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Utilization of ultraviolet light for the detection of hydrocarbon seeps at a historic condensate spill in Central Alberta

RemTech 2026

Presented by

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1 Introduction

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2 Site background

Site background



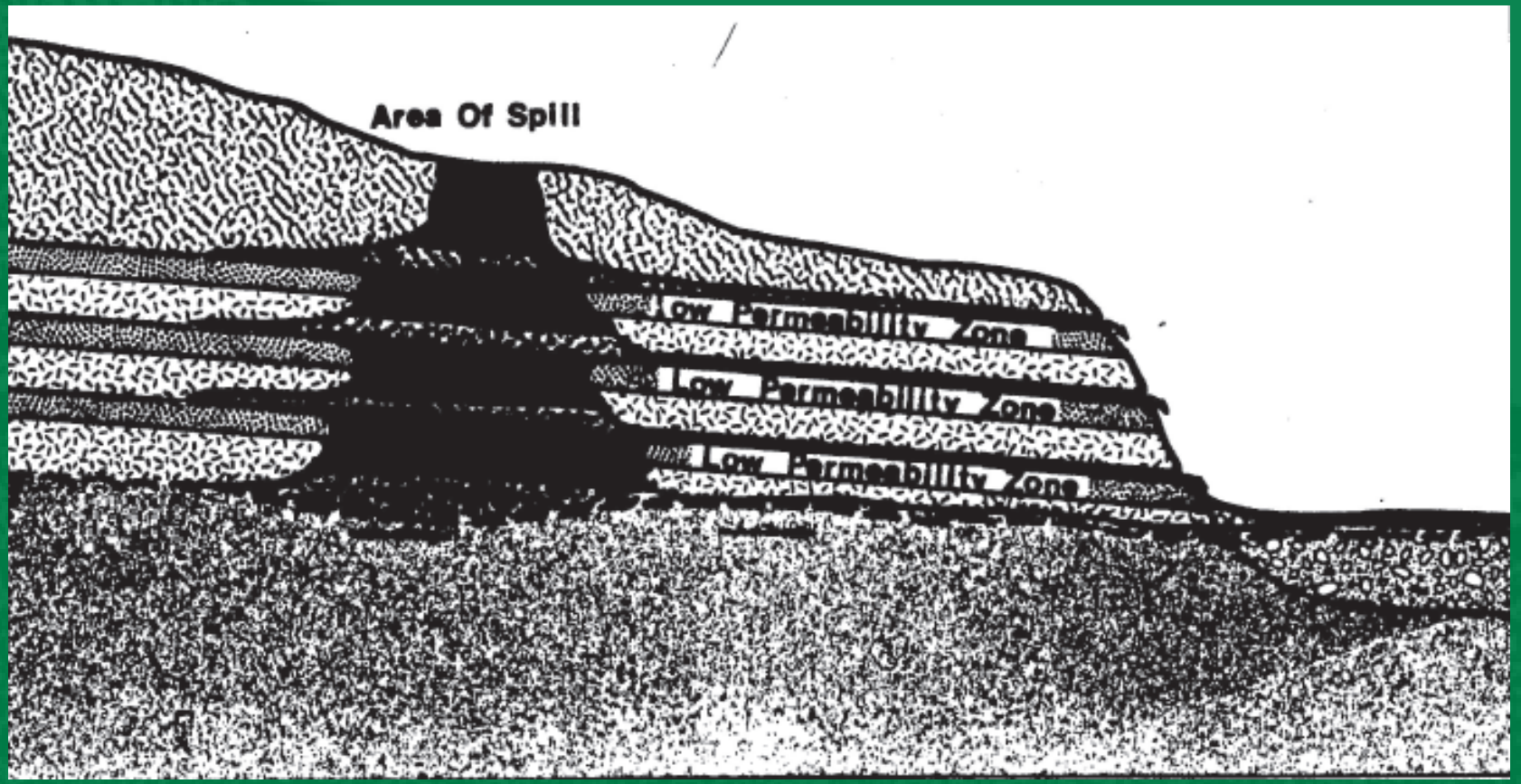
Site is a historic condensate release in northern Alberta associated with oil and gas operations.

Release event occurred in the mid-1980s with ongoing assessment and remediation work .

Contamination is associated with light end hydrocarbons (condensate) present in a dissolved phase and an LNAPL plume.

Hydrocarbons continue to discharge from seeps and springs into the environment where they undergo rapid biodegradation.

Site conceptual diagram



LNAPL migration concept

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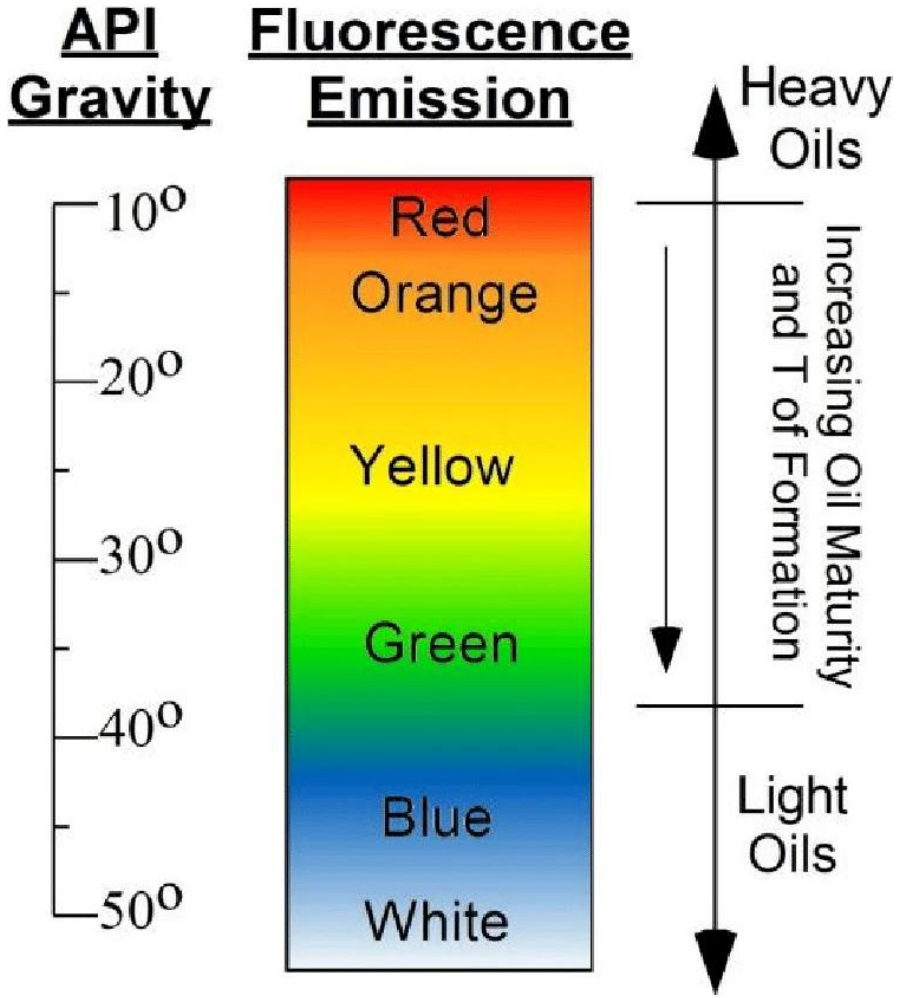


3 Technology description: Hydrocarbons and UV

Hydrocarbons and fluorescence

- **Many hydrocarbons fluoresce under UV.**
- **Different UV frequencies produce different yields of fluorescence.**
- **The intensity of fluorescence is a function of the content and the chemistry.**
- **The colour of fluorescence is dominated by the chemistry of the hydrocarbons.**
- **The colour of hydrocarbons fluorescing under human vision ranges from electric blue to a deep, dark red.**
- **Lighter hydrocarbons emit more intense fluorescence. Heavier, more weathered hydrocarbons emit less intense signals.**

  Redshifting is a function of both chemical weathering and volatile loss. Intense blues in unweathered material mask weaker reds.

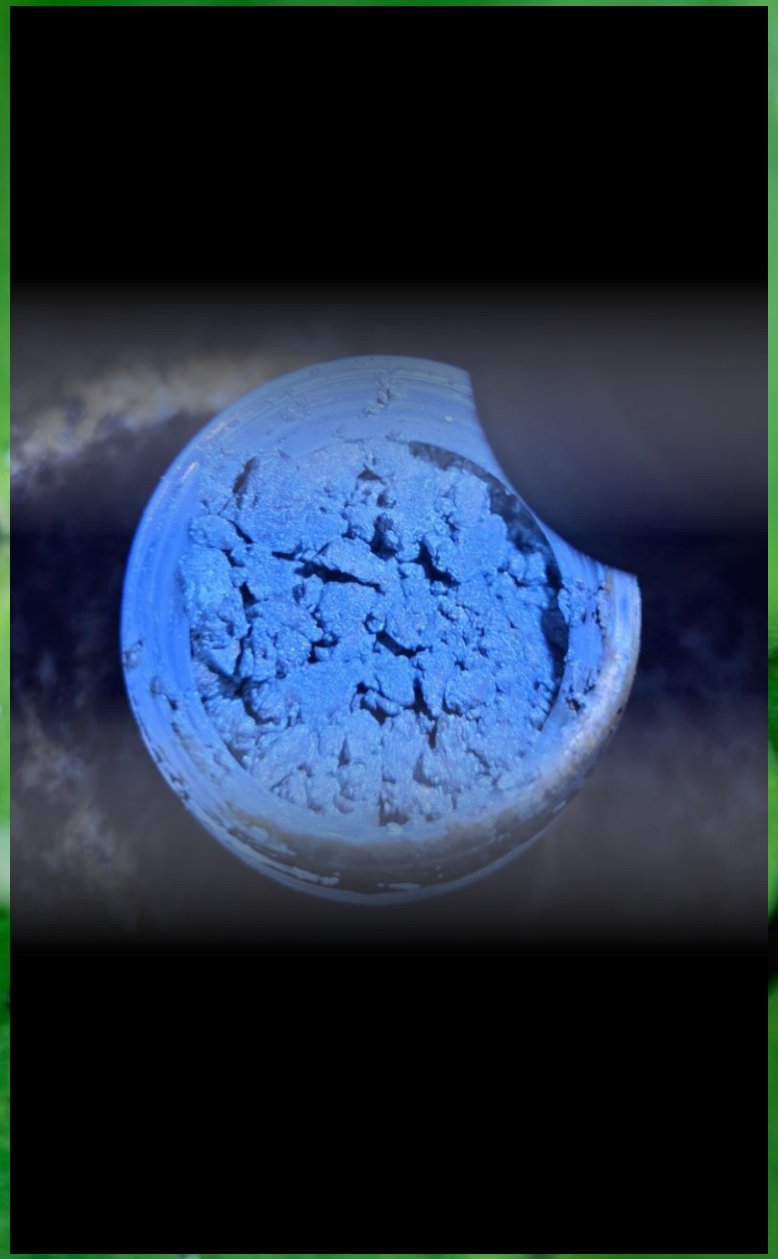


From: Costanzo, Alessandra & Hunt, Jon & Feely, Martin. (2017). Fluid Inclusion Studies of 47 samples from Ogmund E-72 Well #70.

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Site hydrocarbon sample

Soil samples collected on site to test fluorescence and confirm frequency response (λ365 nm).







4 Methodology



Methodology of the survey

UV detection

- λ365 nm and λ395 nm
- Modern LED flashlights produce excess visible light that interferes with accurate observation of the fluorescence
- Wood’s Glass or ZWB2 filter glass

Night survey

- Areas of known seeps were identified and a survey planned during night
- Dark-adapted eyes
- Logistical complexities with executing work at night in a remote area

Following seep identification

- Shovel was used to expose the seep and expose fresh material and present a clean face to examine
- Humans described the fluorescence as well as photographs taken

Field description of fluorescence

Variables used in describing fluorescence:

- **Brightness**

  Quantifiable, not quantified.

  A five-point scale for simple qualitative description was used: Barely visible, dim, moderate, bright, very bright.

  To serve as a “very bright” control reference, a sheet of office paper that contains optical brighteners can be used.

- **Colour**

  Highly detailed and artistic descriptions: Creamy orange-yellow, electric blue-white.

- **Texture**

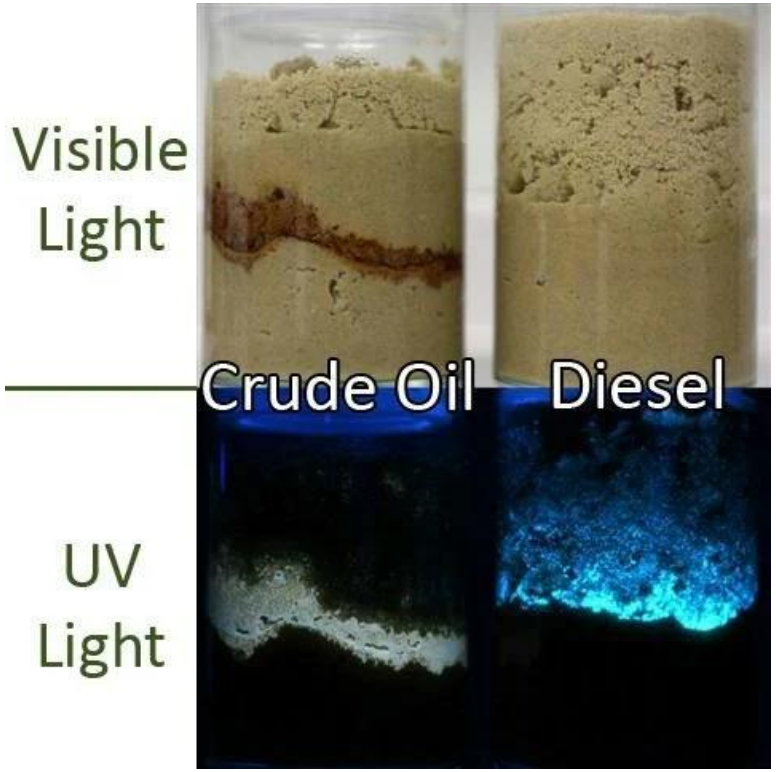
  Pattern of the fluorescence, both macroscopically and under 10x hand lens in sample.

  Is it uniform, coating grains, following roots and vegetation or in discrete pods?

- **Solvent cut**

  Adding acetone to bring out hydrocarbons onto the surface and describing changes in the above brightness and colour.

  Acetone doesn’t fluoresce on its own.



From: Prvanović, Aleksandar & Nikic, Zoran. (2022). Use of laser-induced fluorescence method in characterization of the site contaminated by petroleum hydrocarbons in United States. Zastita Materijala. 63. 122-127. 10.5937/zasmat2202122P.

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5 Results

Results at Seep 2



Seep 2 (UV)



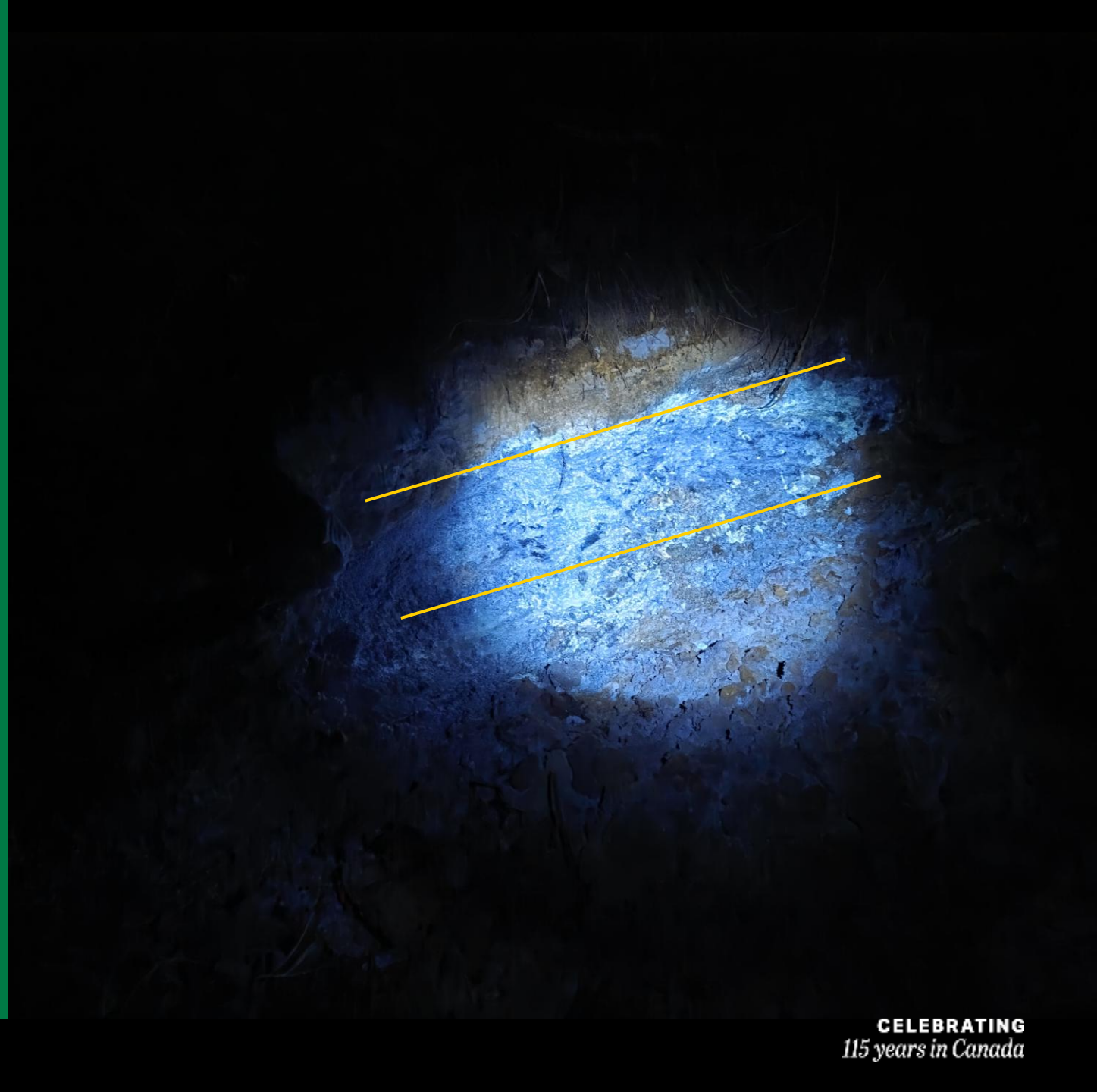
Seep 2 (Daylight)

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Results at Seep 2

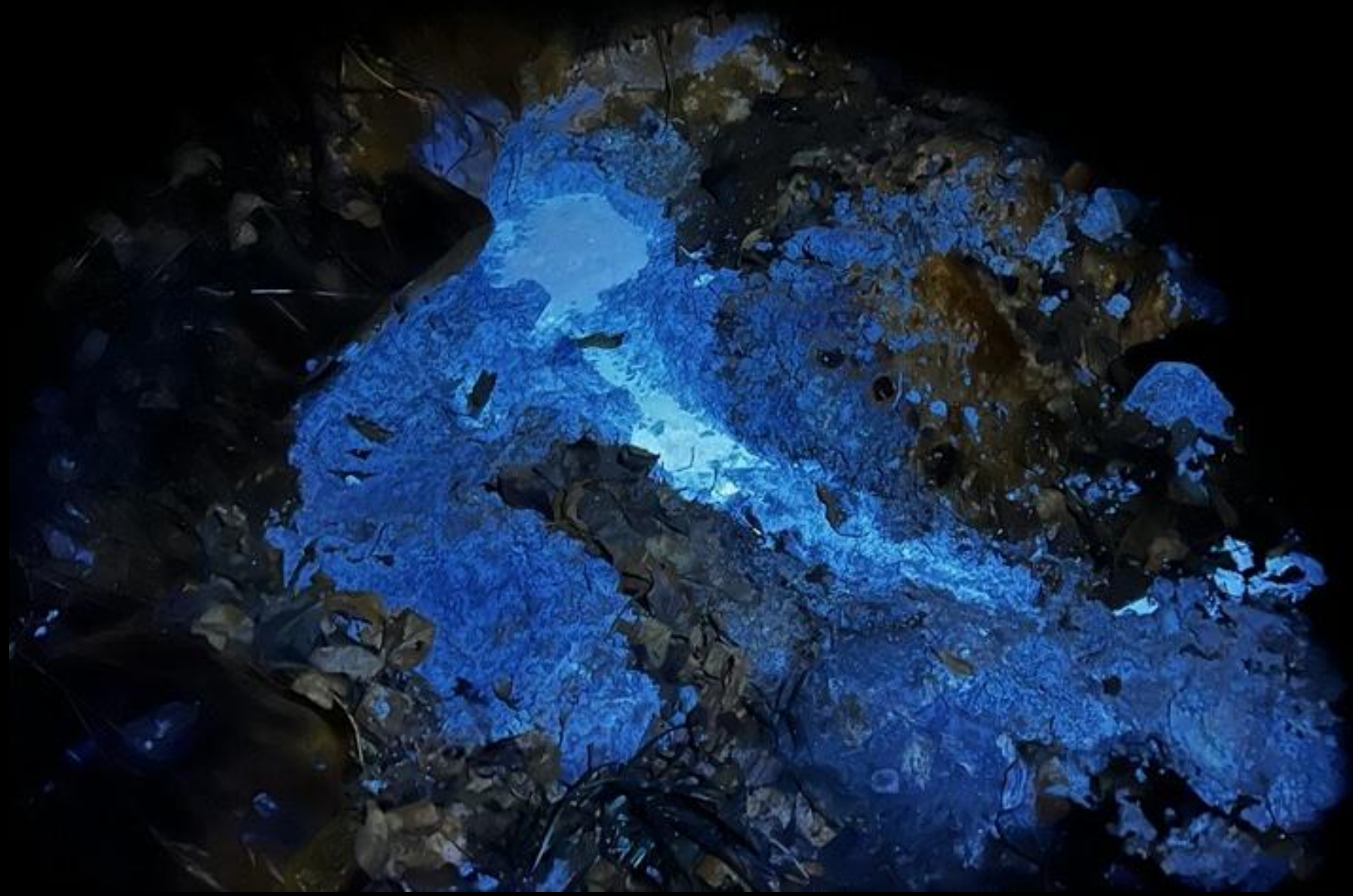
Intense blue suggests hydrocarbons have undergone limited weathering.

Staining in daylight suggests intensive weathering occurs within a short distance of hydrocarbon discharge.



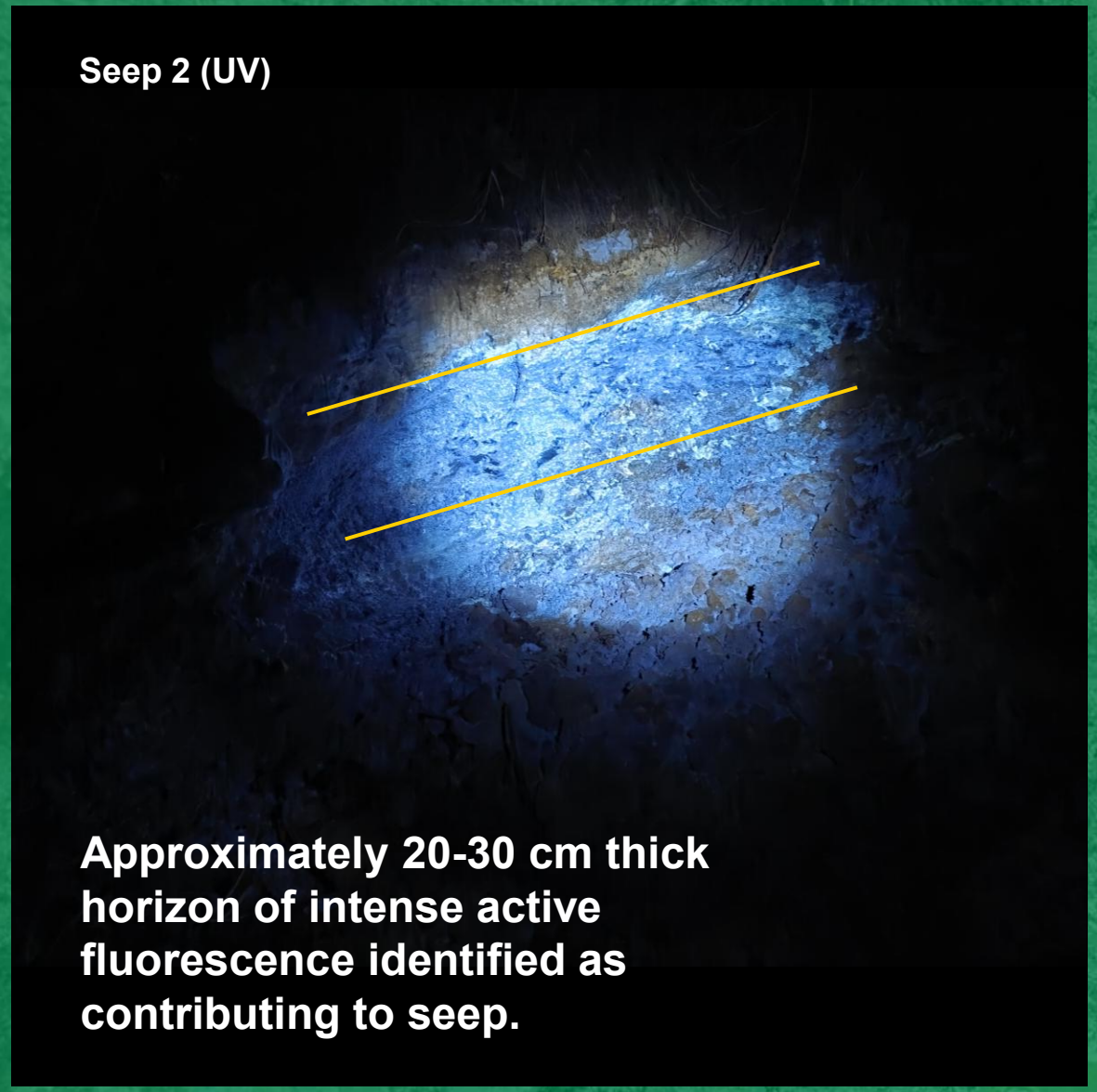
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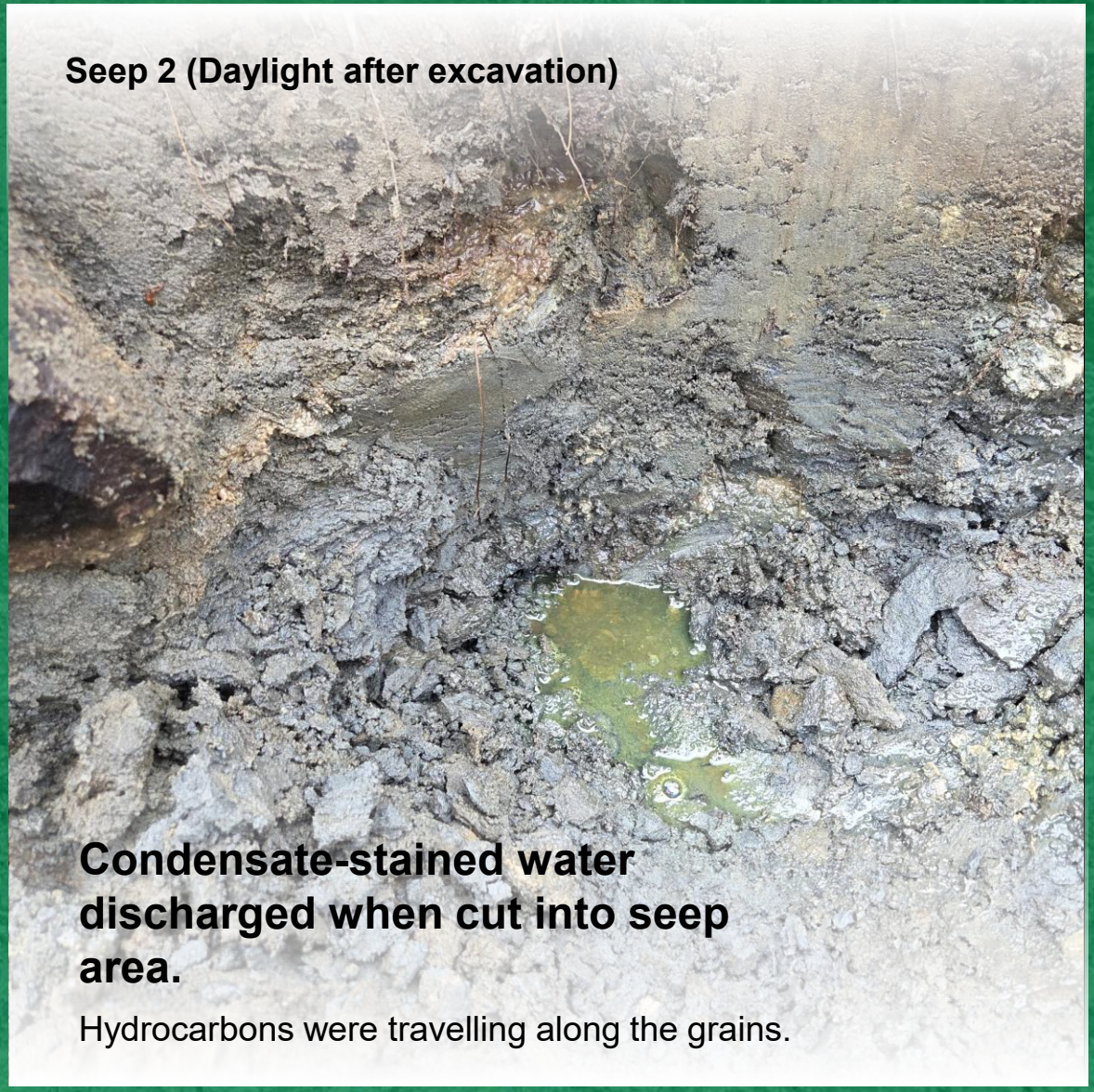
Results at Seep 2



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Results at Seep 2





Results at Seep 1





Results at Seep 1

Less intensive blue suggests hydrocarbons are slightly more weathered.

Approximately 6-8 cm thick horizon of intense active fluorescence identified as contributing to seep.



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Results at Seep 1

Red fluorescence on margin showing more intensive weathering in the near-surface and post-discharge.



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Results at Seep 1

Hydrocarbons were migrating in fracture planes of a weathered coal seam.



Seep 1 (UV)

Condensate bound to coal particles when disturbed.

"Starfield" of specks of light in the discharged water.

Seep 1 (UV)

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Results at Seep 1

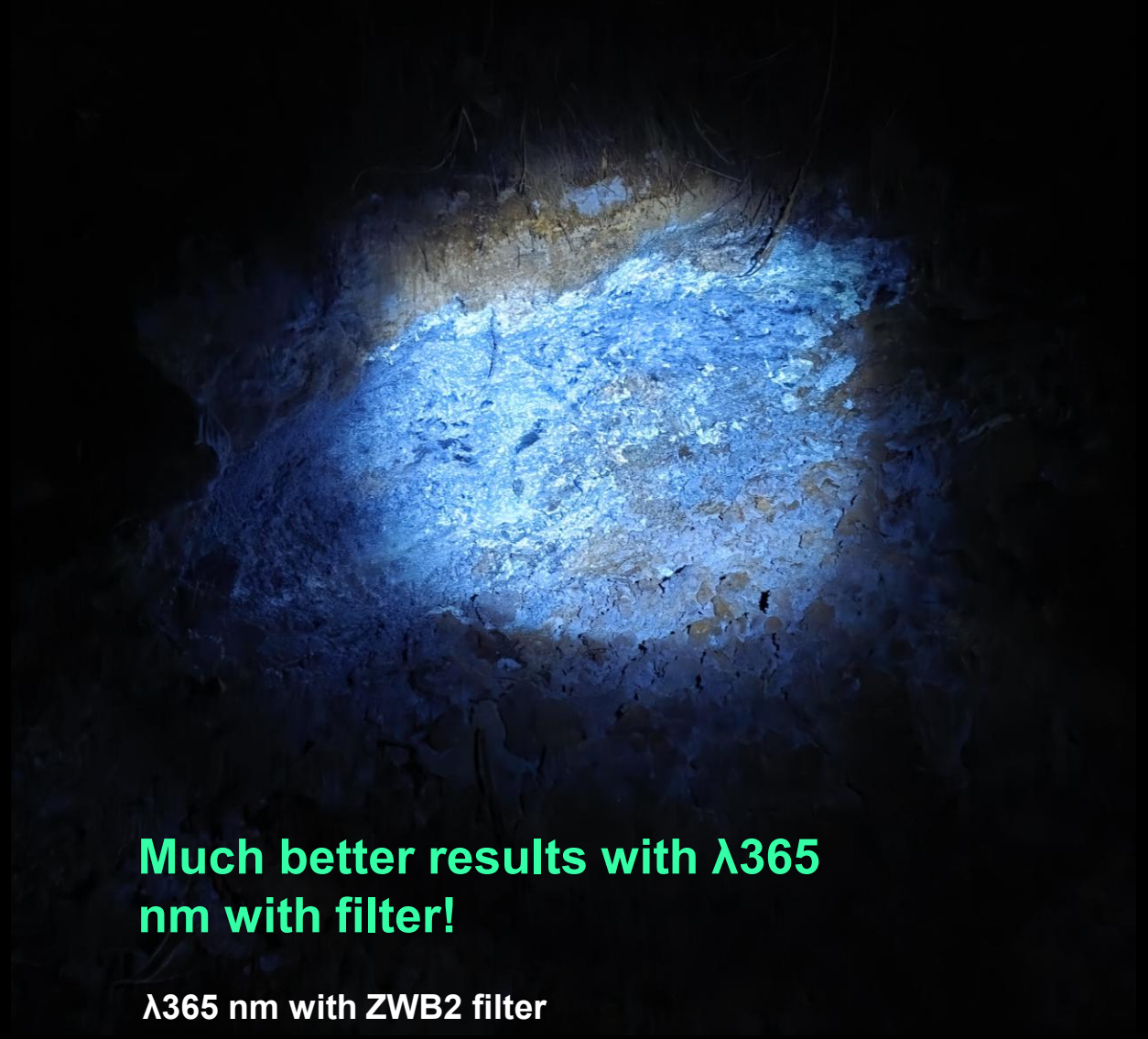




Results: Comparison of different wavelength light sources



λ395 nm without filter



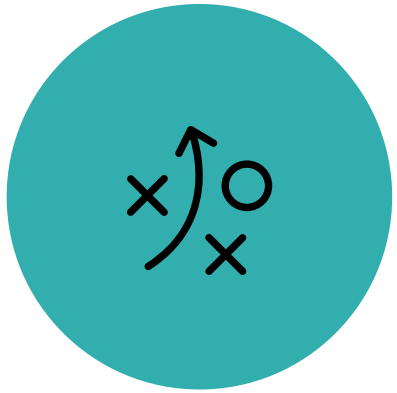
Much better results with λ365 nm with filter!

λ365 nm with ZWB2 filter

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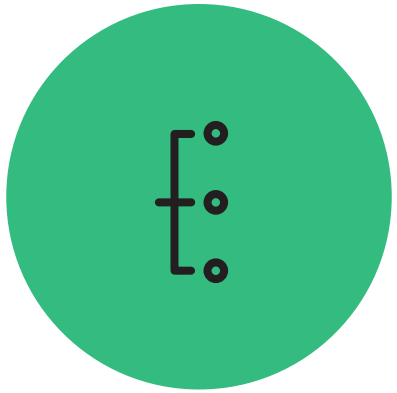

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Future work directions

Future work direction and plans



Initial work

- Expand the program to other sites
- Refine field descriptions
- Work on a better methodology for conducting work in daylight to avoid safety risks associated with night work



Quantification

- A talk on its own
- Quantifying the fluorescence with a chip on board spectrometer
- Quantifying light signal – Integration of spectra
- Peak detection and area by integration for quantifying colour



Construction of prototype hardware tools

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7 Summary

Summary of results and lessons learned

1. **UV is an effective tool for detecting and understanding hydrocarbons in the near surface.**

   Best results obtained using λ365 nm with ZWB2 filter.

2. **Work can be executed at night in remote areas.**

3. **Weathering of condensate occurs within a short distance of the surface.**

4. **Condensate transport and discharge are occurring within narrow distinct horizons.**

5. **Hydrocarbons are intensely weathering following discharge.**

6. **Active area of work to expand and develop new and better tools for our characterization of hydrocarbons on site.**

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