Passell, T.O. *Pd-110/Pd108 Ratios and Trace Element Changes in Particulate Palladium Exposed to Deuterium Gas, PowerPoint slides*. in *Tenth International Conference on Cold Fusion*. 2003. Cambridge, MA: LENR-CANR.org.

Slide 1

Pd 110/108 and Trace Element Changes in Pd Powder Exposed to Deuterium Gas

Thomas O. Passell

Neutron Activation Analysis (NAA)

- Method uses Integral Photopeak Ratios of Gamma Rays of Neutron Capture Isotopes
- Pd110/Pd108 Possible using 342 keV gamma of 7.45 day Ag-111 and 88 keV gamma of 13.47 hour Pd-109
- Ag-109, Co-59, Zn-64, Ir-191, and Au-197 all Accessible to this method

Time of Flight Secondary Ion Mass Spectrometry (TOF-SIMS)

- Characterizes tiny spots on Surfaces and Layers just under the surface
- Subject to uncertainties from Multiple Atom Ions Except in the Case of Lithium
- Li-7/Li-6 Ratios Immune from Multiple Atom Ion Effects
- Results of the Analysis of Li-7/6 Ratios Included to complement NAA

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Sample Name	Pd110/Pd108 Atomic Ratio (One Sigma)	Ag109/Pd110 Atomic Ratio (X 10^6)
Pd-D (Virgin)	Exactly 1 By Definition	53
Pd-A (Active)	1.037(.008)	663 A/D=12.5
Pd-B (Active)	1.089(.008)	152 B/D=2.87
Pd-C (Active)	1.014(.009)	488 C/D=9.21

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Sample Name	Co59/Pd110 Atomic Ratio (X 10^6)	Zn64/Pd110 Atomic Ratio (X10^6)
Pd-D (Virgin)	227.5	83
Pd-A (Active)	286 A/D=1.26	516 A/D=6.22
Pd-B (Active)	377.5 B/D=!.66	1259 B/D=15.2
Pd-C (Active)	730 C/D=3.21	608 C/D=7.33

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Sample Name	Au197/Pd110 Atomic Ratio (X10^6)	Li7/Li6 Atomic Ratio (One Sigma)
Pd-D (Virgin)	19.4	13.6(1.0) Natural Li=12.5
Pd-A (Active)	89.4 A/D=4.61	14.5(0.3) A/D=1.07(.08)
Pd-B (Active)	20.6 B/D=1.06	22(1.4) B/D=1.62(.16)
Pd-C (Active)	24.1 C/D=1.24	16.2(0.1) C/D=1.19(.09)

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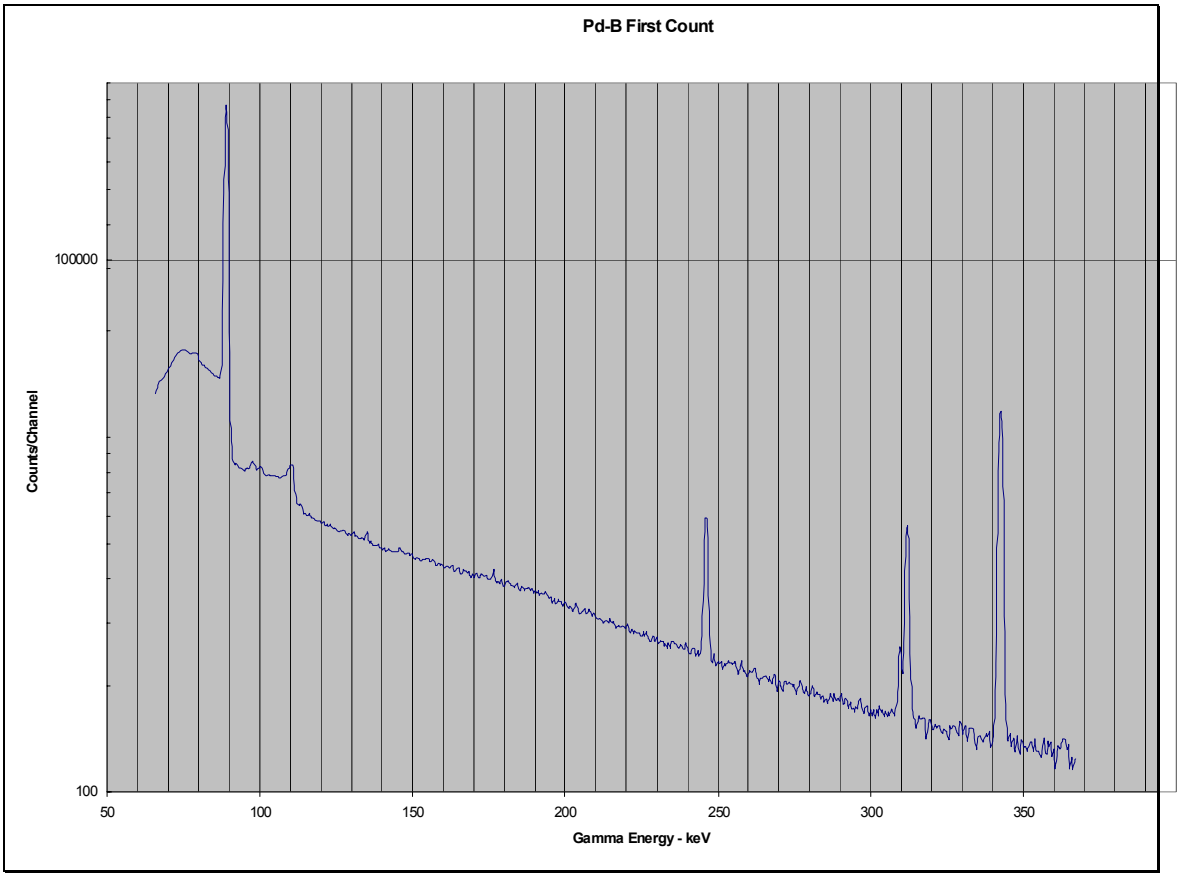
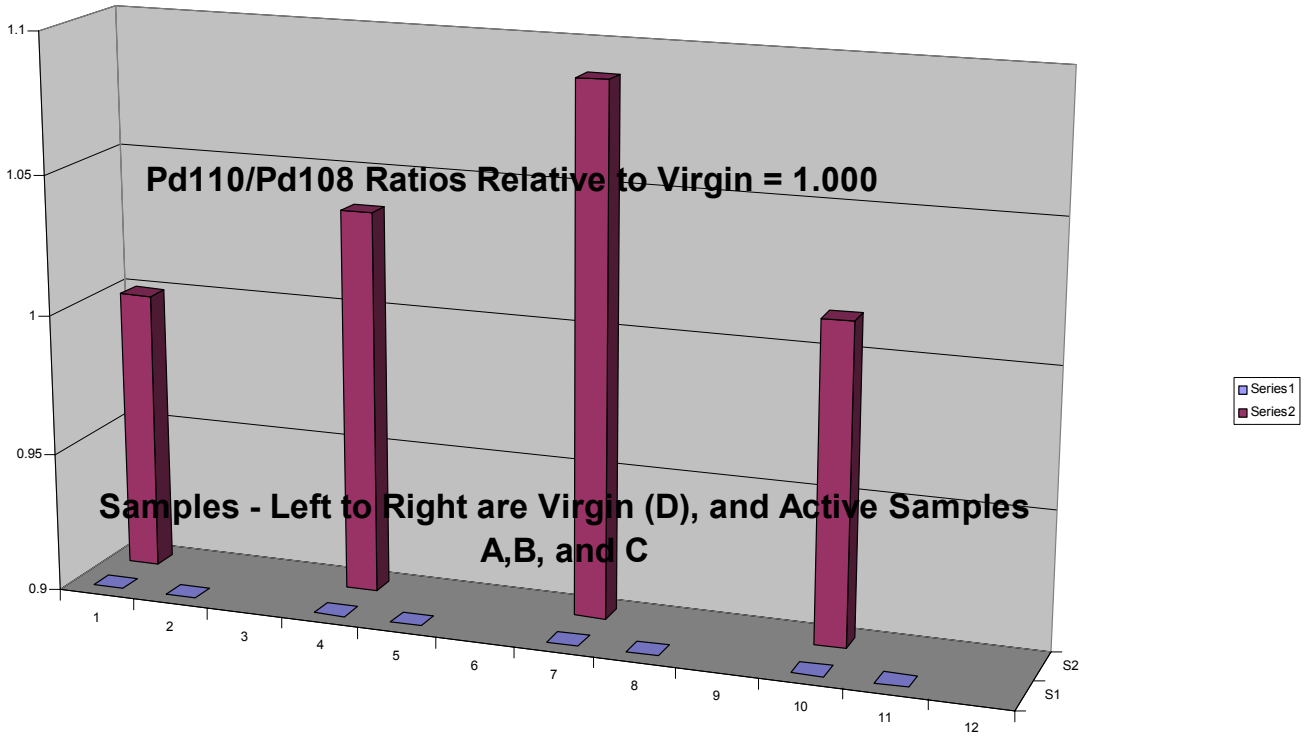
Sample Name	Ir191/Pd110 Atomic Ratio (X10^6)
Pd-D (Virgin)	2.26
Pd-A (Active)	17.8 A/D=7.88
Pd-B (Active)	0.84 B/D=0.37
Pd-C (Active)	1.5 C/D=0.66

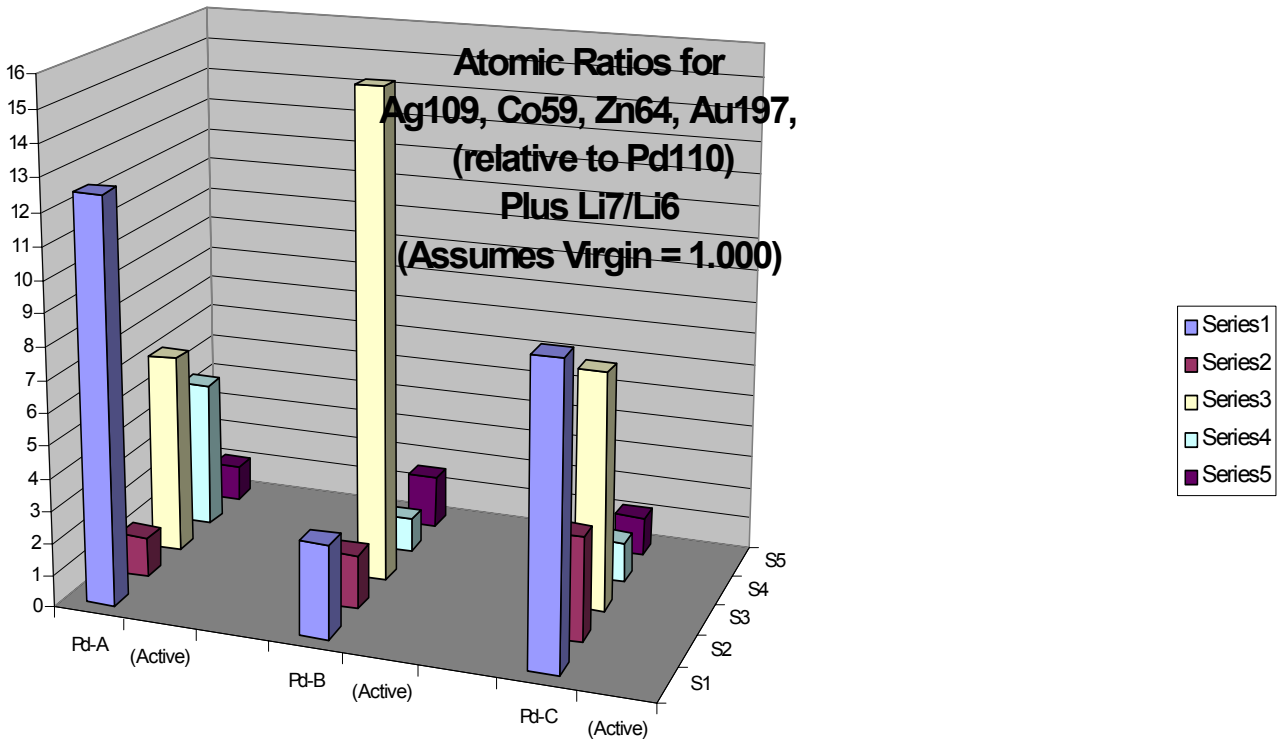
Slide 8


Pd-B First Count
Counts/Channel
100000
100
50
100
150
200
250
300
350
Gamma Energy - keV

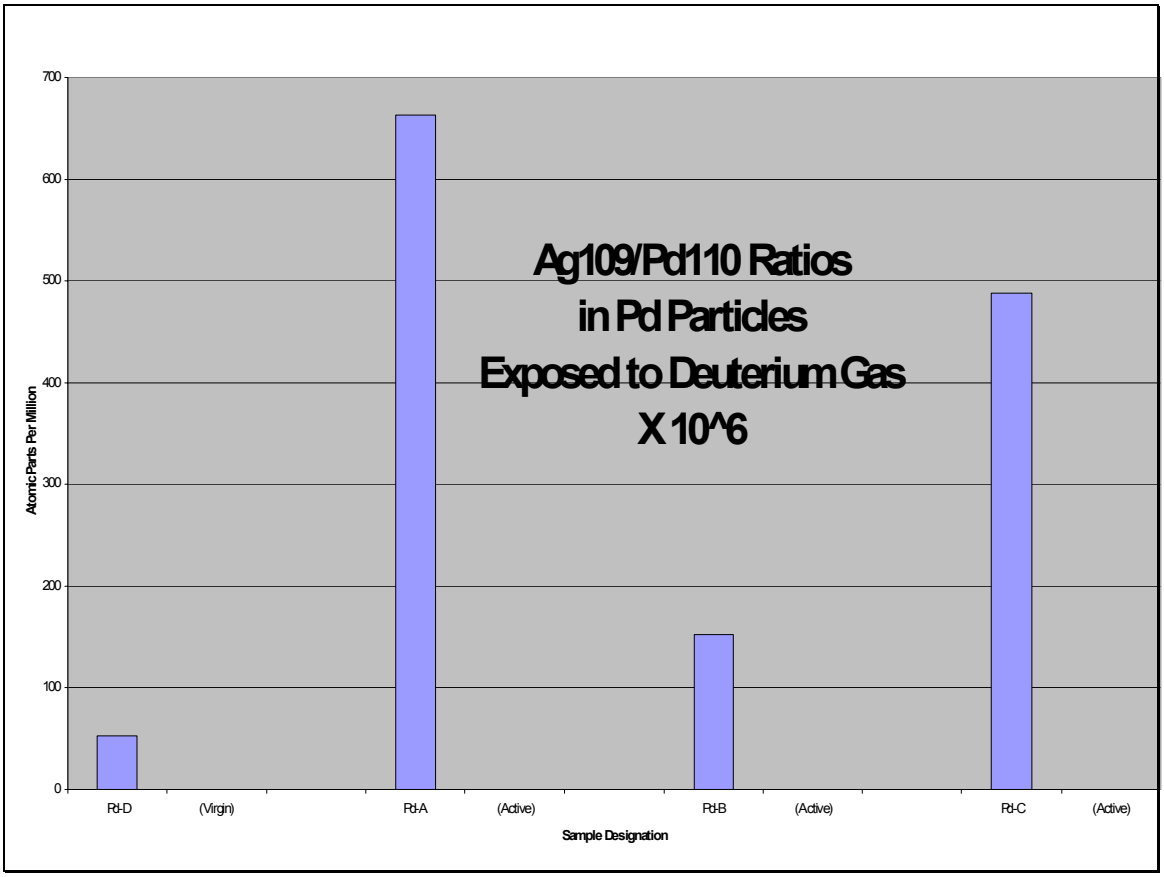
Slide 9


Pd110/Pd108 Ratios Relative to Virgin = 1.000
Samples - Left to Right are Virgin (D), and Active Samples A,B, and C
1.1
1.05
1
0.95
0.9
1
2
3
4
5
6
7
8
9
10
11
12
S2
S1
Series1
Series2

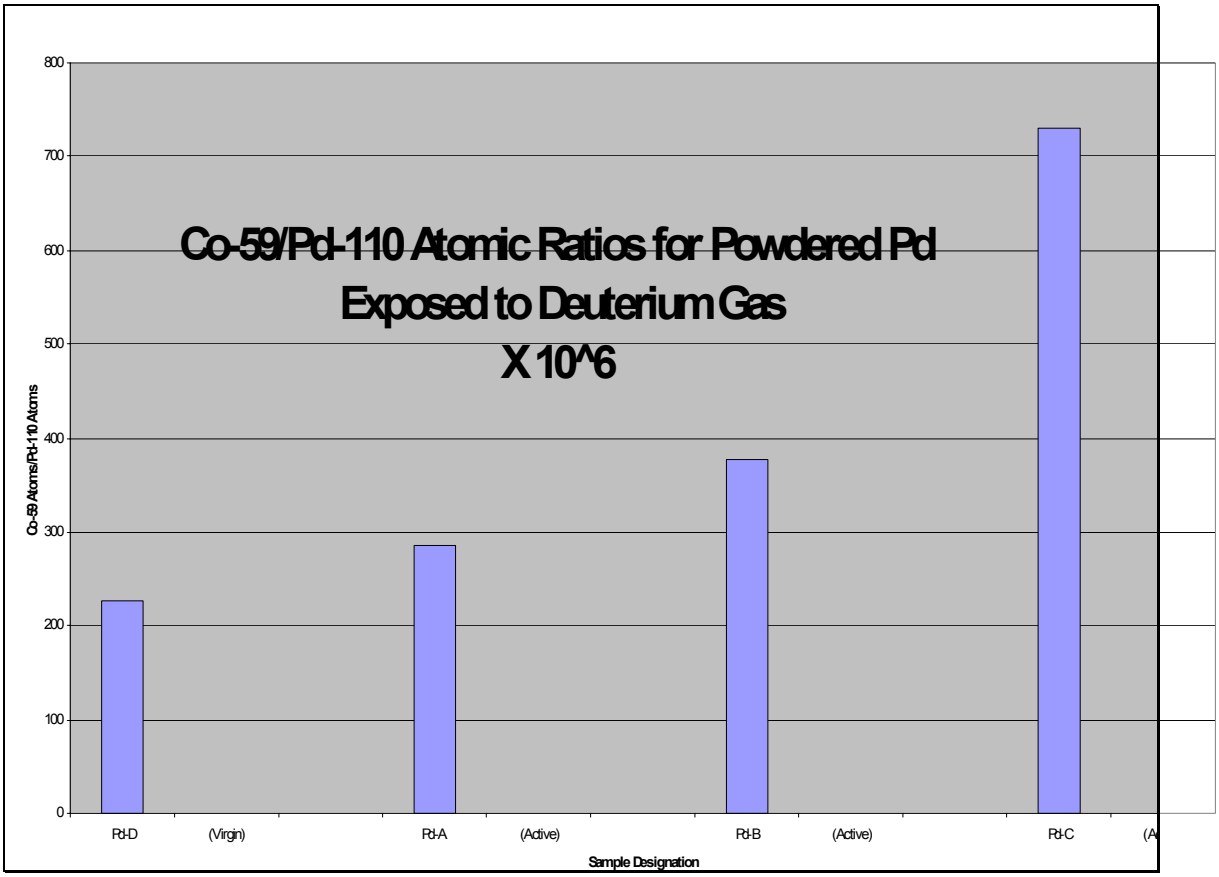
Slide 10


Atomic Ratios for
Ag109, Co59, Zn64, Au197,
(relative to Pd110)
Plus Li7/Li6
(Assumes Virgin = 1.000)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Pd-A
(Active)
Pd-B
(Active)
Pd-C
(Active)
S5
S4
S3
S2
S1
Series1
Series2
Series3
Series4
Series5

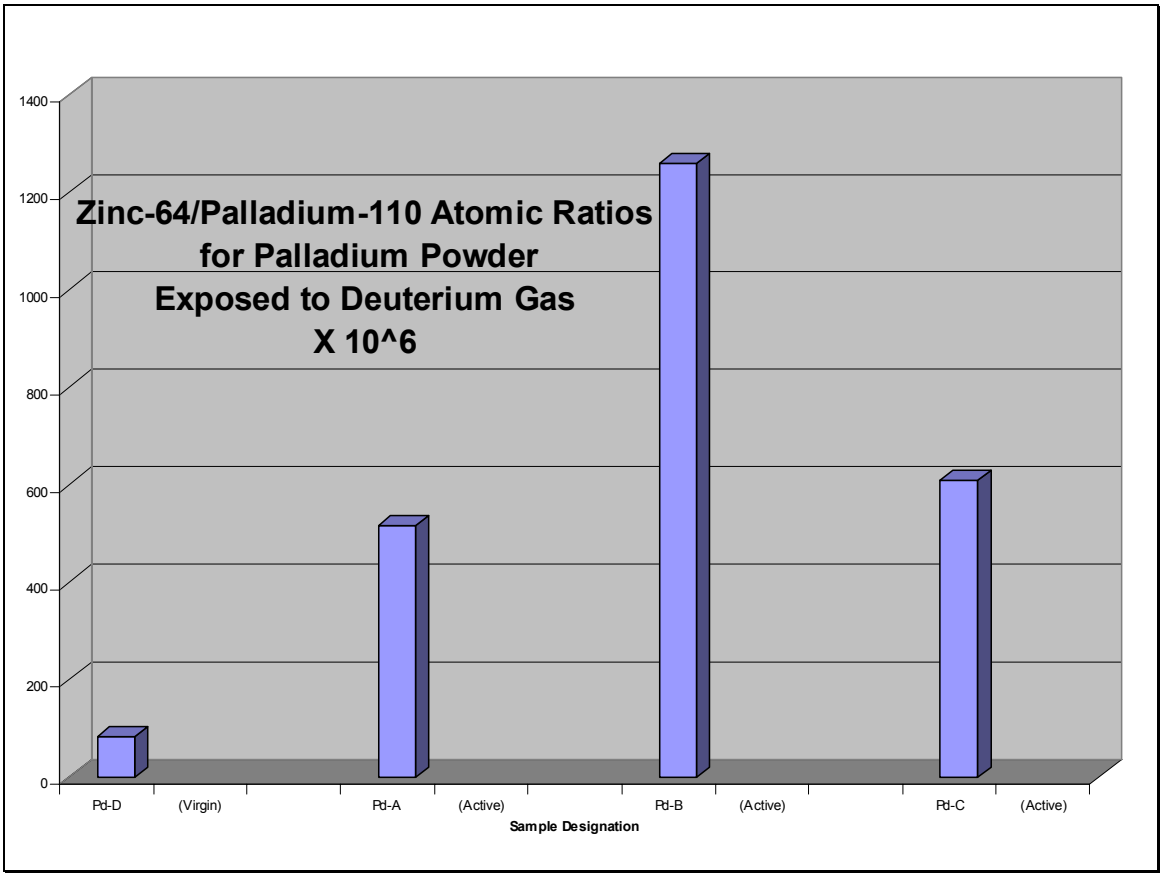
Slide 11


Ag109/Pd110 Ratios
in Pd Particles
Exposed to Deuterium Gas
X 10^6
Atomic Parts Per Million
700
600
500
400
300
200
100
0
Pd-D
(Virgin)
Pd-A
(Active)
Pd-B
(Active)
Pd-C
(Active)
Sample Designation

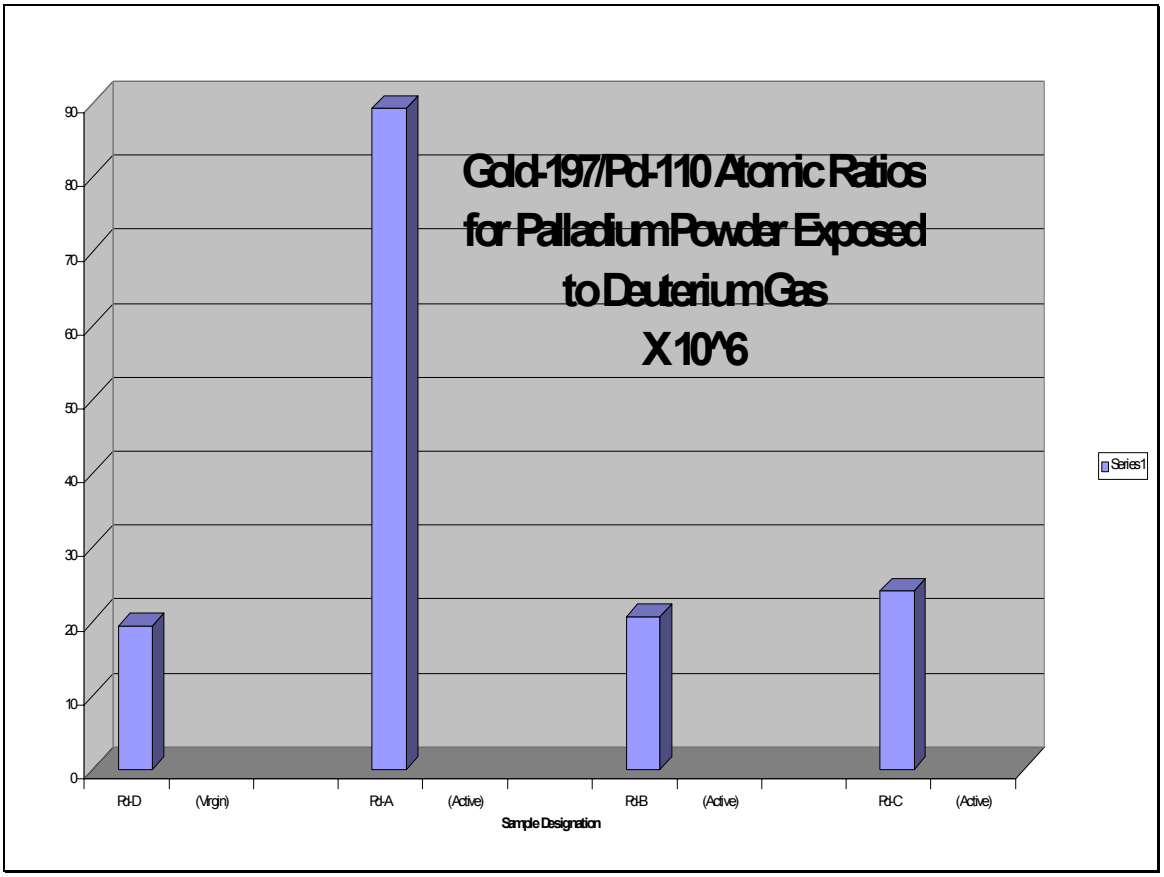
Slide 12


Co-59/Pd-110 Atomic Ratios for Powdered Pd
Exposed to Deuterium Gas
X 10^6
Co-59 Atoms/Pd-110 Atoms
800
700
600
500
400
300
200
100
0
Pd-D
(Virgin)
Pd-A
(Active)
Pd-B
(Active)
Pd-C
Sample Designation

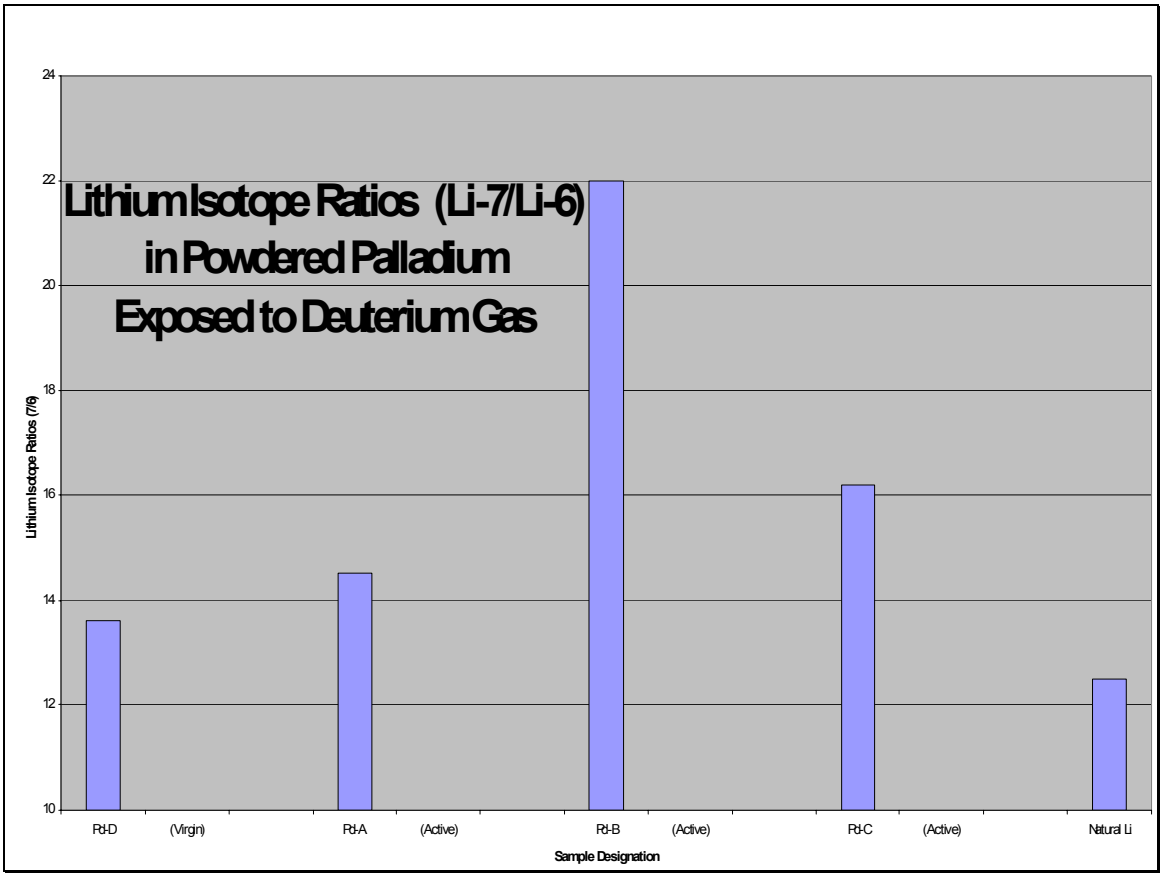
Slide 13


Zinc-64/Palladium-110 Atomic Ratios
for Palladium Powder
Exposed to Deuterium Gas
X 10^6
1400
1200
1000
800
600
400
200
0
Pd-D
(Virgin)
Pd-A
(Active)
Pd-B
(Active)
Pd-C
(Active)
Sample Designation

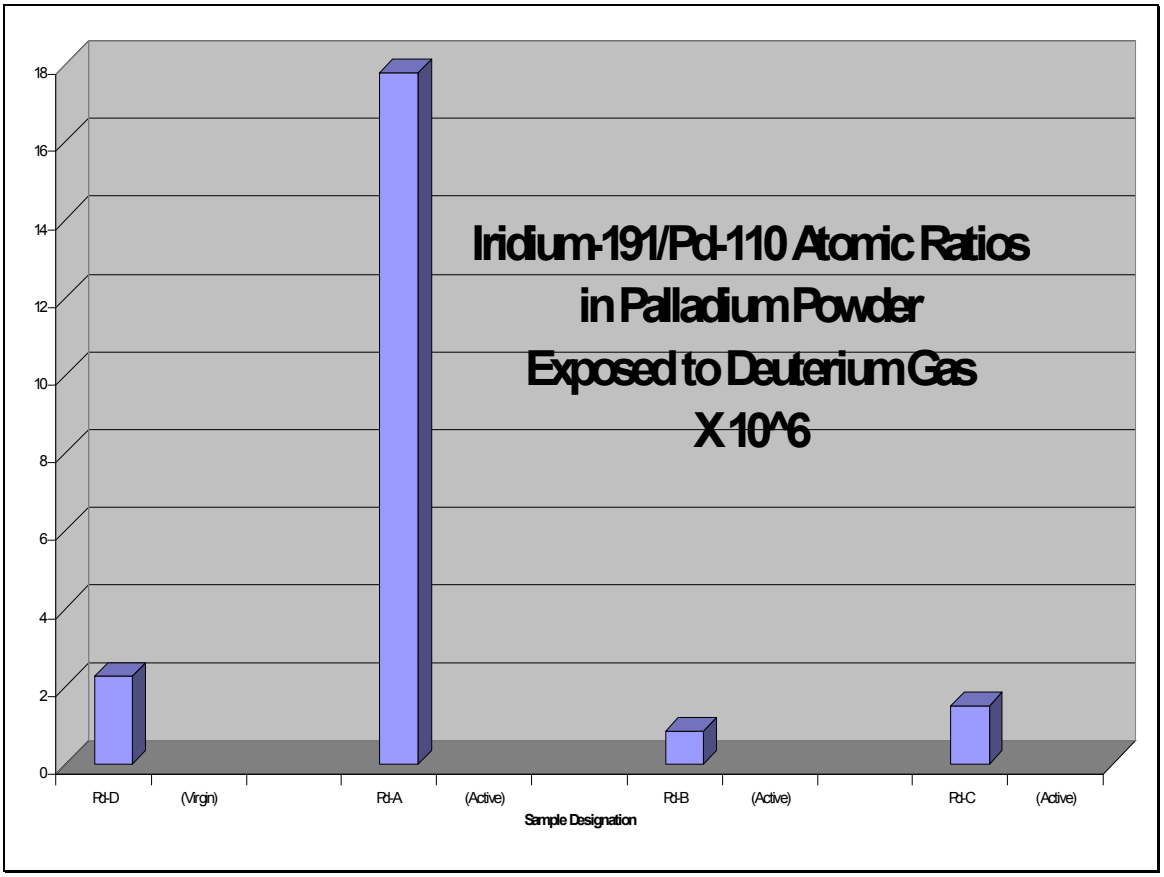
Slide 14


Gold-197/Pd-110 Atomic Ratios for Palladium Powder Exposed to Deuterium Gas X10^6
90
80
70
60
50
40
30
20
10
0
Rd-D
(Virgin)
Rd-A
(Active)
Rd-B
(Active)
Rd-C
(Active)
Sample Designation
Series1

Slide 15


Lithium Isotope Ratios (Li-7/Li-6) in Powdered Palladium Exposed to Deuterium Gas
Lithium Isotope Ratios (7/6)
24
22
20
18
16
14
12
10
Rd-D
(Virgin)
Rd-A
(Active)
Rd-B
(Active)
Rd-C
(Active)
Natural Li
Sample Designation

Slide 16


Iridium-191/Pd-110 Atomic Ratios
in Palladium Powder
Exposed to Deuterium Gas
X 10^6
18
16
14
12
10
8
6
4
2
0
Rd-D
(Virgin)
Rd-A
(Active)
Rd-B
(Active)
Rd-C
(Active)
Sample Designation

Conclusions

- Impurity Variations May be Random Fluctuations or Due to Changes from Closure of Hollow Cylindrical Chamber Containing the Powdered Palladium by Electron Beam Welding
- If Due to Some Nuclear Process, The Isotopic Ratios Should Differ From Terrestrial Values – For Elements with 2 or more Isotopes
- Lithium 7/6 Ratios Show Differences On Surface
- Silver 109/107 Being Measured For Pd-A and Pd-D by Accelerator Mass Spectroscopy (Immune From Multiple Atom Ion Confusion)

Conclusions (continued)

- Only Nuclear Sources for Producing Li-7 with Positive Q with Deuterons are
- Li-6(d,p)Li-7, (Q=+5.03 Mev)
- Be-9(d,Alpha)Li-7 (Q=+7.06 Mev)
- Silver, Cobalt and Zinc Could Come From Deuterons on Palladium –(d,n) or (d,fission)
- Gold Could Come From Deuterons on Impurity Platinum (Pt-196(d,n)Au-197 Q=3.44 Mev)
- Two Cases of Iridium Depletion could be Fission