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Autonomous Deep–Sea Robot In Development for Marine Research

INSEC TEC researchers are developing a highly advanced autonomous underwater vehicle capable of remaining on the seabed for weeks to provide cost-effective logistical support and continuous data collection during remote deep-sea missions

By **Abi Wylie** / 04 Jun 2026



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Researchers at INSEC TEC are developing a new autonomous robotic system designed to revolutionize logistical support and environmental monitoring in deep-sea operations.

The prototype vehicle, named PETRA (Long-Range Deep-Sea Logistic AUV), has been under development for around two years, with its first mission scheduled for May 2027 in the Atlantic Ocean as part of a European project. The robot is engineered with the capability to descend to 6,000 meters and features the autonomy to remain positioned on the seabed for two weeks during its initial deployment.

According to INSEC TEC researcher and Porto School of Engineering (ISEP) lecturer José Miguel Almeida, the vehicle represents “a *highly innovative system, due to the logistical support function for deep-sea operations in remote locations*”. Almeida explained that “*it enables the transport and recovery of equipment, e.g., seabed sensor nodes, the collection of the data they record, and the recharging of their batteries. These unique features make it possible to maintain underwater infrastructures without continuously relying on research vessels or offshore operation ships, nor on the use of work-class ROVs (remotely operated underwater vehicles) in lengthy and extremely costly operations – thus introducing new possibilities for the observation and monitoring of vast areas at great depths, at costs that are a fraction of current solutions.*”

The development addresses the high economic, human, and environmental costs associated with conventional oceanographic research vessels, which traditionally serve as the central platforms for deploying sensors and robotic vehicles. “*The cost of operating conventional vessels (economic, human and environmental) is clear: it involves crews, engines and combustion generators, and noise,*” Almeida stated. He noted that “*many of the operations these vessels perform, whether using surface-based sensors, ROVs, or even autonomous vehicles, could be carried out more efficiently using platforms such as PETRA, enabling these operations to be scaled and allowing for the collection of more spatially and temporally dense data.*”



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Furthermore, the financial efficiency of the robotic system could fundamentally alter operational scaling. *“The operating cost of a single vessel can be equivalent to that of an entire fleet of these robots,”* Almeida explained. Environmental resilience provides an additional advantage over traditional ships, allowing operations to persist through severe weather and challenging environments. *“There is also the issue of operating conditions. Even during stormy weather, this robot can continue to operate. In polar regions, where it is practically impossible to reach areas by vessel in winter, we can collect data throughout the entire year.”*



The system's modular and reconfigurable architecture allows the vehicle to vary between 6.4 and 8 meters in length and carry a payload exceeding two cubic meters. While *“there are similar concepts in the world, but INESC TEC is the first to develop something of this kind”*, Almeida highlighted that the platform uniquely combines deep depth capability, high autonomy, logistical capacity, and resident seabed operation within a single unit.

Beyond scientific research, the vehicle is designed to support national defense and security operations, complementing existing crewed assets in terms of capability, cost efficiency, and scalability. Potential applications include detecting illegal underwater exploitation activities and monitoring strategic assets such as submarine cables. *“Imagine there is suspicion of illegal exploitation in specific areas, or that it is necessary to monitor an underwater cable. The mission is defined from a remote-control centre, and from there the vehicle can not only follow the plan, but also make autonomous decisions that help achieve the objective,”* Almeida continued. *“If it encounters difficulties, it returns to the surface or to a base, communicates with the control centre to report and receive updates, and continues the mission.”*

Future operational paradigms for the technology include direct deployment between ports and the establishment of underwater bases along the Portuguese coast. This infrastructure would allow a fleet of these robots to operate between different bases, extending operational reach into the Atlantic, transporting energy, installing infrastructure, and providing national-scale monitoring coverage across the entire Portuguese continental shelf.

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