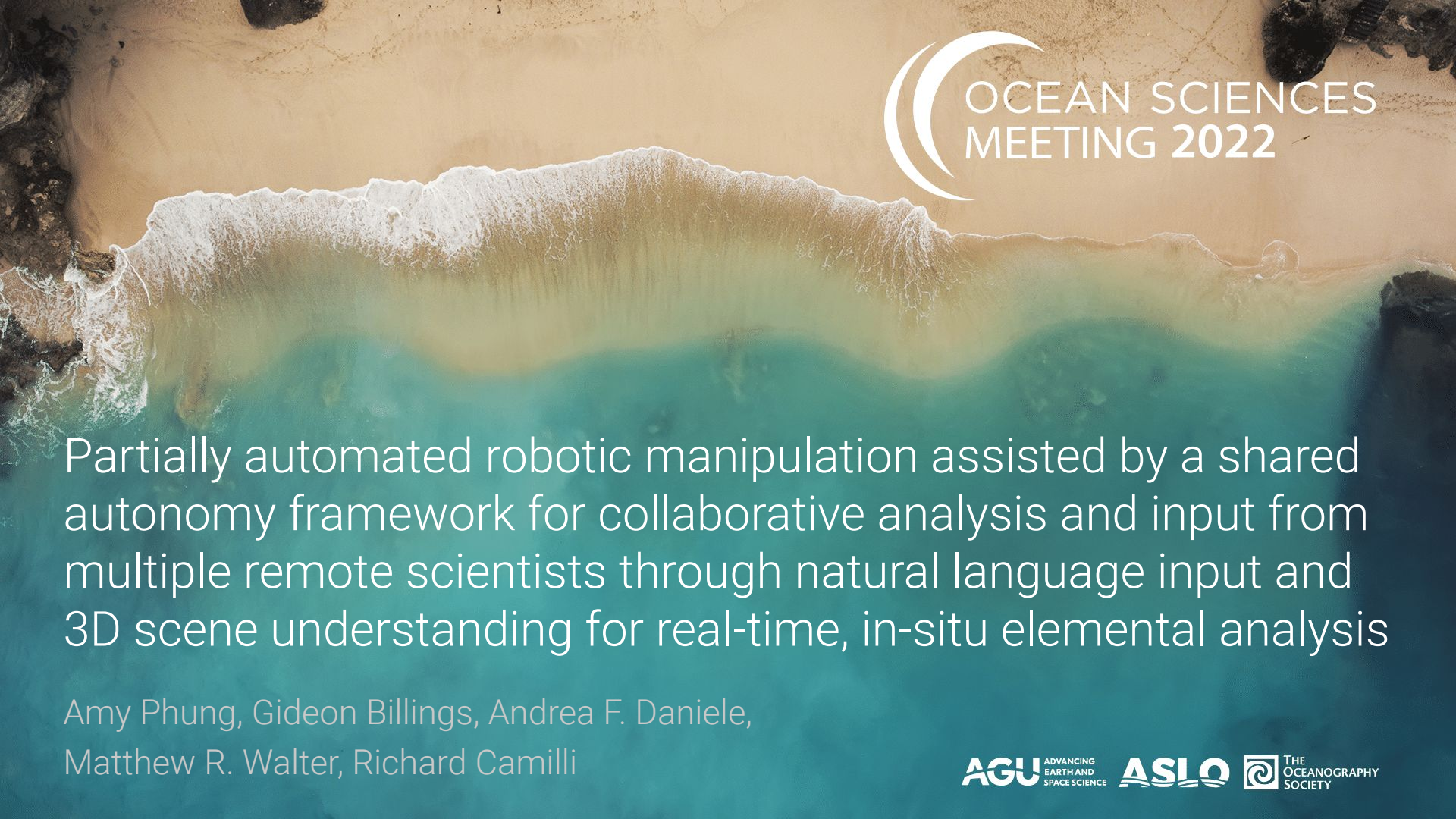


Partially automated robotic manipulation assisted by a shared autonomy framework for collaborative analysis and input from multiple remote scientists through natural language input and 3D scene understanding for real-time, in-situ elemental analysis

Amy Phung, Gideon Billings, Andrea F. Daniele,
Matthew R. Walter, Richard Camilli

AGU ADVANCING EARTH AND SPACE SCIENCE ASLO THE OCEANOGRAPHY SOCIETY

Ocean Exploration Methods

Divers

+ Dexterity
+ Low-Cost
- Limited by depth
- Limited operation time

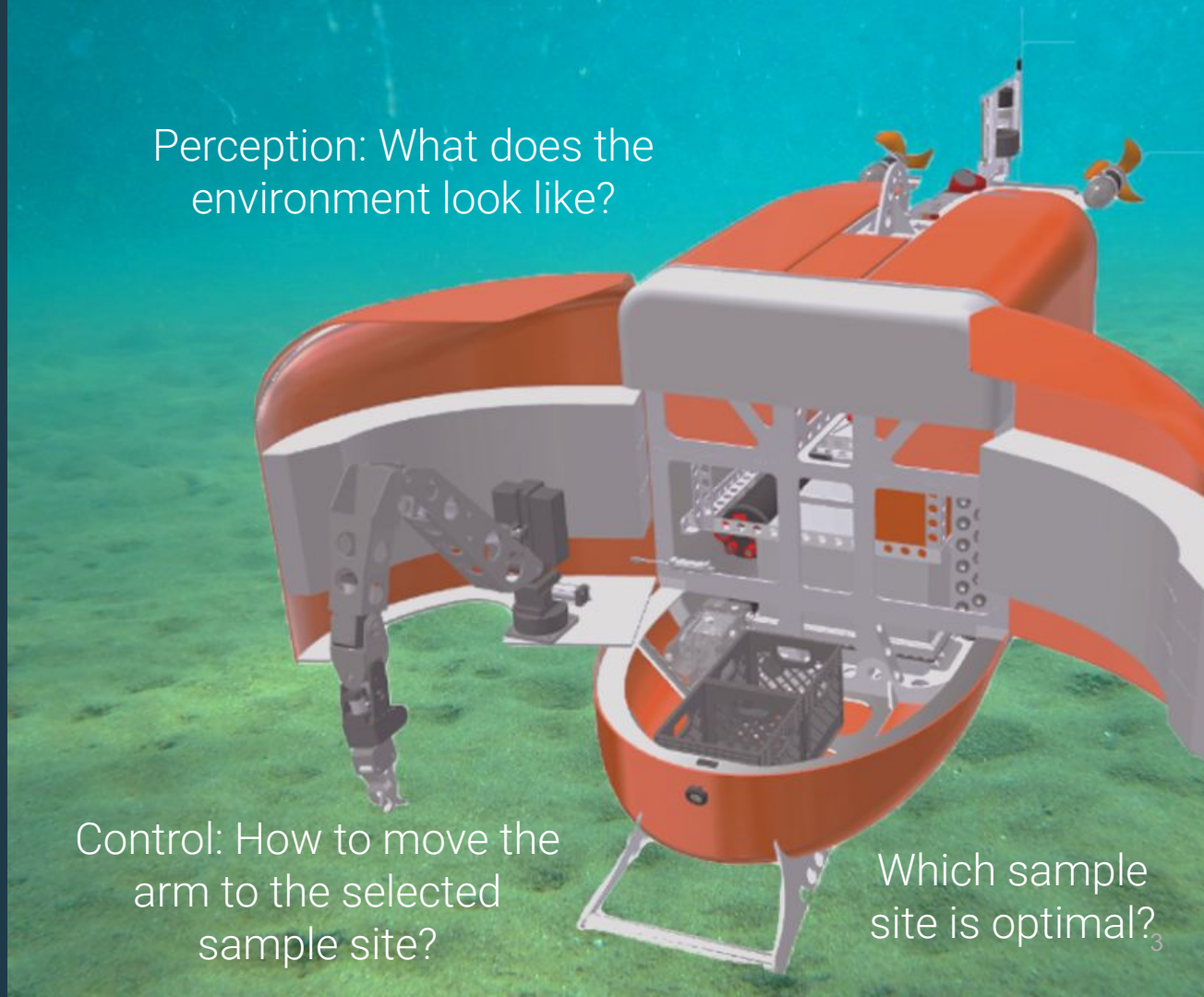
ROVs

+ Dexterity
+ Long operation times
- Expensive - requires support vessel
- Participation limited by space on ship

AUVs

+ Autonomy = lower operation cost
+ Support for multiple remote operators
+ Long operation times
- Intervention remains a challenge

Autonomous Manipulation Challenges



SHARC: SHared Autonomy for Remote Collaboration

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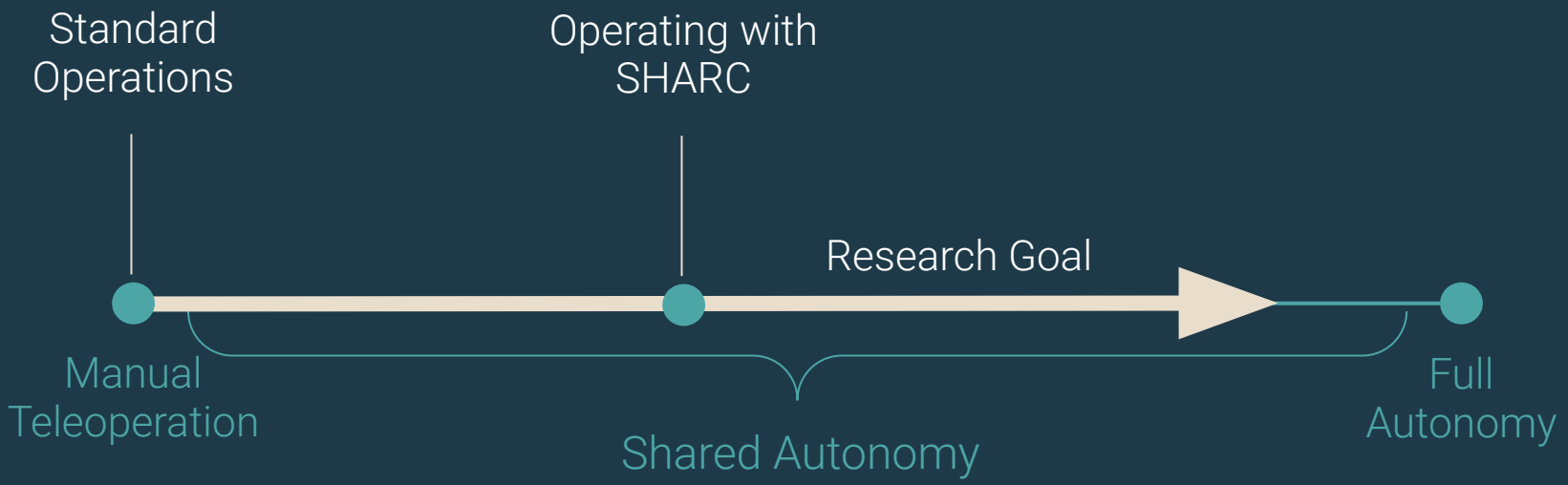
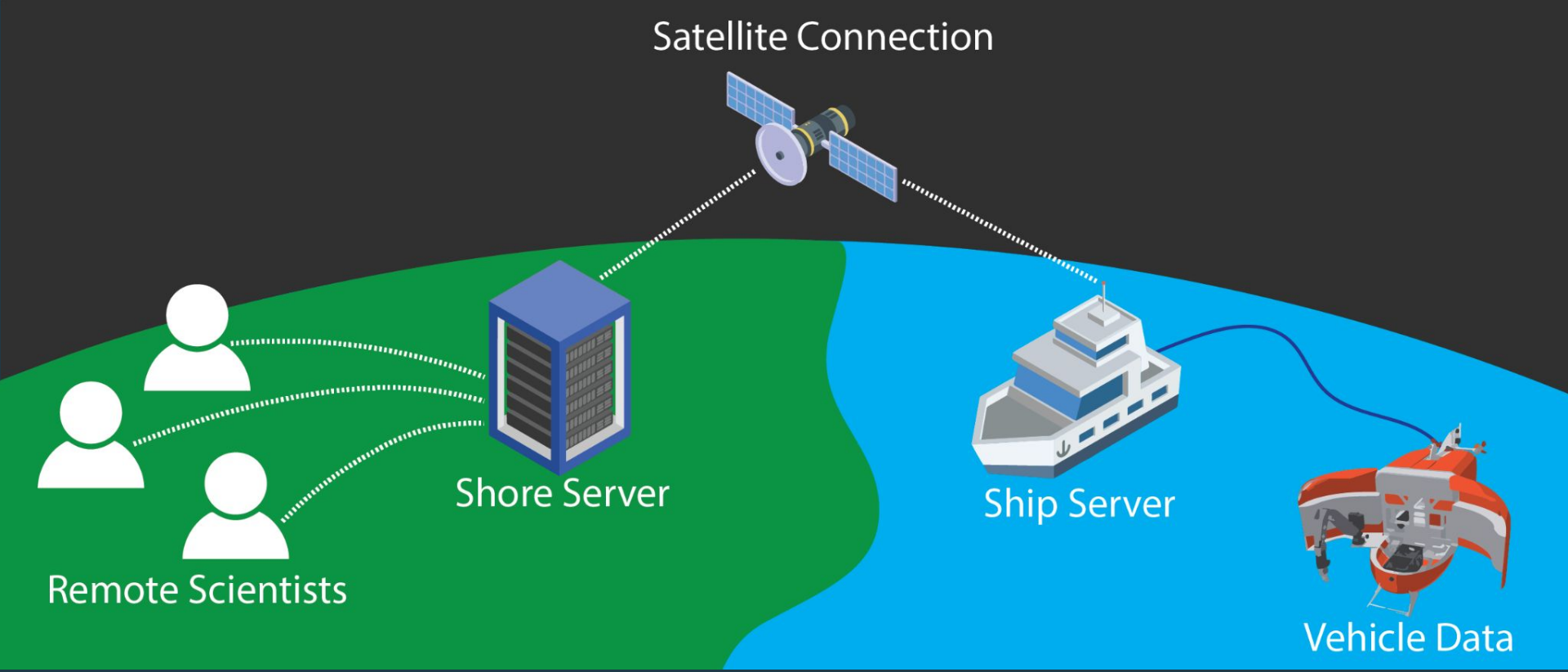
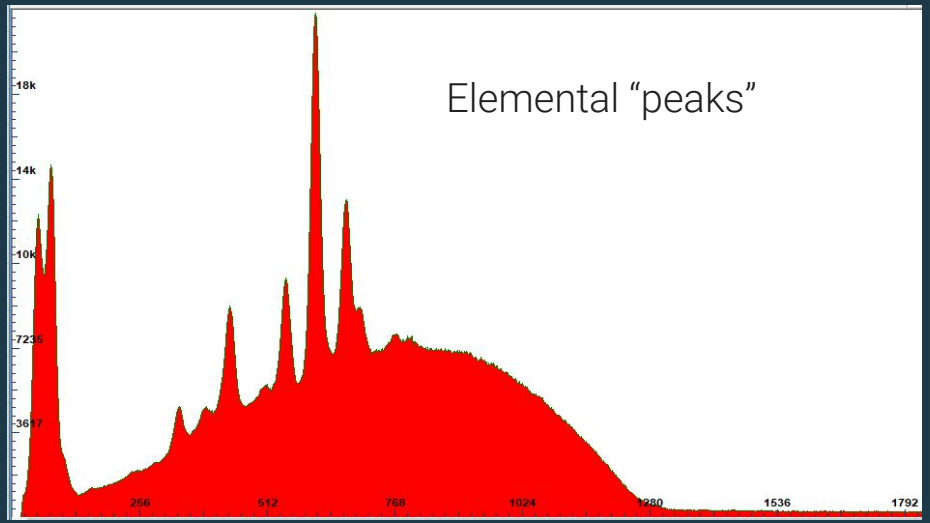




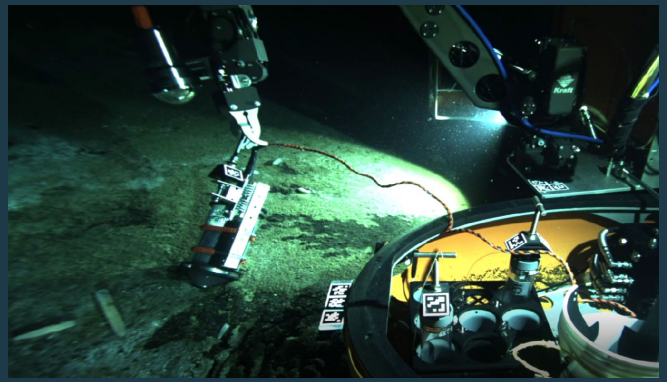
SHARC System Overview

Case study: XRF Sampling

XRF
(X-Ray Fluorescence)



Output emission spectrum

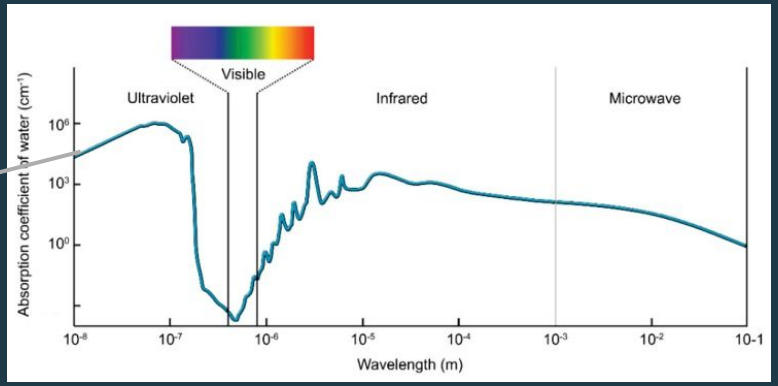


XRF instrument

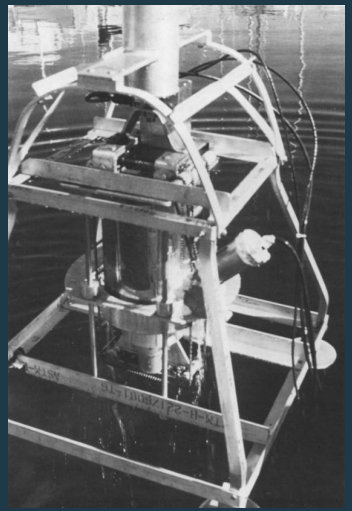
XRF Setup (photo by Amptek)

In-situ XRF Challenges & Prior Work

X-rays get attenuated rapidly

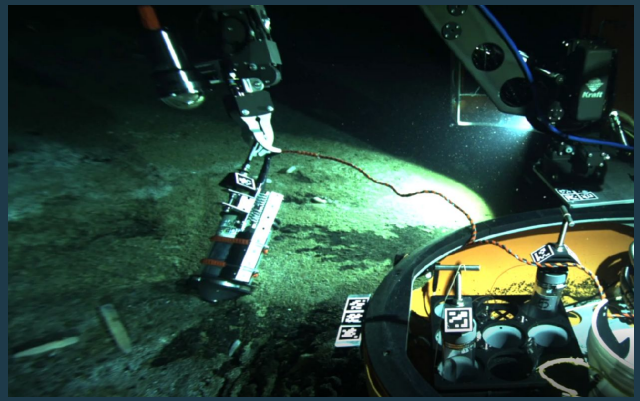


Schirripa Spagnolo et al.



Wogman and Nielson (1976)

J. Breen et al. (2012)



Our Team (unpublished - 2021)

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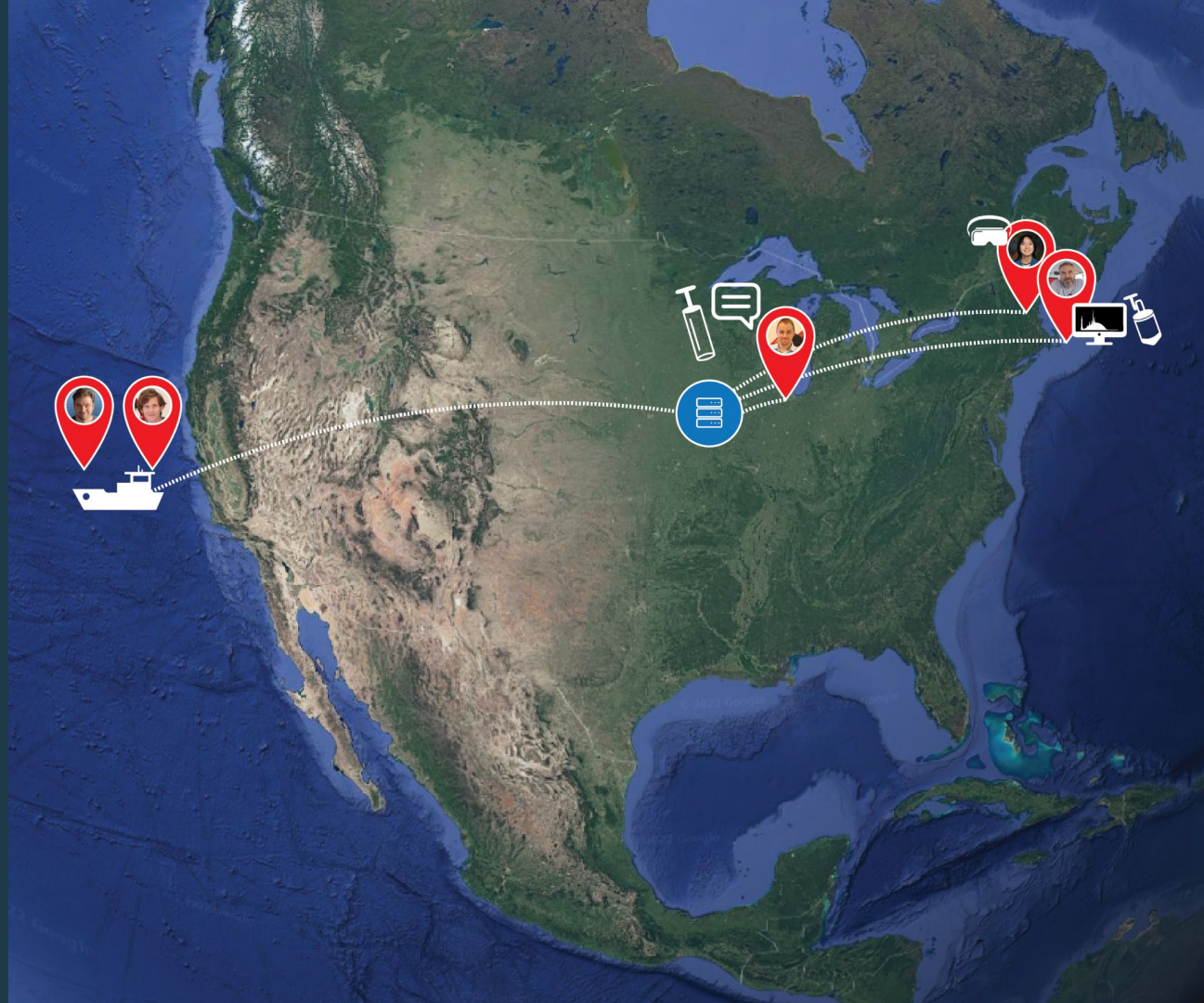
Sampling Process with SHARC



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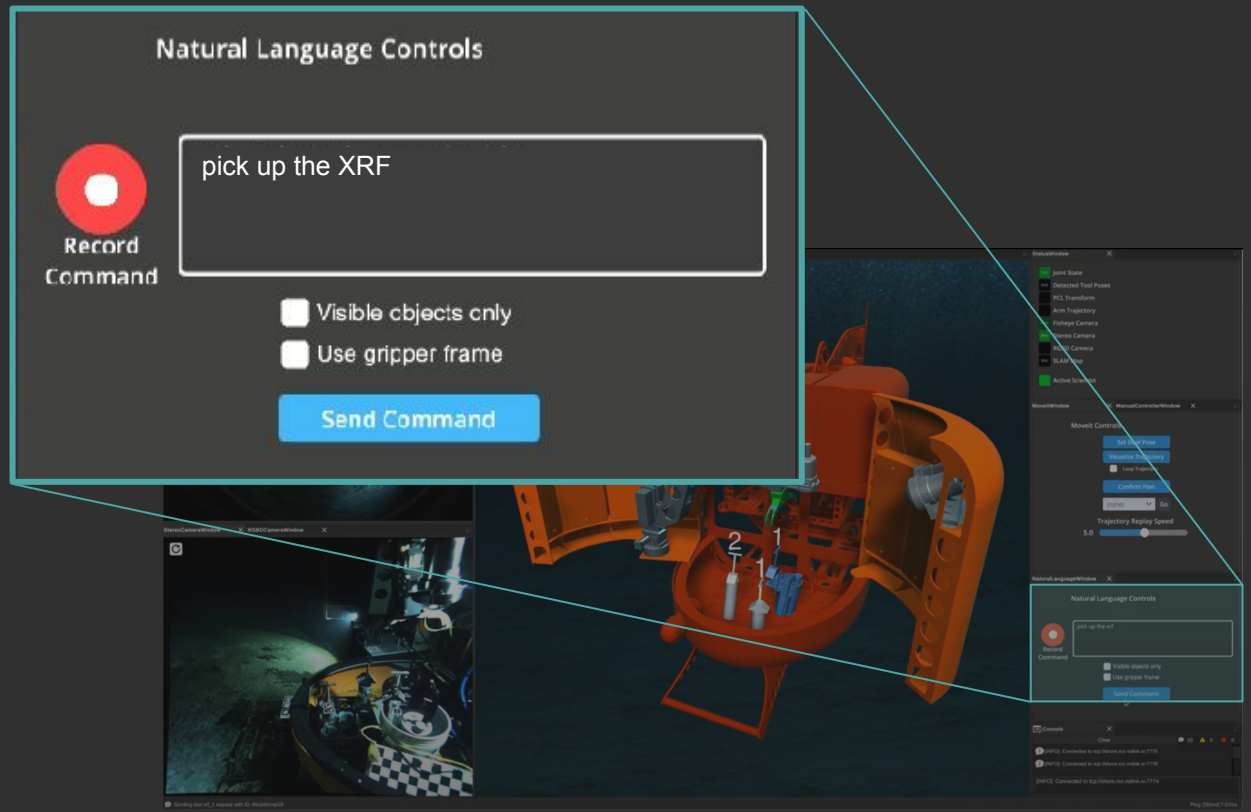
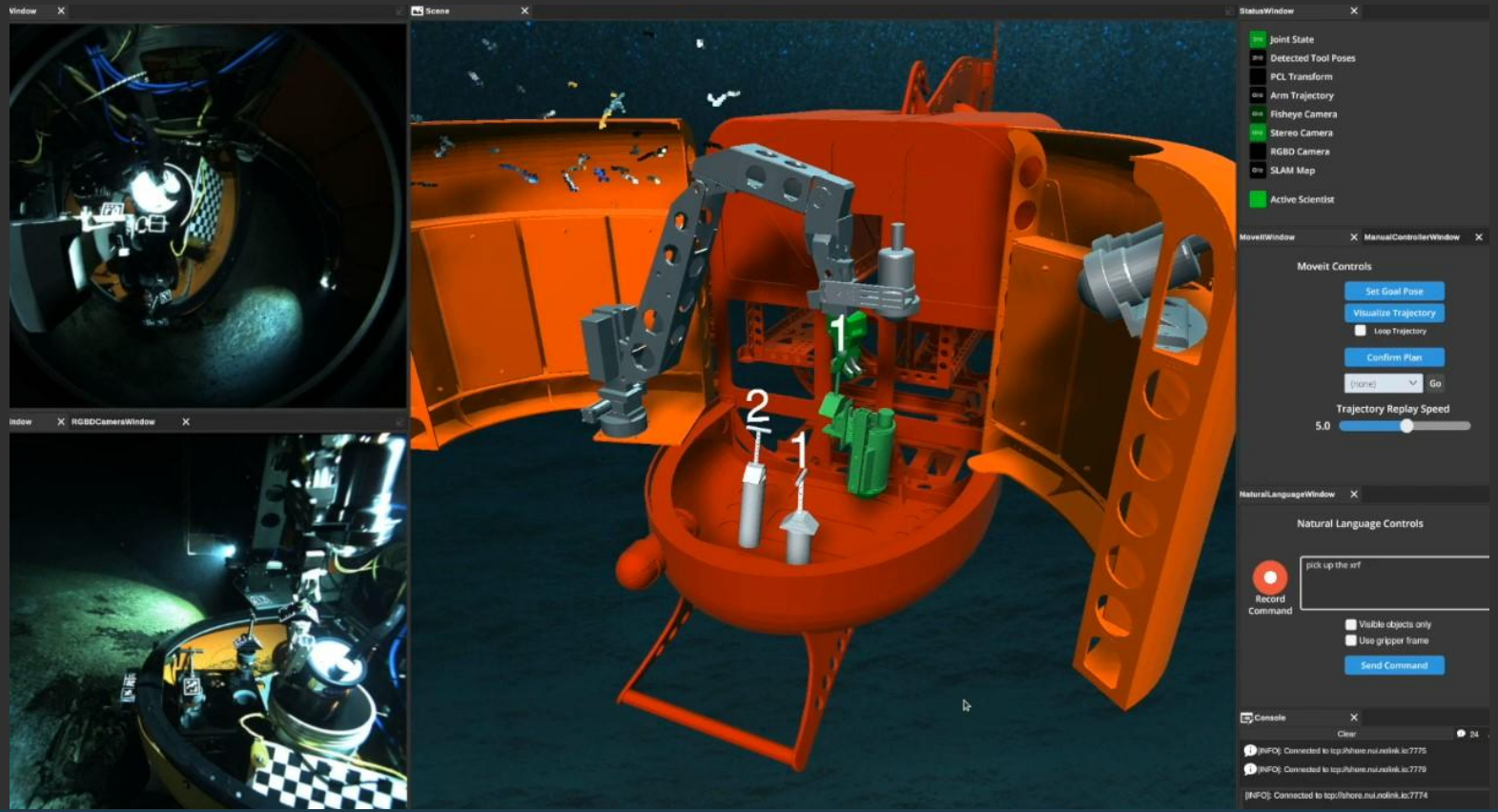
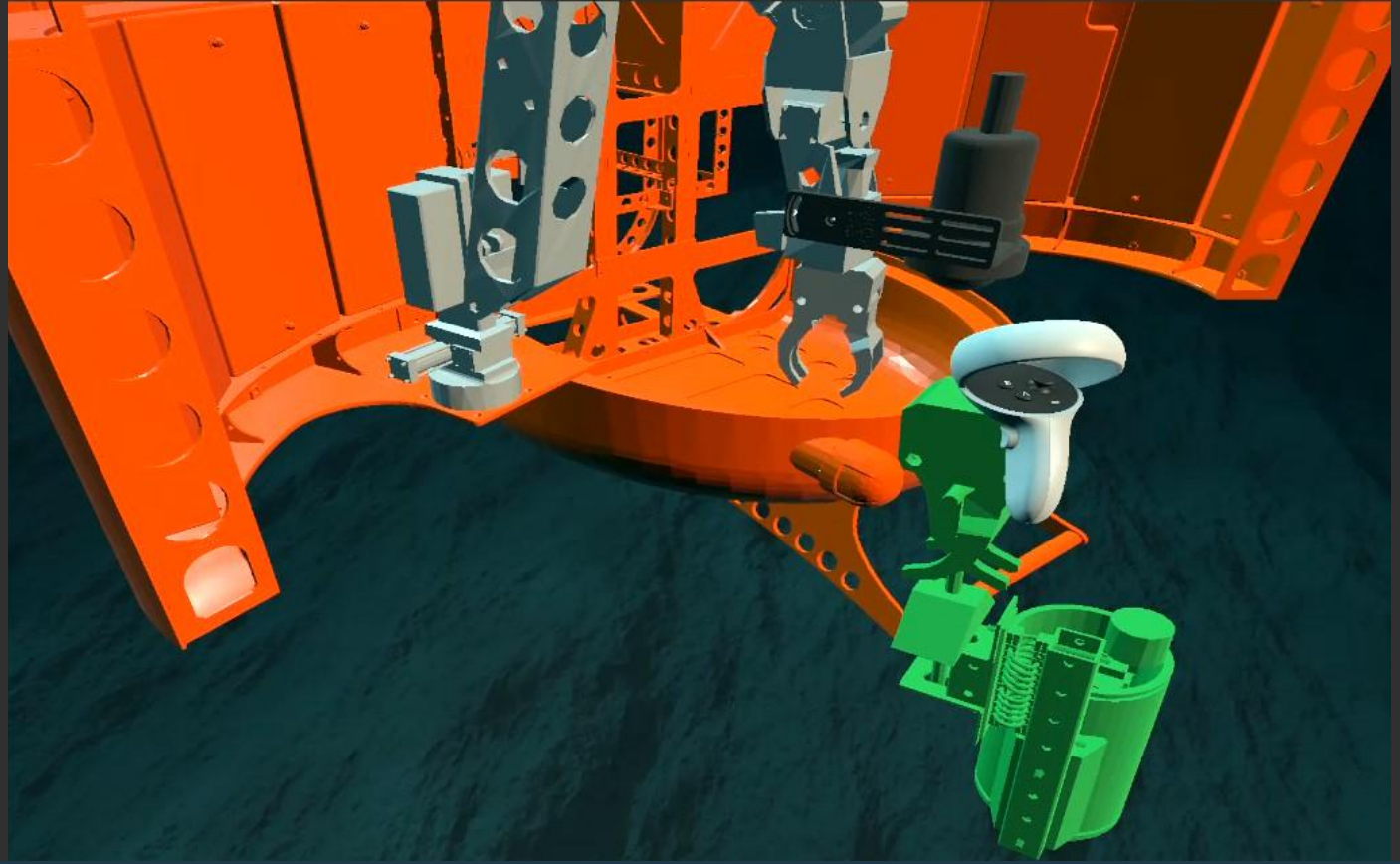
Remote Scientist: “Pick up the XRF”



Use Natural Language to pick up tool



Review Planned Trajectory



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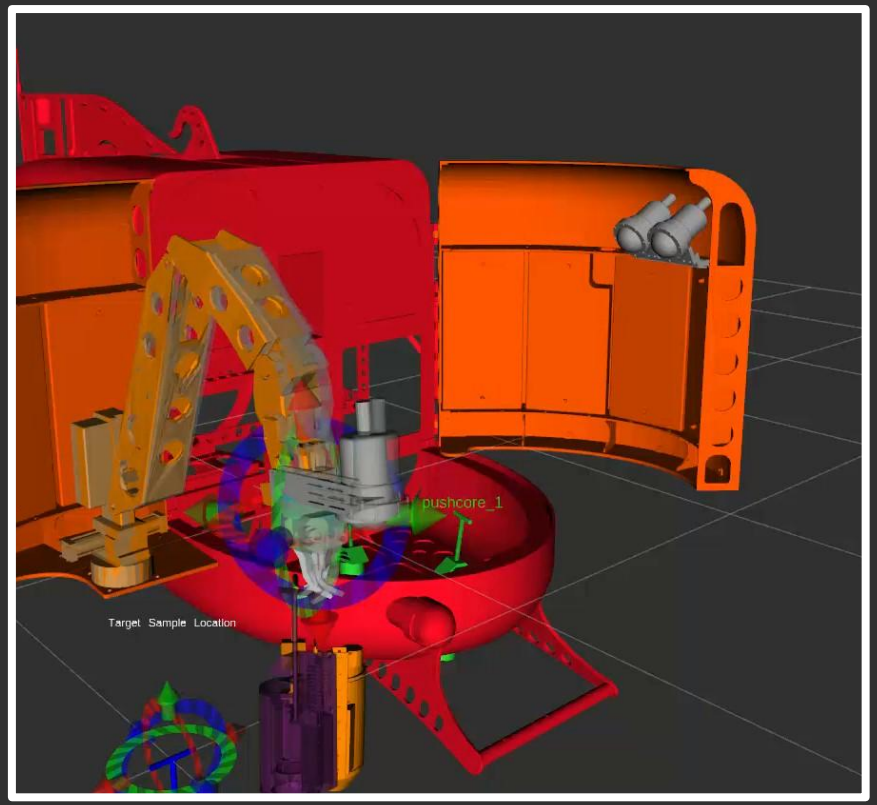
Scientist uses VR to Set Sample Location



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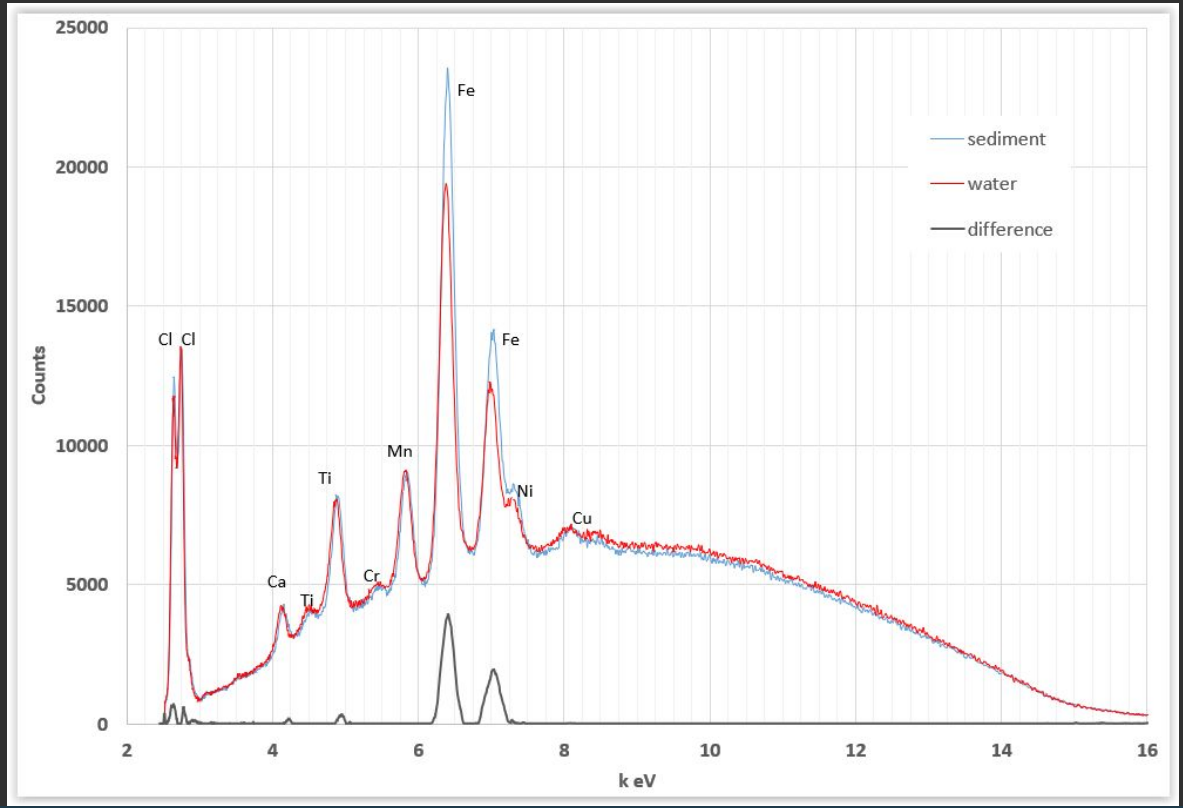
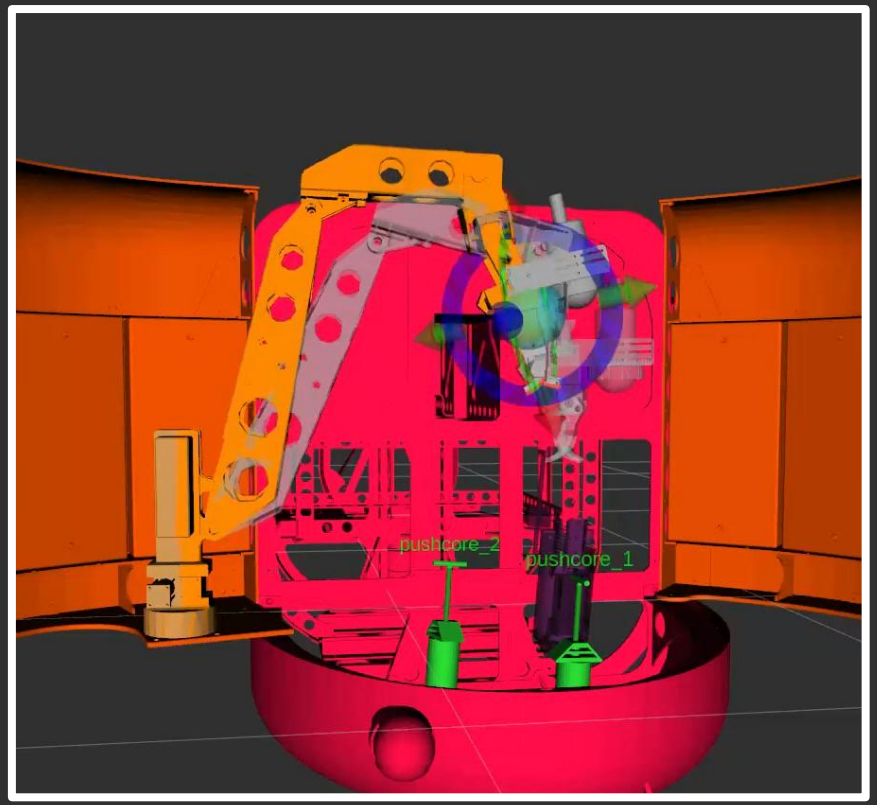
Manipulator Moves to Sample Location



Scientist analyzes XRF Data



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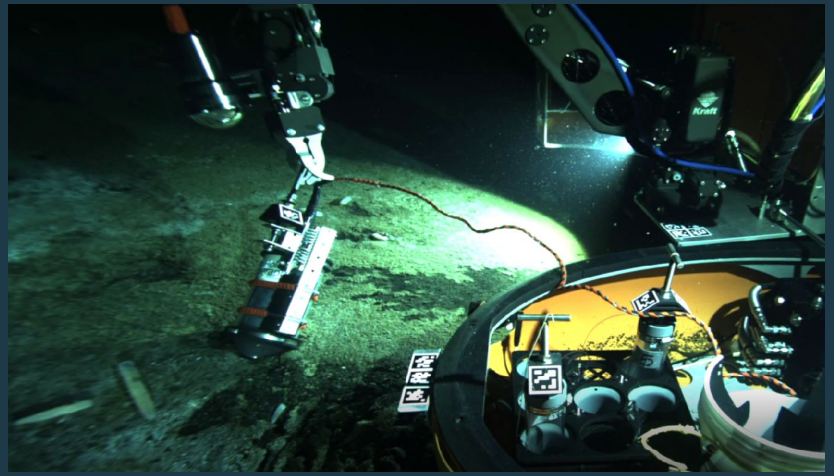
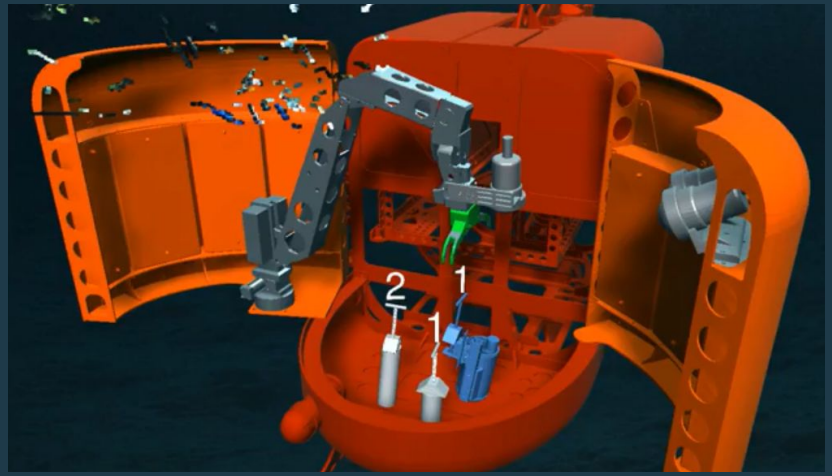
XRF Returned to Tool Tray

Discussion

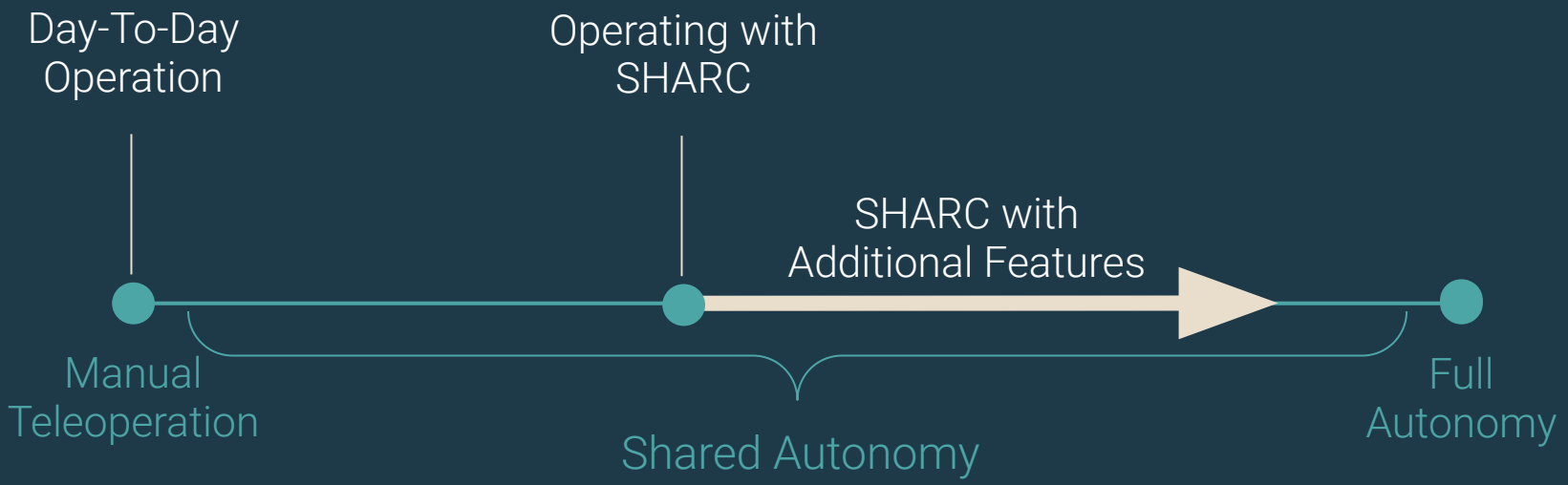




- Site selection
- Data analysis & interpretation
- Varied expertise

- Tool detection
- Low-level control

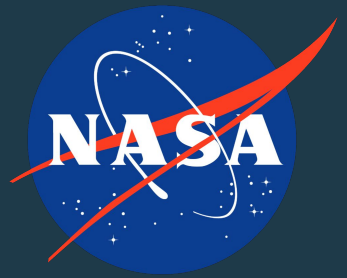
Looking Forward



Thanks For Listening!

Email: aphung@whoi.edu
Website: amyphung.github.io

Supported by:



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