STS.011 American Science: Ethical Conflicts and Political Choices
Fall 2007

Cold War Science and Technology:
Military-Industrial-University complex

Lecture - STS.011 – 9/19/07

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Science: The Endless Frontier

[N]owhere in the Governmental structure receiving its funds from Congress is there an agency adapted to supplementing the support of basic research in the universities, both in medicine and the natural sciences; adapted to supporting research on new weapons for both Services; or adapted to administering a program of science scholarships and fellowships.

A new agency should be established, therefore, by the Congress for the purpose. Such an agency, moreover, should be an independent agency devoted to the support of scientific research and advanced scientific education alone.

Vannevar Bush, 1945
Director, OSRD

General Dwight D. Eisenhower, Supreme Allied Commander

Photo: U.S. National Archives.□□

President Dwight D. Eisenhower, 1961

"In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.

Akin to, and largely responsible for the sweeping changes in our industrial-military posture, has been the technological revolution during recent decades. In this revolution, research has become central; it also becomes more formalized, complex, and costly.

The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present and is gravely to be regarded.

Yet, in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite."

Military systems transferred to peaceful uses:

- Interchangeable parts manufacturing (back to 1840s)
- ARPANET → internet
- ICBMs → space program; satellite communications, inertial guidance systems (commercial airliner navigation)
- Radar and sonar
- Digital computing (from Project Sage and Project Whirlwind)
- Nuclear weapons and research → nuclear power *(one facet: Doc Edgerton's strobe photography)*
- Global Positioning System
- Naval war fighting, intelligence gathering, and espionage → deep submergence technology

Deep submergence technology

- Submarine fleet: SSBN force, SSN counterforce
- Enabling technologies: nuclear energy, inertial guidance, digital computing
- SOSUS (SOund SUrveillance System) net and sonar (Doc Edgerton again)
- Materials science
- Global Positioning System

Sherry Sontag and Christopher Drew, *Blind Man's Bluff*

Loss of USS *Thresher*, 1961

Photo: Naval Historical Center

Photo # NH 97555 Navy ships operating over the sinking site of USS Thresher, 15 April 1963

Photo: Naval Historical Center

Earliest attempts - Bathyscaphe TRIESTE

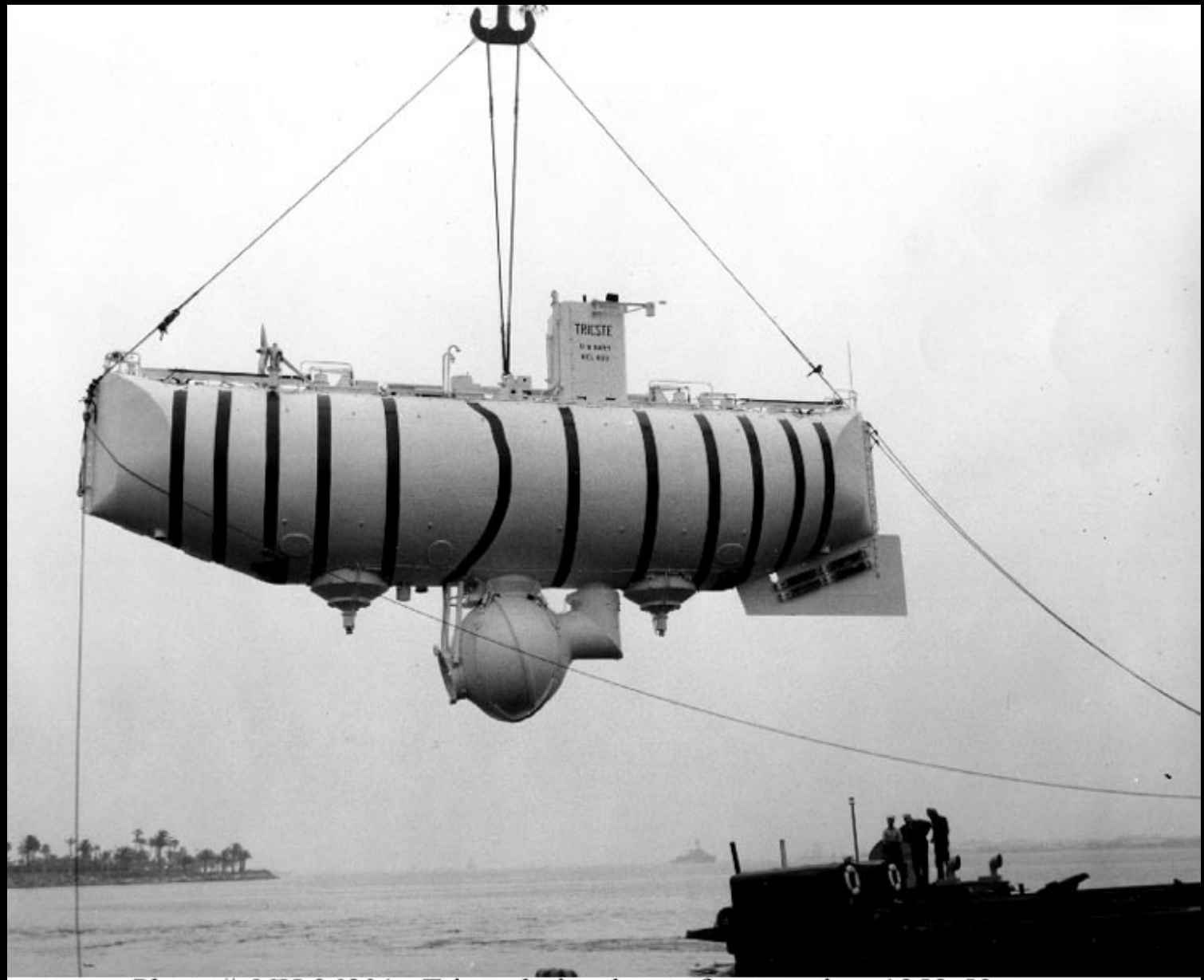


Photo # NH 96801 Trieste hoisted out of water, circa 1958-59

Photo: Naval Historical Center

Photo # NH 96805 Trieste's pressure sphere, ca. 1958-59

Photo: Naval Historical Center

Literally, a gas bag

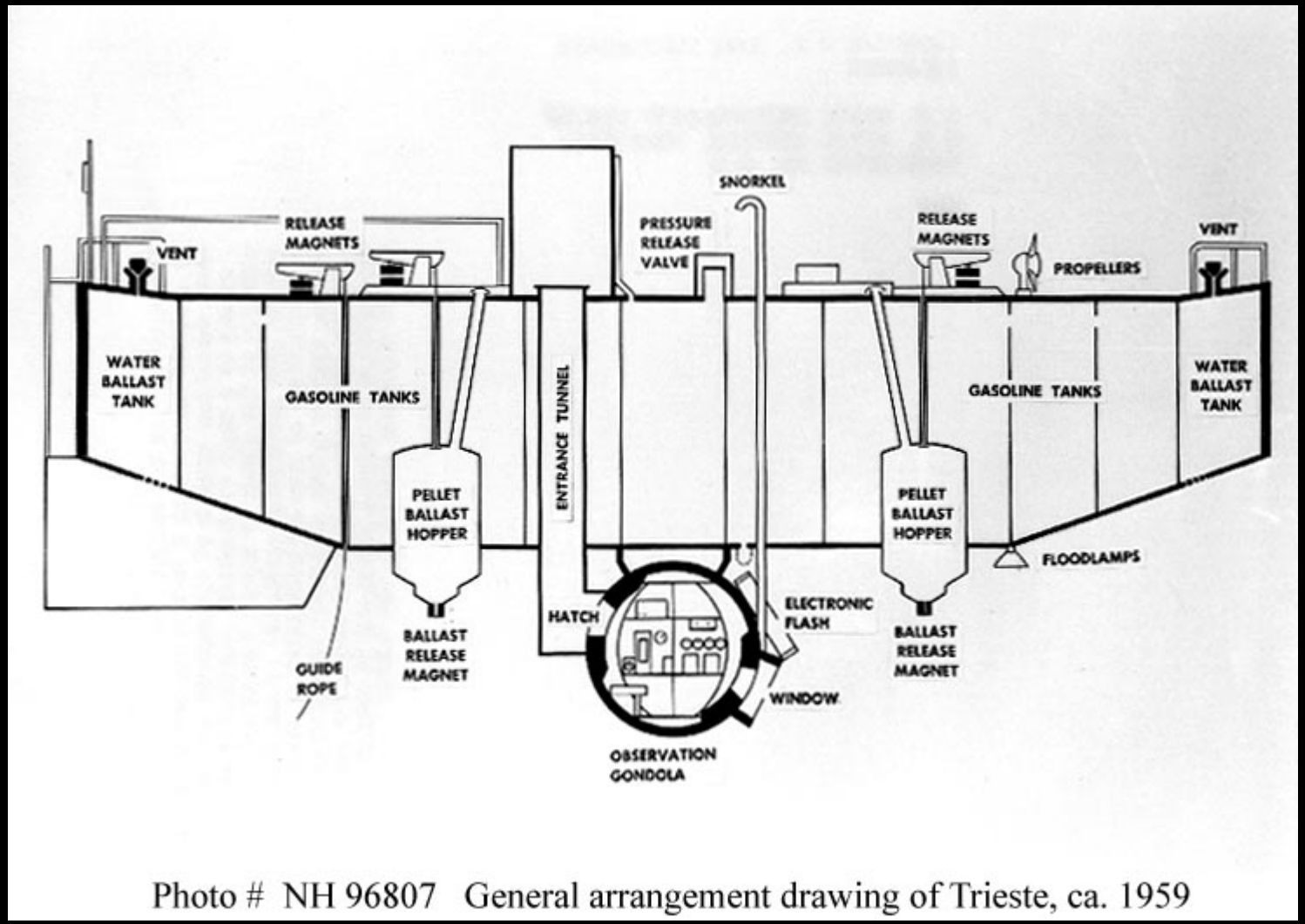


Photo # NH 96807 General arrangement drawing of Trieste, ca. 1959

Photo: Naval Historical Center

Photo: Naval Historical Center

Photo: Naval Historical Center

And again in 1968: loss of USS *Scorpion*

Photo: Naval Historical Center

Photo: Naval Historical Center

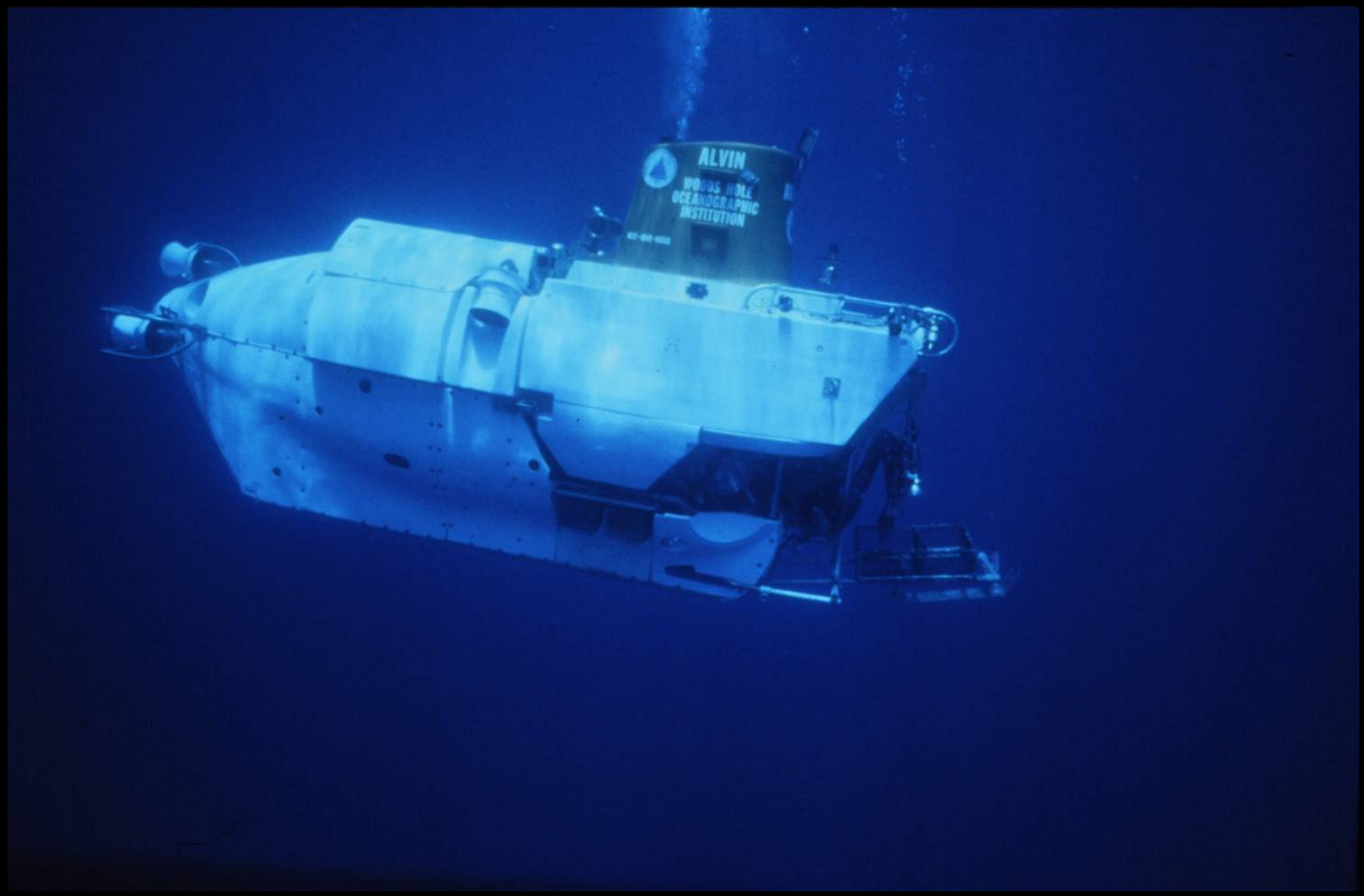
The real deep submergence story begins 35,000 over Spain, 1966…

Courtesy of Boeing Corporation. Used with permission.

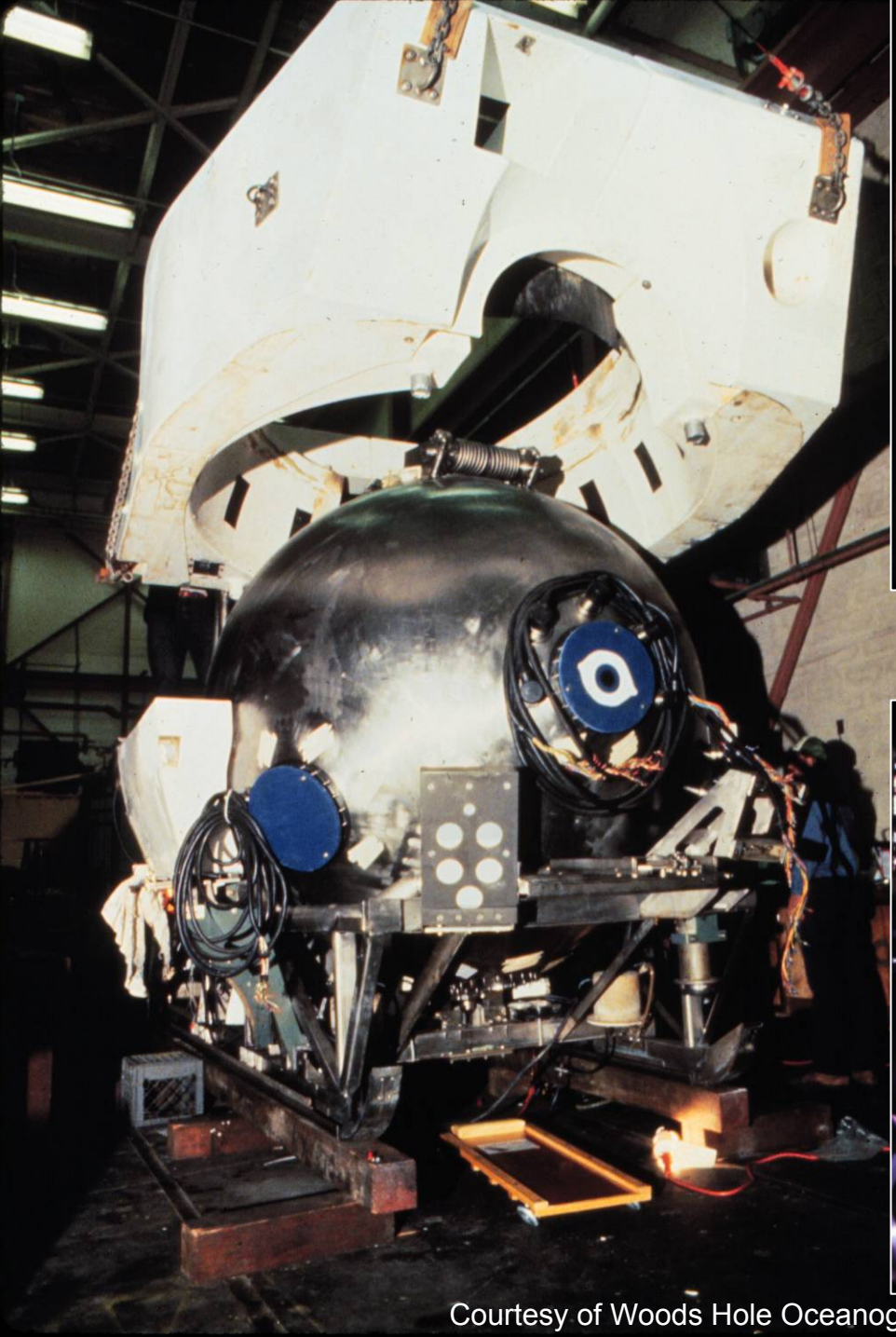
Hydrogen bomb recovered on land at Palomares.
Three bombs fell on land, one fell into Mediterranean Sea.

Photo: U.S. Navy

WHOI submersible ALVIN

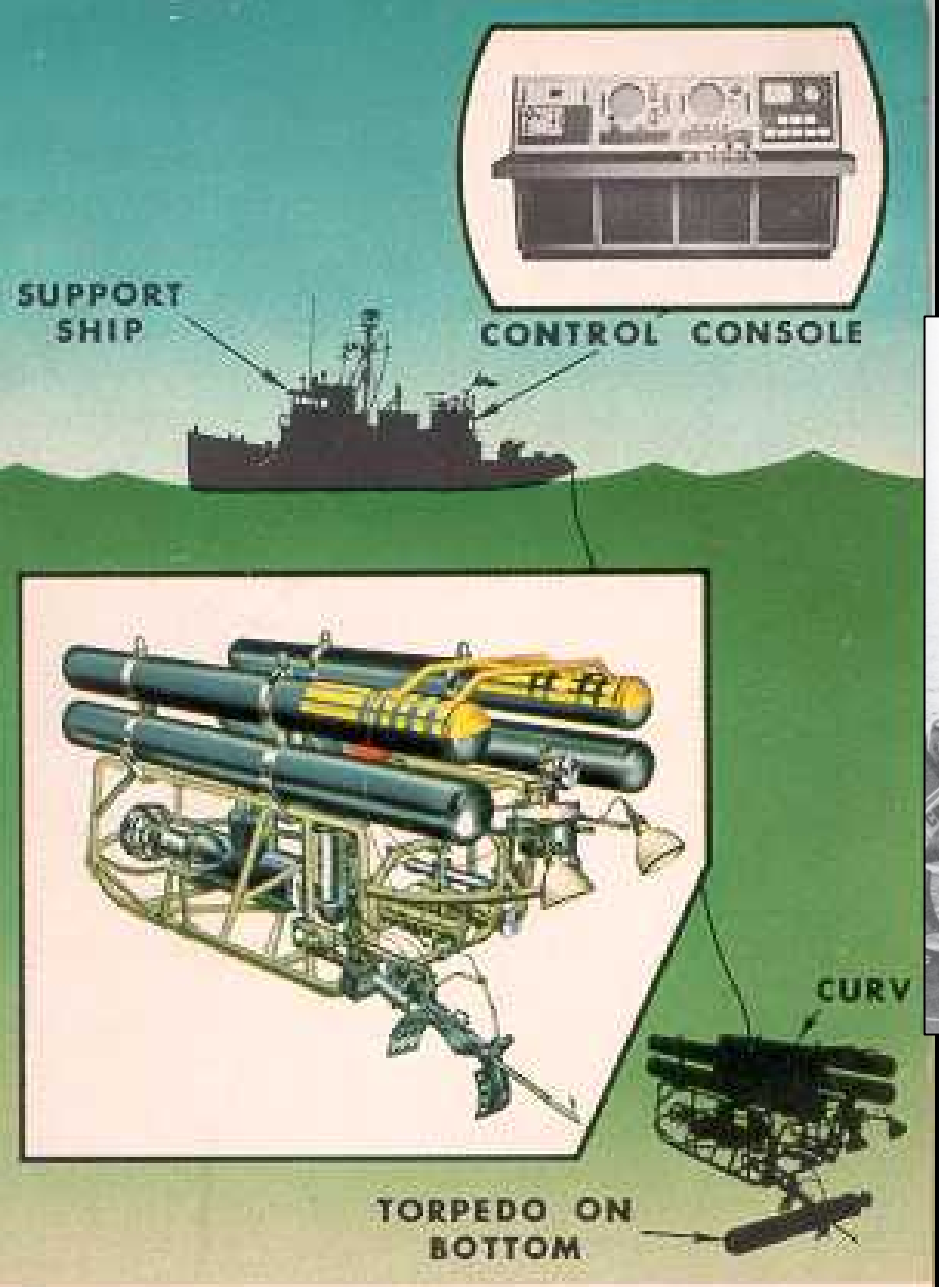


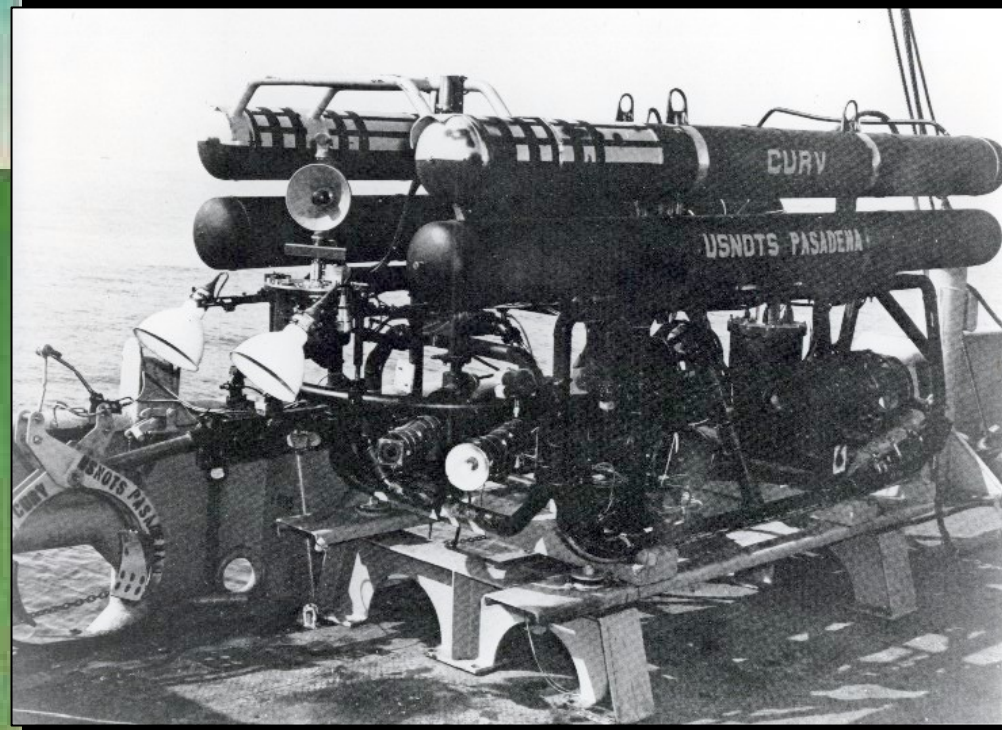
- 1.83 m diameter sphere in housing
- crew of 3
- now depth rated to 4500 m



Alvin grapples the H-bomb at 800 meters, parachute and shrouds enveloping manipulator

Photo removed due to copyright restrictions.
See Lewis, Flora. *One of Our H-Bombs Is Missing*. New York, NY: McGraw-Hill, 1967.





U.S. Navy's Remotely Operated Vehicle, 1966

Images: U.S. Navy

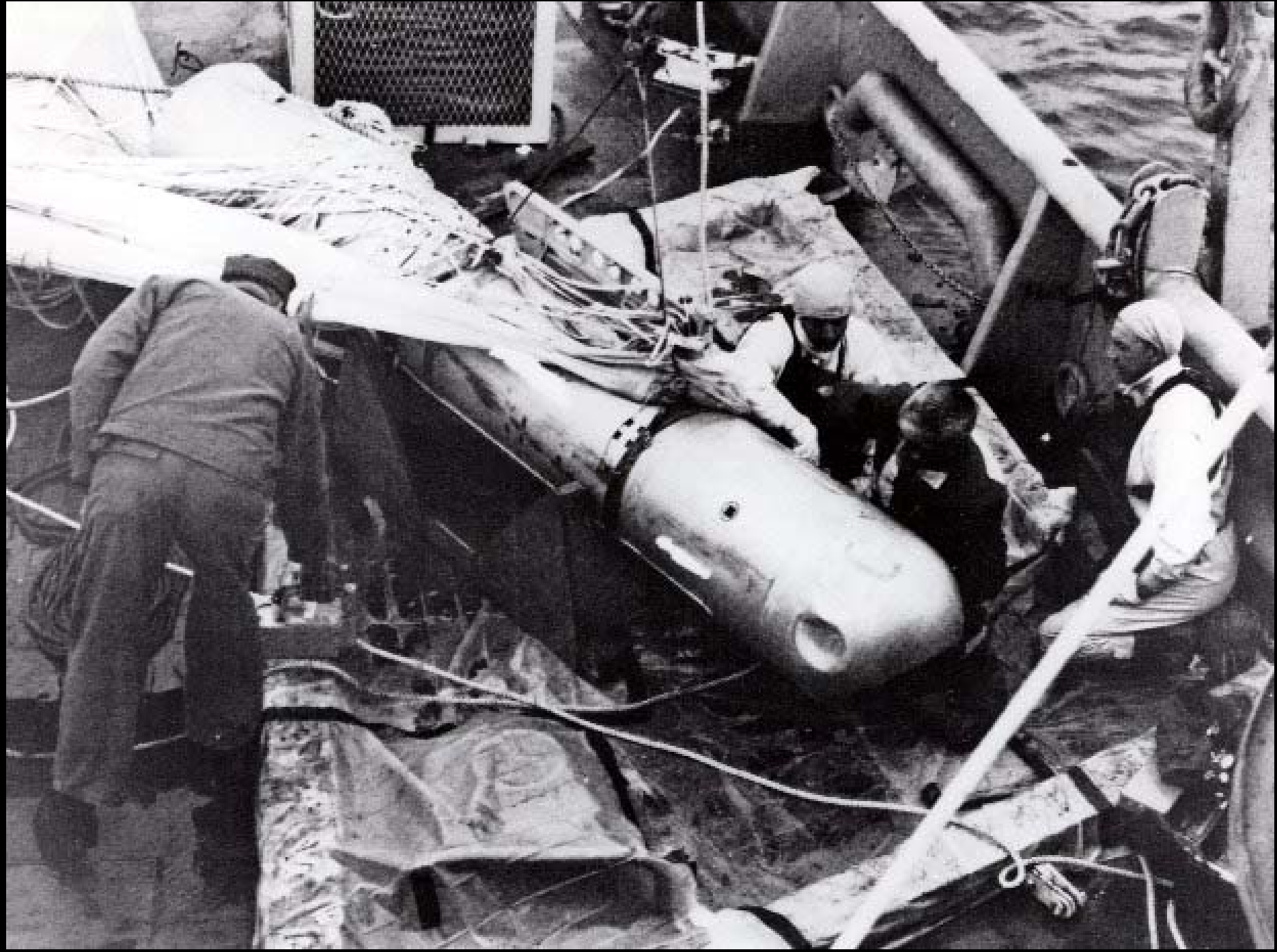


Photo: U.S. Navy

Photo: U.S. Navy

Lessons learned from H-bomb recovery

- Possible to work in deep water
- Manned systems (Alvin) good for identifying objects on seafloor, but limited in dive duration and comfort
- ROVs promising technology, and keep people safely on surface

* Lessons applied to surveys of USS *Thresher*, USS *Scorpion* (and Soviet losses?)

Launch of Polaris missile from submerged “boomer”

Gravimetry essential for accurate ICBM targeting – initial conditions calculations largest error component in trajectory estimates

Photo: U.S. Navy

Seafloor observations result in
significant discoveries

(French-American Mid-Ocean Undersea Study)

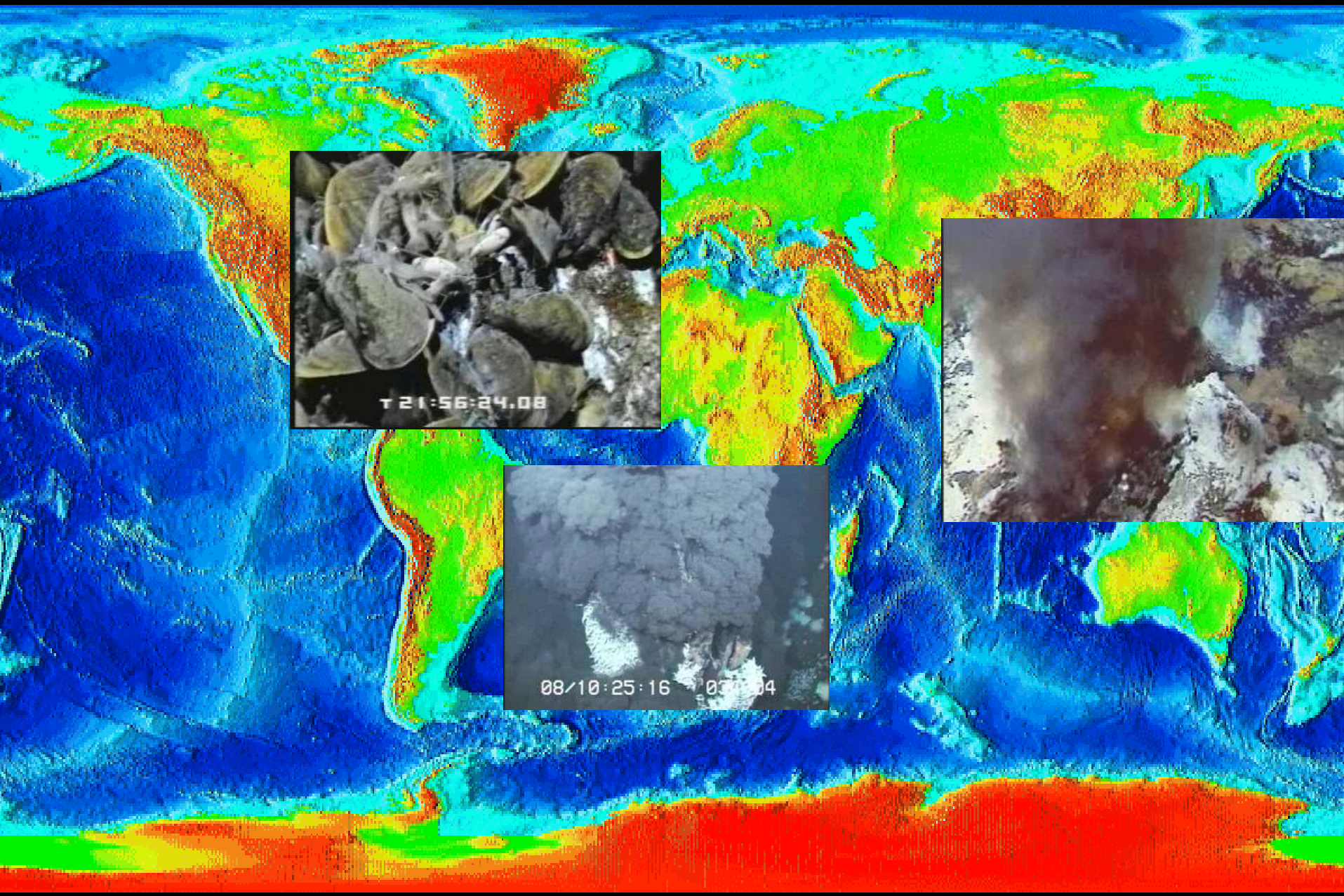
Map image removed due to copyright restrictions.
"World Ocean Floor" by Heezen and Tharp.

See: http://www.earthinstitute.columbia.edu/news/2006/images/HeezenTharp_900.jpg

Project FAMOUS - 1974
First observations and mapping
of the mid-ocean ridge crest

Exploration of the deep ocean by geologists possible with the enabling technology, *Alvin*.

Two map images removed due to copyright restrictions.



Map: National Geophysical Data Center, NOAA.

Seafloor observations result in significant discoveries

Confirmation of mid-ocean ridge volcanism
Mid-Atlantic Ridge (FAMOUS) 36°N–1974

Discovery of hydrothermal vent communities
Galápagos Rift 86°W–1977

Discovery of black smoker hydrothermal vents
East Pacific Rise 21°N–1979

Observation of high bacterial production during eruption, East Pacific Rise 9°50'N–1991
Sparked continuing interest in a subsurface biosphere, life in extreme environments, and deep-sea microbiology

Seafloor observations result in significant discoveries

Discovery of hydrothermal vent communities
Galápagos Rift 86°W - 1977

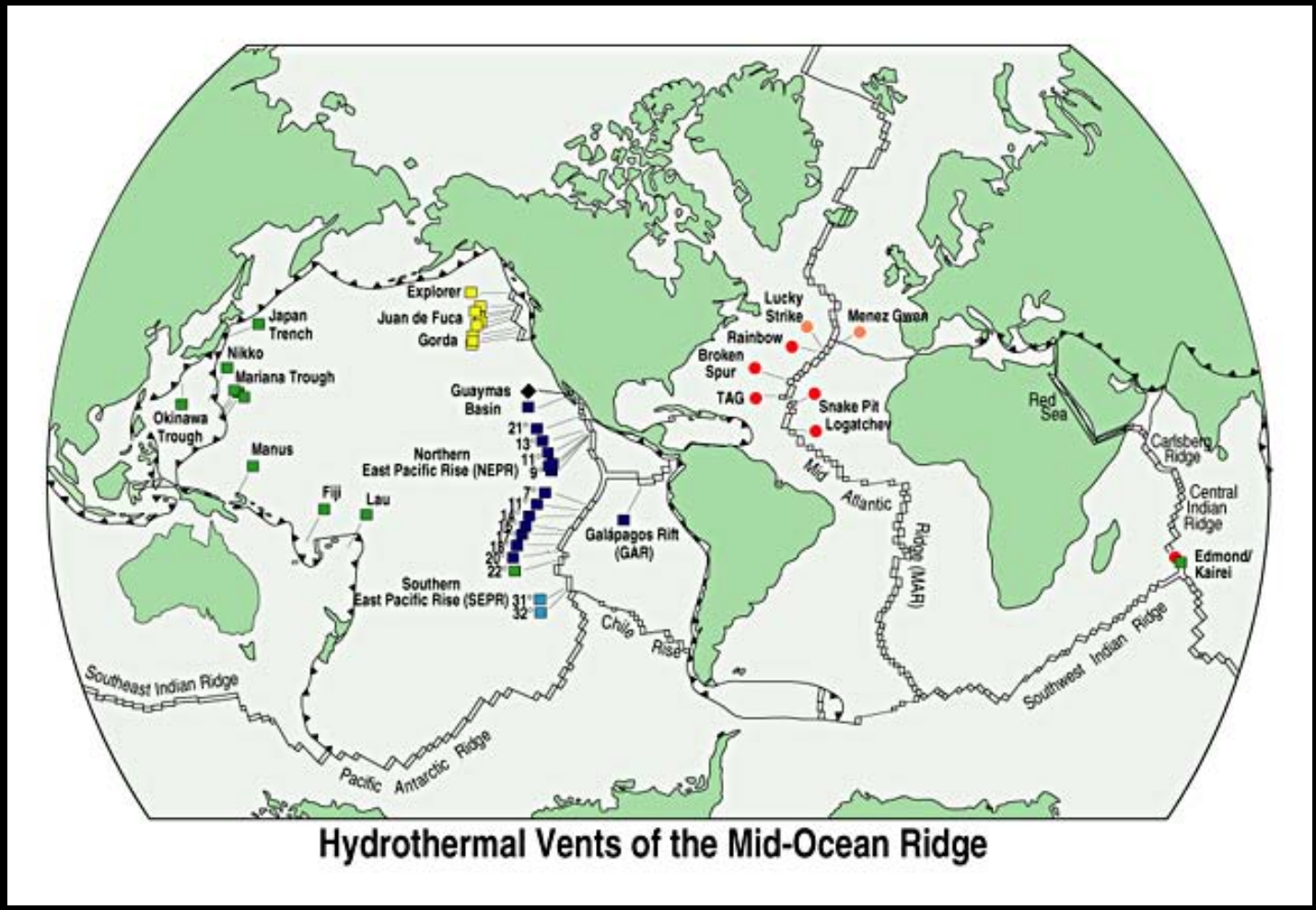
Photomosaic
130 electronic still
images combined

Two images of hydrothermal vent removed due to copyright restrictions.
Photomosaic and 3D sonar map.□□

Scanning sonar
3D rendering

These *Jason* maps
used to help *Alvin* and
ROPOS Operations

Seafloor observations result in significant discoveries



Time series studies of vent colonization
Global vent biogeography & microbiology

Deep submergence started with search for lost objects; the deep seafloor is littered with the material remains of our past.

Titanic, 1986 – Reagan and the Soviets

Image removed due to copyright restrictions.
Painting of submersible exploring wreckage of *Titanic*, by artist Ken Marschall.

Tethered to ALVIN, ROV Jason Jr. peers into window on *Titanic*

1958 disposal of
Liberty ship
William C. Ralston
off San Francisco,
loaded with Lewisite
and mustard gas

Another application of chemical sensing:
U.S. disposal at sea
64 million lbs chem weapons
400,000 bombs and rockets

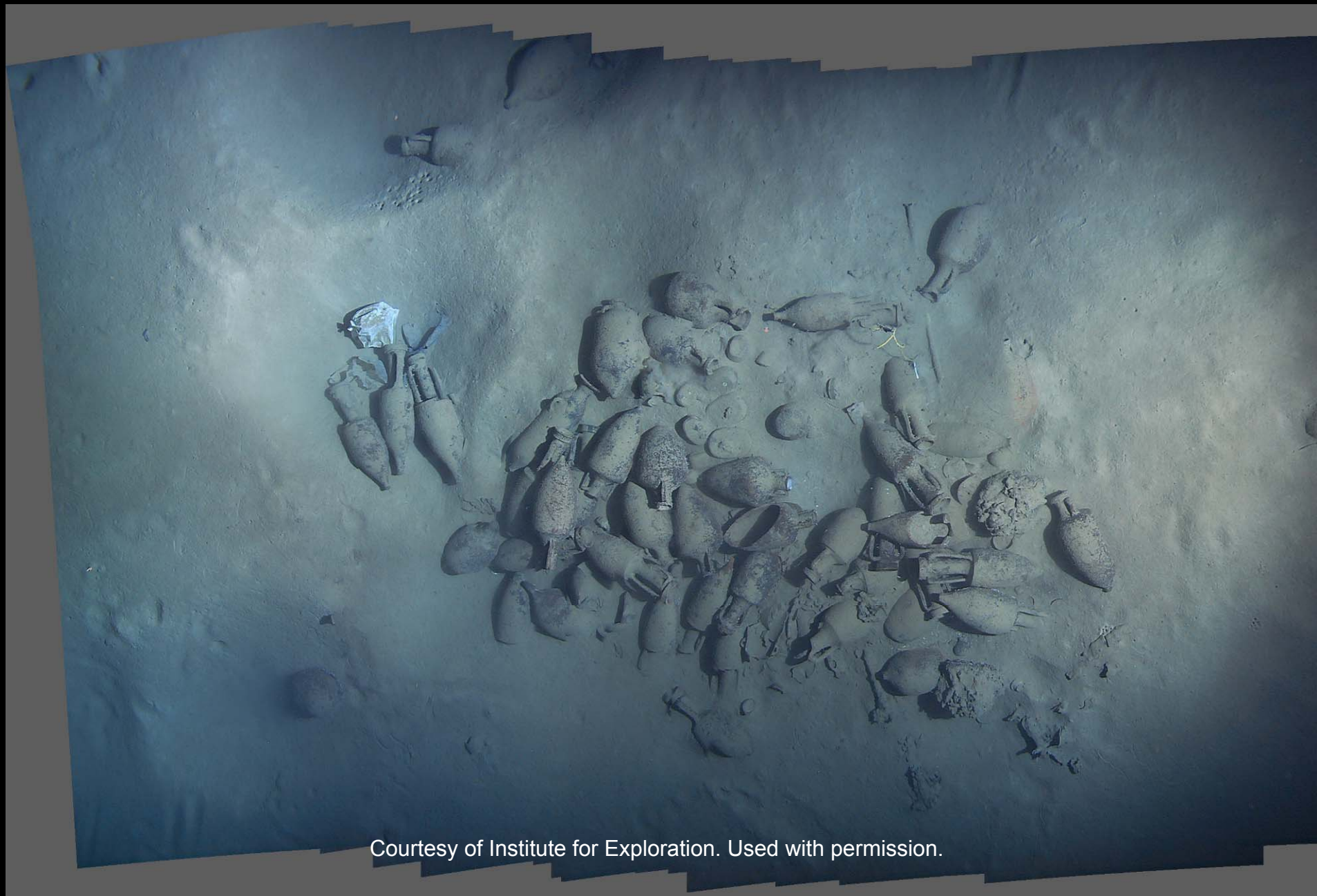
Photos: U.S. Army

2005 - 318 pieces
unexploded ordnance
recovered off U.S. east coast

Dover AFB EOD technician
injured by 75 mm mustard gas
shell in driveway

Photos: U.S. Army

2003 photomosaic Skerki D



Classical Bronze statues

all found underwater

Photos: Brendan Foley