Measuring Salinity Around the World – Video Tutorial

How can we measure the exact salinity of a body of water? There are a number of methods, but you can imagine one would be to simply measure 1 kilogram of seawater. Evaporate the water, then weigh the remaining residue, which should be made of all the evaporates. That would give us an accurate answer, but it's not so easy or fast. Fortunately there are plenty of other methods available that can be done on site. The ions dissolved in water are what allow water to carry a current. It's for this reason that you're warned not to go swimming during a lightning storm. A hand-held salinometer simply sends a current through a vial of water. The greater the conductance of thecurrent, the greater the number of dissolved ions. Remember: we know the exact proportions of the major ions in seawater, regardless of the salinity, so we can preprogram these devices to know how much conductance we'd expect based on those proportions. As the conductance goes up, so too does the salinity.

There are methods for measuring the chloride content of water – using something called a colorimeter and some chemical reactions. Once we know the amount of chloride, we can use the principle of constant proportions to calculate the total salinity. Remember: chloride is 55% of all dissolved ions, so roughly twice the chloride content is the total salinity or twice the chlorinity is the salinity.

Finally, you also should remember that as salinity increases, so too does density. So we can use our hydrometer to measure the density, and based on that calculate the salinity that would create that density at that temperature. Remember, temperature also affects density, so we have to correct for that as well. The hydrometer is an inexpensive tool that is easy to read and is the most common tool used for home aquaria. This graph shows you how it's used: measure density – pick the line that represents the right temperature, and from that determine salinity. Again, like the salinometer, this works only because we already know the main constituents of seawater and their constant proportions. That allows us to calculate these lines and draw these graphs based on the known weights and proportions of these ingredients.

Another method for measuring salinity is the **refractometer**, which measures the angle at which light bends or refracts – a property that changes as salinity changes.

Though the oceans have an average salinity of 35 parts per thousand, there ARE local variations. Remember: the proportions of the dissolved ions stay the same, but the total amount can vary. What are some of the major processes that affect salinity of the water and create these local variations? Since the major source of these ions is river water, but only over billions of years of collecting, we can't simply add more ions quickly to create a local variation. So since we can't add or remove ions quickly, we will have to focus on changing salinity by adding or removing water. If we can add more freshwater to any area of the ocean, there will be a local reduction in salinity there, as that freshwater slowly mixes. Similarly, if we can remove freshwater, there will a local increase in salinity. So what are the various natural methods for adding and removing water? For adding water, there is rain (precipitation), runoff (river mouths), and melting ice. For removing water, there is the opposite – formation of sea ice and evaporation.

Now let's look at a map showing the average surface salinity of the entire world ocean. The freshest waters correspond to a region along the equatorial Pacific, the area south of southeast Asia, and the surface around the north and south poles. Why are these areas so much fresher? They must have a higher rate of rain and/or sea ice melting and/or river runoff than evaporation. The saltiest waters are shown in two belts: one at about 30 degrees North and the other at 30 degrees South of the equator. Why are these areas saltier than other areas? They must have a higher rate of evaporation than rain.

This next graph demonstrates that correlation even better. In the graph, we see the difference between evaporation and rain (or precipitation). When the difference here is 0, the rates of both are equal. There is no net change in water salinity. When the difference is high, that means the climate is dry; air soaks up water and evaporation rates are high. The high evaporation rates leave the surrounding water more saline. And the reverse, more rain than evaporation, leaves the surrounding water fresher. The freshest parts of the world's oceans are at the equator and towards the poles. The highest salinity is around 30 degrees north and south. In fact, the equator is the rainiest part of the planet, and the areas around 30 degrees north and south correspond to desert belts. We'll talk more next week about why this is true. For now, make sure you understand how the relative dryness or humidity of the air (the climate) has a big impact on the salinity of the surface water.

Pause now.

For more information and more detail, continue on to the next video in this series.

[End credits]

<u>Seawater Chemistry Series:</u>
Part I: Salty Seas
Part II: Measuring Salinity
Part III: Carbonated Oceans
Part IV: Salinity's Impact on Marine Life

Measuring Salinity Around the World
Geoscience Video Tutorial
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