

Double-pulse LIBS technology provides environmentally friendly analysis of deep-sea materials

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Illustration of a diving robot that uses laser-induced plasma spectroscopy (LIBS) to analyse materials in the deep sea in an environmentally friendly way. Credit: INP

The seabed contains large quantities of valuable minerals and metals that are urgently needed for modern technologies such as electric cars and

wind turbines. However, discovering these deposits has so far been complicated. Diving robots use grippers to take samples, which are then analyzed onboard a research vessel. An innovative method is now opening up new possibilities for more environmentally friendly exploration of our oceans.

With laser-induced plasma spectroscopy (LIBS) using double-pulse lasers, the Laser Zentrum Hannover e.V. (LZH) has developed a method for the environmentally friendly analysis of materials at a depth of 6,000 meters below sea level.

Together with the Leibniz Institute for Plasma Science and Technology (INP) in Greifswald, the fundamental process behavior was investigated as part of a DFG project. The method provides precise elemental analysis in real time and replaces time-consuming sampling of the seafloor.

The double-pulse technique uses two laser pulses: the first pulse creates a cavity in the water at the surface of the material, while the second pulse evaporates material from the surface and creates a plasma containing the elements for spectroscopic analysis. The problem is the [high pressure](#) underwater, which makes it difficult to generate meaningful spectra for accurate analysis.

Optimized for deep sea use

The current research focuses on analyzing materials at pressures of up to 600 bar, such as those found 6,000 meters below the surface, and using laser pulses with energies of up to 150 millijoules. By adjusting the laser parameters, the team was able to optimize the measurements for the high pressure of the deep sea.

The short delays of 0.5 microseconds between the [laser pulses](#) and the

precise adjustment of the start times of the spectrometer measurements are crucial for the quality of the data obtained.

[The research](#) has been published in the journal *Spectrochimica Acta Part B: Atomic Spectroscopy*.

More information: M. Henkel et al, Double-pulse LIBS in water with up to 600 bar hydrostatic pressure and up to 150 mJ energy of each pulse, *Spectrochimica Acta Part B: Atomic Spectroscopy* (2024). [DOI: 10.1016/j.sab.2024.106877](#)

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