

Development of a Personal Monitoring System for Airborne Enzymes

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Objectives

- To develop a system for collection and analysis of airborne enzymes.
- Simple and cost effective solution for personal exposure monitoring.

Initial Target

- Subtilisins – protease enzymes widely used in industry.
- Respiratory sensitizers.
- Exposure limits in much of the world;
 - US 60ng/m³ (ACGIH TLV; NIOSH REL)
 - UK 40ng/m³ (WEL)

2 Component System

- Cassette
 - Sample collection
 - Assay
 - Single use
- Reader
 - Multi-wavelength spectrophotometer



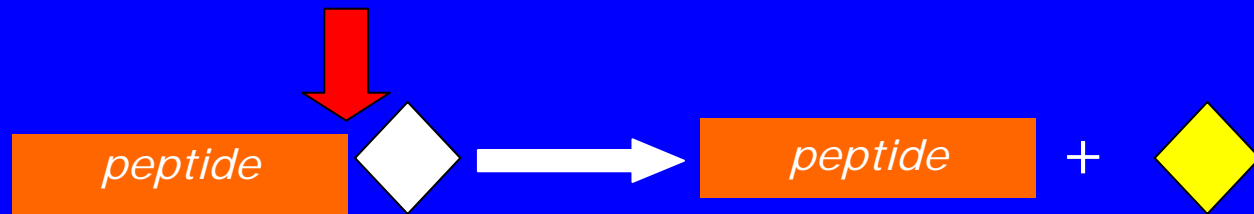
Assay Method

Activity measurement – change in optical density with time:

- Not dependent on antibody availability.
- Applicable to mixtures of Subtilisins.
- Platform for other enzyme analyses.
- Colorless peptide dye complex split by enzyme, yielding colored product.

Assay

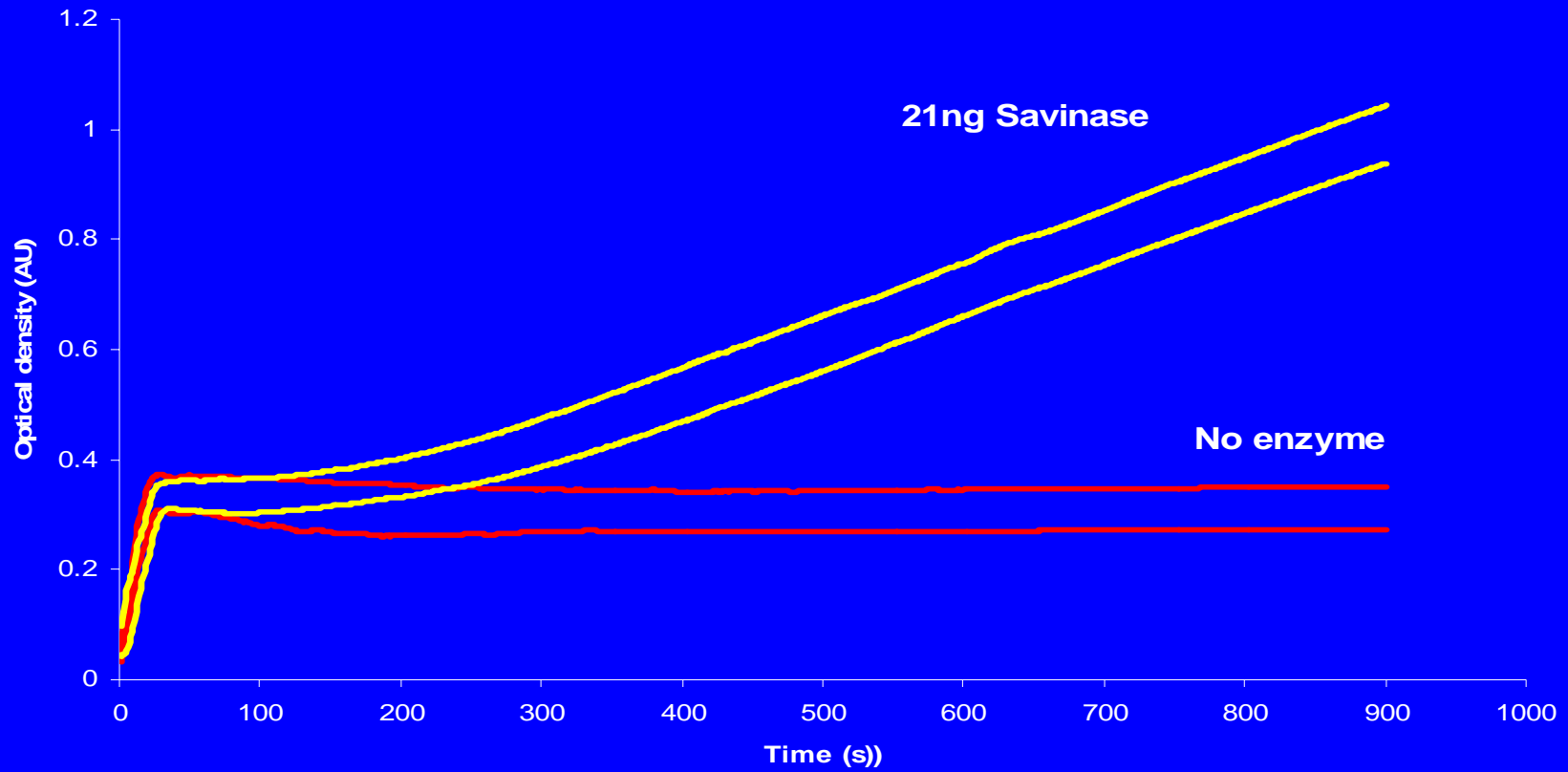
Subtilisin



Substrate (peptide +
dye complex)

Substrate + free dye

Response

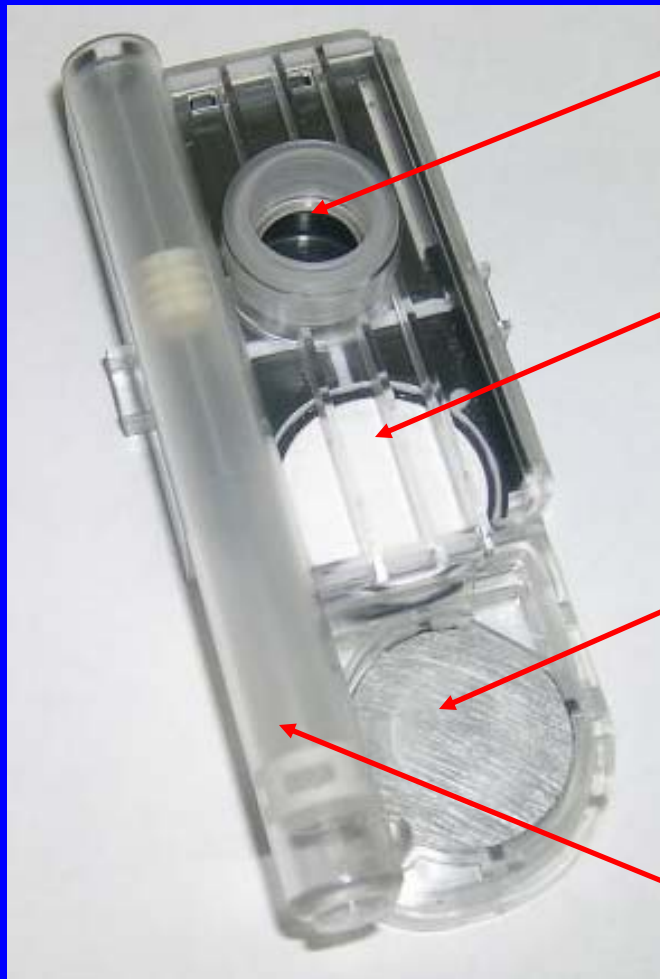


Cassette Design

- Cassette inserts into holster.
- Designed to be worn on lapel / collar.
- Attaches to standard air sampling pump.
- Contains all reagents for assay.



Cassette Components



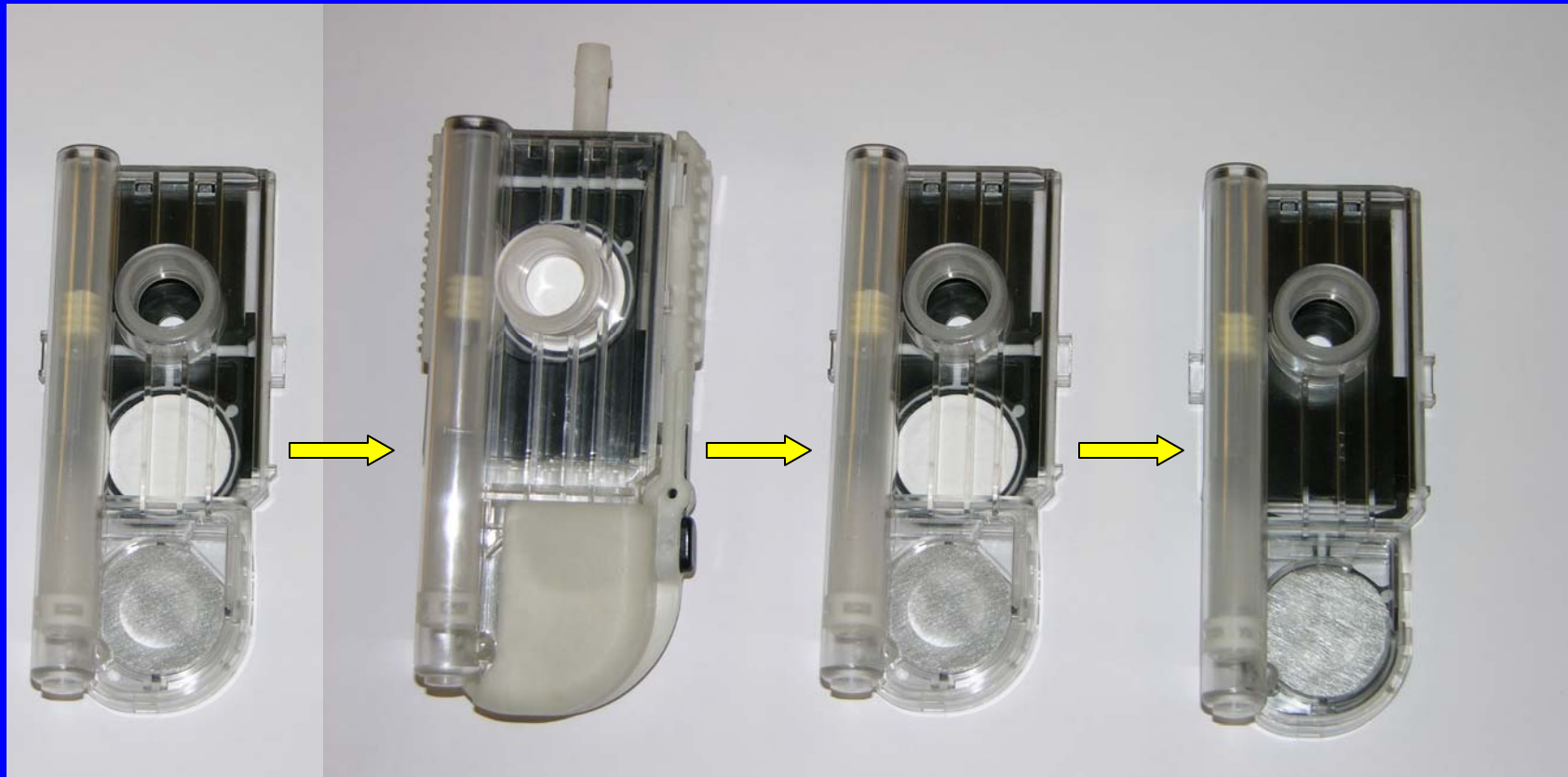
Air inlet.

Sample collection filter (in safe position).

Substrate pad in reaction chamber.

Reagent reservoir

Actuation



Transit

Sampling

Transit "safe"

Analysis

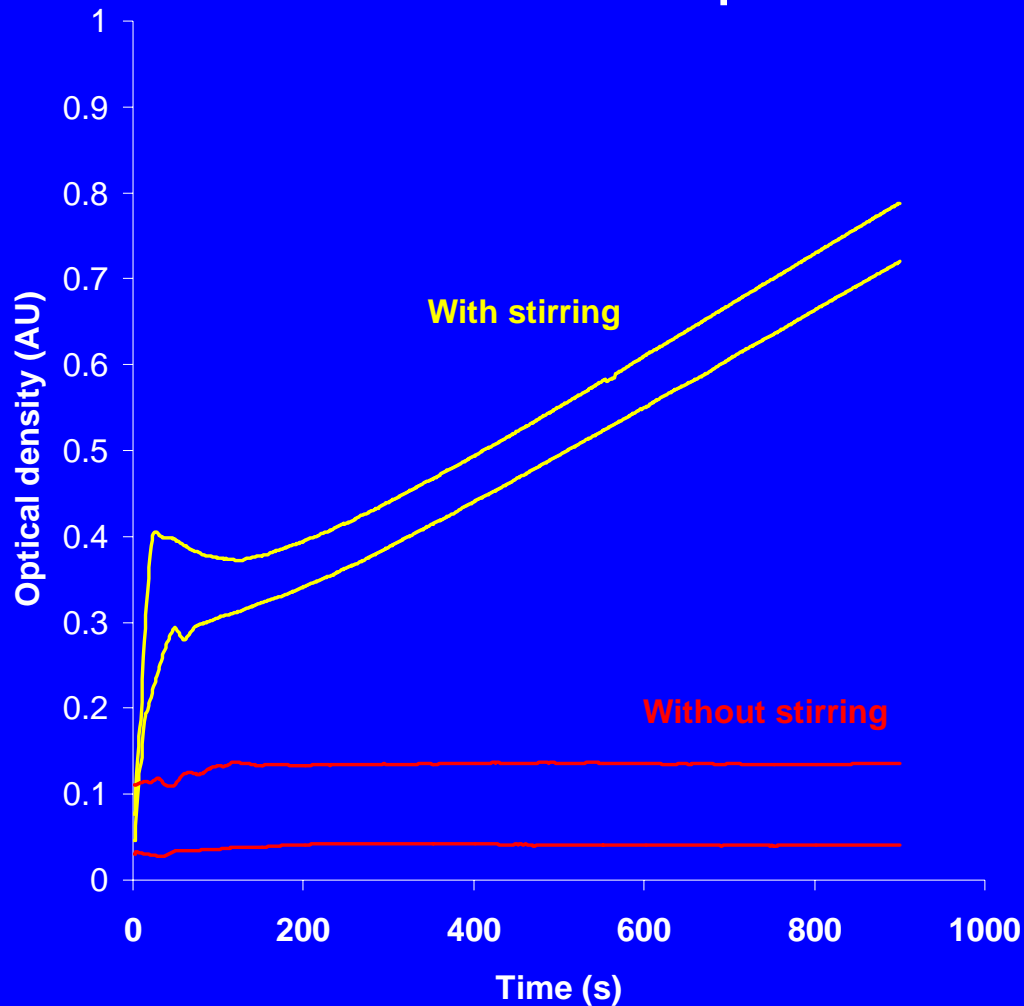
Reader Instrument

- Multi-wavelength spectrophotometer.
- Temperature control.
- Integral stirring.
- Data output & analysis.

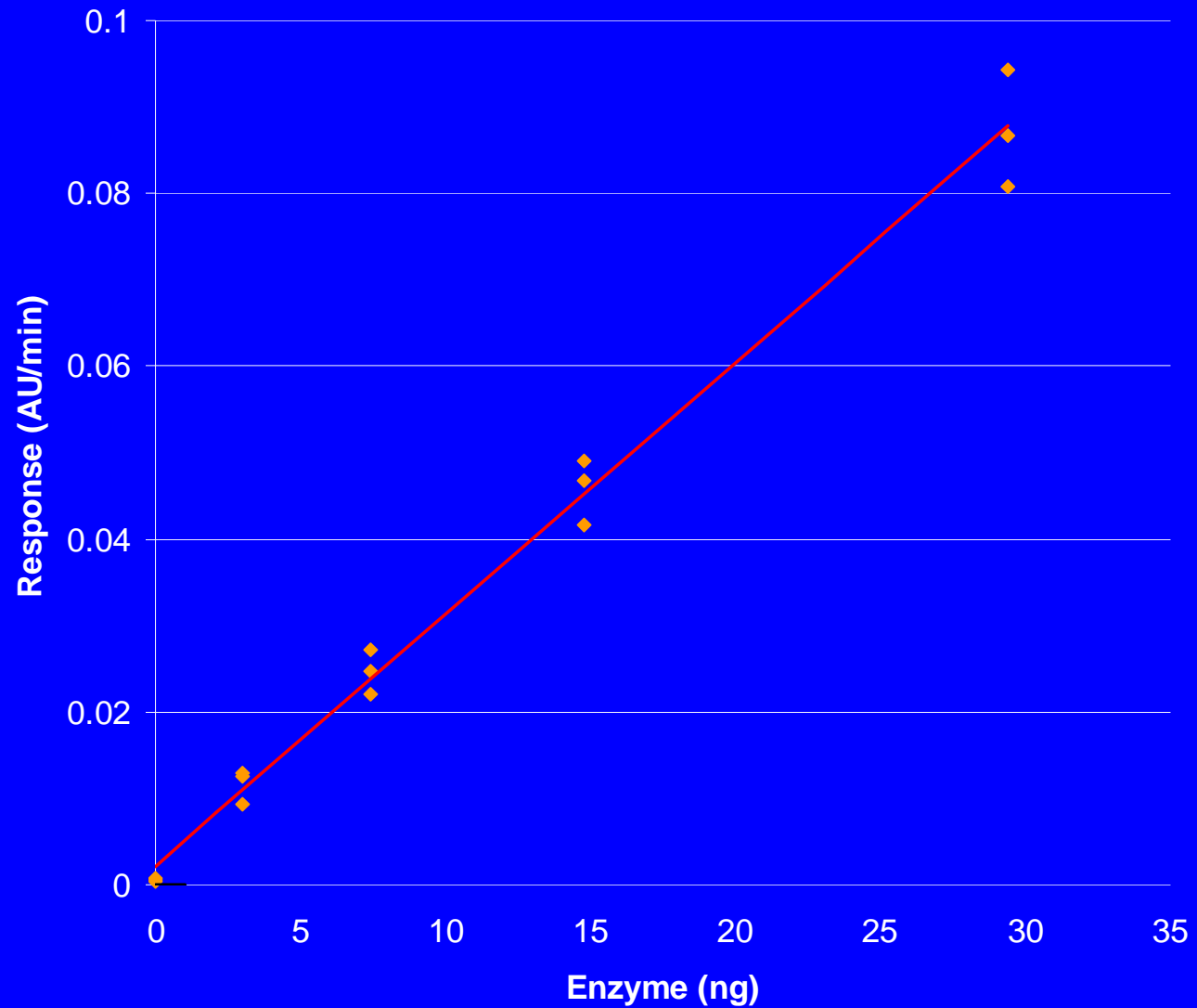


Stirring

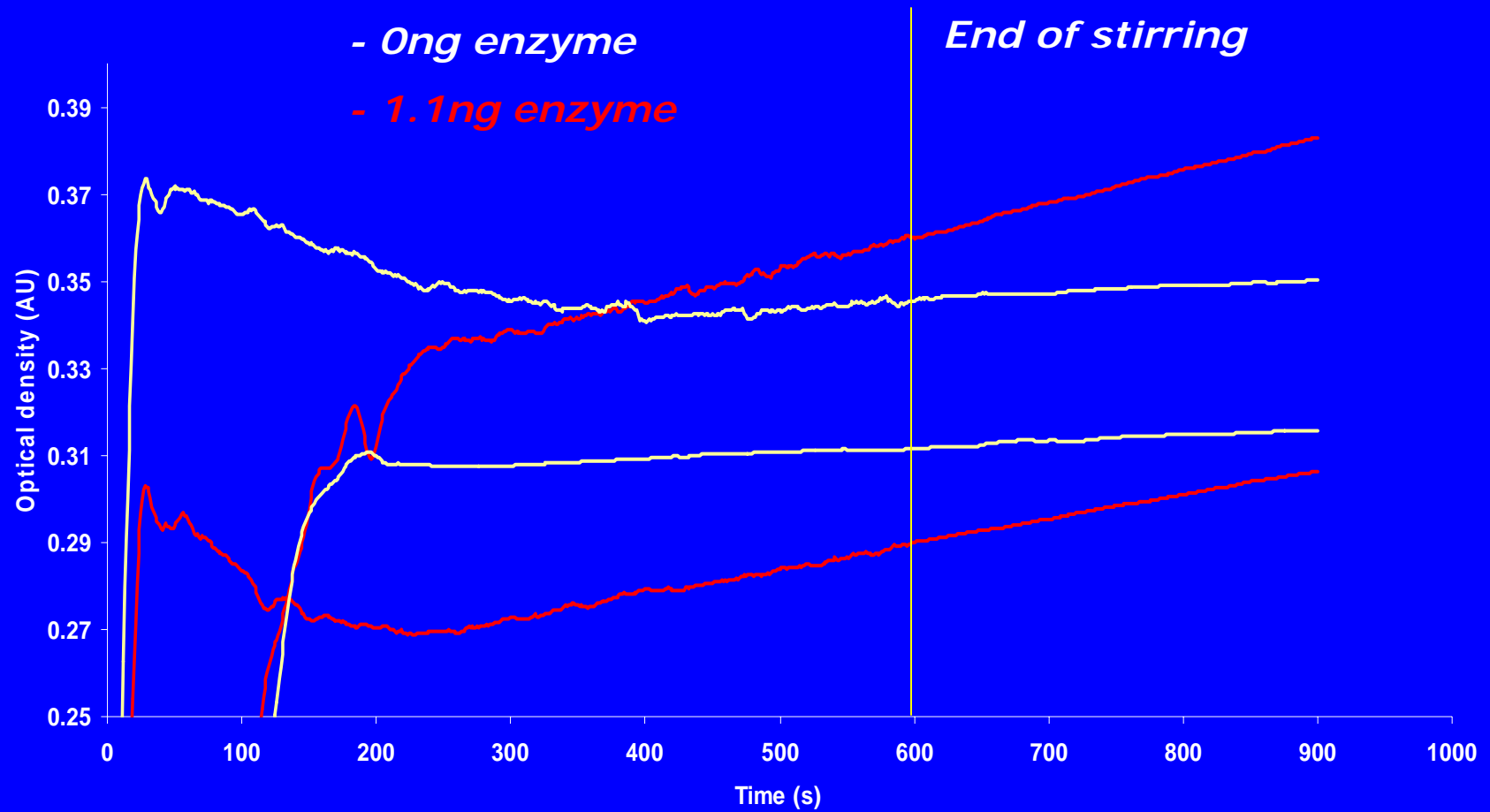
- Stirring releases sample from filter and substrate from pad and mixes reactants.



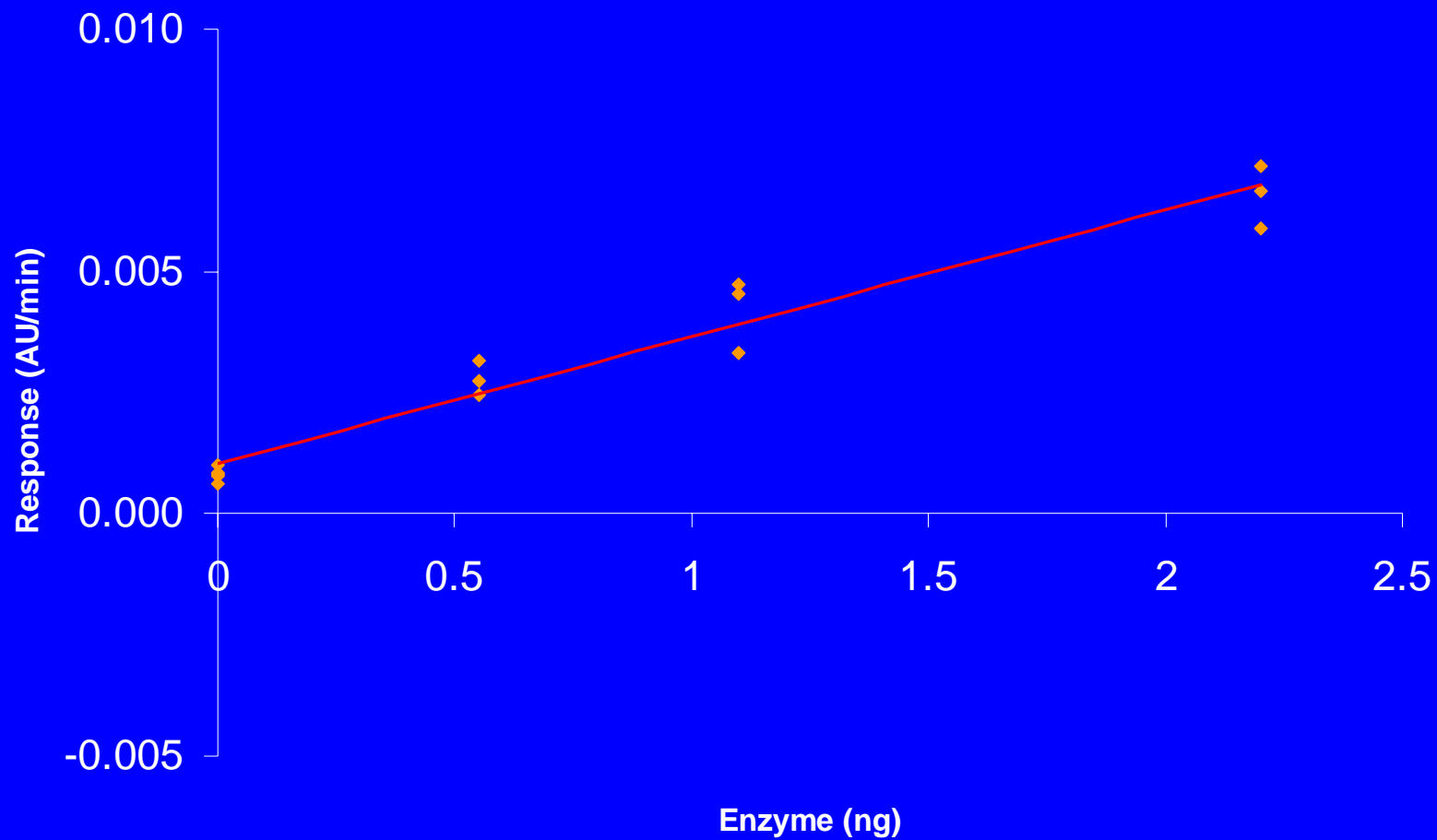
Linear range



Sensitivity

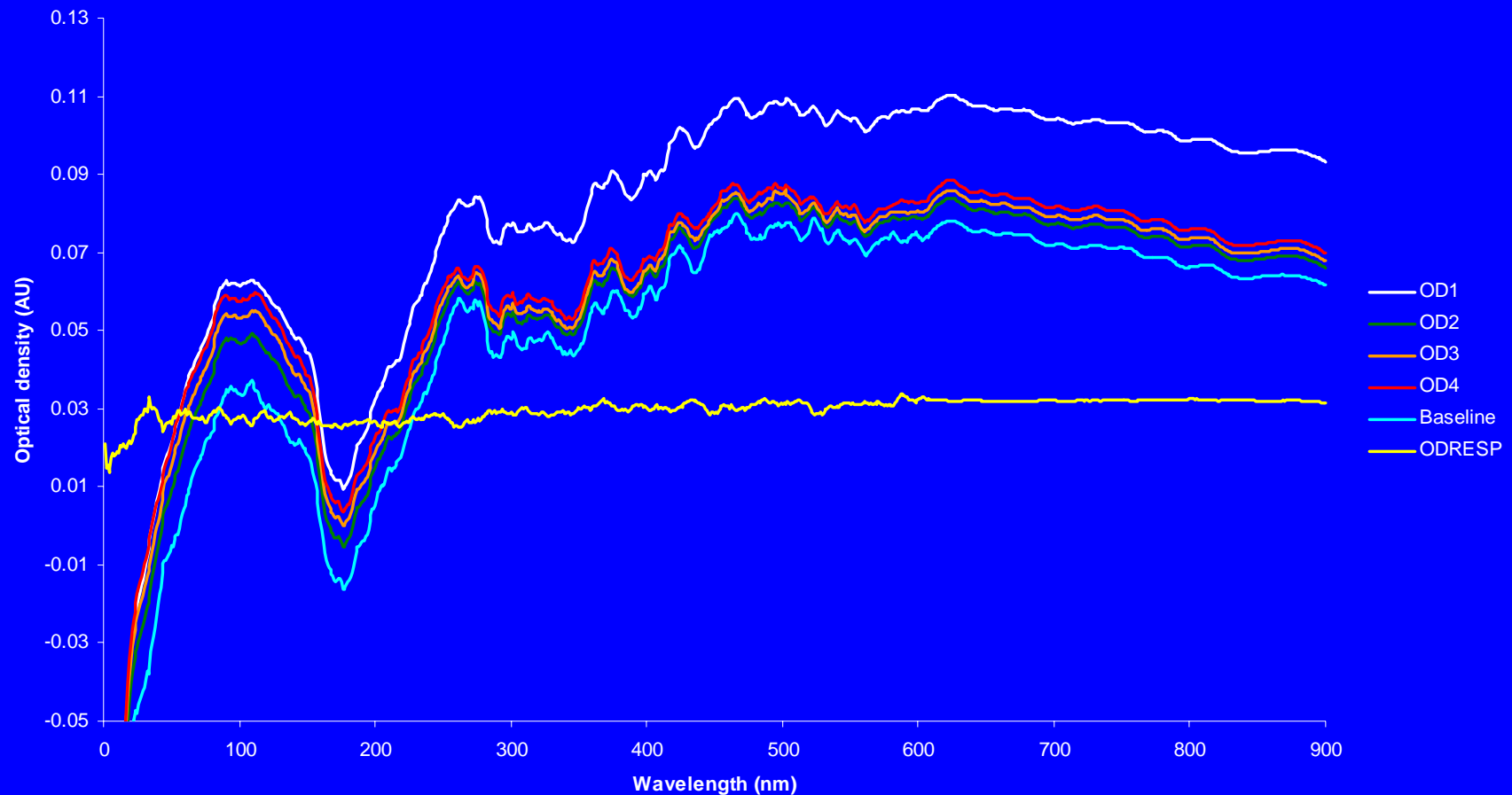


Sensitivity



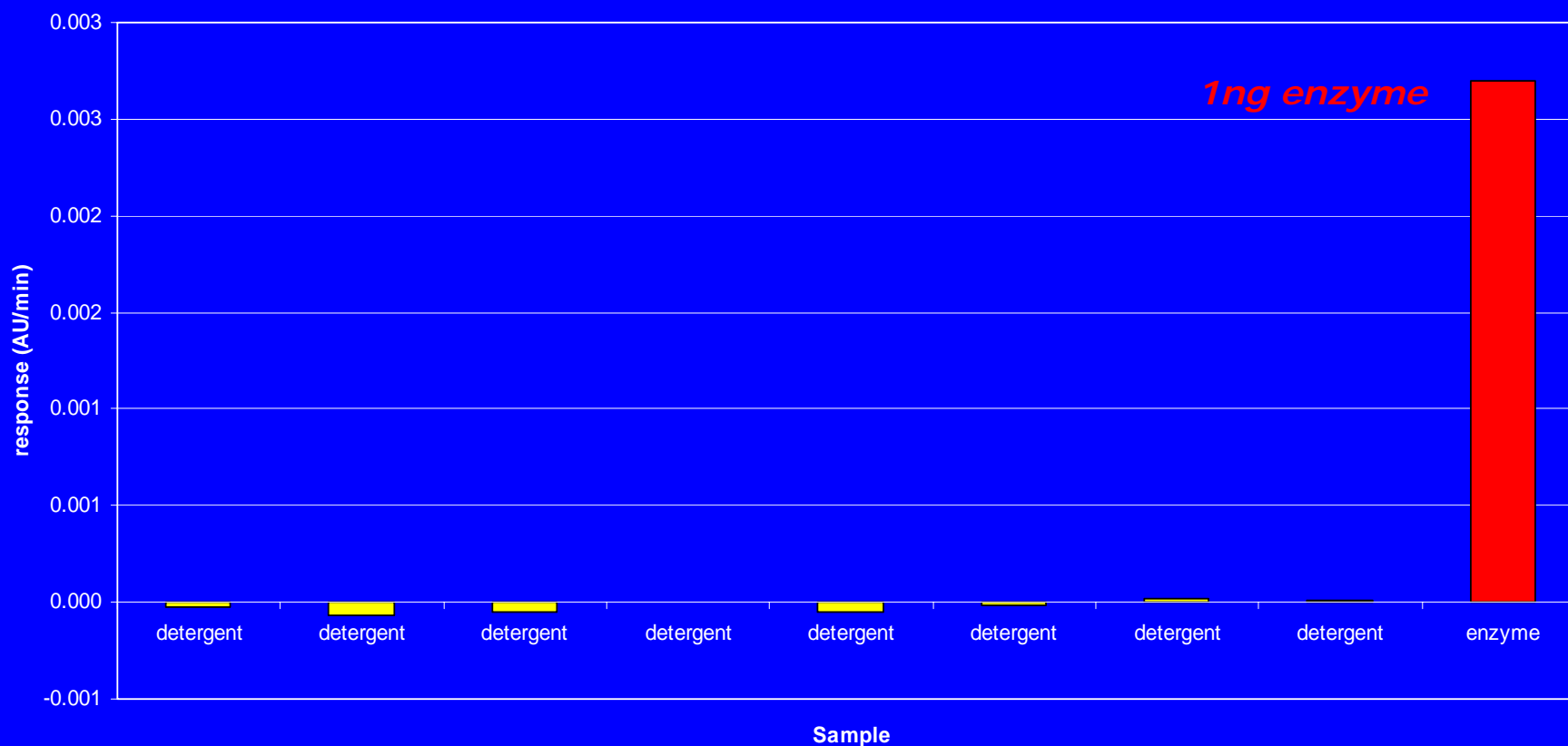
Multiple Wavelength

Compensates for changes in background absorbance – i.e caused by turbidity:



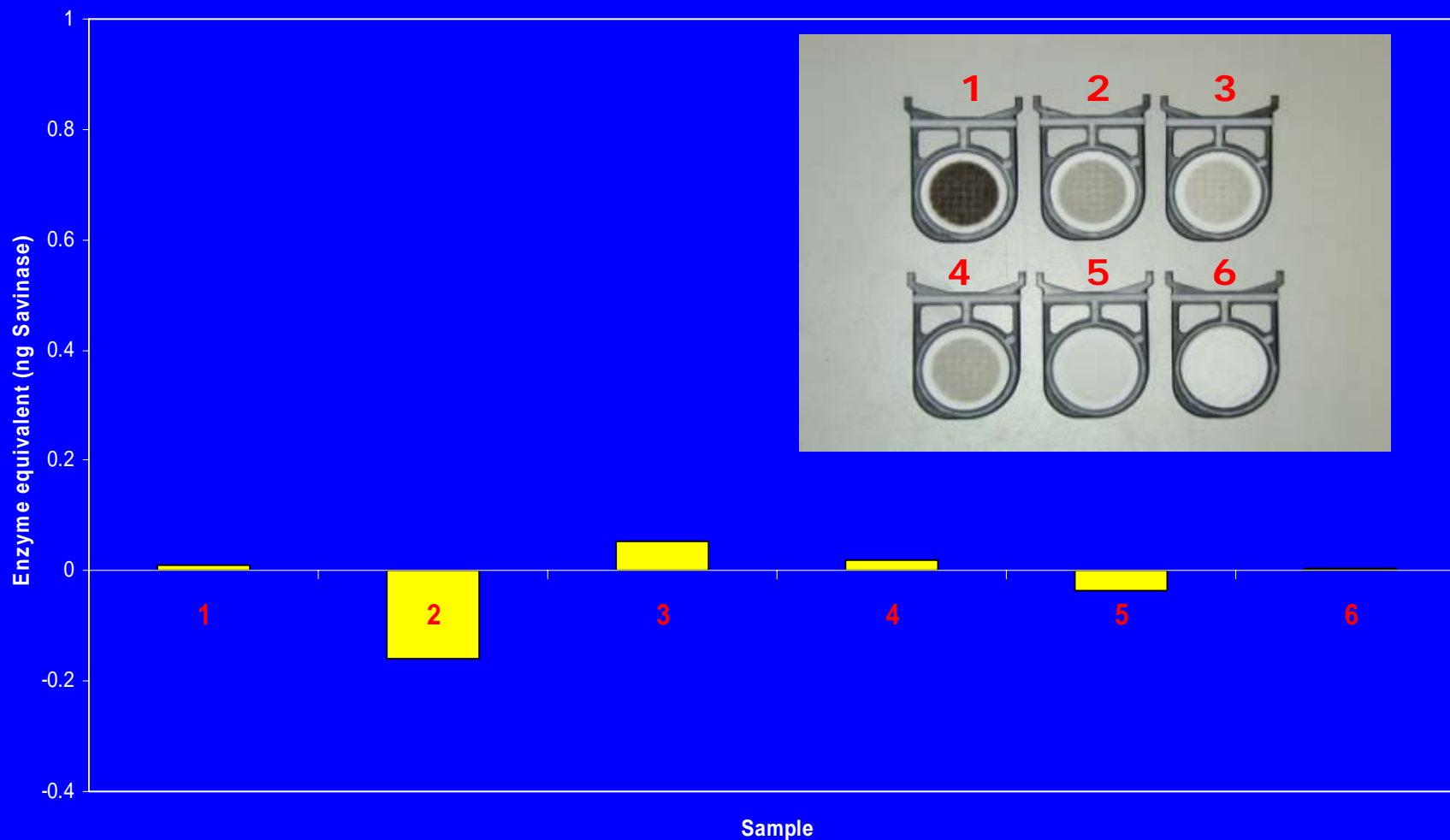
Background Interference

Interference effects from 1mg powder/tablet detergent



Environmental Effects

Effect of diesel exhaust fumes:



Conclusions

- Easy to use.
- Self contained device - no liquid handling or sample extraction steps.
- Sensitive – *ca.* 1ng LOD
- Robust - no significant interference.
- Provides a viable solution for personal exposure monitoring to airborne enzymes.

City Technology co-workers

- Ian Christie PhD, BSc.
- Peter Brumwell HNC.
- Tanja Baker BSc.
- Ian Andrews.
- Paul Meighan BSc, MSc.
- Tony Downer.