UCSD Efforts/ Initiatives

Oxygen Isotopes Through Laser Fluorination From Genesis Collectors

First Goal

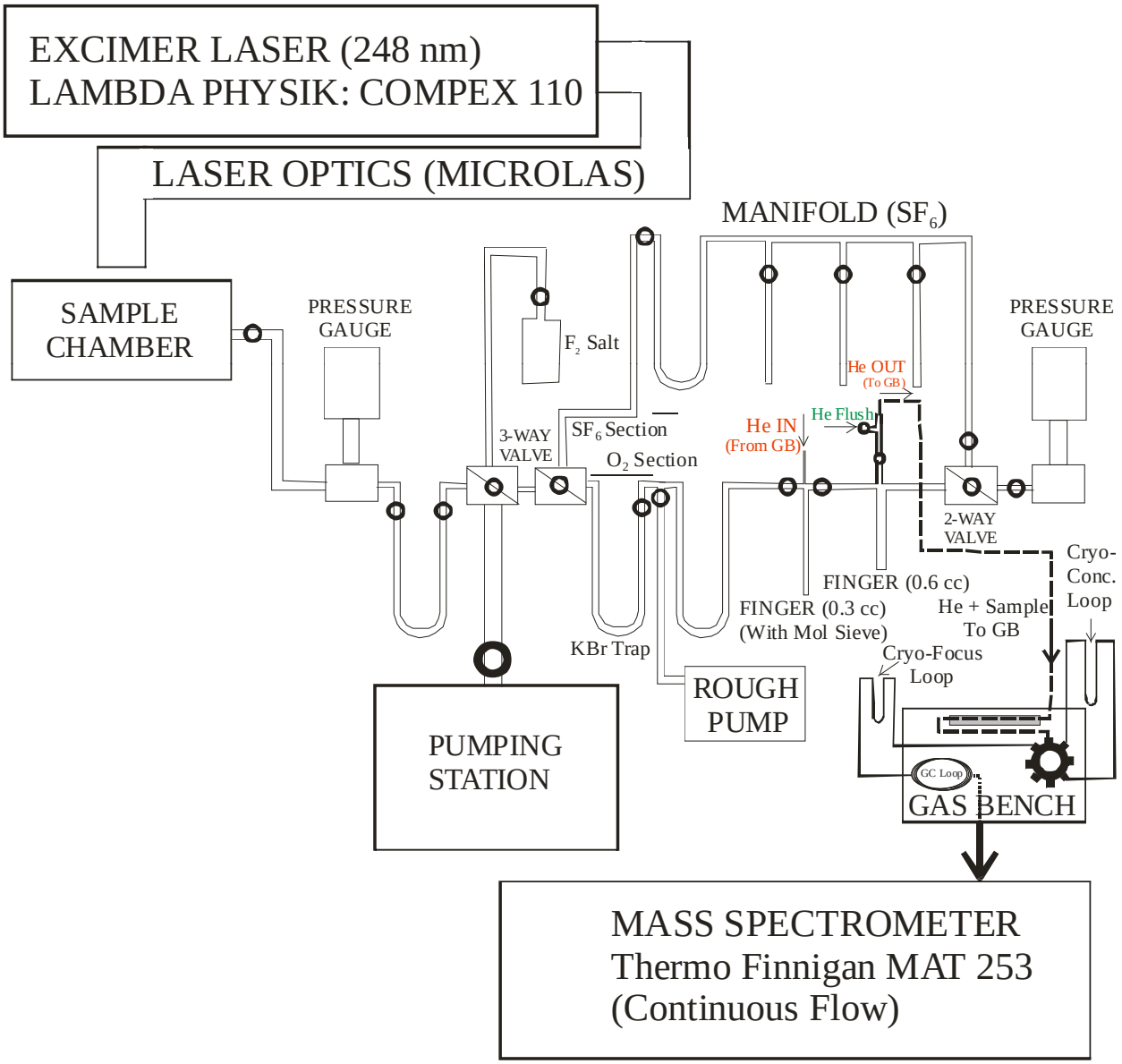
- Solar wind oxygen isotopic composition determination through laser fluorination

  – Extraction of solar wind atomic oxygen by
    - Ablating solar wind collector substrate by a excimer laser
    - In presence of ultra high purity fluorine gas (F_2)
    - Subsequent cleaning of analyte gas oxygen
    - Determination of oxygen isotopic ratio by IRMS

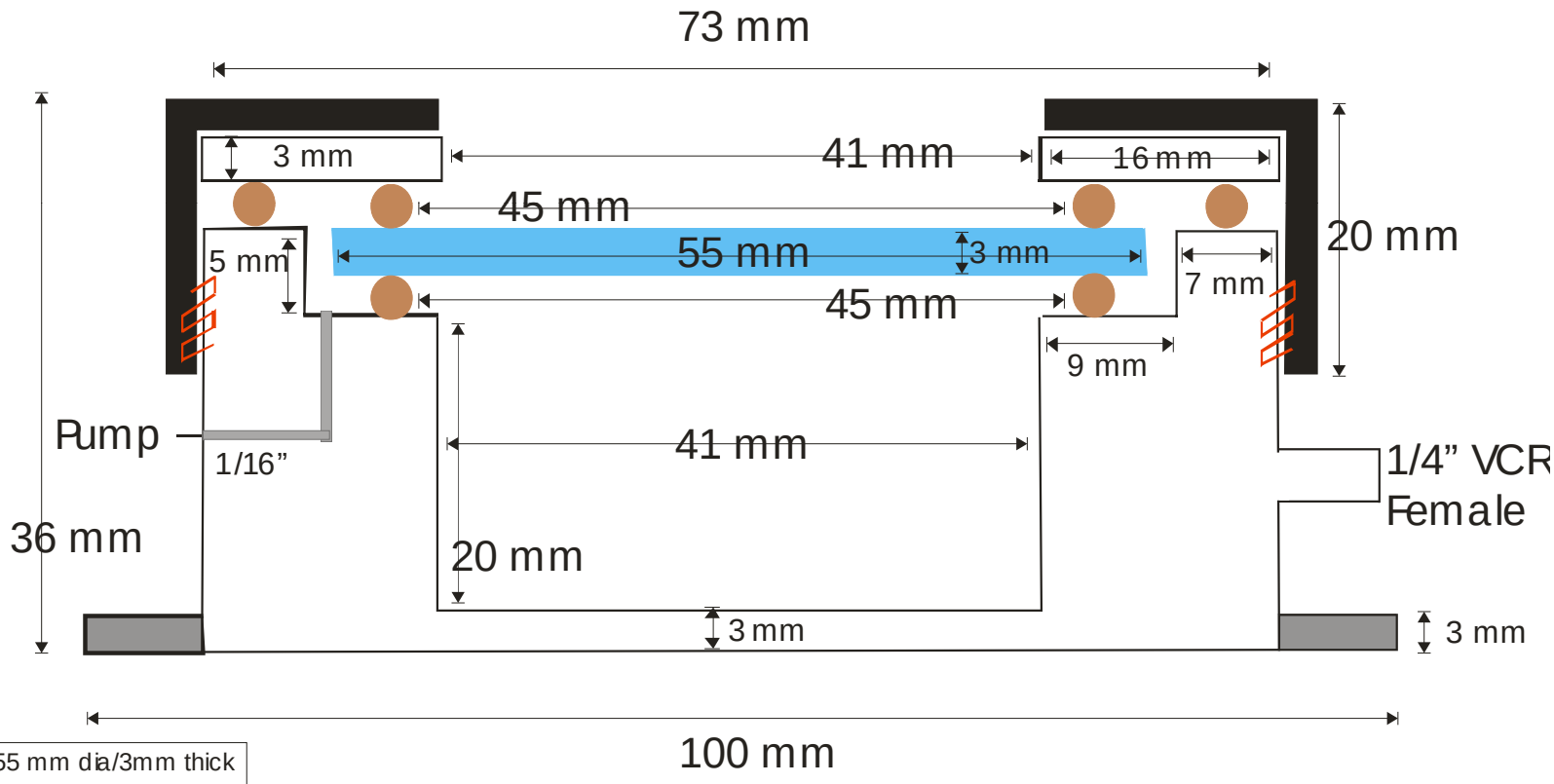
4 Steps to Reach the Goal

1. Building up a ultra low oxygen background fluorination system
2. Generating ultra low background F_2
3. Setting lasing parameters and lase (artificially) implanted samples
4. Lase flight samples

Schematic: Laser Fluorination Line



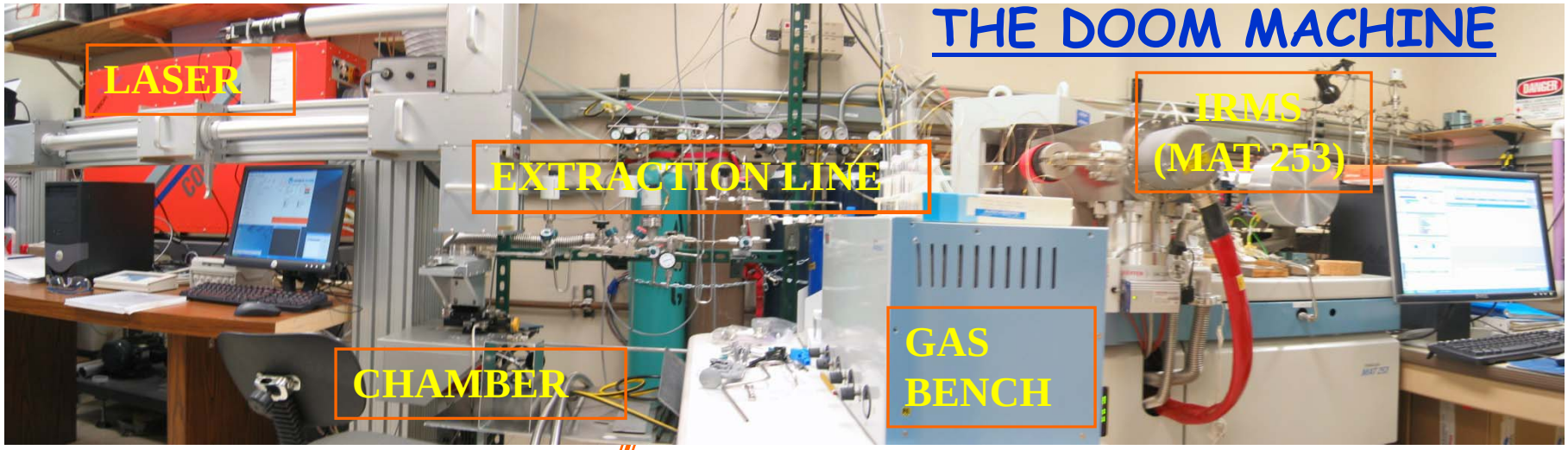
Schematic: Differentially pumped sample chamber

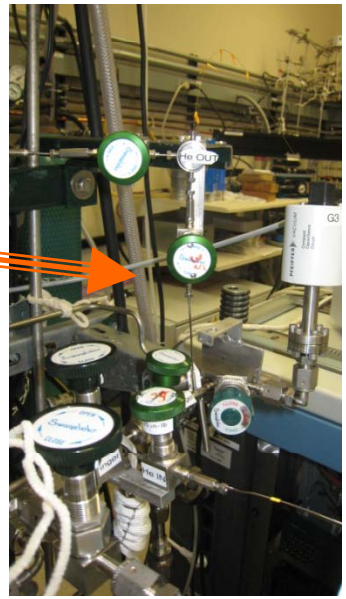


MgF_2 Window= 55 mm dia/3mm thick
Kalrez O-Ring 8575(Inner one)
44.5/3.0 mm (Parker# K42027)

Neoprene O-Ring (2 outer)
1. 44/3 mm
2. 63/3 mm

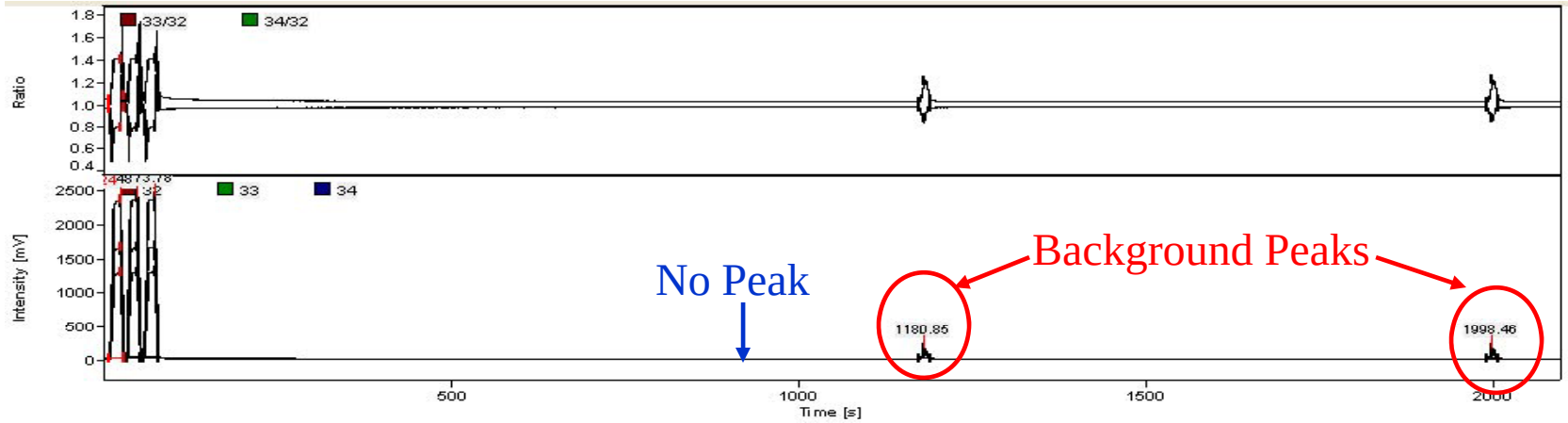
Picture: Fluorination System



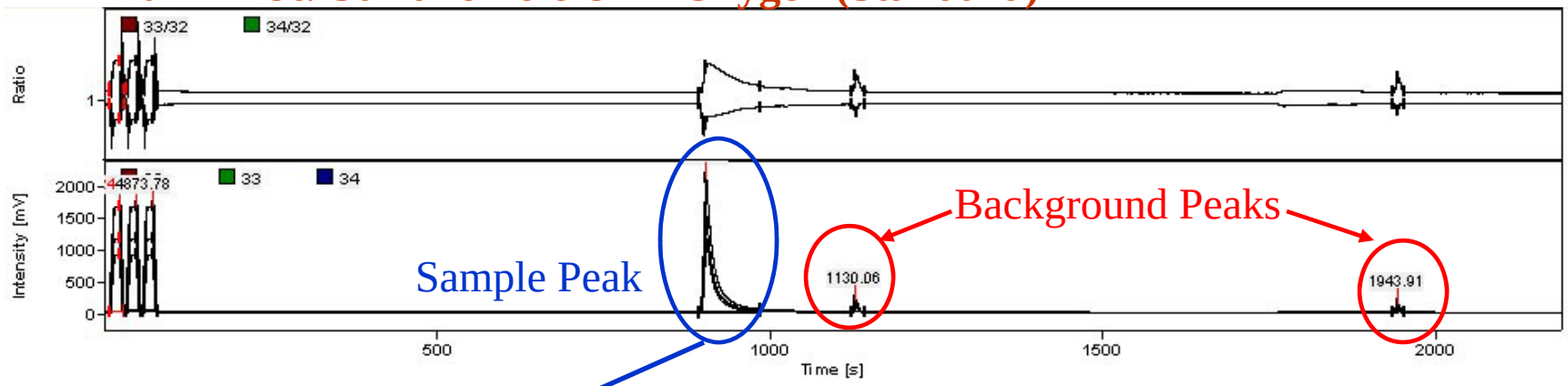


Oxygen peak detection and measurement

Run# 2082. He Blank



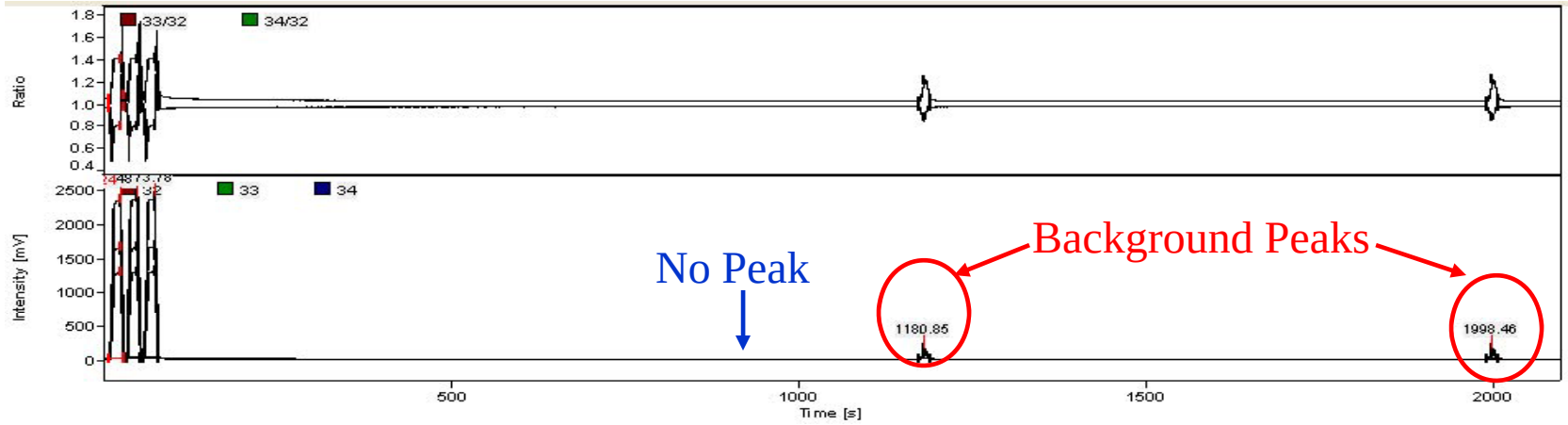
Run# 2286/ 30 nanomole UHP Oxygen (Standard)



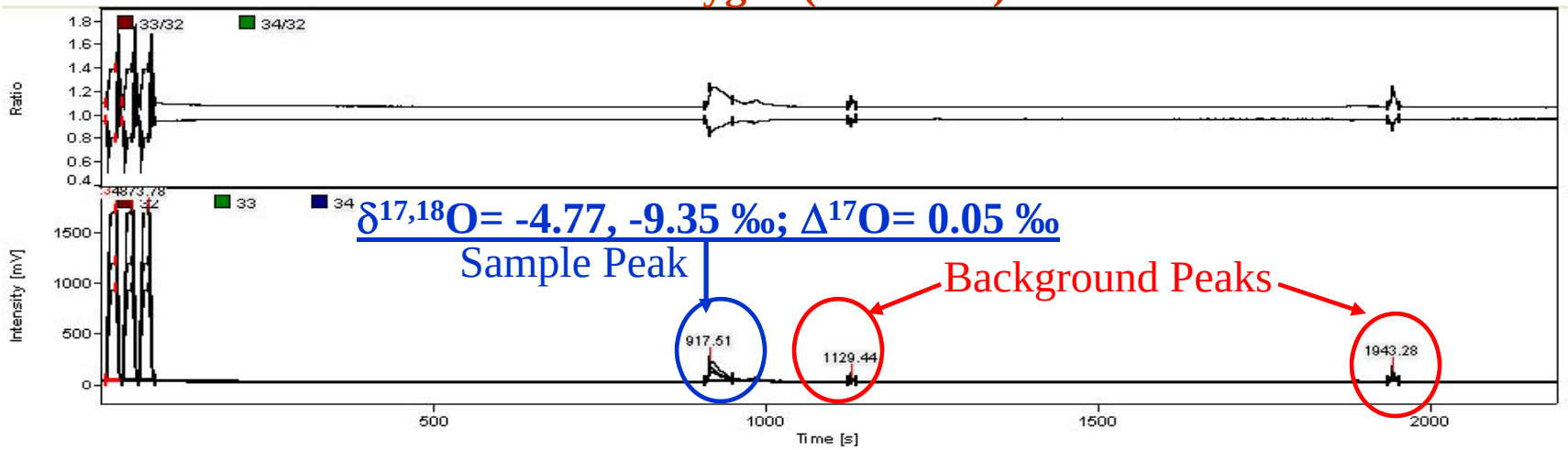
$\delta^{17,18}O$= -4.8, -10.1 ‰; $\Delta^{17}O$= 0.44 ‰

Oxygen peak detection and measurement

Run# 2082. He Blank



Run# 2290/ 2 nanomole UHP Oxygen (Standard)

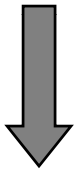


Ultra Low Oxygen Blank Fluorine

F_2 Cleaning:

UHP F_2 from the tank transferred to F_2 generator (Salt: K_3NiF_6*KF)

Distilled **THRICE** from one generator to other for cleaning



F_2 Blank checked:

For 15 mbar of F_2 inside the chamber for 2 hours (typical lasing time)

Yield 0.10 nanomoles of oxygen

(too small a signal to get the isotopic composition)

Lasing Parameters

Fluorine Pressure: 10 – 15 mbar (inside 22 cc chamber)

Laser Power: 100 mJ

Pulse Rate: 5 Hz

Spot Size: 200 μm

Lasing by: Rastering (user programmable area)

Raster speed: 300 μm/sec

Sample Inventory

14582 Non Flight SiC Implanted (LANL)			
1	14582-A	1 x 2 cm	Lased (1/2)
2	14582-B	1 x 1 cm	Lased
3	14582-C	1 x 2 cm	-
SiC Implanted in Wisconsic Plasma Source (air O_2)			
1	SICWP-A	SiC 2,2 irregular pc	Lased
2	SICWP-B	SiC 2,6 (1 x 1.5 cm)	-
3	SICWP-C	SiC 2,5 irregular pc	-
Non Concentator Flight Samples (Brown Strain)			
1	Fz-Silicon F500	2 x 2 cm	-
2	Fz-Silicon F500	2 x 2 cm	-
3	Fz-Silicon F500	2 x 2 cm	-
4	Fz-Silicon F500	2 x 2 cm	-
5	Fz-Silicon F500	2 x 2 cm	-
6	Fz-Silicon F500	2 x 2 cm	-

Sample Inventory

Sample Inventory for Genesis Project UCSD)								2/11/2009							
1	14582	Non Flight SiC Implanted with 16O (d18O=-510 per						Got from Peter Mao (UCLA), March 2007							
		A	1 cm x 2 cm				Implaned in LANL								
		B	1 cm X 1 cm		Superglued in Al										
		C	1 cm x 2 cm												
2	CIA16-400								Received from Don Burnett (4/24/07)						
3	SiC Implanted in Wisconsin Plasma source with air oxygen														
		A	SiC 2,2	Irregular Piece											
		B	SiC 2,6	Square piece of 1 cm x 1.5 cm^2											
		C	SiC 2,5	Irregular Piece											
4			Fz Si Implanted on Wi		1 cm x 1 cm piece from P. Mao (8/26/07)										
5	SiC Non-Flight, Non-Implant Samples (for background testing)								Received from Amy, 3/25/08						
		A	SiC	1 quardrant of 2.3 cm radius circle					Received from Amy, 3/25/08						
		B	SiC	2 quardrant of 2.3 cm radius circle											
6	34S + 18O + Ne Implanted samples								Received from Amy, 8/29/08						
		a	18O Implant	~1.5cm x 1.5 cm											
		b	18O Implant	~1.5cm x 1.5 cm											
		g	18O Implant	~1.5cm x 1.5 cm											
		h	18O Implant	~1.5cm x 1.5 cm											
		e	18O Implant	~1.5cm x 1.5 cm											
7	18O + 34S Implanted Samples								Received from Amy, 9/25/08						
		a	18O Implant	~1.5 cm x 1.5 cm											
		b	18O Implant	~1.5 cm x 1.5 cm											
		c	18O Implant	~1.5 cm x 1.5 cm											
		d	34S Implant	~1.5 cm x 1.5 cm											
Non-concentrator Flight Samples															
		1	Fz-Silicon F500-3	Send By: DSB 4-3-06				2 cm x 2 cm	These are non-concentrator Brown strained samples						
		3	Fz-Silicon F500-4	Send By: DSB 4-3-07				2 cm x 2 cm	Received 4/10/08						
		5	Fz-Silicon F500-5	Send By: DSB 4-3-08				2 cm x 2 cm							
		6	Fz-Silicon F500-6	Send By: DSB 4-3-09				2 cm x 2 cm							
		7	Fz-Silicon F500-7	Send By: DSB 4-3-10				2 cm x 2 cm							
		8	Fz-Silicon F500-8	Send By: DSB 4-3-11				2 cm x 2 cm							

Results

Lasing Blanks (Non-flight SiC)

Date	Lasing#	Area Lased	New/ Old	Pre-cleaned	Type	Lasaer Para	F2 (torr)	Run#	Yield (nmoles)	d18O	d17O	D17O
2/25/2009	*Lasing# 1*	*1.06*	*New*	*NO*	*Defocused*	*75mJ/ 5 Hz*	*0*	*3859*	*0.4*	*-14.0*		
2/26/2009	Lasing# 2	1.06	Old	Yes	Focused	100mJ/ 5 Hz	8.05	3862	2.4	18.1	10.2	0.9
3/10/2009	Lasing# 3	1.06	OLD	YES	Focused	108mJ/ 5 Hz	10	3895	1.9	9.4	5.5	0.6
3/12/2009	Lasing# 4	1.06	OLD	YES	Focused	110mJ/ 5 Hz	10	3903	8.1	10.2	5.4	0.2
3/13/2009	Lasing# 5	1.06	Old+ New	NO-New	Focused	100mJ/ 5 Hz	10.12	3906	9.8	17.8	9.7	0.5
3/16/2009	Lasing# 6	1.06	OLD	YES	Focused	100mJ/ 5 Hz	10.04	3909	16.5	3.8	2.1	0.1
3/17/2009	Lasing# 7	1.06	OLD	YES	Focused	100mJ/ 5 Hz	10.12	3911	13.1	5.6	2.5	-0.4
3/19/2009	Lasing# 8	ONE SPOT	OLD	YES	Focused	100mJ/ 5 Hz	10.09	3915	24.6	10.0	5.2	0.0
3/20/2009	Lasing# 9	1 (SS-Plate)			Focused	100mJ/ 5 Hz	10.12	3922	22.2	5.8	3.5	0.5

F2 Blanks

2/11/2009							10.09	3822	3.7	-12.3	-6.7	-0.4
3/11/2009							10	3905	2.6	-10.1	-5.2	0.0
3/20/2009	(Kept in line (not cjamber) for 2 hrs)						10.12	3921	2.7	-12.6	-6.2	0.2

10 Torr F2 Blanks (3 hrs in Chamber)

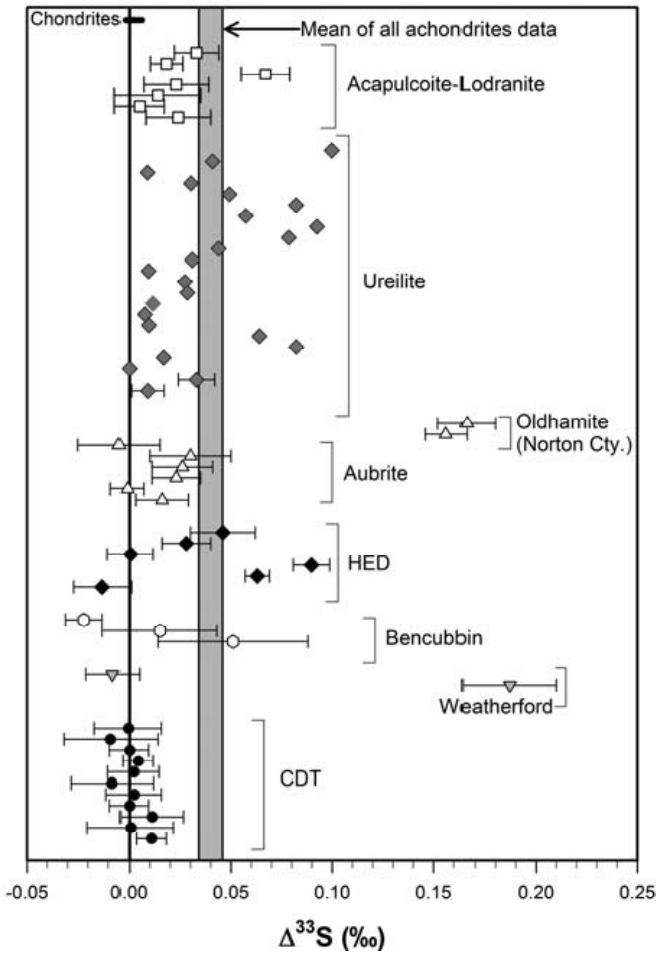
3/4/2009							*10.41*	*3883*	*21.9*	*10.4*	*5.9*	0.5
3/9/2009							*10.05*	*3892*	*48.7*	*2.3*	*1.3*	0.1
3/11/2009							9.85	3900	3.6	-10.9	-6.0	-0.4
3/13/2009							9.9	3905	3.3	-10.1	-5.2	0.0

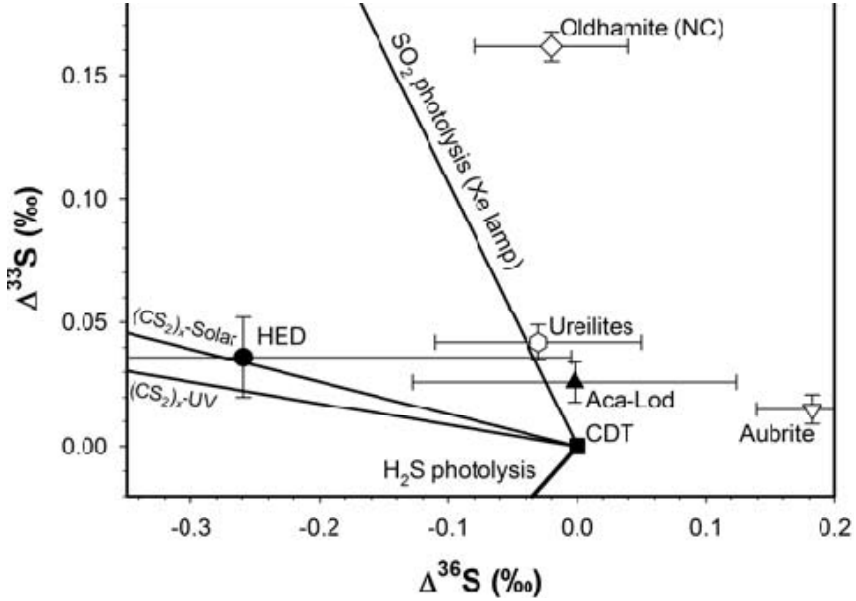
Second Goal (But Important!!)

- Solar wind sulfur isotopic composition determination through laser fluorination

  - Analyte gas SF_6
  - Similar extraction as oxygen
  - Modified sample gas purification protocol
  - Additional modification of Gas-Bench (Thermo Finnigan) for SF_6 purification
  - Continuous Flow Stable Isotope Ration mass spectrometer (CF-IRMS, MAT 253) for sulfur isotopic ratio determination using SF_5^+ signal

Importance of Sulfur





Rai et al., Science, 2005