



## The Tropic Marin® Block Analysis System

Tropic Marin®  
Block Analysis System

**BAS**

### The basics

For several years now, ICP systems have been used successfully for water analysis in seawater aquariums. ICP stands for “inductively coupled plasma”. In a flame (plasma), molecules (e.g. magnesium chloride) are ionized or separated for analysis. One could say that the ICP prepares the “elements” for measurement.

Ions differ or are defined by their size and weight. For example, the magnesium ion has specific properties that no other ion has. These differences can be very small, making it difficult to analyze each individual ion precisely.

The actual measurement then takes place in the detector. Two types of detectors have become established for analyzing samples from saltwater aquariums. On the one hand, MS (mass spectrometry) and on the other hand, OES (optical emission spectroscopy). The two detection systems differ, among other things, in their measuring range. In terms of seawater analysis, one can say that MS has its strengths with trace elements with very low concentrations, while OES delivers more reliable values in the higher concentration range. Both analysis methods have their strengths and weaknesses.

Aquarists differentiate between macro elements, minor elements and trace elements. The macro elements include, for example, magnesium, calcium and potassium. Minor elements are strontium, boron, bromine and fluorine. Trace elements include copper, chromium, manganese, iron, molybdenum, nickel, vanadium or zinc.

Several years ago, Tropic Marin® decided to use a device for internal quality controls that can measure quickly and is reliable in the higher concentration range. We therefore test our salt mixtures using an ICP-OES analysis, which is constantly being developed further.

### The challenge

The so-called matrix, in the case of seawater aquariums the composition of seawater, is a major challenge for ICP-OES analysis for two reasons. On the one hand, a large number of different elements have to be analyzed and on the other hand, the elements are present in very different concentrations. The device must be able to measure from the macro

element range (1000 milligrams per liter) to the trace range (micrograms per liter). That's 6 orders of magnitude or a factor of one million. These prerequisites in combination with the requirements (e.g. quick measurements) result in measurement inaccuracies (deviations or tolerances from the actual value). These tolerance ranges are defined for each element to be measured and should be as small as possible so that the aquarist receives a plausible result.

Accurate measurement tolerances are usually not known to aquarists and therefore lead to uncertainty. Which aquarist knows the device-specific measurement tolerances for each element? A deviation of 200 % from the target value is not a problem with vanadium, but with magnesium this would be life-threatening for fauna and flora in the aquarium.

In addition to the efforts to reduce these measurement tolerances, Tropic Marin® also deals with measurement limits. All devices currently used on the market have a low concentration measurement threshold. Trace element concentrations often fall into the range of the lower detection limit. As a result of the measurement, the aquarist finds a zero value in his evaluation. However, this does not mean that this element is not present. It simply says that this element was not detected; the concentration is therefore smaller than the measuring range of the machine. At this point, the aquarist must decide how important this element is to the operation of their aquarium and, if necessary, use a different measuring method.

The Tropic Marin® laboratory is constantly working to improve measurement tolerances and detection limits. The focus is particularly on the topic of measurement tolerance in connection with the Tropic Marin® salt mixtures. As already mentioned at the beginning, the problem with ICP-OES is that elements with similar properties are more difficult to analyze. For example, part of the concentration of element X could be attributed to another element. The aquarist would then be given element Y too high and element X too low.

This similarity does not exist in all elements but is a known phenomenon for several elements. This problem is exacerbated by the number of elements in sea salt. Tropic Marin® salts mixtures contain all elements that occur in the ocean. That's more than 60 elements that should be analyzed by ICP-OES - a lot of elements for this technique.

### The Tropic Marin® Block Analysis System

Tropic Marin® has developed a system that can support ICP-OES analysis: We know that different elements are consumed in the aquarium depending on each other. For example, there is a definable group of elements that are necessary in the nitrogen cycle and are broken down there in equal proportions. There is also a group whose elements are incorporated in the coral skeleton in equal proportions. Another group is responsible for the hardness of the skeleton and is installed there proportionally. Trace metals are, among others, essential for enzymes. Enzymes function as protein factories, detoxifiers, compound transformers and have many other essential roles in all biological life and thus for the maintenance of a functional reef aquarium. Last but not least, there are elements that have no direct influence on fauna and flora but are still necessary to guarantee special ion balances in seawater.

Changes in the concentration of a single element therefore result in proportionally equal changes in the concentration of the remaining elements in this group. If you know the requirement of an element, you can use this indicator element to calculate the consumption of several other elements (similar to the composition of Tropic Marin® All-For-Reef®). These indicator or guide elements can be analyzed very well using ICP-OES and have a very low tolerance range. Particularly in the case of seawater salts, which contain a large number of elements, it is more expedient to consider only special conductive elements (with low measurement tolerance) under the measured values of the ICP-OES and to include the elements with very low concentrations in a certain ratio. This indirect concentration determination shows a smaller deviation from the actual value for some elements than the direct ICP-OES measurement. Concentration data with high measurement tolerances of the ICP-OES for elements that are difficult to determine can be neglected in this way without causing a deficiency in these elements.

Tropic Marin® has developed mixtures of elements from the element groups mentioned: the Tropic Marin® BAS Solutions (BAS = Block Analysis System). Based on the indicator elements, all other elements in the aquarium are (also) dosed - including elements with very low natural concentrations, which might not be analyzed in the ICP-OES (as they are below the measurement limit). This method expands the capabilities of ICP testing, making it more useful for the marine aquarium and optimizes and simplifies the supply of elements in the aquarium.

