

Dermal *in vitro* bioavailability of HMW PAHs in Gasworks soils

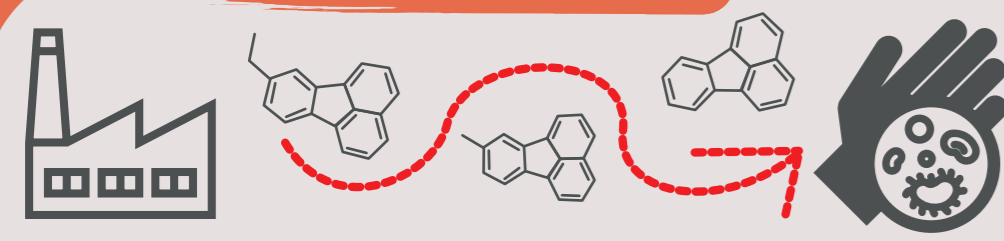
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BACKGROUND



This NERC and industry funded PhD research project has investigated the relationships between the *in vitro* dermal bioavailability of different high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs) and the bulk soil organic matter (OM) from highly contaminated gasworks sites. Both parent and alkylated HMW PAHs were investigated.

RESEARCH QUESTIONS



Are there differences in the dermal bioavailability between different parent and alkylated PAHs?



Which soil bulk organic matter (OM) properties determined by Rock-Eval(6) Pyrolysis have influence on the dermal bioavailability of both parent and alkylated PAHs?



Dermal *in vitro* experiments were conducted in triplicate for each time step for each soil sample. Dermal matrices (soil, membrane and receptor solution) were dried, weighed, and processed using accelerated solvent extraction (ASE) and solid phase extraction (SPE). Quantification of PAHs was determined by GC-MS/MS.

Experiment Conditions:

- Soil surface area: 8.55 cm²
- Soil moisture content: 25%
- Temperature: 32 °C
- Time Steps: 1, 10, 24 h
- 5 GW soils and 1 CRM soil

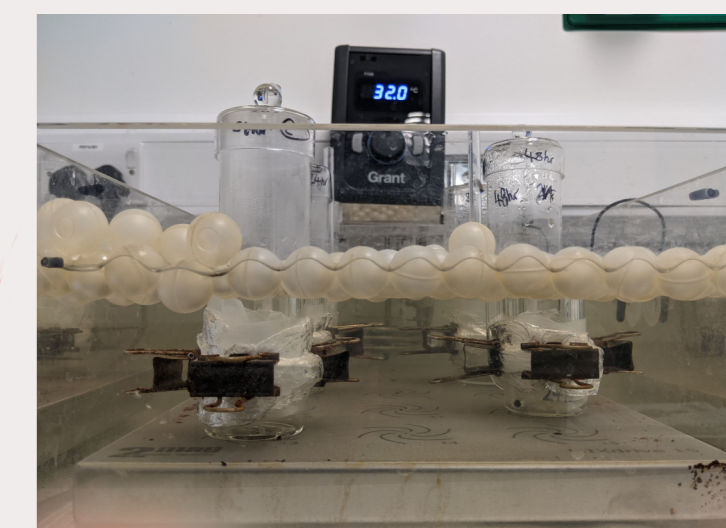


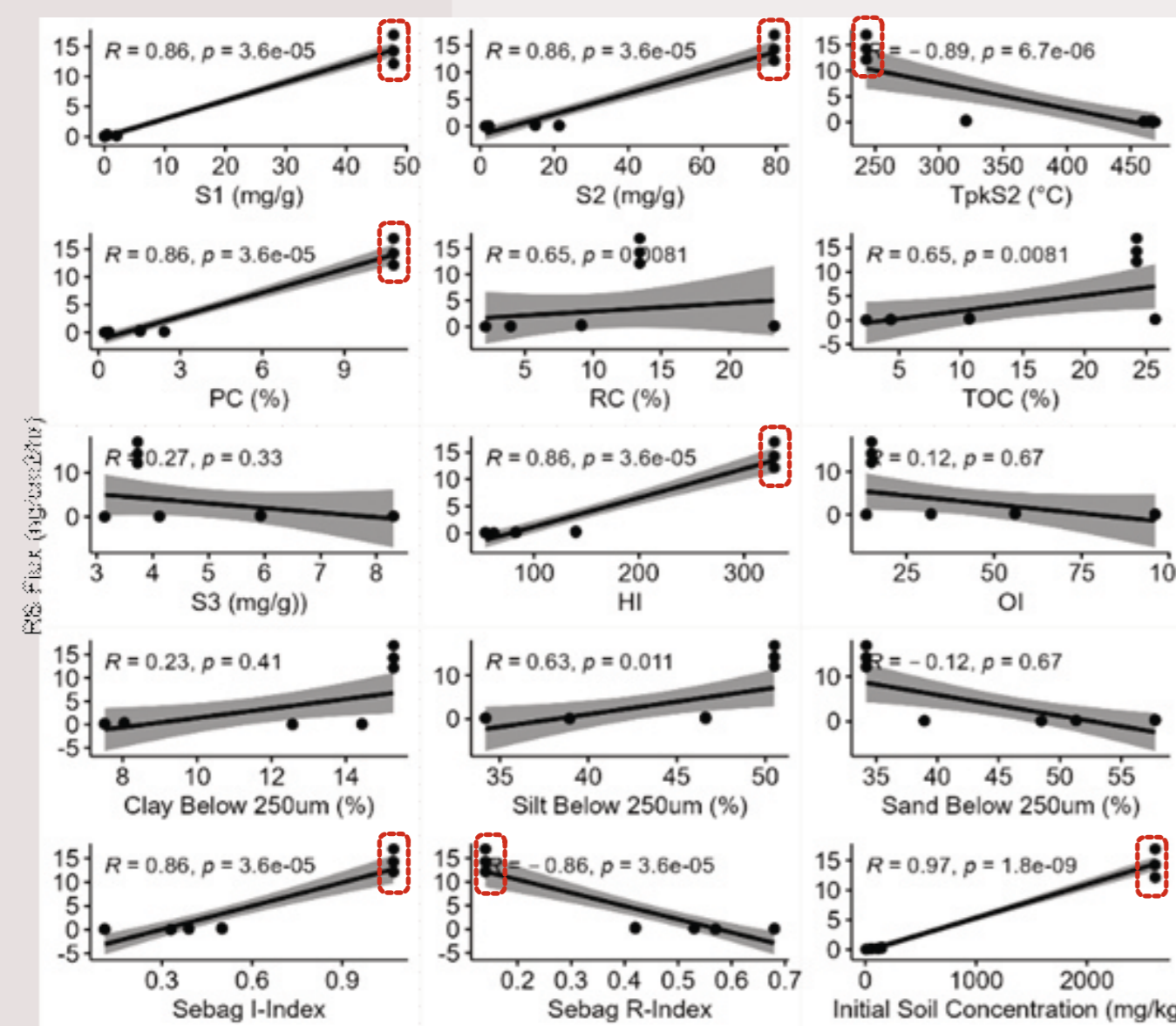
Figure: Photo of dermal *in vitro* experiment in lab.

METHODS

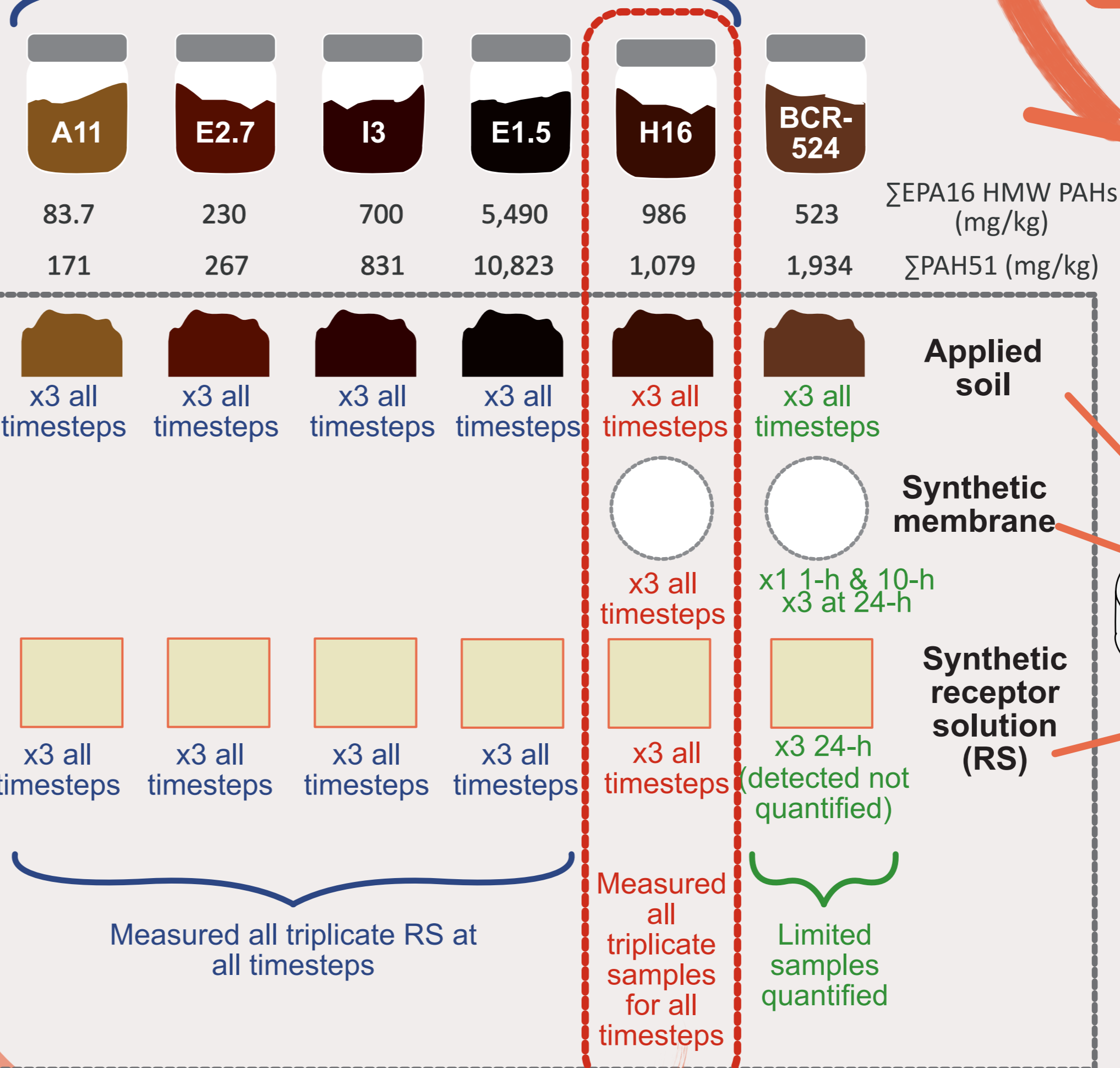
CORRELATIONS WITH ROCK-EVAL(6) PYROLYSIS

Rock-Eval(6) Pyrolysis (RE) is capable of measuring the release of hydrocarbons with increasing temperature. Key findings:

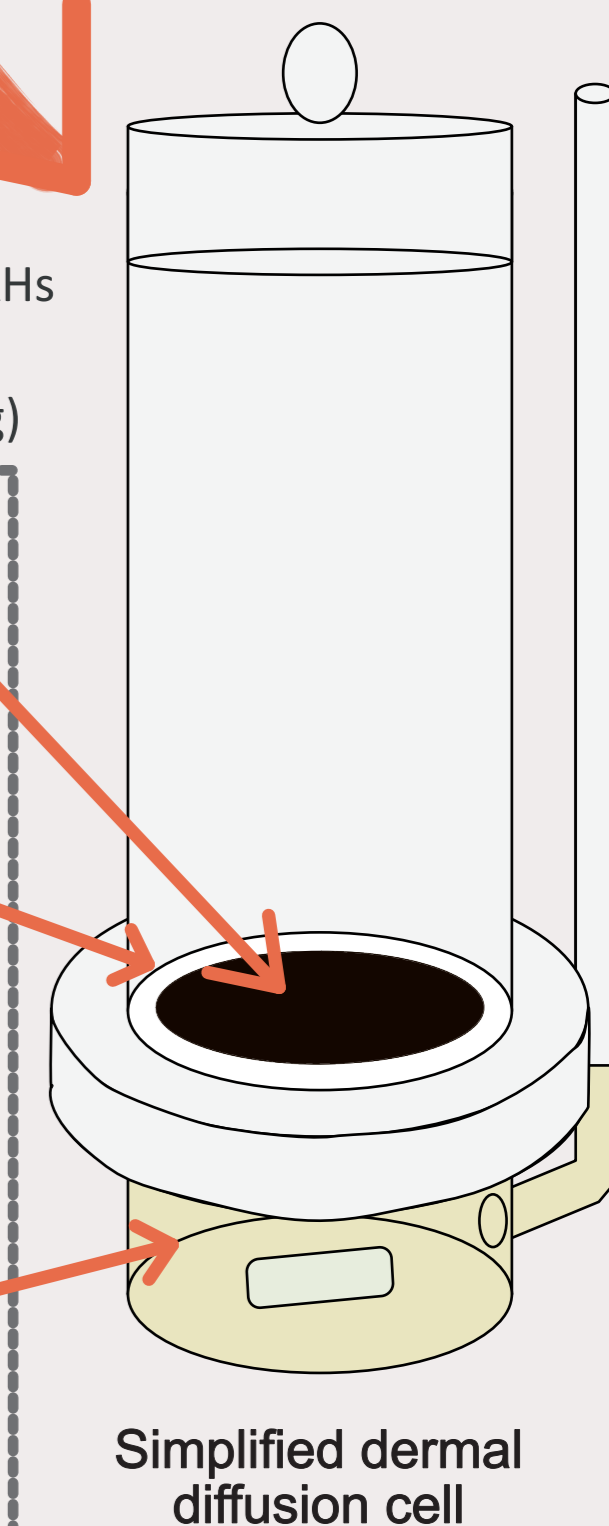
- Common correlation trends for RS fluxes and RE parameters for 12-13 HMW PAHs for the 5 MGP soils.
- Increasing amounts of labile OM (cracked at lower temperatures) increased dermal fluxes. E.g. High S1, S2, TpkS2, HI and I-index.
- Correlations predominantly driven by highly contaminated E1.5 (highlighted in red) - creating uncertainties with predictions.



MGP Soil Samples



SAMPLES ANALYSED



CONCLUSION

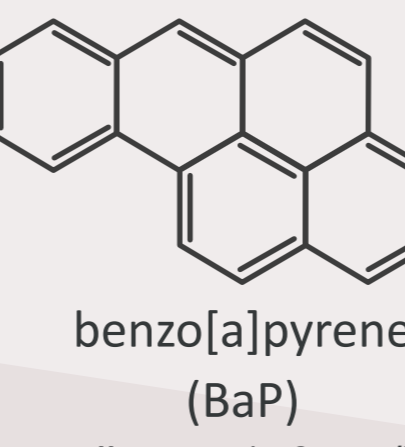
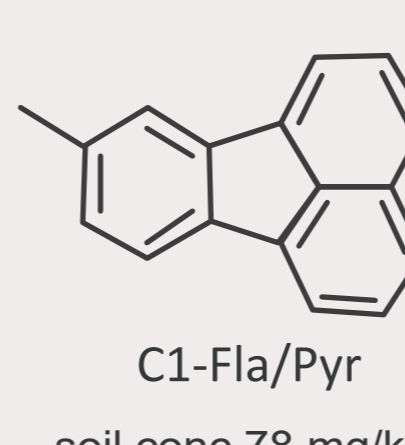
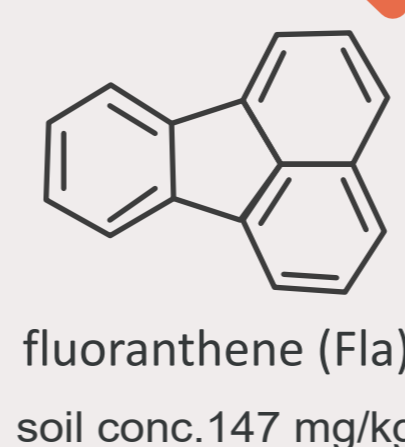
Some of the key findings found in this research are:

- HMW PAHs measured different dermal bioavailabilities in different soils - suggests soil impact.
- 4-ring HMW PAHs measured highest dermal absorptions.
- HMW PAHs can remain for long periods in the skin (especially with increased ring size).
- Alkylated C1-Fla/Py breakthrough into membrane and RS at longer timesteps.
- RE could potentially help with estimating dermal bioavailabilities risks with HMW PAHs, but future work needed on a larger soil dataset.

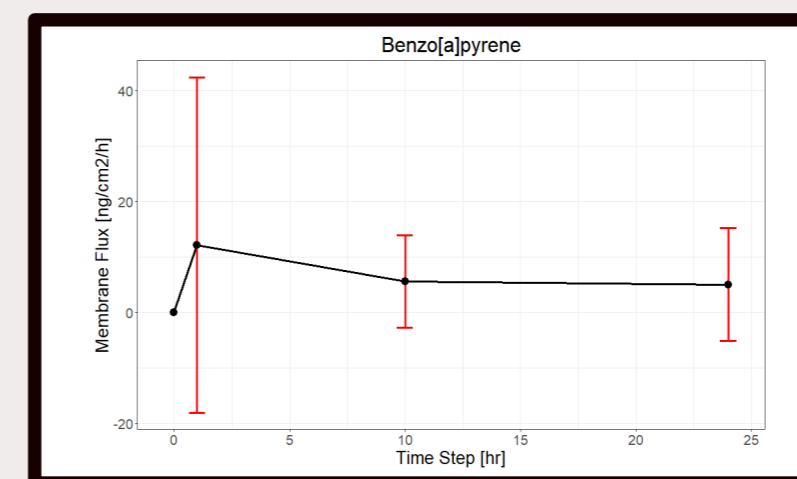
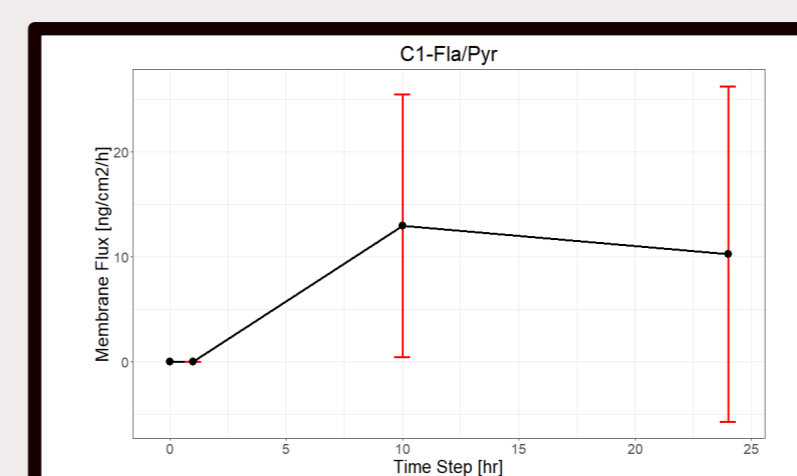
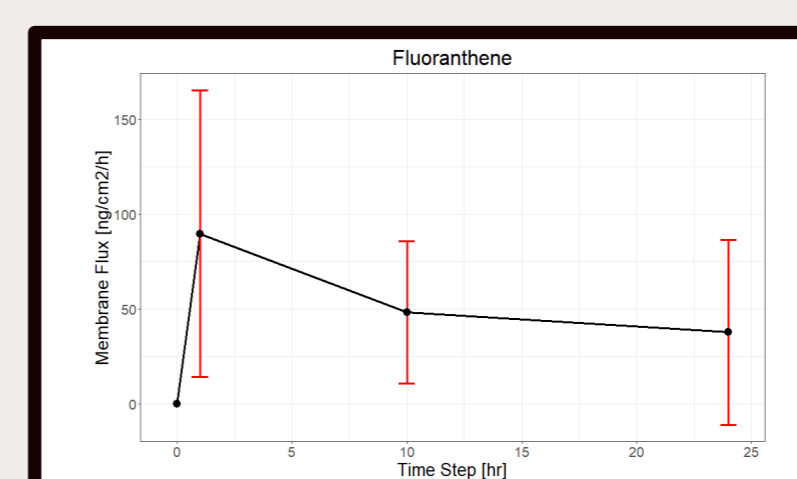
SAMPLE H16 STUDY

Dermal fluxes (penetration rate) for 27 parent & alkylated HMW PAH at each timestep were calculated. Examples in plots on the right. Key findings:

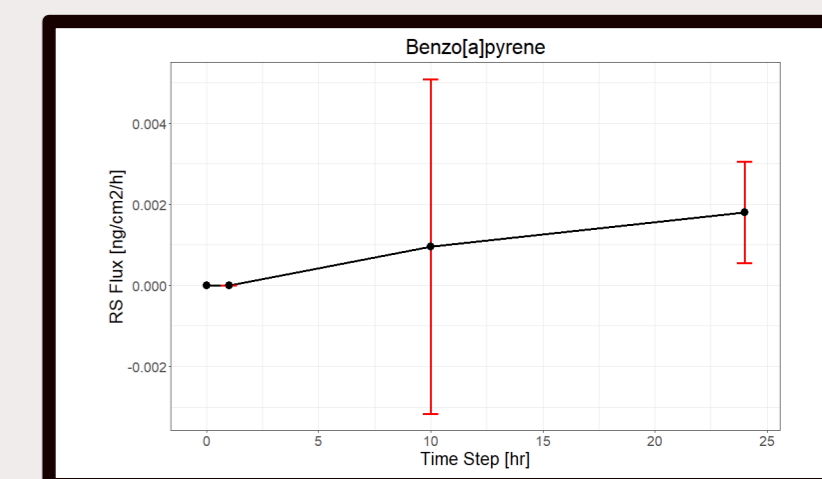
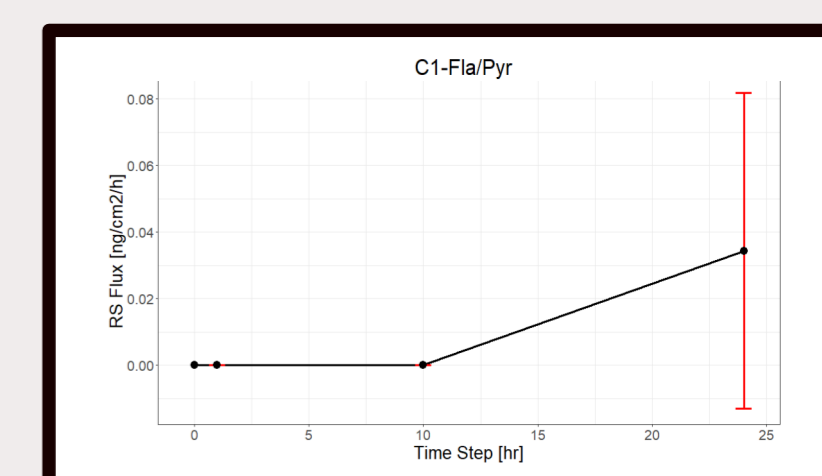
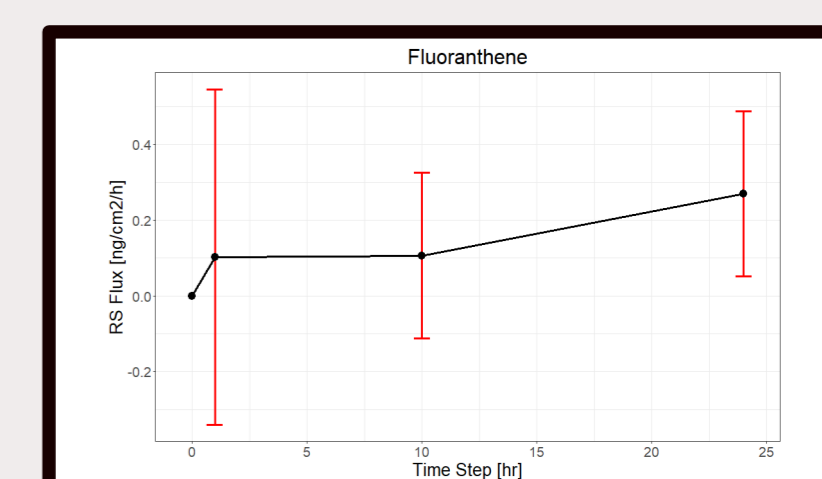
- Majority of available PAHs within membrane, membrane flux >> RS flux.
- Increase ring size or alkylation decreases dermal fluxes.
- The only alkylated HMW PAH compound detected and third highest flux at longer timesteps was C1-fluoranthrene/pyrene (C1-Fla/Pyr).
- HMW PAHs fluxes fall below previous studies and current HHRAs guidance with BaP. (UK dermal absorption fraction (ABS_d) 0.13, H16 ABS_d was 0.0086 for 24-h).



Membrane



Receptor Solution



*Note y-axis flux (ng/cm²/hr) different scales, error bars 95% CI.