Product Sheet: Hydrocarbon seep detection

### Hydrocarbon seep detection

Image credit: Grid Petroleum Corp.

### PRODUCT DESCRIPTION

<table>
<thead>
<tr>
<th>Category</th>
<th>Component products</th>
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</thead>
<tbody>
<tr>
<td>Near Surface Geology</td>
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#### Uses

- Surface geology mapping - mapping geological features
- Logistics planning and operations - monitoring of assets

#### Geo-information requirements

- Terrain information
- Air quality and emissions
- Lithology, geology and structural properties of the near surface

#### Description

This product responds to oil and gas industry requirements to detect oil seeps from a reservoir at the surface, as well as from pipelines. An additional interest is the detection of oil concentration in soils and sediments in and around existing or former onshore oil and gas facilities.

Macroseepage refers to the visible presence of oil and gas seeping to the surface, which may be localized at the termination of faults, fractures, and outcropping unconformities or carrier beds. Microseeps are not visible and are defined by the presence of detectable hydrocarbons in soils, sediments, or waters.

Areas of oil and gas seeps are often characterized by anomalously high concentrations of ethane, propane/propane and methane. These anomalies can produce mineral alteration in soil and rock, radiometric anomalies, temperature anomalies, and geo-botanical anomalies which can be detected with EO methods.

Direct detection is defined as the detection of either oil pools or mineral alteration related to seepages. Indirect detection focuses on secondary effects resulting from the seepage of light hydrocarbons to the surface, notably changes in the vegetation structure (vegetation stress that can be observed using optical data).

Detection of oil leaks from pipelines is a novel technology that detects methane or ethane emissions (based on hyperspectral infrared analysis).

Very high and high resolution hyperspectral data can effectively detect oil seeps. Improved hyperspectral data from space (e.g., EnMap) will allow EO methods to compete with aerial techniques. Currently available multispectral very high and high resolution EO data also provide useful products.

The hydrocarbon seeps product delivers analytical results delineating the location and extent of detected seeps. A report is included providing the confidence of detection associated with each seep area.

#### Known restrictions / limitations
Availability of optical data is limited by cloud cover and seasonal changes in the environment (e.g., snow).

Direct methods to detect macro seeps work best in areas with minimal or no vegetation. Indirect methods are less reliable.

The desired spatial scale and sensitivity for pipeline leak detection cannot be currently delivered with current EO systems, making collection by airborne sensors a preferred method. New EO systems will be available shortly which may be competitive with aerial methods.

### Lifecycle stage and demand

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<th>Exploration</th>
<th>Production</th>
<th>Decommission</th>
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*Pre-License and Exploration*: Hydrocarbon seepages detection is important in exploration. Macroseep detection has contributed to the discovery of several of the most important oil and gas fields in the world. Companies would like information on oil content around existing or former onshore oil and gas facilities.

*Development*: N/A

*Production*: Hydrocarbon leakage detection is an increasingly important component of pipeline management.

* Decommissioning*: Environmental monitoring in post-production.

### Geographic coverage and demand

Seeps occur predominantly in the tectonically active areas. North America is a key market for pipeline leak detection.

### Challenges Addressed

OTM:025  Early identification of potential hydrocarbon basins

HC:5402  Detection of oil contamination and oil seeps

### PRODUCT SPECIFICATIONS

#### Input data sources

**Optical:** VHR1, VHR2, HR1, HR2, MR1

**Hyperspectral:** Hyperion, EnMap (DLR planned launch after 2017), CHRIS (PROBA-1)

**Supporting data:**
- Surface geology mapping data
- Field spectroradiometer measurements

#### Spatial resolution and coverage

Spatial resolution: 1–60 m.

#### Minimum Mapping Unit (MMU)

Variable, depending on source data.

#### Accuracy / constraints

**Thematic accuracy:** 60-70% for direct detection.

**Spatial accuracy:** Depending on input data, but within 1 pixel desirable.

#### Accuracy assessment approach & quality control measures

In-situ measurements and confirmation of seeps or leaks detected.

#### Frequency / timeliness

**Observation frequency:** Depending on the sensor, from daily acquisitions (e.g., RapidEye) to 16 days per acquisition (e.g., ASTER).

**Timeliness of delivery:** Processing can be completed in near real time (< 24 hours) for leak detection. The processing of data for seep detection requires professional/expert interpretation and is typically a consulting assignment of weeks to months.

#### Availability

On-demand availability from commercial suppliers (standard optical systems).

ASTER, Sentinel-2, Landsat8: available at no charge.

#### Delivery / output format
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<tr>
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<tbody>
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<td>• Geotiff</td>
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<tr>
<td>• Vector (depending on customer needs)</td>
<td>• Shapefile or any other OGC standard file formats</td>
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<tr>
<td>• Likelihood/confidence report</td>
<td>• Standard office formats</td>
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Download product sheet.

<table>
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<th>Lead author:</th>
<th>Hatfield Consultants/SRC</th>
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