The Potential and Actual Presences of Soil Water Repellency in Preferential Flow Paths

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1. Introduction

- Water repellency is an important soil physicochemical property that strongly affects near surface soil water transport by creating a reduced infiltration capacity, increased runoff, and preferential flow.
- Preferential flow is the rapid movement of water and solutes through soils that bypasses large proportion of the soil matrix.
- Soil water repellency makes soil difficult to wet, thereby forcing water and solutes to flow via preferential flow paths(Fig. 1). The role that soil water repellency plays in development of preferential flow paths is not well known.

Fig. 1. a) Vegetation (Jack pine) cover in the sites, b) Presence of soil water repellency as shown by non-uniform wetting.

2. Objective

- This study was conducted to determine whether the potential soil water repellency is related to actual soil water repellency in preferential flow paths.

3. Materials and Methods

- Study Site: Long Term Soil and Vegetation Monitoring Plots 26 (57º51'N 111º43'W) and 27 (57º50'N 111º44'W) North Eastern, Alberta Canada (Fig. 2).

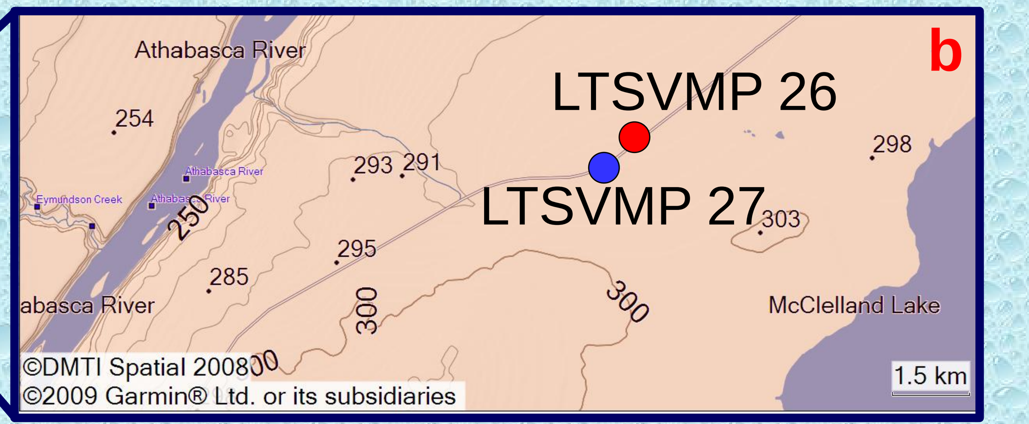
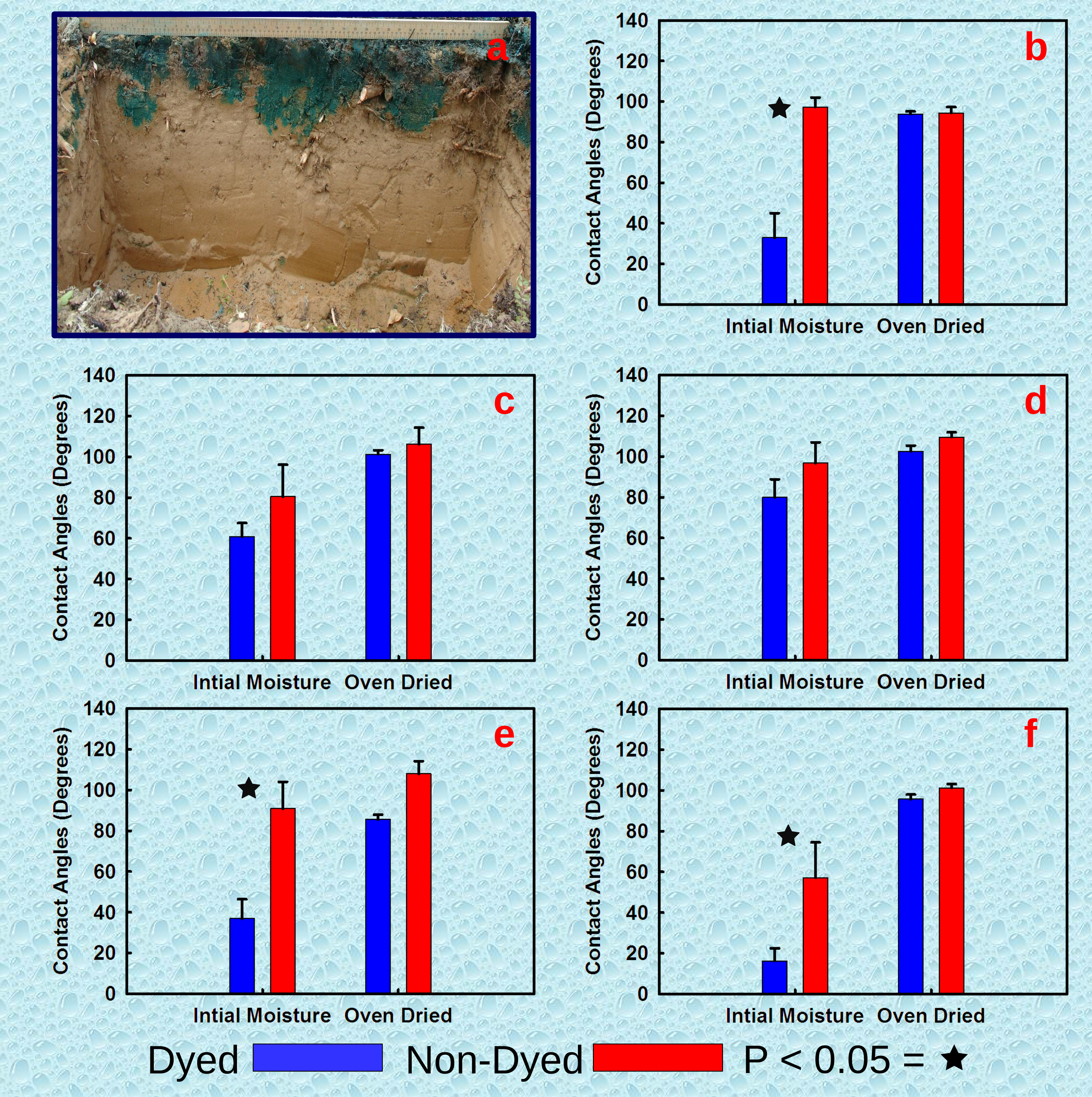


Fig. 2. a) Map of the area occupied by the Athabasca Oil Sands, b) Location of the Long Term Soil and Vegetation Monitoring (LTSVMP) Plots 26 and 27 where the pits are located.

- Preferential flow patterns were visualized by dye tracers (Brilliant Blue FCF) (Fig. 3a).
- Samples were taken from dyed and non dyed flow paths, as well depth and width were taken so the precise point where the sample was taken could be assessed for soil water repellency (Fig. 3a).
- Water drop contact angles were measured in the soil sample initially for the actual degree (initial moisture) of soil water repellency. Sub samples were then oven dried at 105 ° C for 24 hours to determine the water content.
- Water drop contact angles were finally measured on oven dried soil to determine the potential degree of soil water repellency.

4. Results & Discussions



- **Figure 3.** a) Photograph of preferential flow paths visualized by Brilliant Blue FCF dye tracer in excavated soil pits. Plot of the mean contact angle in degrees between dyed (preferential flow paths) and non dyed samples (soil matrix), on samples with calculated initial moisture(actual) and oven dried sub-samples (potential) from b) soil pit 1, c) soil pit 2, d) soil pit 3, e) soil pit 4, and f) soil pit 5.

4. Results & Discussions (Cont.)

- There was a lower degree of soil water repellency in soils from preferential flow paths (dyed) compared to the soil matrix (non-dyed) (Fig. 3).
- Higher degree of soil water repellency was observed in oven dried soil samples from preferential flow paths compared to soil samples with initial moisture (Fig. 3).
- This suggest that soil in preferential flow paths has the potential to exhibit soil water repellency.
- Soils in the soil matrix showed similar degree of soil water repellency between soil samples with initial moisture and oven dried (Fig. 3).

5. Conclusions

- Soils in the preferential flows paths have a lower degree of soil water repellency as opposed to the soil matrix. This is due to increased water content compared to the soil matrix.
- Potential soil water repellency is related to actual soil water repellency in the soil matrix as compared to soils in preferential flow paths.

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