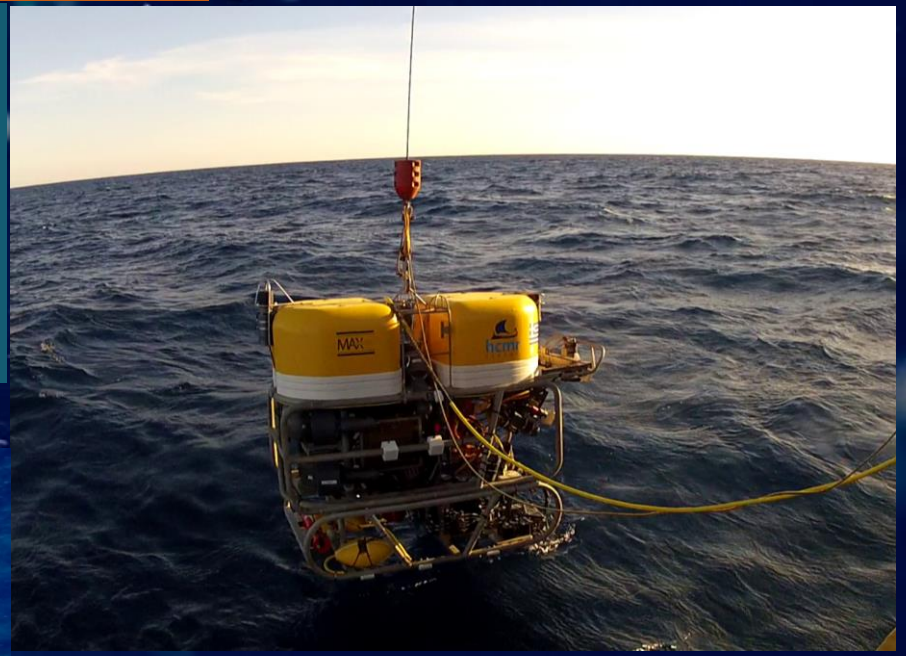
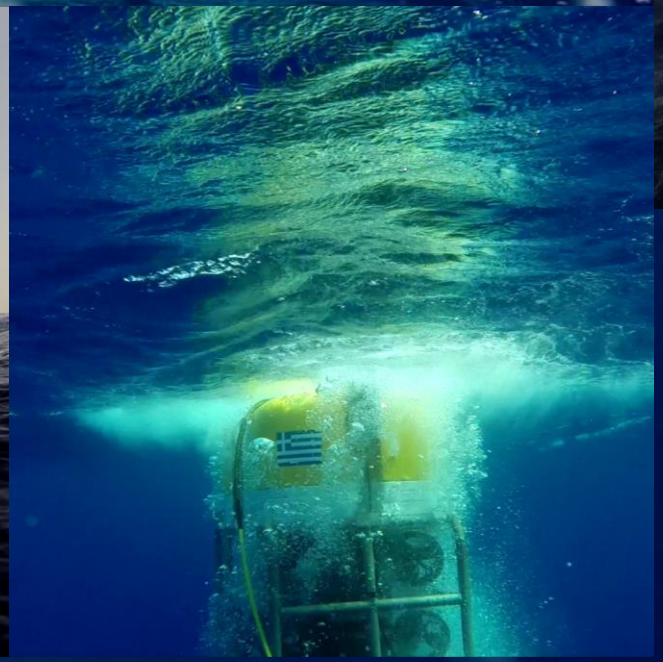
How does a ROV float?

Hellenic Centre for Marine Research - ROV team

How does a ROV float?

Remotely **O**perated **V**ehicles are a family of underwater robotic vehicles that allow us to work in conditions and environments that are neither friendly nor easily accessible to humans.



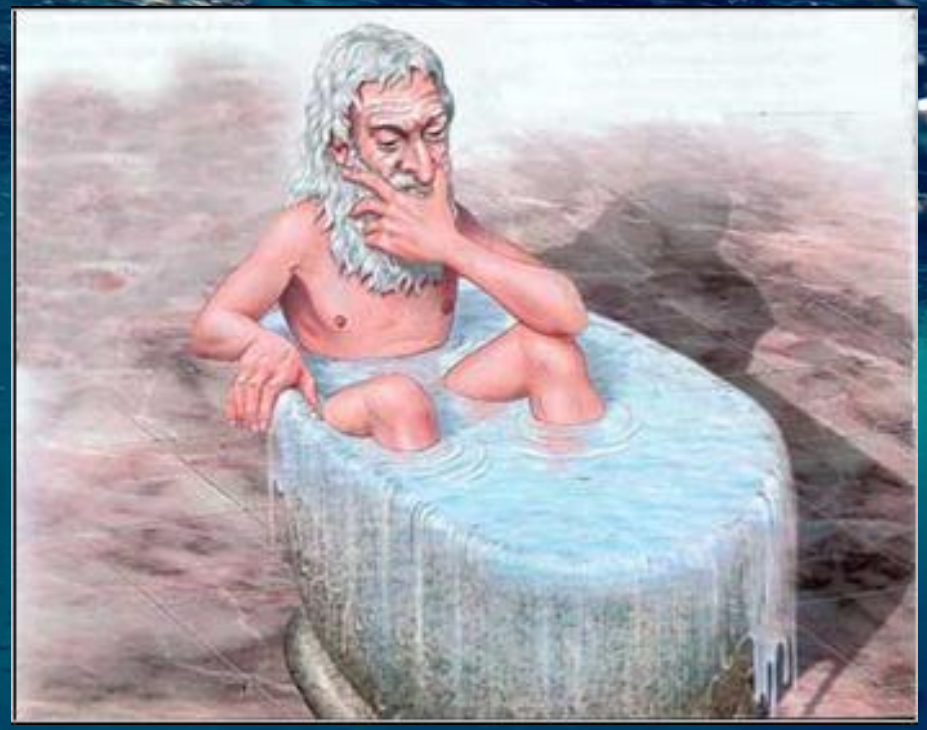


But how does it float inside the sea?

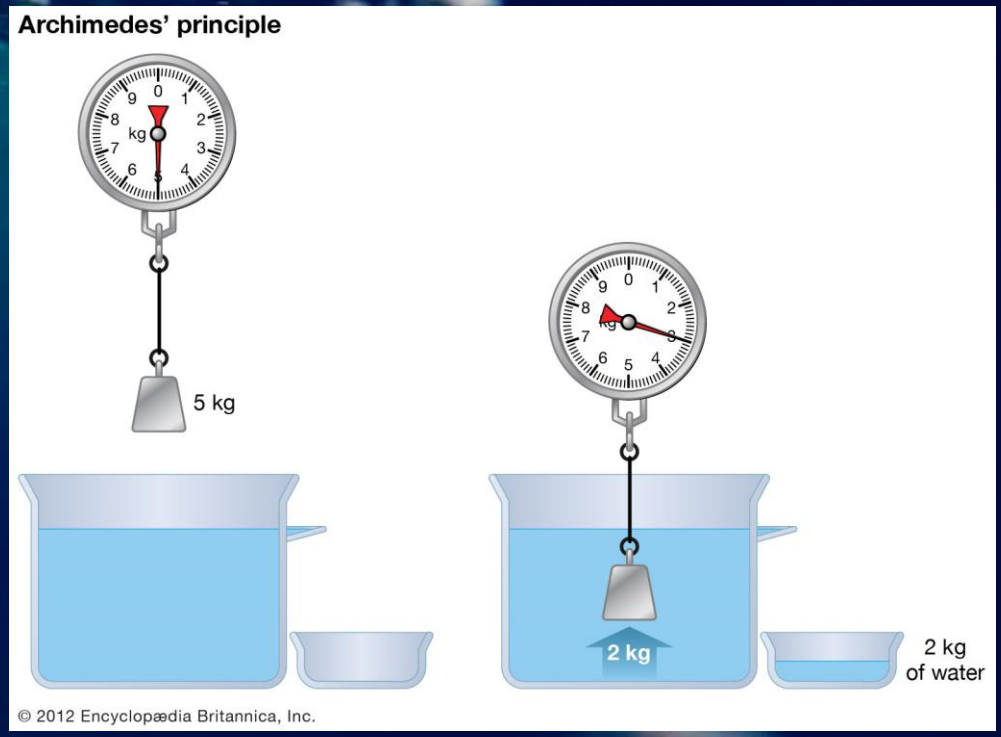
Photos @F.Pantazoglou/HCMR

How does a ROV float?

Archimedes principle



"An object immersed in a fluid experiences a buoyant force that is equal in magnitude to the force of gravity on the displaced fluid."



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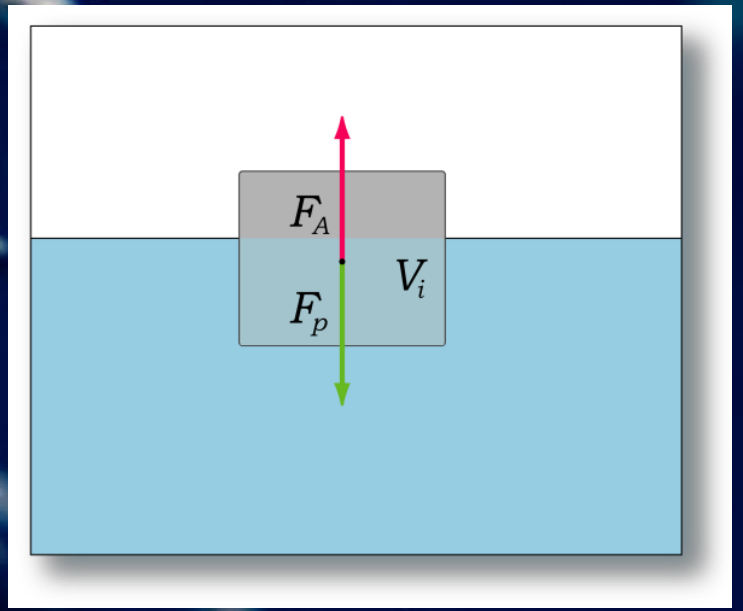
How does a ship float

RV AEGAEO floats because the ship's weight F_p and its buoyancy F_A are equal in size.



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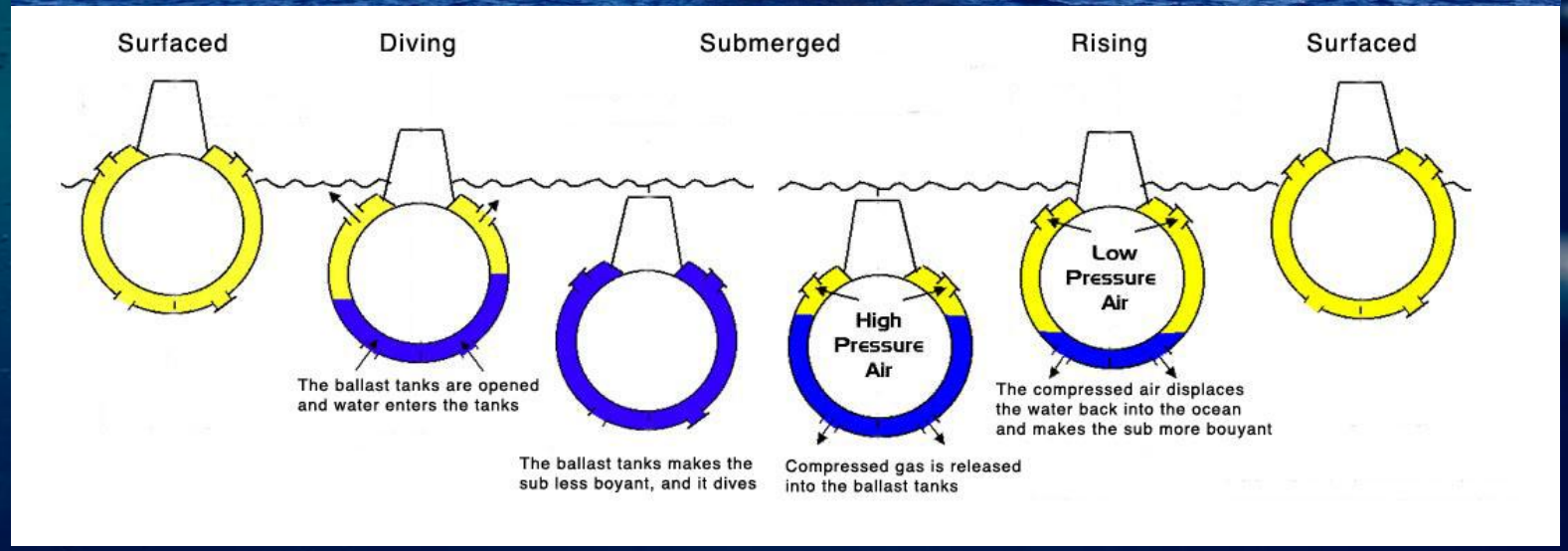
How does a submersible float



Submersibles like submarines use special designed tanks to control their buoyancy.

By flooding those tanks with water they submerge to the desired depth.

Releasing the water from the tanks gives them positive buoyancy and so they rise to the surface.

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The objective of a ROV flotation system is to counteract the negative buoyancy effect of heavier than water materials on the ROV (frame, pressure housings, sensors, motors etc.) with lighter than water materials (i.e., buoyancy material)

A near neutrally buoyant state is our goal when we design our ROV.

How does a ROV float?

Flotation materials for ROVs

Flotation material should maintain its form and resistance to water pressure at the anticipated operating depth.

Photos @F.Pantazoglou/HCMR

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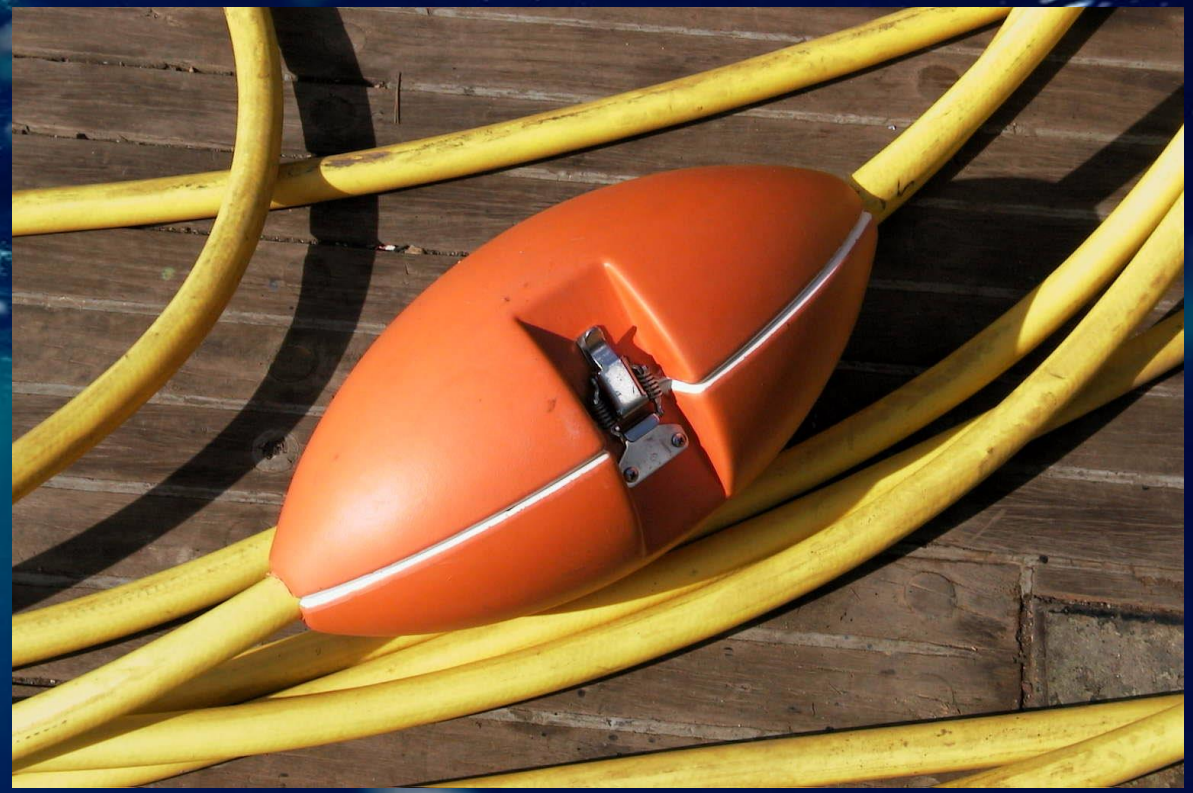
Flotation materials for ROVs

Rigid lightweight materials like polyurethane or polyvinyl. Those type of materials are used for shallower depths.

Syntactic foams. We use them to cover full ocean depths. From 0m until the operational depth of our submersible.

Ceramic spheres for the deepest sea trenches and environments.



Photos @F.Pantazoglou/HCMR

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Rigid lightweight materials Polyisocyanurate foams

Generally low-density, insulation-grade foams, usually made in large blocks via a continuous extrusion process. These blocks are then put through cutting machines to make sheets and other shapes.

ROV manufacturers generally cut, shape, and sand these inexpensive foams and then coat them with either a fiberglass covering or a thick layer of paint to help with abrasion and water intrusion resistance.

These resilient foam blocks have been tested to depths of 330 m of sea water and have proven to be an inexpensive and effective flotation system for shallow water applications.

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Syntactic foam

For deep water applications, syntactic foam has been the material of choice. Syntactic foam is an air/micro balloon structure encased within a resin body.

This way of floatation is widely accepted because of their reliability to perform over numerous excursions to their design depth. The desired density remains stable for many years of service.

The drawback to solid syntactic foam is that they cannot be cast as very large parts.

MaxRover ROV uses syntactic foam (yellow and white parts in the photo at left) to achieve near neutrally buoyant state.
In fact our ROV has a slightly positive buoyancy.

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Ceramic spheres

Ceramic spheres have been developed that can withstand the pressure of very deep environments.

Typically 9 cm in diameter and capable of providing buoyancy to 11,000 m.

One shortcoming is the potential for sympathetic implosion. This phenomenon is also a potential for large glass spheres.

THANK YOU

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