



HYDROGEN CHLORIDE $^{37}\text{Cl}/^{35}\text{Cl}$ ISOTOPIC RATIO FIELD ANALYZER FOR THE INVESTIGATION OF VOLCANIC PLUMES

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MANCHESTER
1824
The University of Manchester

INTRODUCTION

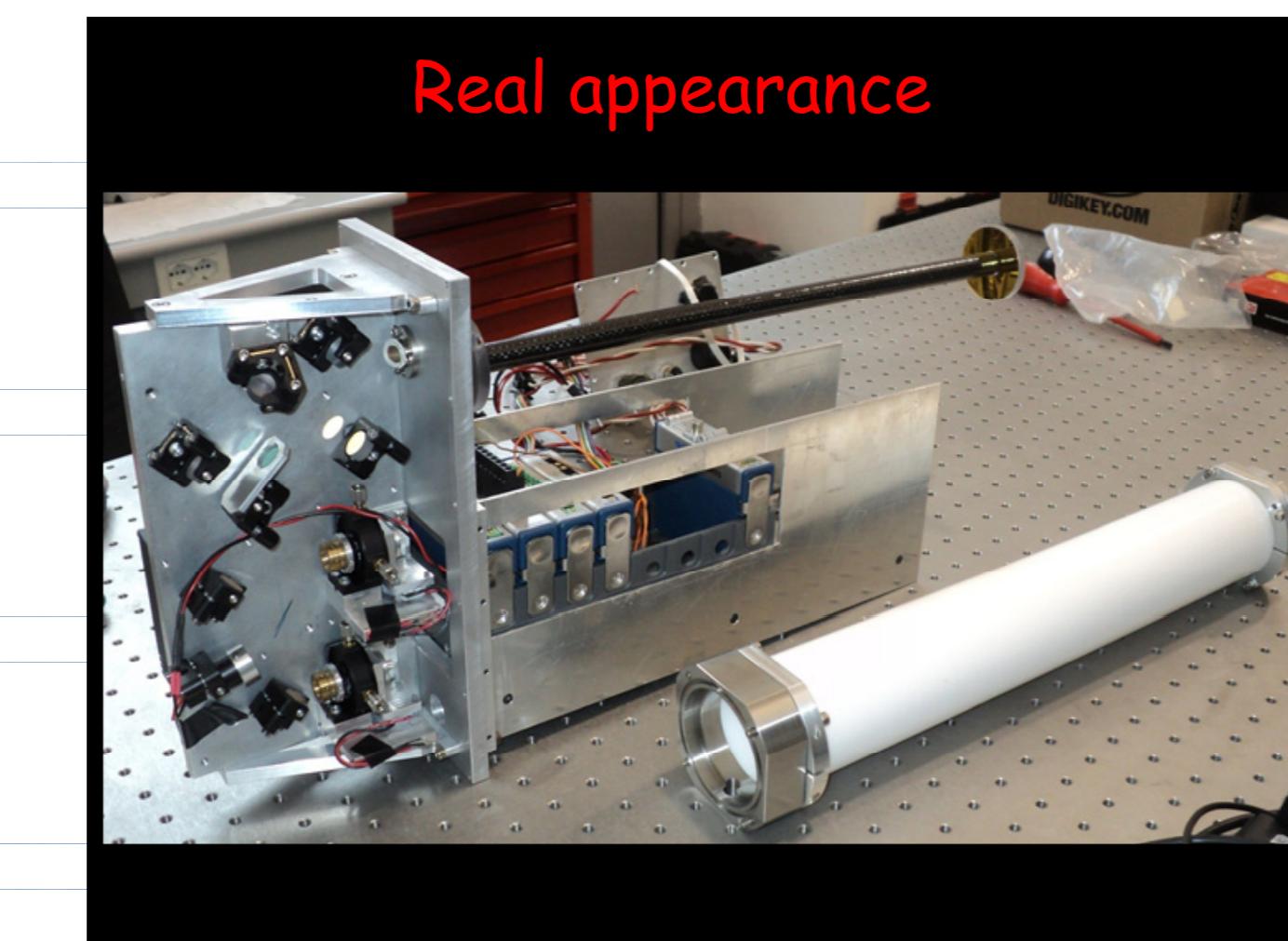
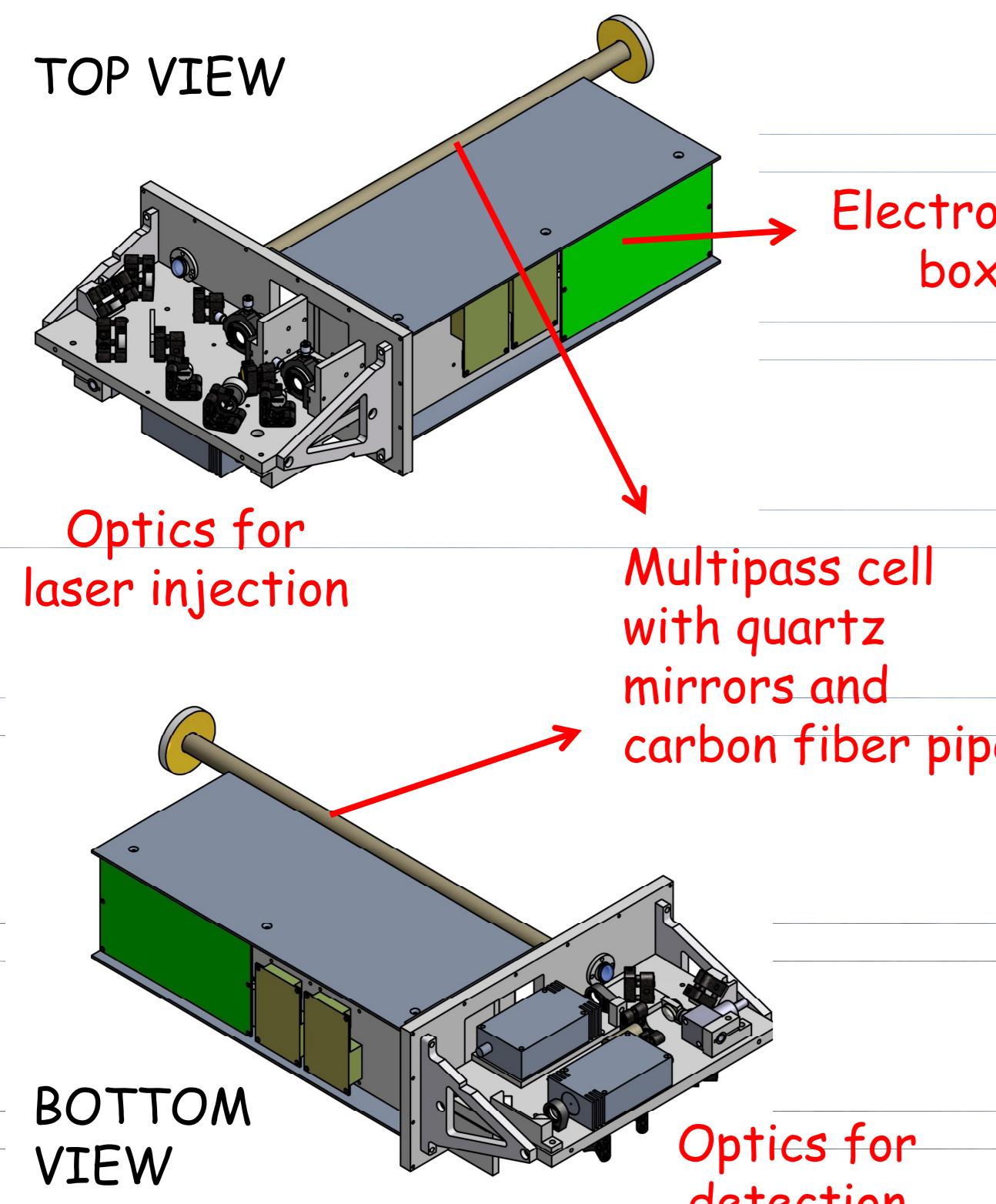
Chlorine is the main halogen in volcanic fluids and is discharged from magma mainly as HCl. HCl concentration in plume and volcanic gases provides crucial data for understanding the degassing process and for predicting the evolution of active volcanoes. Moreover the Cl isotope composition of magmatic and volcanic products gives useful information about the mantle source. The standard procedure for measurements of Hydrogen Chloride $^{37}\text{Cl}/^{35}\text{Cl}$ isotopic ratio requires: (i) gas sampling in situ (ii) post-analysis with mass spectrometry

GOAL

First in-situ measurement of $\text{H}^{37}\text{Cl}/\text{H}^{35}\text{Cl}$ isotopic ratio (without gas sampling and pre-treatment)

THE ANALYZER

Dual Source Mid-Infrared Tunable Diode Laser Spectrometer based on Direct Absorption with Multipass Cell.

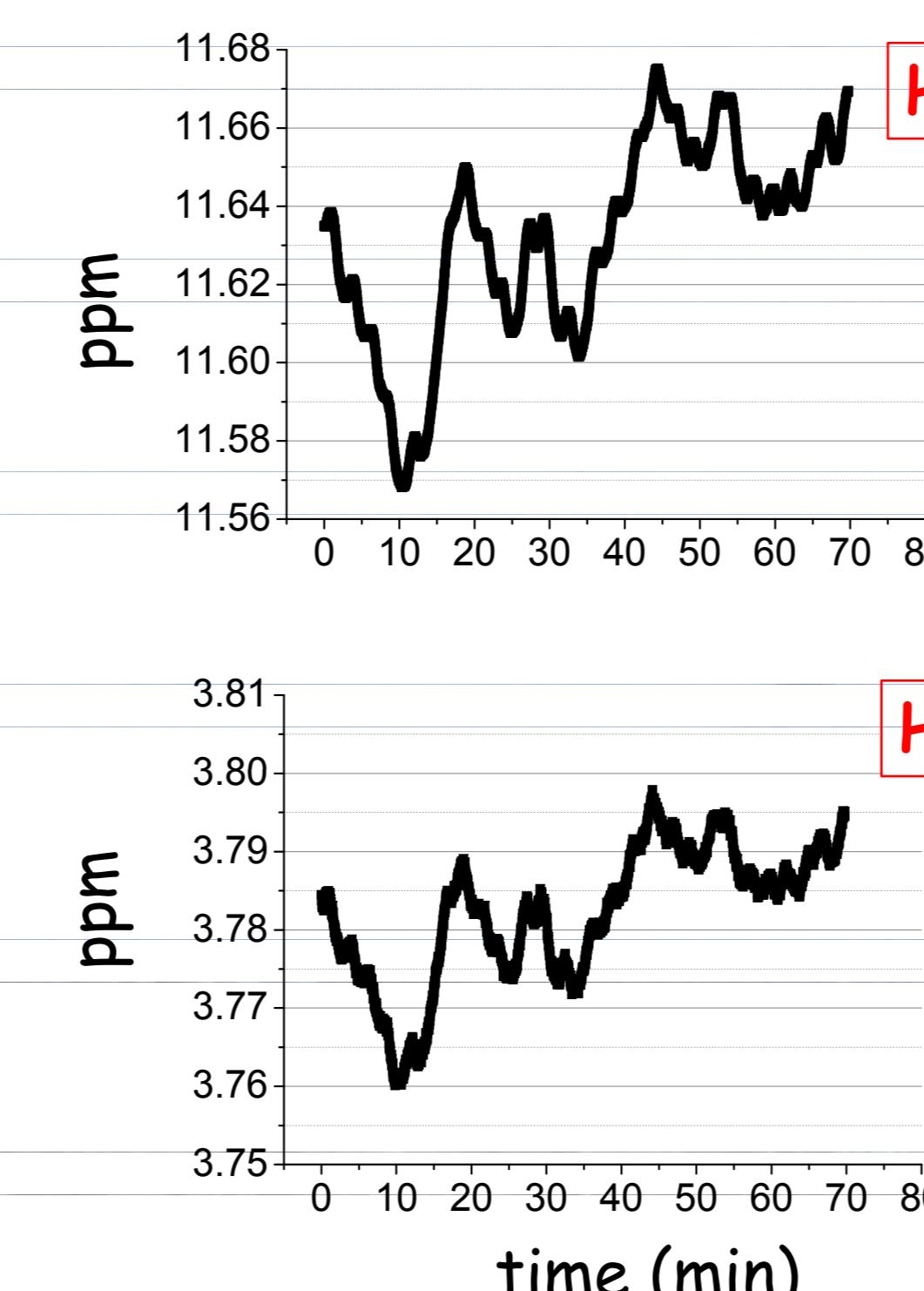


- Sources: DFB Diode lasers emitting at 2942.7 cm^{-1} and 2944.9 cm^{-1}
- Absorption pathlength: 20 m (52 passes)
- Dimension: $59 \times 27 \times 12 \text{ cm}$ Weight: 10 Kg
- Power consumption: 40 W

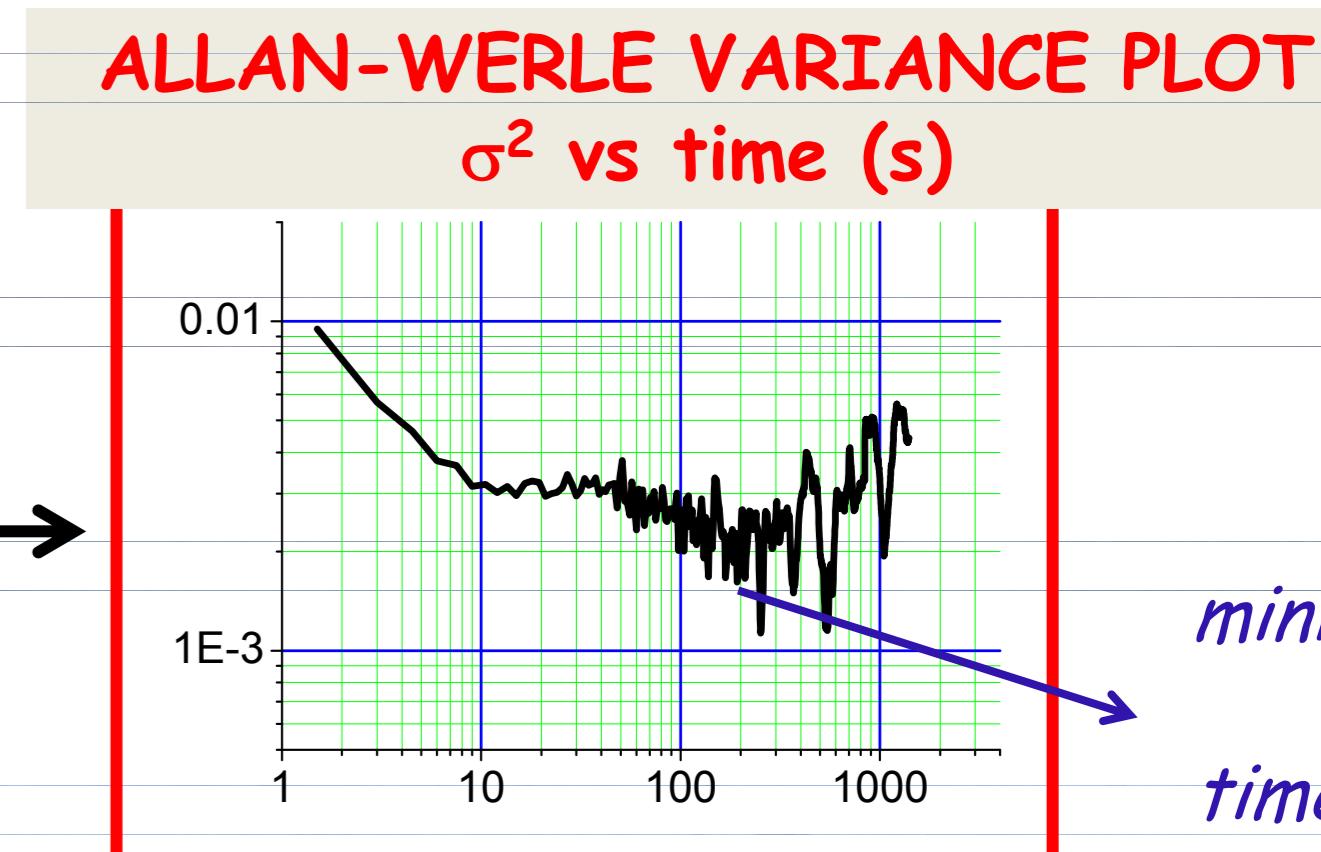
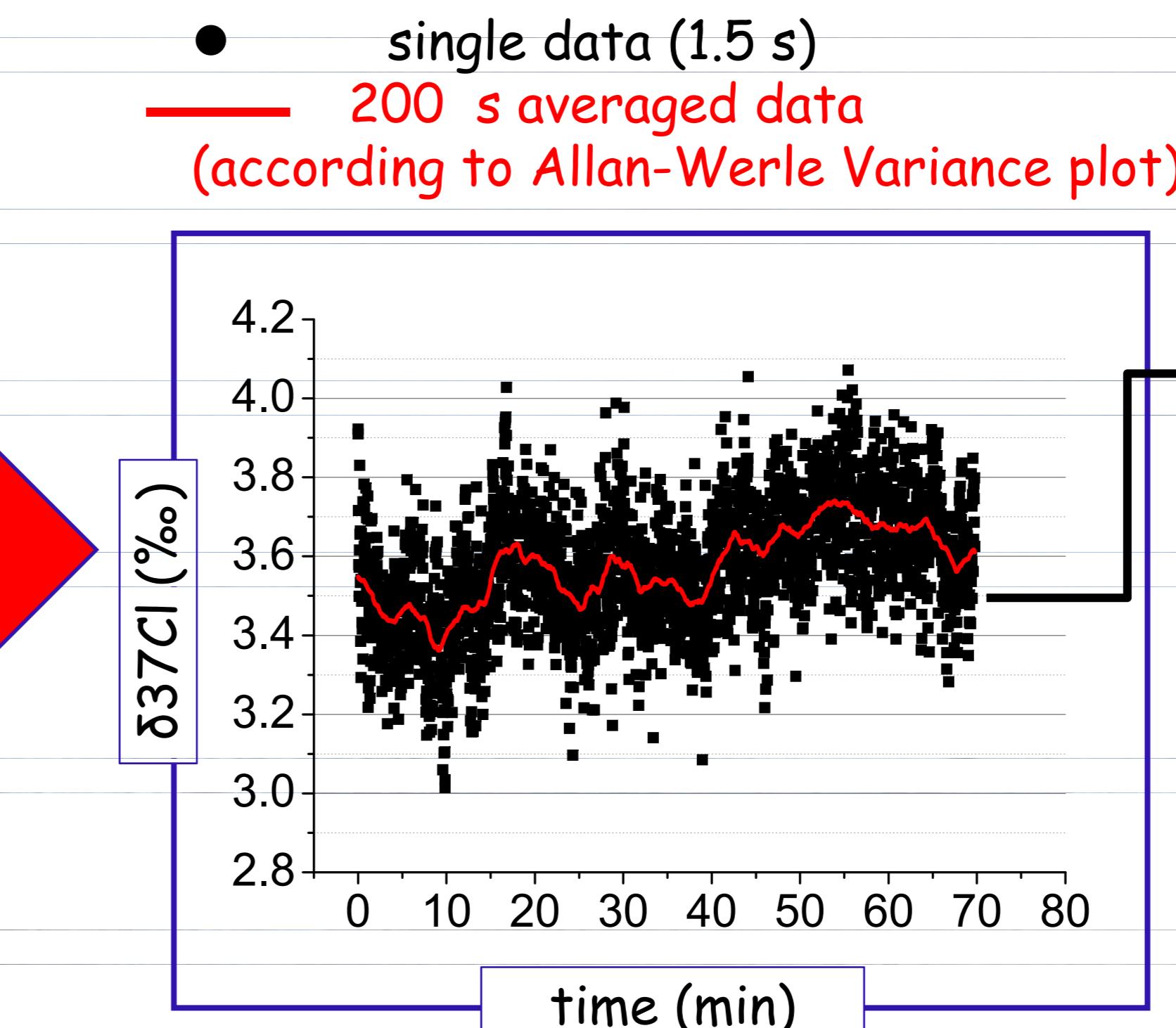
LABORATORY TEST

HCl Isotopic Ratio measurements of a mixture of HCl in air inside a climatic chamber (Pressure 1 atm; Temperature 24°C)

HCl ISOTOPES CONCENTRATIONS



$\delta^{37}\text{Cl}$ -VALUES (%) VERSUS STANDARD MEAN OCEAN CHLORIDE (SMOC)



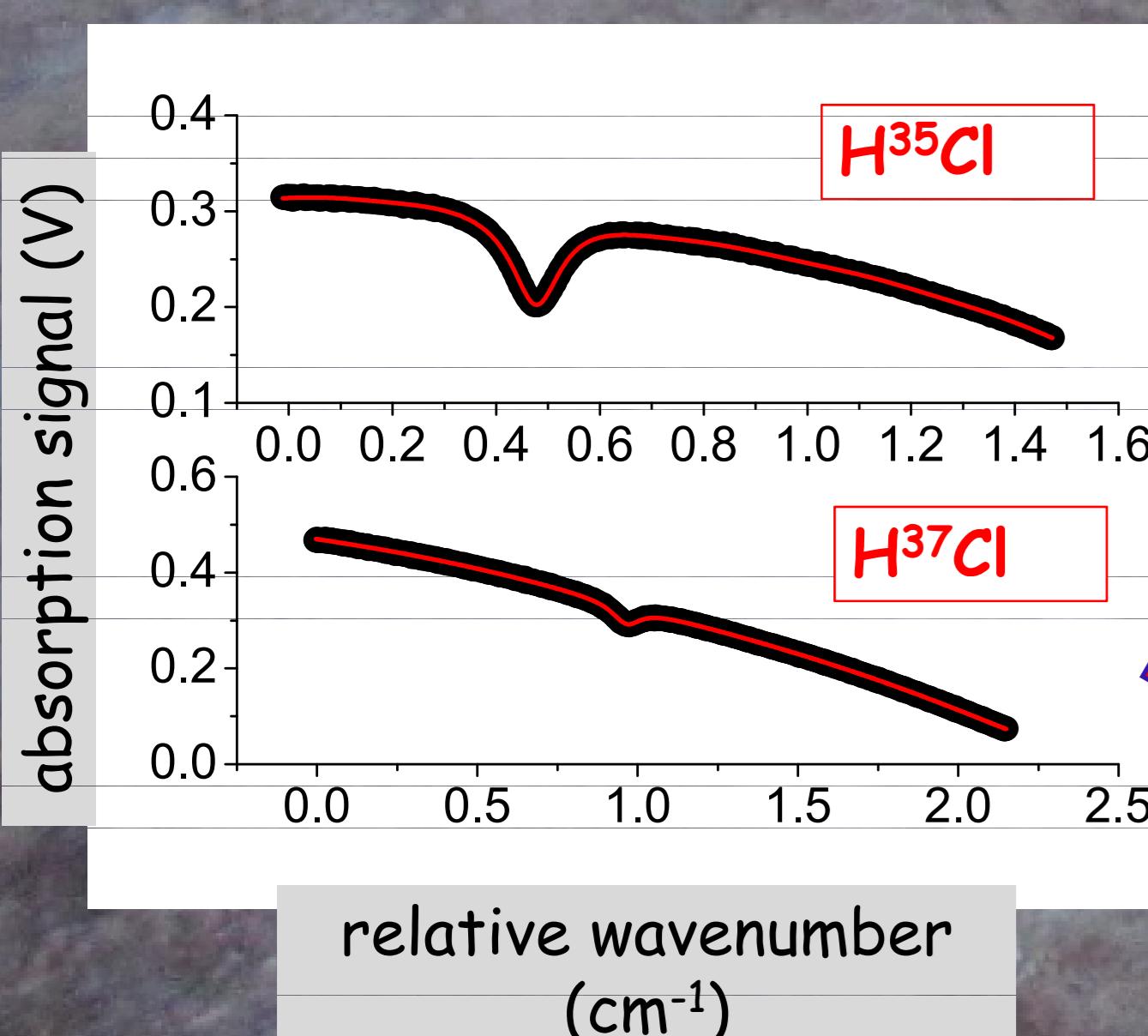
Mean value for $\delta^{37}\text{Cl}$:
 $\Rightarrow (3.57 \pm 0.15) \text{ \% @ 1.5 s}$
 $\Rightarrow (3.57 \pm 0.09) \text{ \% @ 200 s}$

TEST CAMPAIGN on ETNA

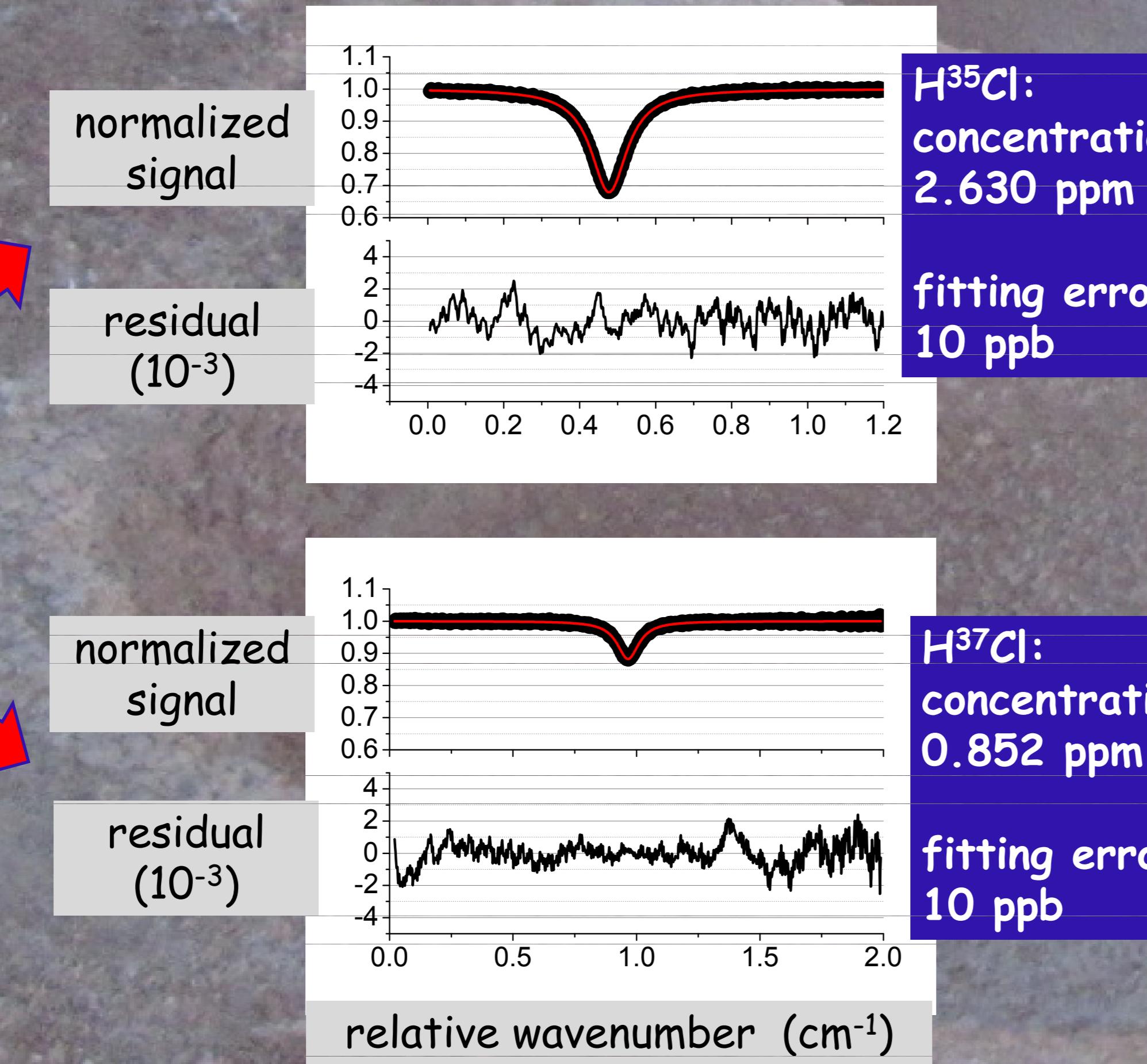
ACQUISITION and FITTING PROCEDURE

- EXPERIMENTAL SIGNAL
- FIT with VOIGT FUNCTION

ACQUIRED SIGNAL



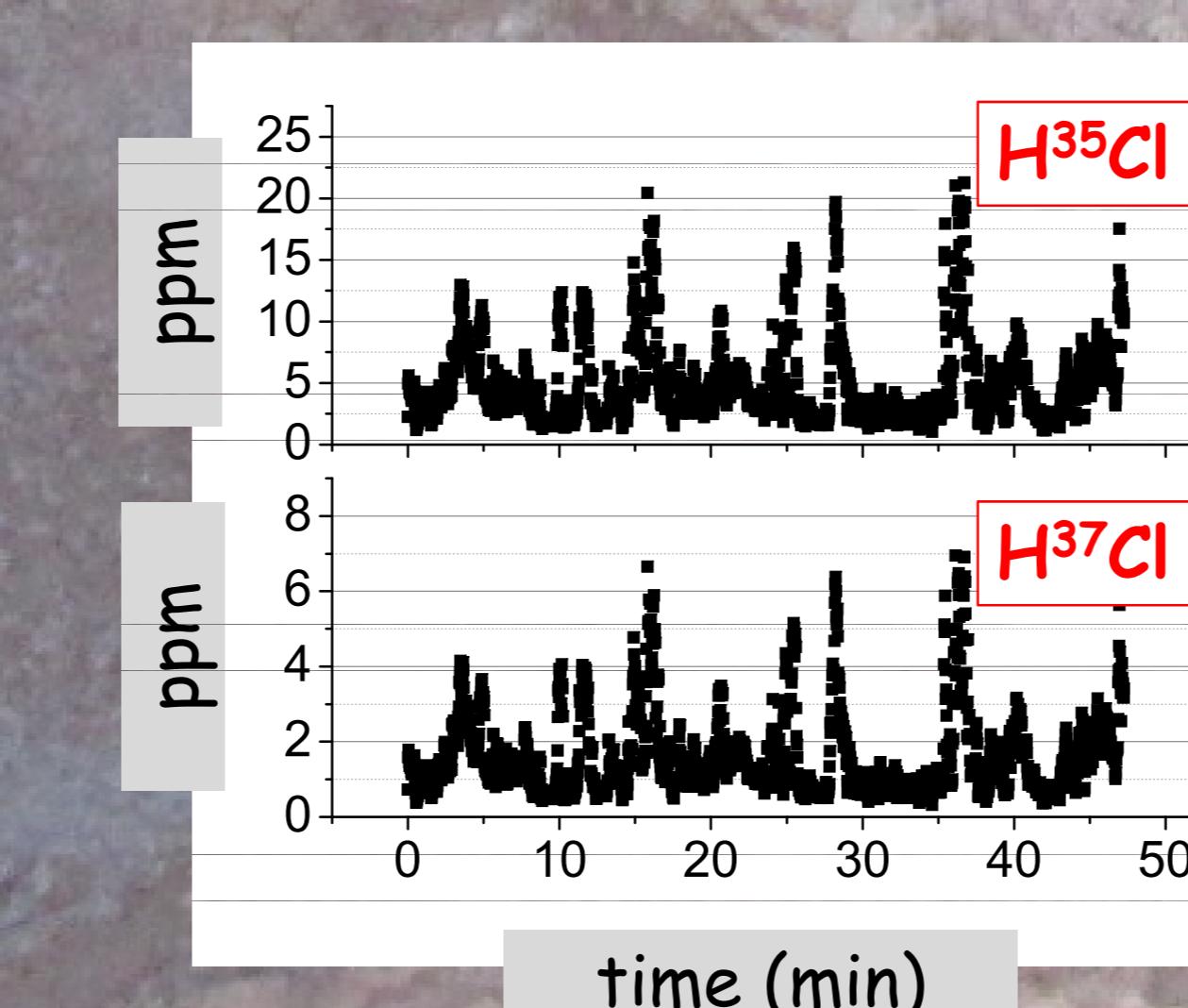
NORMALIZED SIGNAL, FIT and RESIDUAL



MEASUREMENT CONDITIONS:

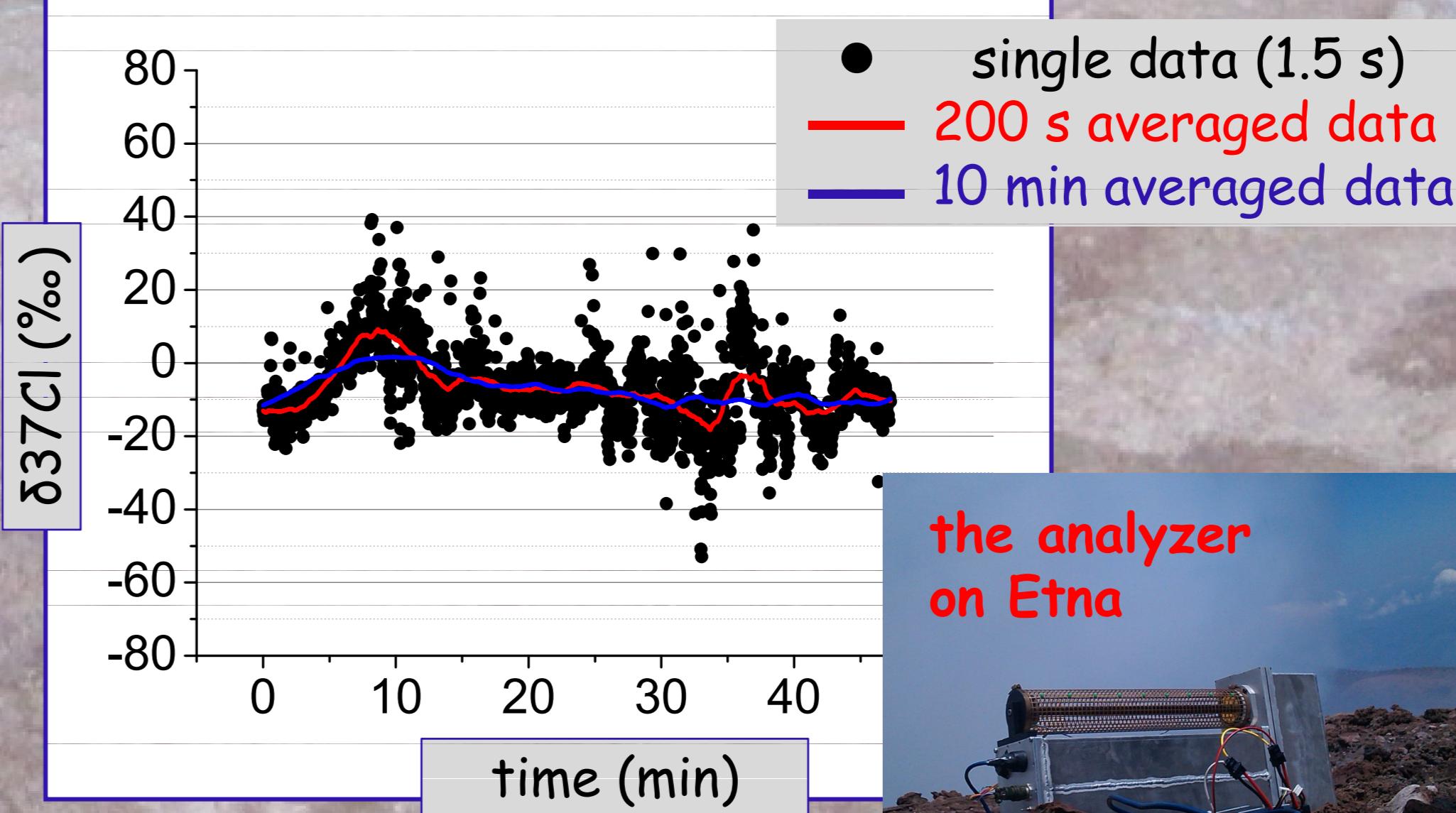
Pressure $\sim 0.7 \text{ atm}$
Temperature $\sim 5 \div 10^\circ\text{C}$
Location: Etna NEC
Open-path measurement

HCl ISOTOPES CONCENTRATIONS



ETNA RESULTS

$\delta^{37}\text{Cl}$ -VALUES (%) VERSUS STANDARD MEAN OCEAN CHLORIDE (SMOC)



the analyzer on Etna

Mean value for $\delta^{37}\text{Cl}$:

$\Rightarrow (-6.9 \pm 10) \text{ \% @ 1.5 s}$
 $\Rightarrow (-6.9 \pm 6) \text{ \% @ 200 s}$
 $\Rightarrow (-6.9 \pm 4) \text{ \% @ 10 min}$

PERFORMANCES

LABORATORY PRECISION (2σ) on $\delta^{37}\text{Cl}$:

0.2 % @ 200 s integration time

IN-FIELD PRECISION (2σ) on $\delta^{37}\text{Cl}$:

8 % @ 10 min integration time

ACKNOWLEDGMENTS
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