



# MARINE INDUCED POLARIZATION (MARINE IP)

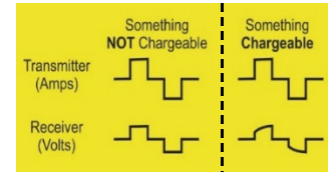
AN ELECTRICAL IN-WATER HYDROCARBON DETECTION TECHNOLOGY

INDUCED POLARIZATION ASSOCIATES | Seattle, WA

## Marine Induced Polarization

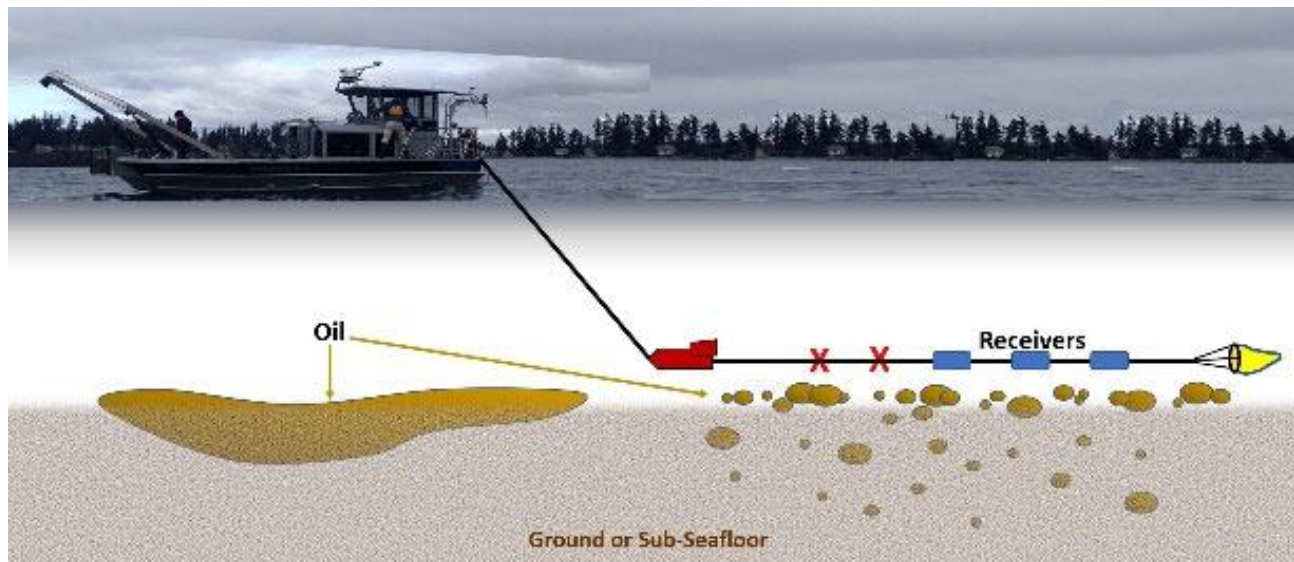
Marine Induced Polarization (Marine IP) is new technology for the mapping of certain classes of minerals, hydrocarbons, and polarizable contaminants. Known polarizable materials include most sulfides, metallic objects such as buried wrecks and pipelines, munitions, ilmenite ( $\text{FeTiO}_3$ ), and now hydrocarbons (non-floating oil). Induced Polarization Associates (IPA) is an LLC formed to further the development and commercialization of Marine IP.

**How it Works:** A controlled electrical current into the water using two transmit electrodes, and measuring the induced voltage using two non-polarizing receiver electrodes. The shift between the known current and the measured voltage is used to discriminate between various materials, including hydrocarbons.



Having multiple receiver dipoles enables the ability to distinguish the responses in depth layers. The distance between each pair determines how deep a given dipole reaches into the sediment and the width of the measurement swath, and the number of different dipole lengths determines how many depth layers are obtained. The spacing and number of the receivers can be designed and built to meet the needs of the site.

**General Operation:** A streamer or cable array is towed behind a vessel, pulled along the surface of the sediment or suspended in the water column. In shallow water deployments (<35 m water depth), the cable can be deployed and recovered by hand, and secured to the boat's cleats during towing.





# Induced Polarization Associates LLC

## Equipment Specifications:

- **Salinity:** Sea Water, Rivers, Lakes. The equipment can be operated in any Salinity. Salinity measurements are taken at the time of deployment for instrument calibration.
- **Minimum Temperature ( C):** -2. Received signals from Marine IP are dependent on the signal's ability to travel through the water. At -2 degrees, water becomes ice, which is not conductive.
- **Sensitivity:** In laboratory, detection of oil down to 2 ppm.
- Current cable configuration:
  - **Total cable length:** 86m, **Weight:** ~150 lbs.
- **Cable's breaking strength:** 6500 lbs.
- **Water depth:** 1m to Full Ocean Depth
- **Penetration in sediment:** Down to either 3m or 5m, theoretically possible down to 20m
- **Measurement swath:** Either 6m or 10m

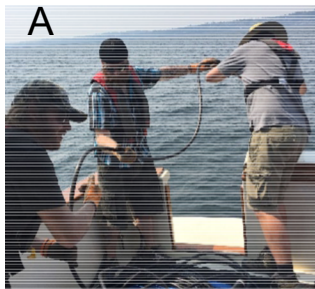
## Equipment Operations:

Loading the equipment. The equipment has a small logistics footprint and comfortably fits in the back of a Jeep or standard vehicle. The cable can be carried by two people or transported in a standard dock cart.



Setup and Deployment. For a shallow water environment, the equipment

can be deployed by hand, tied off to a cleat on the boat during towing and recovered by hand. The cable is laid on the boat deck near the location it will be deployed. During equipment deployment, the cable is lowered hand over hand to the desired length, carefully uncoiling the cable.



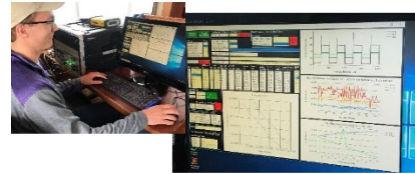
A) Cable is laid close to deployment location on vessel. B) Cable being towed on stern of vessel. C) Cable tied off to a cleat and fed into cabin to data acquisition box.

For more information:

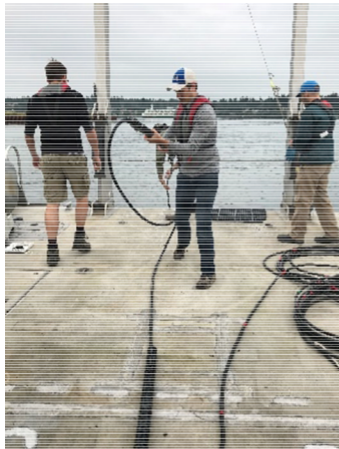
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Data Collection. Data is collected and raw data are displayed on the Data Acquisition System. GPS data is also collected and displayed by the Data Acquisition System. Data is delivered as a \*.csv or other file type, as needed.



A



B



A) Cable recovery, the cable coiled in a figure 8 shown on the right side of the picture. B) The electrode laid out for easy access and deployment.

Recovery. During equipment recovery, the cable is

pulled up hand over hand, and the leading section of the cable that does not contain electrodes should be carefully coiled into a figure 8. The section that contains the electrodes should be laid out so that the electrodes are easily accessed and redeployed, as pictured.

## Equipment Requirements:

A GPS and CTD, which can be provided if not available on the vessel of opportunity.

Vessel size of at least 25 feet in protected waters but can vary considerably dependent on sea conditions, maximum depth requirement and the number of people on the vessel (surveyors and observers). The vessel should have a cabin or covered area to protect the Data Acquisition equipment, as well as 220v power outlets.

For current cable configurations, a water depth less than 35 m is ideal. Depths from 35 m to full ocean depth are possible with alternate deployment methods or further development for integration with an ROV or sled.

Definition of survey area including water depth.

Daytime operations.

For mapping contaminants, assay of targeted material from within the survey area may be required.

Sensor calibration: lab testing of the targeted materials at the IPA facility. For long-term contaminated areas, access to assayed samples with sequestered contaminants within the sediments is critical.

In the case of recently introduced contaminant materials, lab measurements from the materials origin source may be applicable. Assays may be required post-mission.

**Availability:** With equipment available, the Marine IP team can mobilize and be available to set up for survey at a site that is within a 4-hour travel radius of Seattle within 48 hours of being called.

All data acquired will be treated as proprietary; ownership of all data belongs to the client. Formal permission from the client is required for use of data in public forums or presentations.

**For more information:**

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