Holland Professional Club
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3 Jan. 2019

Looking into the Oceans

(Surveying the Oceans)

Sea stories

Seeing Our World:

- SPACE: Telescopes
  - 13.8 billion years
- MICROWORLD: Microscopes
  - (1/75,000,000 in)
- OCEANS: ?????
  - ? 6-30 feet ?

Oceans:

- Water World: 74% of surface
  - Salt water (97.5%)
- Oceans are a mystery
  - Depth, topography
- Know more about space
- Know about?
  - Currents, Affects weather
  - Ocean life (food)
  - Trade & security

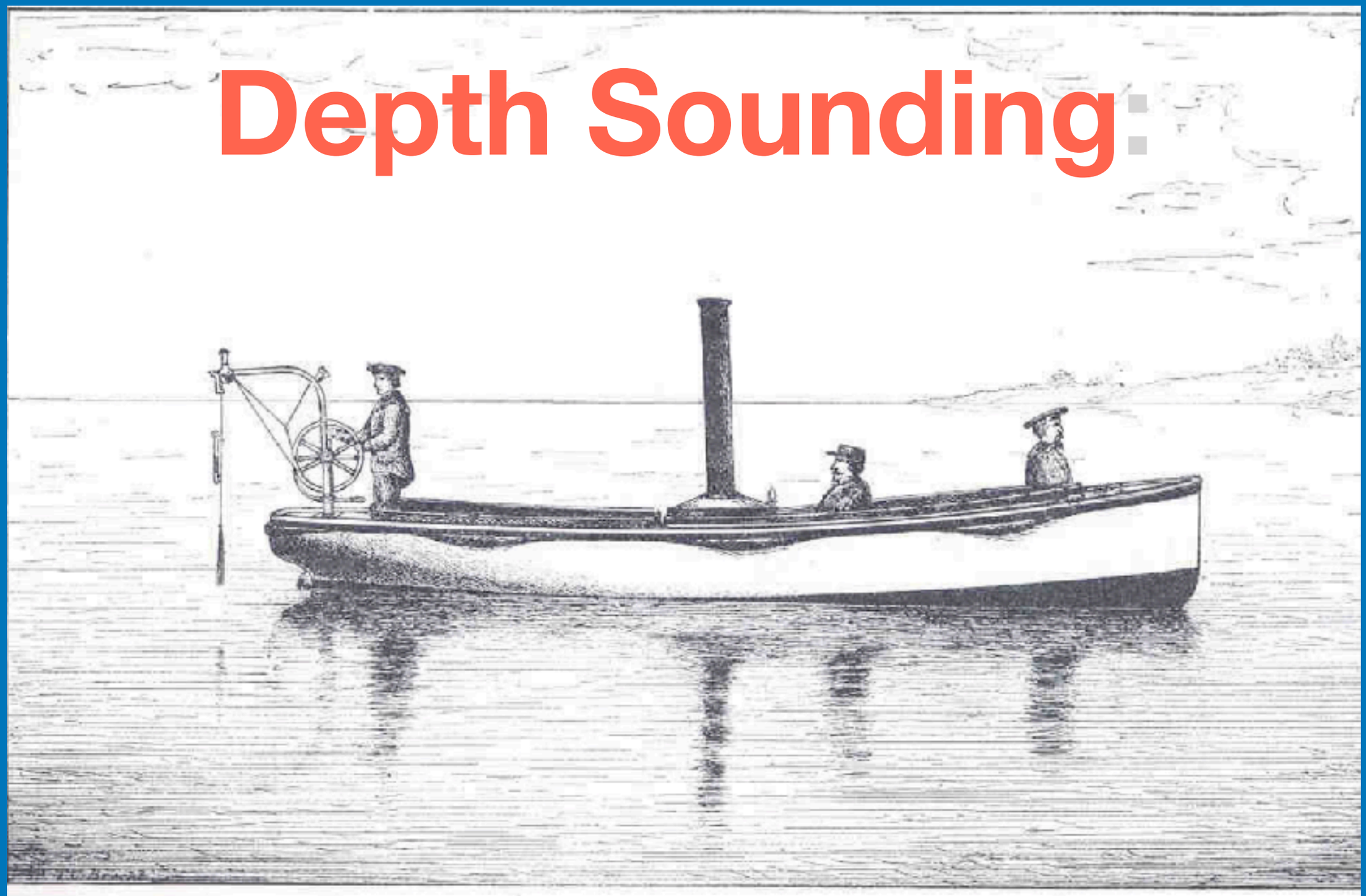
Oceans:

- 50-80% of life in oceans. 99% of living space in oceans
- >10% of oceans explored
- 85-90% of oceans is “deep sea” (cold & dark)

Looking into Ocean:

- Depth sounding
  - Plumb line
  - Diving
    - 30-60 feet
  - Photo sensors (light)
  - Sound sensors (sonar)

Depth Sounding:



THE TANNER SOUNDING MACHINE MOUNTED IN THE STEAM CUTTER.

Diving Bell (1690):

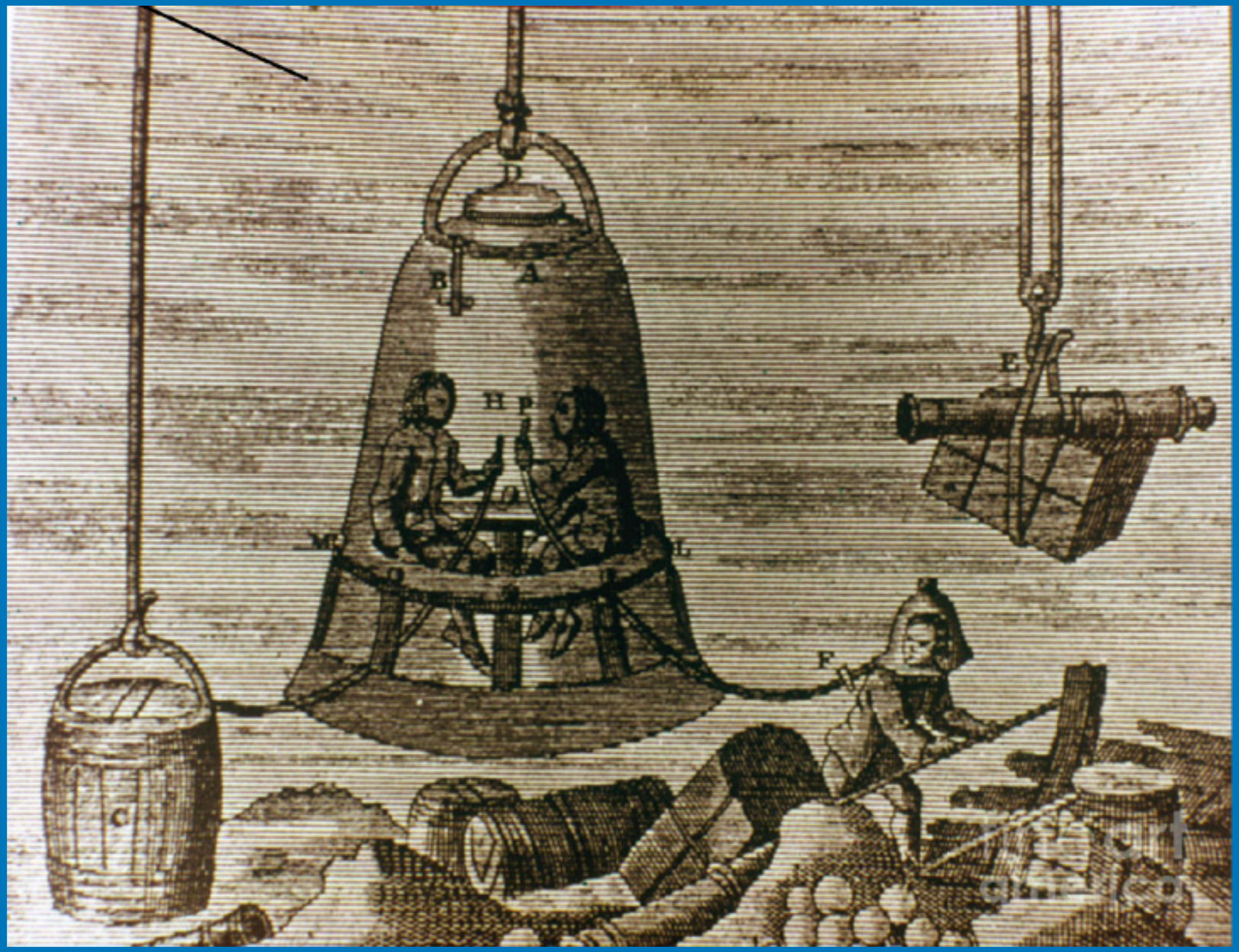


Photo Sensors:

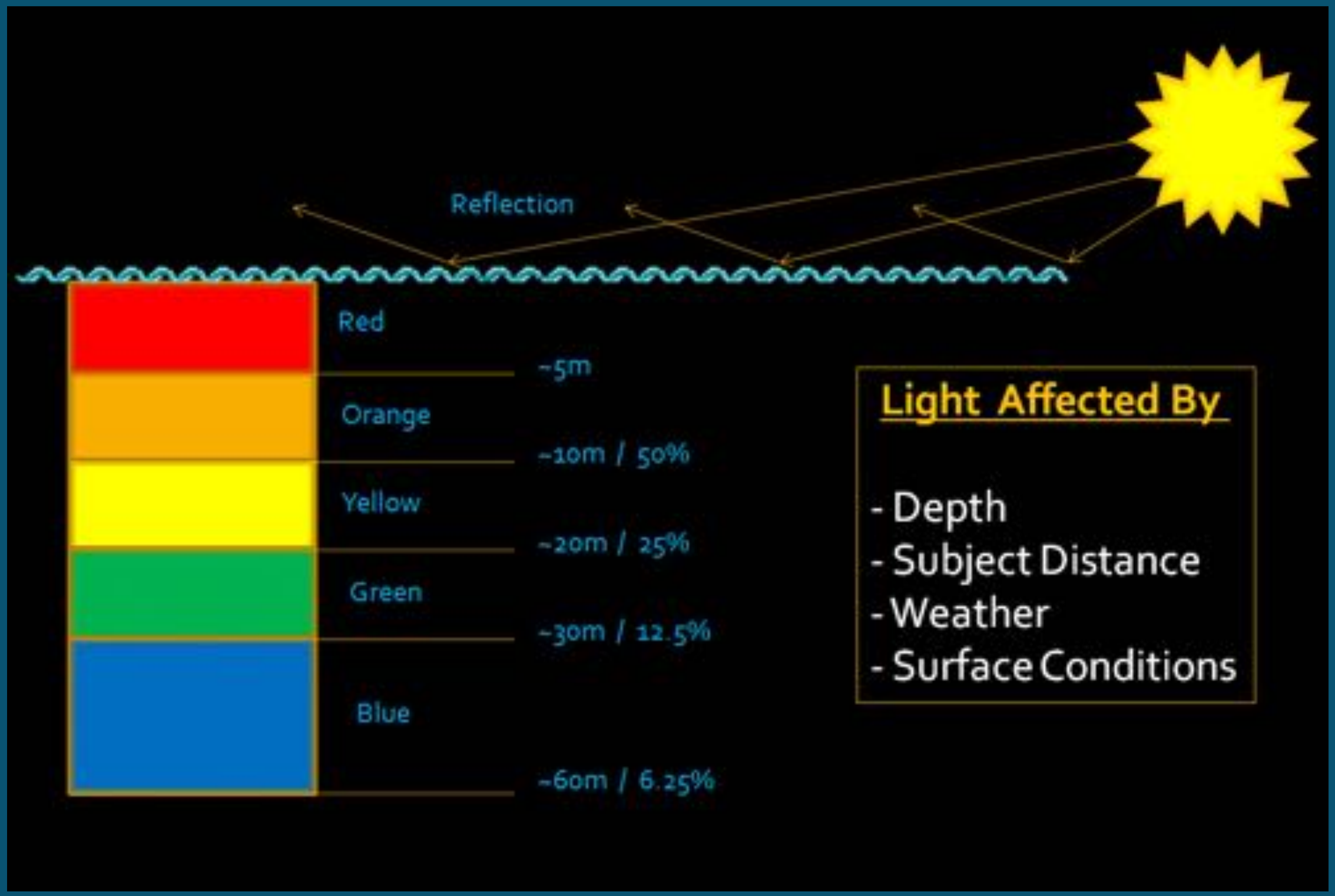
Pros:

- High resolution
- Image stability

Cons:

- Very low range
- Require clear water
- Sensor placement
- Sensor control
- Geo-referencing

Looking into Ocean:



Sound Sensors:

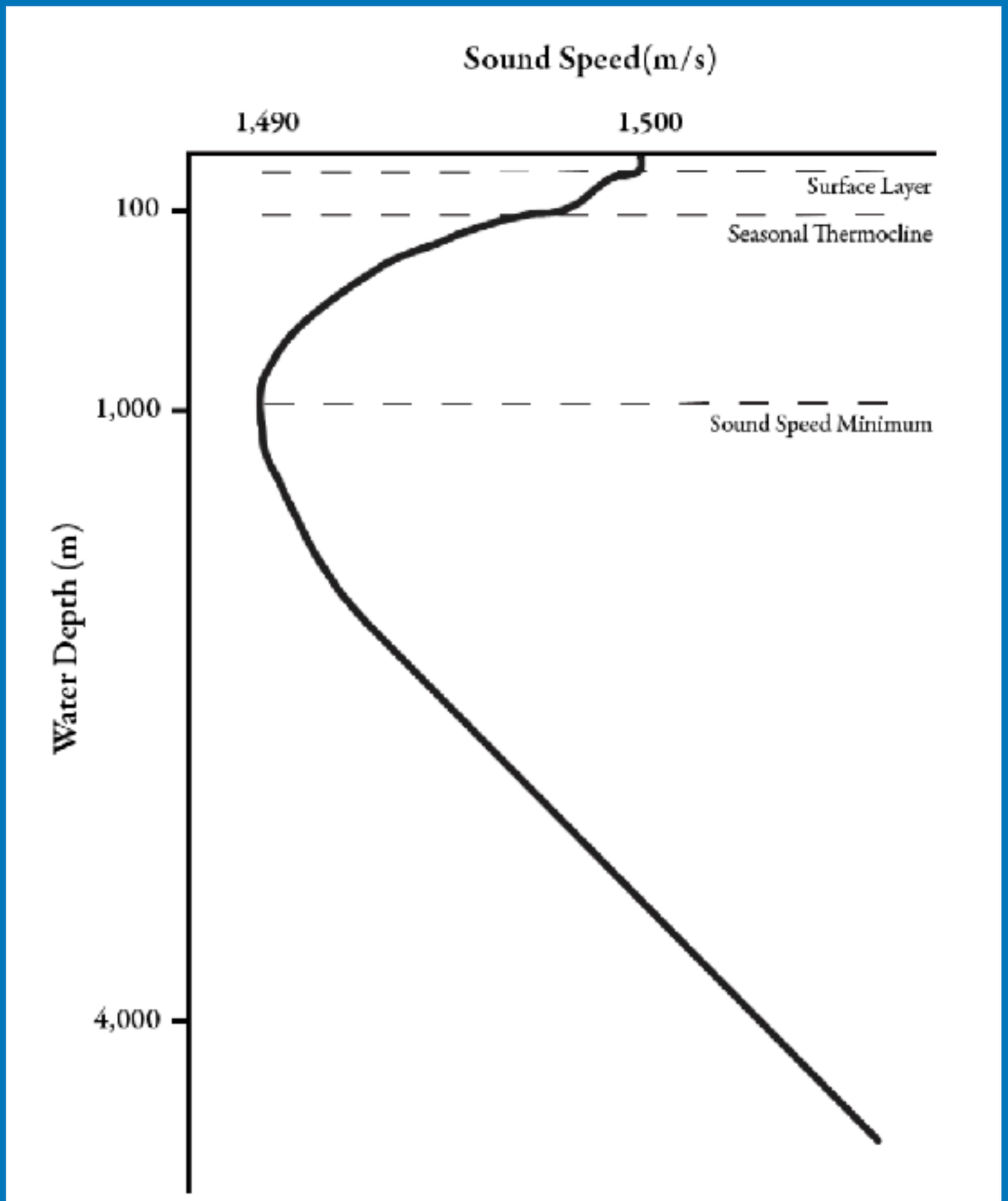
Pros:

- Long range

Cons:

- Low resolution
- Sensor instability
- Data processing
- Geographic rectification
- Geo-referencing
- Spackle, scintillation

Sound (acoustic) Sensors:



Profile of speed of sound in water. Note the sound speed minimum at 1000 meters. Copyright University of Rhode Island.

Sound and light is “bent” in water:

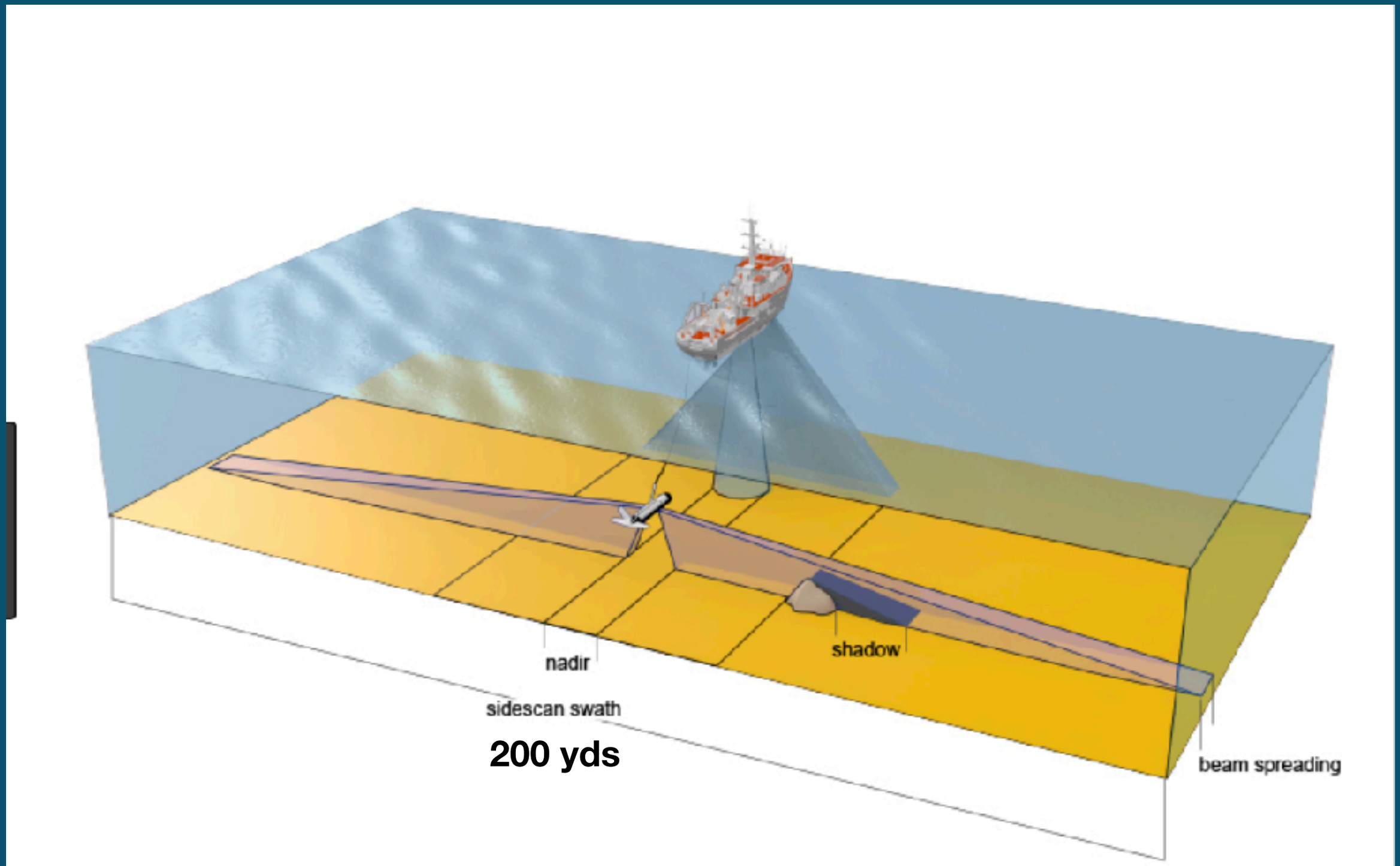
Sonar Freq. vs Range:

- 3 khz, range: 20,000 yd
  - Massive array (60 ft).
- 10 khz, range: 5,000 yd
- 20-30 khz, range: 2,500 yd
- 100-500 khz, range: 100-150 yd
  - Side scan.
- 1,200 khz, range: 200 ft.
  - Fish finders.

Side-Scan Frequency:

- 100 khz resolution
  - resolution (1/2 wavelength)
  - 3/2 m = 1.5 m (~5 feet)
  - range: 250-500 m
- 500 khz resolution
  - Depth, topography
  - 0.6/2 m - 0.3 m (1 foot)
  - range: 100-150 m

Side-Scan:



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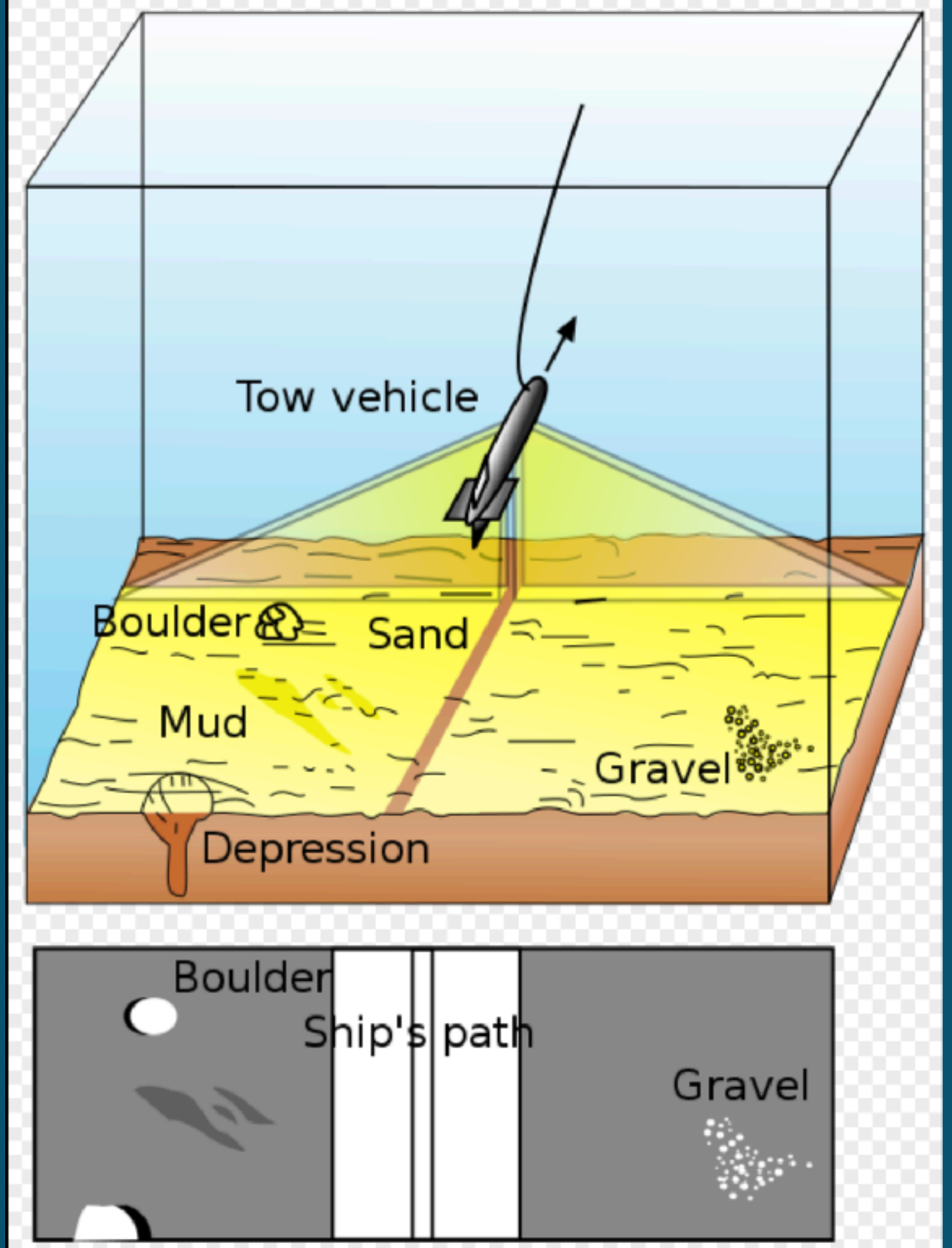
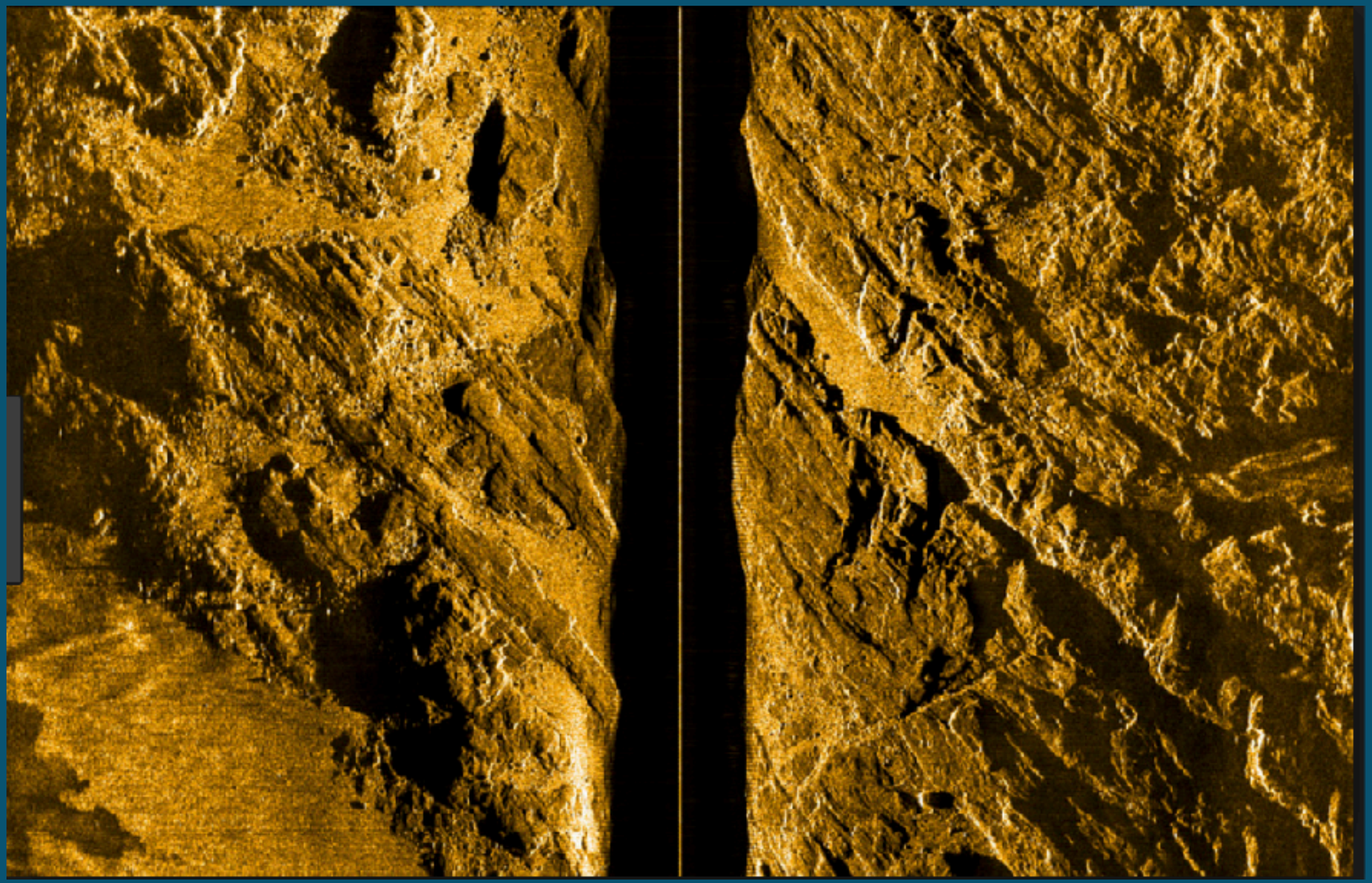

Tow vehicle
Boulder
Sand
Mud
Gravel
Depression
Boulder
Ship's path
Gravel

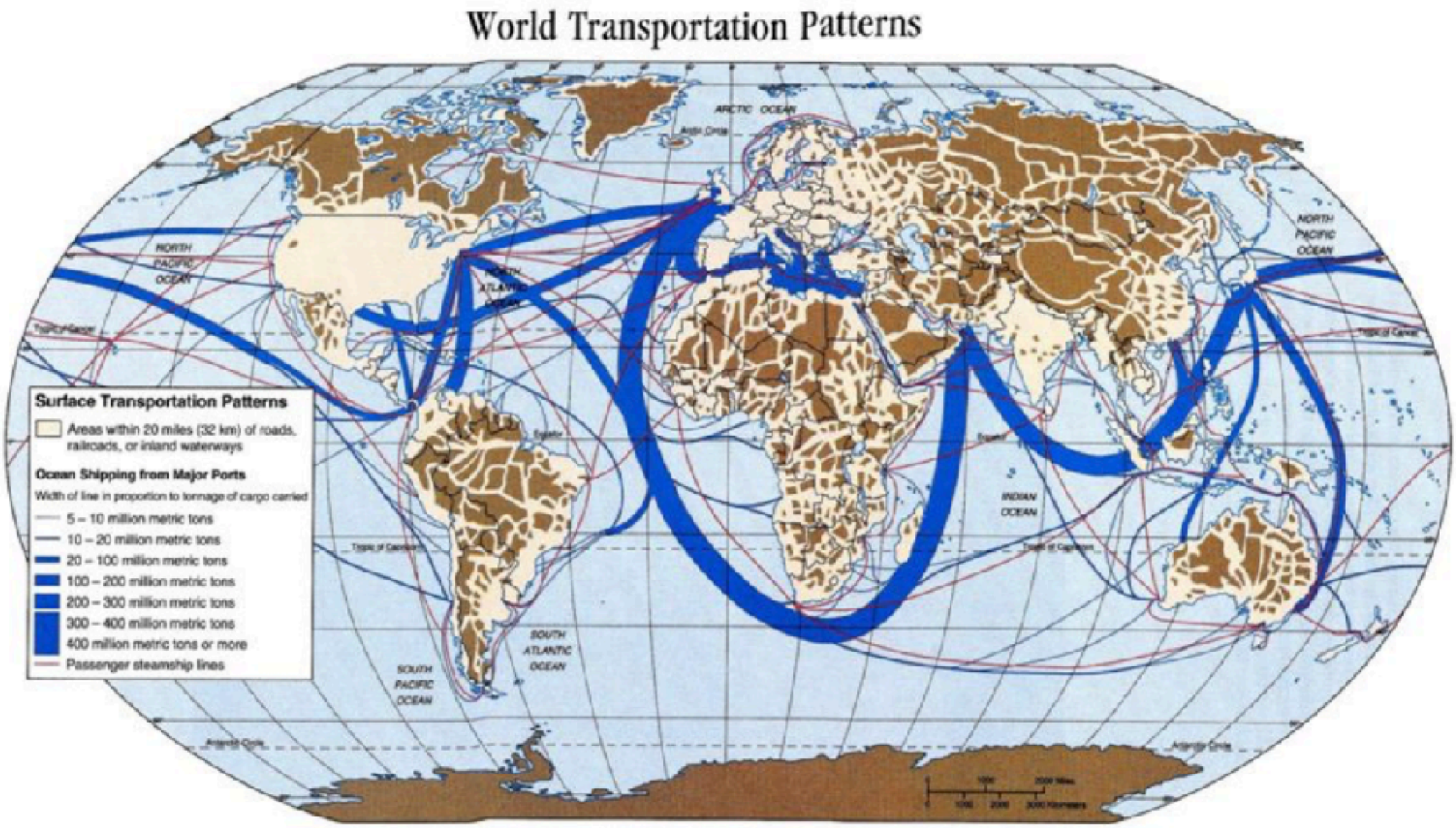
Side-Scan:



Why “look” into Oceans?

- Science (50-80% of life, weather, pollution, etc.)
- Maritime trade
- Fishing
- Oil & mining
- Security (nuclear triad)

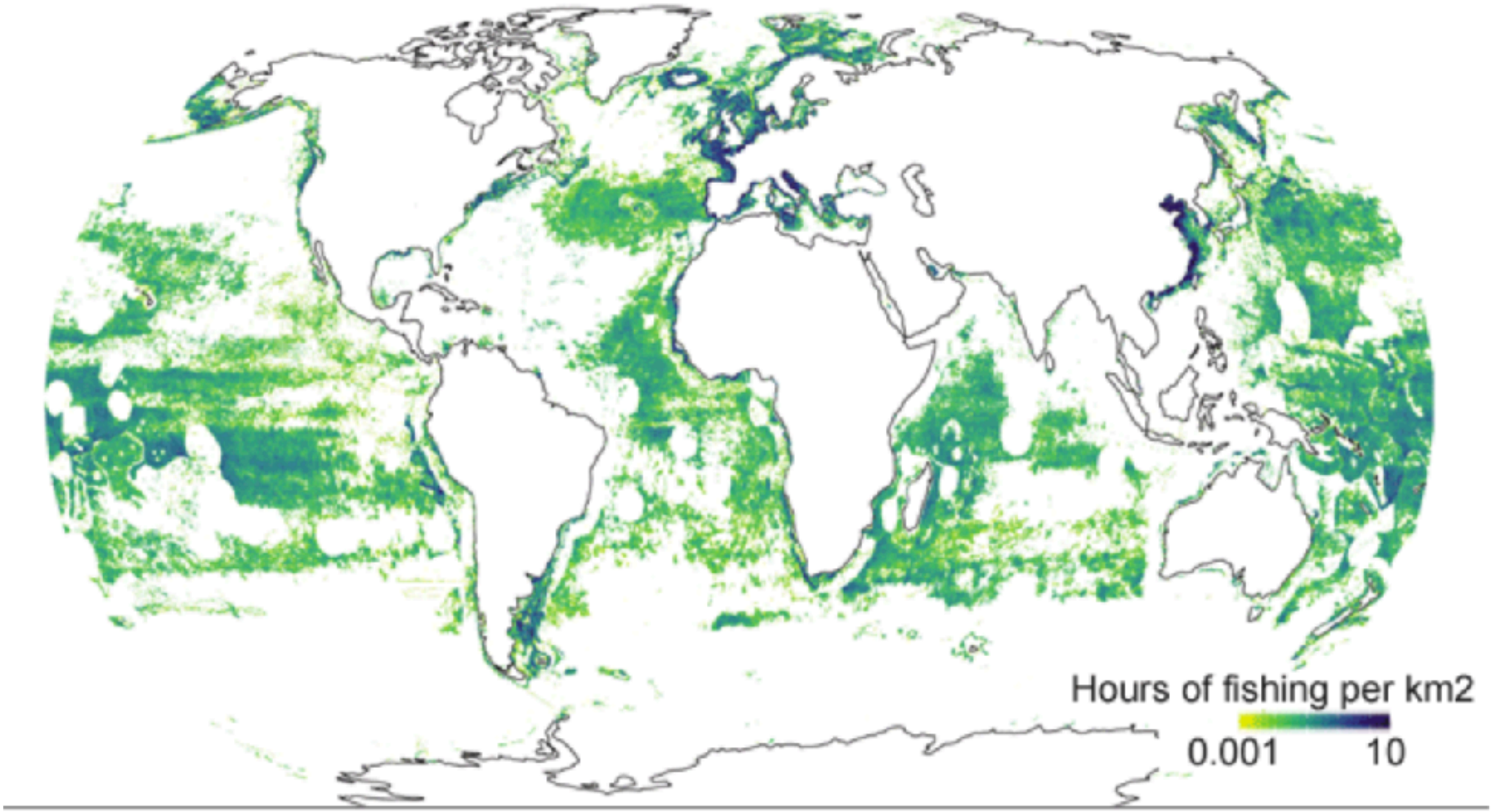
Maritime Trade



Maritime Shipping

- 90+% of trade
- 52,000 merchant ships
- 10.3 billion tons/year
- 9,000+ navy ships
- Pollution (bunker oil)
  - 15 mega-ships = all cars

Fishing (2016)



Source: Global Fishing Watch

BBC

World Fishing

- Wild catch: 1-2.7 trillion/year
  - 93.2 million tons
- Fish farm: 52+ million tons
- ~ 12% of pop. in fishings
- 16% of animal protein
  - ~ 38 lb/pers/year
- Aquatic plants: 1.3 million ton
  - Aquaculture: 15 million ton

Oil & Minerals

- 37% oil extracted from oceans
  - 26% of oil reserves
- 22% of oil shipped by water
  - 2 billion tons/year
- Large mineral deposits on ocean floor
- Minerals trade & shipping
  - rare earth metals

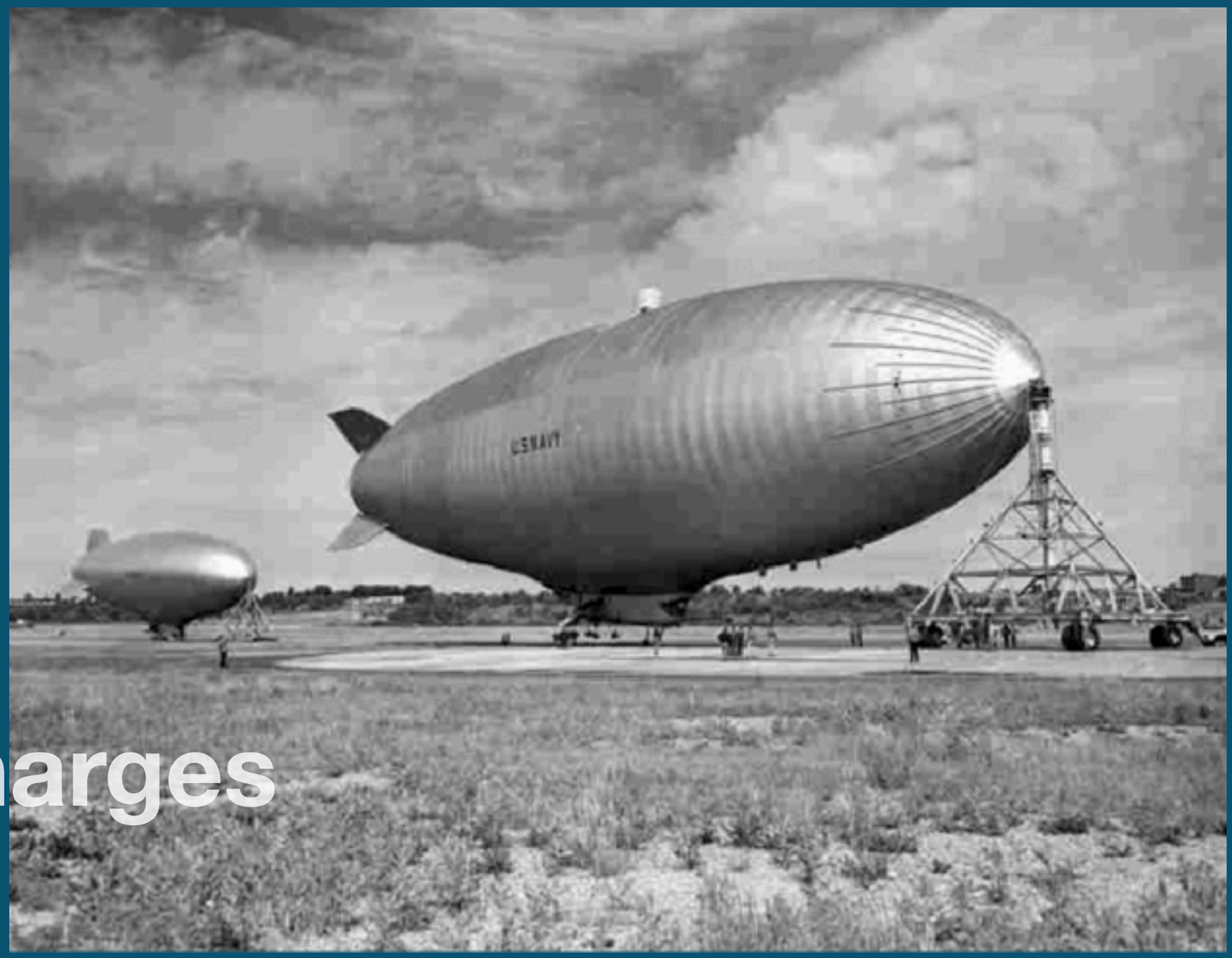
National Security

– Submarine Warfare

Submarine Warfare

WWII:

- Convoys
- Escorts
- Sonar
- Blimps
- Depth Charges



National Security

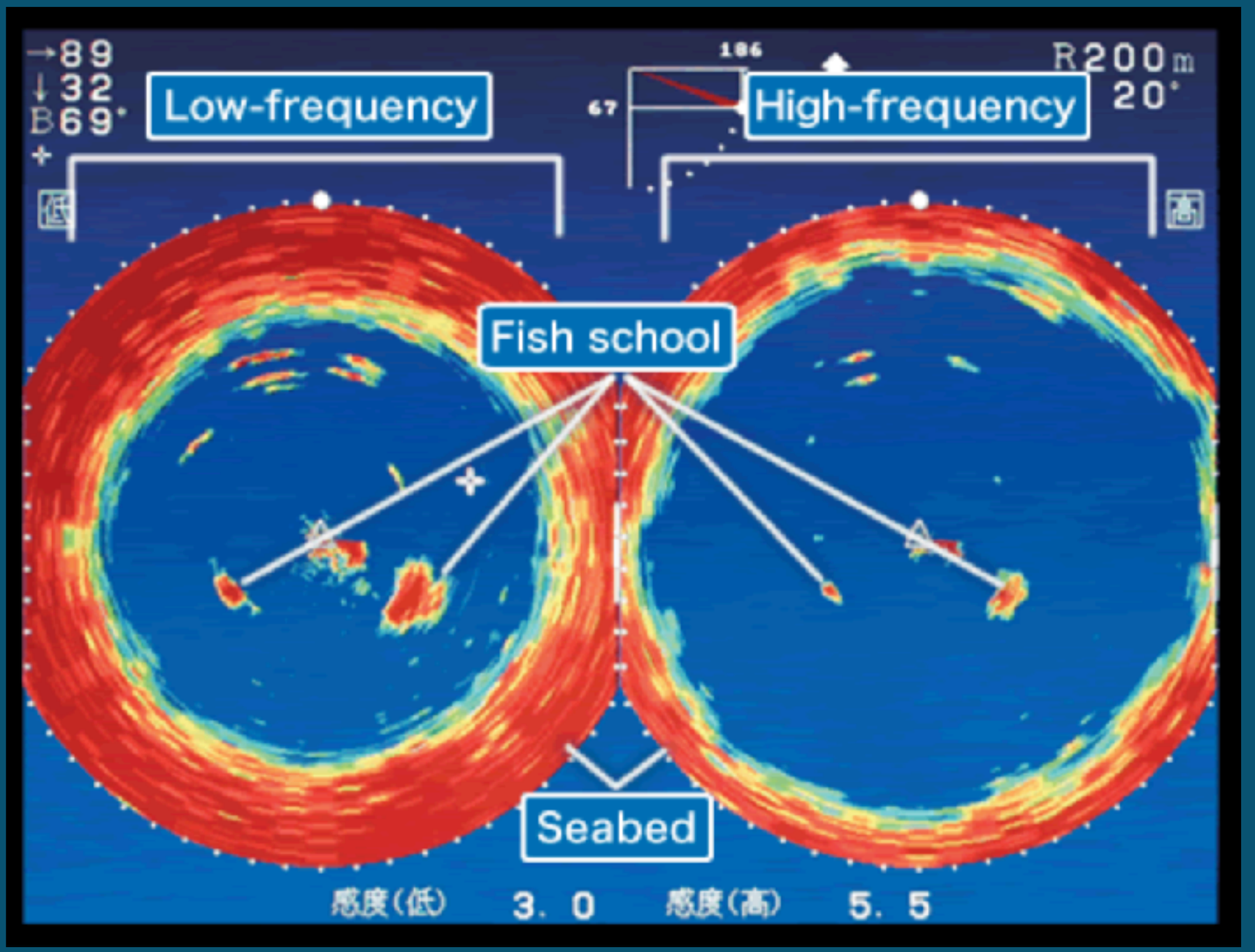
– P3 Orion (757 built)

Shipboard Sonar

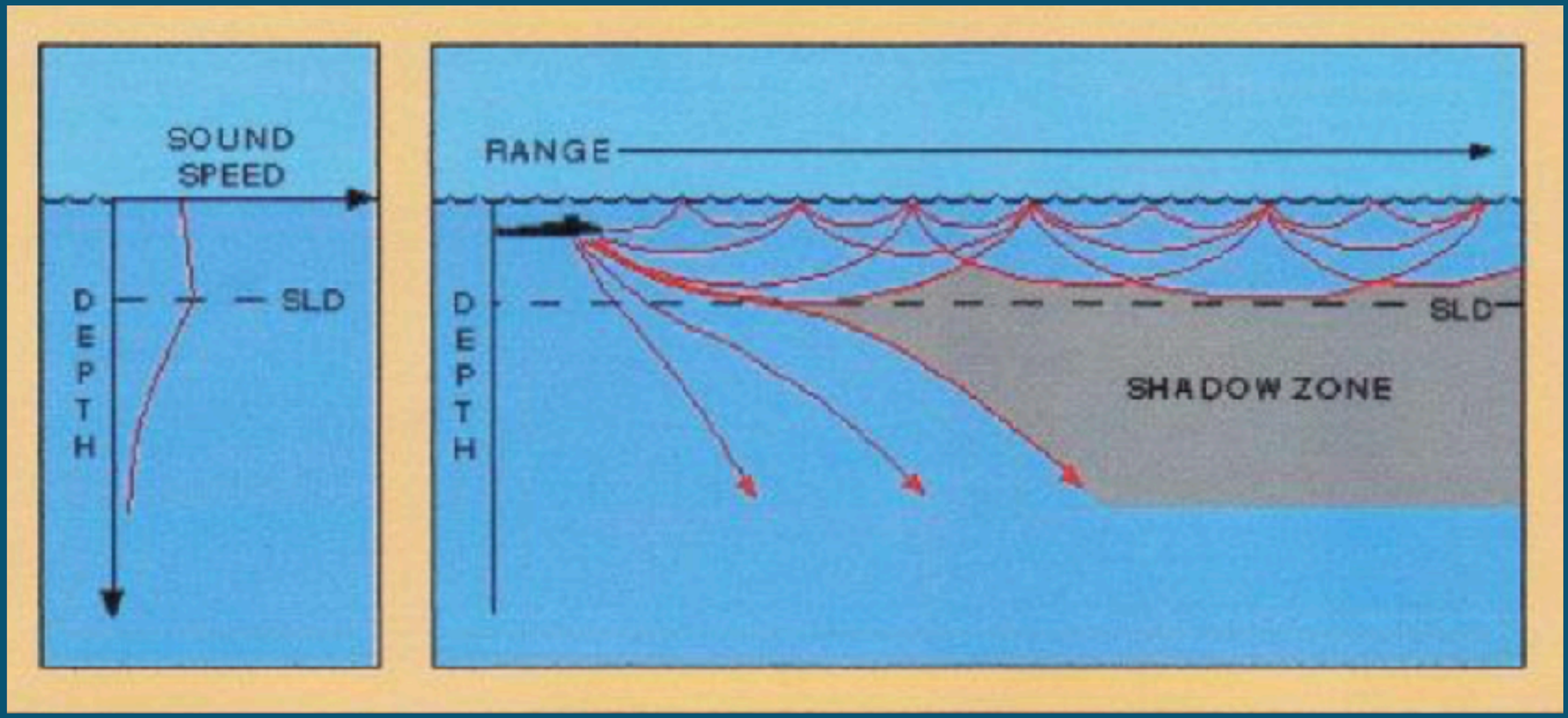
Shipboard Sonar

Provides:

-Range
~ 3 mi.
-Direction
-~~Elevation~~



Sub Hunting:



Sub Hunting:

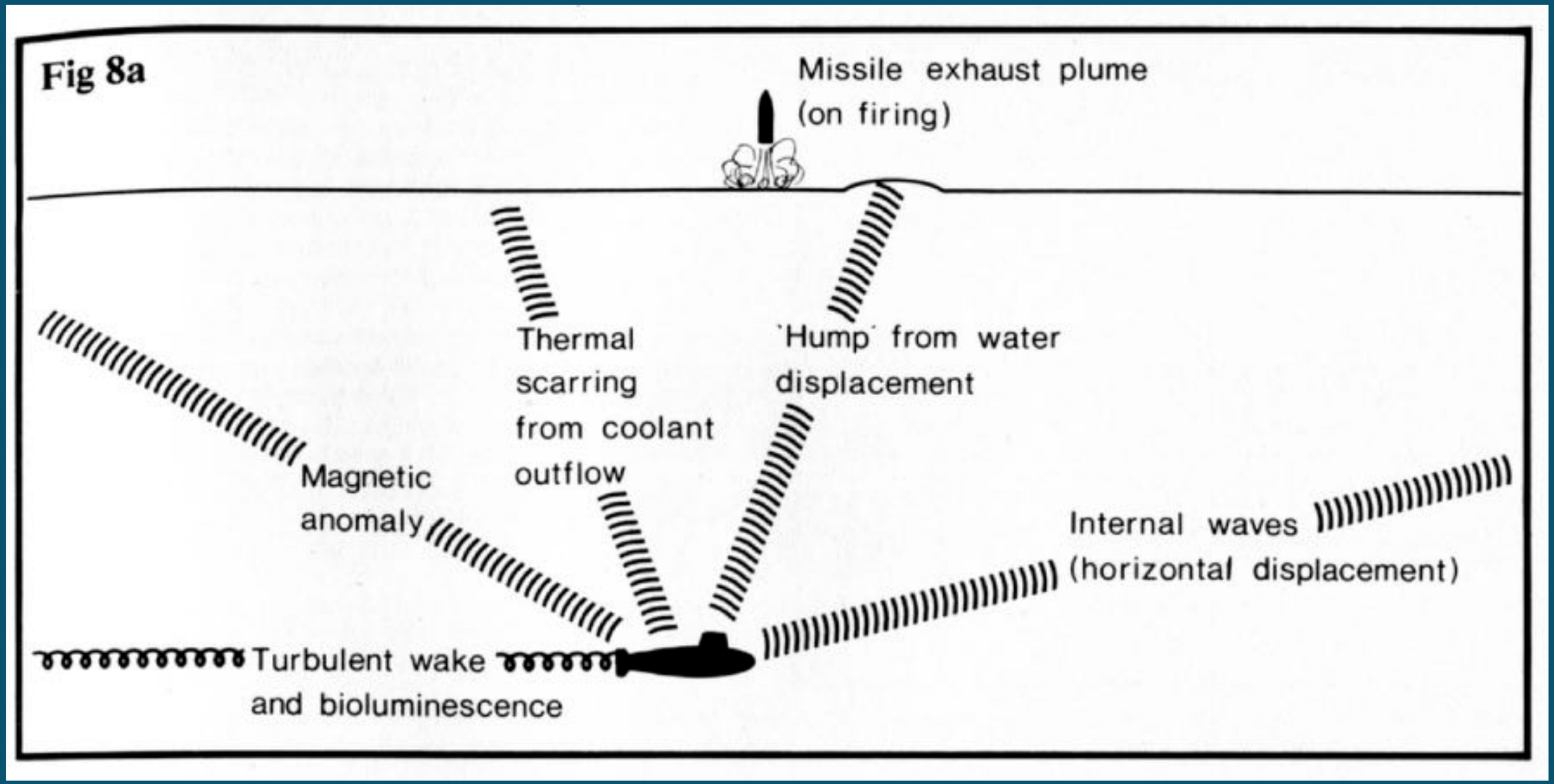
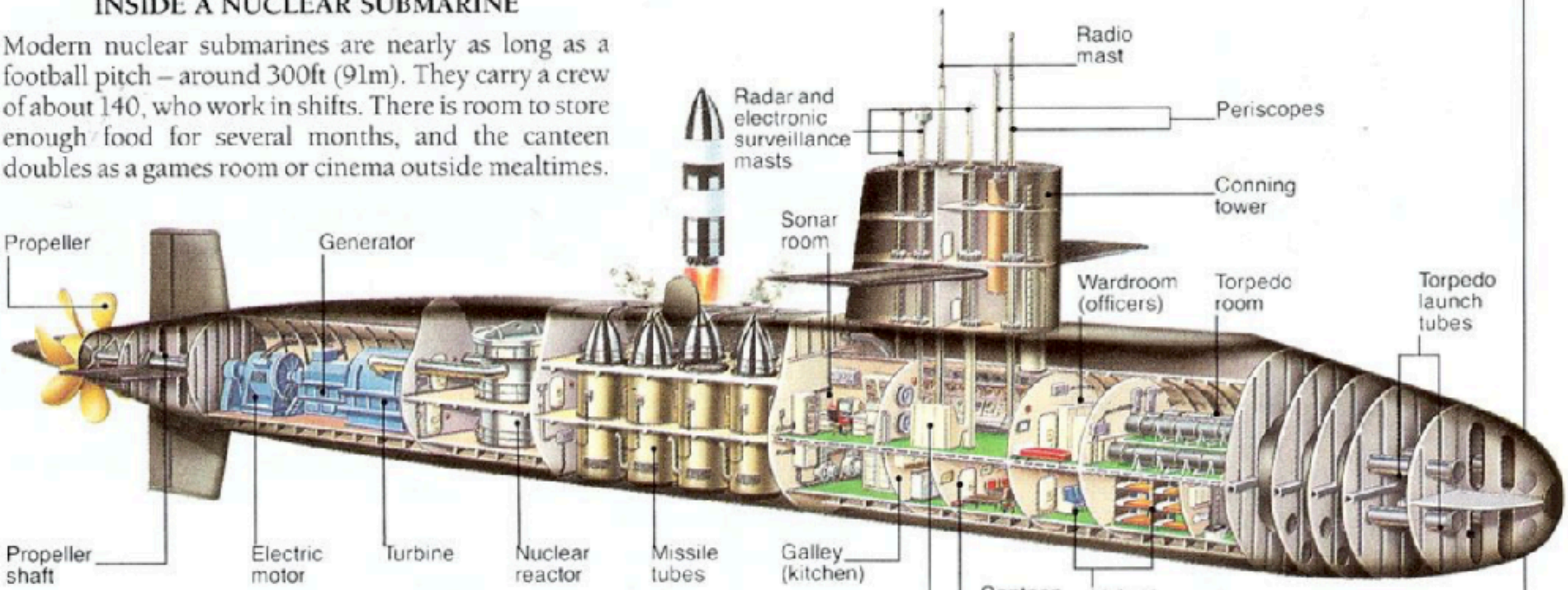


Fig 8a
Missile exhaust plume
(on firing)
Thermal
scarring
from coolant
outflow
'Hump' from water
displacement
Magnetic
anomaly
Internal waves
(horizontal displacement)
Turbulent wake
and bioluminescence

Why monitor oceans?
The Strategic Triad:

INSIDE A NUCLEAR SUBMARINE

Modern nuclear submarines are nearly as long as a football pitch – around 300ft (91m). They carry a crew of about 140, who work in shifts. There is room to store enough food for several months, and the canteen doubles as a games room or cinema outside mealtimes.



Power Heat from the nuclear reactor, fuelled by uranium, generates steam to drive the turbines that turn the vessel's propeller shaft.

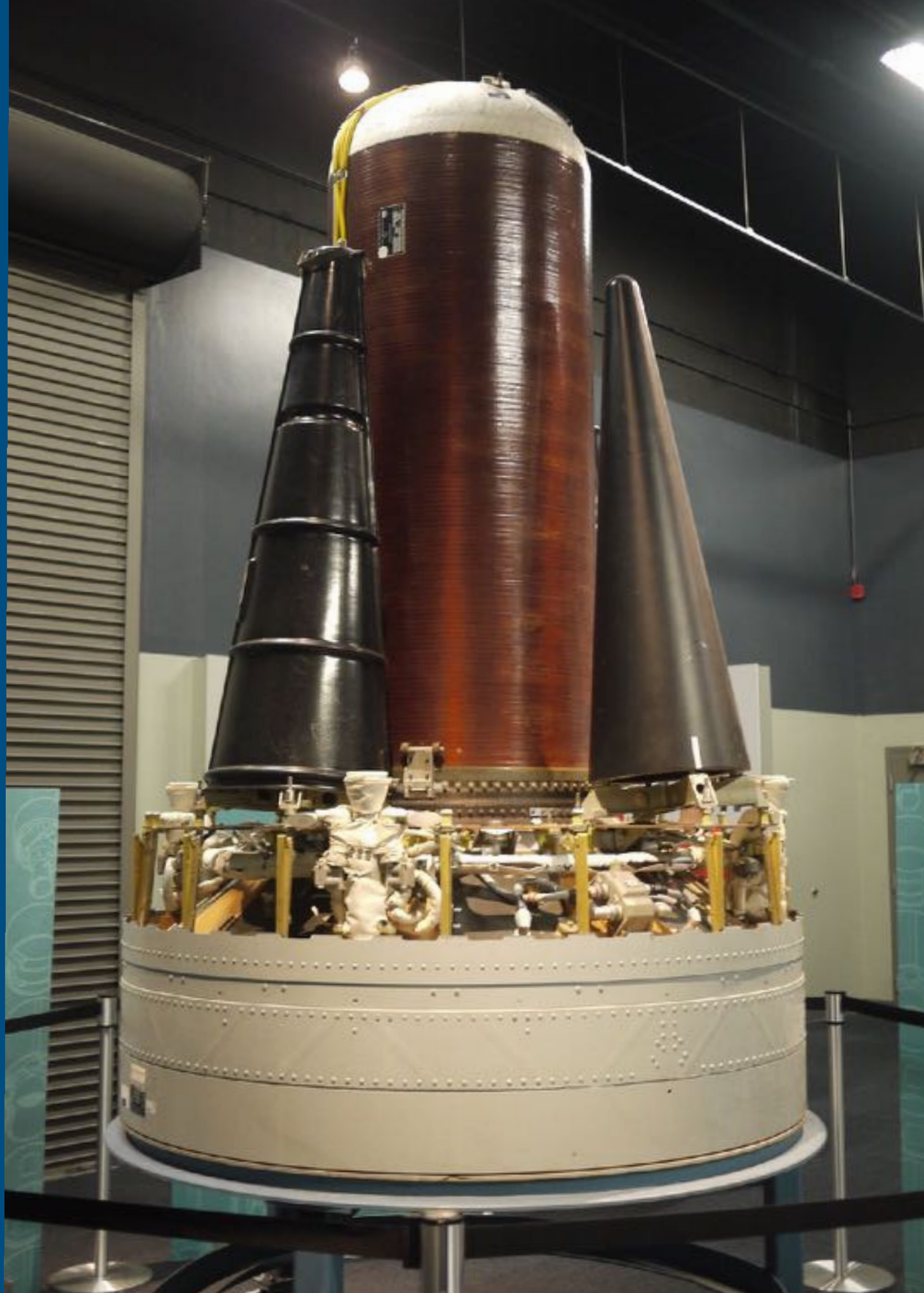
Nuclear weapons On some submarines, long-range missiles for firing from underwater to land are kept in vertical tubes.

Control Room Navigation, steering, and weapon firing are controlled here. Two 'pilots' steer, in front of instruments that show the course, speed and depth.

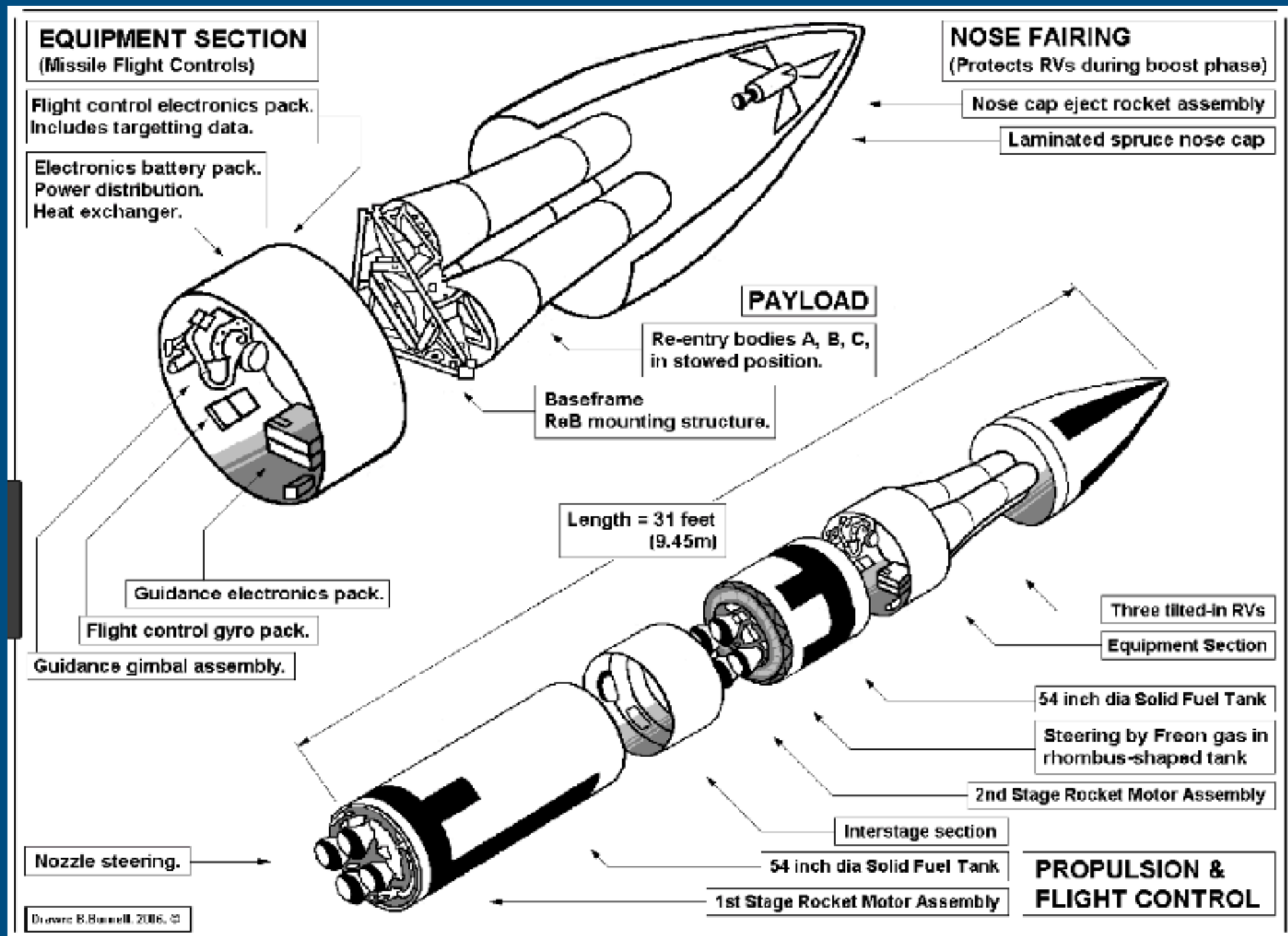
Missiles Torpedoes about 20ft (6m) long are launched from bow tubes at targets in the water. Aiming is computer-controlled. Missiles that float to the surface then launch into the air to attack ships are fired from the same tubes.

Ballistic Missile Submarine

Submarine Launched Ballistic Missile



Submarine Launched Ballistic Missile



Polaris A3T Missile.

Kilotons

- Hiroshima: 20 kt
- Nagasaki: 15 kt
- Polaris (1961-96): 41 subs
  - 200 kt x 3 x 16
- Trident: (1984-…): 12 subs
  - 100 kt x 12 x 24
  - range: 7.5 kmile

surv-towed-array-sensor-system

SURTASS

100-500 Hz

155 Tonnes

CANCELED

Array length: 4,900 ft.

Req. speed: 3.2+ knots

Issues:

1. Ocean acidification?
2. Pollution!
3. Loss of ocean diversity?
4. Overfishing?
5. Global warming-changing currents, weather patterns?
6. Other?

Side-Scan:

Búsqueda y rescate del

SUBMARINO ARA "SAN JUAN"

Ministerio de Defensa
Presidencia de la Nación

CHILE
BOLIVIA
PARAGUAY
BRA
URUGUAY
MAR ARGENTINO
MAR DEL PLATA
PUERTO MADRYN
COMODORO RIVADAVIA
USHUAIA
430 km
125 km
6000 m

ÁREA DE BU
EN TORNO A
DE ANOMAL

40.000 km² a

Ultimo contac
miércoles 15

Anomalia Hid
miércoles 15
Lat 46°12'Su

4040 hom
28 buques
9 aeronaves
18 paises e

Side-Scan:

Questions & Comments