IMPACT CHALLENGE

Hybrid Mixed-Reality Proposal - Physical Submersible + VP LED + Meta Quest 3

BEFORE WE KNEW YOUR NAME

Mission: Scholl Deep

A physically embodied mixed-reality expedition into the Kermadec Trench, built around one living rock, one possible new lifeform, one careful field portrait, and one collective record of observation, responsibility, and action.

University of Canterbury | Aotearoa New Zealand | Hybrid VP/MR prototype | 4-5 person interdisciplinary team
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Project statement - 186 characters

Enter a moving mixed-reality sub to Scholl Deep, uncover a living community on one solitary rock, and build a collective field record that turns discovery into responsibility and action.

Core emotional premise

Before we understood this world, we had already begun to change it. Even discovery leaves a trace—every descent brings light, sound, movement, and touch into a world that evolved without us. Exploration is more than an act of curiosity. It is a responsibility to observe carefully, minimize disturbance, and protect what we come to know.

1. Executive summary

Before We Knew Your Name: Mission Scholl Deep is a shared immersive learning experience that places participants inside a physical submersible cabin replica, mounted on a mechanically or robotically controlled motion platform. Positioned within UC's virtual-production stage, the cabin sits before an HDR-capable, 14-metre-wide curved LED wall with a fine 1.9 mm pixel pitch, supported by four modular wild walls and an overhead projection scrim. Together, these elements create an approximately 270-degree visual and lighting wrap. The LED environment, rendered in Unreal Engine, provides the shared macro-scale journey through the water column, Kermadec geology, the descent to Scholl Deep, and the exterior world visible through the submersible viewport.

UC's Virtual Production Stage is also equipped with a state-of-the-art OptiTrack infrared camera array integrated with Motive motion-capture software. The system supports up to 300 tracked rigid bodies, real-time interaction across six degrees of freedom, latency of less than five milliseconds, and sub-millimetre spatial precision. These capabilities create opportunities to track physical research tools and other assets, synchronize the moving cabin with the LED environment, and investigate how Meta Quest 3 passthrough and world-locked mixed-reality content can interact with the physical set and LED screens.

Participants also wear Meta Quest 3 headsets in mixed-reality passthrough mode. They continue to see the physical cabin, one another, and the real controls, while the headsets add world-locked marine life, particles, research interfaces, role-specific information, spatial audio, and selective visual effects. The LED wall remains the principal environmental setting; the headsets deepen the experience rather than replacing the shared world.

The pivotal moment occurs at the solitary rock community. After first documenting it from the submersible, participants undergo an interpretive change of scale: the cabin and rock appear to expand around them until they experience the community at organism scale. They are no longer looking at a small object from the outside. They become guests within a living city, observing feeding currents, minute ecological relationships, the possible candidate organism, and traces of human activity that have reached even this remote place.

Observation and documentation continue throughout the entire journey. Participants record geological features, known organisms, environmental signals, behavioral responses, evidence of disturbance, and the possible new lifeform. The narrative moves from wonder and direct connection to unease, responsibility, agency, and action. Conservation and advocacy are not delivered as a lecture at the end of the experience; they emerge from what participants have noticed, how their own presence has affected the environment, and what they have learned to care about.

The concept combines the emotional foundation of *Before We Knew Your Name*, the contained setting of *The Rock at 6,124 Metres*, the evidence-building process of *The First Portrait*, the surface-to-trench connection of *The Things We Send Down*, and the shared public format of *Mission Scholl Deep*. Originally developed as separate directions during the early ideation process, these elements now form one coherent, collaborative mixed-reality expedition.

2. The hybrid experience architecture

The experience works as each layer has a distinct job. The physical submersible creates bodily presence and shared risk; the LED wall establishes the large-scale world and a pathway for those sensitive to head mounted displays; the mixed-reality headsets bring life and information into the participants' immediate space; and the field record turns the journey into an ongoing contribution and educational experience.

Layer	Primary function	How it appears in the experience
Physical submersible + controlled motion	Embodiment, shared space, tactile credibility	A seated cabin with real surfaces, controls, vibration and low-amplitude motion. Participants remain researchers rather than vehicle pilots to assist in maintaining focus and avoiding motion sickness.
VP LED wall + Unreal Engine	Shared macro environment	The main dive view: water column, Kermadec geology, hydrothermal vignette, descent, Scholl Deep and the solitary rock. It is visible to participants and spectators.
Meta Quest 3 mixed reality	Near-field life, information and scale	Passthrough preserves the physical cabin while virtual fish, invertebrates, marine snow, data overlays, annotations and the scale-shift sequence occupy the participants' space.
HMD spatial audio + physical-space PA	Shared orientation, atmosphere, crew communication, and role-specific scientific interpretation	The room PA delivers captain dialogue, mission instructions, hull ambience, geological events, safety cues, and collective narrative moments. The HMDs add world-locked marine life, localized environmental signals, instrument sonification, and brief role-specific research cues.
Physical or tracked research tools	Agency through careful observation	Camera, light, sensor, field-notes and limited manipulator roles translate research methods into collaborative action.
Living digital field record	Persistence, learning and action	Evidence from the mission becomes part of a growing archive, followed by one practical conservation or civic next step.

Design rule

The LED wall will establish the world everyone shares. The headsets will add what only mixed reality can do: bring life close, place evidence in context, individualize research roles, and change the participant's sense of scale.

Dual-layer audio: HMD spatial audio + physical-space PA

Audio is delivered through two synchronized layers. A PA system in the physical VP space carries the shared expedition soundscape—including captain or guide narration, mission briefings, countdowns, safety instructions, hull and engine sounds, geological events, alarms, and major collective narrative cues. This ensures that the entire research crew hears and responds to the same journey.

Each Meta Quest 3 headset adds close, directional, and role-specific spatial audio. Participants may hear nearby marine life moving around the cabin, particles passing their position, instrument sonification, subtle environmental signals, or research prompts connected to their assigned role. These headset-based sounds deepen proximity and discovery without replacing the shared audio environment.

The PA system anchors participants within one physical submersible and supports face-to-face communication, while the HMD layer provides spatial precision and intimate detailing. Both audio systems are controlled by the central show-control session and synchronized with the LED environment, motion platform, lighting, interactions, and narrative timeline.

3. What the combination experience includes

Component	Purpose	How it appears in this version
Before We Knew Your Name	Emotional backbone	Discovery becomes relationship rather than possession. The experience moves from care to responsibility and action.
The Rock at 6,124 Metres	Contained setting	One solitary rock becomes an entire living neighbourhood and the visual centre of the prototype.
The First Portrait	Discovery mechanic	Participants assemble a living field portrait from image, scale, behaviour, habitat, environmental data, illustration and uncertainty.
The Things We Send Down	Environmental reveal	Organic matter, synthetic fibres, fishing debris and surface decisions connect the audience's world to the trench.
Mission Scholl Deep	Shared format	A physical moving submersible, VP panorama, MR headsets, bounded research roles and a collective evidence record create a participatory public experience.

4. Why the Kermadec Trench

The Kermadec Trench gives the project local identity and global significance. Scholl Deep is the deepest known point of the trench, roughly 10 kilometres below sea level, and the trench extends for more than 1,000 kilometres north of Aotearoa New Zealand. During the 2022 crewed expedition, scientists observed small animals and tracks in the sediment, while also encountering fishing floats and nets at more than 10,000 metres. Discovery and disturbance occupy the same place, creating the project's central emotional pressure point.

The region should not be treated simply as a backdrop. The wider Rangitāhua/Kermadec context carries ecological, cultural, political and conservation significance. Te Mana o Rangitāhua, a Ngāti Kuri-led research programme developed with Auckland Museum and science partners, demonstrates that this is already a place of Indigenous-led reconnection, research and ecosystem stewardship. Any use of te ao Māori, mātauranga Māori, iwi or hapū relationships, kaitiakitanga, or culturally specific narrative will be developed through appropriate partnerships and co-designs.

4A. Aotearoa relevance: protection, rights and an ongoing national debate

The sanctuary proposal, existing marine protections, Treaty-based fisheries rights, iwi-led stewardship and the possibility of future resource development all sit within the same regional story. Existing protections are not equivalent to the much larger sanctuary that was proposed. The experience can help audiences understand that "protected" and "fully protected" are not interchangeable, and that durable conservation depends on ecological evidence, legitimate relationships and accountable public decisions.

The Kermadec Arc is currently reserved from non-petroleum mineral permitting, through January 2028, while official statements describe that period as time to improve information for future decisions. Our proposal therefore frames the future of the region as an unresolved conservation and policy issue, and will not imply that seabed mining has already been approved or is underway.

Activism should emerge from informed agency. Participants can learn how to follow verified consultation processes, support marine research and protection, learn from iwi-led environmental work, share accurate science, distinguish current law from future proposals, and participate in evidence-based advocacy.

Aotearoa relevance

The experience can be urgent and conservation-minded while remaining accurate about sanctuary history, current protections, fisheries rights, mineral-policy status and the need for genuine iwi partnership.

Interpretive stance

The project should help participants feel what is at stake before telling them what to think. Wonder, evidence and relationship create the emotional basis for action.

5. Audience journey: a story told through the expedition

Prepare and calibrate: Participants enter a green-screen or XR onboarding space and are cast as researchers aboard a fictional expedition vessel. They receive a role, context for Scholl Deep, a comfort and accessibility briefing, and a physical or tracked tool. The Meta Quest 3 headsets are fitted and calibrated to the submersible before the motion platform begins.

Enter the physical submersible: Participants step into the cabin, take their seats, and continue to see one another through mixed-reality passthrough. The LED wall fills the viewport with the shared exterior environment, while the mechanical or robotic motion system introduces restrained movement, vibration, and orientation cues. A captain or expedition guide directs the journey primarily through the PA system in the physical space, allowing the whole crew to hear the same instructions, commentary, and mission events. The participants' HMDs supplement this shared audio with nearby marine life, directional environmental sounds, instrument readings, and role-specific cues. Participants act as researchers rather than captains or pilots of the vessel.

Descend through the living geology: The LED wall carries the large-scale descent through darkness, bathymetry, volcanic terrain and a brief hydrothermal sequence inspired by the wider Kermadec Arc. MR life passes near the windows and, at selected moments, appears to move around or above the participants. Spatial audio locates distant calls, instrument signals, moving animals and geological activity. Short role-specific overlays invite observations before the group ever reaches the rock.

Approach Scholl Deep: The movement quiets, the sound field thins and the environment becomes sparse. The contrast makes every small signal matter. Participants record seafloor tracks, sediment movement, environmental readings and known life, building a mission log throughout the descent rather than waiting for a single "discovery" interaction.

Find the rock: On an apparently empty seafloor, one solitary rock slowly resolves into a living neighbourhood of anemones, sponges, small corals, sea stars, a sea squirt, sediment trails and other organisms. HMD overlays reveal subtle depth and proximity without turning the rock into a glowing game target.

Build the first portrait: The team notices a small, scientifically plausible candidate organism associated with the rock. They photograph it, observe behaviour, use a brief ethical scale reference, compare habitat relationships, collect environmental context and develop a scientific illustration. The assessment progresses from unidentified to unusual to candidate for further study; it never declares that a new species has been discovered.

Change scale - become guests in the city: The mixed-reality layer becomes the main storytelling instrument. The physical cabin remains the safety anchor, but the participants' apparent scale changes. The rock expands until its surface becomes a landscape that the team has teleported to while they experience the community at organism scale. Feeding currents, tiny shelter spaces, biological interactions and drifting particles surround them. The emotional relationship changes from inspecting an object to entering another community as guests.

Recognize the trace: Observation continues at the smaller scale. The group sees organic material moving through the same currents as synthetic fibres and other particles; they notice how light, sound, proximity and careless contact can alter behaviour; and they encounter documented human traces such as lost fishing gear in the wider environment. Harm is not delivered as one final shock. It becomes apparent through the evidence they have gathered and the consequences of their own choices and human activity. The field record helps the crew distinguish between what they directly observed, what wider research has documented, and what remains scientifically uncertain. In this way, the conservation message emerges through evidence and interpretation rather than through a predetermined accusation or dramatic reveal.

Return with agency: The view pulls back from particle to organism, rock, food web, trench and surface. The mission evidence becomes a shared field entry. Participants leave with a final question: "You have helped bring this life into human understanding. What will you carry back to the surface?"

Pivotal scale moment

At human scale, the rock first appears to be an object. At organism scale, it becomes a city - and the participants become guests. This is the moment that turns information into empathy.

6. Observation and documentation throughout the experience

The research process should not be confined to one button press at the rock. Every stage contributes to the field record, so participants learn that discovery is a chain of attention, interpretation and evidence.

Though a one-person build may be used for internal technical testing, the intended prototype is a synchronized, co-located experience for two to four researchers, each contributing different observations to one collective field record. Technical development will begin with a single-device system test before the complete crew experience is networked.

A Shared Research Mission

The intended audience experience places two to four participants inside the same physical submersible as a co-located research crew. They descend together, see one another through mixed-reality passthrough, encounter the same world-locked organisms and environmental events, and contribute complementary evidence to one shared scientific record.

Each researcher receives a distinct but interdependent role. One may control imaging and brief scale-reference capture; another carefully directs light and monitors disturbance; another interprets environmental or acoustic readings; and another records morphology, habitat relationships, and behavioral observations. Some information can be shared across every headset, while other prompts are role-specific. This gives each participant a reason to communicate. No participant receives enough information to complete the field portrait alone. At key moments, each researcher responds to short, role-specific evidence prompts using observation tags, predefined response options and confidence ratings. These contributions are added to the crew's shared field record and reviewed collectively at the end of the mission.

The possible candidate organism becomes scientifically meaningful only when the crew communicates, compares observations, and combines its evidence. The experience therefore rewards collective attention rather than individual speed or technical performance. The emotional achievement belongs to the group: **we noticed this together**.

The headsets can also support captions, adjustable text size, visual sound indicators, color-safe interface modes, seated interaction and simplified input. The shared LED view keeps the experience legible to facilitators and spectators even when the headsets deliver individual layers. The HMDs will provide different responsibilities within the same shared reality, not four separate versions of the story.

Research Role | Tool	Participant action	MR contribution	Learning function	What they need from others
Imaging Researcher | Camera and documentation	Capture slow pans, stills, scale reference, visual detail, and comparison views.	Frame guides, evidence tags, capture prompts, and later sketch/record overlays appear in the HMD.	Shows that a single image is incomplete and that documentation choices matter.	Light placement, behavioral context, and biological interpretation.
Ecological Observer | Light	Observe movement, habitat relationships, feeding, and response to disturbance. Control illumination carefully to reveal organisms without overwhelming them.	Virtual beam shape, exposure feedback, and animal response cues appear in the HMD.	Turns illumination into an ethical decision rather than a spectacle control. Shows that observation changes what can be seen.	Imaging evidence and environmental context.

Research Role | Tool	Participant action	MR contribution	Learning function	What they need from others
Environmental Researcher | Sensor, limited manipulator	Tune into instrument data and spatial sound: depth, temperature, current, pressure, acoustic or particulate readings. Use only approved, non-invasive actions and withdraw when organisms respond.	Directional sound, sonar-like cues, and environmental readings occupy the participant's local space. Proximity zones and subtle evidence-quality cues indicate disturbance without "punishment" graphics.	Adds visual and non-visual evidence, broadens access to the experience, and shows that exploration is an intervention that benefits from restraint.	Location, imaging evidence, and behavioral observations.
Field Recorder / Biological Interpreter	Create scientific illustrations, compare evidence, annotate behavior and habitat relationships, distinguish observation from inference, track uncertainty, and assemble the final field entry.	Role-specific prompts help distinguish observation, inference, and confidence. Evidence summaries, comparison overlays, and record-building tools appear in the HMD.	Prevents the experience from collapsing scientific uncertainty into an instant answer. Shows that knowledge is built collaboratively through synthesis, interpretation, and careful record-making.	Every other researcher's observations, captures, and readings.

A behavior might only become visible when the light researcher illuminates the correct area gently enough. The imaging researcher then captures it, the ecological observer interprets it, and the recorder adds it to the field portrait. The evidence system advances because the team combines information—not because one person activates the right button.

This is consistent with physical or tracked tools deliberately creating collective activity among the participants.

The scale-change sequence will also remain collective
The "shrink to the rock" moment will not become a private headset segment. The entire crew will undergo the scale transition together.

They all enter the living city at the same time, but each researcher contributes a different part of the environmental interpretation:

- A drifting synthetic fibre becomes large enough for the crew to inspect alongside organic particles moving through the same feeding currents.
- The Imaging Researcher documents the fibre, its scale, its movement, and its relationship to the surrounding organisms.
- The Ecological Observer watches how a filter or suspension feeder encounters the particles and records any visible response without assuming that the response proves harm.
- The Environmental Researcher follows the current, particulate readings, and possible pathway through which the material may have reached the rock community.
- The Field Recorder / Biological Interpreter classifies each contribution as directly observed, supported by wider research, or still uncertain.

The sequence will not require participants to observe something as extreme as an animal or organism becoming visibly ill or die, as a moment like that could feel manipulative and would risk overstating what the evidence supports. The more powerful realization is that food, sediment, and synthetic material can move through the same pathways—and that a particle originating at the surface can become part of an ecosystem more than ten kilometers below it.

This distinction also preserves scientific integrity. The crew may observe a fibre, a feeding current, and an organism's behavior, but it cannot automatically conclude that the organism has ingested the material or that a particular behavior was caused by pollution. Those questions remain part of the field record's uncertainty layer.

The researchers must talk to one another to understand the whole community.
This also strengthens the emotional intention. They do not individually visit a tiny world; the research crew collectively realizes that what looked like a single rock is a densely connected community.

Preventing the headsets from isolating the participants
Because everyone is wearing an HMD, the design will deliberately preserve social presence:

- Passthrough remains active so participants can see one another, the cabin, and the physical tools. However, if the opportunity presents itself, we'd like to explore adding moments that transition into and out of full VR where the crew is represented by avatars they've designed for themselves as part of the onboarding process when they are in VR mode. That's something that we might include in revised iterations.
- Major story events and the captain's guidance use shared cabin audio.
- Role-specific HMD cues remain brief and complementary.
- Shared creatures and evidence are registered to the same physical locations.
- Participants point, speak, compare, and pass information verbally.
- A central cabin display or LED-based evidence panel shows the crew's combined progress.
- The final field entry belongs to the crew, while still recording each researcher's contribution.

Our proposal already recommends separating shared cabin audio from role-specific HMD cues so participants can hear the guide and one another; that will become a core social-design requirement rather than a technical note.

7. Living field record and action

The living field record is a structured, crew-built evidence record rather than a passive log. Throughout the mission, the system automatically captures image frames, scale references, environmental readings, tool use, light exposure, proximity, and signs of disturbance. At key moments, each researcher responds to brief role-specific observation prompts using predefined evidence tags, multiple-choice responses, and confidence ratings, including "uncertain" or "not enough evidence." Their contributions are timestamped and added to one shared record.

At the end of the dive, the crew reviews its combined photographs, readings, behavioral observations, habitat notes, scientific sketches, care decisions, and unresolved questions. Together, participants select a provisional assessment—unidentified, unusual, or possible candidate for further study—and identify what additional evidence would be needed. The completed field entry then presents verified conservation and civic-action pathways connected to what the crew encountered. The group chooses one practical next step, and its entry joins the records of previous crews.

Record layer	What it contains	Why it matters
Observation	Images, scale frames, environmental data, behavior notes, scientific sketches and uncertainty levels.	Shows that knowledge grows through accumulated evidence rather than instant certainty.
Care	Whether the crew limited light, avoided eyes, withdrew after behavioral change, reduced sediment disturbance and protected the living rock.	Makes ethical exploration part of the record instead of a message added afterward.
Connection	Organic matter, synthetic particles, fishing debris, geology, food-web pathways and the relation between surface decisions and trench environments.	Connects the remote deep ocean to daily life and public policy.

Record layer	What it contains	Why it matters
Action	One practical next step selected by the crew and carried forward for the next participants to see.	Turns reflection into agency without reducing the experience to a performative pledge.

The verified action pathways presented to the crew may include reducing synthetic-fibre release; contributing to citizen science or verified environmental data; joining restoration or clean-up work; supporting marine research and protection; learning from iwi-led environmental programs; following consultation on Rangitāhua/Kermadec protection or mineral policy; sharing accurate ocean science; or participating in evidence-based advocacy.

Closing question

You have helped bring this life into human understanding. What will you carry back to the surface?

Practical Functionality

1. **Automatically captured evidence**
   The system records things produced directly by the tools and simulation: photographs, scale-reference frames, environmental readings, light exposure, proximity to the rock, tool use, and observable reactions from the organism.
2. **Role-specific participant observations**
   At selected moments, each researcher receives a short question or evidence prompt based on their role and what has just happened.
3. **Collective scientific interpretation**
   At the end, the four researchers review their combined evidence and agree on a **provisional assessment or working hypothesis**.

> Unidentified → Unusual → Candidate for further study

The role-based questions will be multiple choice, select-all-that-apply, confidence ratings, or simple evidence tags. The key thing is that they will not feel like they are being quizzed. Participants are not being tested on marine-biology knowledge they were expected to possess before entering. They are being asked to interpret what they have actually seen, heard, or measured.

Every prompt will include options such as:

- **Uncertain**
- **Not enough evidence**
- **No observable change**
- **More than one interpretation is possible**

In science, recognizing that the evidence is incomplete is often a correct response.

How the four roles contribute

Researcher	What the system records automatically	What the participant contributes
Imaging Researcher	Captured frame, camera angle, focus, scale-reference visibility, time of capture	Identifies which features are clearly visible and whether the image provides usable evidence
Ecological Observer	Light intensity, duration, beam position, organism movement before and after illumination	Records behavior, habitat relationships, feeding, sheltering, or response to disturbance
Environmental Researcher	Depth, temperature, pressure, current, turbidity, acoustic and particulate readings	Identifies relevant changes or anomalies and connects them to the organism's location or behavior
Field Recorder / Biological Interpreter	Receives the other three researchers' evidence and any preliminary sketch overlays	Distinguishes observation from inference, records uncertainty, compares evidence, and guides the crew's final assessment

Example prompts during the experience

Imaging Researcher

After capturing a usable frame:

Which features can be confirmed in this image?

- Segmented body structure
- Paired appendages
- Distinctive lateral markings
- Relationship to the rock or host organism
- Scale can be estimated
- Image is inconclusive

Then:

How confident are you in this observation?

- Low
- Moderate
- High

The image itself is automatically added to the record. The participant adds the interpretation and confidence level.

Ecological Observer

After the light is adjusted:

What happened when illumination increased?

- No visible response
- The organism moved toward the light
- The organism withdrew or sheltered
- Its posture or movement changed
- Nearby organisms responded
- The response is unclear

The system already knows how bright the light was and how long it was active. The observer supplies the biological interpretation.

Environmental Researcher

After using the sensor:

Which environmental condition may be relevant to the organism's location?

- Increased particulate movement
- Reduced current near the rock
- A temperature or pressure variation
- A change in acoustic activity
- No meaningful variation detected
- More evidence is required

The readings themselves are automatically stored; the researcher identifies what may be meaningful.

Field Recorder / Biological Interpreter

This researcher might be shown two statements:

Which statement is a direct observation?

- "The organism moved beneath the rock when the light intensified."
- "The organism is nocturnal and uses the rock for permanent shelter."

The first is an observation. The second is a hypothesis that may be plausible but is not yet demonstrated. That distinction is a strong learning opportunity in the experience.

The record should preserve disagreement

The crew should not be forced into artificial agreement.
For example:

- The Imaging Researcher may identify six appendages.
- The Ecological Observer may believe two more were hidden.
- The Field Recorder can mark the entry as “appendage count unresolved: six visible, possibly eight.”

That is more scientifically authentic than turning every question into one correct answer. It shows participants that a field record can contain:

- confirmed observations;
- tentative interpretations;
- conflicting evidence;
- missing information;
- confidence levels;
- recommendations for further study.

How the final synthesis would work

Near the end of the mission, the four streams of evidence appear together on a shared cabin display or MR field-record interface.

The crew sees something like:
Evidence collected

- **Image:** clear lateral and dorsal frames
- **Scale:** approximate body length established
- **Behavior:** withdrawal observed following increased light
- **Habitat:** repeatedly associated with the shaded rock edge
- **Environment:** stable conditions with local particulate movement
- **Morphology:** several features do not match the comparison record
- **Uncertainty:** underside and genetic evidence unavailable
- **Care record:** light reduced after behavioral response; no physical contact made

The system could then display three possible assessments:

1. Insufficient evidence for assessment
2. Unusual organism requiring further observation
3. Possible candidate for further scientific study

The crew discusses the evidence and selects the assessment they believe is best supported. The system may recommend one based on completeness and evidence quality, but we would not have it silently generate a verdict. The participants should perform the final act of scientific reasoning together.

Crucially, the result should **never be “You discovered a new species.”** Even the strongest outcome remains: **“Possible candidate for further scientific study.”** That preserves the uncertainty already central to our proposal.

From evidence to environmental meaning and action
Once the crew has completed its provisional assessment, the shared field record moves through four sequential interpretation layers. These can appear as tabs, cards, or stages on the central cabin display and within the mixed-reality interface. The layers are revealed in order so that the conservation message grows directly from the crew’s evidence rather than appearing as a generic environmental information panel.

1. What the crew observed
This layer contains only evidence gathered during the current mission. It may include:

- fishing gear, a synthetic fibre, or other human-made material near the rock;
- particle movement through feeding currents;
- an organism’s visible movement or behavioral response;
- light exposure, proximity, sound, sediment disturbance, and tool use;
- human-generated material documented at extreme depth.

These entries are drawn from the crew's photographs, instrument readings, observation prompts, confidence ratings, and care record. The system should clearly identify these as mission observations, not universal scientific conclusions.

2. What wider research has documented
The second layer connects the crew's observations to carefully selected and source-labelled research. It may explain that:

- deep-sea amphipods collected from several trenches, including the Kermadec Trench, have contained synthetic particles;
- larger marine debris can entangle animals, continue catching wildlife through ghost fishing, abrade organisms, and damage or smother habitats;
- microplastics have affected feeding, filtration, respiration, or other biological processes in some experimentally studied marine organisms;
- human-made materials can move through water, sediment, feeding pathways, carrion, and food webs.

Each item should identify whether it represents documented Kermadec evidence, evidence from other marine organisms or environments, or an interpretive visualization used by the experience. This prevents broader research from being presented as a direct diagnosis of the simulated candidate organism.

3. What remains uncertain
The third layer makes scientific uncertainty visible rather than hiding it. It may include:

- whether the candidate organism has ingested synthetic material;
- whether an observed behavior was caused by pollution, light, sound, proximity, or another environmental factor;
- what long-term effects synthetic particles may have on this particular rock community;
- how pollution, climate stress, resource extraction, exploration disturbance, and other pressures may interact;
- what additional observation, environmental sampling, or laboratory analysis would be needed.

"Uncertain" and "not enough evidence" are valid scientific outcomes. The record should show participants that recognizing a gap in knowledge is not a failure; it is often the beginning of the next research question.

4. What the crew can do
Only after the first three layers have been reviewed does the system present verified action pathways connected to the evidence. These may include:

- reducing synthetic-fibre and plastic release;
- supporting marine-debris prevention and recovery;
- participating in citizen science or verified environmental monitoring;
- supporting deep-ocean and Kermadec research;
- joining restoration or clean-up initiatives;
- following and participating in consultation relating to Rangitāhua/Kermadec protection;
- sharing accurate ocean science;
- supporting marine conservation and evidence-based advocacy.

The four participants choose one collective crew action to attach to their shared field entry. Where appropriate, each participant may also receive a QR code or take-home link leading to a personal next step, relevant research, consultation information, or a verified local organization.

Their entry might end with:

- **Crew assessment:** Possible candidate for further scientific study
- **Recommended research:** Additional non-invasive observation and environmental sampling
- **Crew commitment:** Follow and participate in verified consultation relating to protection of the Kermadec region

That complete entry joins the records of earlier crews, allowing future participants to see not only what previous teams observed, but what remained uncertain and what actions they chose to carry forward.

8. Scientific integrity and grounded fiction

The candidate organism should remain a scientifically plausible simulation unless a research partner provides verified Kermadec imagery, specimen data or permission to adapt a real unresolved organism. This protects the project from overclaiming while allowing participants to experience authentic scientific uncertainty.

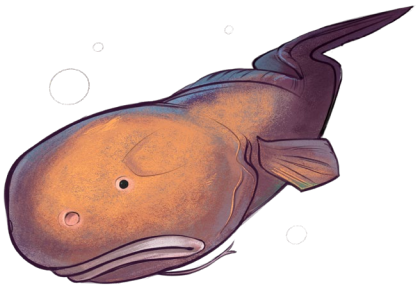
What is simulated: one hero organism, designed with marine-biologist guidance to have credible scale, movement, sensory constraints, habitat relationships and adaptations to low-light, high-pressure conditions. Its behaviour should respond plausibly to light, sound, proximity and the living rock.

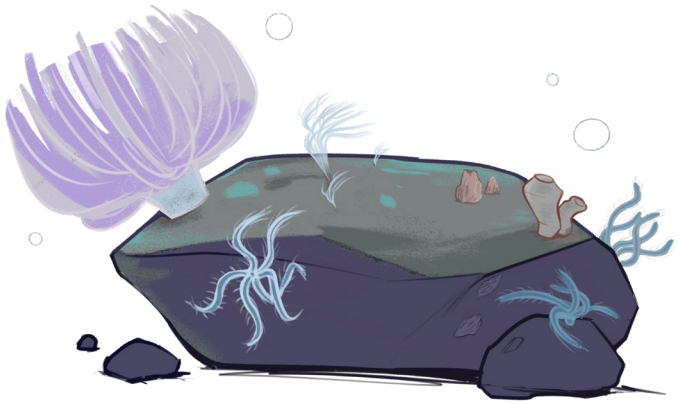
What is real and grounded: the Kermadec/Scholl Deep setting; deep-sea exploration methods; submersible and ROV observation; environmental readings; photography; scientific illustration; paired scale references; eDNA concepts; the uncertainty of species identification; hydrothermal geology of the wider Kermadec Arc; documented fishing debris; and the conservation implications of poorly understood life.

What is interpretive: the dramatic change of scale, the visual compression of distant Kermadec features into one guided journey, the microscale particle view, and any scent cue. These elements support understanding but should be labelled as visualization rather than literal events or measurements.

Transparency language for the experience

The organism encountered in this experience is a scientifically informed simulation based on Kermadec biodiversity studies at 6000m deep and beyond. Its environment, adaptations and documentation methods are grounded in deep-sea research and developed with marine-biologist guidance. The scale transition is an interpretive visualization designed to reveal relationships that are difficult to perceive at human scale.





9. Ethical presence: motion, light, scale and sensory design

The experience should demonstrate that the tools used to understand a place can also alter it. The participants' presence brings light, sound, movement and attention into a world that evolved without them. Evidence quality should improve when the group acts with restraint.

- Use low-amplitude, scripted motion as a narrative and bodily cue, not as an amusement-ride feature.
- Use red or low-visible scale references where appropriate, activate them only for brief evidence frames, aim away from eyes and provide passive alternatives when the organism, creature or animal reacts.
- Treat over-lighting, sudden sound, sediment disturbance and unnecessary proximity as changes to behavior and evidence quality.
- Use the HMD for virtual relighting, bioluminescent cues and selective visual emphasis; synchronize cabin practical lighting and the LED wall so the physical space remains comfortable and intelligible.
- Keep the participant(s) seated during the scale transition. The perception of shrinking comes from visual, audio and motion cues rather than physical locomotion.
- Offer a static-motion mode, headset-free spectator role, clear stop signal, facilitator oversight and accessible alternatives for participants who cannot use the motion platform or HMD.

9A. Optional olfactory layer

A headset-mounted or cabin-based scent device could provide a restrained atmospheric cue, but it will remain optional and outside the critical prototype path. It will not imply that participants can literally smell the deep ocean from inside a sealed submersible. A salt-air cue at departure or return, or a clearly interpretive mineral/metal cue during the hydrothermal vignette, may support memory and transition. Any scent system requires opt-in participation, allergy screening, low-intensity delivery, replaceable hygienic components, ventilation and a no-scent mode.

Design principle

The question is not only what we find, but how gently we choose to find it.

10. Surface-to-trench connection and conservation story

The environmental reveal should be a pivot rather than the ending. Participants first develop curiosity and care for the rock community and candidate organism. Only after that investment does the experience show how surface systems reach the trench: organic material sustains deep-sea life, while synthetic fibres, debris and human decisions can also descend into hadal environments.

The 2022 expedition's fishing floats and nets provide a direct, documented symbol of human reach. The microplastic evidence will remain precise: a study of amphipods from six deep-ocean trenches, including Kermadec, found at least one microparticle in 65 of 90 individuals. Note - The experience will not imply that the simulated organism contains microparticles or that the full percentage applies only to Kermadec.

The organism-scale sequence can show organic particles, sediment and synthetic fibres moving through the same water and feeding currents. It can introduce plausible exposure pathways without claiming that every organism ingests particles or that effects found in laboratory species have been demonstrated at Scholl Deep. Laboratory studies in other anemones and sponges support a qualified discussion of possible feeding, filtration and physiological effects, but our proposal will keep the boundaries clear.

The field record will do more than show that human-made material has reached the deep ocean. It will help participants understand why its presence matters to marine life, habitats, food webs, and wider ocean ecosystems. Lost fishing gear and larger debris can entangle animals, continue catching wildlife through ghost fishing, abrade organisms, and crush or smother sensitive habitats. Plastic fragments may also be swallowed, potentially blocking or damaging digestive systems and interfering with normal feeding.

At smaller scales, synthetic fibres and microplastic particles can enter feeding and filtration systems. Their effects differ among species, particle types, concentrations, and exposure conditions, but laboratory research has shown that polyethylene microplastics can reduce filtration and respiration in at least one marine sponge species, with effects continuing after the sponge was returned to uncontaminated water.

Our experience will distinguish between what has been directly documented in the Kermadec region, what has been demonstrated in other marine organisms, and what remains uncertain. It should not imply that every particle produces the same harm or that the simulated candidate organism has been proven to contain or suffer from microplastics. Instead, participants encounter evidence of risk, ecological connection, and unanswered questions—reinforcing why further research, careful exploration, pollution reduction, and protection are necessary.

Finding human material in the trench tells us where it has travelled. Understanding its possible effects tells us why that journey matters.

During the descent, the hydrothermal sequence establishes another conservation tension. Mineral-rich fluids form black-smoker chimneys and seafloor massive sulphides containing copper, iron, zinc and gold. The sequence can inspire awe while asking whether irreversible extraction decisions should be made before associated ecosystems, recovery times and cultural relationships are adequately understood.

The advocacy layer will be woven through the journey. Participants first see a place worth knowing; then they understand how surface activity and exploration reach it; finally, they receive verified pathways to participate in research, protection and public decision-making. The project remains conservation and action-minded without becoming a doom-and-gloom experience.

Scientific boundary for the microscale sequence	**Narrative purpose**
The scale transition is an interpretive visualization. It will ensure it does not claim that the simulated organism contains microplastics, that every member of the rock community has ingested them, or that laboratory findings in other species are direct Kermadec evidence.	The smaller scale makes distant consequences emotionally digestible. It allows the audience to see the rock community on its own terms before pulling back to the larger food web, trench and surface.

11. Technical architecture and show control

The experience's impact depends on the physical submersible, LED environment, mixed-reality content, audio, lighting, and field-record system working together as one coherent journey—not on adding unnecessary technical complexity.

In practical terms, the following systems need to stay coordinated:

- the physical submersible's movement;
- the Unreal environment on the LED wall;
- the mixed-reality content in each Quest headset;
- cabin lighting;
- PA narration and shared sound;
- directional HMD audio;
- research prompts and participant interactions;
- the collective field-record system.

For example, when the submersible banks or descends, the LED environment, headset graphics, spatial sound, lighting, and physical motion should all communicate the same movement. When the candidate organism reacts to light, that response should appear consistently to the crew, be reflected in the Ecological Observer's prompt, and enter the shared field record at the correct time. If those systems fall out of sync, the illusion breaks—and mismatched visual and physical motion could also increase discomfort.

One central mission state should coordinate the LED wall, motion platform, Quest clients, cabin lighting, shared audio, optional scent cues and field-record system.

System	Prototype approach	Feasibility note
Central Unreal / show-control session	Maintains mission timing, environment state, evidence events and participant progress.	The scripted 8-10 minute journey reduces networking and branching complexity.
LED-wall render	Displays the shared macro environment and remains visible to the room.	The LED view is the authoritative external world and a fallback if an HMD layer is interrupted.
Quest 3 MR clients	Use colour passthrough for cabin visibility and render lightweight near-field content, UI, scale effects and spatial audio.	Standalone clients avoid tether hazards; they receive synchronised state over a local network.
Cabin-relative alignment	Calibrate each headset to a known cabin reference; send the motion platform pose to the MR scene so overlays remain attached to the moving sub.	This is an early technical proof point. Spatial anchors or marker-based calibration may support initial alignment, but dynamic motion requires a tested cabin transform strategy.
Motion platform	Receives pre-authored, low-amplitude cues tied to the mission timeline.	Engineering sign-off, limits, interlocks and an emergency stop are mandatory.
Evidence and field-record service	Collects interaction events and assembles the final shared record.	Can begin locally and later support networked classroom or museum installations.

Meta's current Quest platform supports full-colour passthrough, Unreal passthrough development, world-locked spatial content and spatial audio. Those capabilities make the hybrid concept technically plausible, but the specific combination of moving cabin, LED wall and multiple co-located headsets will need to be treated as an integration prototype rather than assumed to work without testing.

11A. Early technical tests needed

- Test how Quest 3 passthrough cameras reproduce the VP LED wall, including exposure, refresh interaction, moiré, and readability.
- Test headset tracking inside a cabin that moves relative to the room; establish a cabin-relative coordinate system and recovery procedure for drift.
- Prototype one headset first, then add shared synchronization and additional participants after the LED, motion, and HMD alignment is stable.
- Build the scale transition as a controlled seated sequence with a physical safety anchor visible before and after the most immersive moment.
- Design a graceful fallback in which the LED wall and cabin can complete the mission even if one headset loses tracking or connectivity.
- Synchronize and test the PA and HMD audio as one layered system. Shared narration, safety instructions, major environmental events, and cabin ambience must remain clearly audible through the physical-space PA, while the headsets deliver only the directional, near-field, and role-specific sounds that benefit from spatial placement. Audio levels, timing, and frequency ranges should be designed so that headset content never masks the guide, safety cues, conversation, or collaboration between crew members

12. Prototype scope, safety and feasibility

The first working version should remain tightly scoped. The goal is not to build a full trench simulator, a free-roaming game or an elaborate multi-location attraction. The final experience can feel expansive while relying on one principal site, one hero organism, one guided descent and one decisive change of scale.

Must have	Optional enhancement
One physical submersible cabin with safe, low-amplitude mechanical or robotic motion	More complex motion profile or additional physical effects
One VP LED macro environment and guided Kermadec descent	Additional Kermadec sites or longer vent exploration
Intended audience prototype: A synchronized two-to-four-person Quest 3 research crew with shared spatial anchors, complementary roles, common environmental events, and one collective evidence record. **Development sequence:** Validate MR alignment, tracking, LED compatibility, and motion synchronization with one device before networking the full crew.	Full shared-anchor multiplayer and networked role persistence
One solitary-rock community and one plausible candidate organism	Additional species, motion-captured creature performance or puppetry
Four evidence types and a field portrait that preserves uncertainty	AI-assisted anomaly suggestions or adaptive guide dialogue
One organism-scale transition revealing the rock as a living city	Extended microscale food-web sequence
One surface-to-trench reveal and one living field-record ending	Optional olfactory attachment and expanded multisensory cues
8-10 minute audience journey	Travelling or museum-scale multi-station version

12A. Safety and accessibility requirements

- Qualified engineering and technical staff will need to certify the motion platform, cabin structure, load limits, interlocks, restraints and emergency-stop system.
- Participants remain seated; motion is constrained, predictable and guide-controlled. A static-motion version must deliver the same learning journey.
- Headsets require hygienic interfaces, rapid removal, facilitator supervision, sufficient ventilation and clear procedures for discomfort or tracking loss.
- The experience should provide captions, adjustable visual intensity, reduced-motion mode, headset-free observation, alternate controls and an accessible route into the cabin or equivalent non-motion station.
- Scent, if developed, is opt-in and removable from the experience without affecting the narrative or assessment of the prototype.

Feasibility position

The creative, scientific, real-time and interaction work can remain UC-led. The moving platform does, however, require qualified mechanical/robotic engineering support and safety approval. That support is an implementation requirement, not an external creative dependency. Possible partnership opportunity with the UC Hit Lab.

13. Working team roles

Team member	Role in the hybrid prototype
Nikki	3D and real-time lead: Kermadec environment, rock community, candidate organism, lighting, Unreal integration in collaboration with Bree, VP content in collaboration with Ellie, MR scene coordination and overall visual pipeline.
Bree	Technical development: central show control, Quest/LED synchronisation, evidence logic, interaction states, local networking, platform telemetry integration and field-record system.
Pablo	Visual development and UI: scientific illustration, field notes, role-specific MR interfaces, diagrams, creature studies, evidence language and visual identity.
Ellie	Audience journey and virtual production: onboarding, captain/guide structure, physical-sub staging, pitch-video direction, pacing, spatial storytelling, editing and sound collaboration.
Mark	Marine biology and science review: organism plausibility, behaviour, environmental conditions, discovery methods, scale and lighting ethics, learning outcomes, conservation framing and research/community connections.
UC technical / engineering support | UC HitLab	Motion-platform design or integration, physical cabin fabrication, control-system safety, load testing, interlocks and certification. This role is required for the moving hardware but does not change creative ownership of the concept.

Kōawa, Kiri & Lou-related practitioners, students or other collaborators may add specialist production support later, but the media, interaction, science communication and prototype direction will remain achievable and owned by the UC-led core team. The physical motion system is the one area where qualified institutional engineering support is essential.

14. Fit with OceanX selection criteria

Scientific integrity: Grounded in documented Kermadec exploration, deep-sea observation methods, hydrothermal geology, qualified pollution research, clearly labelled simulation and transparent distinction between evidence and visualization.

Audience insight: Participants remain physically together, see one another, perform meaningful research roles, observe throughout the journey, build a shared record and choose an informed next step.

Originality: A robotically controlled physical submersible, shared VP world and co-located mixed reality combine public spectacle with intimate, organism-scale perspective. The experience is about how knowledge is formed and how presence changes what is observed, not about collecting a glowing target.

Feasibility: One principal environment, one rock, one candidate organism, one guided motion profile, a bounded set of MR overlays, one scale transition and one field-record ending. Optional scent, complex multiplayer and additional locations remain outside the critical path.

Emotional impact: Participants move from wonder to intimacy, then recognise their own connection and influence. Seeing the rock as a city and entering it as a guest makes the conservation message relational rather than abstract.

Potential to scale: The Unreal environment and evidence system can support a UC installation, static MR version, headset VR adaptation, museum module, classroom experience or travelling OceanX format. The LED experience also remains visible and discussable for spectators.

Final experience promise

One expedition. One rock. One possible new lifeform. One shared record. The audience enters as researchers, becomes a guest in another community, and returns knowing that seeing is only the beginning.

15. Sources and verification notes

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Verification note: Political, legal, permitting and product/SDK status still need to be checked again before public exhibition. The prototype will and needs to distinguish documented facts, scientific inference, speculative visualization and advocacy opportunities. The moving-cabin/LED/passthrough integration will need to be validated through hardware testing rather than assumed as a solved system.