UN Oceans Conference

Fighting Ocean Acidification with nuclear science

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TALKING POINTS

Introduction

Excellencies, distinguished fellow panel members, colleagues,

- Oceans are at the forefront of climate change. They absorb 30% of the CO_2 emissions we cause, and the impact it's having on their health is evident. One could say that oceans are dying to keep us alive. This is of course why your work and the UN's Decade of Ocean Science for Sustainable Development is so critically important.

- Some of you may be wondering why the Director General of the International Atomic Energy Agency is talking about this, so let me begin by explaining what we do. It's true that we are well known as the world's nuclear weapons watchdog. But we have an equally important mandate to widen the access to the peaceful uses of nuclear technology, science and techniques. We provide support and assist in developing the technical capabilities in nuclear techniques of our Member States. It's worth noting that the use of nuclear techniques contributes directly to more than half of the UN Sustainable Development Goals, including, as you will see, Goal 14: life below water.

- The IAEA is a scientific and technical organization at the heart of the nuclear field and our 175 Member States benefit from our

unique assistance and our indispensable laboratories in Austria and Monaco. For more than 60 years, our laboratories in Monaco have been the centre for the study of marine environments through nuclear techniques. Let me give you a few specific examples of these techniques at work:

- We have in-house expertise and equipment to monitor all kind of pollutants in the marine environment, including for example mercury, which can cause serious seafood safety issues, and organic pollutants released by catastrophic events such as oil spills. We also have expertise in measuring anthropogenic radionuclides, such tritium, cesium or plutonium. In our labs, scientists apply radiotracer techniques to improve our understanding of the processes involved in the dynamics of radionuclides and contaminants in general in the marine environment, including organisms. One could say these tracers 'light up' the evidence.

- We also use nuclear techniques that enable us to date sediment cores and provide a timeframe of the evolution of pollution at a given site. This means we can assess the legacy of pollution recorded in marine sediments and use these as archives. To do this, our scientists use radionuclides that are present in the environment and naturally occurring, such as Lead-210, or artificial, such as Cesium-137 and Pu isotopes, allowing them to estimate timescales of decades or centuries.

- One other area in which we use nuclear science in the marine environment is in tracing microplastics. Of course, plastic pollution is not related to ocean acidification. But it is worth mentioning to gain a full picture of the wide-ranging benefits of nuclear science and technology, and of the work of the IAEA, when it comes to oceans. You may have already heard more detail on this at a side event we held yesterday.

    - According to projections, by 2025 the ocean will contain one tonne of plastic for every three tonnes of fish. Due to their small size, micro-plastics can be mistaken for plankton and ingested by marine animals and transferred through the food chain.

    - Last year, the IAEA launched the Nuclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics). The goal is to help countries track and quantify the movement and impact of microplastic particles in the environment. To do this, we use nuclear and isotopic techniques, including tracers. They allow us to better understand microplastics' abundance and effects on organisms, and to evaluate any additional contamination risks from associated pollutants.

- As it turns out, one of the world's smallest things – the atom – has

the power to help save one of its biggest – the ocean.

1. The Oceanic Benefits of Nuclear

Nuclear Energy

- Science tells us that reducing greenhouse gas emissions is the single most important aspect to reducing the impacts of ocean acidification and deoxygenation. Nuclear and hydro are the world's two biggest sources of low-carbon power, providing three quarters of its globally generation. Over the past 50 years, the use of nuclear power has reduced CO_2 emissions by more than 60 gigatonnes – nearly two years' worth of global energy-related emissions. As more and more countries adopt and expand nuclear energy, more carbon emissions will be avoided. But the benefits of nuclear go beyond power stations.

Studying how the ocean is changing

- Nuclear techniques provide a unique window into the process behind ocean changes. Nuclear and isotopic techniques are powerful tools for studying ocean acidification and have contributed widely to investigating past changes in ocean acidity and potential impacts on marine organisms. For example, boron isotopes enable

scientists to assess past ocean pH levels using corals and fossilized organisms and identify past 'acidification events', with possible correlations with mass extinctions and changes in ecosystem structure. Meanwhile, magnesium isotopes can be used as a proxy for assessing past temperature measuring isotopes in sediment, ice cores or coral cores.

Assessing the impact of ocean acidification (OA)

- Nuclear and isotopic techniques can also be used to study the impact of ocean acidification on marine organisms, measuring parameters such as calcification rates, metabolomics, and co-contamination. IAEA scientists at our marine environment laboratories in Monaco are using different radioactive tracers, including the Calcium-45 radioactive tracer technique. By setting up aquaria with seawater at different pH levels and adding calcium-45 as a tracer, they measure minute differences between the growth of organisms, including coral and shellfish. This data allows us to better protect coral reefs, ecosystems and the coastal communities that rely on them.

- The ocean is suffering several stressors at once and our scientists also use other radiotracers, such as Zinc-65 or Cadmium-109, or equipment, such as nuclear magnetic resonance spectroscopy, to determine the impact of the combination of stressors, including ocean acidification, hypoxia, increases in temperature and

contaminants, which are aspects also connected to our dialogue today.

2. Science to solutions

Food Security

- Understanding the impact of ocean acidification in one part of the food chain helps to better predict what will happen to those creatures higher up in the food chain, including us humans at the very top. More than a billion people could be affected by OA and food security is an important consideration. The data collected through nuclear and isotopic techniques, such as calcification rate or past pH conditions, allows policy makers to take action and fisheries to adapt, for example by reorienting to species less affected by observed stressors. This not only helps protecting a vital source of protein in local diets, but also the income coastal communities depend on.

- This is an example of why the IAEA is assisting 16 countries in using a common basic experimental approach for a long-term study on the impacts of ocean acidification on key local seafood species. The experiment involves nuclear techniques that highlight the impact of such environmental stress on calcification for the shells of seafood species or more generally on the physiological state. Such changes and deteriorations can end up impacting seafood

production and therefore have a social and economic impact on communities who rely on that specific marine species for food and industry.

Carbon Sequestration

- The oceans play a major role in absorbing CO_2 from the atmosphere, thereby regulating our climate. By assessing the capacity of both the open ocean and coastal areas to sequester organic carbon (Blue Carbon), smart polices to boost the process can be implemented by our Member States.

- For example, we have established a dedicated laboratory to determine the burial rates of organic carbon in coastal vegetated ecosystems - mangroves, saltmarshes and seagrasses. These ecosystems accumulate large amounts of carbon in their sediment and are therefore globally important long-term sinks for atmospheric CO_2, in addition to their superbly important ecosystem functions and services. This makes them relevant nature-based solutions to mitigating climate change. We use natural and artificial radionuclides present in the marine environment as chronometers to date sediment cores at different time scales, from years to millennia. This data is then combined with the analysis of organic carbon contents and its origin through elemental and isotopic mass spectrometry techniques, allowing us to determine the magnitude of carbon sequestration and storage and facilitate sustainable

solutions to the problem of climate change and derived ocean degradation.

- Research studies in this area are being conducted in more than 20 countries worldwide, and, in parallel, we assist Member States in establishing this capacity themselves. This year, for instance, we launched a regional program on Blue Carbon in Africa. Several other national and regional projects are being planned to begin in 2024.

3. The IAEA's Ocean Acidification International Coordination Centre

- The IAEA supports its Member States in building their own capacities, including by facilitating the transfer of valuable knowledge; bringing experts together from all over the world to learn from each other and find solutions together.

- In response to the need for increased international coordination and collaboration on ocean acidification, the IAEA launched the Ocean Acidification International Coordination Centre (OA-ICC) at the UN Rio+20 conference in 2012.

- The OA-ICC, hosted by the IAEA Environment Laboratories based in Monaco, facilitates international activities on ocean acidification science, capacity building and communication. This helps support the advancement of the field, especially in the area of assessing the impact of Ocean Acidification on marine organisms. In this area nuclear techniques, such as Ca-45 or other radiotracers, complement more conventional approaches. Our target audience is not only scientists, but also policy makers, media, schools and the general public. We bring together experts to discuss issues of importance to the global OA community; provide training and capacity building for countries and scientists starting OA research; centralise information; and provide a number of online resources.

- We are also proud partners of the UN Decade of Ocean Science endorsed programme: "Ocean Acidification Research for Sustainability," which is helping to further develop the science of ocean acidification by enhancing ocean acidification capacities worldwide.

- We are increasing the involvement of developing countries in the Global Ocean Acidification Observing Network, assisting more than 40 countries on all continents in building their capacity to measure and study ocean acidification. We also connect countries and regions with an interest in OA.

- Let me give you two specific examples of international knowledge transfers and capacity building: A current PhD student from Croatia, who participated in one of the basic OA training courses on pH and alkalinity measurement, now serves as an OA university lecturer. She just assisted in an OA course held in Sweden as a lecturer. Another example is a student who participated in several of our earlier trainings and is now leading her own OA research project which includes the use of nuclear magnetic resonance spectroscopy to assess the impact of OA on the fish metabolism in Costa Rica.

- We work with leading international experts in OA research and all activities are carried out in close collaboration with other global actors on OA, including the Intergovernmental Oceanographic Commission of UNESCO, the Global Ocean Acidification Observing Network (GOA-ON), the National Oceanic and Atmospheric Administration of the US (NOAA), and the Prince Albert II of Monaco Foundation.

4. Our Global Science Databases

- You can't advance the study of OA without data. That's why we host and maintain several different databases. One is an on-line

bibliographic database - a comprehensive collection of the entire corpus of literature on OA. That's 9572 references – and counting.

- Data is much more useful when it's comparable and we make that possible. The number of studies investigating the effects of ocean acidification on marine organisms and communities is increasing every year. But carbonate chemistry and ancillary data, are not always reported in similar units and scales and may not be calculated using similar sets of constants. We make it comparable and accessible through our database.

Conclusion

- Just like a good isotopic tracer, I hope I have illuminated the IAEA's value in helping us to reach our common oceanic goals and given you some specific examples of the enormous benefits of nuclear science and technology. Our contribution is made possible by the financial support of our esteemed partners, in particular our Member States. As challenges such as ocean acidification and marine plastic pollution mount, and the need for our services increases, we are reaching out to Member States to secure the necessary financial contributions and to newer partners like development banks and the private sector. We are playing our part in a unique and impactful way, and I look forward to working together with all of you in deepening our collaboration ahead.