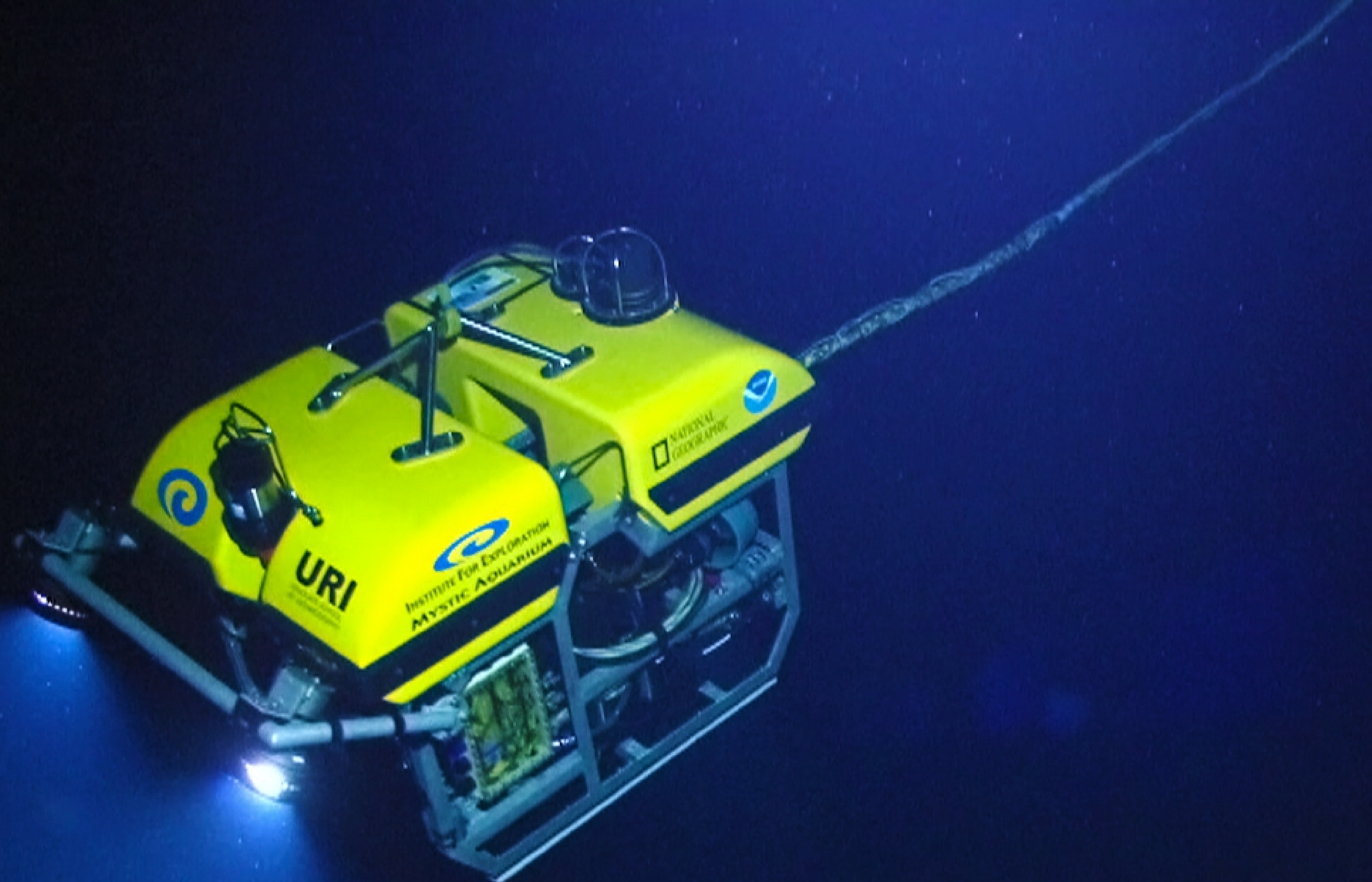



# Underwater Robots

**Jenny Gabel | 06.01.2014**

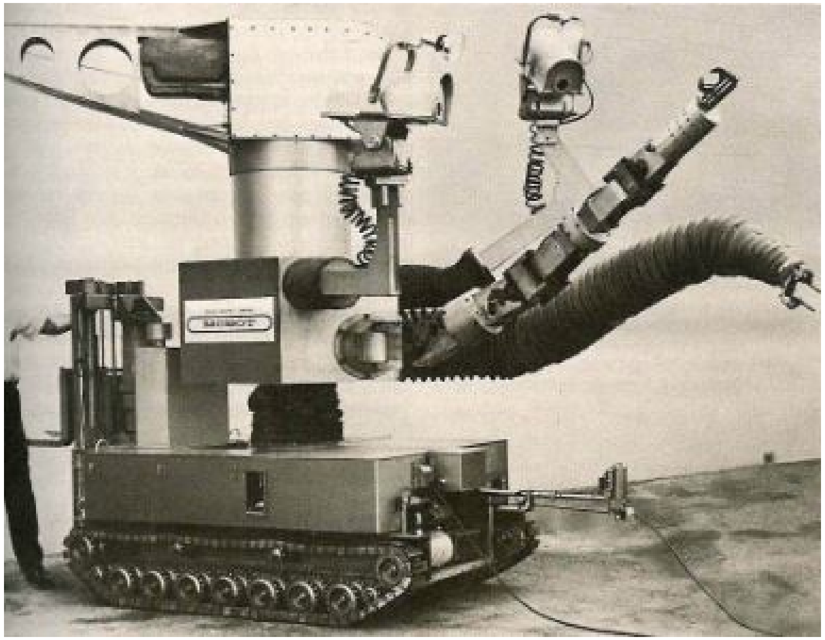
# Table of Contens

# Introduction

# Introduction

1950's:

- first models developed out of robots working on land
- remotely operated
- funded by U.S. Navy



1960's:

- commercial interest and development (oil industry)

# Introduction

Underwater Robots today:

- Unmanned underwater vehicles/robots
- Introduced for commercial use in the 1970's
- Used in industry, science and research, military and lately for documentary filming
- Two main types: remotely operated and autonomous robots

# Introduction

- Vary in shape and size: from small torpedo-shaped to box-shaped as big as a compact car

# Introduction

Operational Areas:

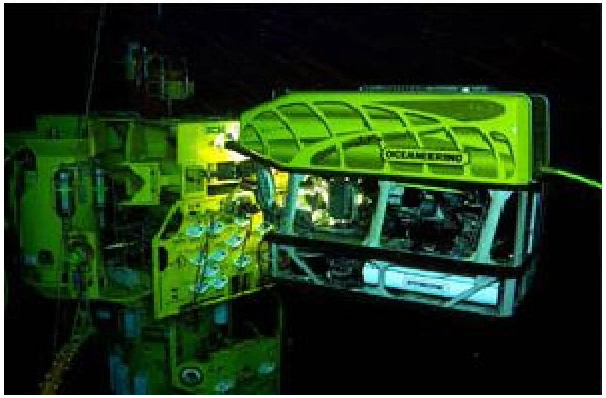
Power station surveys

Destruction of mines

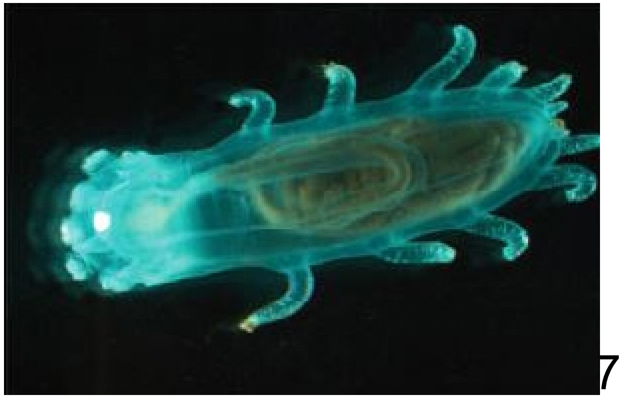
Inspection of Dams

Investigation of sunken objects

Oil and gas industry



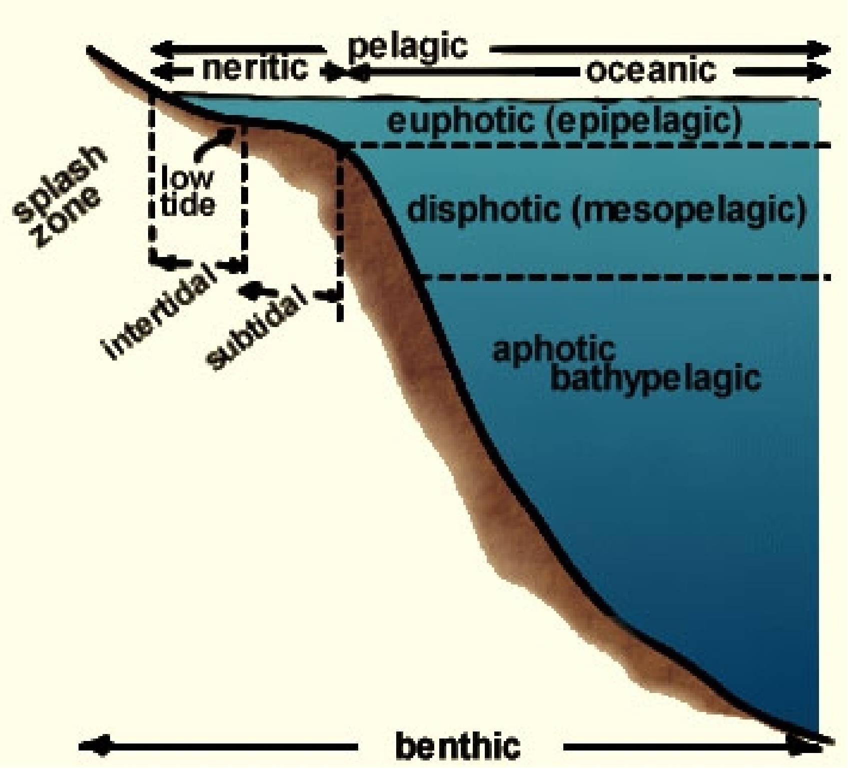
Sea life and environmental research



# Challenges of Underwater Exploration

# Challenges of Underwater Exploration

- About 71% of the earth's surface is covered by oceans
- Deap-sea: depths beneath 800m, lightless zone (aphotic zone) = over 70% of the oceans




- Up until today very little is researched and known about the deep-sea

# Challenges of Underwater Exploration

- High pressure: atmospheric pressure is increasing by 1 atmosphere every 10m diving
- Orientation and navigation underwater
- Collecting and sending data
- Power supply
- Size and weight
- Reliability and maintainability
- Costs

# Remotely Operated Vehicles

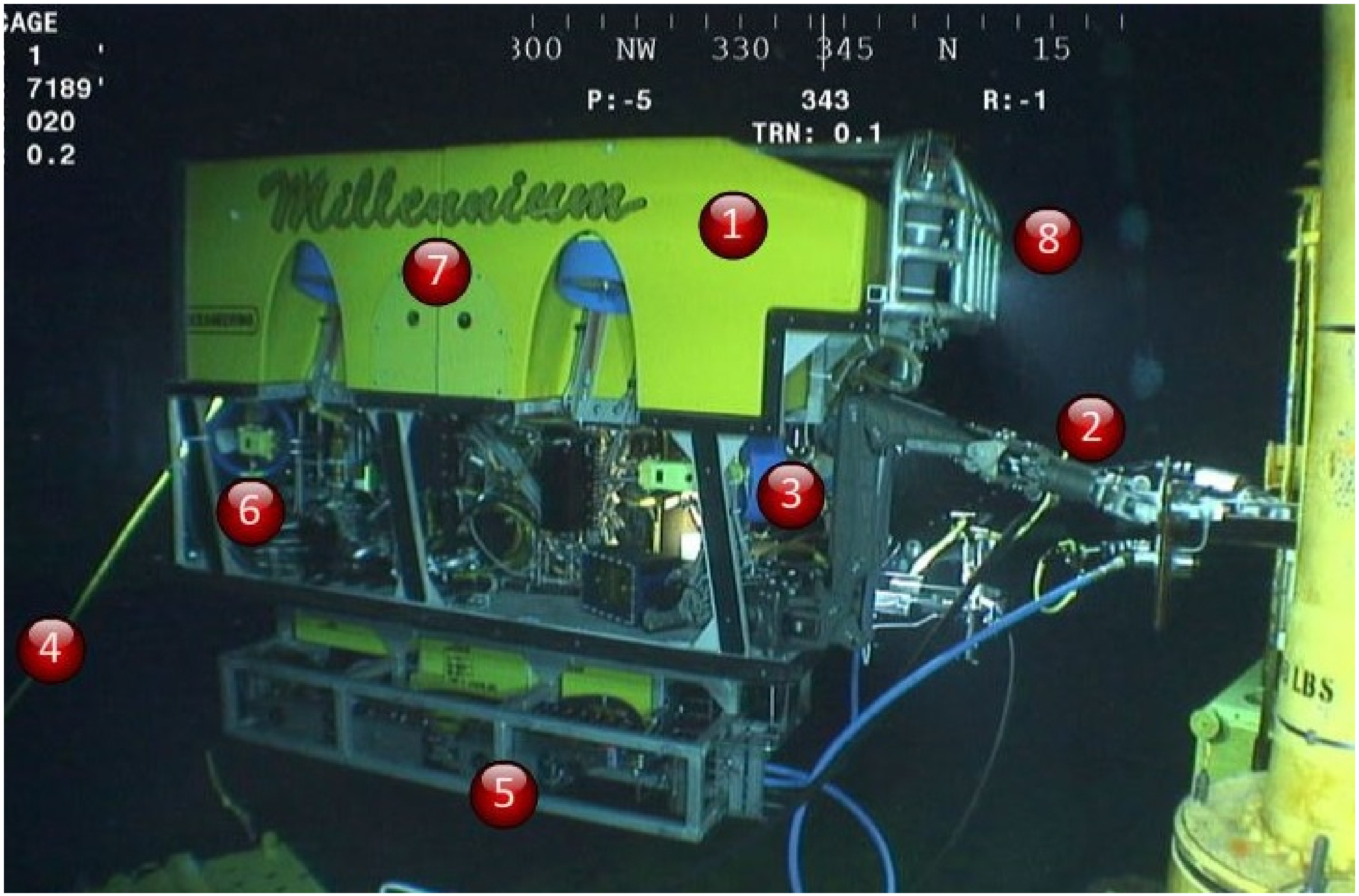
# Remotely Operated Vehicles (ROV)

- Tethered underwater robots, operated by a human aboard a vessel
- Power and communication through tether
- Subsea cage to launch and recover the ROV
- Mostly rectangular-/box-shaped

# Remotely Operated Vehicles (ROV)

- **Observation ROV:** observation, research, inspection (and documentary filming)
- **Work class ROV:** additonally equipped with specific tools
- **Bottom crawling ROV:** limited movement across seafloor, designed for special tasks e.g. burial of deep-sea cables

# Remotely Operated Vehicles (ROV)



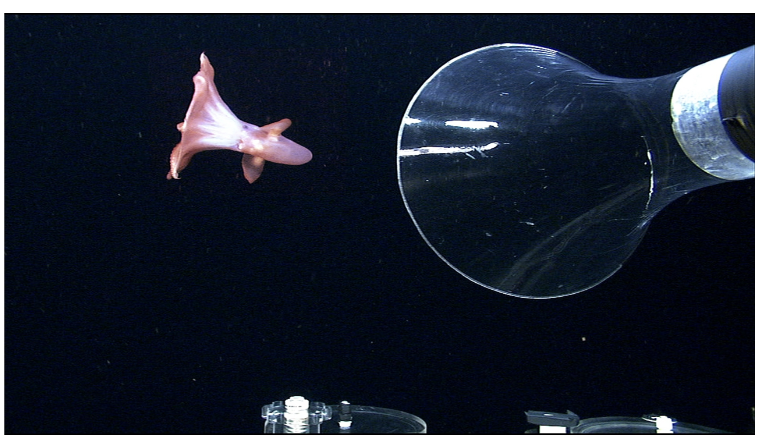

1. Work class ROV
2. manipulator arms
3. HD video camera
4. tether
5. various skids for special tasks
6. thruster
7. main floatation
8. ultra high intensity LED light

# Remotely Operated Vehicles (ROV)

# Remotely Operated Vehicles (ROV)

Observation ROV

- Low overall weight
  → air transport
- Modular components
  → highly configurable



*Global Explorer*

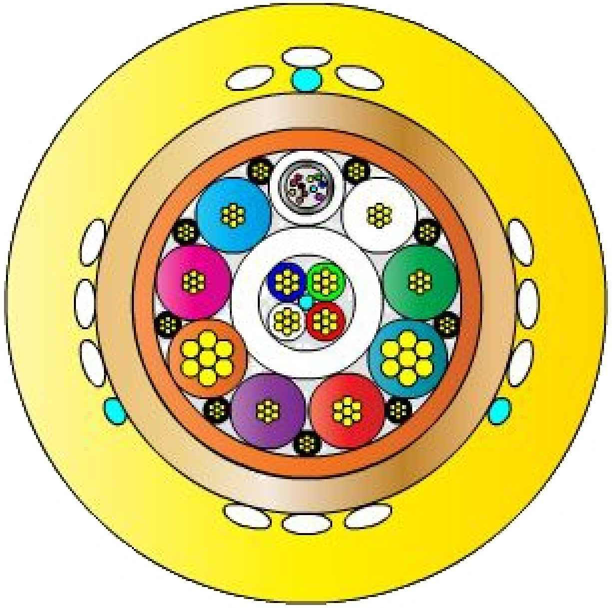
# Remotely Operated Vehicles (ROV)

Limits of ROVs:

- Dependent on surface vessel, tether and operator
- Cable has to support weight, transfer power and communications

→ Small range and limited operation time

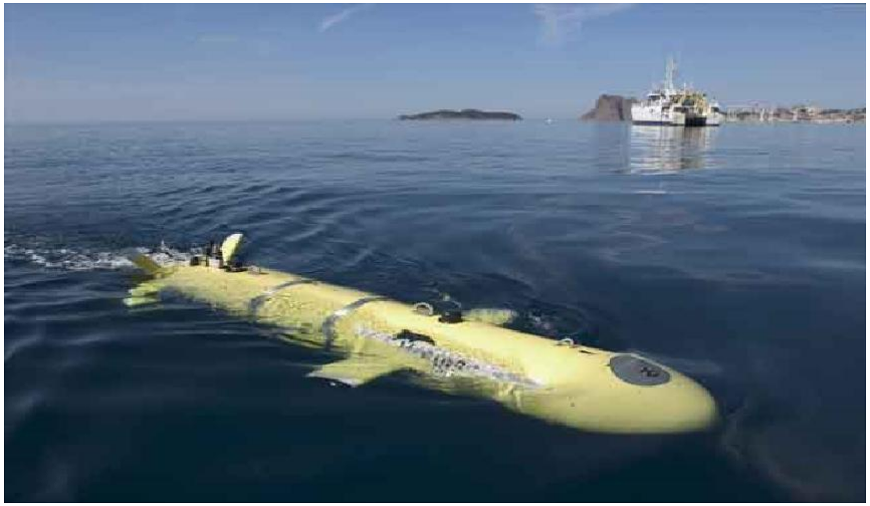
*Tether components*



# Autonomous Underwater Vehicles

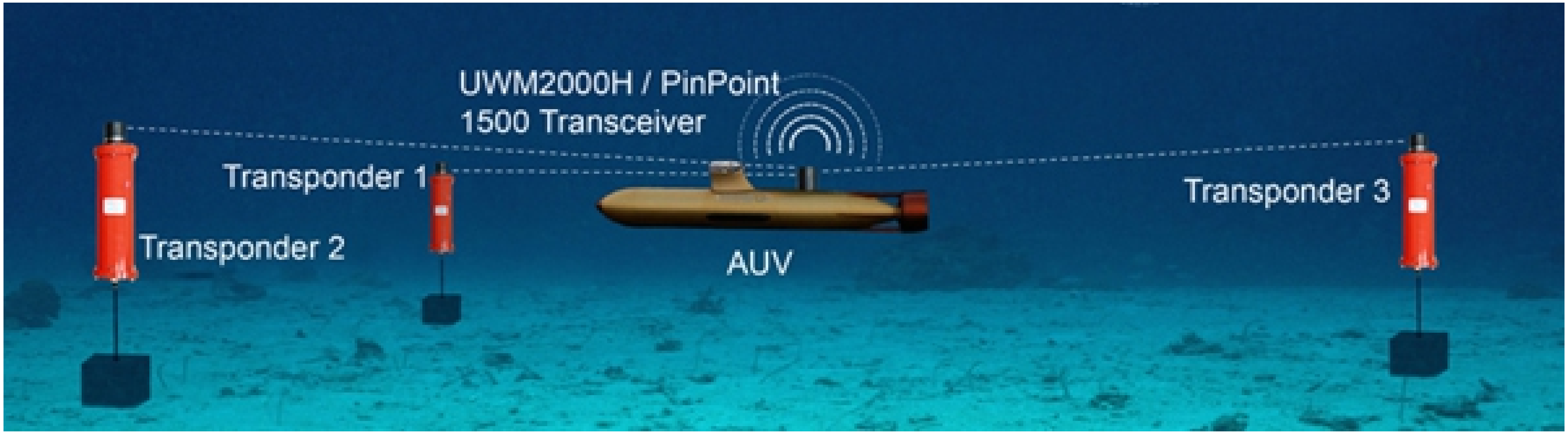
# Autonomous Underwater Vehicles (AUV)

- Computer controlled robot travelling and operating underwater
- Own power source and propulsion
- Shaped like torpedoes, stingrays or have attached flippers



# Autonomous Underwater Vehicles (AUV)

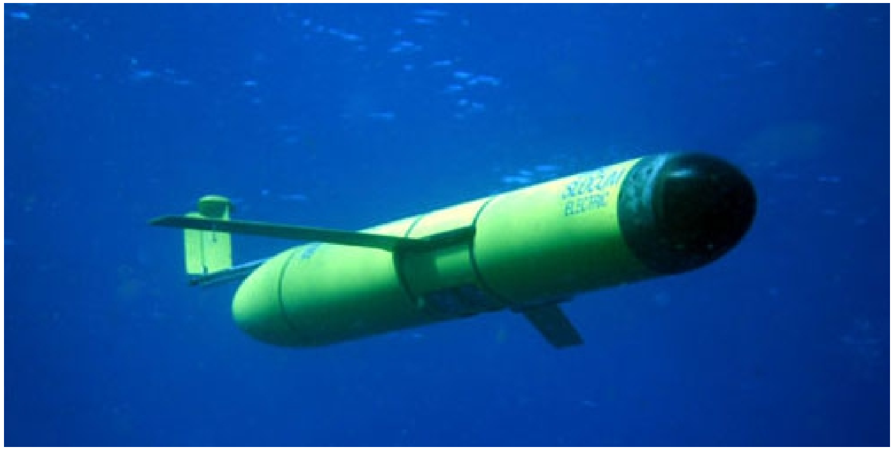
- Using sonar and underwater acoustic positioning systems to navigate and map surroundings
- Lithium-ion batteries as power source, use of solar power and hydrogen are still in testing/not marketable

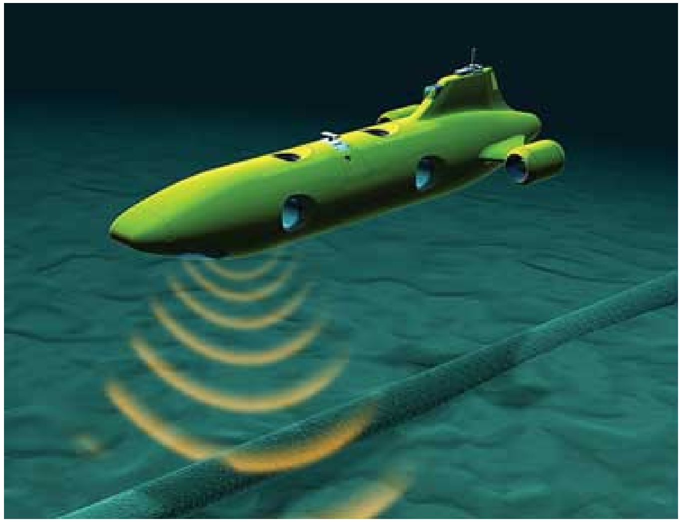


# Autonomous Underwater Vehicles (AUV)

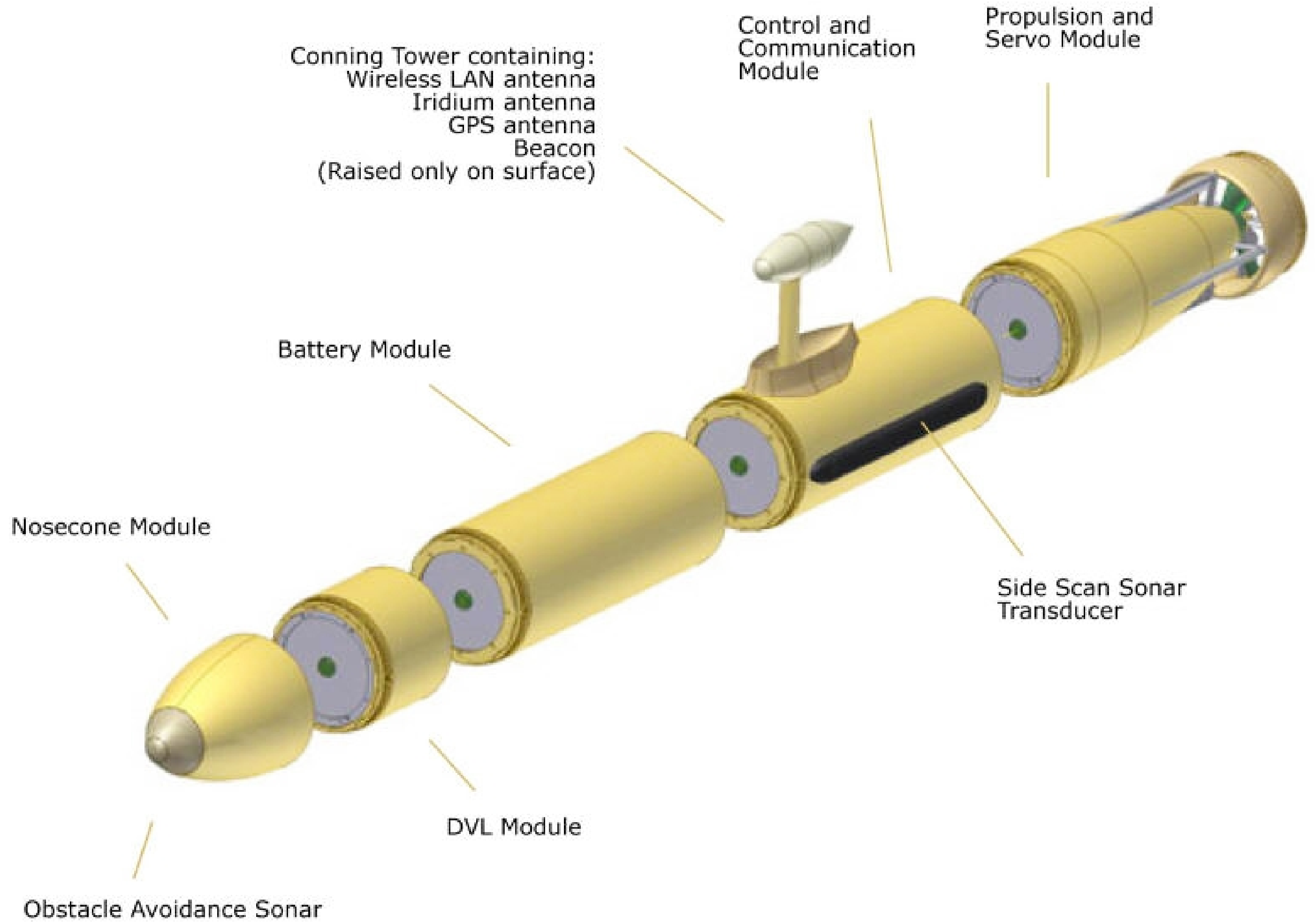
- **Underwater Glider:** slow, but very low power consumption and high range

- **Intervention AUV:** interventions at underwater facilities or for retrieving biological samples





# Autonomous Underwater Vehicles (AUV)




Modular build, highly configurable:

- Turbulence measurement
- Plankton pump
- Bioluminesence detection
- Video camera
- etc.

# Autonomous Underwater Vehicles (AUV)

Limits of AUV's:

- Dependent on capacity of power source
- No complex operations
- No real-time images/videos

→ limited tasks and operation time

# Future Perspectives

# Future Perspectives

- Diving deeper and deeper into the ocean
  → development of deep-sea robots

- More complex tasks
  → advanced processing capabilities and more efficient power sources are needed

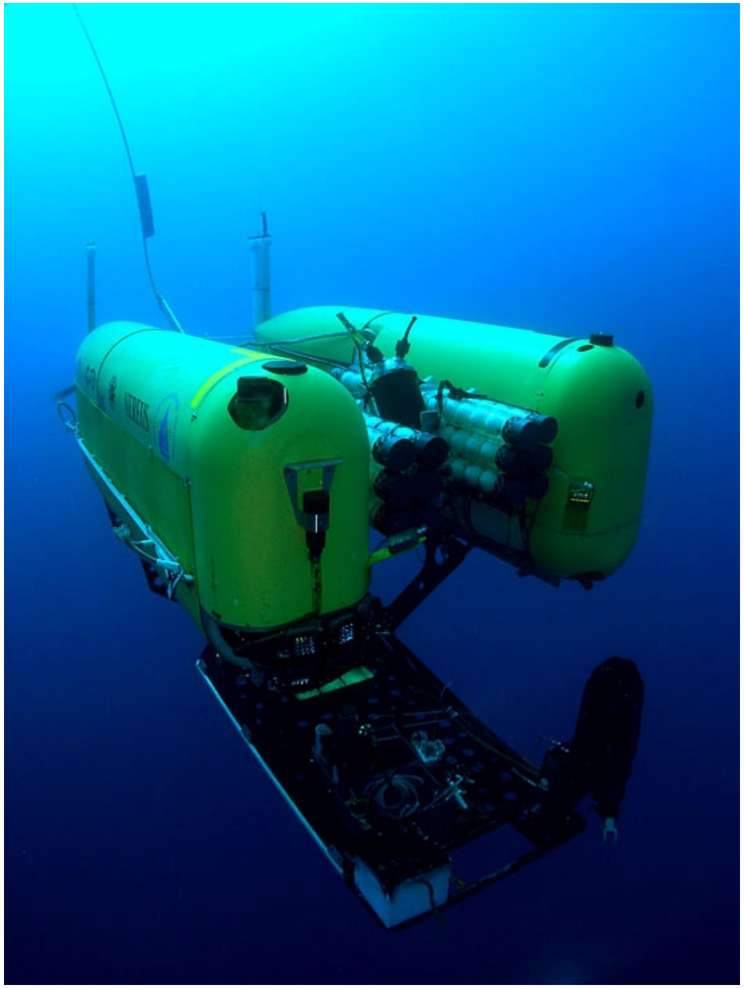
- Combining advantages of ROVs and AUVs
  → development of hybrids that can operate tethered or untethered

# Future Perspectives

Hybrid „Nereus“

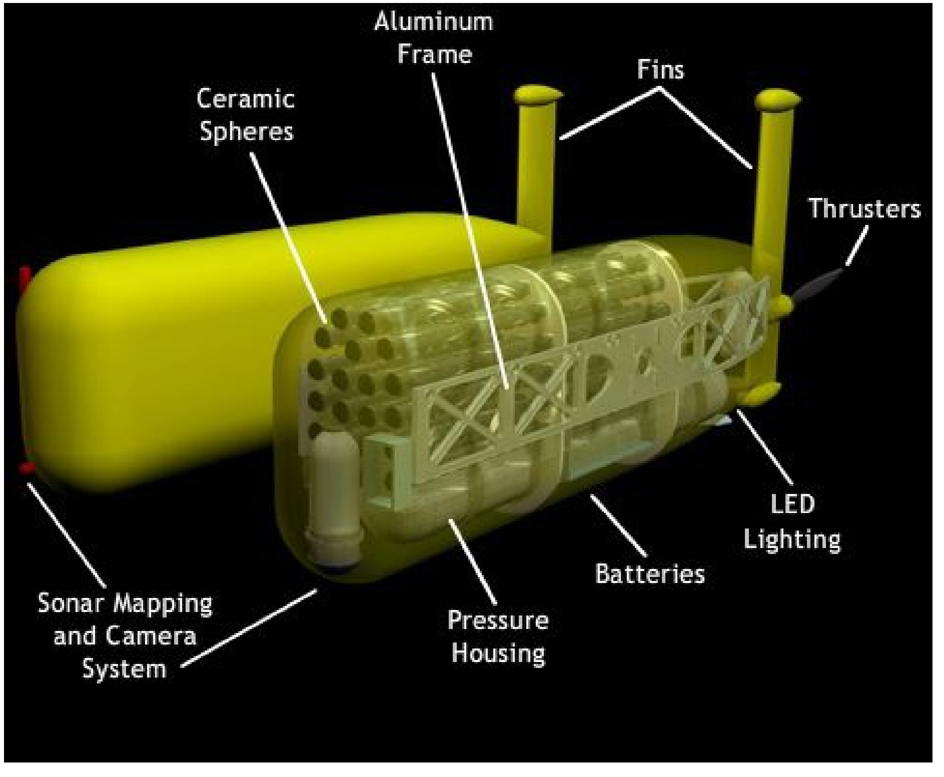
- Dove to 10,902 meters into the Mariana Tench in 2009
- AUV mode: survey large undersea areas and photograph seafloor
- ROV mode: precise control and manipulations, high quality real-time images

*Nereus in ROV-mode*

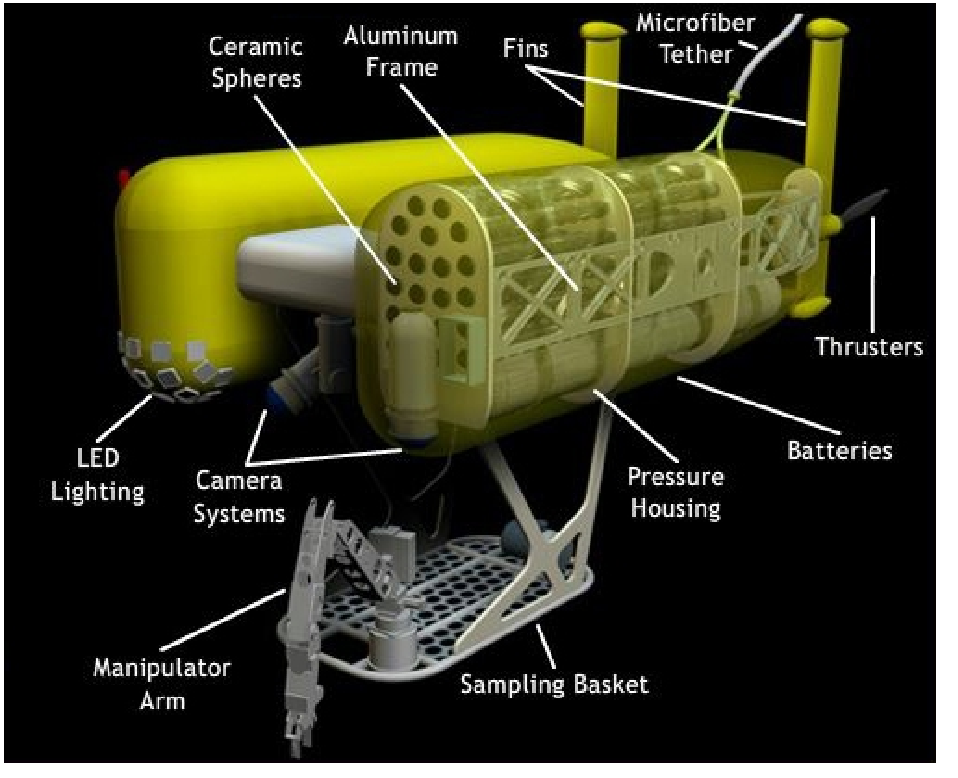


# Future Perspectives

Hybrid „Neureus“




*AUV-mode*




*ROV-mode*

# Future Perspectives

Bionic robots

- Using principles and methods found in nature
- AUVs designed based on marine animals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