainly because water keeps flowing! Throughout the world, rivers carry an estimated four billion tons of dissolved salts to the seas and oceans annually.

Are the seas and oceans getting saltier? The answer for the moment is no, probably not. The input of salts is probably balanced by the same tonnage of salt from ocean water getting deposited as sediments on the sea and ocean bottom. Hence their water is not getting any saltier.

In the end, here's a little trivia to get you thinking: By some estimates, if the salt in all the seas and oceanscould have been removed and spread evenly over the Earth's land surface, it would have formed a layer more than 500 feet thick, about the height of a 40-story office building!