GeoVoltaic: Seawater-Activated Cement–Carbon Galvanic Power Modules

Proposal for Student Degree Project Collaboration (30 ECTS)

Industry Mentor: Sigurd Österud
External Developer, Skåne

Target Collaboration: Lund University (LTH)

September 8, 2026

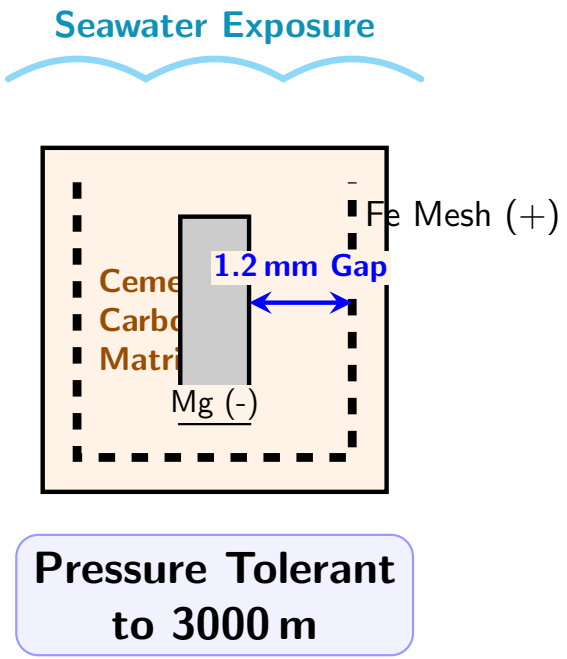
Context & Motivation

The Subsea Challenge

Long-duration instruments require bulky pressure housings and battery packs, adding cost and material burdens.

The GeoVoltaic Concept

A one-time, seawater-activated galvanic power module left in place with a minimized footprint.



Pressure Tolerant to 3000 m

- **Matrix:** Cement-carbon composite matrix.
- **Electrodes:** Mg Anode / Fe Cathode.
- **Target:** Powering Low-power subsea sensors.
- **Voltage:** Nominally $\sim$4.5 V target.
- **Depth:** Qualified up to 2500–3000 m.

Core Research Questions

The project demands systematic academic investigation focusing on:

1. **Electrochemistry:** How do cement formulation, porosity, and curing affect open-circuit voltage and internal resistance?
2. **Materials:** How do conductive carbon additive types (graphite, fibers, nanotubes) affect electrical pathways?
3. **Geometry:** How do electrode spacing and exposed area influence the power–lifetime trade-off?
4. **Scalability:** Can a small series-connected multi-cell architecture (nominally $\sim$4.5 V) reliably supply ultra-low-power subsea loads?

Flexible Project Scope

Highly suitable for either a single ambitious student or a productive **two-student collaboration**:

Student Project	**Main Focus**	**Shared Interface**
Student A Materials/Electrochem	Cement-carbon mix, electrodes, activation, and degradation	Supplies validated ce performance data
Student B Electrical/Systems	Load profiles, power conditioning, architecture, and circuit modeling	Converts cell data int usable subsea design

Academic Requirement

Each student maintains a clearly independent scientific question, methodology, and final thesis report.

Timeline & Key Deliverables

Planned over a standard **20-week** semester framework:

- **Weeks 1–4:** Scoping, safety review, literature study, and test matrix.
- **Weeks 3–14:** Specimen manufacturing, curing, and electrical test campaign in synthetic/natural seawater.
- **Weeks 12–20:** Multi-cell prototype development, empirical modeling, thesis writing, and final seminar.

Expected Deliverables

- Public LTH thesis report (patent-sensitive data excluded).
- Reproducible manufacturing protocol and quantitative dataset.
- One physical multi-cell demonstrator / load test emulator.

Resources & Collaboration Setup

Provided by External Partner:

- Concept background and prior prototype metrics.
- Core raw materials (cement, carbon additives, electrodes, molds).
- Regular technical mentorship.

Requested from LTH:

- Academic supervisor and examiner.
- Lab access with safety support.
- Basic testing instruments (multimeters, data loggers, load/potentiostat).

IP & Confidentiality Note

Technology is under a provisional patent. A formal project agreement detailing publication boundaries and background confidentiality must be signed before launch.