Isotopic composition of nitrogen in Genesis target material

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Laser (193 nm) ablation – static MS

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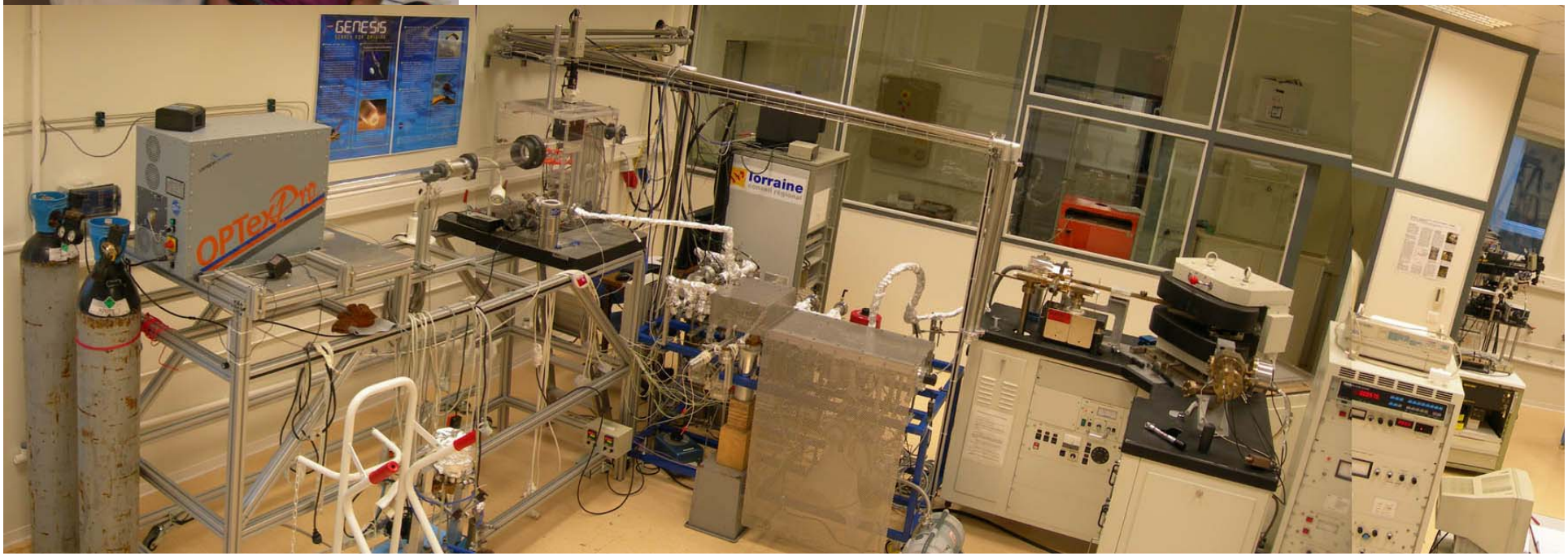
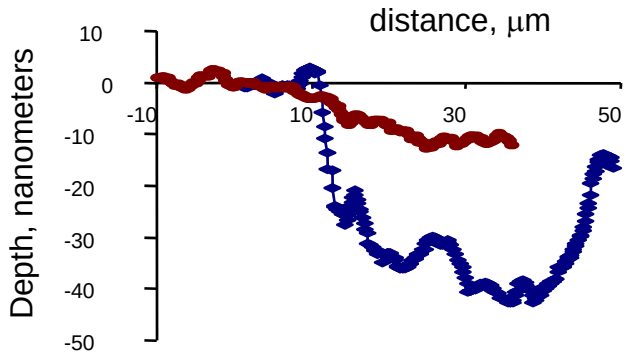
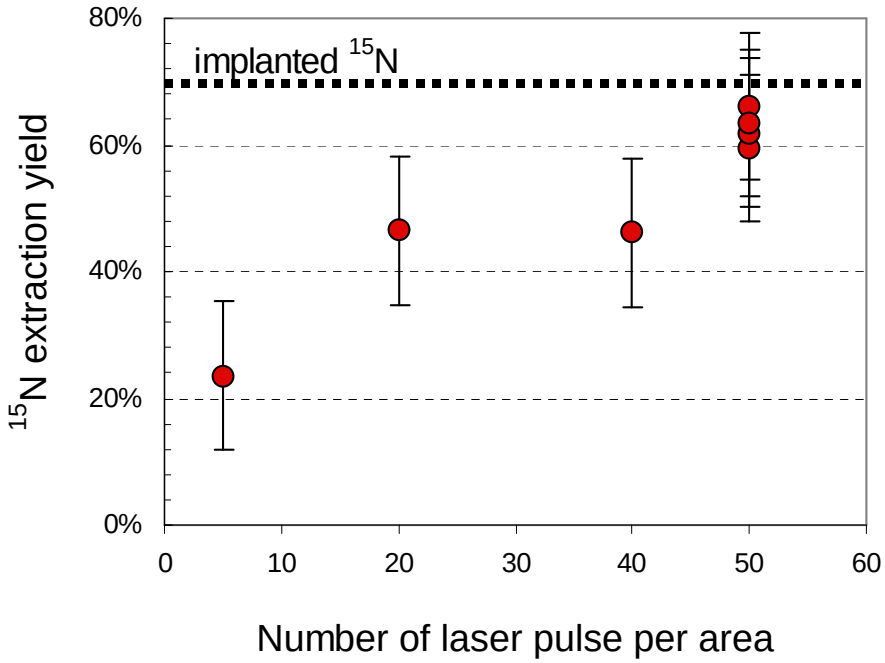
Ozone cleaning (organics, brown stain…) at Open Univ. UK, thanks to S. Sestak & I.A. Franchi

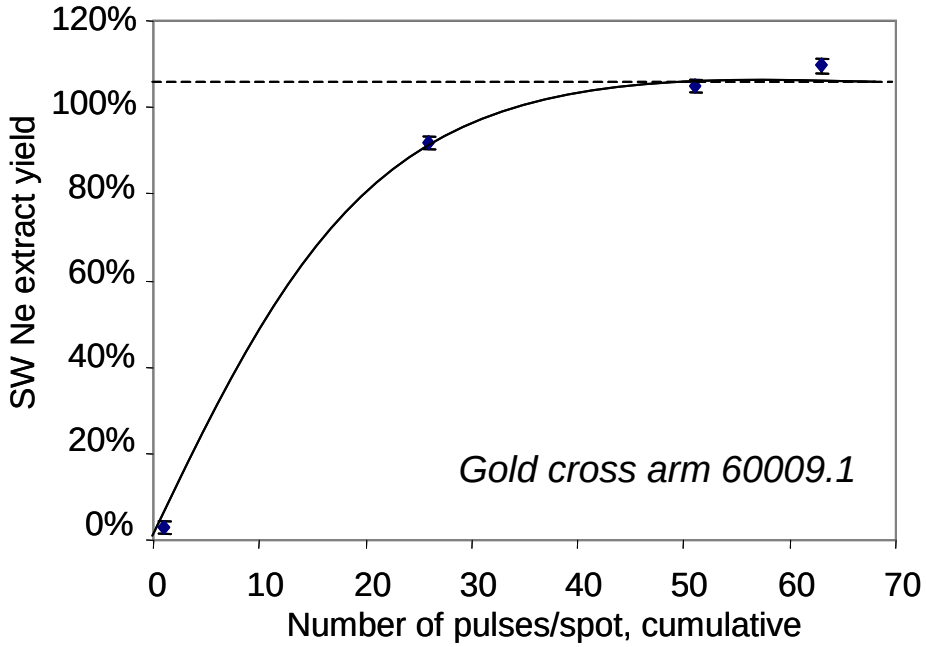
- Static MS
- He, Ne, N, Ar abundances and isotopic ratios
- 26 months to decrease nitrogen procedural blanks to 3 x 10^{-13} mol N_2
- N blank < 10 % analyzed N



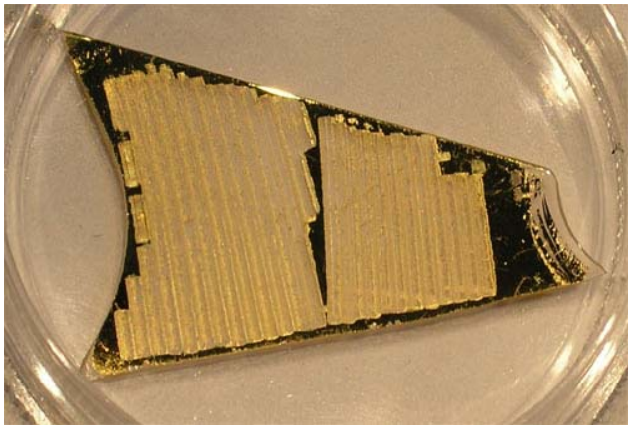


atomic force microscopy :
1 pulse ~ 1 nanometer

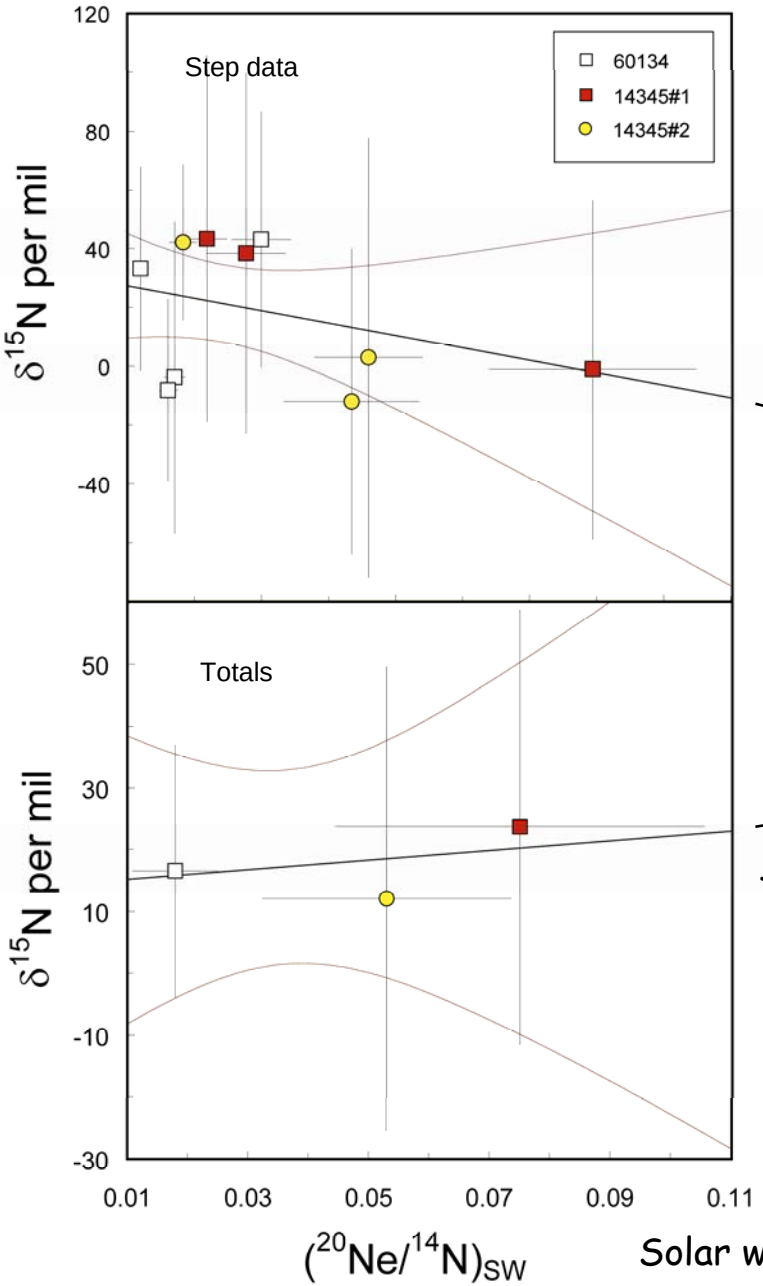




Gold Over Sapphire – AuoS



1.0 cm



-210±410 ‰, 2 σ

+91±660 ‰, 2 σ

Rastered area are large (cm^2), 29/30 are low (27 to 100), correction are important, precision is low

Solar wind $^{20}Ne/^{14}N$ = 1.14±0.23

Nitrogen analyzed as N_2 : 28 and 29 on Faraday (FC)
29 and 30 on Multiplier (EM)

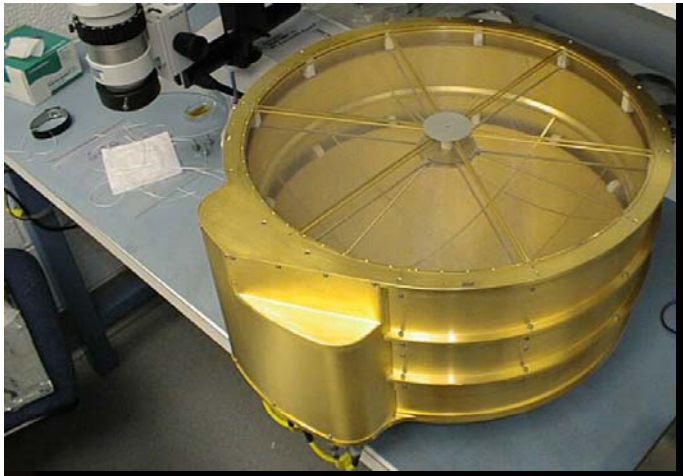
• Contributions of *CO* and hydrocarbons at these masses

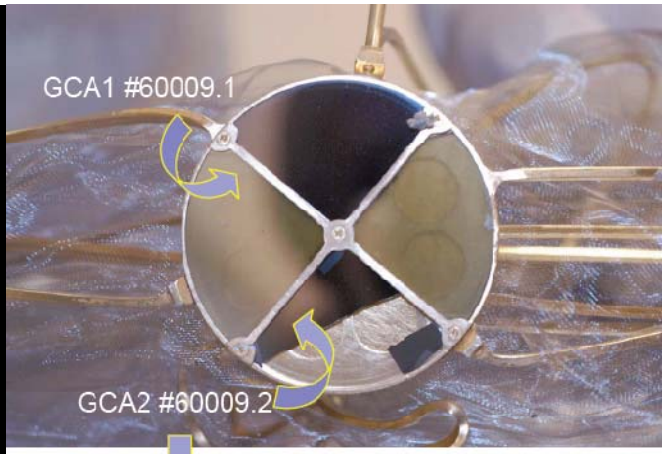
• Purification of nitrogen through oxydation of *CO* and hydrocarbons (*CuO* trap, conversion to H_2O and CO_2 which are trapped in a cold trap just above liquid N_2 temp.)

• Mass resolution of 650 on EM : hydrocarbons resolved from N_2+*CO*

• Correction for residual *CO* using 29/30 ratios : 5.72 for *CO*, 544 for atm. N_2

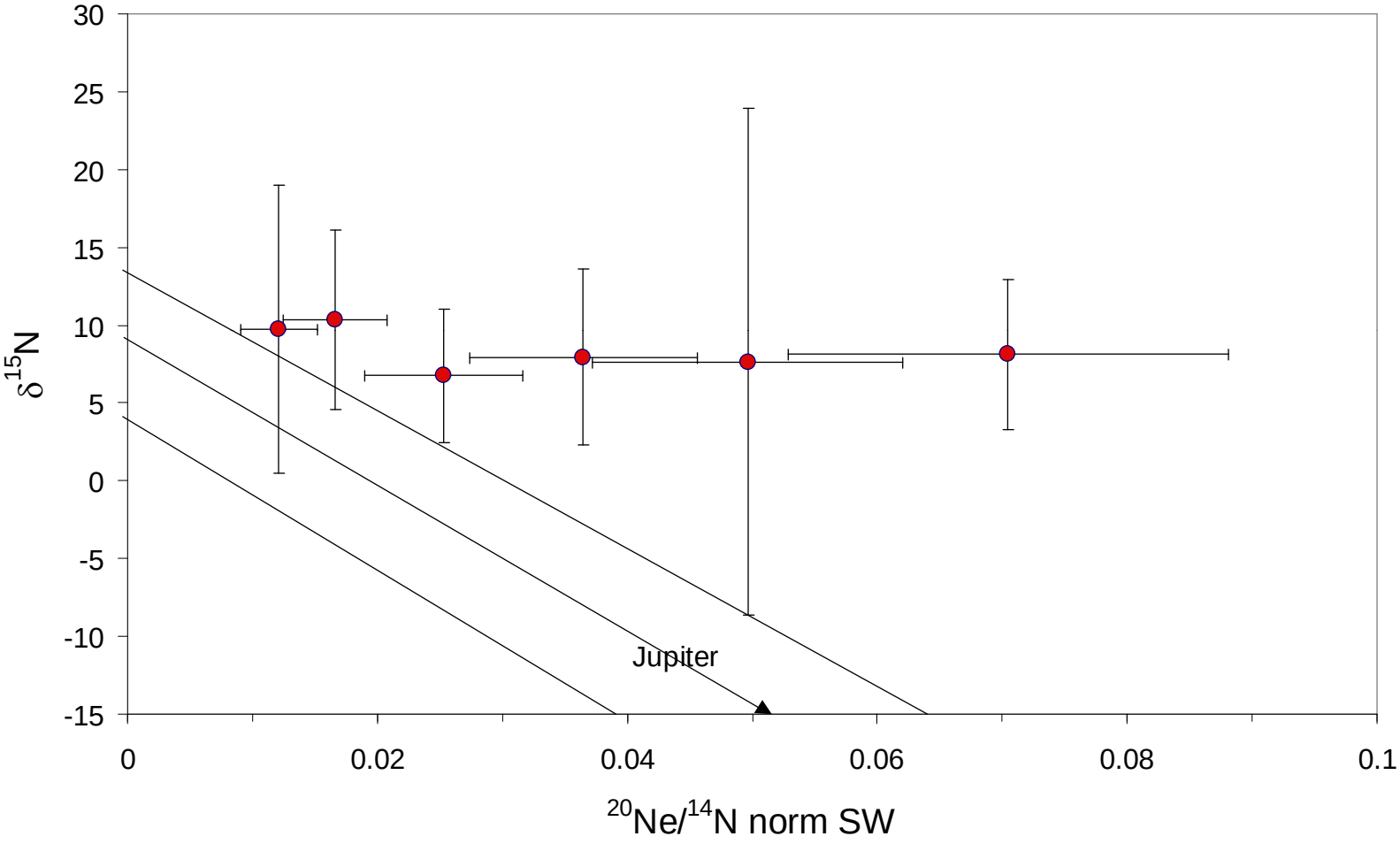
•For AuoS, 29/30 : 27-100, large correction
•For gold cross arms, 29/30 > 400, correction small (few per mil)




GCA1 #60009.1
GCA2 #60009.2

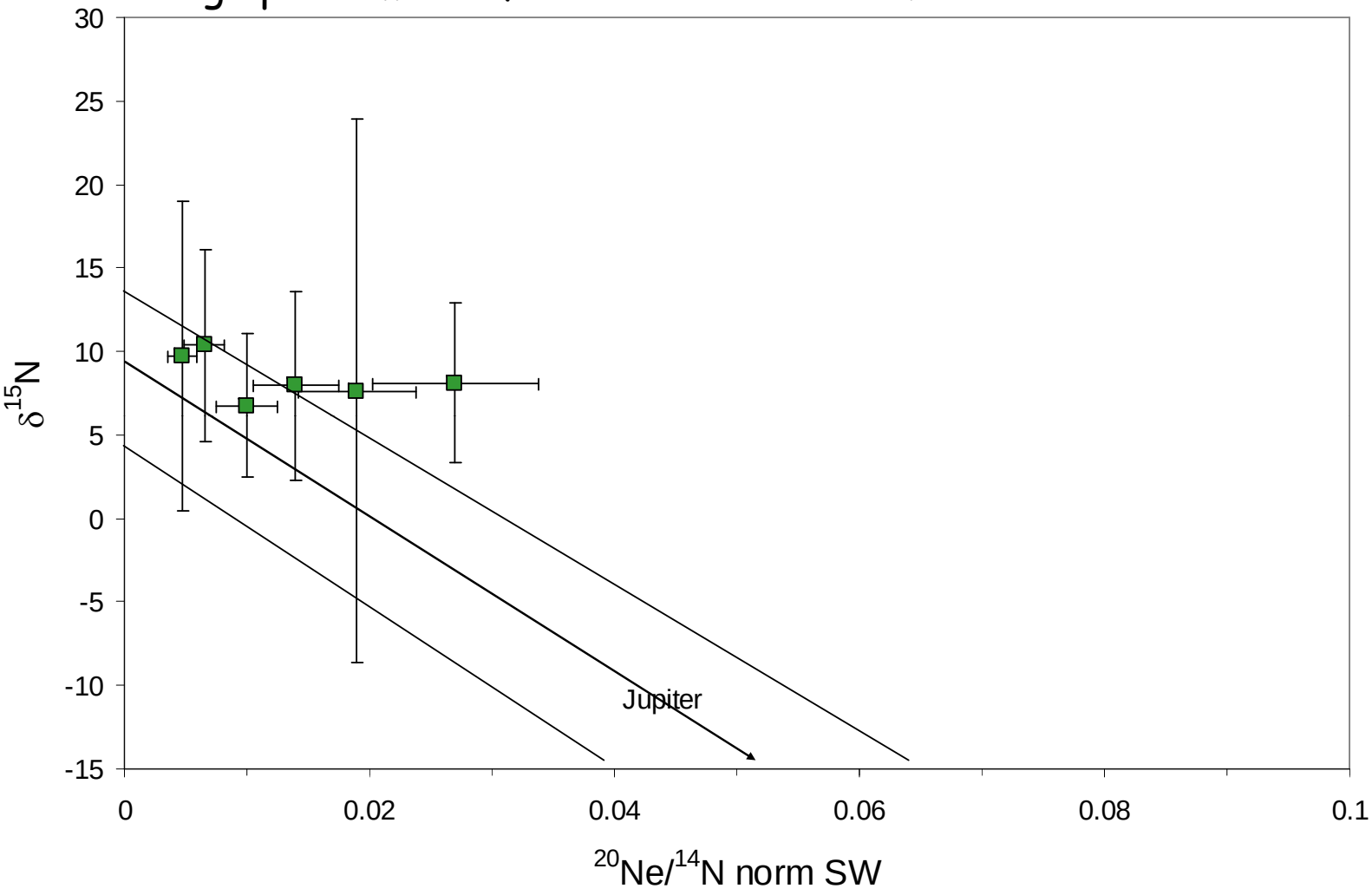

#1
#2
#3
#4
#5
#6
EDGE
CENTER

Analysis of gold cross arm 69001.01 (last LPSC) : no evidence for light N in the modern solar wind

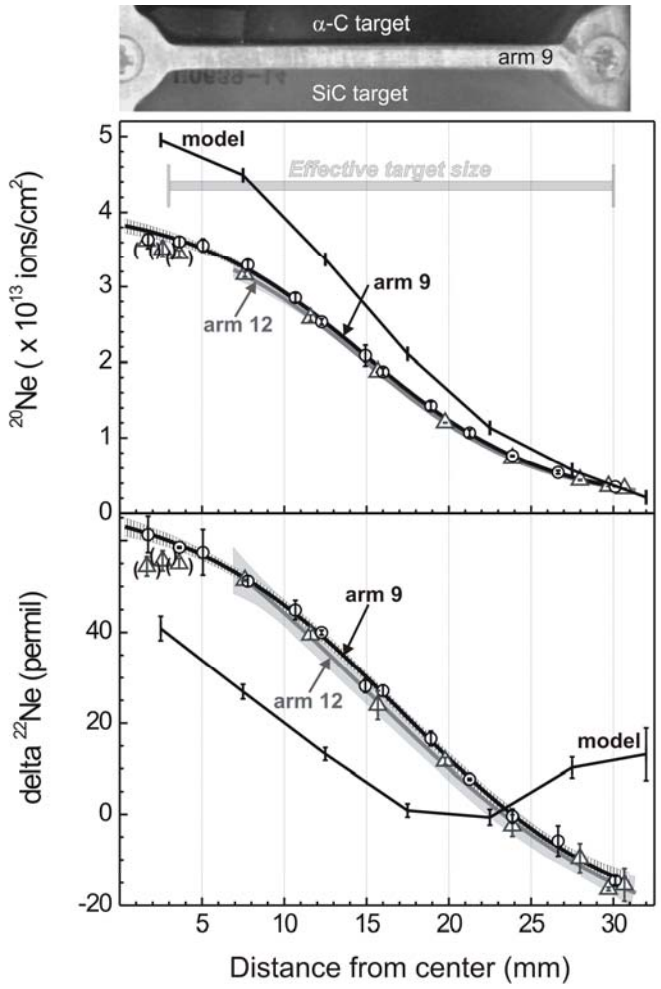


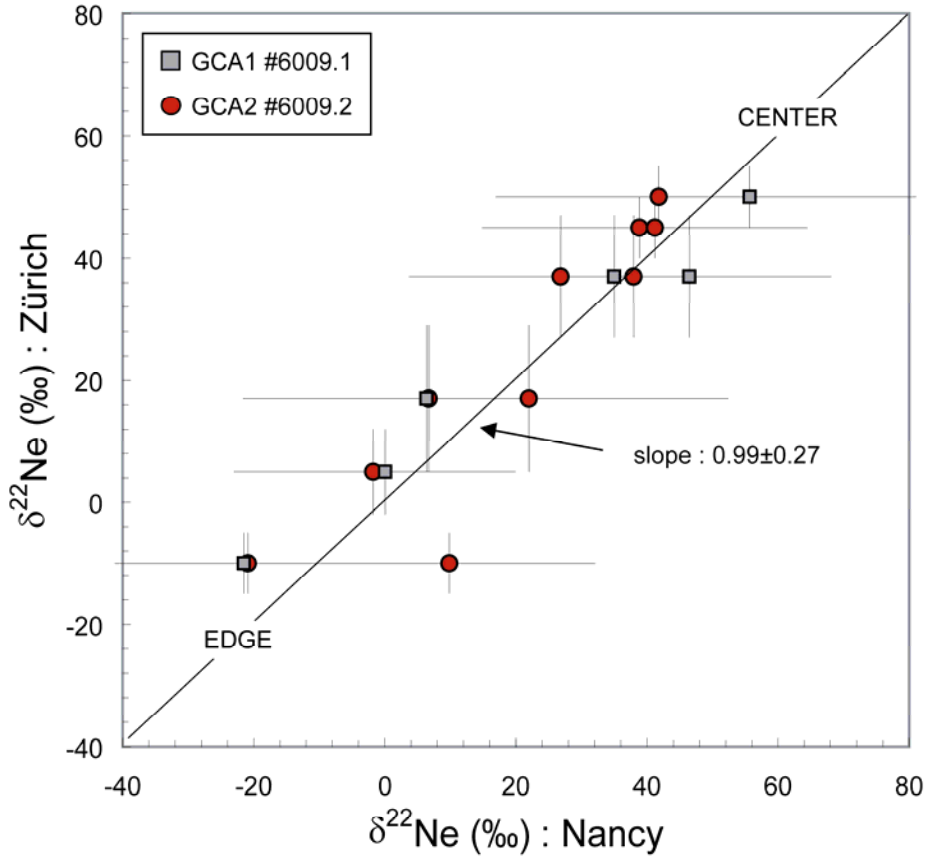
Since then, several developments….

Scaling up estimate of the solar wind $^{20}Ne/^{14}N$

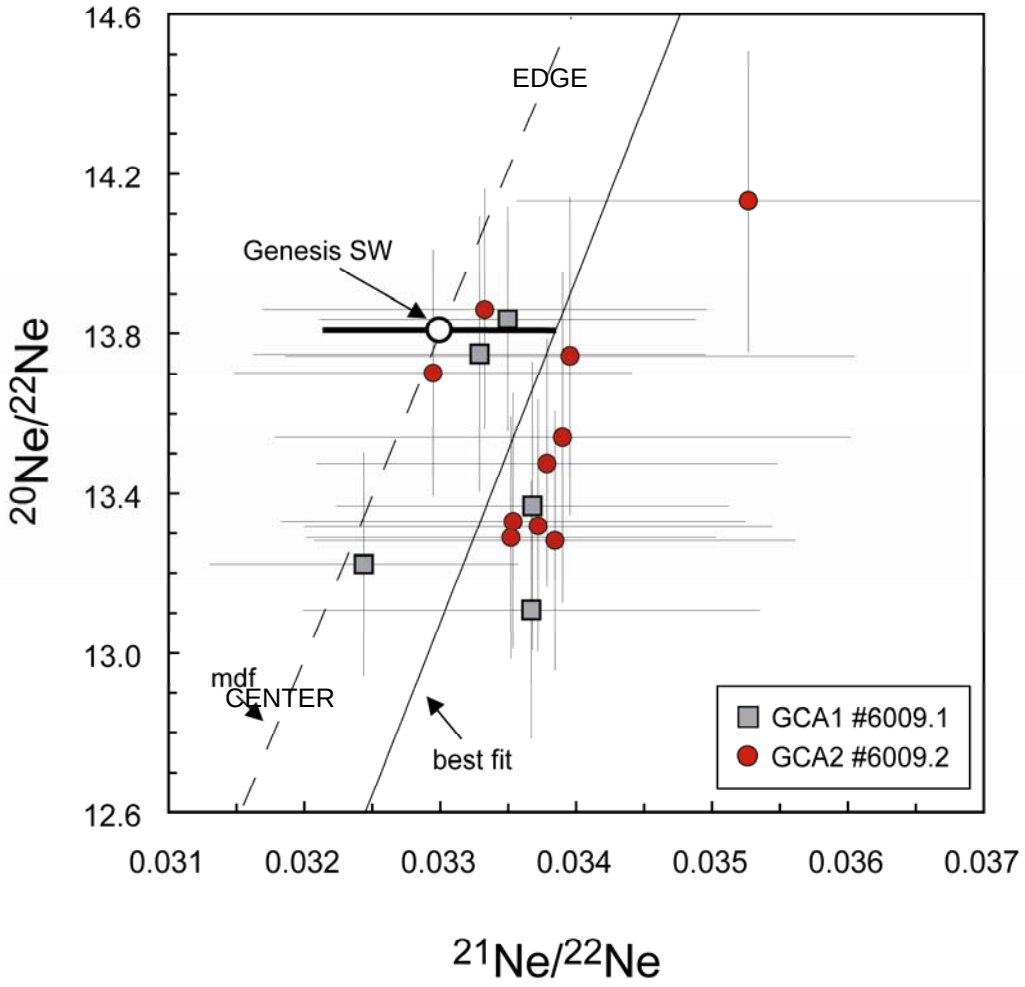


We first used the Gloecker and Geiss (2007)'s $^{20}Ne/^{14}N$ ratio of 0.50, derived from Ulysses' coronal hole measurement. Probably too low (P. Bochsler) : averages of 2 slow and fast regimes measurements (from Von Steiger, 2000, compilation) are ~40 % higher, and Reames (1995)'s SEP even 60 % higher. We adopt now $^{20}Ne/^{14}N$ = 1.14±0.23 from coronal abundances, consistent with in situ analysis : 1.24±0.30 from the ACE mission (Dan Reisenfeld)

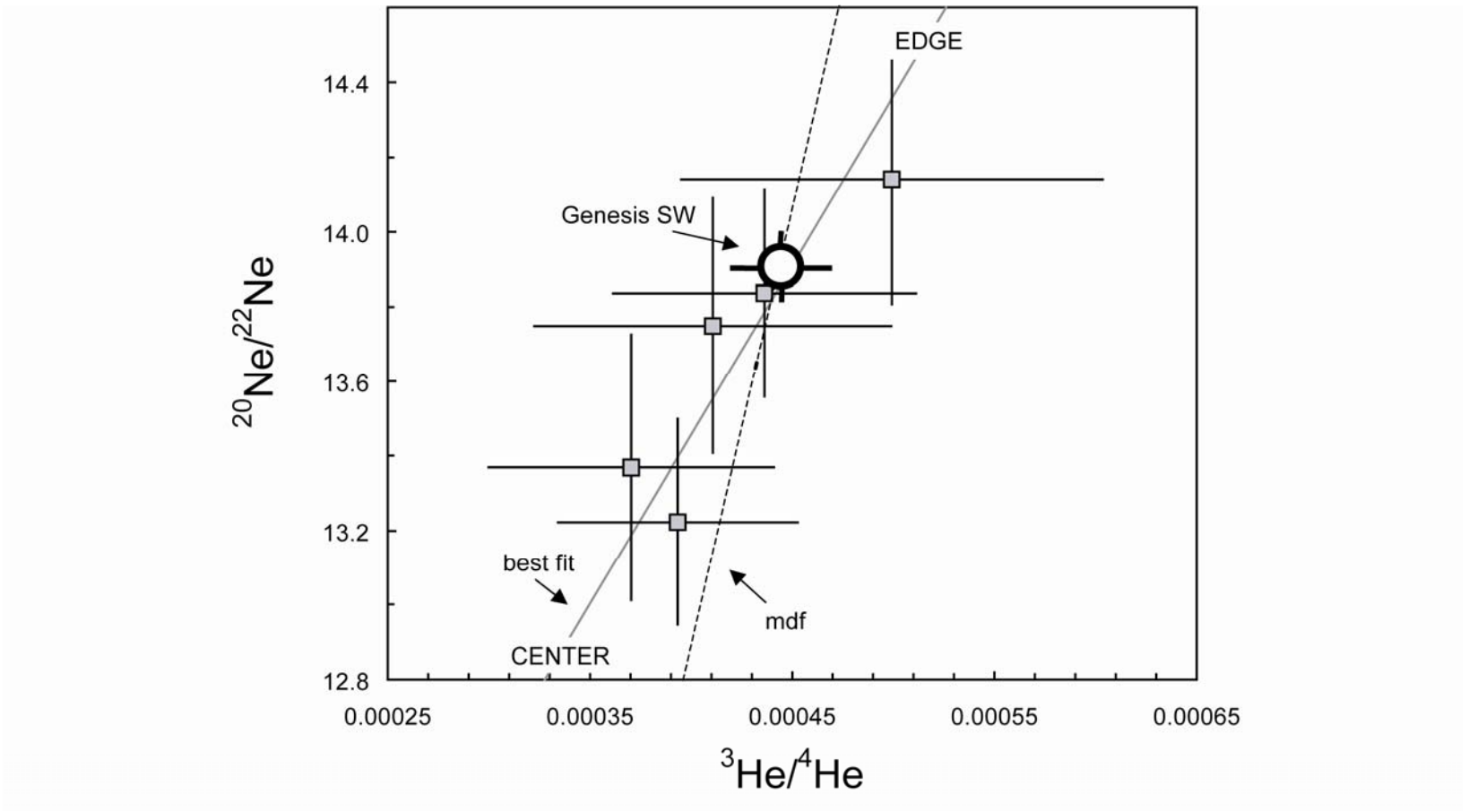


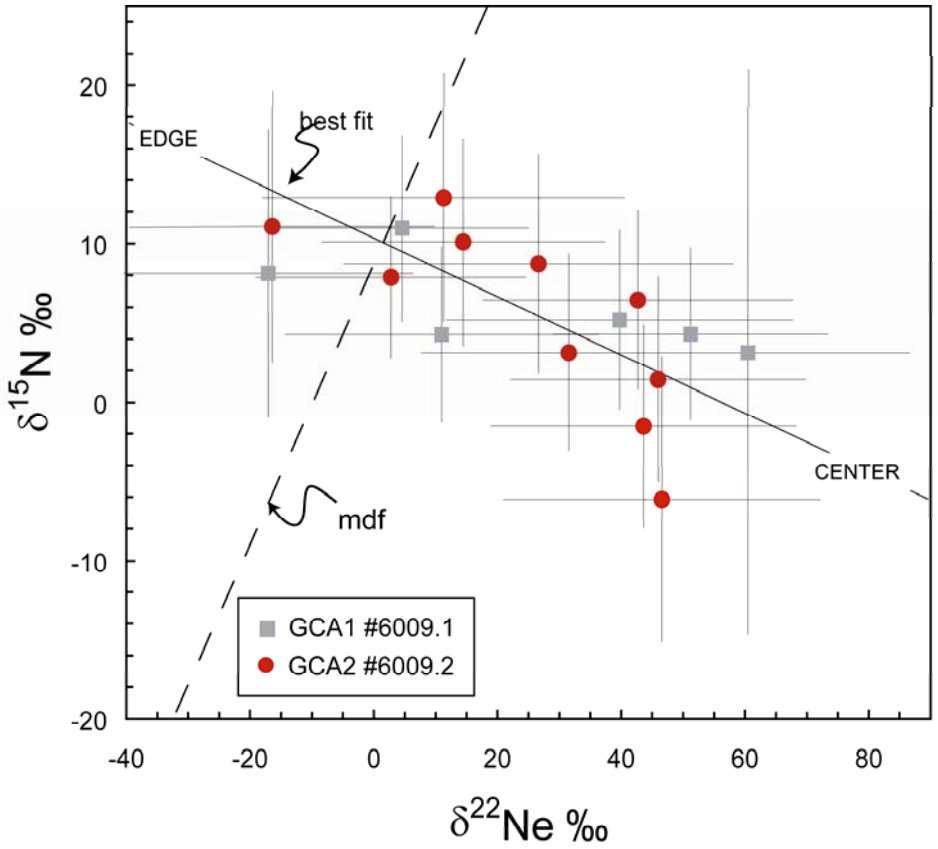


Neon spot-analyzed at ETH Zürich by Heber et al. (2008) : laser spot size : 100 μm diameter
In Nancy, lasered area were 4-6 mm^2



Mdf : mass-dependent fractionation assuming proportionality to $m^{-1/2}$


EDGE
Genesis SW
best fit
mdf
CENTER
14.4
14.0
13.6
13.2
12.8
0.00025
0.00035
0.00045
0.00055
0.00065
$^{20}Ne/^{22}Ne$
$^{3}He/^{4}He$

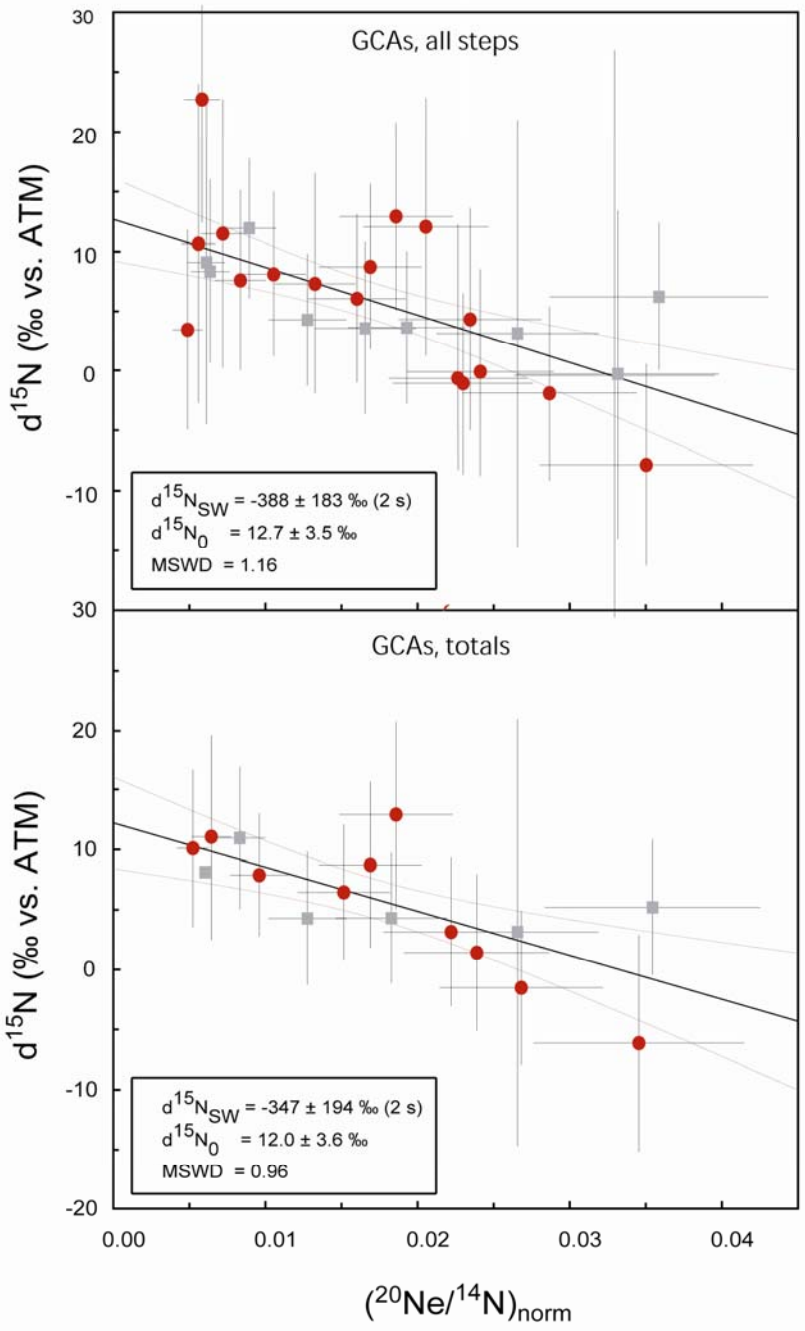


Mdf : mass-dependent fractionation assuming proportionality to $m^{-1/2}$

Nitrogen in SW as N^{5+} and N^{6+} , mean charge state : +5.5; m/q = 2.54 and 2.73 for ^{14}N and ^{15}N, respectively

Neon in SW as Ne^{8+}, m/q = 2.50 and 2.75 for ^{20}Ne and ^{22}Ne, respectively.

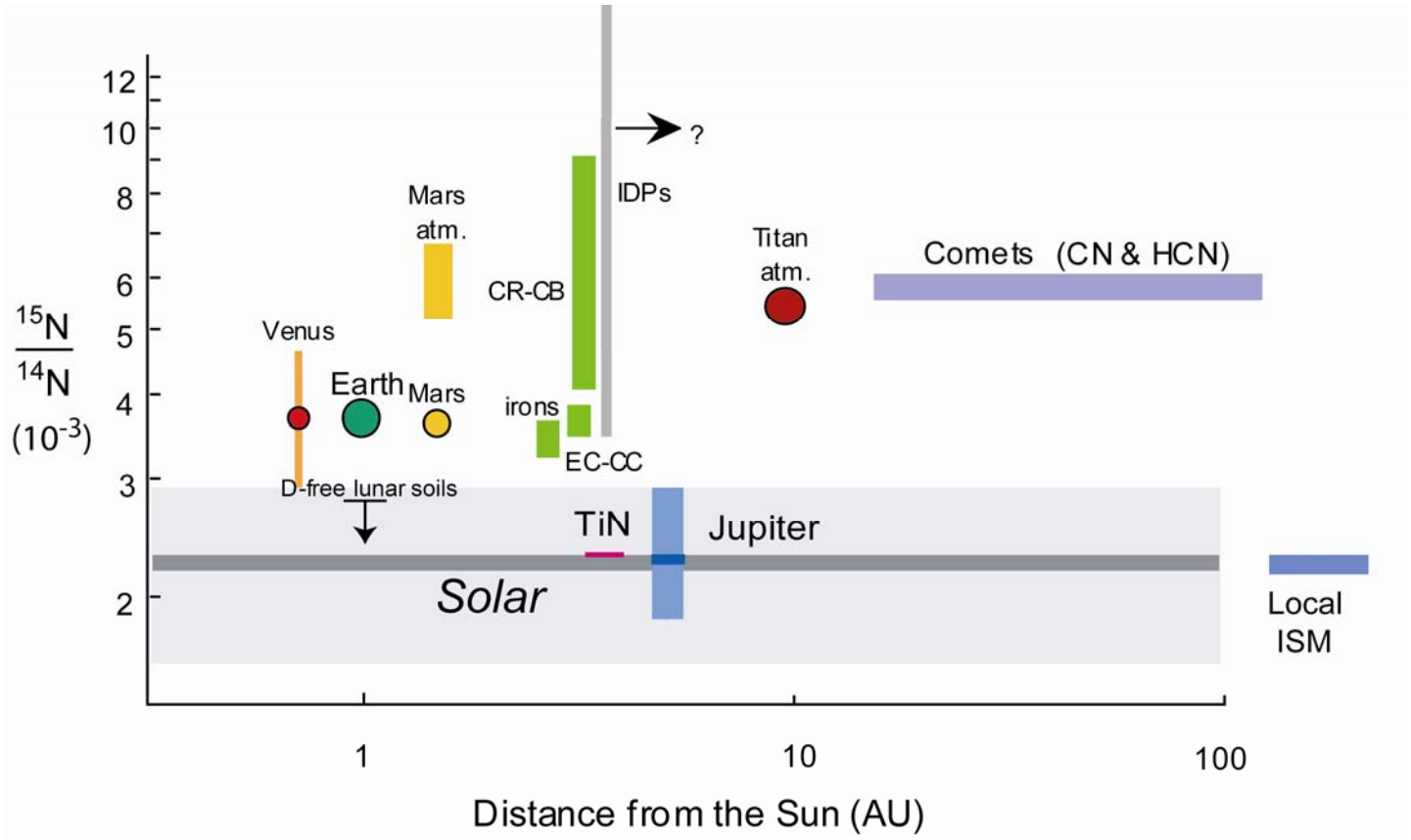
Same extent of isotope fractionation for $^{15}N/^{14}N$ and $^{22}Ne/^{20}Ne$



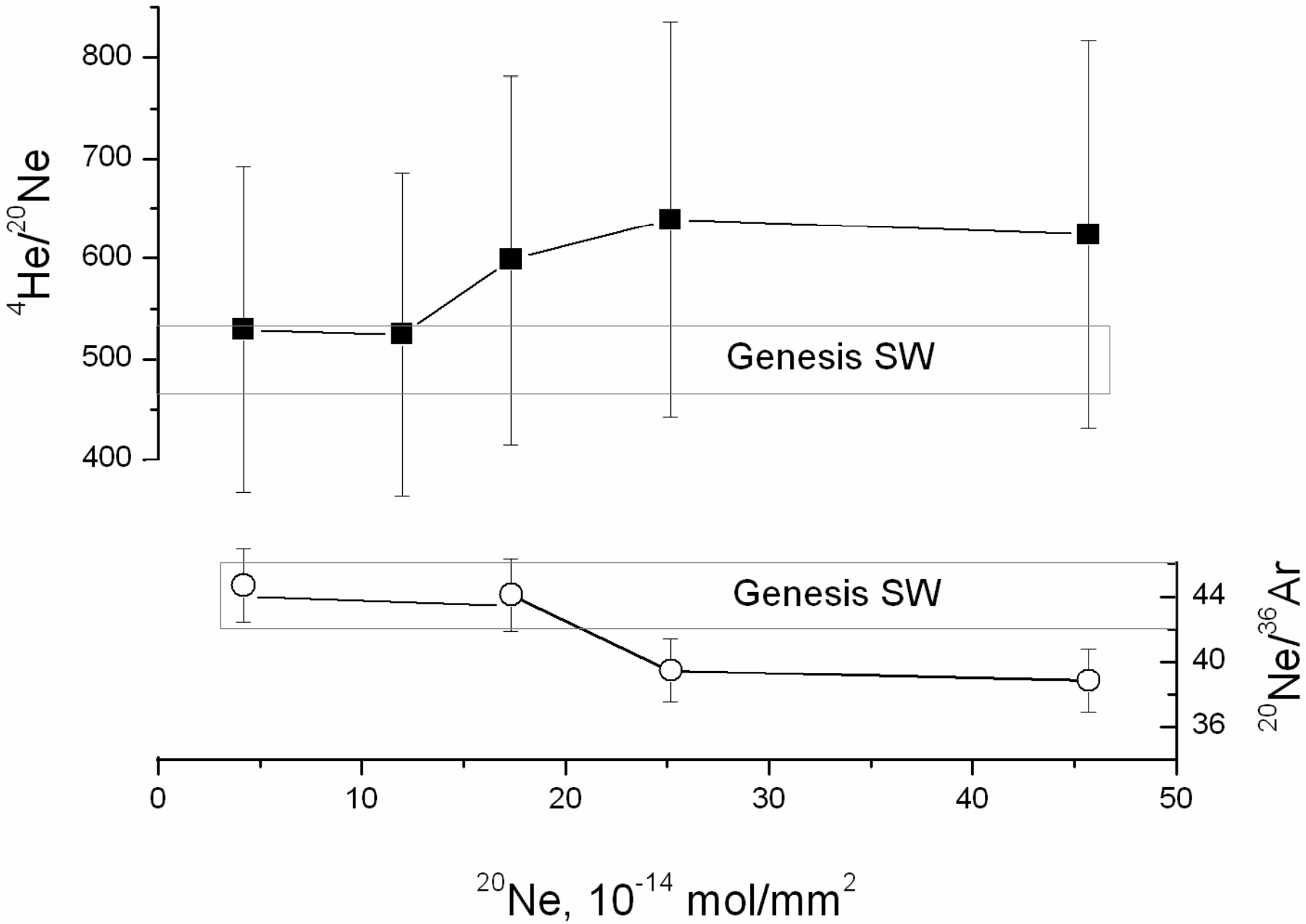
Mixing between terrestrial N and ^{15}N-depleted N

δ^{15}N data corrected for concentrator fractionation; Only the SW fraction of N was corrected

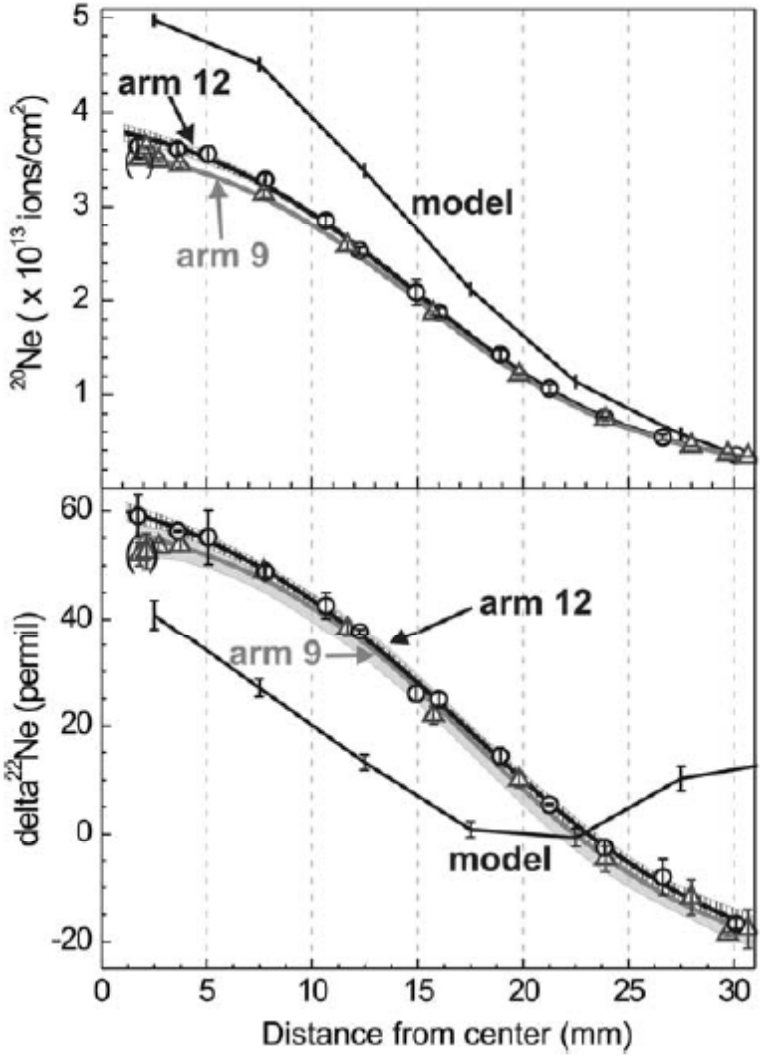
Correction is between 0.2 and 3 per mil, cannot account for correlation (too small, goes in the other way)


12
10
8
6
5
4
3
2
$^{15}N/^{14}N$ (10^{-3})
Mars atm.
IDPs
?
Titan atm.
Comets (CN & HCN)
CR-CB
Venus
Earth
Mars
irons
EC-CC
D-free lunar soils
TiN
Jupiter
Solar
Local ISM
1
10
100
Distance from the Sun (AU)

MetSoc 2009, Nancy, France


800
700
600
500
400
$^4He/^{20}Ne$
Genesis SW
Genesis SW
44
40
36
$^{20}Ne/^{36}Ar$
0
10
20
30
40
50
^{20}Ne, 10^{-14} mol/mm^2

Gold cross arm (GCA) analyzed for Ne amount and isotopes at Zurich : correction for elemental and isotopic fractionation



ETH : Heber et al., 2007

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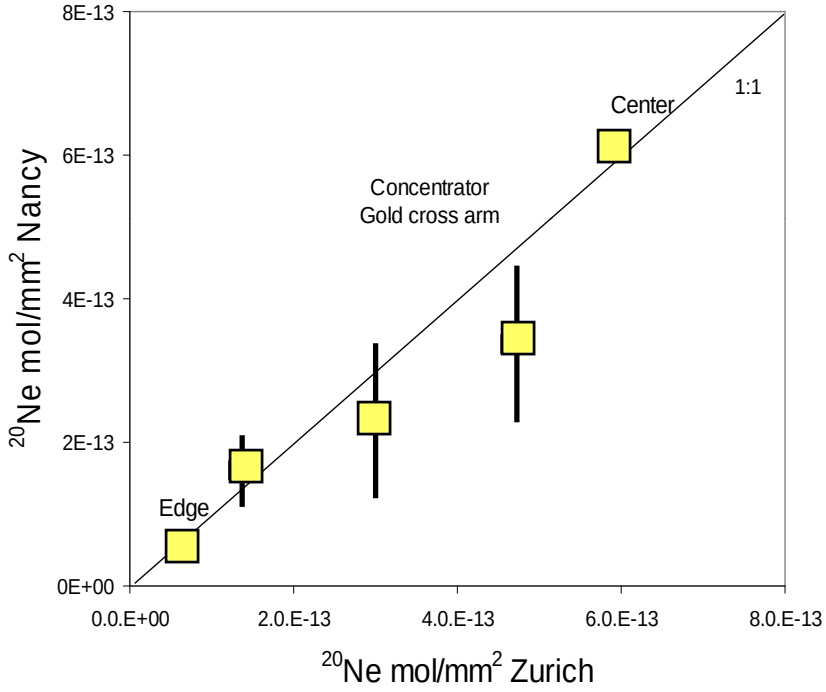

5 area with sizes ~5 mm^2 rastered along the gold cross arm from the edge to the center