Strategies for Characterizing Shallow Soil Gas Flux and Chemistry, Blan Farm, Hancock County, Ky.

Investigators:

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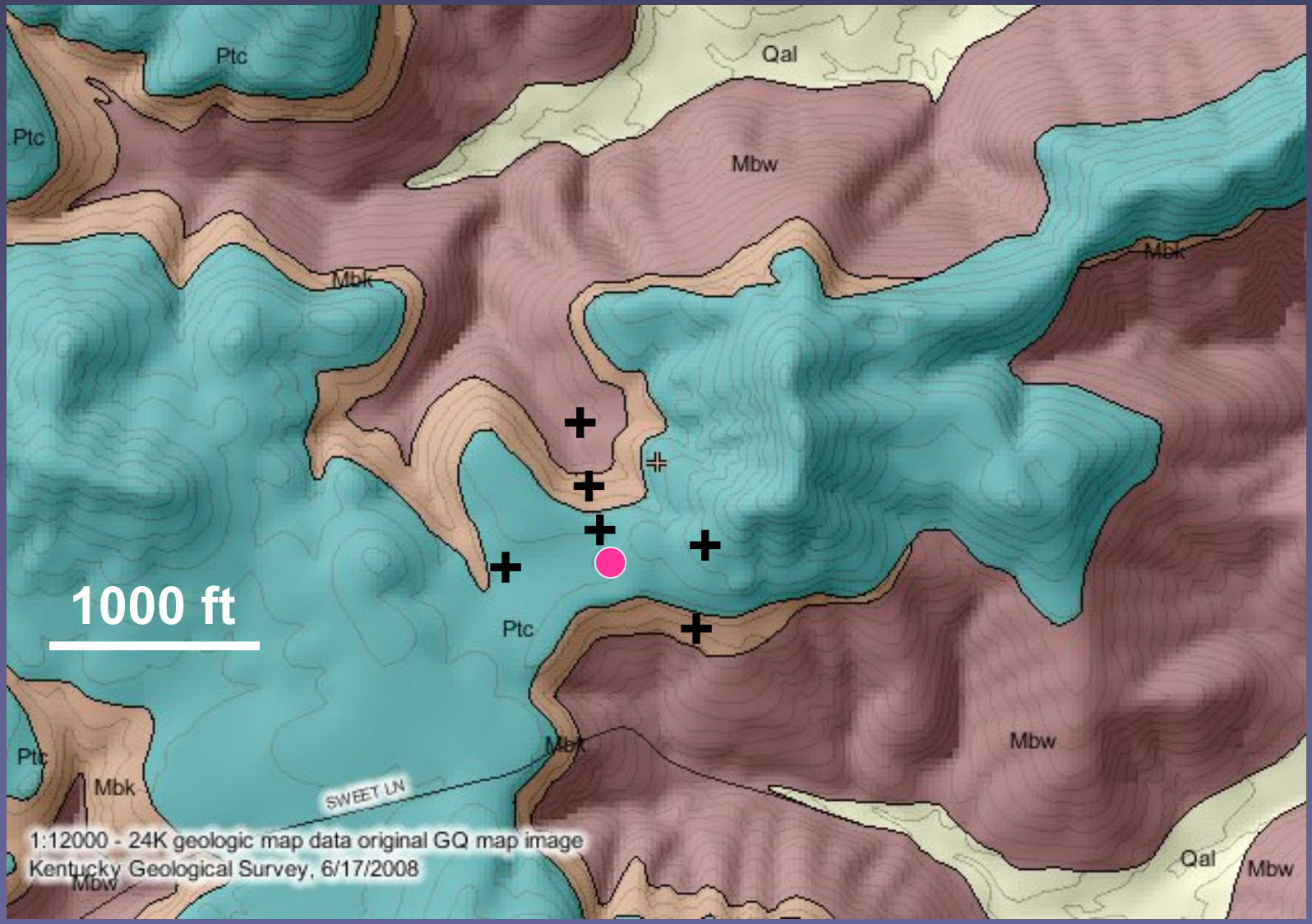
Monitoring, Mitigation, and Verification (MMV)

- MMV—portfolio of geophysical, geochemical, geological, and engineering techniques used to accurately document the fate of CO_2 injected into subsurface reservoirs.
- DOE's perspective—successful sequestration means that 99% of injected CO_2 remains in the reservoir for geologically significant time periods.
- *"For surface and near-surface soil gas measurements to be effective as an MMV tool, need to understand natural carbon cycle and its variability." (GEO-SEQ, 2004)*

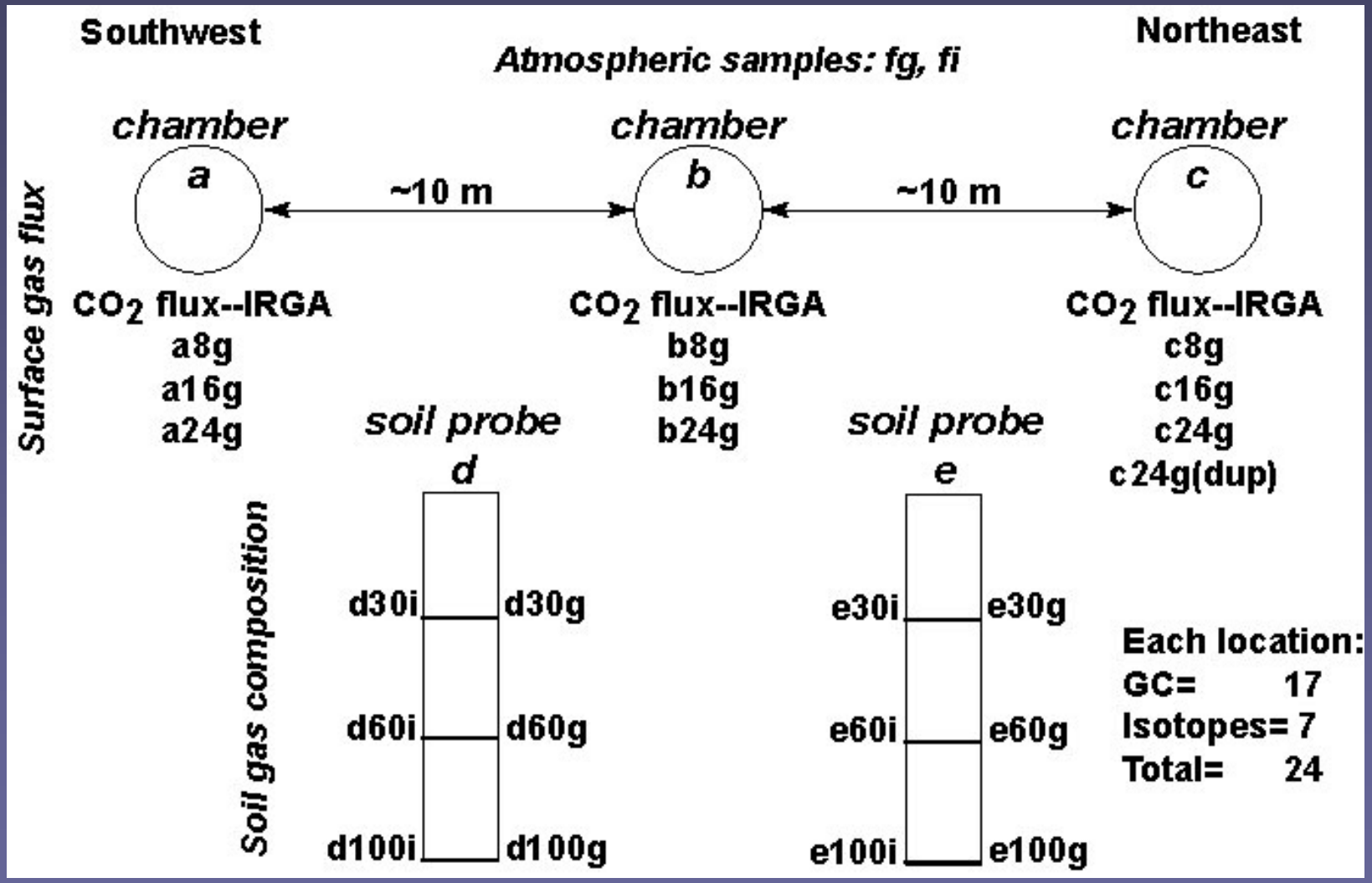
Soil Gas Chemistry Objectives

- Develop pre-injection database characterizing atmospheric, biologic, and geologic (microseepage) contributions to soil gas flux and chemistry
- Use database to resolve anomalies, if any, during injection and post-injection phases
- Evaluate influence of basin specific factors on soil gas flux and chemistry, e.g. shallow coals and reclaimed mine lands
- *The challenge: resolve microseepage signal << biologic and atmospheric signal*

Blan Farm Geologic Setting



Shallow (< 1 m) Measurements



Shallow Soil Gas Chemistry

- Measured bulk (CO_2, CH_4, C_2H_6, C_3H_8) and carbon isotopic composition ($\delta^{13}C$-CO_2)
- Duplicate measurements per location at 30, 60, 100 cm
- Bulk and isotopic atmospheric composition also measured
- Characterize season variation and anthropomorphic influences

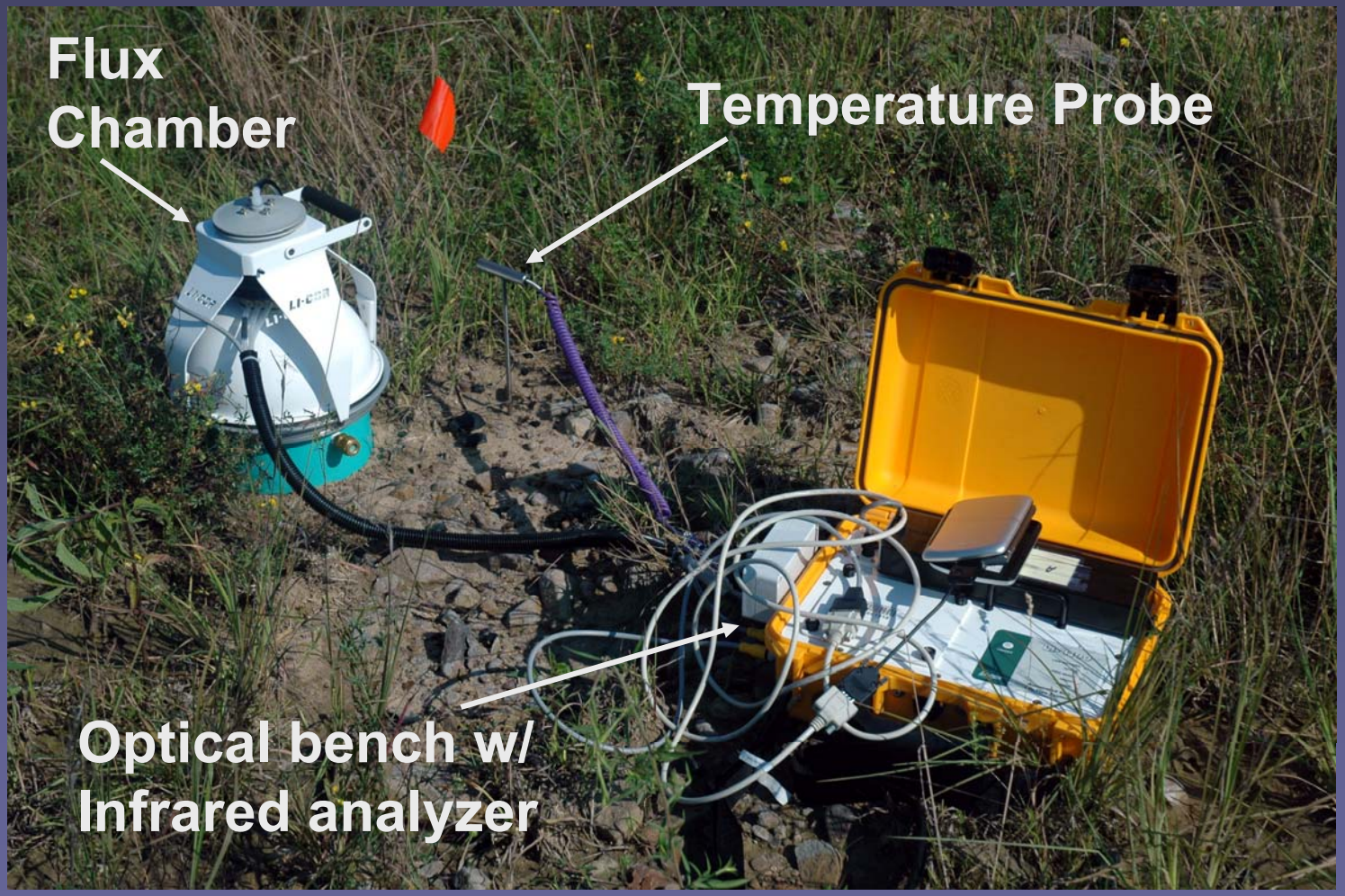
Shallow Soil Gas Chemistry

Collecting soil gases in Robinson Forest, fall 2005

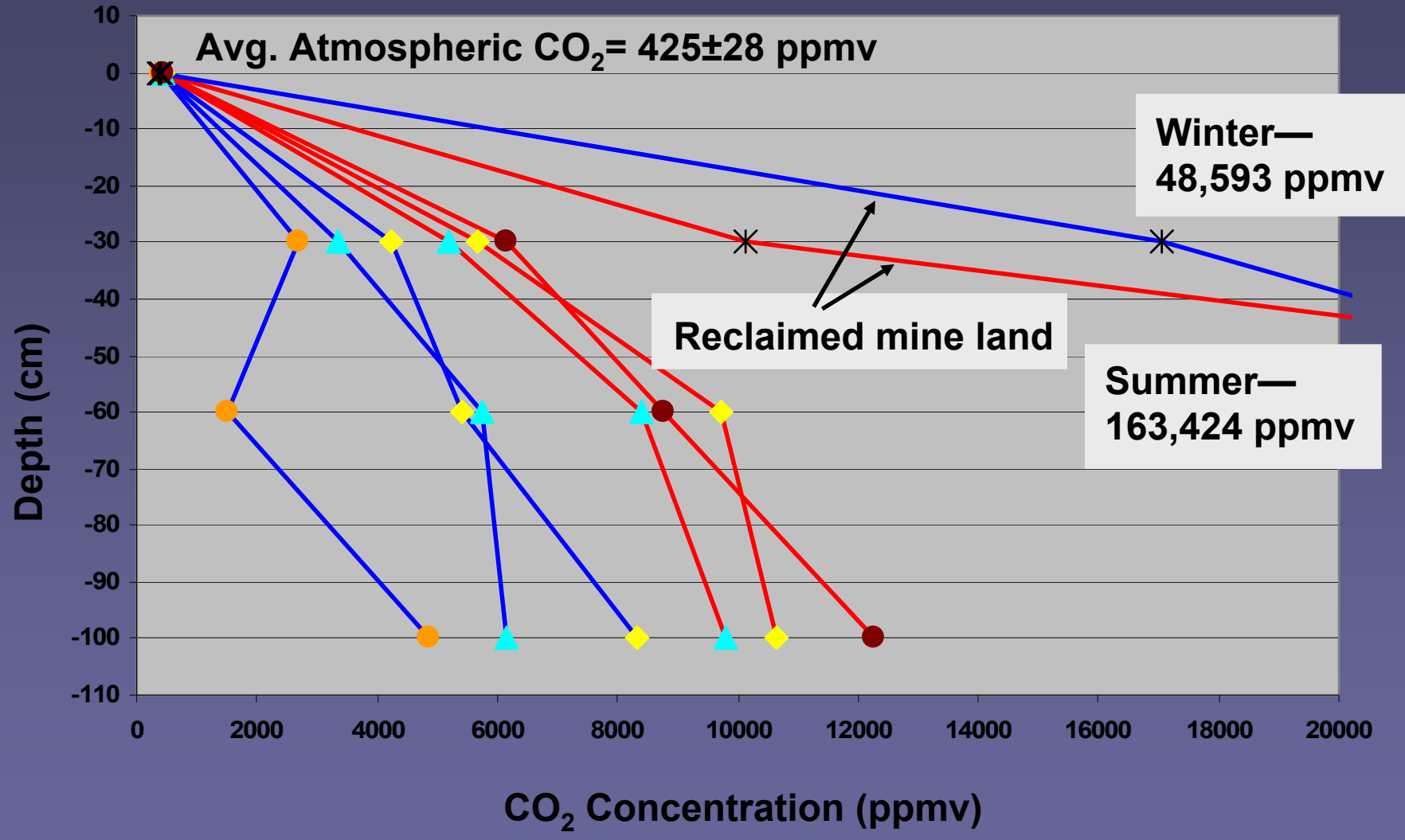
Soil Gas Flux

- Measure fluxes using closed chamber method
- CO_2 flux measured directly w/ Licor LI-8100 equipped w/ infrared gas analyzer
- CH_4 flux determined indirectly by measuring change in chamber composition w/ time
- Triplicate flux measurements per location to capture variability

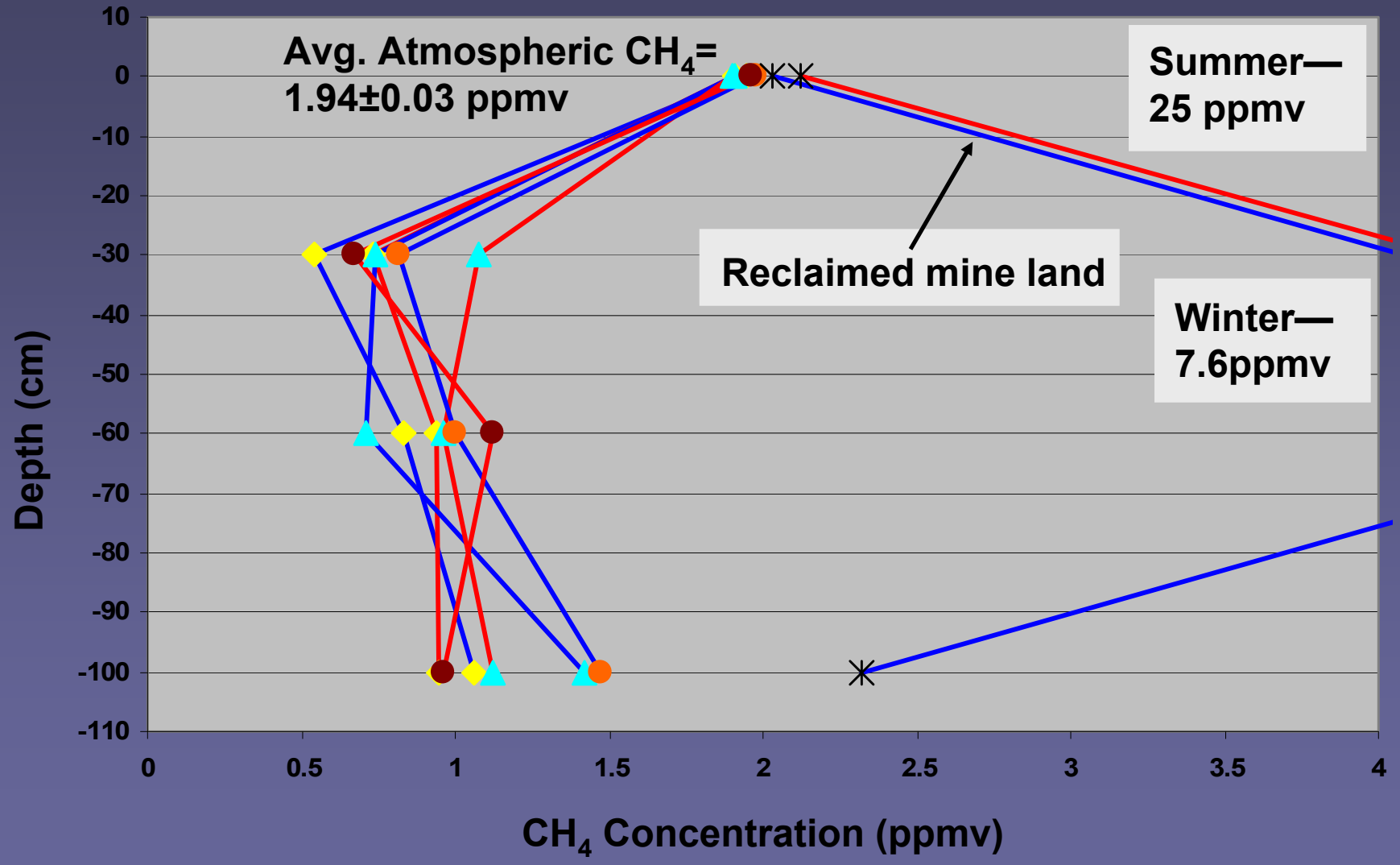
Soil Gas Flux



Average W06, S06 Soil Gas CO_2



Average W06, S06 Soil Gas CH_4



CO_2 and CH_4 Fluxes

- Positive CO_2 fluxes measured at all locations
- Summer (avg.= 15.7±6.2 grams/m^2/day, n= 84) > winter (avg.= 4.6±0.8 grams/m^2/day, n=83)
- For CH_4, most chamber locations (65%, n= 106) showed no consistent decrease or increase w/ time
- 28% (n= 46) showed negative CH_4 flux (avg.= 1.69±1.5 grams/m^2/day)
- 7% (n= 11) showed positive CH_4 flux (avg.= 1.31±1.4 grams/m^2/day)

Soil Gas Anomalies and Microseepage

- Positive CH_4 fluxes in oxidized soils
- Soil gas CH_4 concentrations consistently > atmospheric in oxidized soils
- Enriched $\delta^{13}C$-CO_2 values relative to atmosphere-soil organic matter mixing line
- Presence of light hydrocarbons (e.g. C_2H_6, C_3H_8)

Reclaimed Mine Lands and MMV