



APPLICATIONS OF FAST TRANSPORTABLE CHROMATOGRAPHY

Gulf Coast Conference

**Prepared by: A. Coderre (Clearstone Engineering Ltd)
On assignment and unable to attend GCC 2013**

Presented by: Brian Rohrback (Infometrix, Inc.)

Introduction: Adam Coderre

- M.A.Sc., Mechanical Engineering
 - Specializing in emissions measurement
 - Thesis research in optical PM (soot) diagnostics
- Project Engineer with Clearstone
 - Emission inventories and environmental reporting
 - Field measurements and emission factor development



Introduction: Clearstone Engineering

- Canadian company specializing in energy, greenhouse gas and air pollution management at oil and gas facilities.
- Domestic focus on quantification methodology, data management systems and emission reporting
 - Calculate/report emissions for oil & gas companies,
 - Verify regulated facilities and reduction projects,
 - Support regulation development and refinement.
- International work in Mexico, Colombia, Ecuador, USA, Uzbekistan, Qatar, Russia, Ukraine and China:
 - Flare gas and methane emissions reduction,
 - Energy efficiency management,
 - Related auditing and capacity building.

Clearstone Clients



Testing & Measurement Equipment

- Target parameters:
 - Temperature, pressure, velocity or flow, and composition
- Key criteria:
 - Portable, safe, and practical to use
 - Accurate and repeatable
 - Data logging and trending capabilities
- Advanced techniques:
 - HC emission imaging IR cameras (leak detection, plume tracking)
 - Clamp-on flow meters (transit-time and Doppler systems)
 - Real-time trend analysis (short & medium term)
 - Micro-GCs:
 - Detailed gas analyses (C_1 to C_{16} , fixed gases; N_2O coming soon)
 - Liquid analyses (C_3 to C_{44})
 - Tracer tests (e.g., to determine flaring rates and efficiencies)

Gas and Liquid Analyses



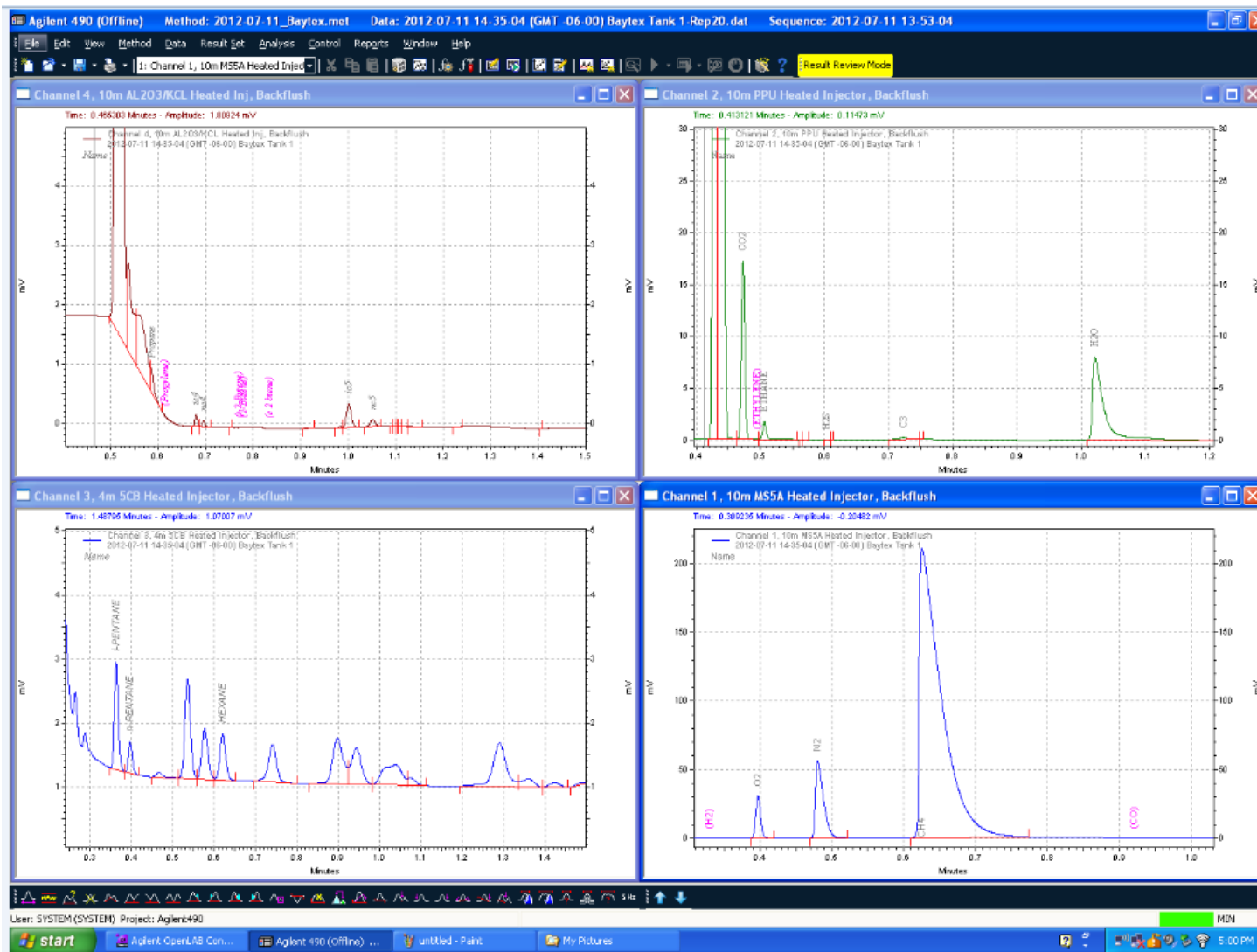
- Normal practice: off-site lab or temporary setup of standard full-sized GCs:
 - Transport issues, instrument warm-up time, stability issues, potential sample degradation, slow analyses
- Use of custom micro-GCs:
 - Fast, light-weight, compact, modular, easy setup, stable operation, low power requirements
 - Direct process connection, eliminating potential sample degradation



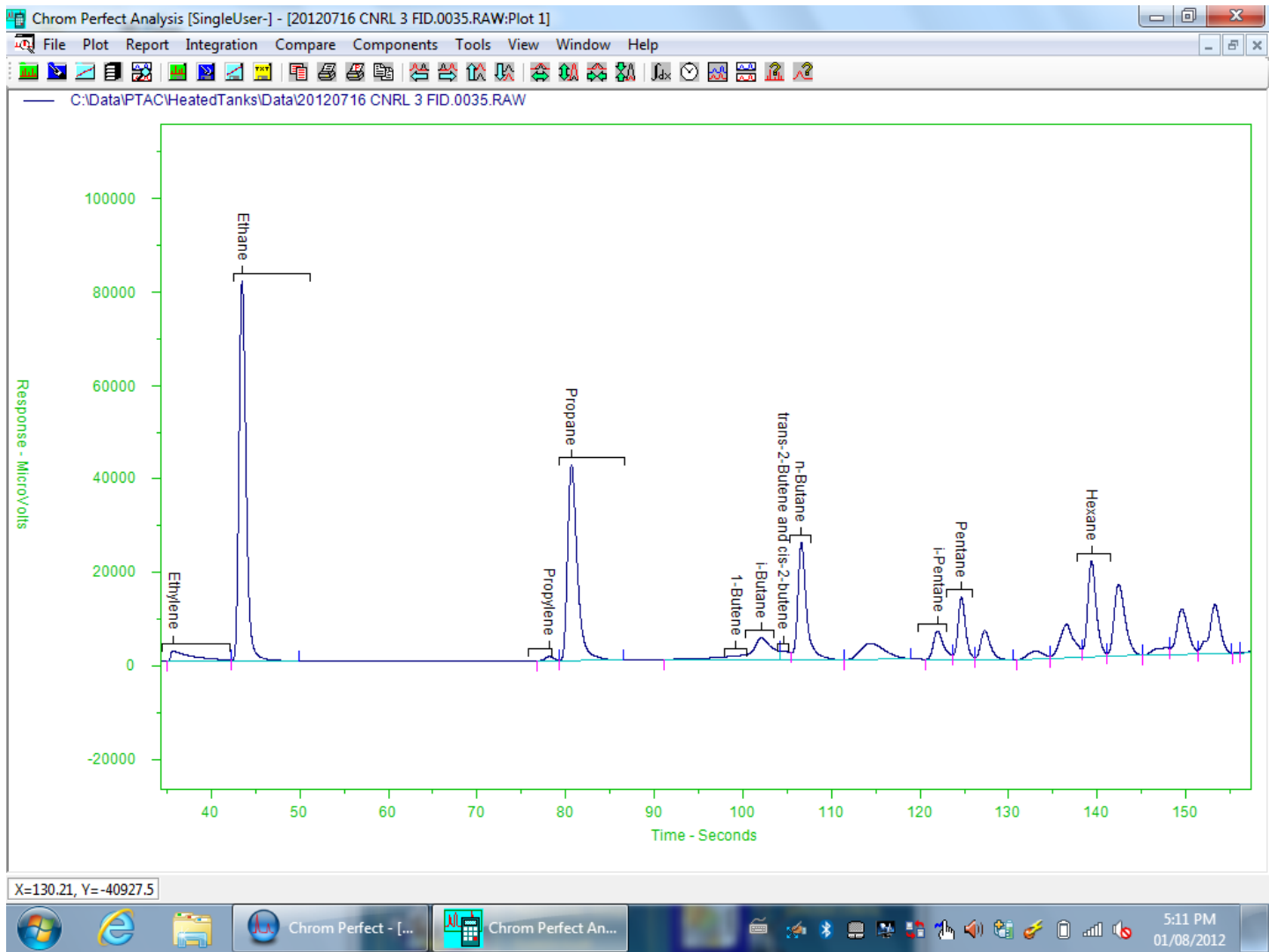
Clearstone Gas & Liquid GCs

- Agilent 490
 - Four channels with TCDs
 - Isothermal column modules
 - Easy set-up with field case (batteries, carrier gas cylinders)
- Calidus CS
 - Parallel FID and TCD
 - Column-switching mechanism expands low-end resolution
 - Temperature ramping capability
- Calidus 101-HT
 - Single-channel FID
 - Liquid analysis (boiling point profile) up to C₄₄

Sample Chromatogram: 490



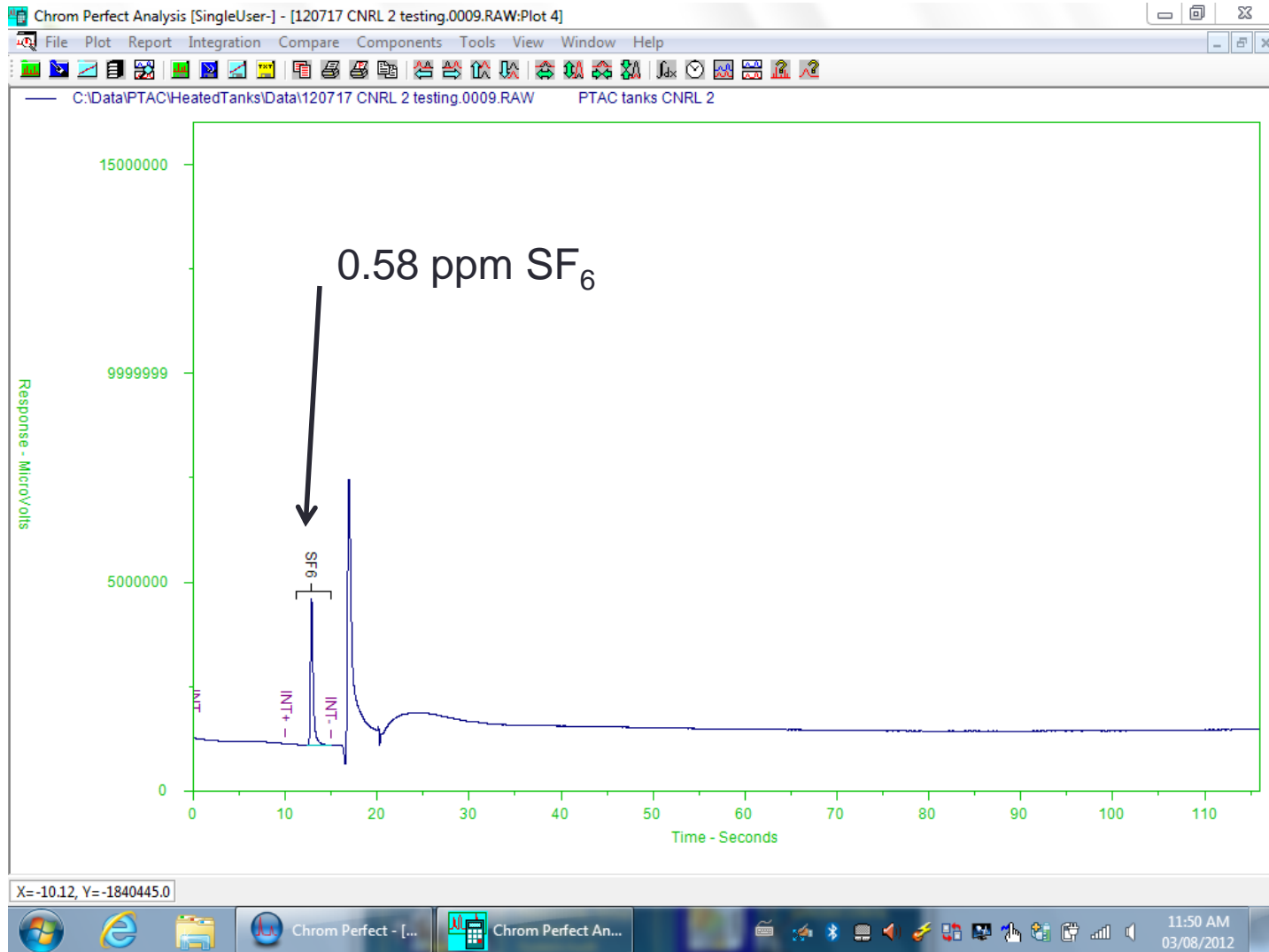
Sample Chromatogram: CS FID



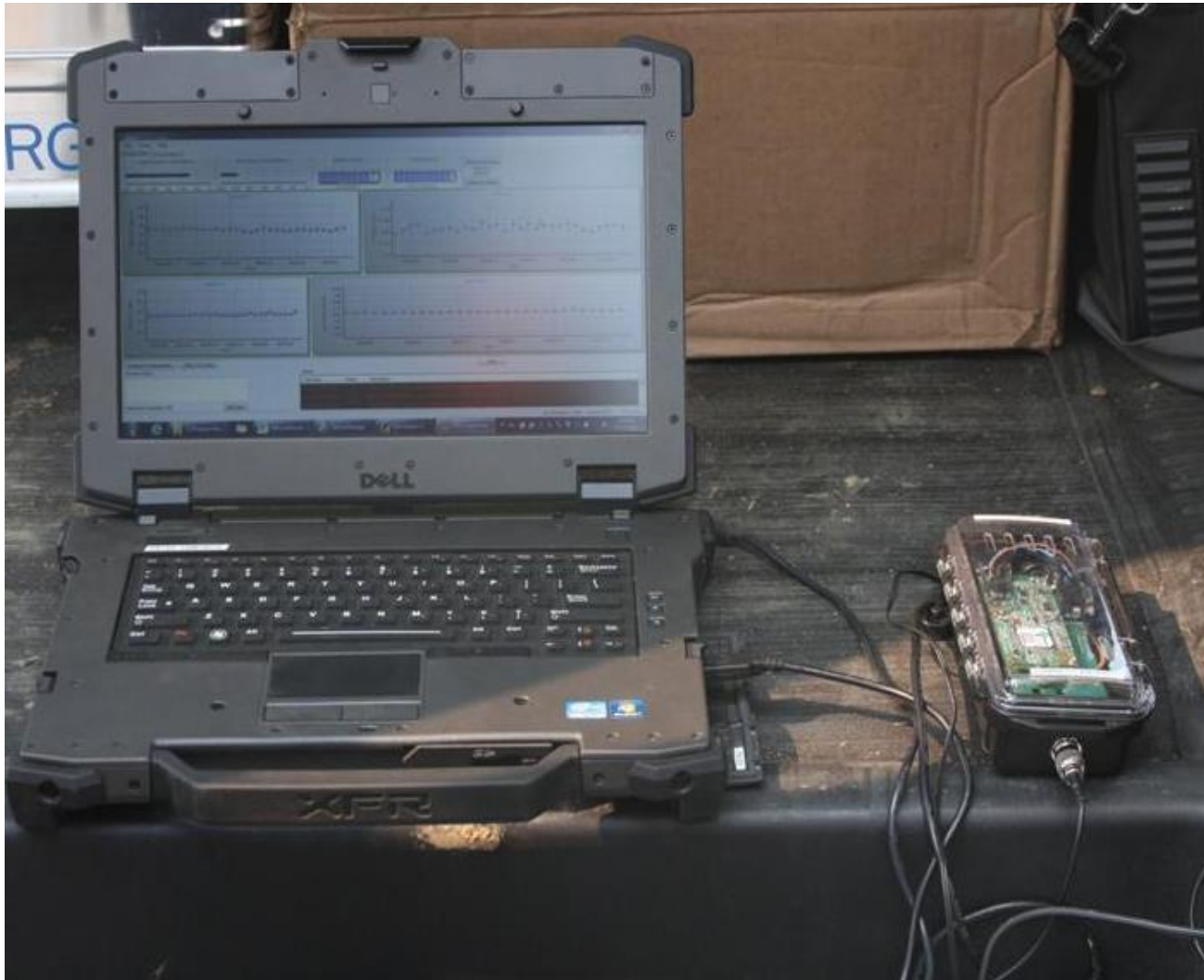
Tracer Testing

- Tracer compound (SF_6) introduced, measured downstream
- Flow rate by concentration
- Dispersion data by concentration ratio
 - Known ratio of SF_6 to target compound at release point
 - Trace SF_6 measured downstream, scaled to find target concentration
- Custom Calidus GC from Falcon Analytical
 - DBD/DID detector
 - Can measure low ppb levels of SF_6
 - Testing feasibility of also measuring N_2O

Sample Gas Chromatogram



Real-Time Trend Analysis



Application: Heated Heavy Oil Tanks

- Objectives of the study:
 - Evaluate magnitude and composition of vapour losses
 - Determine variability in emission rate and composition
 - Evaluate the impact of tank operating temperature on emissions
 - Determine the fate and composition of any aerosol emissions
- Work completed:
 - Emissions tests performed on 6 tanks at 6 heavy oil batteries
 - Detailed laboratory analyses of tank vapours, casing gas, and PM conducted for each site
 - Trending of temp, flow, and composition data
- Work remaining:
 - Tracer tests
 - Tank temperature variations

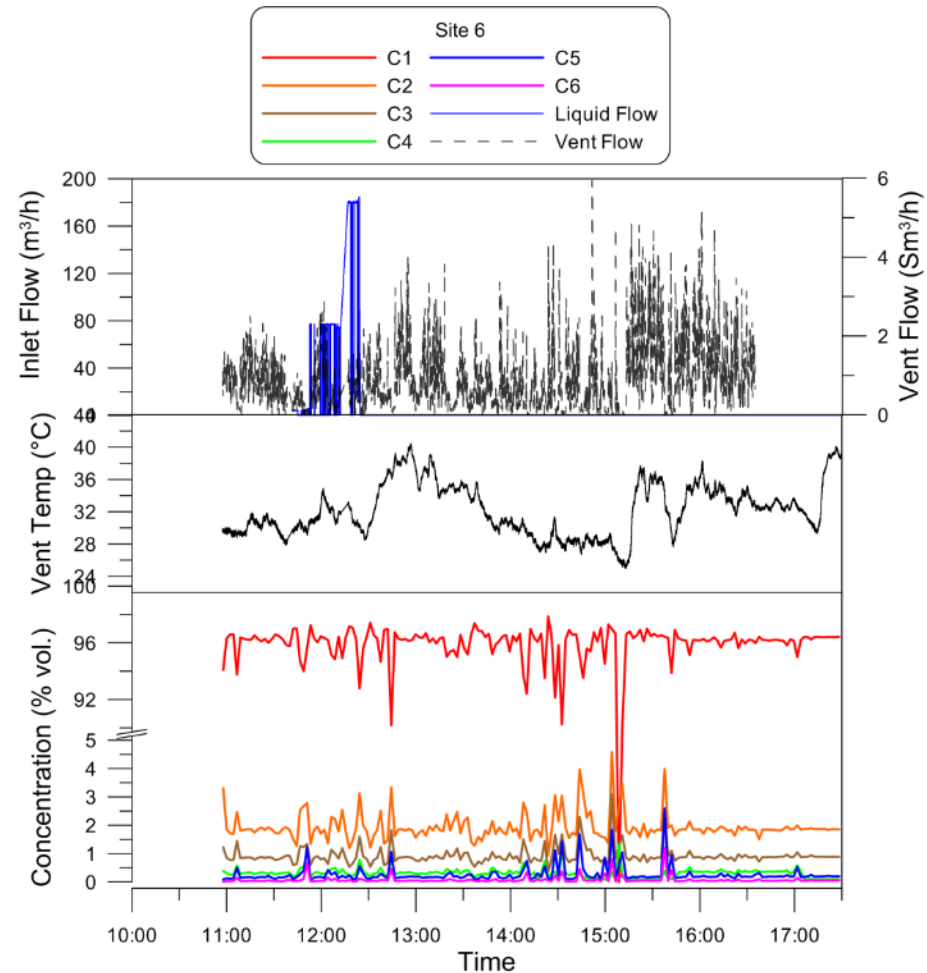
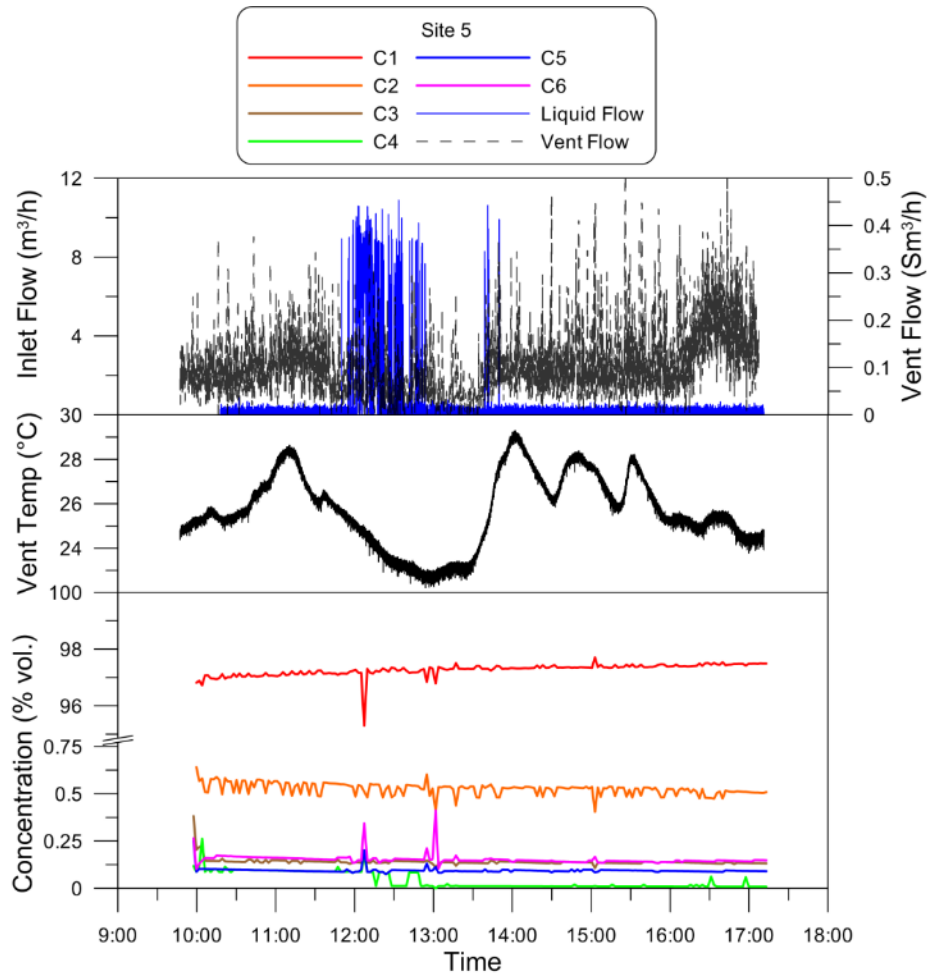
Micro Gas Chromatographs & Sampling System



Micro Gas Chromatographs



Sample Measurement Results Expressed on an Air-free Basis



Application: Convective Losses

- Quantifying thermal convective losses from storage tanks
 - Fixed-roof, free-venting tanks
 - Hydrocarbon liquids, gasoline
- Vent Emission Monitoring Systems (VEMS)
 - Self-powered, standalone, state-of-the-art SCADA system
 - Cellular and satellite communication with Clearstone servers
 - On-site radio and wired connections to laptop
 - Control-room style control and trend analysis
 - Data collection and trending over substantial time periods
- Vapour analysis and monitoring a key element

VEMS Installation

- Continuous measurements:
 - Ultrasonic flow meter
 - Oxygen sensor
 - Hydrocarbon sensor
 - Vent gas temperature
- Current: underground gasoline storage tank
- Several more systems for other applications in development



Application: NAMA Development

- Nationally Appropriate Mitigation Actions
 - Fundamental for market-based post-2012 climate regime
 - Measurable, quantifiable reductions in GHG emissions
 - Access to funding for mitigation action
- Canada working with Mexico and Columbia to develop highly-credible NAMAs for Oil and Gas production:
 - Baseline activity determination
 - Quantification of mitigation/reduction opportunities
 - Economic evaluation, business case development
 - Performance improvements: measurable, monitorable, sustained
- Clearstone began measurement work in November 2012
 - Measurement studies at representative facilities
 - Gas/liquid analyses and tracer tests are key components
 - Pictures from the field work follow

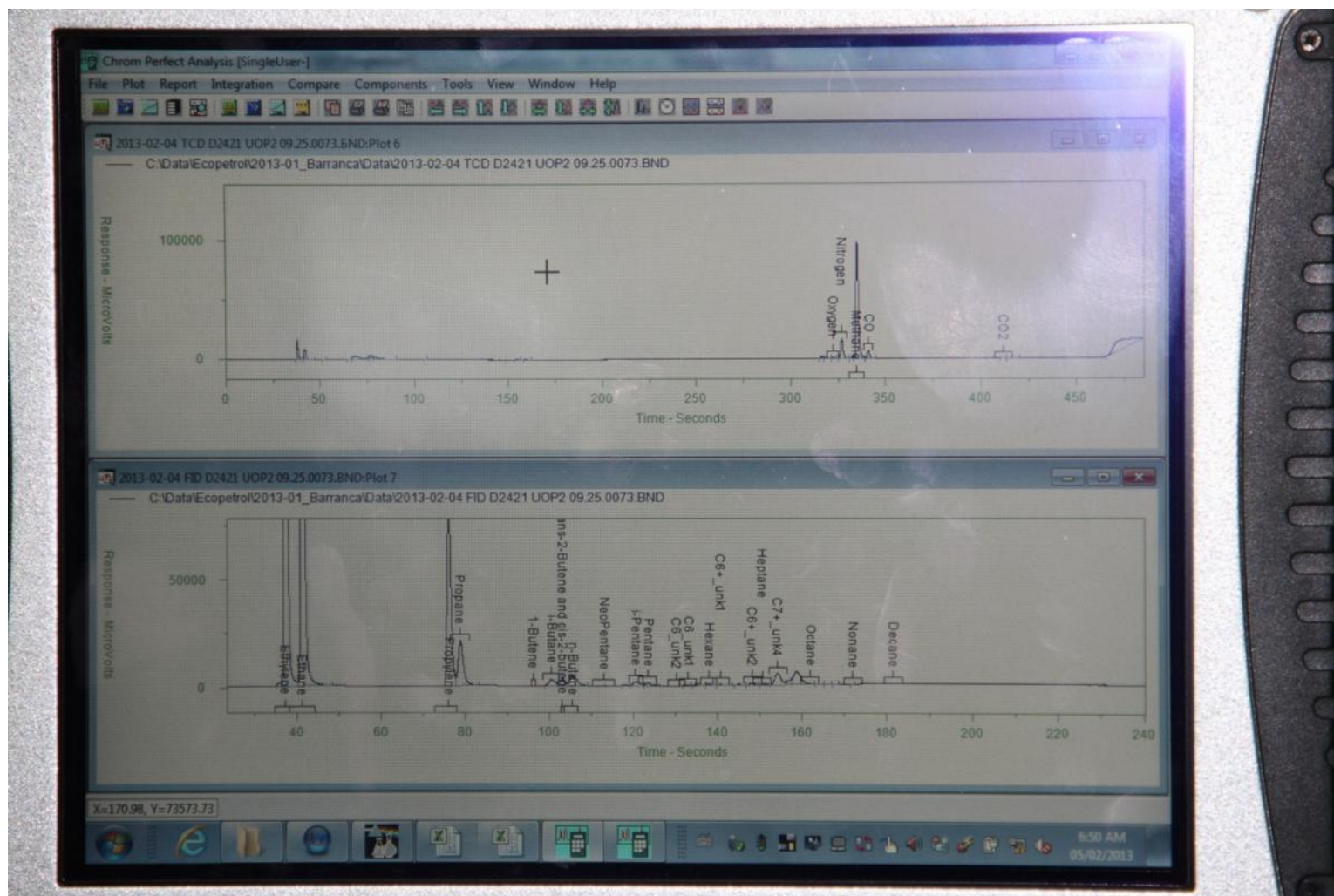
Overview of Field Laboratory



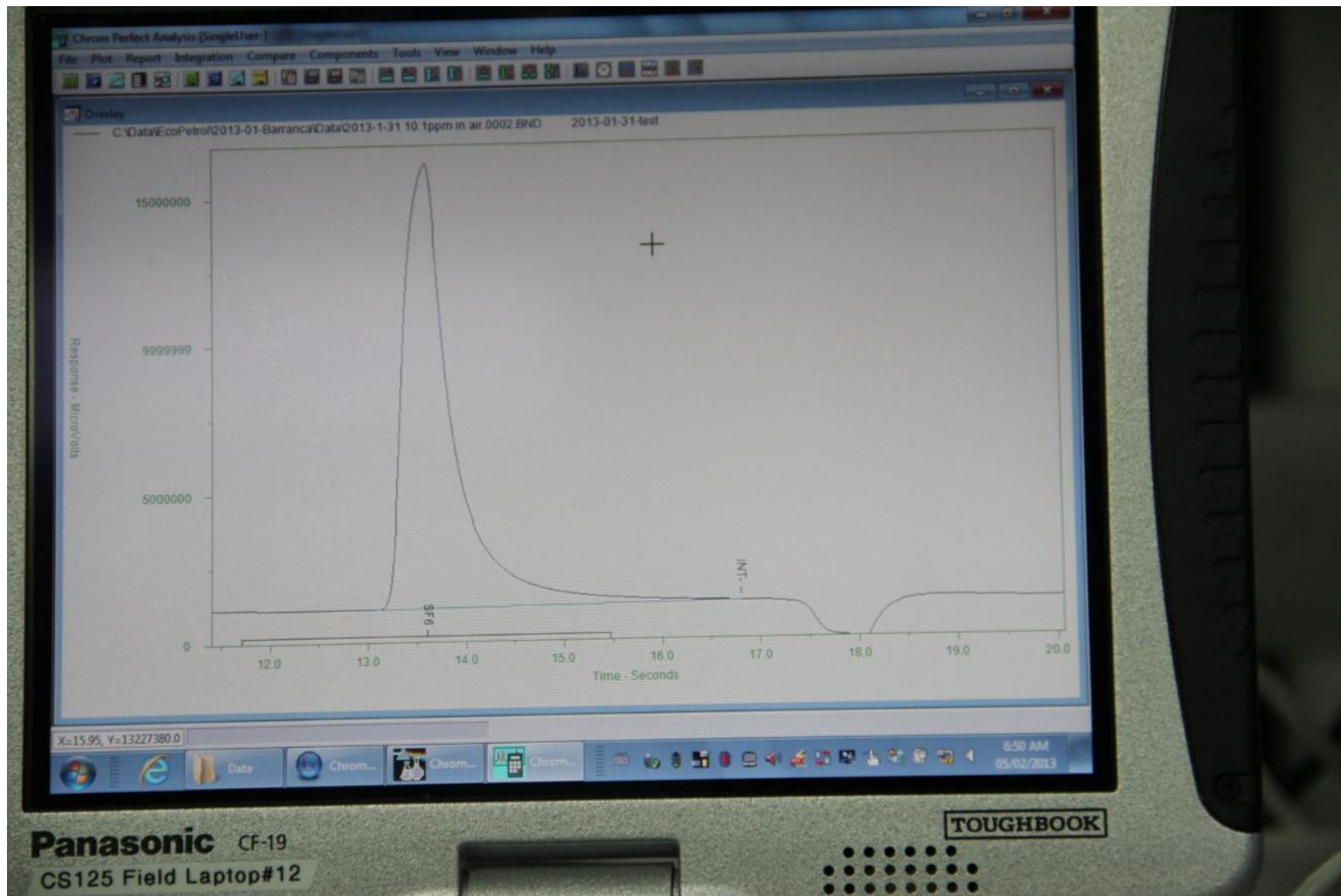
Field Operations



Example Field Results on Calidus CS



Example Tracer Analysis



Thank you!

Thanks for your attention and understanding for Adam's absence.

