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BSB-27 MONITOX
PP3: SAMPLING AND ANALYSIS OF HEAVY METALS IN SAMPLES WATER, SEDIMENTS & FISHE, FROM NESTOS RIVER AND DELTA USING ICP-MS

Digital Scientific Materials for Students

Καβάλα Μάιος 2021

Καθηγ. Δρ. Θ. Σπανός

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INTERNATIONAL HELLENIC UNIVERSITY
Τμήμα Χημείας

Name of the project BSB-27

Black Sea Basin interdisciplinary cooperation network for sustainable joint monitoring of environmental toxicants migration improved evaluation of ecological state and human health impact of harmful substances, and public exposure prevention - MONITOX

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Κωδικός έργου BSB27

"Δίκτυο διεπιστημονικής συνεργασίας με στόχο την περιβαλλοντική βιωσιμότητα στη Λεκάνη της Μαύρης Θάλασσας μέσω της παρακολούθησης της μεταναστευτικής πορείας τοξικών χημικών ουσιών, της καλύτερης αξιολόγησης της οικολογικής κατάστασης και των επιπτώσεων των ρύπων στην ανθρώπινη υγεία, και της πρόληψης της έκθεσης του πληθυσμού - MONITOX".

Digital Scientific Materials for Students

Καβάλα Μάιος 2021

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INTERNATIONAL HELLENIC UNIVERSITY

Τμήμα Χημείας

Partner project coordinator PP3

- Καθηγητής Δρ. Θωμάς ΣΠΑΝΟΣ
  Ενόργανη Χημική Ανάλυση

μέλη ομάδας PP3:

- Χρηστίνα Χατζηχρήστου, Λέκτορας, MSc
- Vilson Topi, MSc

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Black Sea Cooperation Network MONITOX Monitoring Toxicants

Black Sea CROSS BORDER COOPERATION

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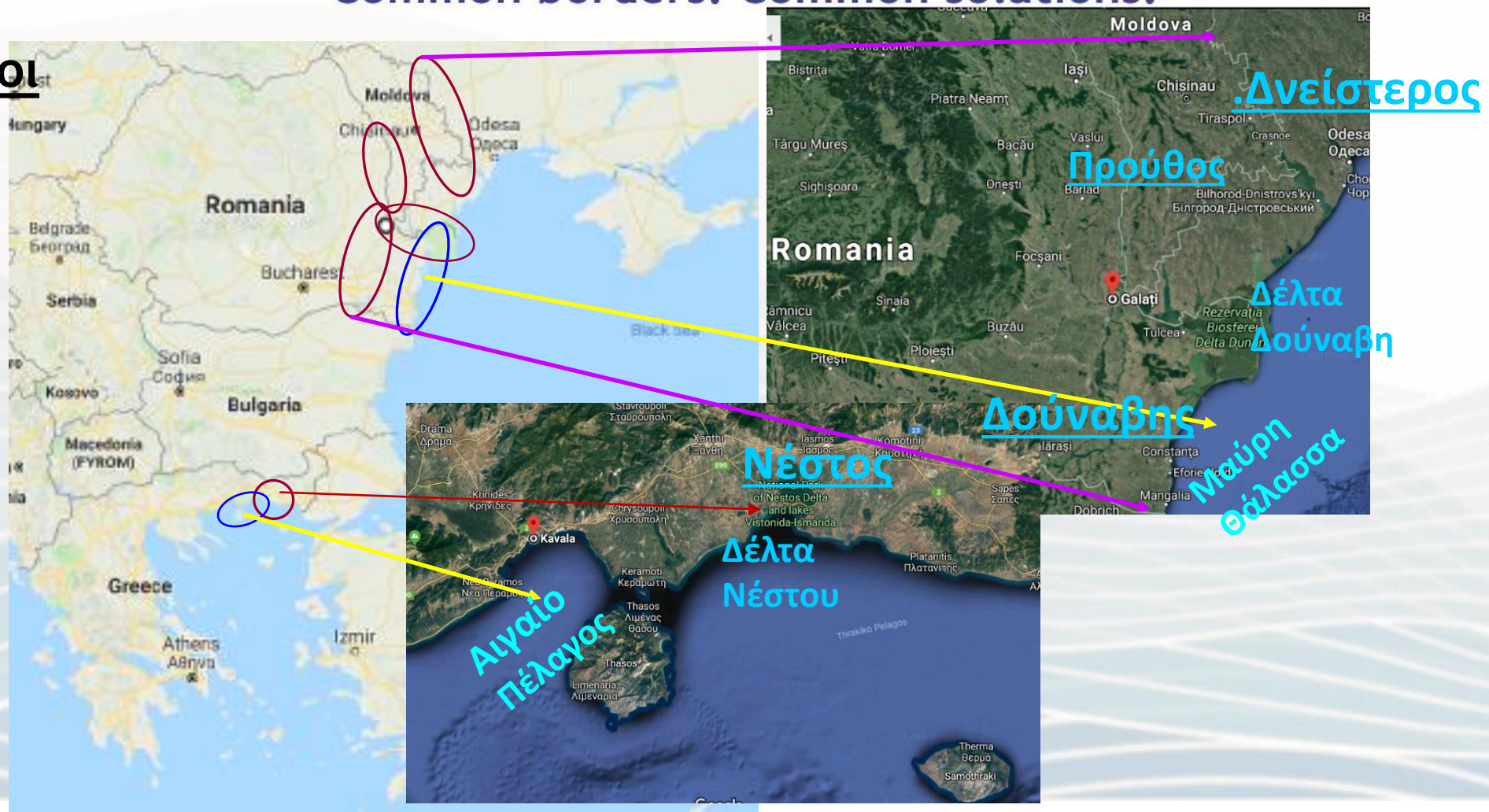
Στοχευμένοι Τομείς



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Εταίροι:

- Πανεπιστήμιο, ”Dunărea de Jos” din Galați; România – **Επικεφαλής**
- Ινστιτούτο Ζωολογίας, Chișinău, Republica Moldova;
- Διεθνές Πανεπιστήμιο της Ελλάδας, Τμήμα Χημείας, Καβάλα, Ελλάδα;
- Ινστιτούτο Γεωλογίας και Σεισμολογίας, Chișinău, Republica Moldova;
- Εθνικό Ινστιτούτο Ανάπτυξης της Έρευνας στο Δέλτα Δούναβη, Tulcea, România;

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Comitetul de conducere a proiectului:

- Prof.dr. habil. ing. fiz. **Antoaneta Ene** – *Manager de proiect, Lider Partener LP1* - Ui Dunărea de Jos din Galați
- Mem. cor. ASM, prof. dr. habil. biol. **Elena Zubcov** – *Coordonator proiect partener PP2,* Institutul de Zoologie, Chișinău, Republica Moldova
- Prof. dr. chim. **Thomas Spanos** – *Coordonator proiect partener PP3*, International Hellenic University, Kavala, Grecia
- Dr. geol. **Oleg Bogdevich** – *Coordonator proiect partener PP4,* Institutul de Geologie și Seismologie, Chișinău, Republica Moldova
- Dr. chim. **Liliana Teodorof** – *Coordonator proiect partener PP5*, Institutul Național de Cercetare-Dezvoltare Delta Dunării, Tulcea

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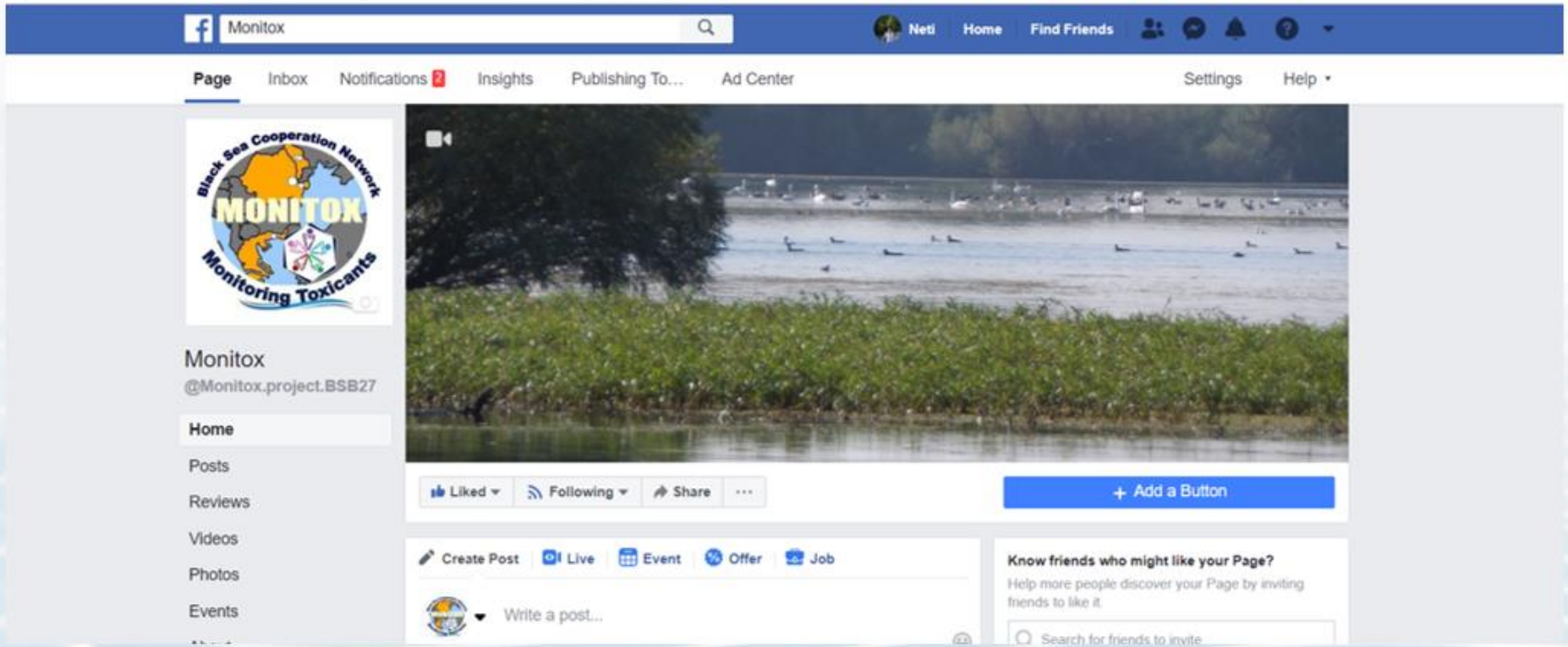
Σελίδα Facebook

fb.me/Monitox.project.BSB27



BSB-27 ΜΟΝΙΤΟΧ, ΔΕΙΓΜΑΤΟΛΗΨΙΕΣ & ΑΝΑΛΥΣΕΙΣ

Κατά την διάρκεια του έργου πραγματοποιήθηκαν περισσότερες από 4 δειγματοληψίες από συγκεκριμένα σημεία του ποταμού Νέστου και του Δέλτα του Νέστου

- **Σε κάθε δειγματοληψία στον Νέστο ποταμό λαμβάνονται:**

➢3 δείγματα νερού και

➢3 δείγματα ιζημάτων από τα ίδια σημεία

- **Σε κάθε δειγματοληψία στο Δέλτα του Νέστου λαμβάνονται:**

➢6 δείγματα θαλασσινού επιφανειακού νερού

➢6 δείγματα θαλασσινού νερού πυθμένα και

➢6 δείγματα ιζημάτων από τα ίδια σημεία

- **Σε κάθε δειγματοληψία ιχθύων στον ποταμό Νέστο ποταμό αλιεύονται:**

➢δύο διαφορετικά είδη ιχθύων Μπριάνα (Barbus strumicae) και Θρακοτιληνάρι (Squalius orpheus), από 3 σημεία του ποταμού.

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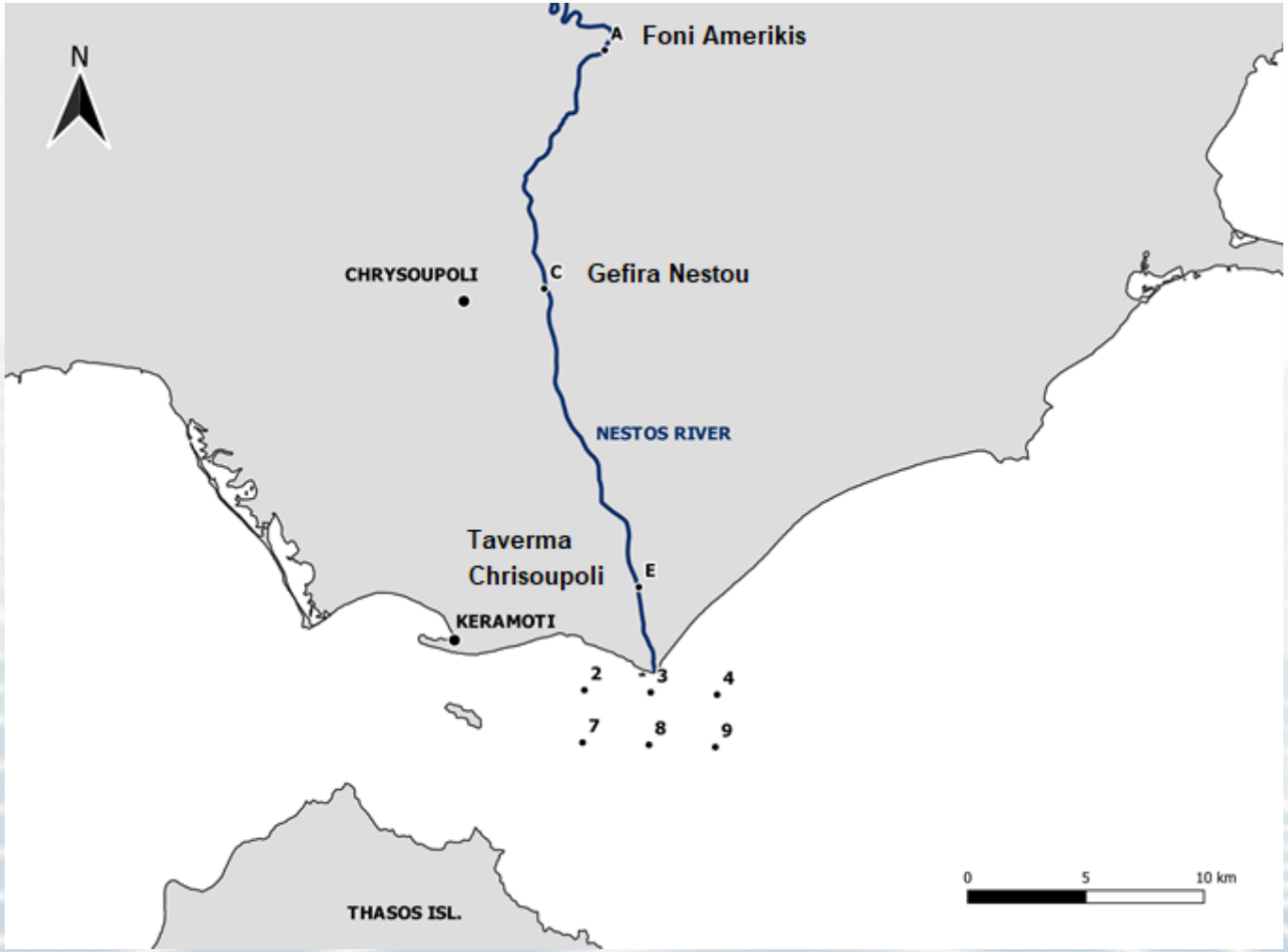
Χάρτης σημείων δειγματοληψίας, Ποταμός Νέστος & Δέλτα



Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ

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εξοπλισμός δειγματοληψίας στα αυτοκίνητα

μετάβαση σε προκαθορισμένα σημεία στον ποταμό Νέστο


14 ΙΑΝΟΥΑΡΙΟΥ
2021 Δειγματοληψία Νερού

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1.1 δειγματοληψίες νερού στον Ποταμό Νέστο

φορητός εξοπλισμός

επιτόπιες μετρήσεις με φορητό εξοπλισμό

1.2 δειγματοληψίες ιζημάτων στον Ποταμό Νέστο

δειγματολήπτης Van Veen

- stainless still

λήψη ιζήματος, καταγραφή στοιχείων

ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ

Μεταφορά δειγμάτων νερού και ιζημάτων από τον Ποταμό Νέστο

στο Εργαστήριο Ενόργανης Ανάλυσης, Τμήμα Χημείας, ΔΙΠΑΕ

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Black Sea Cooperation Network MONITOX Monitoring Toxicants

Black Sea CROSS BORDER COOPERATION

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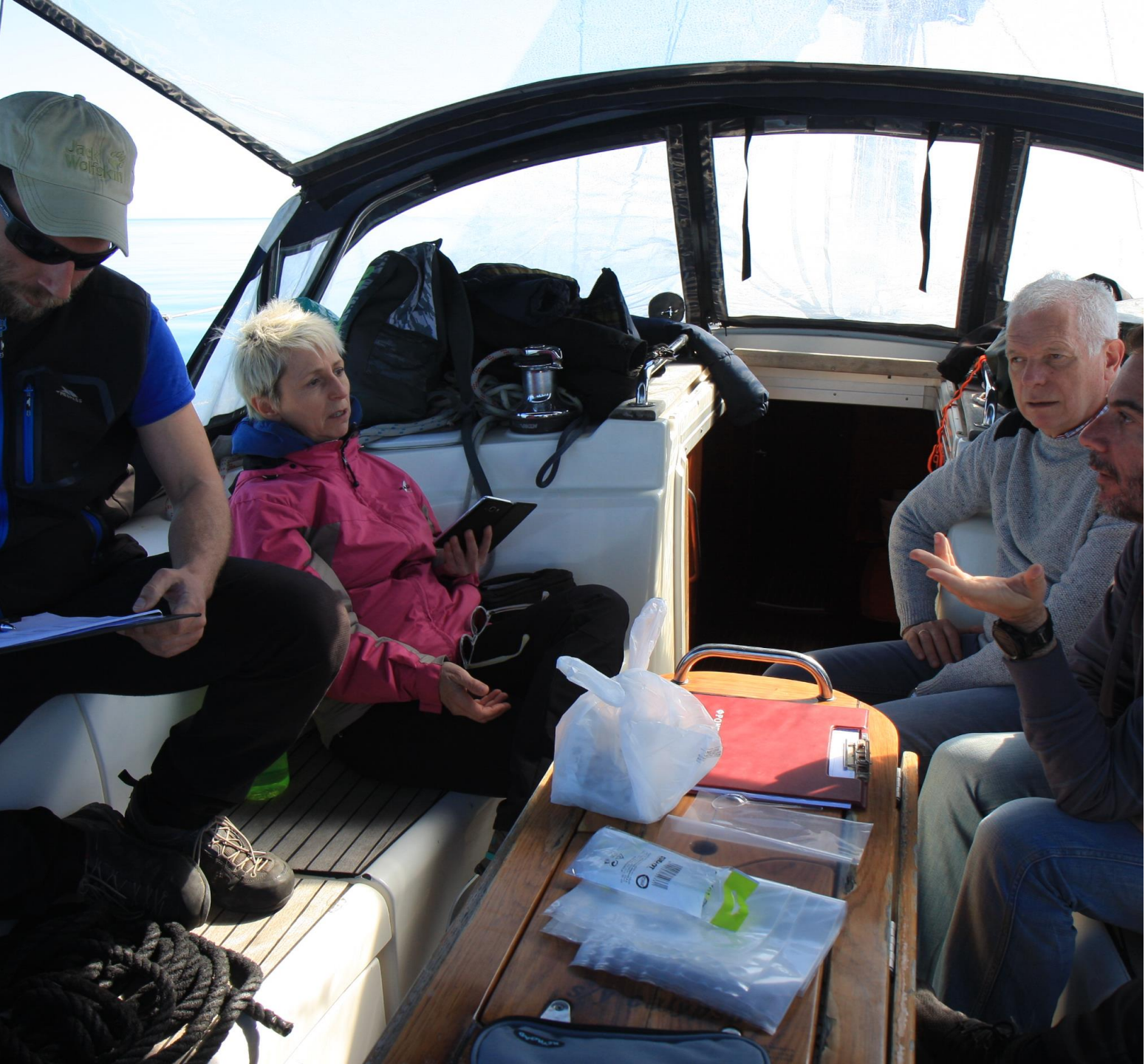
2. δειγματοληψίες στη θάλασσα, Δέλτα Νέστου

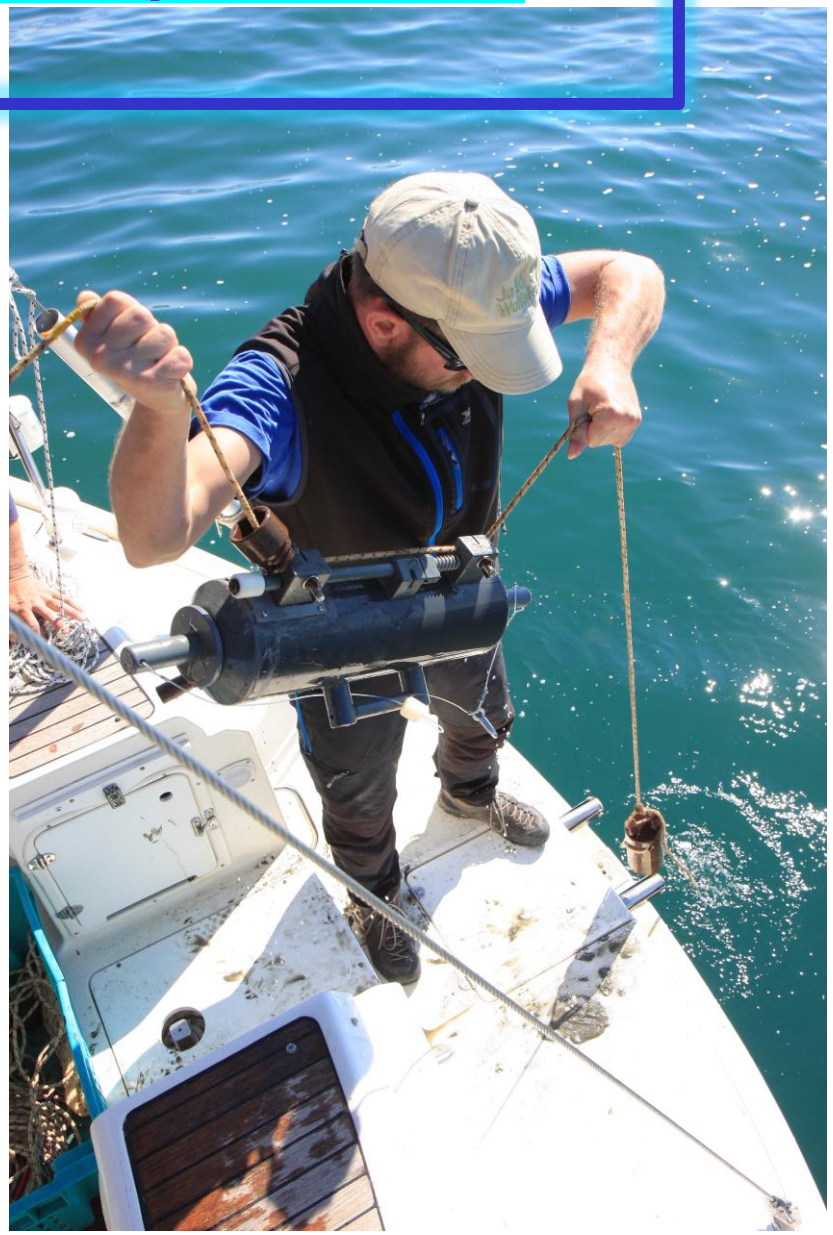

NORTH CAT II



Μετάβαση δια θαλάσσης στο Δέλτα Νέστου

έλεγχος και τακτοποίηση εξοπλισμού στο σκάφος

2.1 δειγματοληψίες θαλασσινού νερού από επιφάνεια και πυθμένα, Δέλτα Νέστου



δειγματολήπτης Niskin

- **PVC**
- **Λήψη επιφανειακού δείγματος ή σε επιλεγμένο βάθος**
- **Με χρήση οδηγού κλείνει στο σωστό βάθος και παγιδεύει το νερό**
- **Τα καπάκια κλείνουν εσωτερικά ή εξωτερικά**

Αναλύσεις:
- **Φυσικοχημικές παράμετροι**
- **Υδρογονάνθρακες**
- **χλωροφύλλη**
- **Ιχνοστοιχεία και τοξικά μέταλλα**

λήψη δειγμάτων θαλασσινού νερού

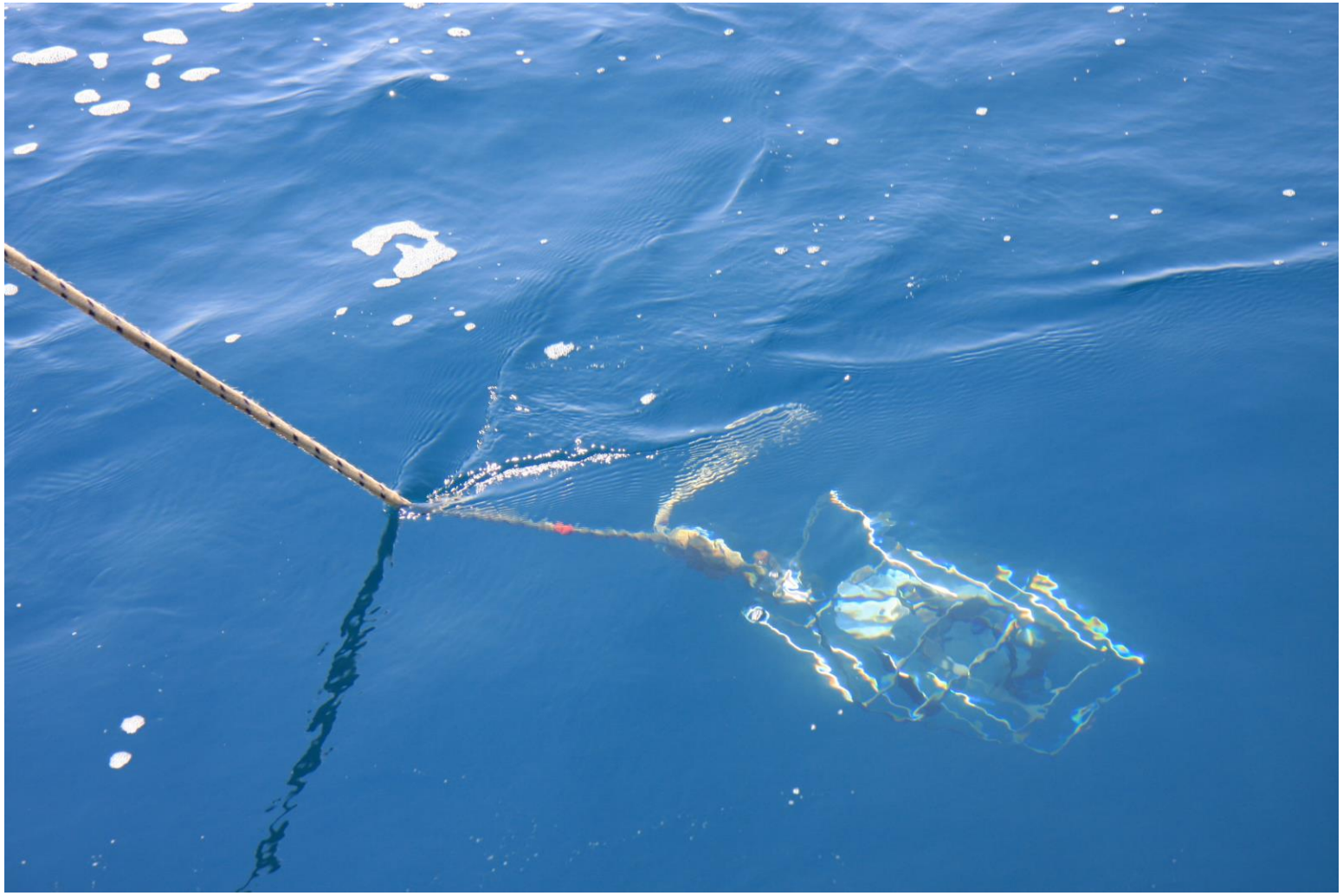
2.2 δειγματοληψίες ιζημάτων, Δέλτα Νέστου

λήψη δειγμάτων ιζήματος

2.3 Αυτόματη καταγραφή φυσικοχημικών παραμέτρων νερού

Chemical toxicology Database (TCD)

- βάθους (πίεσης)
- θερμοκρασίας
- αγωγιμότητας (αλατότητας)
- dissolved oxygen



επιστροφή με δείγματα θαλασσινού νερού και ιζημάτων, Δέλτα Νέστου

ΔΙΕΘΝΕΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΤΗΣ ΕΛΛΑΔΟΣ

Μεταφορά δειγμάτων νερού και ιζημάτων από το Δέλτα του Ποταμού Νέστου στο Εργαστήριο Ενόργανης Ανάλυσης, Τμήμα Χημείας, ΔΙΠΑΕ

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3. δειγματοληψίες ιχθύων- Ποταμός Νέστος

καταγραφή στοιχείων

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δειγματοληψία ιχθύων στον Νέστο

Ξεκούραση !!

λήψη δειγμάτων ιχθύων

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4. ΔΙΠΑΕ, Τμήμα Χημείας, Εργαστήριο Ενόργανης Ανάλυσης

i. Προκατεργασία: δείγματα νερού

- διήθηση
- οξίνιση με π. HNO3

ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ

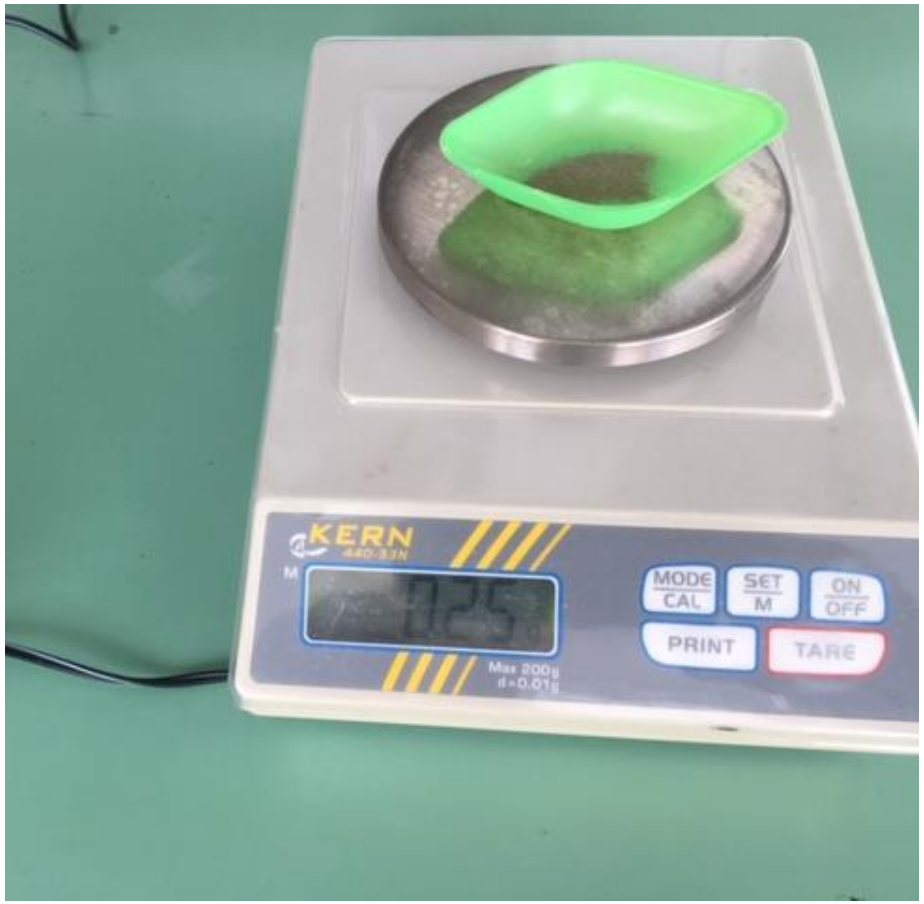
ii. Προκατεργασία: δείγματα ιζημάτων

- ξήρανση

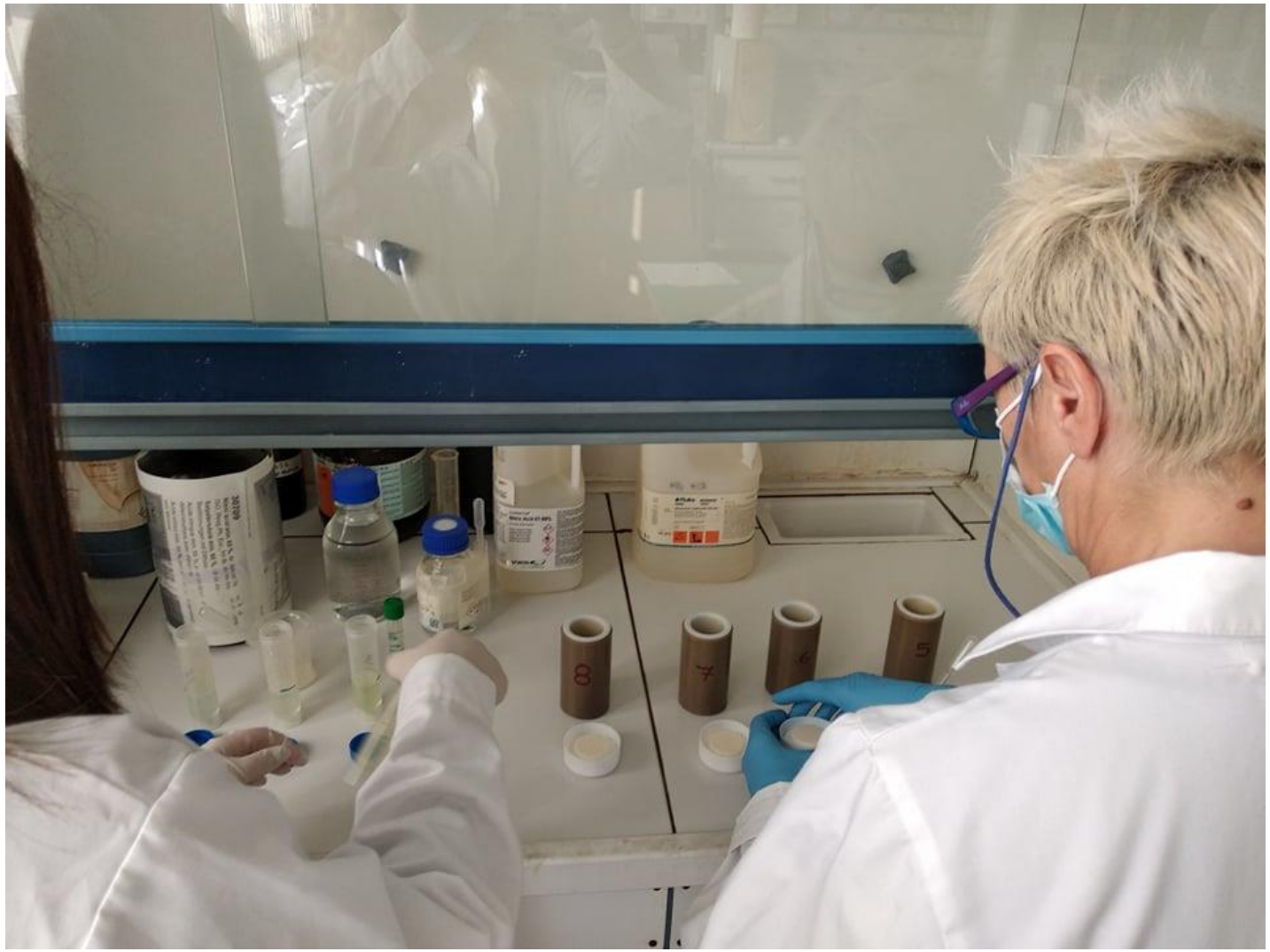
- **λειοτρίβηση**

- **κοσκίνιση**

- **ζύγιση**



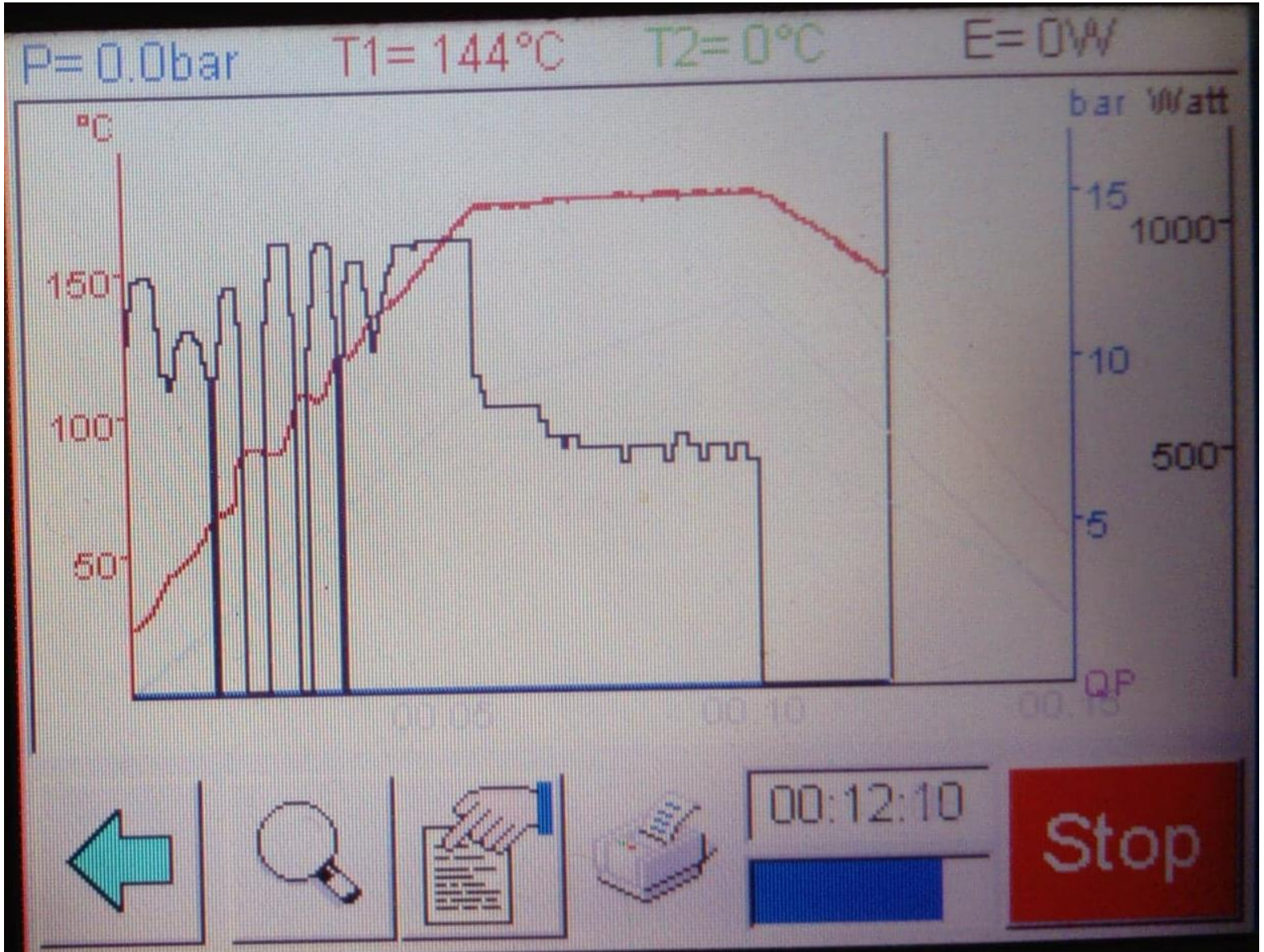
- **οξύνιση, με π. HNO_3**



- σφράγιση κελιών, για χώνευση με μικροκύματα (MW)

- δείγματα για χώνευση στο MW θερμοαντιδραστήρα

- **πρόγραμμα χώνευσης δειγμάτων με MW**



- άνοιγμα κελιών μετά την χώνευση

- **φιλτράρισμα, παρασκευή δειγμάτων ιζημάτων για ανάλυση**

Τμήμα Χημείας, Εργαστήριο Ενόργανης Ανάλυσης

- δείγματα νερών και ιζημάτων έτοιμα για ανάλυση με ICP-MS

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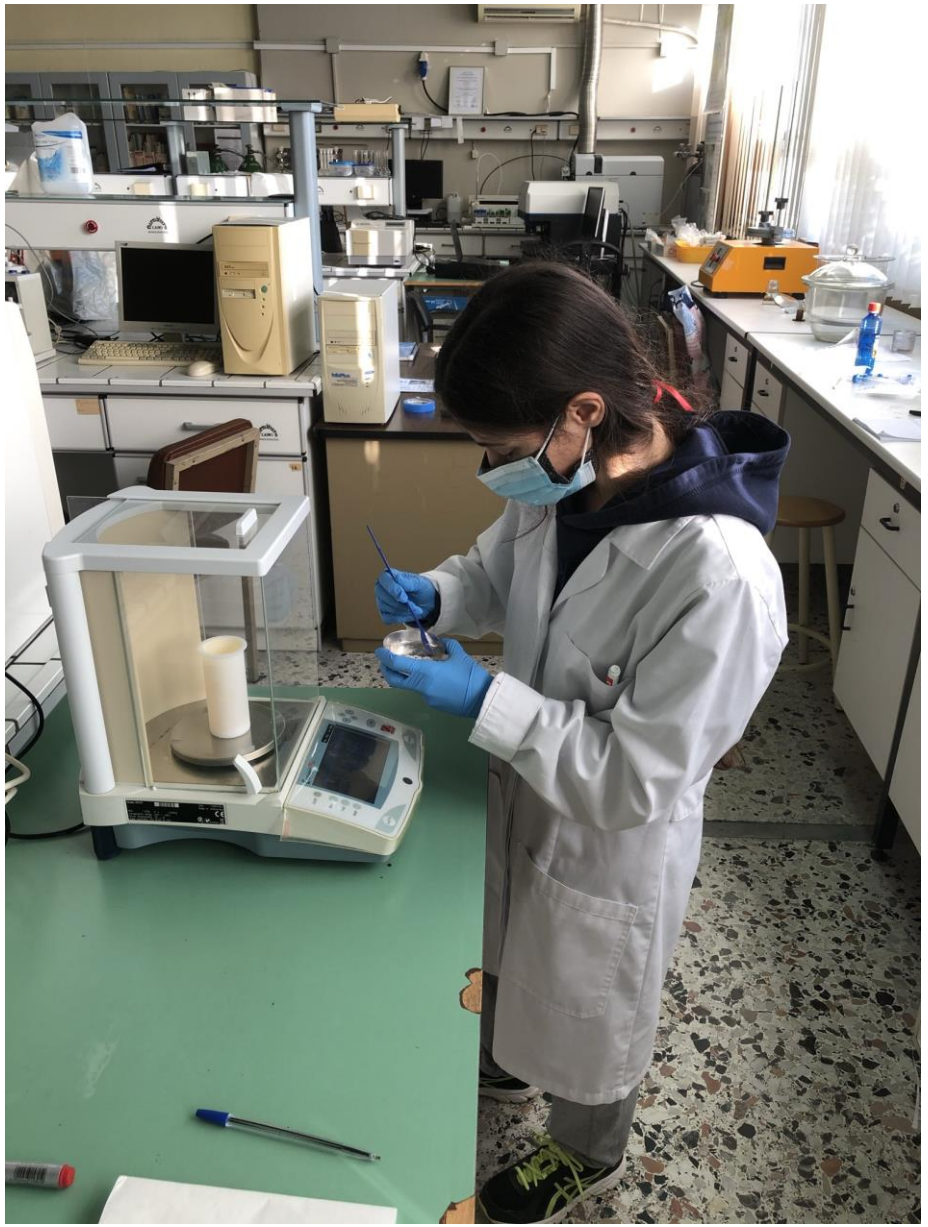
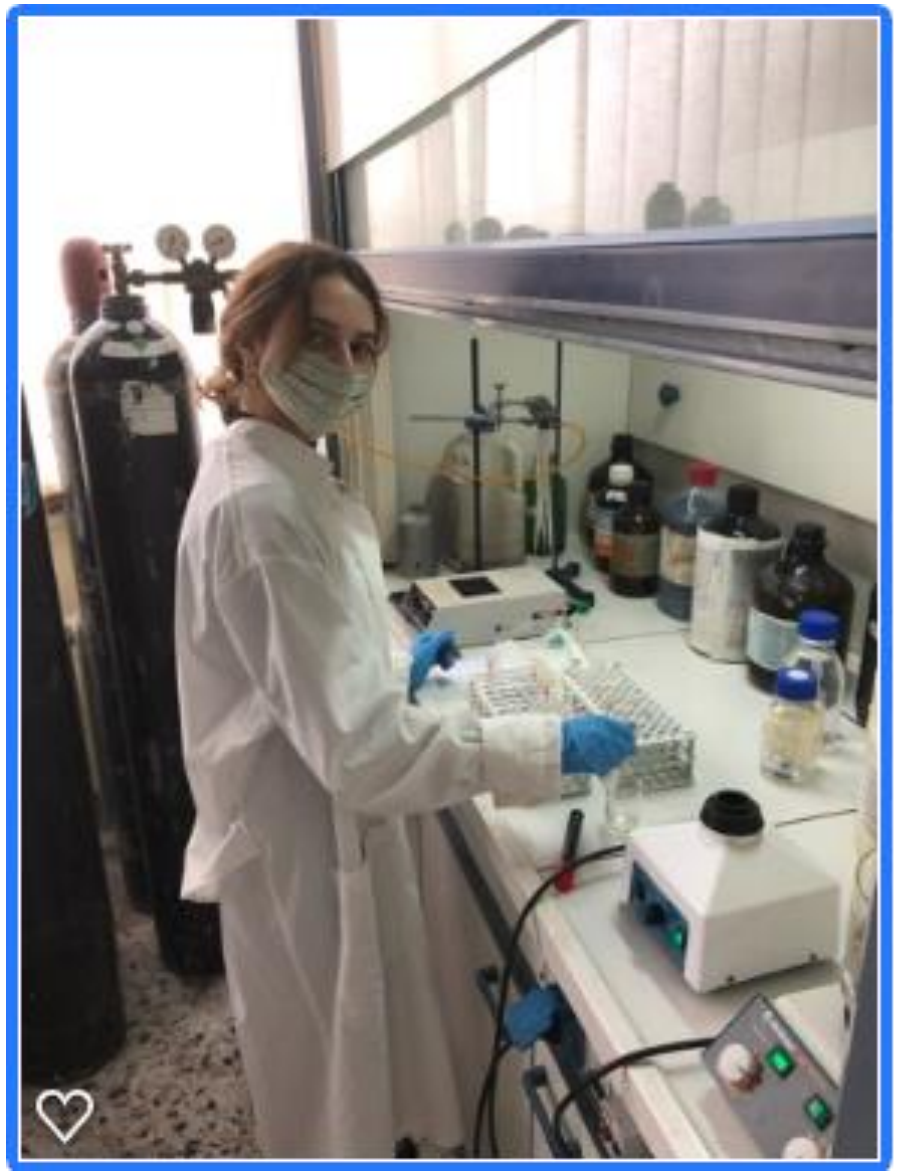
iii. Προκατεργασία: δείγματα ιχθύων

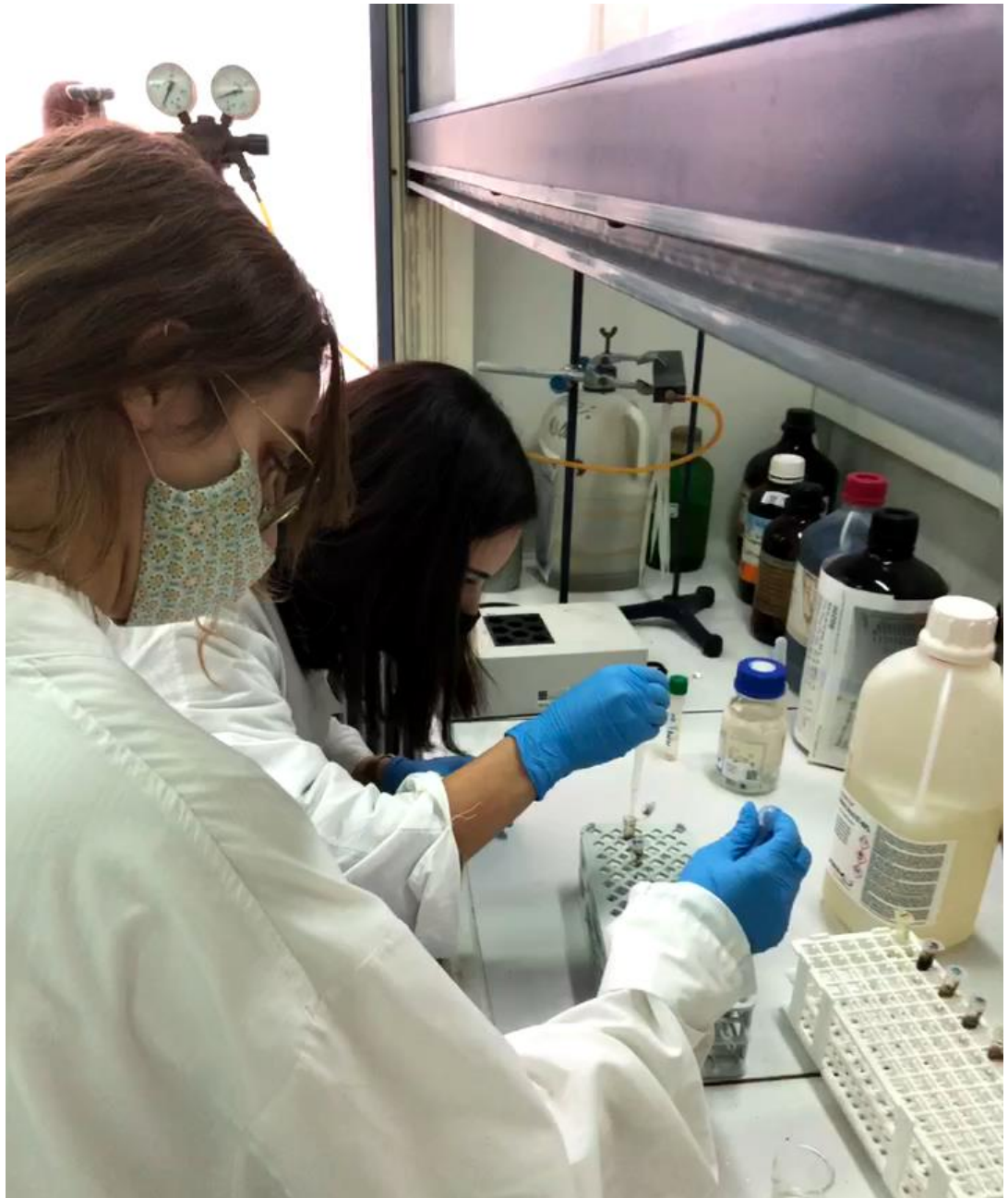
- καταγραφή

- ξήρανση, ζύγιση



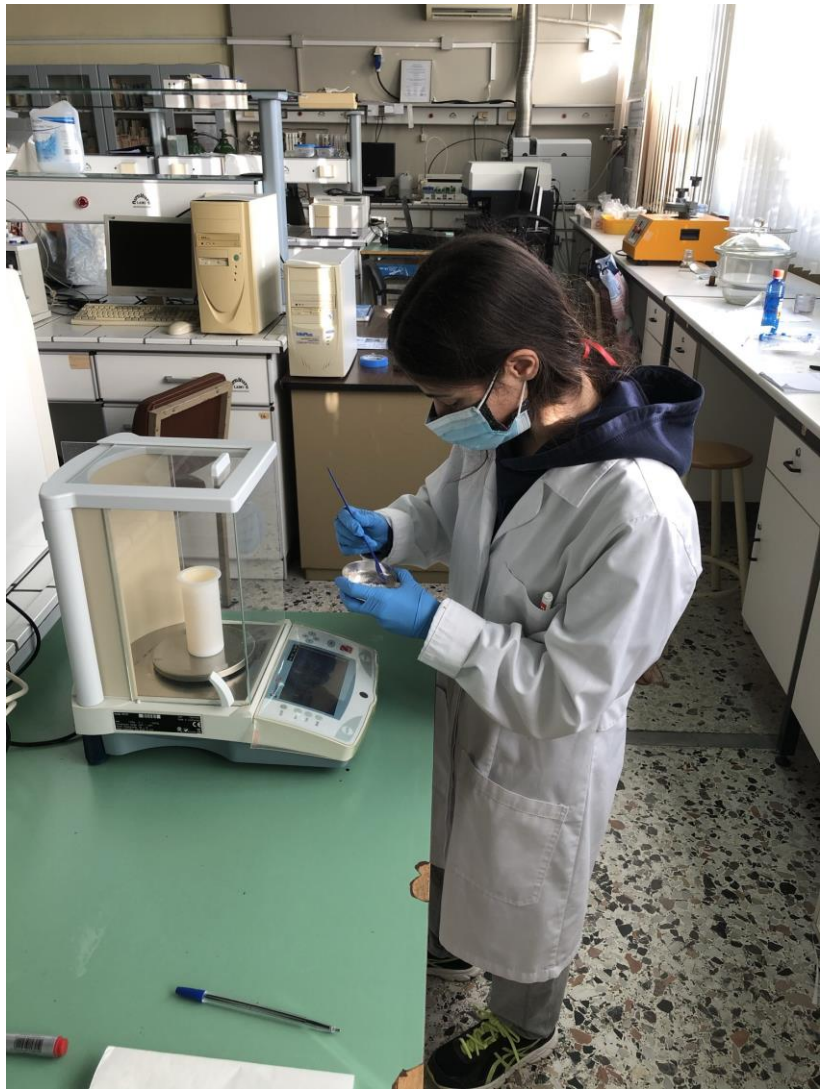
- **προσθήκη οξέος για χώνευση**



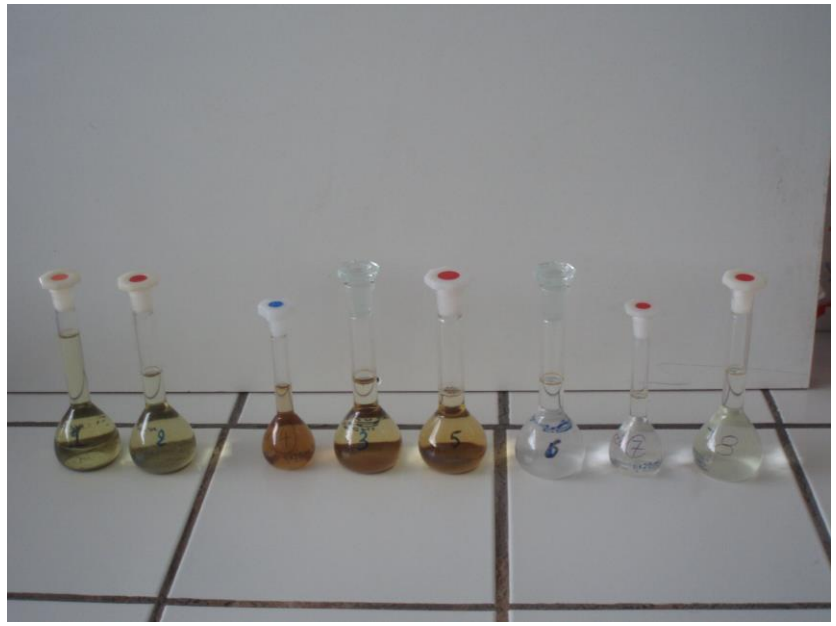


➢ χώνευση Open vessel

- προετοιμασία για χώνευση με MW



➢ δείγματα ιχθύων έτοιμα για ανάλυση με ICP-MS



ΔΙΕΘΝΕΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΤΗΣ ΕΛΛΑΔΟΣ

- Τμήμα Χημείας
- Μέλη Εργαστηρίου και συμμετέχοντες

Καθηγ Θωμάς Σπανός, υπέυθυνος
ΧΧ μέλος
Τόπι βασιλησ μέλος

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ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ

Τμήμα Χημείας

ICP-MS θεωρία

Επαγωγικά Συζευγμένο Πλάσμα-Φασματομετρία Μάζας

Inductively Coupled Plasma - Mass Spectrometry

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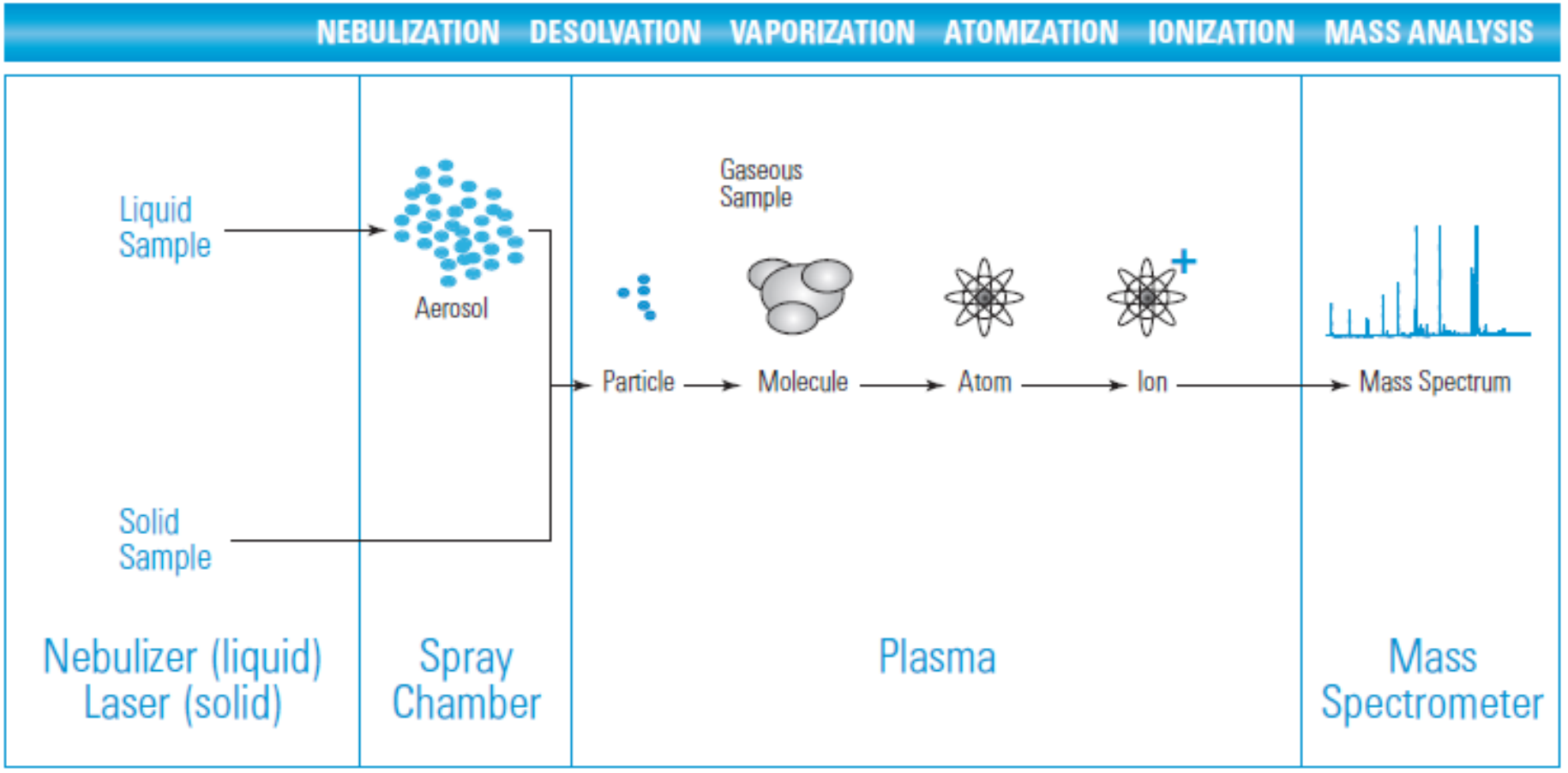
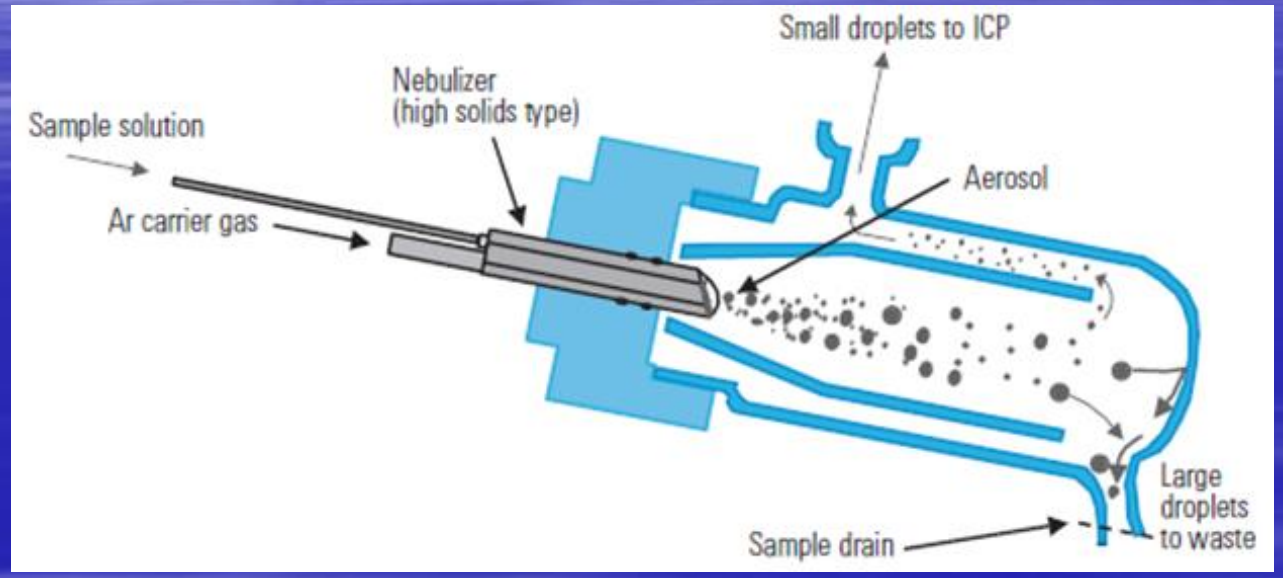
περιγραφή της διαδικασίας ανάλυσης

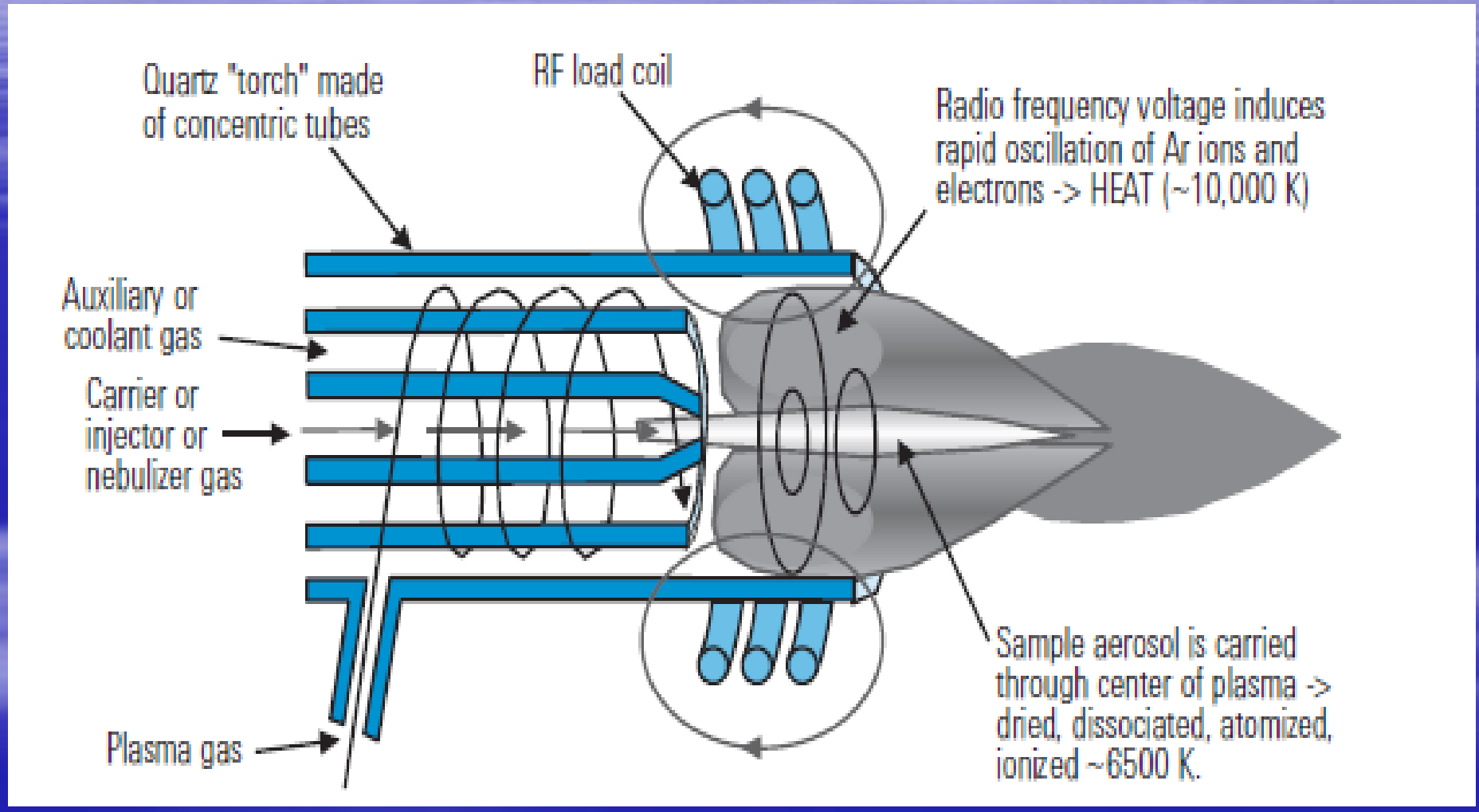


Θάλαμος αεριοποίησης (Spray chambers)
Κυκλωνικός (cyclonic)

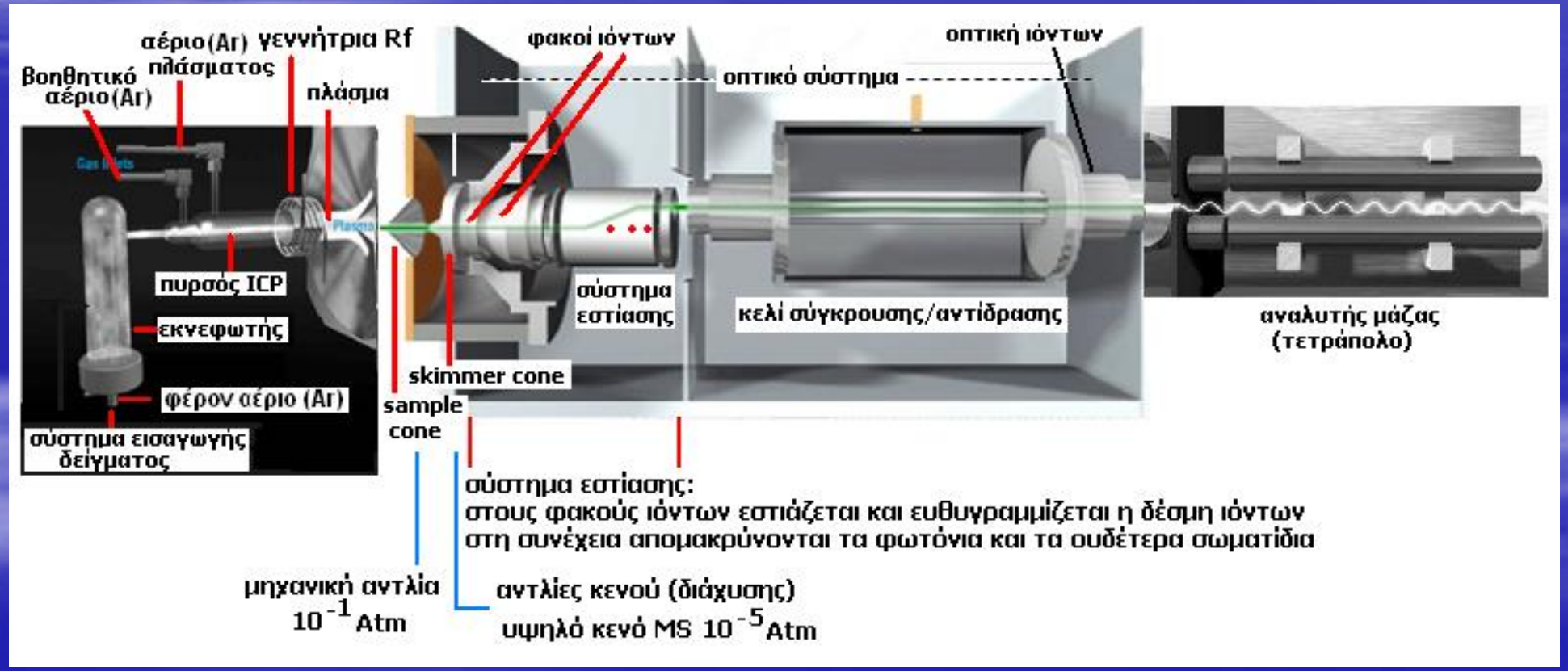


Scoot double pass spray chamber
- Quartz (QZ)
- PFA for HF
- Pyrex Glass (PG) for acids and organic solvants, not HF

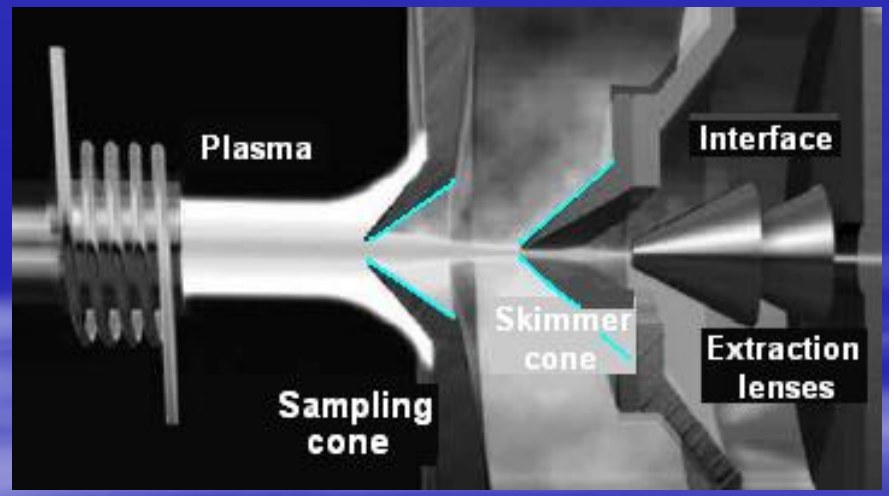
Πυρσός πλάσματος

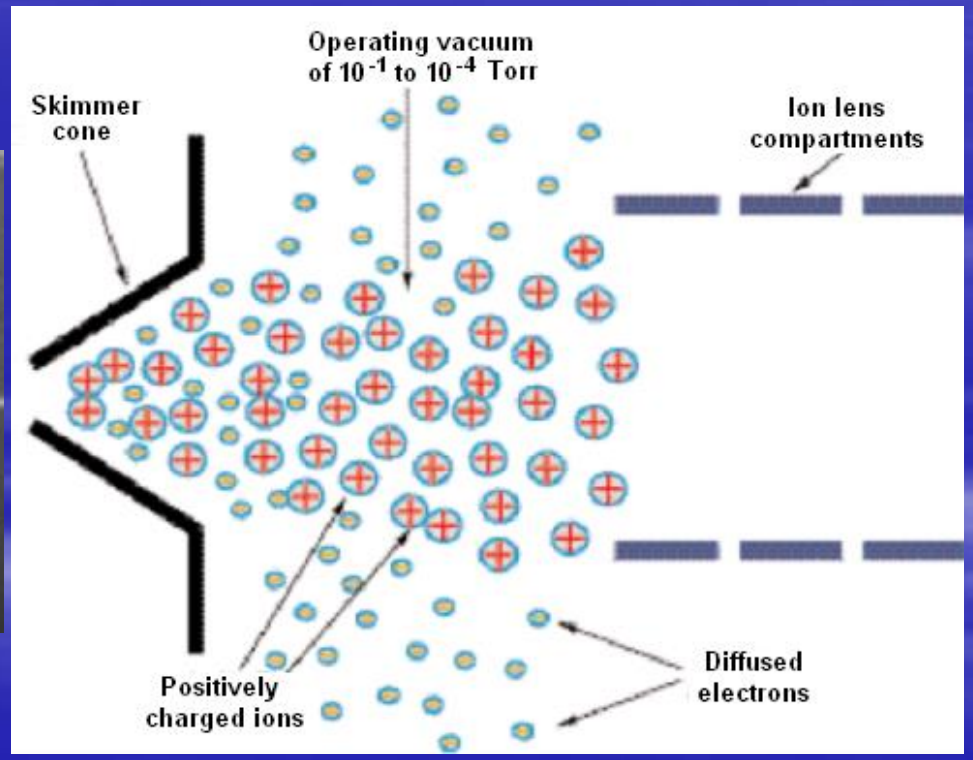


ICP-MS πορεία ανάλυσης



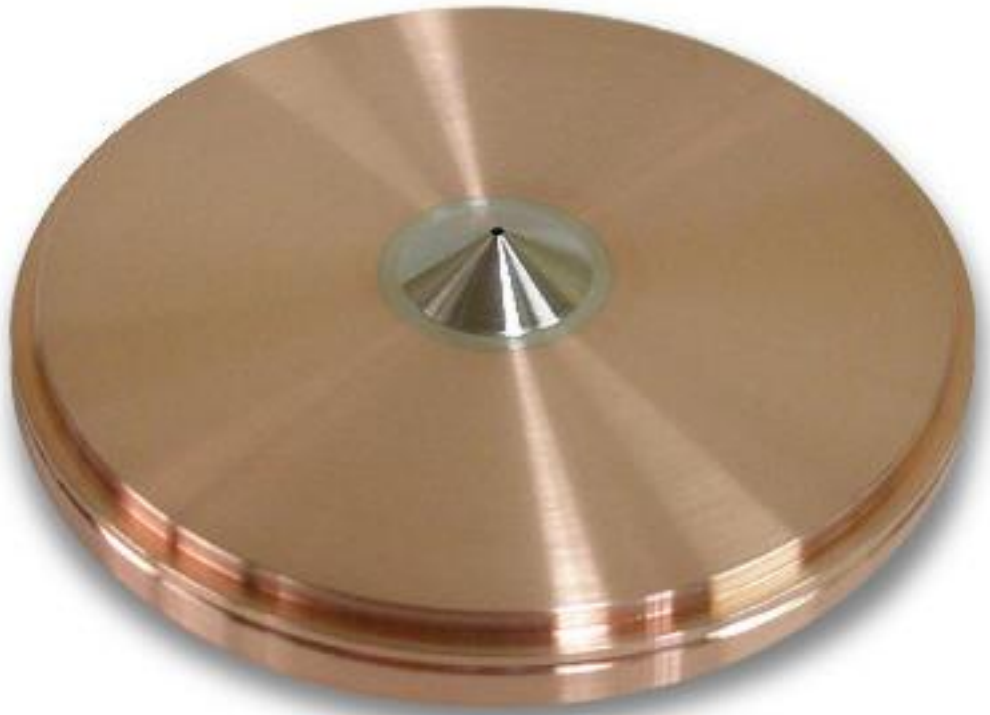
Sampling Interface
Κώνος δειγματοληψίας και αποκορυφωτής





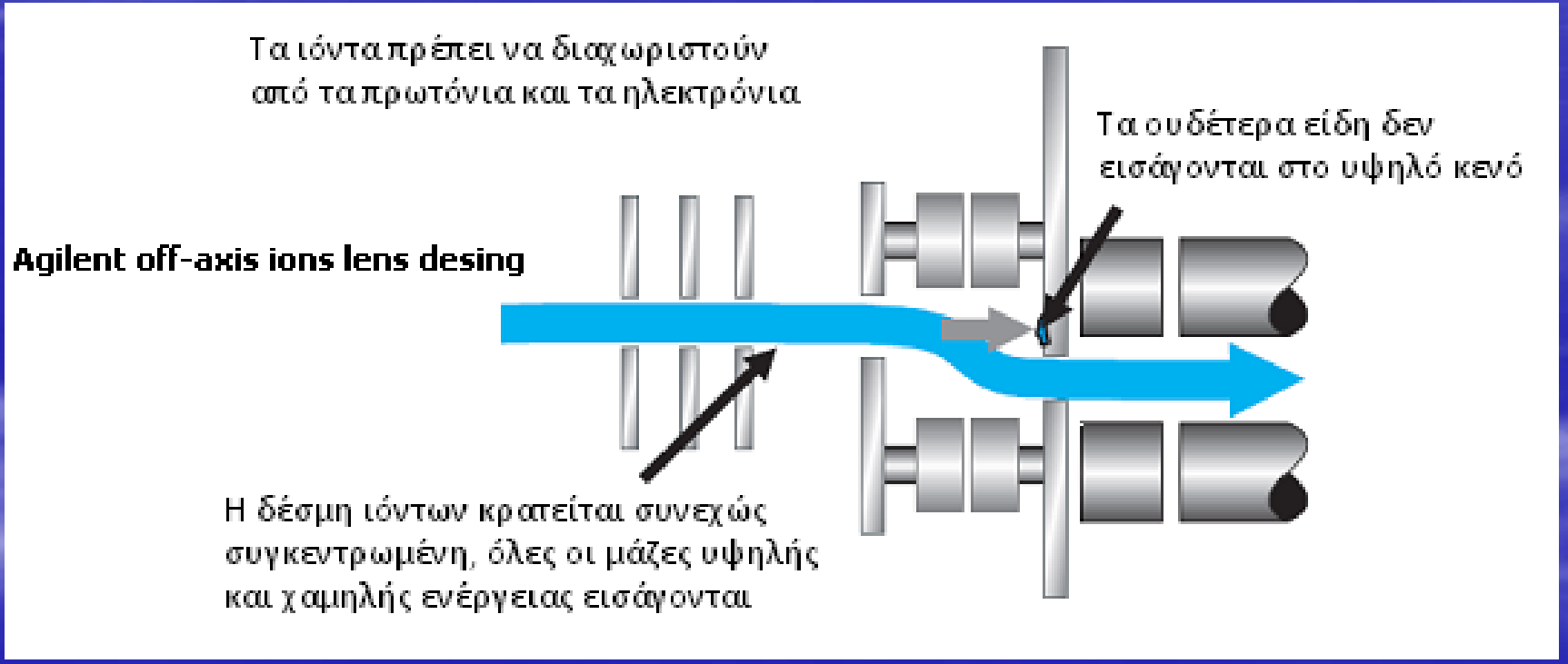
Η μεγάλη πτώση πίεσης στο interface (στον οπτικό θάλαμο ιόντων) δημιουργεί ηλεκτρόνια με διάχυση, επιπλέον της υπάρχουσας δέσμης των θετικών ιόντων

κώνος δειγματοληψίας & αποκορυφωτής
Sampling & Scimmer cone

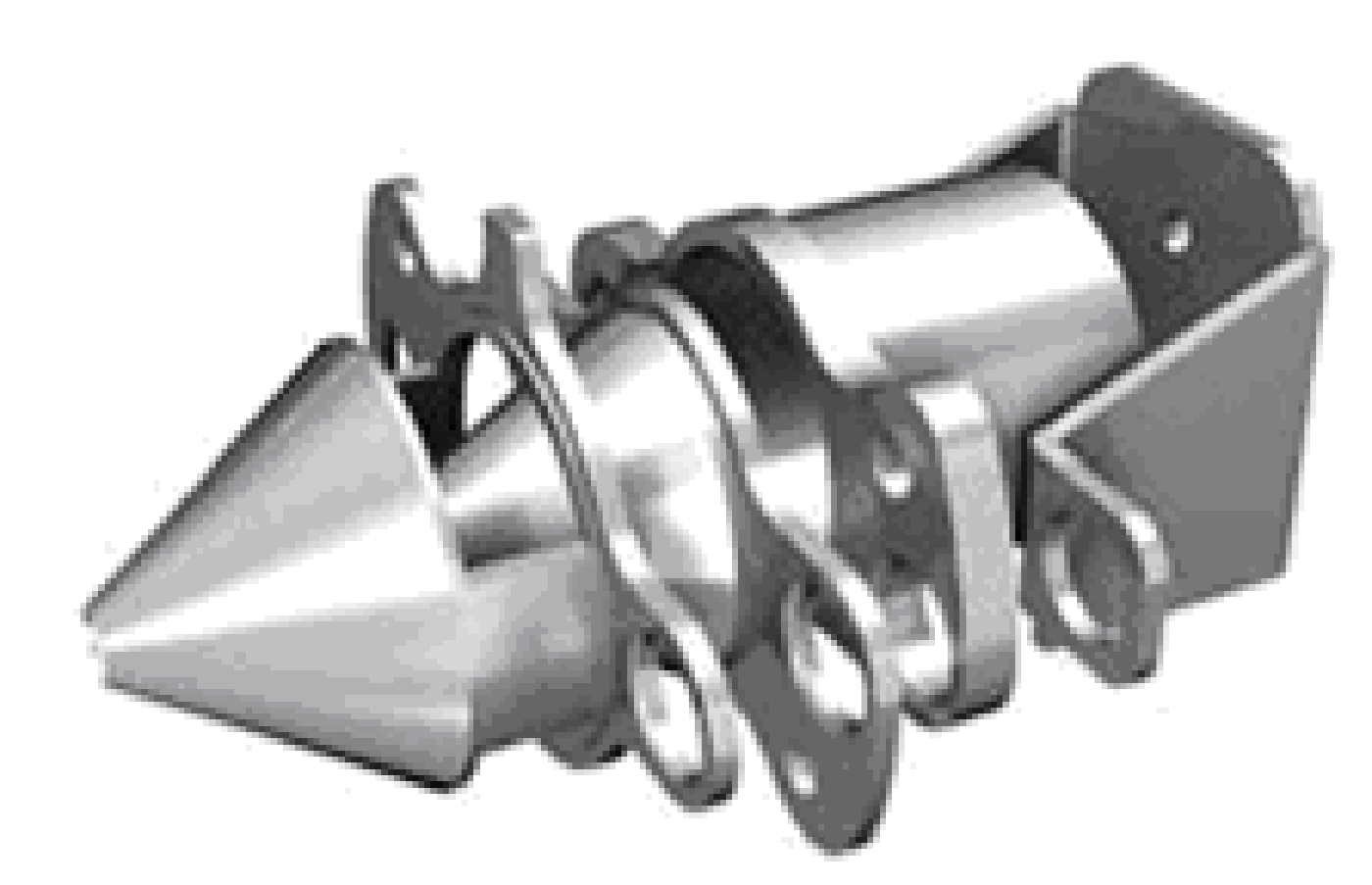


Sampling cone 1mm: Cu, tip Ni. Scimmer cone 0,4mm all Ni

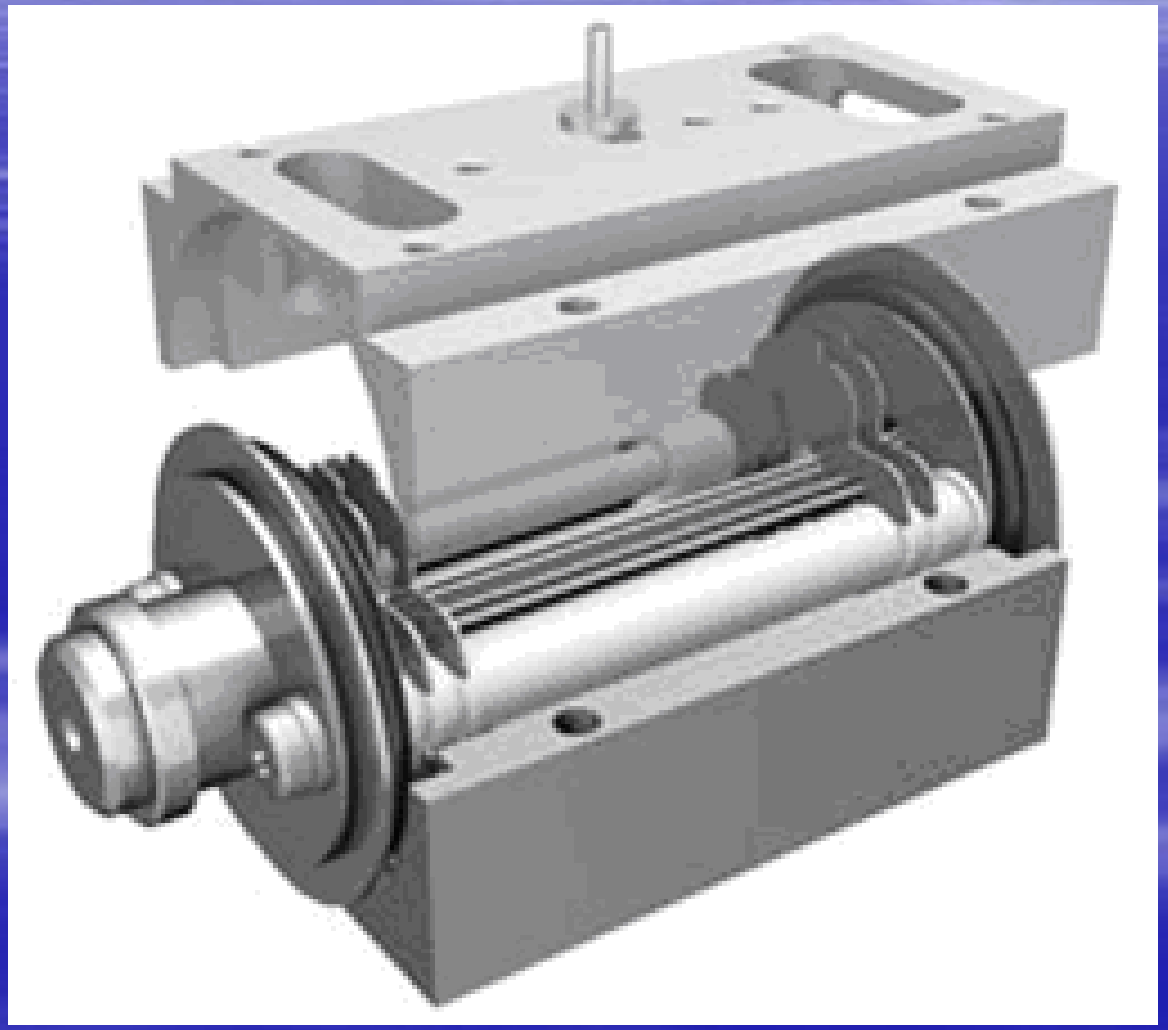
διαχωρισμός πρωτονίων και ηλεκτρονίων από τα κατιόντα



Οπτικό σύστημα
i: φακοί ιόντων, extraction lences



Οπτικό σύστημα
ii: Κελί σύγκρουσης/αντίδρασης

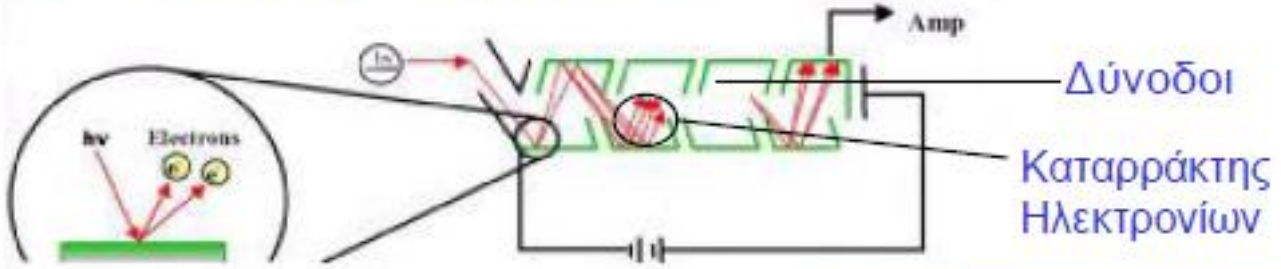


Ανιχνευτές

ΦΩΤΟΠΟΛΛΑΠΛΑΣΙΑΣΤΗΣ

Φωτοηλεκτρικό φαινόμενο (Einstein, 1905):

Εκπομπή ηλεκτρονίων από την επιφάνεια μετάλλων, όταν ακτινοβοληθούν με υπεριώδη ακτινοβολία



- Υψηλή ευαισθησία
- Μεγάλη ταχύτητα απόκρισης
- Μέτρηση hν χαμηλής ισχύος (φωτοστεγανό διαμέρισμα)

ΔΙΕΘΝΕΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΤΗΣ ΕΛΛΑΔΟΣ

Τμήμα Χημείας
Εργαστήριο Ενόργανης Χημικής Ανάλυσης
Καθηγητής Dr. Θωμάς Σπανός,
Μέλος Χρηστίνα MSc Χατζηχρήστου
Συνεργαζόμενος MSc Βασίλης Τόπι

Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

ΔΙΕΘΝΕΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΤΗΣ ΕΛΛΑΔΟΣ
Τμήμα Χημείας

Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

4. ΑΝΑΛΥΣΗ

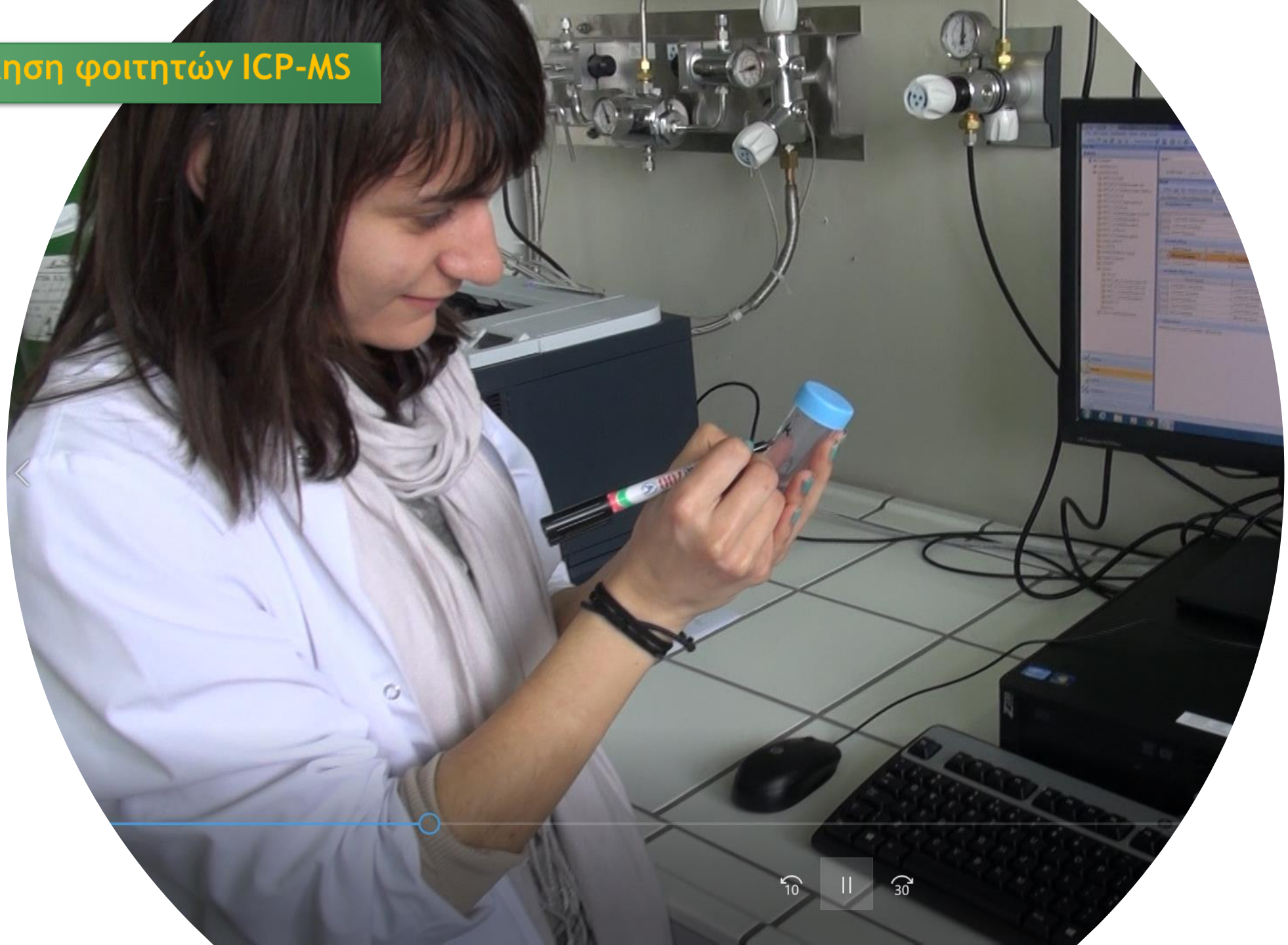
ICP-MS

Inductively Coupled Plasma - Mass Spectrometry

❖ Παρασκευή πρότυπων διαλυμάτων για ICP-MS

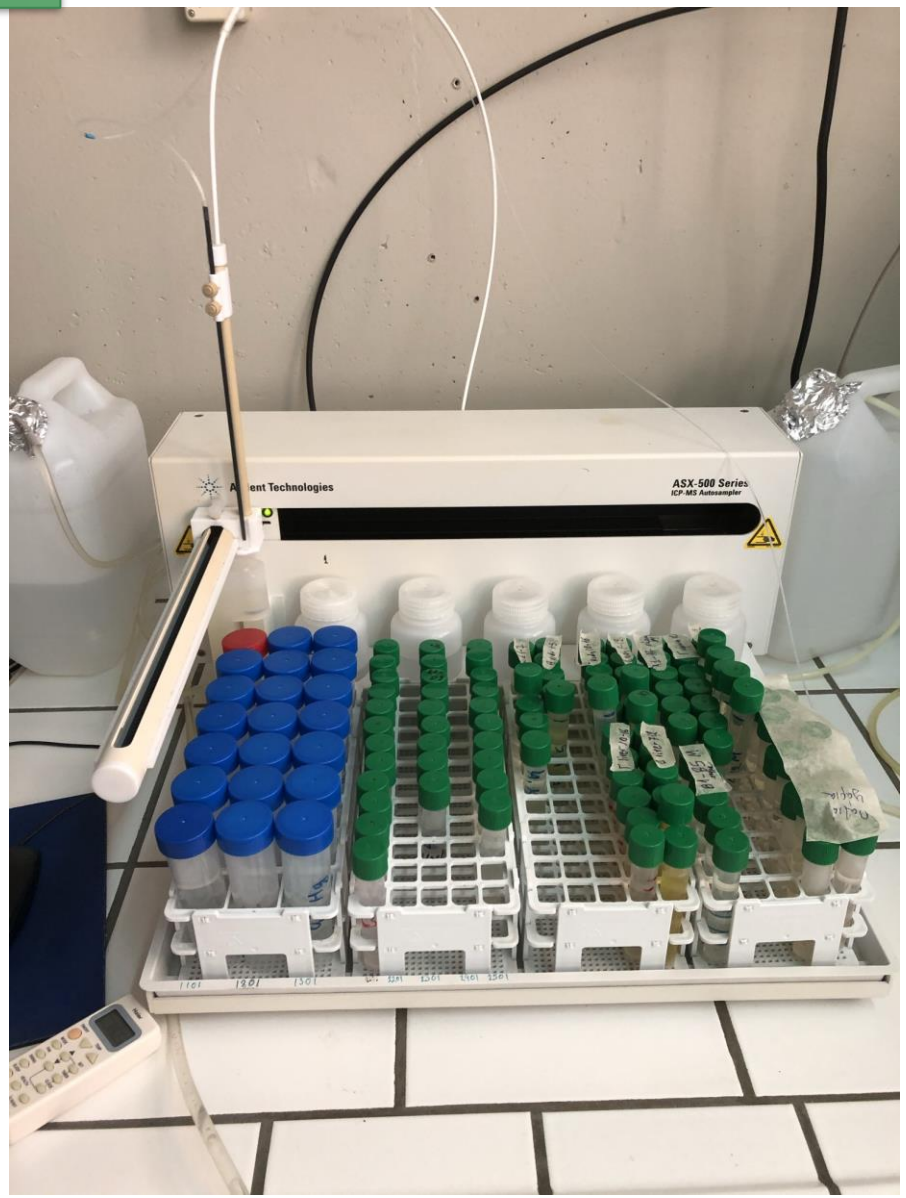

❖ εξάσκηση φοιτητών ICP-MS

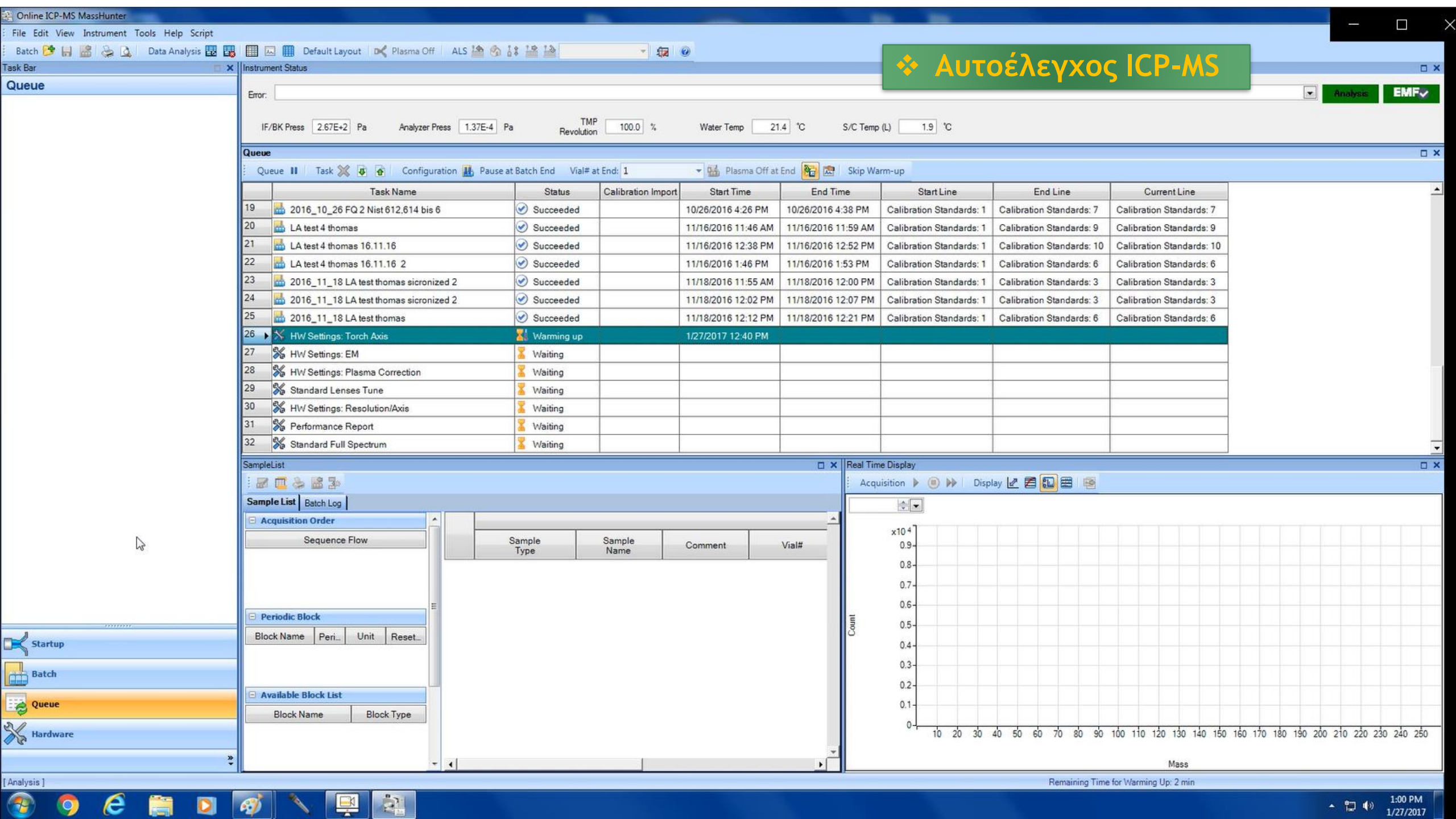
❖ εξάσκηση φοιτητών ICP-MS



❖ εξάσκηση φοιτητών ICP-MS

❖ Πρότυπα και άγνωστα διαλύματα προς ανάλυση ICP-MS




Online ICP-MS MassHunter
File Edit View Instrument Tools Help Script
Batch Data Analysis Default Layout Plasma Off ALS
❖ Αυτοέλεγχος ICP-MS
Task Bar
Queue
Instrument Status
Error:
Analysis
EMF
IF/BK Press 2.67E+2 Pa
Analyzer Press 1.37E-4 Pa
TMP Revolution 100.0 %
Water Temp 21.4 °C
S/C Temp (L) 1.9 °C
Queue
Queue Task Configuration Pause at Batch End Vial# at End: 1 Plasma Off at End Skip Warm-up
Task Name | Status | Calibration Import | Start Time | End Time | Start Line | End Line | Current Line
19 2016_10_26 FQ 2 Nist 612,614 bis 6 | Succeeded | 10/26/2016 4:26 PM | 10/26/2016 4:38 PM | Calibration Standards: 1 | Calibration Standards: 7 | Calibration Standards: 7
20 LA test 4 thomas | Succeeded | 11/16/2016 11:46 AM | 11/16/2016 11:59 AM | Calibration Standards: 1 | Calibration Standards: 9 | Calibration Standards: 9
21 LA test 4 thomas 16.11.16 | Succeeded | 11/16/2016 12:38 PM | 11/16/2016 12:52 PM | Calibration Standards: 1 | Calibration Standards: 10 | Calibration Standards: 10
22 LA test 4 thomas 16.11.16 2 | Succeeded | 11/16/2016 1:46 PM | 11/16/2016 1:53 PM | Calibration Standards: 1 | Calibration Standards: 6 | Calibration Standards: 6
23 2016_11_18 LA test thomas sicronized 2 | Succeeded | 11/18/2016 11:55 AM | 11/18/2016 12:00 PM | Calibration Standards: 1 | Calibration Standards: 3 | Calibration Standards: 3
24 2016_11_18 LA test thomas sicronized 2 | Succeeded | 11/18/2016 12:02 PM | 11/18/2016 12:07 PM | Calibration Standards: 1 | Calibration Standards: 3 | Calibration Standards: 3
25 2016_11_18 LA test thomas | Succeeded | 11/18/2016 12:12 PM | 11/18/2016 12:21 PM | Calibration Standards: 1 | Calibration Standards: 6 | Calibration Standards: 6
26 HW Settings: Torch Axis | Warming up | 1/27/2017 12:40 PM
27 HW Settings: EM | Waiting
28 HW Settings: Plasma Correction | Waiting
29 Standard Lenses Tune | Waiting
30 HW Settings: Resolution/Axis | Waiting
31 Performance Report | Waiting
32 Standard Full Spectrum | Waiting
SampleList
Sample List Batch Log
Acquisition Order
Sequence Flow
Periodic Block
Block Name Peri... Unit Reset...
Available Block List
Block Name Block Type
Sample Type Sample Name Comment Vial#
Real Time Display
Acquisition Display
x10 4
0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0
Count
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250
Mass
Startup
Batch
Queue
Hardware
[Analysis]
Remaining Time for Warming Up: 2 min
1:00 PM
1/27/2017

❖ Εσωτερική βαθμονόμηση οργάνου

Online ICP-MS MassHunter - 2014_05_22.b

File Edit View Instrument Tools Help Script

Batch | Data Analysis | Default Layout | Plasma Off | ALS

Task Bar

Queue

Instrument Status

Error:

Analysis | EMF

IF/BK Press 2.79E+2 Pa | Analyzer Press 1.27E-4 Pa | TMP Revolution 100.0 % | Water Temp 17.7 °C | S/C Temp (L) 1.9 °C

Queue

Queue | Task | Configuration | Pause at Batch End | Vial# at End: <No Move> | Plasma Off at End | Skip Warm-up

	Task Name	Status	Calibration Import	Start Time	End Time	Start Line	End Line	Current Line
62	HW Settings: Plasma Correction	Succeeded		5/10/2014 12:59 PM	5/10/2014 1:05 PM			
63	Standard Lenses Tune	Succeeded		5/10/2014 1:05 PM	5/10/2014 1:06 PM			
64	HW Settings: Resolution/Axis	Succeeded		5/10/2014 1:06 PM	5/10/2014 1:08 PM			
65	Performance Report	Succeeded		5/10/2014 1:08 PM	5/10/2014 1:11 PM			
66	2014_5_10 drinking water	Succeeded		5/10/2014 1:19 PM	5/10/2014 3:53 PM	Calibration Standards: 1	Blank Samples: 1	Blank Samples: 1
67	2014_5_10 e drinking water 2	Succeeded		5/10/2014 3:53 PM	5/10/2014 6:06 PM	Calibration Standards: 1	Blank Samples: 1	Blank Samples: 1
68	HW Settings: Torch Axis	Succeeded		5/22/2014 10:26 AM	5/22/2014 10:50 AM			
69	HW Settings: EM	Succeeded		5/22/2014 10:50 AM	5/22/2014 10:51 AM			
70	HW Settings: Plasma Correction	Succeeded		5/22/2014 10:51 AM	5/22/2014 10:56 AM			
71	Standard Lenses Tune	Succeeded		5/22/2014 10:56 AM	5/22/2014 10:57 AM			
72	HW Settings: Resolution/Axis	In Process		5/22/2014 10:57 AM				
73	Performance Report	Waiting						
74	Standard Full Spectrum	Waiting						

SampleList

Sample List | Batch Log

Acquisition Order

Sequence Flow

Periodic Block

Block Name | Peri... | Unit | Reset...

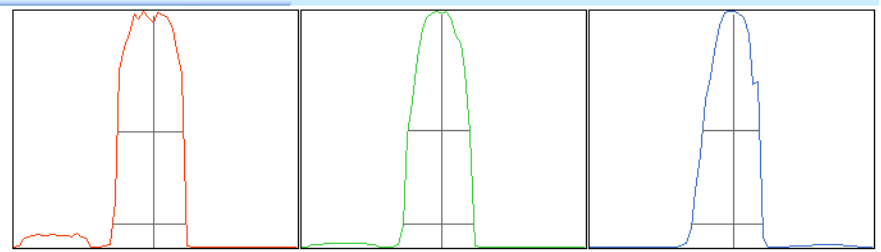
Available Block List

Block Name | Block Type

Sample Type | Sample Name | Comment | Vial#

Real Time Display

Acquisition | Display



Mass	7	89	205
Height	3862	17231	11935
Axis	7.00	89.00	205.05
W-50%	0.69	0.64	0.59
W-10%	0.77	0.74	0.74

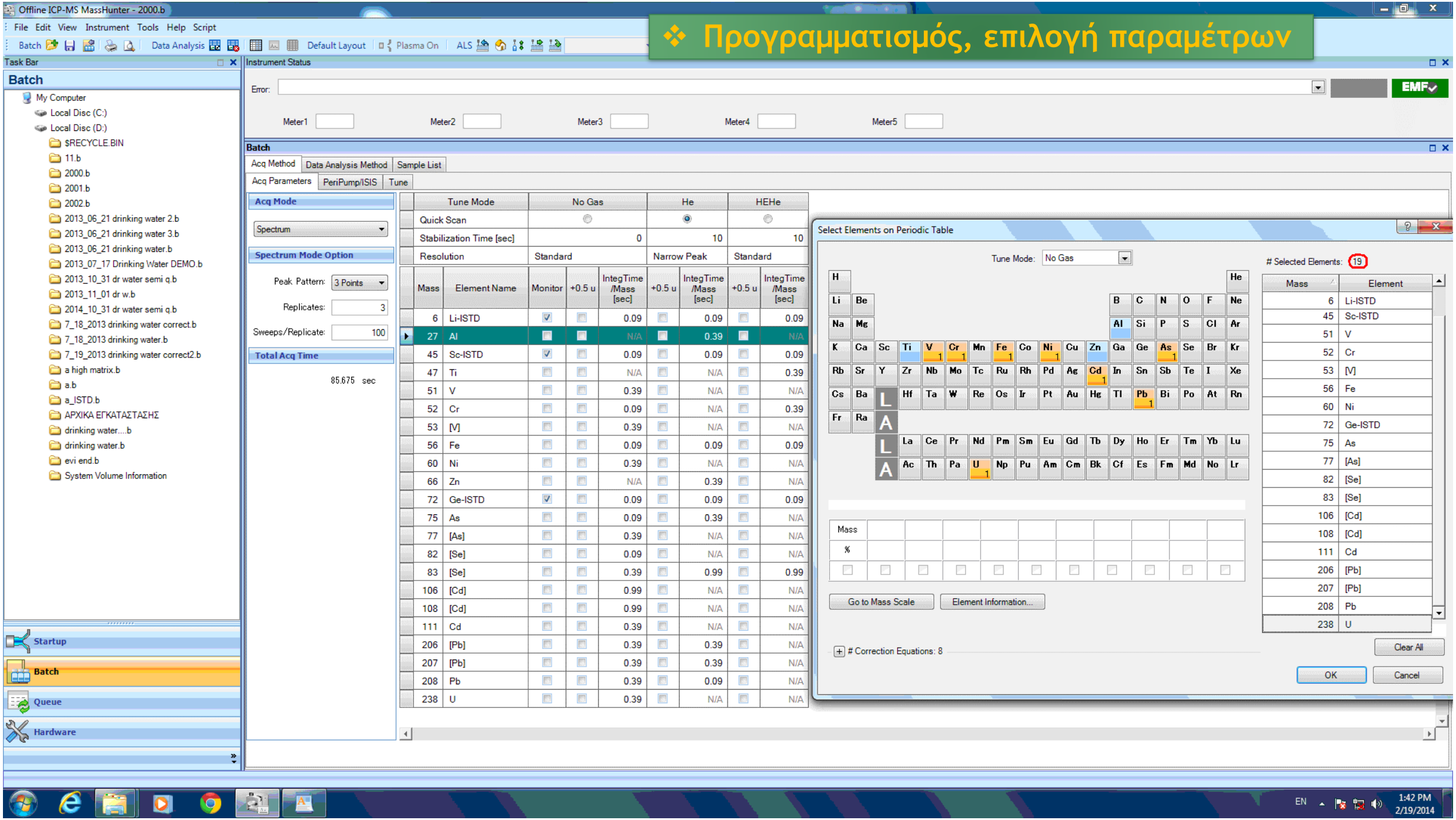
Method Error List

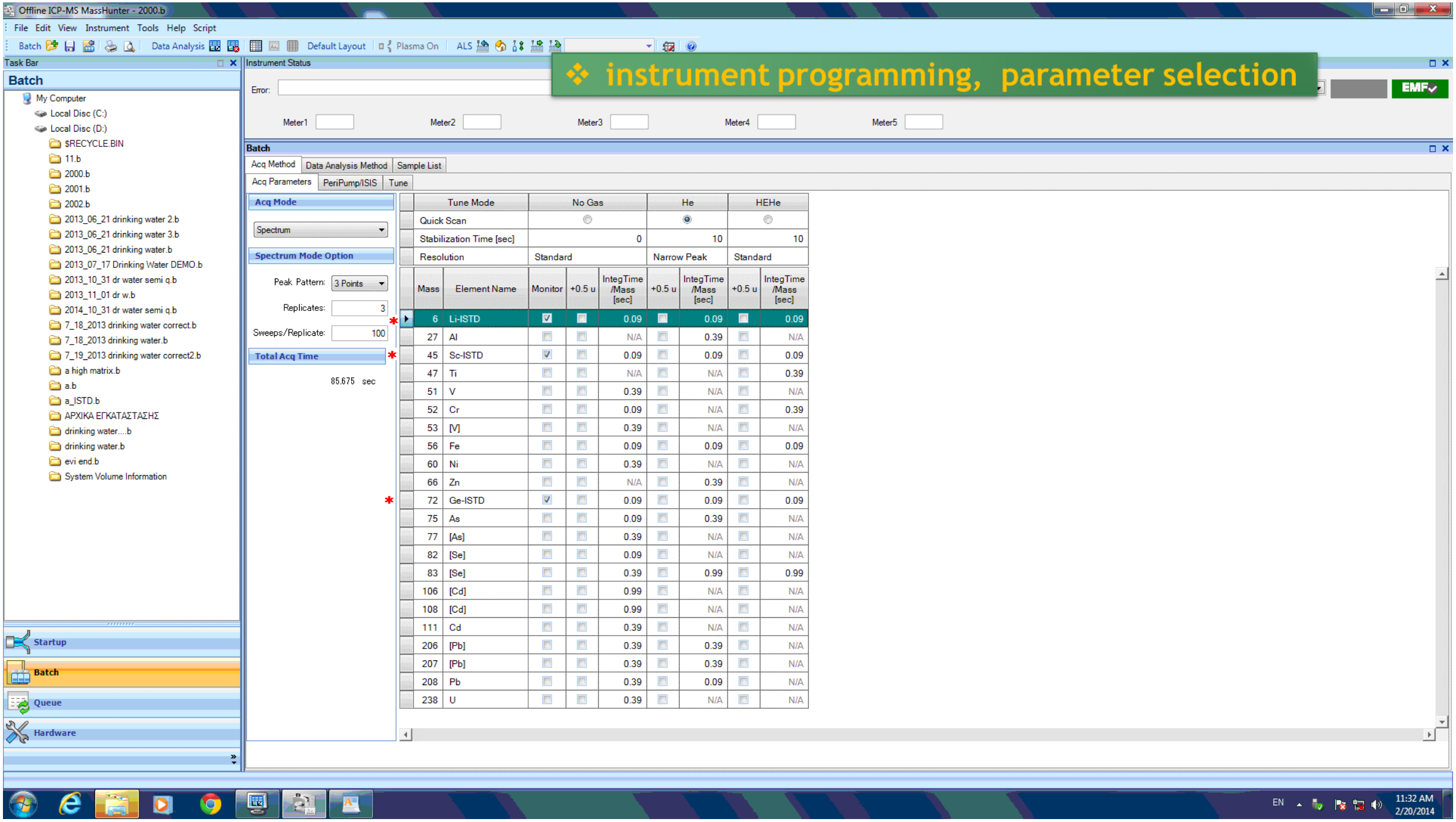
Startup | Batch | Queue | Hardware

[Analysis]

EN 10:57 AM 5/22/2014

❖ Προγραμματισμός, επιλογή παραμέτρων





Tune Mode	No Gas	He	HEHe
Quick Scan	○	◉	○
Stabilization Time [sec]	0	10	10
Resolution	Standard	Narrow Peak	Standard

Mass	Element Name	Monitor	+0.5 u	IntegTime /Mass [sec]	+0.5 u	IntegTime /Mass [sec]	+0.5 u	IntegTime /Mass [sec]
6	Li-ISTD	☑	☐	0.09	☐	0.09	☐	0.09
27	Al	☐	☐	N/A	☐	0.39	☐	N/A
45	Sc-ISTD	☑	☐	0.09	☐	0.09	☐	0.09
47	Ti	☐	☐	N/A	☐	N/A	☐	0.39
51	V	☐	☐	0.39	☐	N/A	☐	N/A
52	Cr	☐	☐	0.09	☐	N/A	☐	0.39
53	[V]	☐	☐	0.39	☐	N/A	☐	N/A
56	Fe	☐	☐	0.09	☐	0.09	☐	0.09
60	Ni	☐	☐	0.39	☐	N/A	☐	N/A
66	Zn	☐	☐	N/A	☐	0.39	☐	N/A
72	Ge-ISTD	☑	☐	0.09	☐	0.09	☐	0.09
75	As	☐	☐	0.09	☐	0.39	☐	N/A
77	[As]	☐	☐	0.39	☐	N/A	☐	N/A
82	[Se]	☐	☐	0.09	☐	N/A	☐	N/A
83	[Se]	☐	☐	0.39	☐	0.99	☐	0.99
106	[Cd]	☐	☐	0.99	☐	N/A	☐	N/A
108	[Cd]	☐	☐	0.99	☐	N/A	☐	N/A
111	Cd	☐	☐	0.39	☐	N/A	☐	N/A
206	[Pb]	☐	☐	0.39	☐	0.39	☐	N/A
207	[Pb]	☐	☐	0.39	☐	0.39	☐	N/A
208	Pb	☐	☐	0.39	☐	0.09	☐	N/A
238	U	☐	☐	0.39	☐	N/A	☐	N/A

Offline ICP-MS MassHunter - a_ISTD.b

File Edit View Instrument Tools Help Script

Batch | Data Analysis | Default Layout | Plasma On | ALS

❖ instrument programming, parameter selection

Task Bar

Batch

- My Computer
  - Local Disc (C:)
  - Local Disc (D:)
    - $RECYCLE.BIN
    - 2013_06_21 drinking water 3.b
    - 2013_07_17 Drinking Water DEMO.b
    - 2013_10_31 dr water semi q.b
    - 2013_11_01 dr w.b
    - 2013_7_18 drinking water correct.b
    - 2013_7_18 drinking water.b
    - 2013_7_19 drinking water.b
    - 2013_7_25 Evi.b
    - a high matrix.b
    - a.b
    - a_ISTD.b
    - ΑΡΧΙΚΑ ΕΓΚΑΤΑΣΤΑΣΗΣ
    - kostas nikoletta.b
    - SPANOS
    - student.b
    - System Volume Information

Startup

Batch

Queue

Hardware

Instrument Status

Error:

Meter1 Meter2 Meter3 Meter4 Meter5

Batch

Batch | Add to Queue | Validate Method | DA Method Task:

Acq Method | Data Analysis Method | Sample List

Basic Information | Analyte | Full Quant | Semi Quant | Isotope Ratio

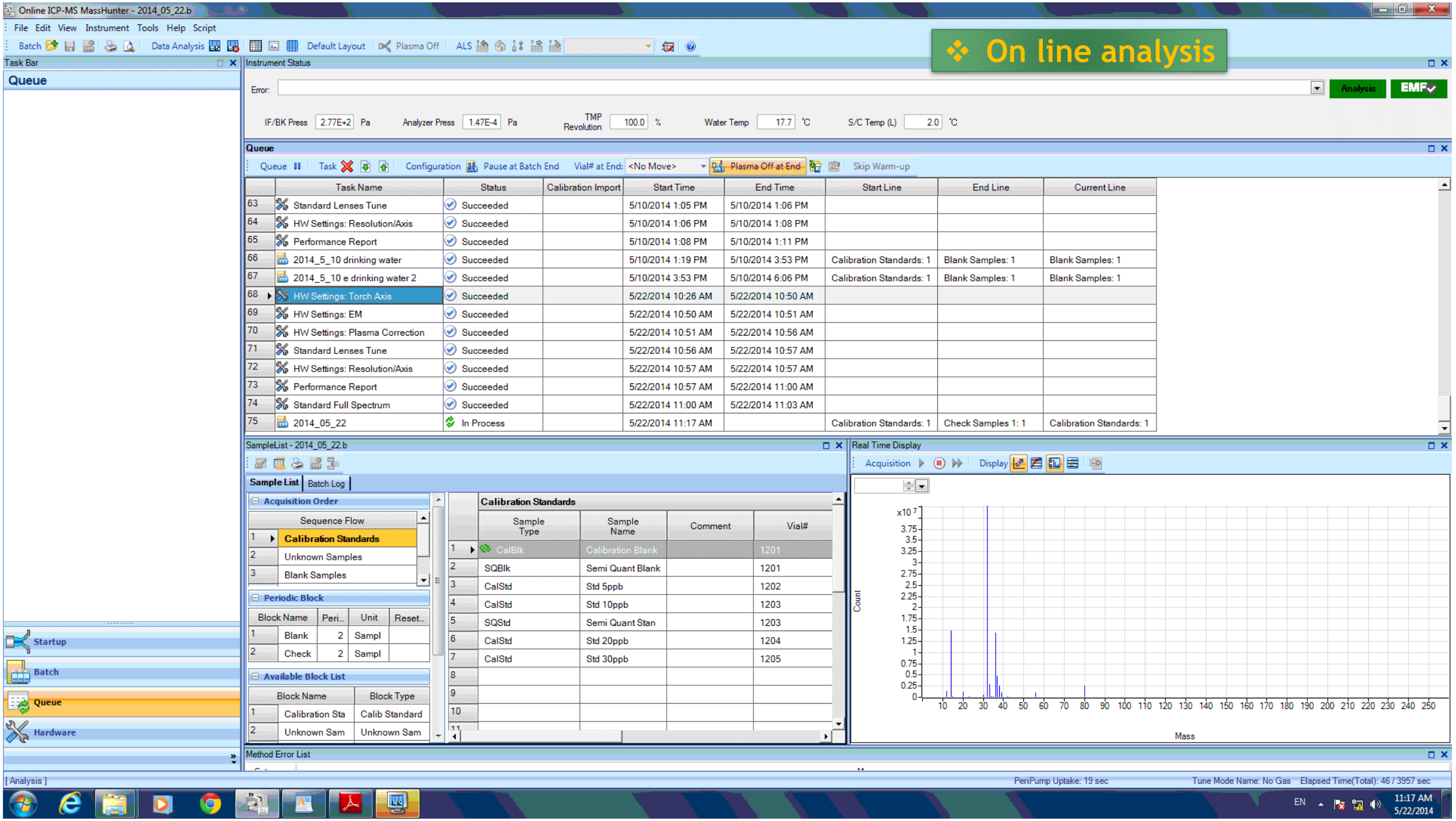
Basic Calibration Parameters				
Calibration Title	Calibration Method	Edit ISTD Conc	Weighting	Virtual ISTD Correction
	External Calibration	☐	☐	☐

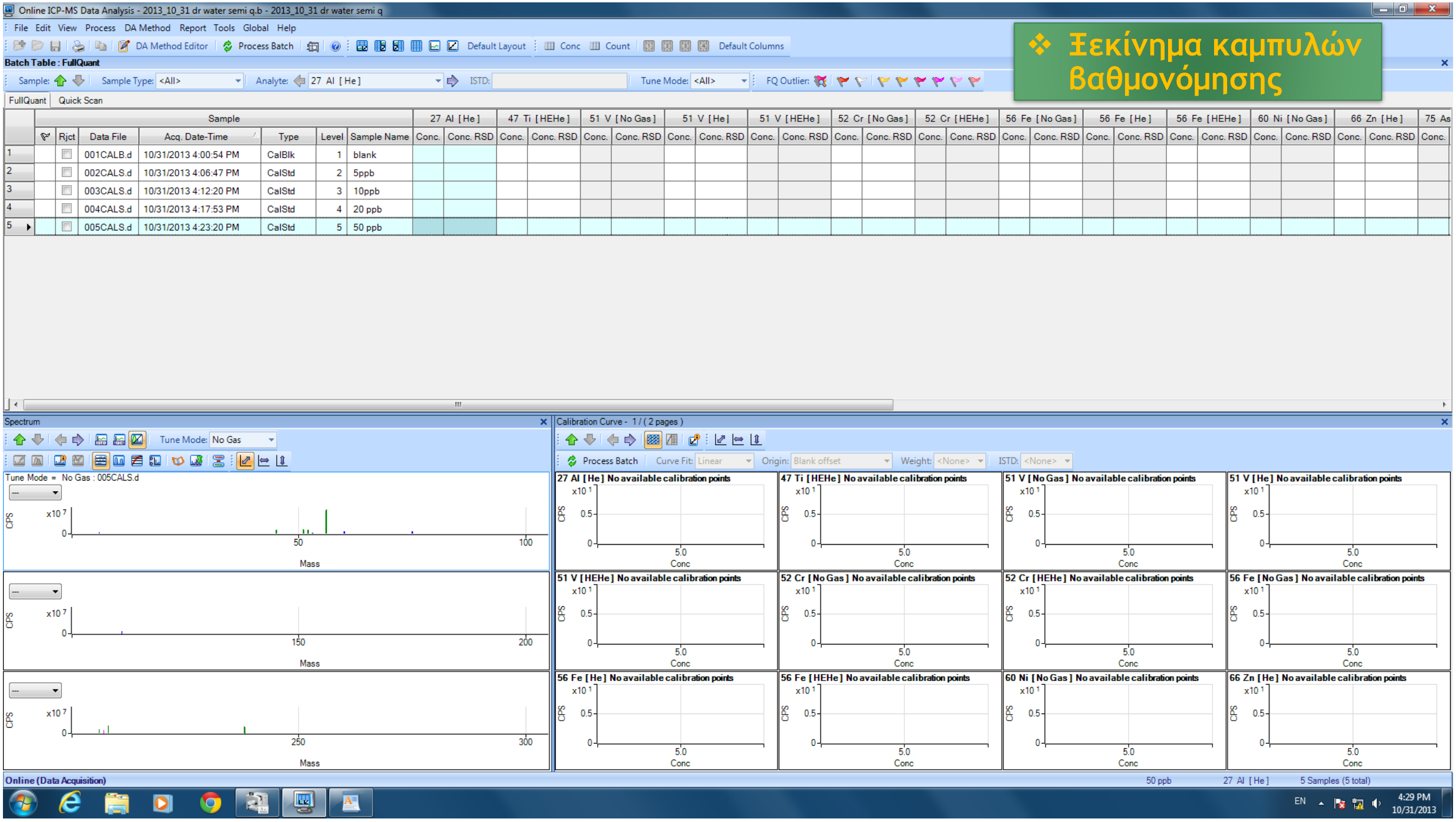
	Analyte								Level						QC	Blank
	Tune Mode	Mass	Name	Curve Fit	Origin	ISTD	Min Conc	Units	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	QC1	BlkVrfy
1	2: He	56	Fe	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
2	2: He	66	Zn	Linear	Blank offset	72	0	ppb	0	5	10	20	50	100	50	**0.7**
3	2: He	75	As	Linear	Blank offset	72	0	ppb	0	5	10	20	50	100	50	**0.7**
4	3: HEHe	56	Fe	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
5	1: No Gas	56	Fe	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
6	2: He	27	Al	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
7	1: No Gas	60	Ni	Linear	Blank offset	45	0	ppb	0	2.5	5	10	25	50	25	**0.4**
8	3: HEHe	47	Ti	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
9	1: No Gas	51	V	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
10	1: No Gas	111	Cd	Linear	Blank offset	<None>	0	ppb	0	5	10	20	50	100	50	**0.7**
11	1: No Gas	208	Pb	Linear	Blank offset	<None>	0	ppb	0	2.5	5	10	25	50	25	**0.4**
12	1: No Gas	238	U	Linear	Blank offset	<None>	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
13	1: No Gas	52	Cr	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**
14	1: No Gas	75	As	Linear	Blank offset	72	0	ppb	0	5	10	20	50	100	50	**0.7**
15	2: He	208	Pb	Linear	Blank offset	<None>	0	ppb	0	2.5	5	10	25	50	25	**0.4**
16	3: HEHe	52	Cr	Linear	Blank offset	45	0	ppb	0	1.25	2.5	5	12.5	25	12.5	**0.2**

	ISTD			
	Tune Mode	Mass	Name	Units
1	1: No Gas	6	Li-IS	ppm
2	2: He	6	Li-IS	ppm
3	3: HEHe	6	Li-IS	ppm
4	1: No Gas	45	Sc-I	ppm
5	2: He	45	Sc-I	ppm
6	3: HEHe	45	Sc-I	ppm
7	1: No Gas	72	Ge-I	ppm
8	2: He	72	Ge-I	ppm
9	3: HEHe	72	Ge-I	ppm

ISTD

EN 1:07 PM 3/18/2014


Online ICP-MS MassHunter - 2014_05_22.b
File Edit View Instrument Tools Help Script
Batch Data Analysis Default Layout Plasma Off ALS
On line analysis
Task Bar
Queue
Instrument Status
Error:
Analysis
EMF
IF/BK Press 2.77E+2 Pa
Analyzer Press 1.47E-4 Pa
TMP Revolution 100.0 %
Water Temp 17.7 °C
S/C Temp (L) 2.0 °C
Queue
Queue Task Configuration Pause at Batch End Vial# at End: <No Move> Plasma Off at End Skip Warm-up
Task Name | Status | Calibration Import | Start Time | End Time | Start Line | End Line | Current Line
63 Standard Lenses Tune | Succeeded | | 5/10/2014 1:05 PM | 5/10/2014 1:06 PM | | | |
64 HW Settings: Resolution/Axis | Succeeded | | 5/10/2014 1:06 PM | 5/10/2014 1:08 PM | | | |
65 Performance Report | Succeeded | | 5/10/2014 1:08 PM | 5/10/2014 1:11 PM | | | |
66 2014_5_10 drinking water | Succeeded | | 5/10/2014 1:19 PM | 5/10/2014 3:53 PM | Calibration Standards: 1 | Blank Samples: 1 | Blank Samples: 1
67 2014_5_10 e drinking water 2 | Succeeded | | 5/10/2014 3:53 PM | 5/10/2014 6:06 PM | Calibration Standards: 1 | Blank Samples: 1 | Blank Samples: 1
68 HW Settings: Torch Axis | Succeeded | | 5/22/2014 10:26 AM | 5/22/2014 10:50 AM | | | |
69 HW Settings: EM | Succeeded | | 5/22/2014 10:50 AM | 5/22/2014 10:51 AM | | | |
70 HW Settings: Plasma Correction | Succeeded | | 5/22/2014 10:51 AM | 5/22/2014 10:56 AM | | | |
71 Standard Lenses Tune | Succeeded | | 5/22/2014 10:56 AM | 5/22/2014 10:57 AM | | | |
72 HW Settings: Resolution/Axis | Succeeded | | 5/22/2014 10:57 AM | 5/22/2014 10:57 AM | | | |
73 Performance Report | Succeeded | | 5/22/2014 10:57 AM | 5/22/2014 11:00 AM | | | |
74 Standard Full Spectrum | Succeeded | | 5/22/2014 11:00 AM | 5/22/2014 11:03 AM | | | |
75 2014_05_22 | In Process | | 5/22/2014 11:17 AM | | Calibration Standards: 1 | Check Samples 1: 1 | Calibration Standards: 1
SampleList - 2014_05_22.b
Sample List Batch Log
Acquisition Order
Sequence Flow
1 Calibration Standards
2 Unknown Samples
3 Blank Samples
Periodic Block
Block Name | Peri... | Unit | Reset...
1 Blank 2 Sampl
2 Check 2 Sampl
Available Block List
Block Name | Block Type
1 Calibration Sta | Calib Standard
2 Unknown Sam | Unknown Sam
Calibration Standards
Sample Type | Sample Name | Comment | Vial#
1 CalBlk | Calibration Blank | | 1201
2 SQBlk | Semi Quant Blank | | 1201
3 CalStd | Std 5ppb | | 1202
4 CalStd | Std 10ppb | | 1203
5 SQStd | Semi Quant Stan | | 1203
6 CalStd | Std 20ppb | | 1204
7 CalStd | Std 30ppb | | 1205
8
9
10
11
Real Time Display
Acquisition Display
x10 7
3.75
3.5
3.25
3
2.75
2.5
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
Count
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250
Mass
Method Error List
Startup
Batch
Queue
Hardware
[Analysis]
PeriPump Uptake: 19 sec
Tune Mode Name: No Gas
Elapsed Time(Total): 46 / 3957 sec
EN
11:17 AM
5/22/2014



❖ Ξεκίνημα καμπυλών βαθμονόμησης

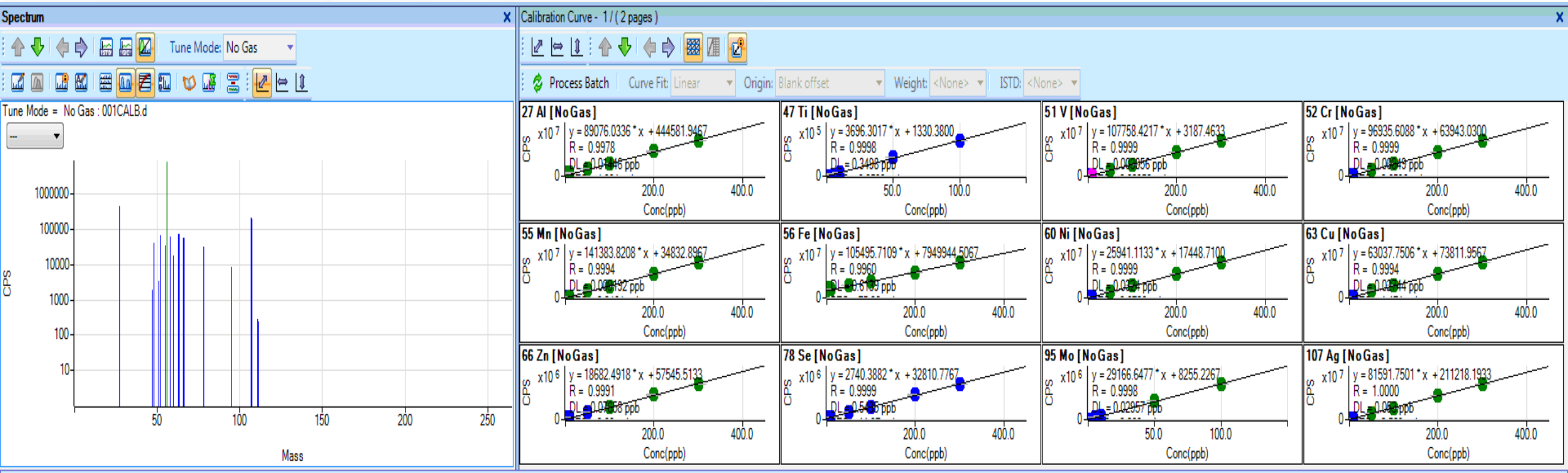
Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

❖ Καμπύλες Βαθμονόμησης ICP-MS



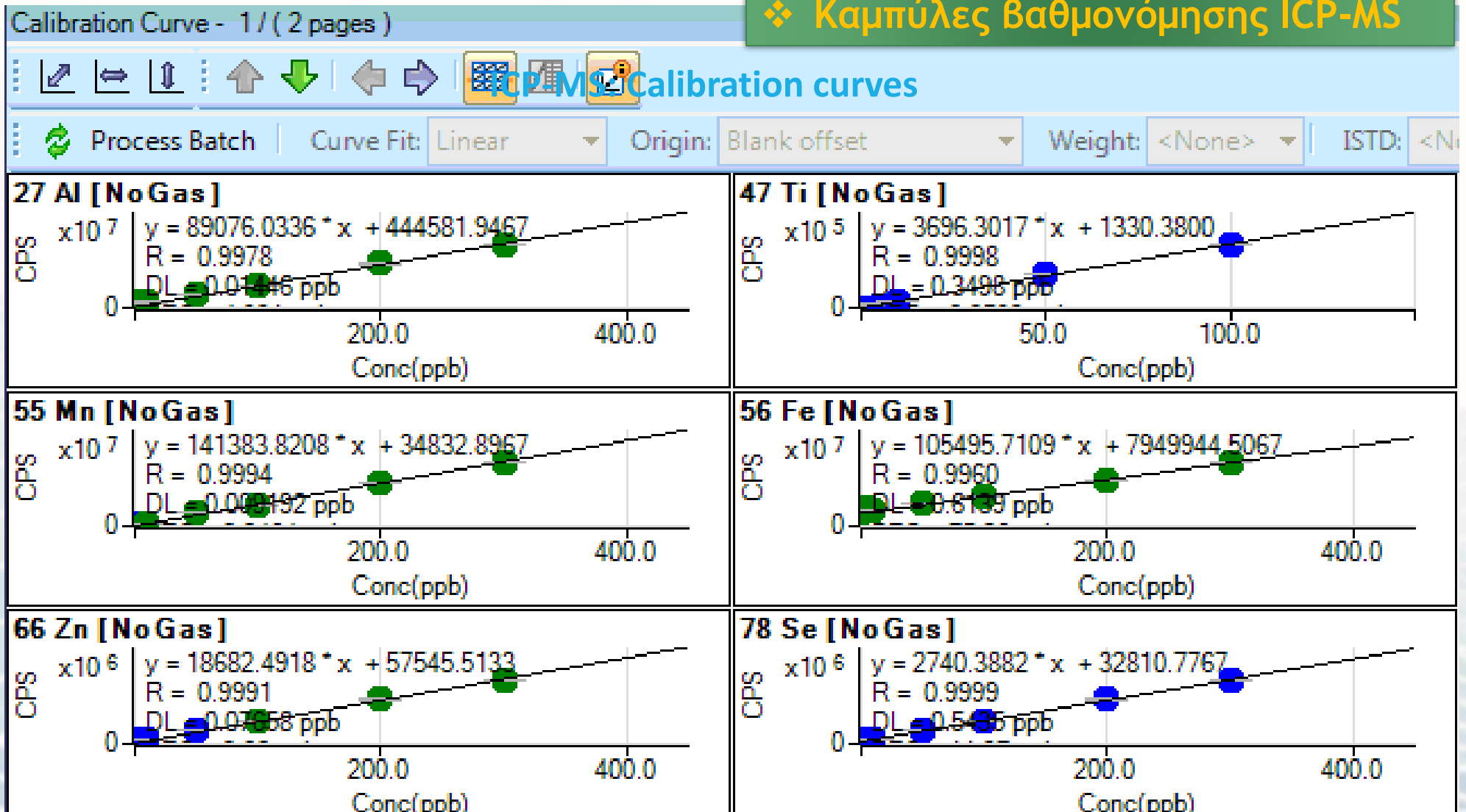
Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

Black Sea CROSS BORDER COOPERATION

❖ Καμπύλες Βαθμονόμησης ICP-MS

ICP-MS Calibration curves



❖ Αποτελέσματα ποσοτικής ανάλυσης

Offline ICP-MS Data Analysis - 2015_1_23 13M.b - test

DA Method Editor | Process Batch | Conc | Count | Default Columns

File Edit View Process DA Method Report Tools Global Help

Batch Table : FullQuant

FQ Outlier:

Sample: | Sample Type: <All> | Analyte: 27 Al [No Gas] | ISTD: | Tune Mode: <All>

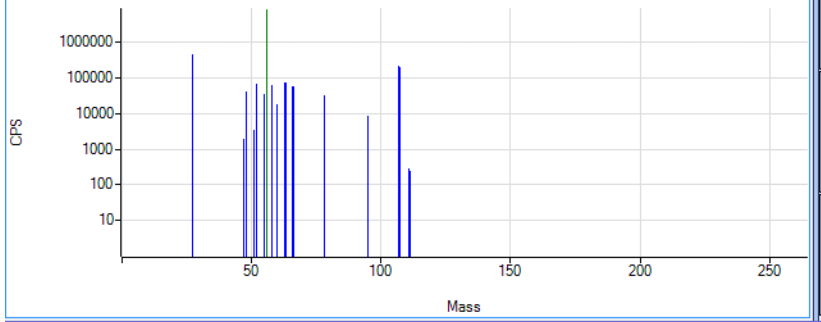
FullQuant | Quick Scan

		Sample					27 Al [No Gas]		47 Ti [No Gas]		51 V [No Gas]		52 Cr [No Gas]		55 Mn [No Gas]		56 Fe [No Gas]		60 Ni [No Gas]		63 Cu [No Gas]		66 Zn [No Ga
		Rjct	Data File	Acq. Date-Time	Type	Level	Sample Name	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Conc. RSD	Conc. [ppb]	Con
1			001CALB.d	1/23/2015 10:23:30 AM	CalBlk	1	Calibration Blank 5%	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A	0.000	
2			002CALS.d	1/23/2015 10:27:50 AM	CalStd	2	Std 5 ppb mixt Agilent	27.245	0.4	1.212	13.2	5.718	0.3	5.887	0.3	6.377	0.2	31.413	0.8	5.903	0.2	6.922	0.6	15.010	
3			003CALS.d	1/23/2015 10:31:51 AM	CalStd	3	Std 10 ppb mixt Agilent	21.871	1.0	0.085	22.3	10.757	0.8	11.038	0.7	13.156	0.7	12.916	1.3	11.203	0.8	12.436	0.6	17.472	
4			004CALS.d	1/23/2015 10:35:53 AM	CalStd	4	Std 50 ppb mixt Agilent	58.269	1.2	0.452	16.9	50.436	1.7	51.094	1.4	61.180	1.3	59.667	3.9	52.388	2.3	59.385	1.8	61.639	
5			005CALS.d	1/23/2015 10:39:47 AM	CalStd	5	Std 100 ppb mixt Agilent	98.452	0.6	0.134	8.7	100.092	0.4	100.785	0.3	99.309	0.3	95.388	0.8	101.594	0.7	102.237	0.3	99.952	
6			006CALS.d	1/23/2015 10:43:41 AM	CalStd	6	Std 200 ppb mixt Agilent	204.533	1.4	0.388	25.9	202.492	0.4	202.855	0.6	201.690	0.7	194.594	1.1	201.907	0.7	203.860	0.1	204.918	
7			007CALS.d	1/23/2015 10:47:33 AM	CalStd	7	Std 300 ppb mixt Agilent	295.350	0.3	0.843	7.8	298.198	0.2	297.603	0.4	297.112	0.6	302.993	0.5	297.744	0.4	295.003	0.2	294.381	
8			008CALS.d	1/23/2015 10:51:26 AM	CalStd	8	Std 5 Mo, Ti ppb TEI	<0.000	N/A	4.973	1.4	0.035	3.7	<0.000	N/A	0.287	2.1	<0.000	N/A	<0.000	N/A	0.302	6.1	10.992	
9			009CALS.d	1/23/2015 10:55:27 AM	CalStd	9	Std 10 Mo,Ti ppb TEI	<0.000	N/A	10.221	0.7	0.051	5.5	<0.000	N/A	0.273	1.0	<0.000	N/A	0.105	18.9	0.346	1.3	9.634	
10			010CALS.d	1/23/2015 10:59:29 AM	CalStd	10	Std 50 Mo, Ti ppb TEI	80.571	0.2	51.392	0.6	0.280	2.4	<0.000	N/A	13.952	0.4	5.675	6.1	0.178	3.0	1.103	1.2	49.374	
11			011CALS.d	1/23/2015 11:03:25 AM	CalStd	11	Std 100 Mo, Ti ppb TEI	0.814	10.6	99.283	0.6	0.645	0.5	0.005	93.4	0.375	1.5	7.719	5.3	0.056	16.3	<0.000	N/A	14.352	
12			012SMPL.d	1/23/2015 11:07:26 AM	Sample		B0	13.231	0.5	0.604	6.6	0.366	2.1	4.418	0.3	1.455	1.2	<0.000	N/A	2.739	1.3	<0.000	N/A	3.057	
13			013SMPL.d	1/23/2015 11:11:21 AM	Sample		B1	126.190	0.3	0.483	8.4	0.222	0.7	4.895	0.5	3.609	0.8	<0.000	N/A	8.608	0.6	2.524	0.5	<0.000	
14			014SMPL.d	1/23/2015 11:15:18 AM	Sample		B2	102.020	0.9	0.504	7.4	0.155	4.2	4.914	0.5	1.003	0.4	<0.000	N/A	7.313	1.0	1.948	1.0	0.267	
15			015SMPL.d	1/23/2015 11:19:12 AM	Sample		C0	0.844	5.8	0.591	1.3	0.327	0.3	4.319	0.3	1.785	0.5	<0.000	N/A	2.811	0.8	<0.000	N/A	6.739	
16			016SMPL.d	1/23/2015 11:23:10 AM	Sample		C1	146.233	0.5	0.500	3.6	0.329	1.0	1.543	1.0	26.558	0.3	49.867	0.3	8.461	0.0	1.922	0.7	5.198	
17			017SMPL.d	1/23/2015 11:27:05 AM	Sample		C2	125.868	0.6	0.544	2.4	0.309	0.9	0.766	0.2	24.682	0.6	<0.000	N/A	7.336	0.6	0.055	16.2	1.973	

Spectrum

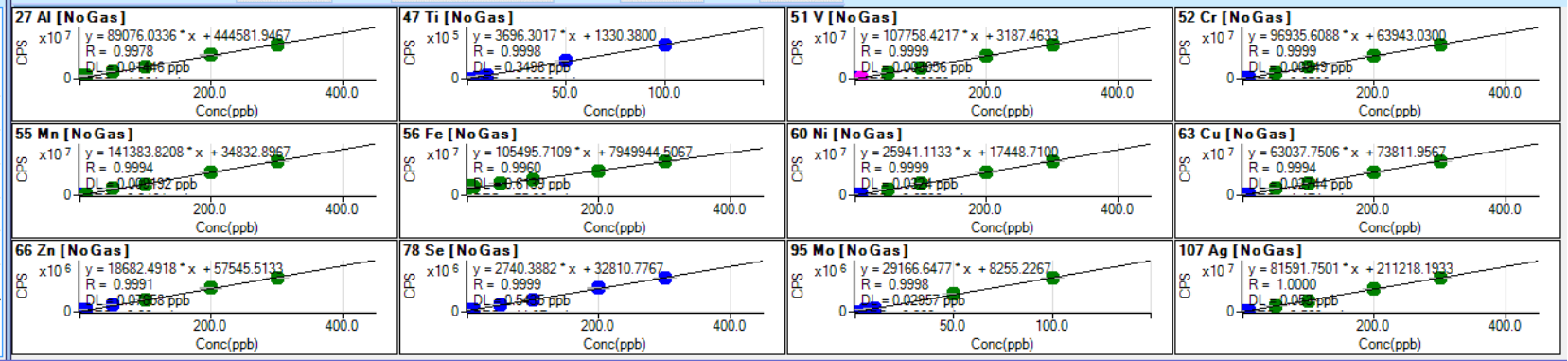
Tune Mode: No Gas

Tune Mode = No Gas : 001CALB.d



Calibration Curve - 1 / (2 pages)

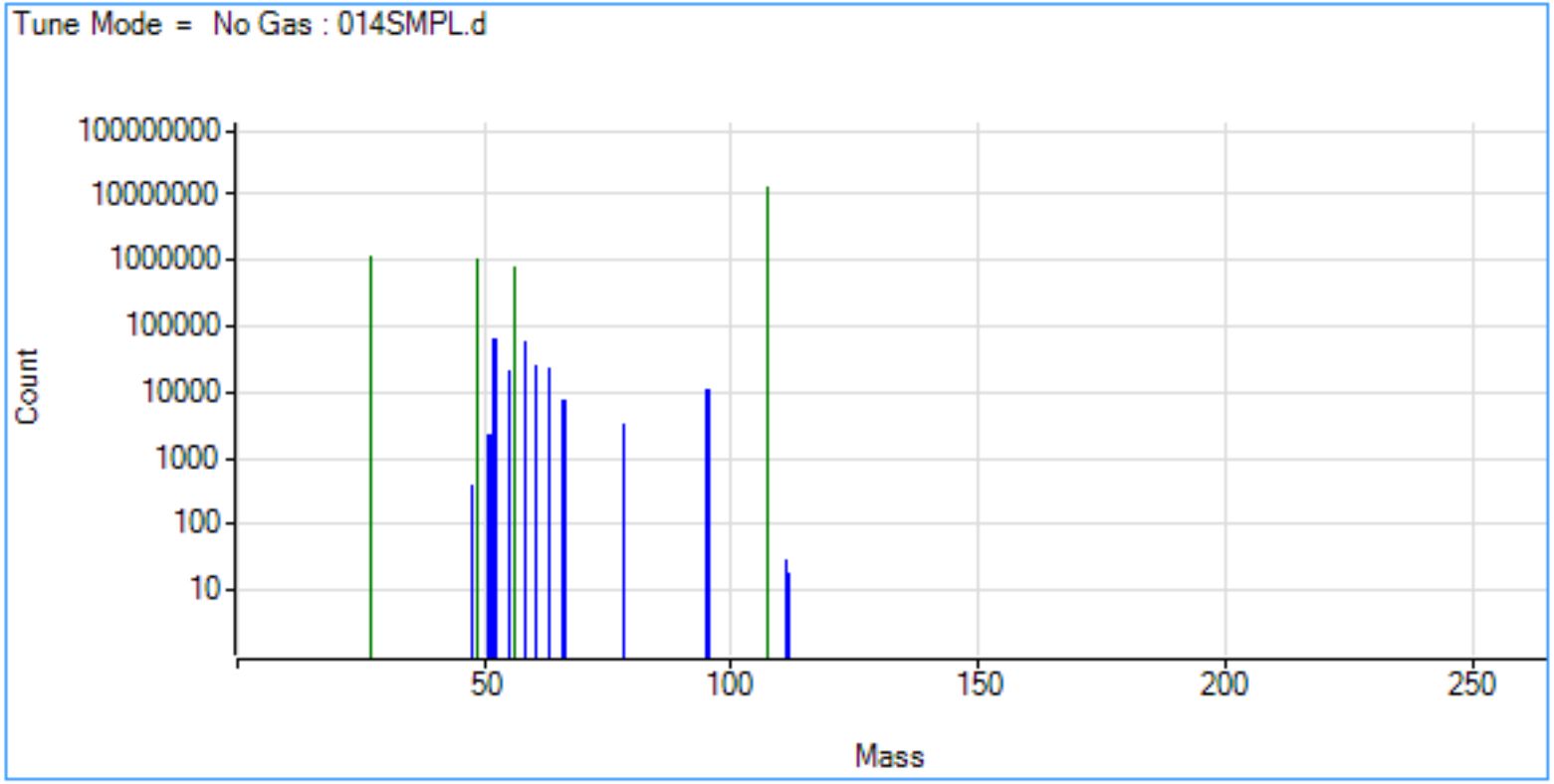
Process Batch | Curve Fit: Linear | Origin: Blank offset | Weight: <None> | ISTD: <None>



Calibration Blank 5% 27 Al [No Gas] 30 Samples (30 total)

EN 10:34 AM 2/3/2015

❖ Φάσμα μαζών


Tune Mode = No Gas : 014SMPL.d
Count
100000000
10000000
1000000
100000
10000
1000
100
10
50
100
150
200
250
Mass

Project funded by

FullQuant | Quick Scan

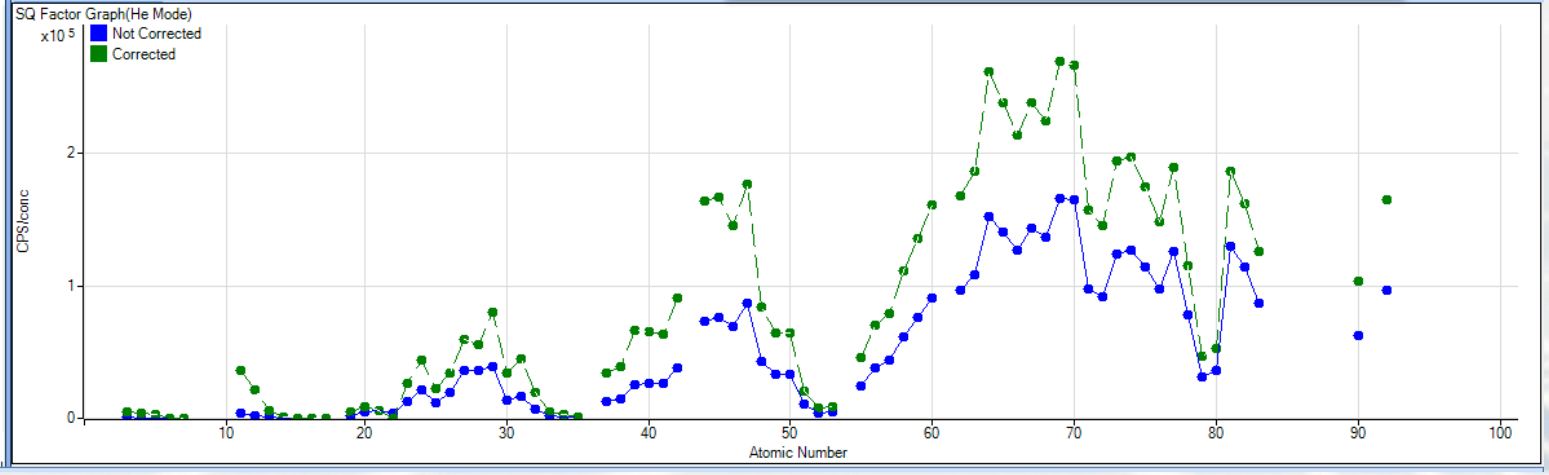
	169 Tm		172 Yb		175 Lu		178 Hf		181 Ta		182 W		185 Re		189 Os		193 Ir		195 Pt		197 Au		202 Hg	
	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit
1	<0.302	ng/l	7.906	ng/l	16.430	ng/l	<1.996	ng/l	<0.402	ng/l	21.166	ng/l	<1.172	ng/l	<3.154	ng/l	<0.631	ng/l	<1.901	ng/l	<1.577	ng/l	<4.600	ng/l
2	0.862	ng/l	906.159	ng/l	2.262	ug/l	<1.996	ng/l	<0.402	ng/l	21.166	ng/l	<1.172	ng/l	<3.154	ng/l	<0.631	ng/l	<1.901	ng/l	<1.577	ng/l	52.575	ng/l
3	<0.302	ng/l	1.580	ug/l	4.300	ug/l	11.408	ng/l	<0.402	ng/l	4.233	ng/l	<1.172	ng/l	<3.154	ng/l	<0.631	ng/l	<1.901	ng/l	<1.577	ng/l	<4.600	ng/l
4	1.724	ng/l	3.047	ug/l	8.932	ug/l	5.704	ng/l	<0.402	ng/l	8.466	ng/l	<1.172	ng/l	<3.154	ng/l	1.803	ng/l	<1.901	ng/l	<1.577	ng/l	13.144	ng/l
5	<0.302	ng/l	7.746	ug/l	22.485	ug/l	5.704	ng/l	<0.402	ng/l	16.932	ng/l	<1.172	ng/l	<3.154	ng/l	<0.631	ng/l	<1.901	ng/l	<1.577	ng/l	<4.600	ng/l
6	1.586	ng/l	9.770	ug/l	29.160	ug/l	<1.262	ng/l	<0.257	ng/l	<0.956	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	27.108	ng/l
7	<0.185	ng/l	<0.857	ng/l	<0.327	ng/l	<1.262	ng/l	<0.257	ng/l	<0.956	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	27.108	ng/l
8	<0.185	ng/l	9.797	ng/l	1.869	ng/l	<1.262	ng/l	<0.257	ng/l	<0.956	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	<3.163	ng/l
9	<0.185	ng/l	<0.857	ng/l	2.804	ng/l	<1.262	ng/l	<0.257	ng/l	32.770	ng/l	6.548	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	-9.036	ng/l
10	<0.185	ng/l	<0.857	ng/l	1.869	ng/l	<1.262	ng/l	<0.257	ng/l	8.192	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	-9.036	ng/l
11	<0.185	ng/l	<0.857	ng/l	<0.327	ng/l	<1.262	ng/l	<0.257	ng/l	<0.956	ng/l	2.183	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	-18.072	ng/l
12	<0.185	ng/l	<0.857	ng/l	<0.327	ng/l	<1.262	ng/l	<0.257	ng/l	<0.956	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	<3.163	ng/l
13	<0.185	ng/l	<0.857	ng/l	<0.327	ng/l	<1.262	ng/l	<0.257	ng/l	2.731	ng/l	<0.764	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	-18.072	ng/l
14	<0.185	ng/l	<0.857	ng/l	<0.327	ng/l	<1.262	ng/l	<0.257	ng/l	270.466	ng/l	4.365	ng/l	<2.078	ng/l	<0.420	ng/l	<1.279	ng/l	<1.073	ng/l	0.000	ng/l

205 Tl		208 Pb		209 Bi		232 Th		238 U	
Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit
23.468	ng/l	4.920	ug/l	166.189	ng/l	29.539	ng/l	40.060	ng/l
1.656	ug/l	12.928	ug/l	2.361	ug/l	2.857	ug/l	2.433	ug/l
3.904	ug/l	22.552	ug/l	4.918	ug/l	6.447	ug/l	4.842	ug/l
8.277	ug/l	38.420	ug/l	9.416	ug/l	13.851	ug/l	9.503	ug/l
20.438	ug/l	89.143	ug/l	22.046	ug/l	34.762	ug/l	23.876	ug/l
25.122	ug/l	102.051	ug/l	23.072	ug/l	42.539	ug/l	25.000	ug/l
<0.381	ng/l	58.726	ng/l	7.934	ng/l	17.914	ng/l	2.609	ng/l
4.350	ng/l	85.587	ng/l	22.673	ng/l	422.318	ng/l	120.990	ng/l
4.350	ng/l	5.177	ug/l	15.870	ng/l	212.382	ng/l	713.500	ng/l
10.874	ng/l	13.425	ng/l	-2.267	ng/l	34.456	ng/l	439.479	ng/l
4.350	ng/l	129.229	ng/l	-4.534	ng/l	28.943	ng/l	353.855	ng/l
<0.381	ng/l	436.494	ng/l	-5.667	ng/l	34.456	ng/l	2.610	ng/l
<0.381	ng/l	2.495	ug/l	2.267	ng/l	-2.756	ng/l	-0.870	ng/l
4.350	ng/l	6.970	ug/l	-3.401	ng/l	13.781	ng/l	1.412	ug/l

SemiQuant Factor

Process Batch

❖ Ημιποσοτική ανάλυση



Offline ICP-MS Data Analysis - 2013_10_31 dr water semi q.b - 9_1_14 test

File Edit View Process DA Method Report Tools Global Help

DA Method Editor | Process Batch | Default Layout | Conc | Count | Default Columns

Batch Table : SemiQuant

Sample: | Sample Type: <All> | Analyte: 7 Li | ISTD: | Tune Mode: <All> | SQ Outliers:

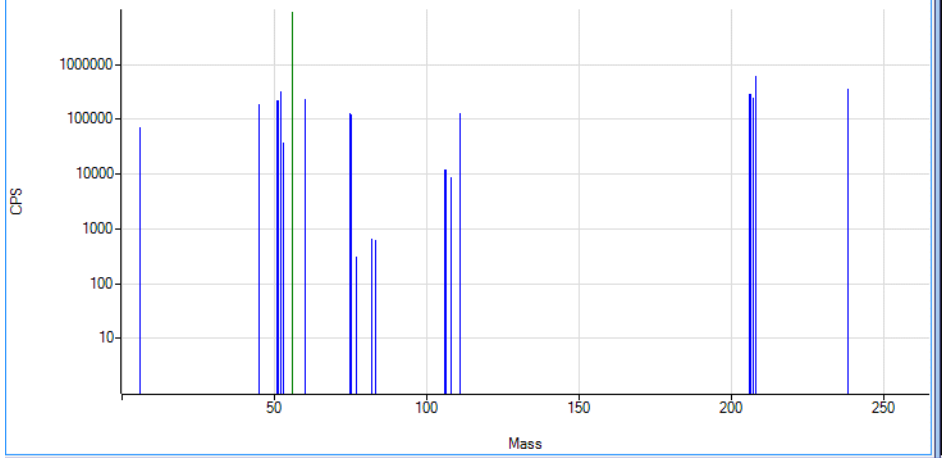
FullQuant | Quick Scan

		Rjct	Sample				7 Li		9 Be		11 B		12 C		14 N		23 Na		24 Mg		27 Al	
			Data File	Acq. Date-Time	Type	Sample Name	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Unit	Conc.	SQ Uni
1			001CALB.d	10/31/2013 4:00:54	CalBlk	blank	592.306	ng/l	<125.313	ng/l	2.849	ug/l	18.750	mg/l	2655.396	mg/l	338.802	ug/l	19.698	ug/l	188.959	ug/l
2			002CALS.d	10/31/2013 4:06:47	SQStd	5ppb	44.311	ng/l	267.859	ng/l	426.287	ng/l	3.123	mg/l	56.382	mg/l	52.719	ug/l	5.606	ug/l	25.000	ug/l
3			003CALS.d	10/31/2013 4:12:20	CalStd	10ppb	<15.509	ng/l	642.880	ng/l	426.287	ng/l	2.985	mg/l	41.465	mg/l	49.697	ug/l	4.678	ug/l	26.058	ug/l
4			004CALS.d	10/31/2013 4:17:53	CalStd	20 ppb	<15.509	ng/l	535.729	ng/l	511.547	ng/l	2.934	mg/l	355.713	mg/l	43.896	ug/l	5.368	ug/l	25.793	ug/l
5			005CALS.d	10/31/2013 4:23:20	CalStd	50 ppb	<15.509	ng/l	1.982	ug/l	341.028	ng/l	3.029	mg/l	477.159	mg/l	51.021	ug/l	8.816	ug/l	29.529	ug/l
6			006CALS.d	10/31/2013 4:28:40	CalStd	100 ppb	177.247	ng/l	5.842	ug/l	<29.839	ng/l	3.300	mg/l	519.507	mg/l	51.855	ug/l	12.556	ug/l	34.130	ug/l
7			013SMPL.d	10/31/2013 5:07:38	Sample	uperkatharo	<15.509	ng/l	<18.750	ng/l	85.256	ng/l	4.037	mg/l	400.702	mg/l	15.565	ug/l	293.304	ng/l	13.650	ug/l
8			007SMPL.d	10/31/2013 4:33:54	Sample	eviva	<15.509	ng/l	<18.750	ng/l	170.513	ng/l	41.876	mg/l	286.155	mg/l	289.115	ug/l	180.774	ug/l	7.131	ug/l
9			008SMPL.d	10/31/2013 4:39:09	Sample	dios	221.559	ng/l	<18.750	ng/l	3.155	ug/l	83.445	mg/l	393.037	mg/l	670.185	ug/l	4.086	mg/l	9.895	ug/l
10			009SMPL.d	10/31/2013 4:46:40	Sample	zagori	<15.509	ng/l	<18.750	ng/l	170.513	ng/l	61.416	mg/l	316.814	mg/l	317.965	ug/l	696.932	ug/l	7.098	ug/l
11			010SMPL.d	10/31/2013 4:51:54	Sample	vikos	<15.509	ng/l	<18.750	ng/l	170.513	ng/l	67.703	mg/l	397.011	mg/l	319.970	ug/l	239.097	ug/l	13.254	ug/l
12			011SMPL.d	10/31/2013 4:57:08	Sample	apionismeno	<15.509	ng/l	<18.750	ng/l	<29.839	ng/l	9.982	mg/l	361.384	mg/l	18.174	ug/l	722.094	ng/l	12.595	ug/l
13			012SMPL.d	10/31/2013 5:02:23	Sample	apestagmeno	<15.509	ng/l	<18.750	ng/l	<29.839	ng/l	6.287	mg/l	330.724	mg/l	12.933	ug/l	801.096	ng/l	10.126	ug/l
14			014SMPL.d	10/31/2013 5:12:52	Sample	kavala	88.623	ng/l	<18.750	ng/l	596.807	ng/l	59.340	mg/l	355.706	mg/l	697.641	ug/l	1.916	mg/l	11.377	ug/l

Spectrum

Tune Mode: No Gas

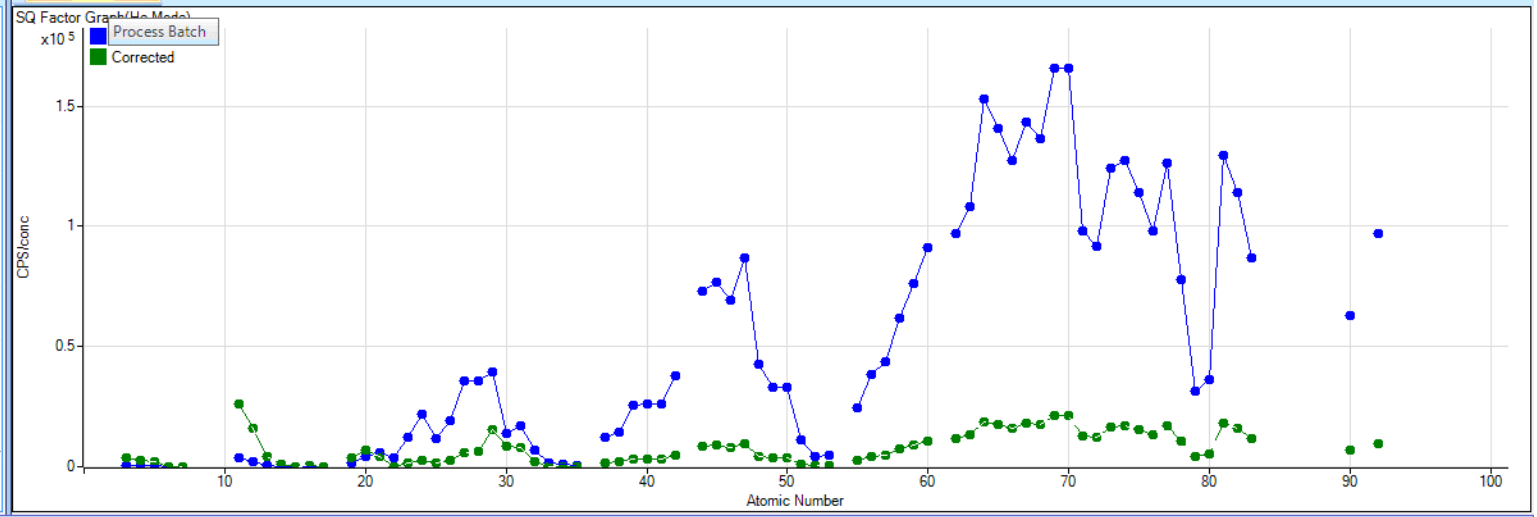
Tune Mode = No Gas : 002CALS.d



SemiQuant Factor

Process Batch

SQ Factor Graph(Ha Mode)



5ppb | 7 Li | 14 Samples (14 total)

EN 1:19 PM 1/28/2014

Τέλος αναλύσεων
όλοι ευχαριστημένοι

Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

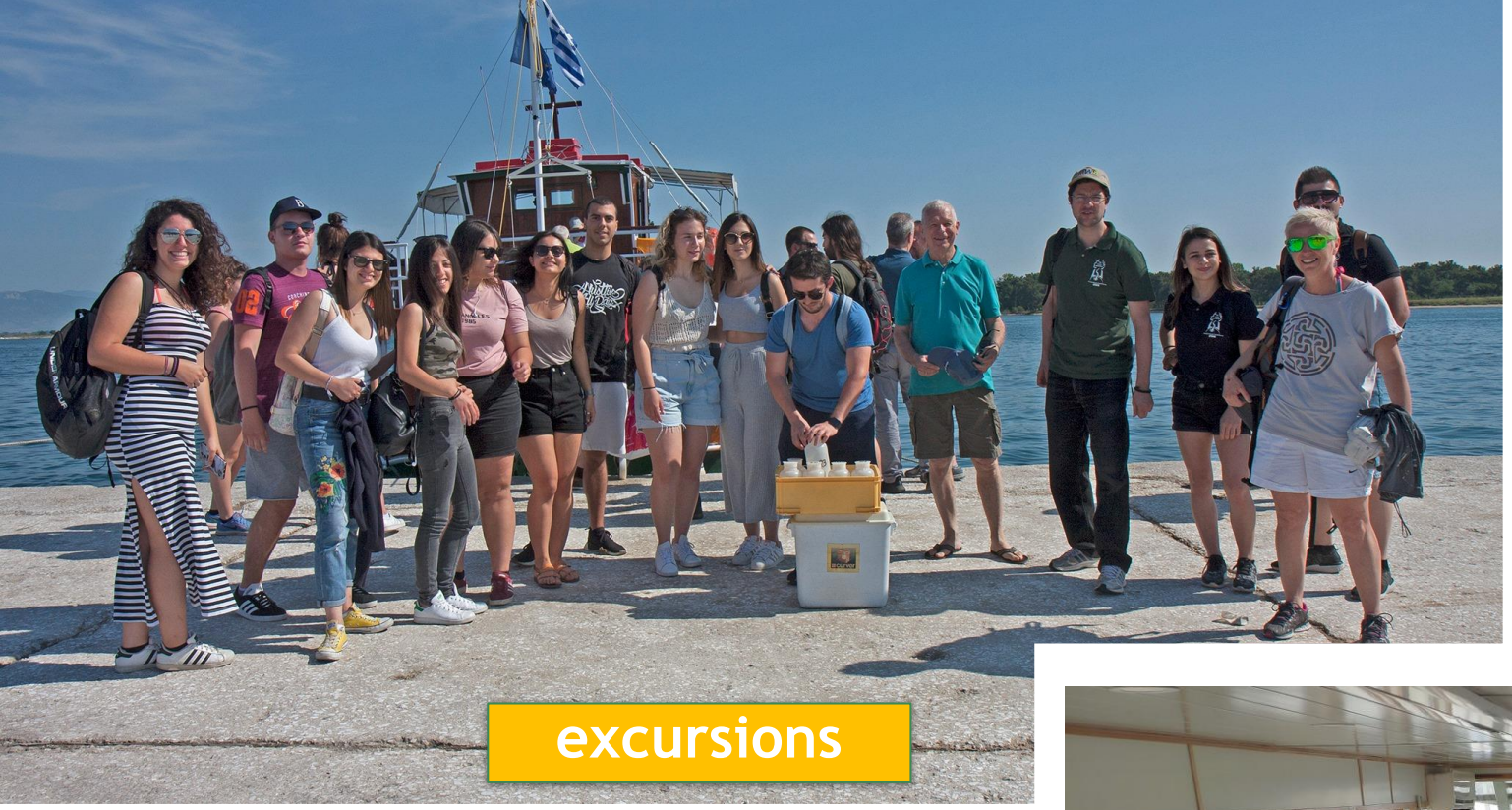
Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

International conferences

meetings

activities



excursions

Project funded by EUROPEAN UNION

Black Sea Cooperation Network MONITOX Monitoring Toxicants

Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

Εν κατακλείδι

Το ΔΙΠΑΕ χρηματοδοτήθηκε με 145.000Ε για μια 3ετία
70.000Ε αναλώσιμα, ανταλλακτικά, εξοπλισμό
Launch Meeting, region workshop, training professional, joint treep, eMS, εκθέσεις/4μηνο, International Conference
5 μέλη ΔΕΠ ΔΙΠΑΕ
5 εξωτερικοί συνεργάτες

International Conference, "Environmental Toxicants in Freshwater & Marine Ecosystem in the Black Sea Basin", GR 2020
International Symposium, "Deltas and Wetlands", RO 2020
International Conference, "Environmental Challenges in the Black Sea Basin: Impact on Human Health", RO 2020
Περισσότερα από 14 επιστημονικές Δημοσιεύσεις
10 Ανακοινώσεις σε συνέδρια
12 poster παρουσιάσεις σε συνέδρια, συμμετοχή φοιτητών

συμμετοχή 3 φορές σε προεδρείο διεθνών συνεδρίων
γνωριμίες και συνεργασίες με πανεπιστήμια, εργαστήρια, τόπους
Είναι η καλύτερη και αρτιότερη επιστημονική εμπειρία που είχα μέχρι σήμερα στην επιστημονική μου καριέρα !!!!

ΔΙΕΘΝΕΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΤΗΣ ΕΛΛΑΔΟΣ

Σας ευχαριστώ για την προσοχή σας

Καβάλα, Μάιος 2021

Καθηγ. Δρ. Θ. ΣΠΑΝΟΣ