

MOHOLE TO THE MANTLE THE NEXT FRONTIER



Drilling to the Earth's Mantle, an idea that began over 55 years ago with Project MoHole, could be realised by the end of the decade with arguably the most ambitious Earth science project in history.

With a new ship, enhanced capabilities, greater understanding of the oceanic crust, and new drilling technologies within reach, what was once considered science fiction is now possible.

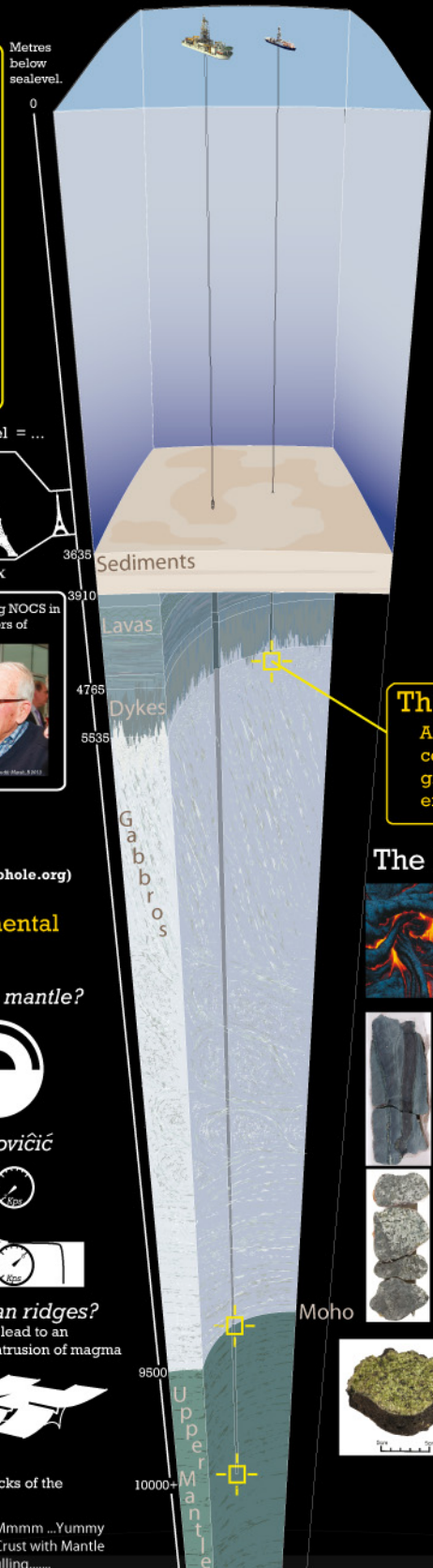
The Mantle makes up ~68% of the Earth's mass making it by far the largest component of our planet. By drilling to the mantle we will gain new insights into the fundamental processes that formed and continue to shape our evolving planet.

MoHole to the Mantle: TARGET more than 10 km below sealevel = ...



Harry Hess (L) and Walter Munk (R, visiting NOCS in 2011) fathers of plate tectonics and founders of Project MoHole.

"Perhaps it is true that we won't find out as much about the Earth's interior from one hole as we hope. To those who raise that objection I say, if there is not a first hole, there cannot be a second or a tenth or a hundredth hole. We must make a beginning" (Harry Hess, speaking in the Great Hall of the NAS in 1958)



The Ships...

CUSS 1, 1957
The pioneer...

- The first Moho attempt (1961)
- Spearheaded by Harry Hess and Walter Munk
- Scientists converted the drilling barge CUSS-1 (Continental, Shell, Union and Superior) into the first dynamically positioned deep-water drilling ship

Glomar Challenger, 1968
A new scientific ocean drilling program...

- Launched March 1968
- Provided definitive proof of plate tectonics
- Fundamental insights into nature of oceanic crust and Earth's changing climate and life.

JOIDES Resolution, 1985
Laying the foundation...

- The world's most successful research vessel
- In operation since 1985
- 132 expeditions
- Over 251 km of core recovered
- Drilled to Gabbros at Site 1256

Chikyu, 2005
Ready for the MoHole challenge...

- The world's most advanced drilling vessel
- 56782 Tonnes
- 10,000 m max drill depth
- First ever riser-enabled scientific drilling vessel

The story so far - Site 1256

At 1521.6 metres below sea floor Site 1256 represents the most complete section of ocean crust to date. Drilling Site 1256 has given us invaluable knowledge of the rocks we are likely to encounter during a Moho attempt and how to drill them.

The Questions ...

"Pristine mantle would be a geochemical treasure trove equivalent to the Apollo lunar rocks" (M2M IODP Proposal, mohole.org)

Drilling to the mantle will answer fundamental questions about the evolution of Earth.

- What is the true nature of the Earth's upper mantle?**
 - What is the chemical composition of pristine upper mantle?
 - What are the physical properties of mantle rocks?
 - What is the scale (cm-m-km) of mantle variability?
- What is the geological nature of the Mohorovičić Discontinuity (The Moho)?**
 - First identified by Andrija Mohorovičić in 1909 as a sharp increase in seismic velocity (> 8km/s).
 - Thought to represent the crust - mantle boundary but...?
 - Deep drilling is the only way to ground-truth theory
- How is new ocean crust formed at mid ocean ridges?**
 - In-situ observations of thermal and chemical interactions will lead to an improved understanding of how new crust is formed by the intrusion of magma formed by the partial melting of the mantle.
 - Key to understanding the formation of new crust is better knowledge of how seawater removes magmatic heat through hydrothermal circulation
- What is the extent of life in oceanic crust?**
 - There is a deep microbial biosphere living on the igneous rocks of the oceanic crust. Deep drilling will allow us to define the limits of life.

The Rocks

Basaltic lava

Dykes

Gabbro

Peridotite

The Technology...

Riser Drilling, the technology that will keep the Mohole stable under the immense pressure of the Earth's crust...

Blow out preventor (BOP): prevents explosive pressure release from the hole.

Riser pipe: Active pumping of pressurizing/lubricating drill mud and recovery of chips as well as core.

Hole casing: To prevent hole collapse at great depth.

Super-hard drill bits: For drilling solid rock to the Mantle.

the MoHole to the Mantle will begin to peel the skin

