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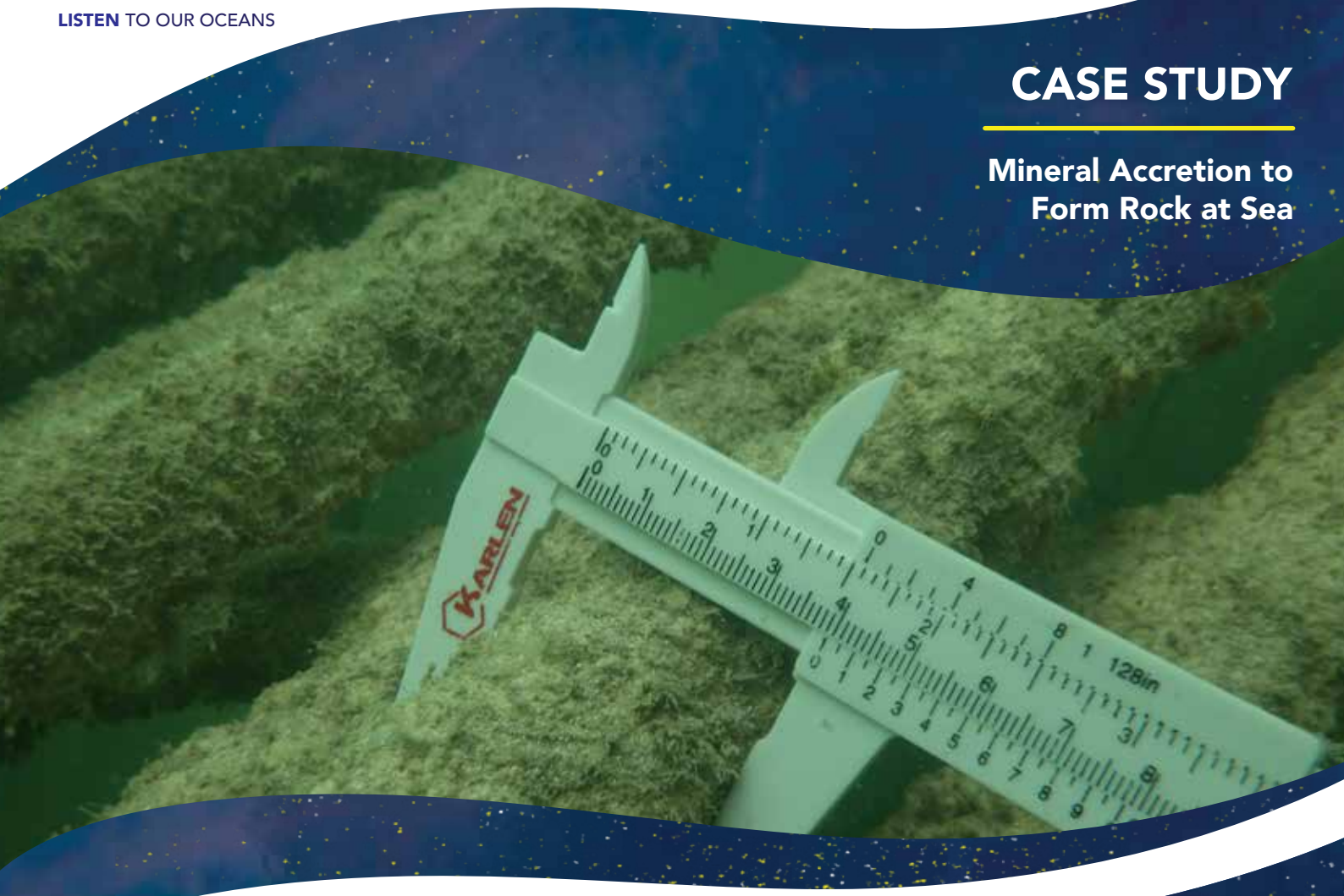
CASE STUDY

Mineral Accretion to Form Rock at Sea



BACKGROUND

CCell reefs are formed from a steel structure, over which a layer of rock is growth from minerals found naturally in seawater. This rock provides both the necessary bulk that enables the reef to resist ocean waves and a textured surface onto which marine life can attach and thrive.

To optimise rock growth, CCell has undertaken trials in the laboratory alongside field trials in UK, Israel and Mexico to explore the impact of varying: temperature water chemistry, reef shape and electrification.

Test units being prepared for installation in Isle of Man, UK

CCELL REEF

Experimentation to optimise the rate and quality of rock formed from seawater minerals.

Structure Type:
Rock Growth Test Units

Owner:
CCell Renewables Ltd

Installations:
Mexico, Isle of Man, and Israel

Dates:
July 2020 - December 2022

OUTLINE

This project explored three core features:

1. In the electrolysis of seawater to form rock, the mineral composition and the temperature of seawater affects the rate of mineral accretion and the type of rock formed. The desired mineral crystal are Brucite, Mg(OH)2 , and Aragonite, CaCO3.
2. Brucite is a soft rock that grows rapidly at high currents, while Aragonite is a strong hard rock that grows much more slowly. The ideal composition is a blend between the two, which yields the necessary bulk to provide wave protection, yet with sufficient strength to prevent immediate erosions as water flows across the reef.
3. Electrical energy can also be conserved through the careful control of the electrical current and the design of reef structure.

PROJECT SPECIFICATIONS

Test Duration:
1 Year

System:
3 units at each site powered by CCell-Sense

Dimensions:
1m (Height) x 1m (Width) x 0.5m (Depth)

RESULTS

A rock growth test rig was created that contains a $1m^2$ mesh panel, which is half a meter away from the electrolysis anode. Three identical sets of experiments were conducted, starting in Mexico, then in the Isle of Man in the UK, followed by Israel.

At each site, three units were installed to ensure the repeatability of the results and accelerate the testing of a range of design alterations and power management strategies.

As part of the design alterations, CCell conducted comparative tests, in Mexico using both parallel wires and a mesh on the same structure. For the same volume of steel, the mesh provided the greatest rock coverage and overall strength.

Trials in the colder water of the UK reduced the percentage of Aragonite from over 85% in Israel and Mexico, to around 60%, with Brucite making up the remainder. Changes in the salinity and water chemistry between Israel and Mexico, which have similar water temperatures, only had a marginal impact.

SEM image of rock growth in Mexico, showing the formation of Aragonite, Brucite and Hydrogen holes.