COMEX from Sea to Space
COMEX and its expertise

The *Compagnie Maritime d’Expertise* (COMEX) was founded in 1961 by Henri Germain Delauze (1929-2012).

It became a worldwide pioneer in the development of technologies for human and robotic intervention in extreme environments.

Saturation dive 180m under ice (1969)

SEACOM dive support vessel (1983)

HYDRA-10 deep-diving record (1992)

FONASURF subsea mining (2017)
From the Deep Sea to the Outer Space

A variety of testing facilities in one single place

The COMEX Hyperbaric Experimental Centre is classified ESA Ground Based Facility.

Hyperbaric Experimental Centre for tests in hyperbaric and hypobaric conditions. External medical platform for tests with human subjects.

CE4000 for tests from vacuum to 400 bar, temperature regulated. Test diameter 2.4 m.

Test Pools (-10 m) for tests of systems and robots, including teams of professional divers.

Hydrosphere hyperbaric and hypobaric tests. The facility includes a habitat for tests with humans.

Image courtesy: GOOGLE Maps

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Air Centre and powered by United by the Sea
From the Deep Sea to the Outer Space

Expertise in pressure chambers and habitats

Development and on-site installation of a test facility for ROLEX watches (600bar) including control by camera. (image courtesy: ROLEX)

Development of a temperature controlled testing chamber for 3000bar

Underwater habitat HIPPOCAMP and AQUABULLE with Jacques ROUGERIE

Development of a temperature controlled testing chamber for 3000bar
From the Deep Sea to the Outer Space

ORUS3D underwater 3D photogrammetry system with real-time coverage and data quality control

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Validation of equipment for aerospace equipment with humans in the loop

COMEX provides test of equipment with human subjects (including medical monitoring team)

High-altitude tests with a COMEX’ subject in the low pressure chamber (Photo: L. Negrel, COMEX)

Hyperbaric Flight Simulator

Test of a stratospheric suit for the “Grand Sault” Mission
Underwater Astronaut Training and NBF Simulations
1987 EVA Training of astronauts (CNES / ESA)

Training of Russian and French Astronauts in the COMEX’ pools for a mission outside the Russian MIR Station.

Mission ARAGATZ to MIR
( Jean-Loup CHRETIEN,
Michel TOGNINI)
1989  Ergonomic tests for the HERMES SAS (CNES - ESA)

Ergonomic tests for extravehicular activities outside of the HERMES Shuttle. The tests were performed in COMEX’ pools.
From the Deep Sea to the Outer Space

1990  IVA Study for COLUMBUS (ESA)
Tests on the installation of racks inside the ISS-COLUMBUS laboratory in simulated microgravity (underwater)
From the Deep Sea to the Outer Space

2013 APOLO XI UNDER THE SEA: Subsea Space mission simulation

Underwater lunar mission simulation offshore Marseilles, France

Photo: Alexis Rosenfeld

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Air Centre and powered by United by the Sea
2013 MOONWALK: Robot-Astronaut Cooperation (European Commission)

Mars mission simulation in Rio Tinto, Spain.

EVA Training Suit
GANDOLFI-2

Robotic Scout
YEMO

Habitat Simulator
SHEE

Sampling tools

Mission Control

EVA Information System

Photo: Space Application Services
From the Deep Sea to the Outer Space

2013 MOONWALK: Robot-Astronaut Cooperation (European Commission)

Moon mission simulation in Marseilles, France

EVA Training Suit
GANDOLFI-2

COMEX’ R/V MINIBEX

Robotic Scout
YEMO

EVA Information System

Sampling tools

Mission Control

Photo: Space Application Services
2015 MOONDIVE: Development of underwater simulations for human missions to the Moon or asteroids (ESA)
2019 Support to the underwater training of astronauts at EAC in Cologne (ESA)
2019 Support of the space suit simulator to the NEEMO mission (ESA)

Photo: H.STEVENIN/ESA/NASA

Photo: NASA
The Lunar GATEWAY
From the Deep Sea to the Outer Space

Lunar Orbital Platform-Gateway
A crew-tended exploration and science outpost in orbit around the Moon

Power and Propulsion Element:
Power, communications, attitude control, and on-orbit propellant storage and retrieval capabilities for the gateway.

ESPRI:
Small propulsion vehicle for orbit insertion and orbital maneuvers.

Utilisation Element:
Small pressurised room for scientific experiments and habitability.

Habitation Modules:
Pressurised volumes with environmental control and life support, fire detection and suppression, waste storage and disposal.

Logistics:
Pressurised cargo volume to deliver consumables and equipment.

Robotic Arm:
Mechanical arm to install and support vehicles, install science payloads.

Airlock:
Pressurised access to accommodate the docking elements.

Robotic Lander:
Pressurised access to the lunar surface.

Orius:
Crew vehicle that will take humans further into deep space than ever before.

Gateway Compared to the International Space Station
The international space station is a permanently manned research platform that has a volume of 600,000 cubic feet. The gateway is a much smaller, more focused platform for expanding initial human activities into the areas around the Moon.
From the Deep Sea to the Outer Space

2018 ESPRIT A/B1 Scientific Airlock (AIRBUS / ESA)
From the Deep Sea to the Outer Space

2020 i-HAB (LIQUIFER / THALES ALENIA SPACE / ESA)
From the Deep Sea to the Outer Space

2019 PEXTEX: Materials for future lunar mission space suits (ESA)

(Images: Liquifer Systems Group, NASA)
From the Deep Sea to the Outer Space

2019 PEXTEX: Materials for future lunar mission space suits (ESA)

Emphasis is given on novel materials, such as smart materials with functionalities such as self-healing, monitoring or dust mitigation.
2014 LUNA Rover Simulator
2020 HYDROSphere Lunar Surface Simulator

Examples of test configurations:
- Cold spots for PSC exploration
- Drilling and sampling tests
- ISRU validations
- Suit and suitport tests
- Sample exchange devices
THANK YOU!