茨城大学大学院理工学研究科
「原子科学と倫理」
2011年12月27日（火）
3時限13:00-14:30

# 核燃料サイクルの資源戦略

## *Resourceability on Nuclear Fuel Cycle*

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**JAPAN**

# Contents

## 1/ Advanced ORIENT Cycle

$^{235}U$ (n,νn) FP , Energy (7.8 x$10^7$KJ/$^{235}$Ug)

**Disposal**

**"Separation&Utilization,"**

1st Nuclear Rare Metal

Highly Radioactive

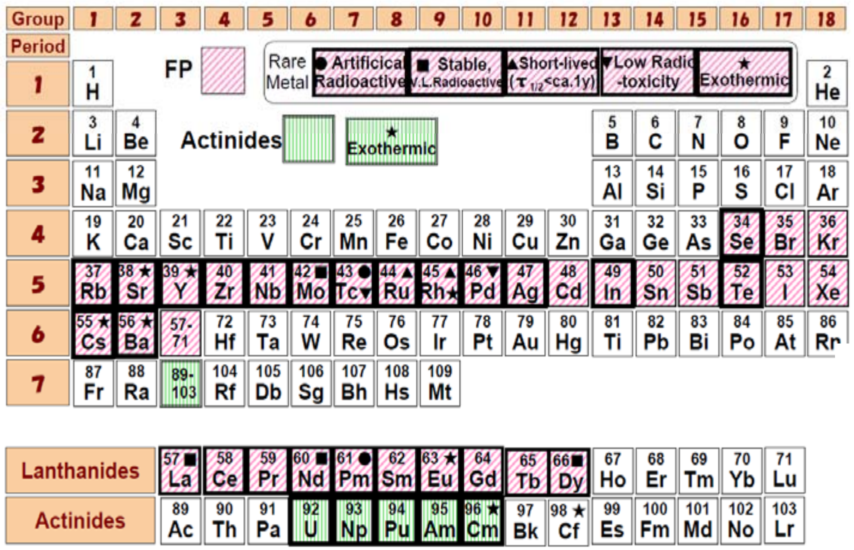
- The 389th Session of Xiangshan Science Conference（香山科學會議)； Radiochemistry of Nuclear Fuel Reprocessing
- 22-24, December 2011
- Beijing, China

*Nuclear Creation of Rare Metals*

Definition as Rare Metals in Japan ; 47 elements, including 17 rare earth

Definition as Nuclear Rare Metals (tentative) ;31 elements in >10g/t,

*e.g.*,excluding Noble gas, Halogen, Cd, Sn, Sb, Bk, Cf




## 2/ Après ORIENT

$$_{Z}FP^{A}\ (n,\gamma)\ _{Z}FP^{A+1} \rightarrow\ _{Z+1}FP^{A+1} + \beta^{-}$$

$K_{eff}$; Φ, σ

β⁻decay

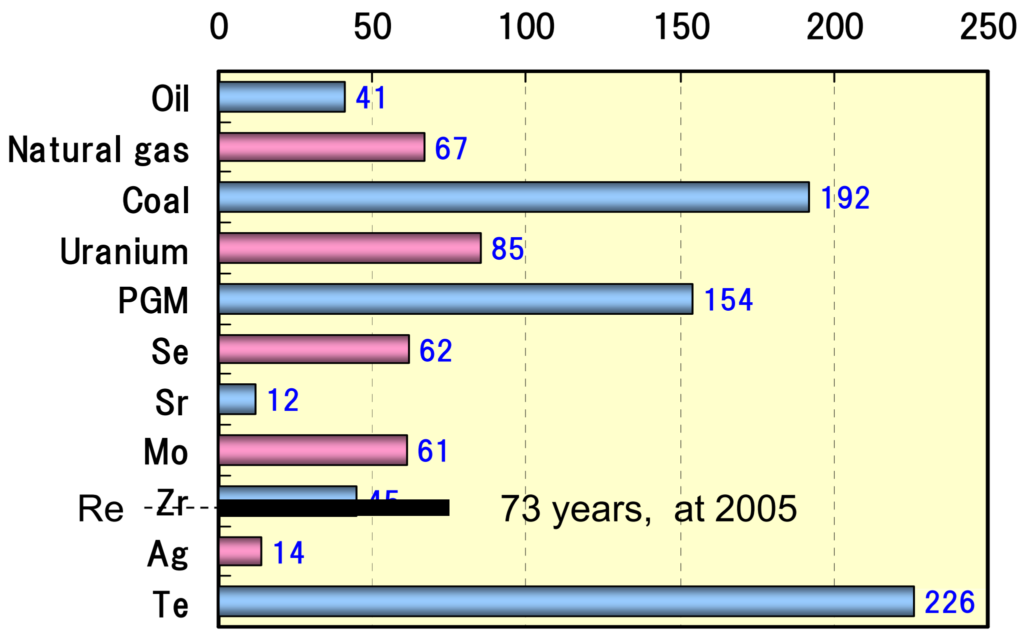
Stability

**"Creation&Utilization"**

2nd Nuclear Rare Metal

Valuable, Stable / Less-radioactive

# *Incentives; Energy and Rare Metals(Earth) for National Security*




**R/P Ratio (year) at 2004 on Estimated Available Time**

■Natural fossil fuels (Oil, Gas) and U are limited to <u>40-80 years</u>, and Coal is limited to around <u>200 years</u>.

■Worldwide $CO_2$ issue (waste of Oil !) is inevitable.

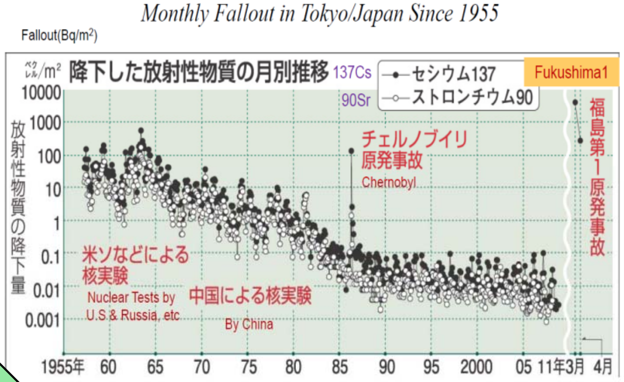
Following Wind

*Nuclear (FBR) Renaissance in Europe, USA, (Japan), etc*

Against Wind

*3.11 Catastrophe of Fukushima NPP in Japan*

*Monthly Fallout in Tokyo/Japan Since 1955*




■<u>PGM</u> (<u>ca.</u>200y) and Rare Earth (RE) <u>(>850y)</u> seems to be rather abundant however, they are extremely localized . Namely, ca.90% of RE were from China (Japanese case), and about 1% of national GDP will drop, if <u>ca.</u>20% of those supply decreased.

南巡講話・鄧小平1992.1 ”中東有石油、中国有稀土”
Rare Metal (Earth) strategy will dominate the national security at every countries, as the same as Energy.

Following Wind

*Urban Mine, <u>Nuclear Ore</u>*

# 放射性廃棄物から白金族（Ru,Rh,Pd）、レアアースの回収 (原子力鉱山）

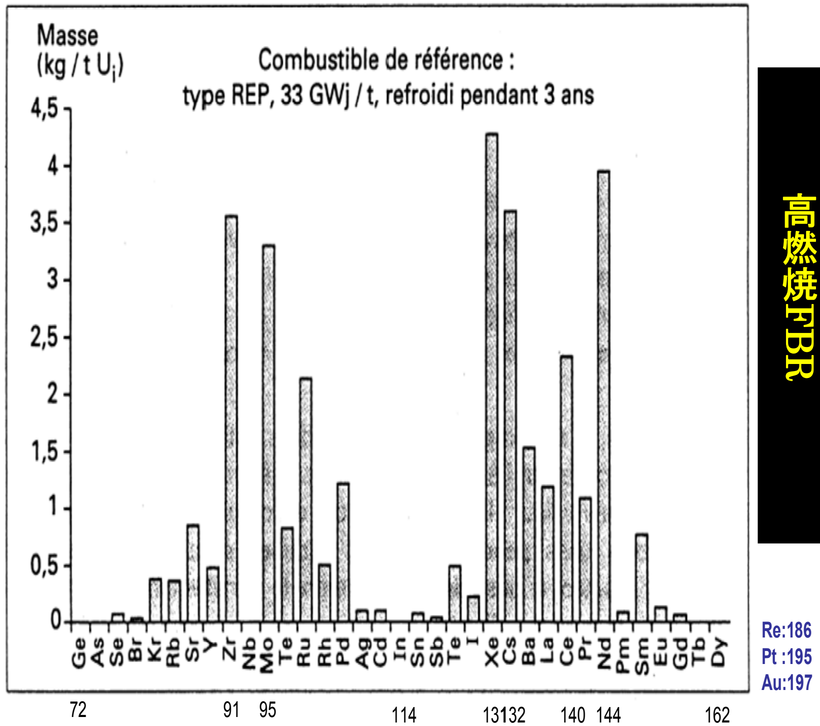


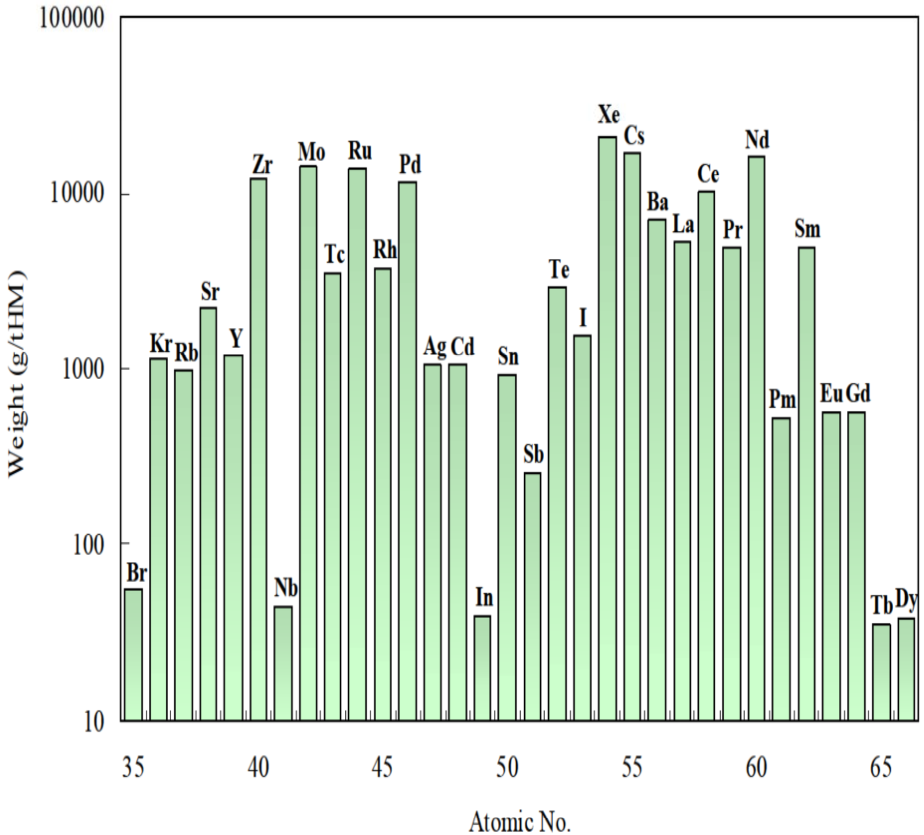

**Figure — Masse des éléments chimiques constituant les produits de fission**

Mass of FP elements in irradiated fuel

(M.Bourgeois, Retraitement du combustible, 1994)

高燃焼FBR

FBR MOX, Inner core, 150GWd/t, cooled 5 years




軽水炉燃料再処理工場800ｔ/y, 回収率80 %とすると

原子力レアメタルの生産量; Tc: 0.64t, PGM: 2.56t, Lns: 6.4t, Mo:1.92t, 他

# *Natural Ore vs. Nuclear Ore(Spent Fuel)*

## *Yield & Quality, Site*

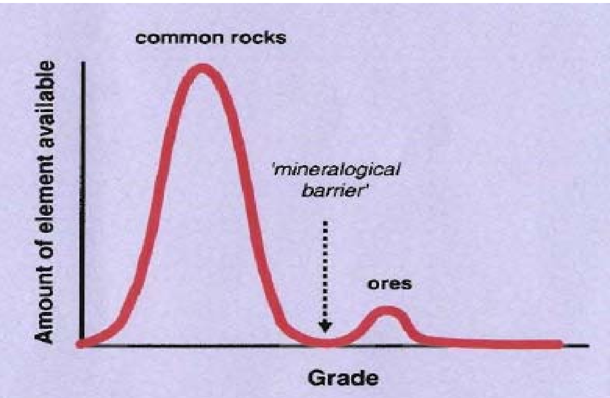



*Figure 2:* Distribution of geochemically scarce metals in the earth crust (Skinner, 1976)

## *Ore Vein, Dressing*

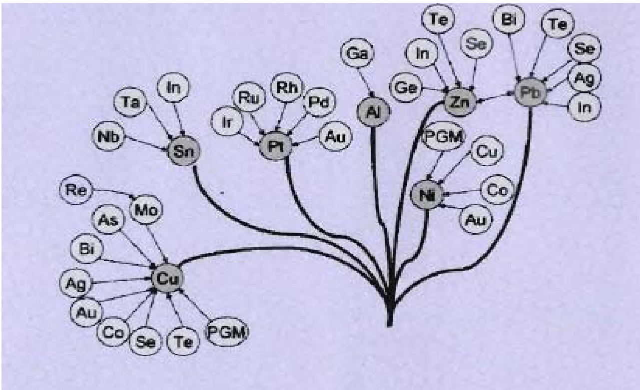



*Figure 3:* Coupling of major and minor metals (Hagelüken and Meskers, 2009)

P.Wager, et al., Sustainable Governance of Scarce Metals, R'09 Twin World Congress (2009).

## *Production Efficiency ; $CO_2$ Emission/kg*

***Table 1:*** *Specific greenhouse gas emissions and aggregated environmental impacts of primary metals production (source: ecoinvent 2.0)*

| | Greenhouse gas emissions [kg CO2-Eq / kg] | Environmental impacts [EcoIndicator'99 - points / kg] |
|---|---|---|
| **Major (base) metals** | | |
| Aluminum (from plant) | 12 | 0.78 |
| Lead (at regional storage) | 1.1 | 0.16 |
| Zinc (at regional storage) | 3.4 | 0.90 |
| **Minor (scarce) metals** | | |
| Gallium (at regional storage) | 190 | 11 |
| Gold (at regional storage) | 13'000 | 1'600 |
| Indium (at regional storage) | 160 | 33 |
| Neodymium (neodymium oxide, at regional storage) | 34 | 3.2 |
| Palladium (at regional storage) | 9'900 | 9'800 |
| Tantalum (at regional storage) | 280 | 20 |

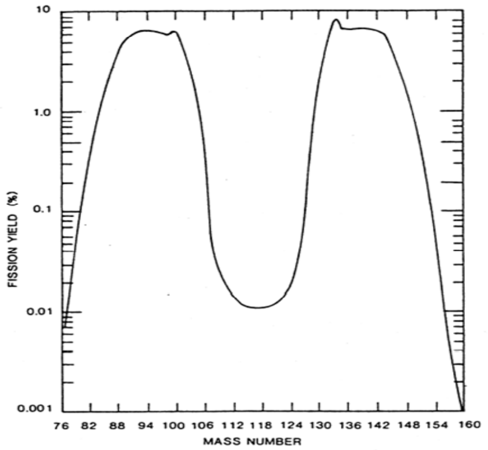
Geological, Geopolitical

NPP, Reprocessing Scheme

Technological Factor

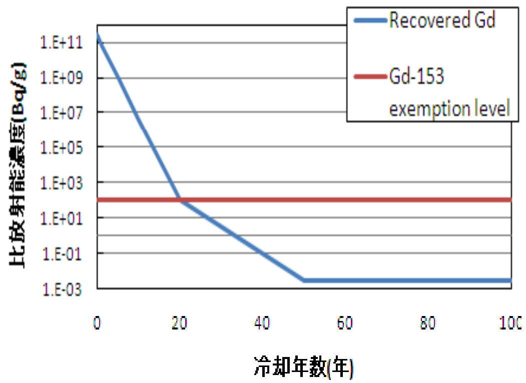
Efficiency & Environmental

Radiological




Mass yield curve for the fission of $^{235}U$ with thermal neutrons. (Drawn from data in Choppin, G. R. and Rydberg, J., *Nuclear Chemistry*, Pergamon Press, London, 1980, 165.)

| Metal | Contents (ppm) | LWR | | FBR | | Remark |
|---|---|---|---|---|---|---|
| | | Conc.(ppm) | Ratio (-) | Conc.(ppm) | Ratio (-) | |
| Se | (12~92) | 50~98 | 1.4 | 140 | 7.1 | Estimated from Cu ore in Russia UGMK (2004) |
| Mo | 140 | 4,021~6,059 | 36 | 8,966 | 84 | Results of Erdenet mine in Mongolia |
| Rh | (0.4~0.6) | 578~949 | 1,527 | 2,543 | 6,652 | Estimate from PGM production results in main mine |
| Pd | 2.4~7.4 | 1,900~4,150 | 617 | 6,988 | 1,426 | Results of North American palladium Ltd in Canada |
| Ag | 46~201 | 102~251 | 1.4 | 715 | 5.8 | Results of Galmony mine in Ireland and Dikulushi mine in Congo |
| Te | (3.6~29) | 634~842 | 45 | 1,840 | 113 | Estimated from Cu ore in Russia UGMK (2004) |




**Time Dependency of Bq/g on Nuclear Rare Metals**

# *Value of Synthesized HLLW*

ca.1975$(148,100¥) / L (HCl-HLLW)

ca.5700$(426, 520¥) / L ($HNO_3$-HLLW)

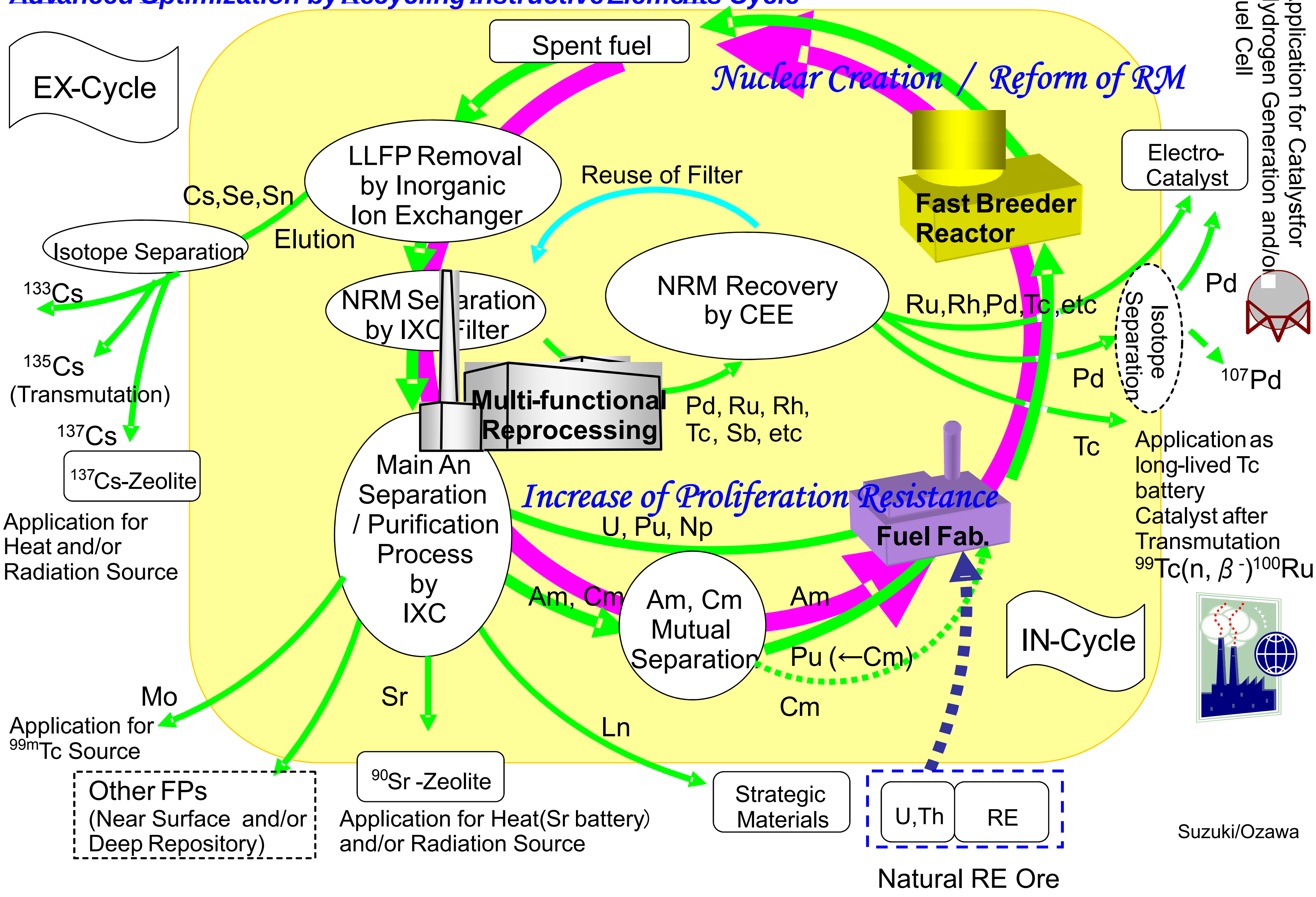
| No. | Element | Conc. (g/L) | Chemical Formula | Grade | ¥/g | $/g |
|---|---|---|---|---|---|---|
| 1 | Fe | 4.340 | $FeCl_2 \cdot 4H_2O$ | 特級 | 6.6 | |
| 2 | Cr | 0.205 | $CrCl_3 \cdot 6H_2O$ | 鹿特級 ＞93.0% | 29 | |
| 3 | Ni | 0.550 | $NiCl_2 \cdot 6H_2O$ | 特級 ＞98% | 68 | |
| 4 | Rb | 0.311 | RbCl | ＞95% | 940 | |
| 5 | Cs | 2.140 | CsCl | ＞98% | 132 | |
| 6 | Sr | 0.769 | $SrCl_2 \cdot 6H_2O$ | 特級 ＞99% | 68 | |
| 7 | Ba | 1.340 | $BaCl_2 \cdot 2H_2O$ | 特級 ＞99% | 56 | 0.7 |
| 8 | Zr | 3.290 | $ZrCl_4$ | ＞99.5% | 820 | |
| 9 | Mo | 2.940 | $MoCl_3$ | 99.5% | 4,950 | 66 |
| 10 | Re | 0.876 | $HReO_4$ | 76.5%水溶液 | 3,400 | 45 |
| 11 | Ru | 1.710 | $RuCl_3 \cdot 3H_2O$ | ＞99.9% | 3,500 | 47 |
| 12 | Rh | 0.349 | $RhCl_3 \cdot 3H_2O$ | – | 35,000 | 467 |
| 13 | Pd | 0.921 | $PdCl_2$ | 特級 | 3,120 | 42 |
| 14 | Ag | 0.037 | AgCl | 99.50% | 980 | 13 |
| 15 | Cd | 0.052 | $CdCl_2 \cdot 2.5H_2O$ | 鹿特級 | 76 | 1 |
| 16 | Sn | 0.039 | $SnCl_2 \cdot 2H_2O$ | 特級 ＞97.0% | 56 | |
| 17 | Se | 0.043 | $Se_2Cl_2$ | — | 2,040 | |
| 18 | Te | 0.456 | $TeO_2$ | ＞99.0% | 140 | |
| 19 | Y | 0.433 | $YCl_3 \cdot 6H_2O$ | 99.99% | 260 | 3.5 |
| 20 | La | 1.100 | $LaCl_3 \cdot 7H_2O$ | ＞95% | 72 | 1 |
| 21 | Ce | 2.110 | $CeCl_3 \cdot 7H_2O$ | ＞99% | 116 | 1.5 |
| 22 | Pr | 1.050 | $PrCl_3 \cdot 7H_2O$ | ＞99.95% | 340 | 5 |
| 23 | Nd | 3.610 | $NdCl_3 \cdot 6H_2O$ | ＞99.95% | 380 | 5 |
| 24 | Sm | 0.767 | $SmCl_3 \cdot 6H_2O$ | ＞99.95% | 280 | 3.7 |
| 25 | Eu | 0.121 | $EuCl_3 \cdot 6H_2O$ | ＞99.95% | 2,200 | 29 |
| 26 | Gd | 0.061 | $GdCl_3 \cdot 6H_2O$ | 99.9% | 2,200 | 29 |
| 27 | HCl | 2M | HCl | 特級35.0-37.0% | 1.7 | |
| Ref | Au | | | | 4,683 | 62 |
| | Tc | | | | | ca.100 |

2nd Transition Elements (4*d*): rows 8–15

3rd Transition Elements(4*f*): rows 19–26

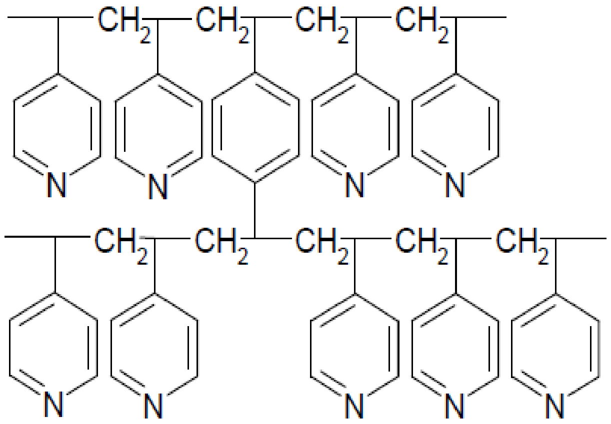
# *Adv.-ORIENT Cycle Since 2006*

***Advanced Optimization by Recycling Instructive Elements Cycle***

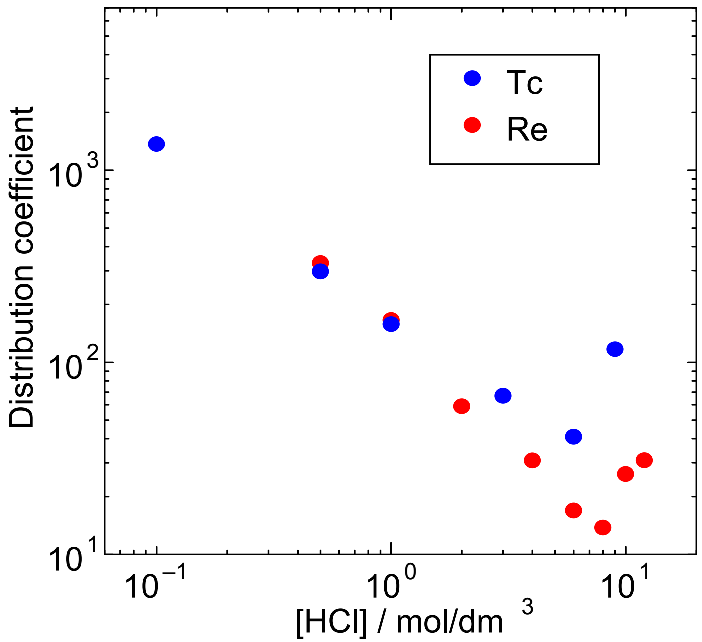


# イオン交換クロマト分離法（IXC）及び 溶媒抽出法（SX）

## Tertiary Pyridine Resin (TPR)

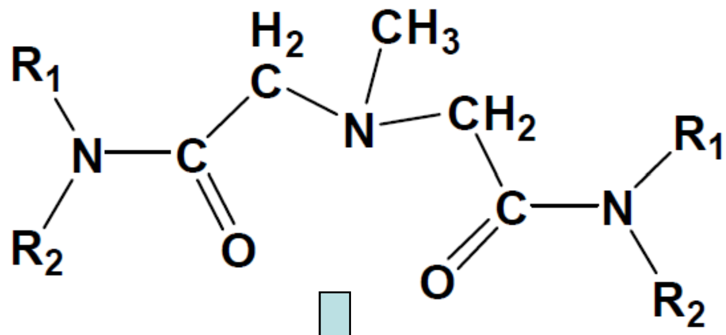


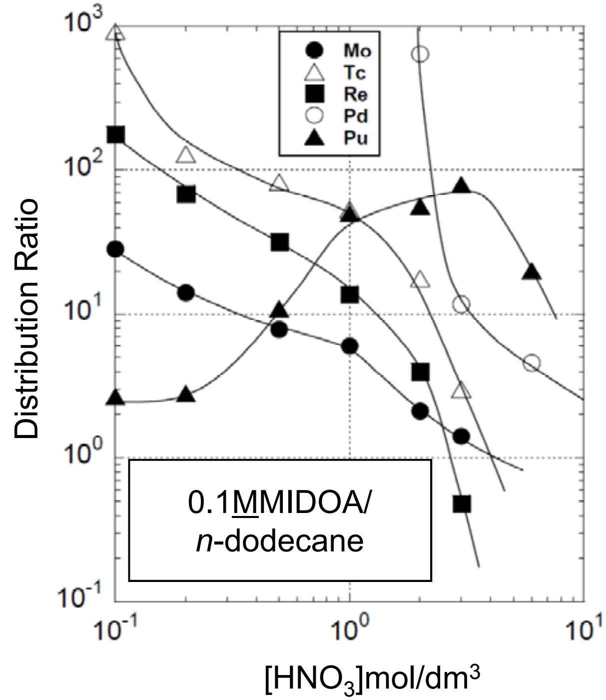

High Porous Silica Carrier φ60μm



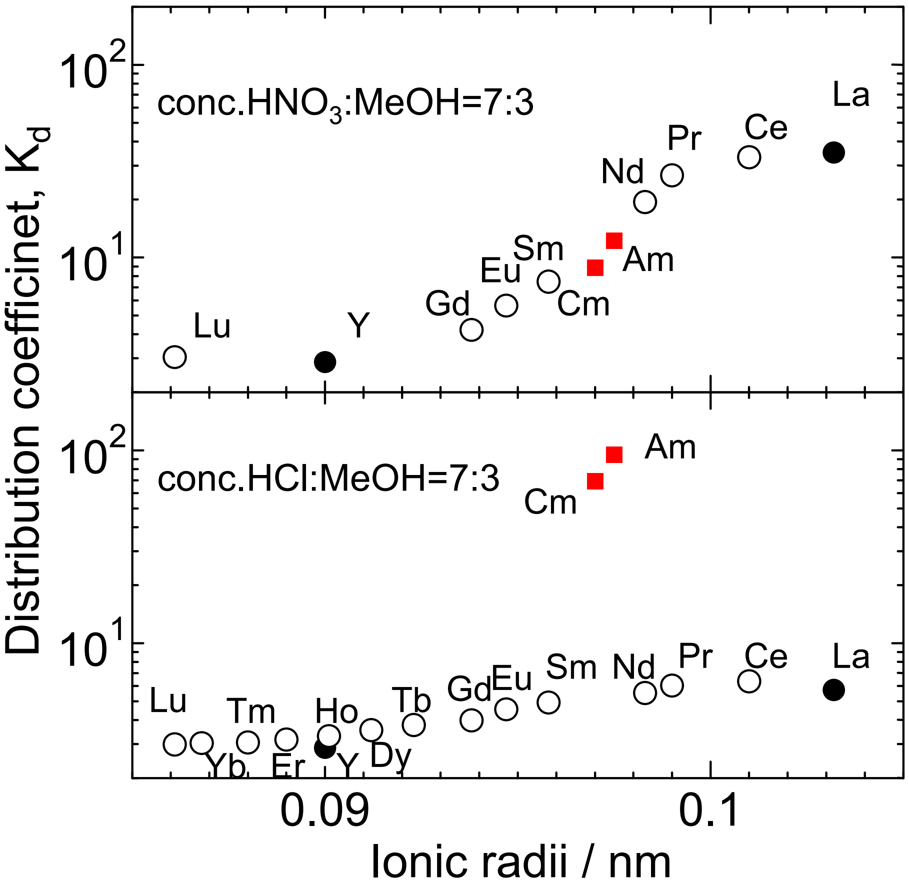

## MIDOA

(Y. Sasaki, et.al., *Chem. Lett.* **36**, 1394 (2007).



# 3級ピリジン樹脂の*f*-元素の分配特性



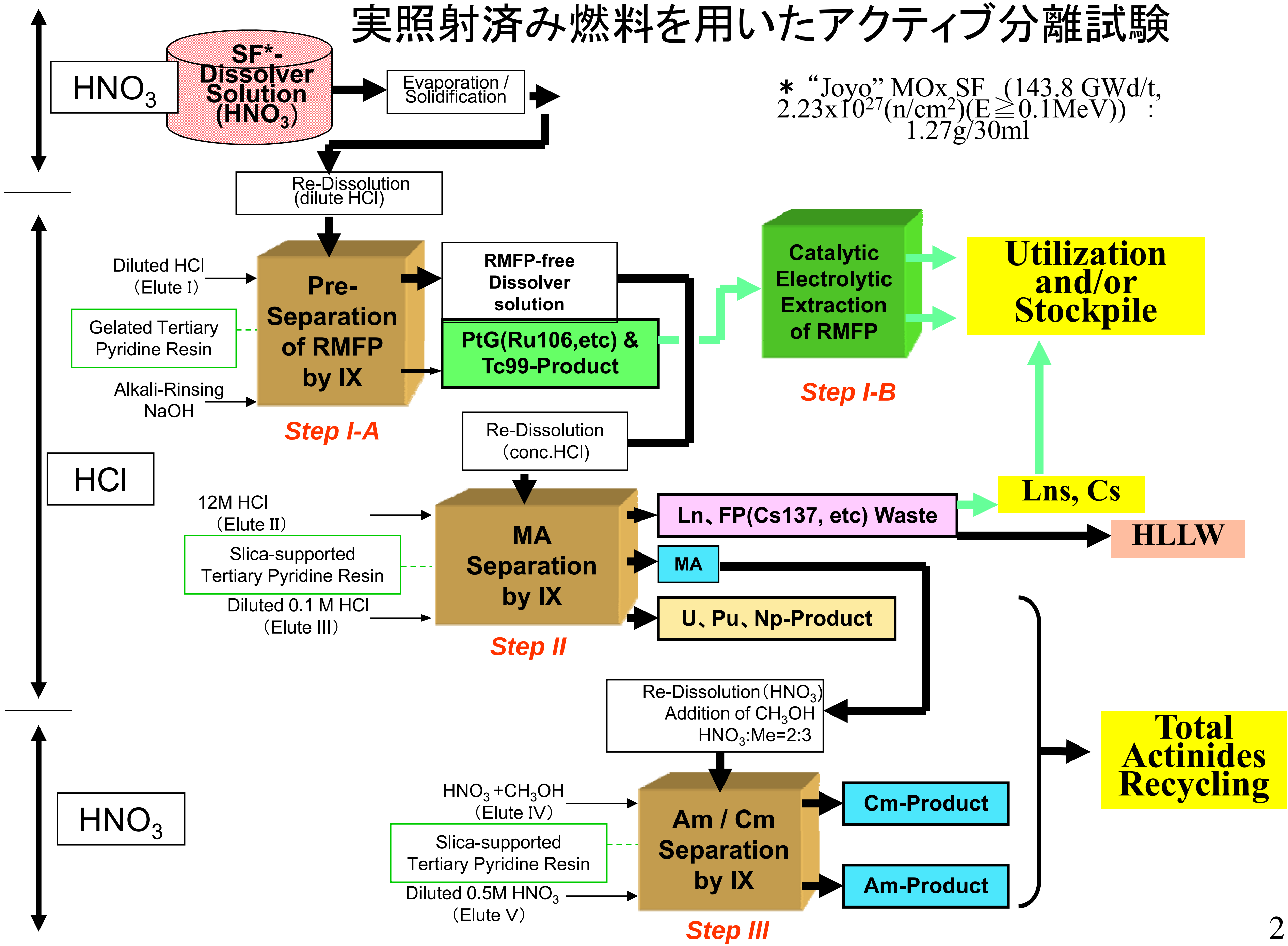

Separability
$HNO_3$ vs. HCl
media

・$HNO_3$ 中では, 分離係数 は イオン半径のみに依存する。

・HCl 中では, 分離係数は、イオン半径ではなく、むしろ 4*f* / 5*f* 元素のソフト性の差異に依存する。

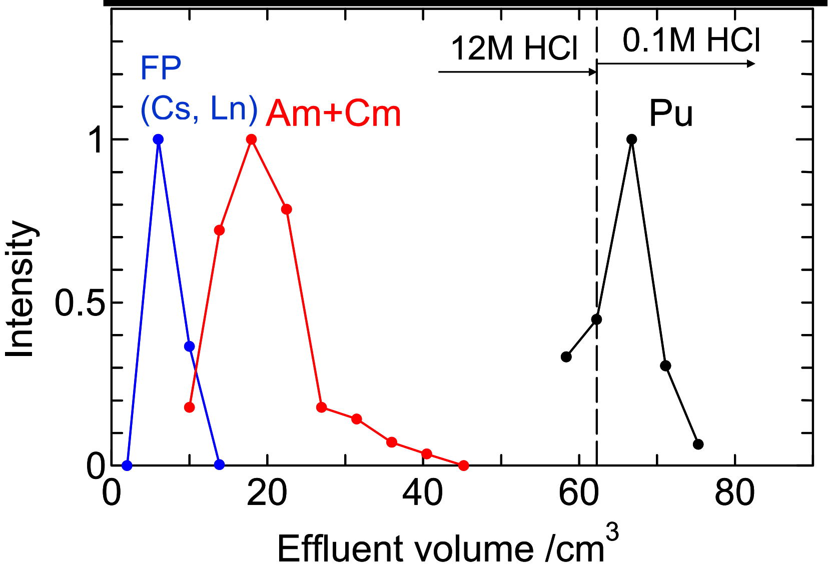
# 実照射済み燃料を用いたアクティブ分離試験

＊ "Joyo" MOx SF (143.8 GWd/t, 2.23x10[27](n/cm[2])(E≧0.1MeV)) : 1.27g/30ml

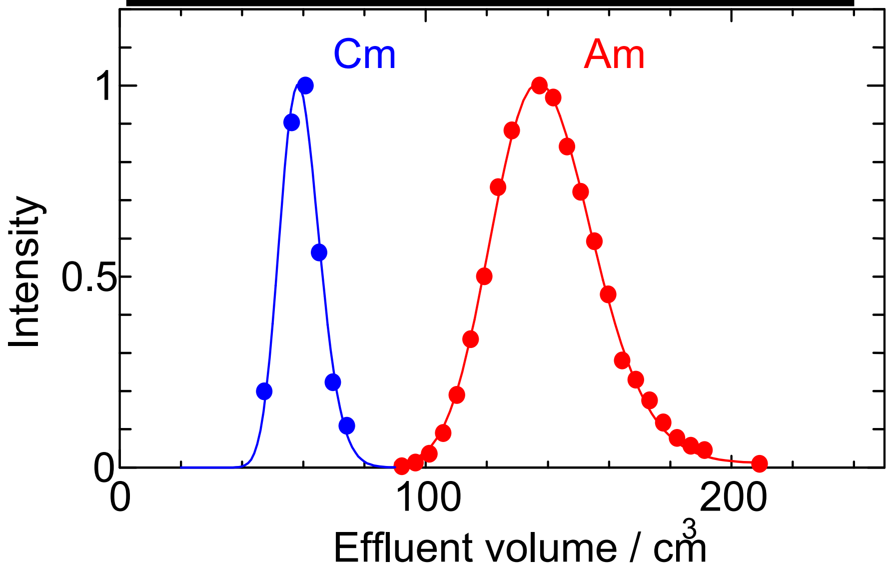


# アクティブ試験結果

**Inter Group (4*f*/5*f*) Separation**



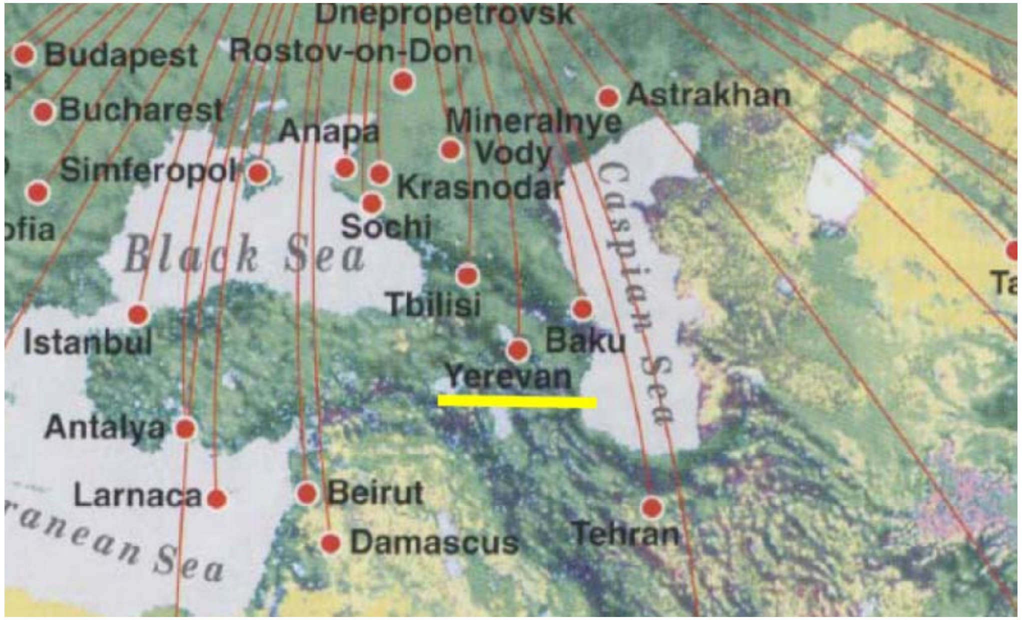

**Intra Group (5*f*) Separation**




- **Perfect Removal of $^{106}$Ru and $^{125}$Sb**
- **Recovery Rate of $^{241}$Am Product ･･･ possibly more than 99.9%**
  - **･>95% ( for *StepII* + *StepIII* )**
- **DF for $^{241}$Am Product（<u>MA/Ln Sptn.</u>） ･･･ far more than 1～2 x $10^3$**
  - **･DF$^{155}$Eu > 1.0 x $10^5$**
- **SF of $^{243}$Cm for $^{241}$Am Product (Am/Cm Sptn.)**
  - **･SF$_{Cm/Am}$ > 2.2 x $10^3$**
- **Purity of $^{241}$Am Product (Cm/Am) ･･･ far less than 1%** ( Ln / MA$_{product}$ <5%$_{mass}$, CEA )
  - **･Ln($^{144}$Ce+$^{155}$Eu) / $^{241}$Am < 0.3 ppm**
  - **･$^{243}$Cm / $^{241}$Am < 1 ppm**
  - **･γFP($^{106}$Ru+$^{125}$Sb+$^{137}$Cs) / $^{241}$Am < 1.8 ppm**
- **Purity of $^{243}$Cm Product (Am/Cm) ･･･ possibly less than 1%**
  - **･$^{241}$Am/$^{243}$Cm = 7.8 x $10^3$ ppm**

# アルカリ金属(Rb, Cs)の同位体分離研究

ISTC Collaboration with IP, Armenian Academy of Science (2002-2004)





**Laser-chemical Isotope ($^{85}$Rb) Separation - Mechanism**

$$^{85}Rb + h\nu\ (780nm) \rightarrow {}^{85}Rb^*\ (5^2P_{3/2})$$

$$^{85}Rb^* + H_2 \rightarrow {}^{85}Rb + H_2^*$$

$$^{85}Rb^* + H_2^* \rightarrow {}^{85}RbH + H$$

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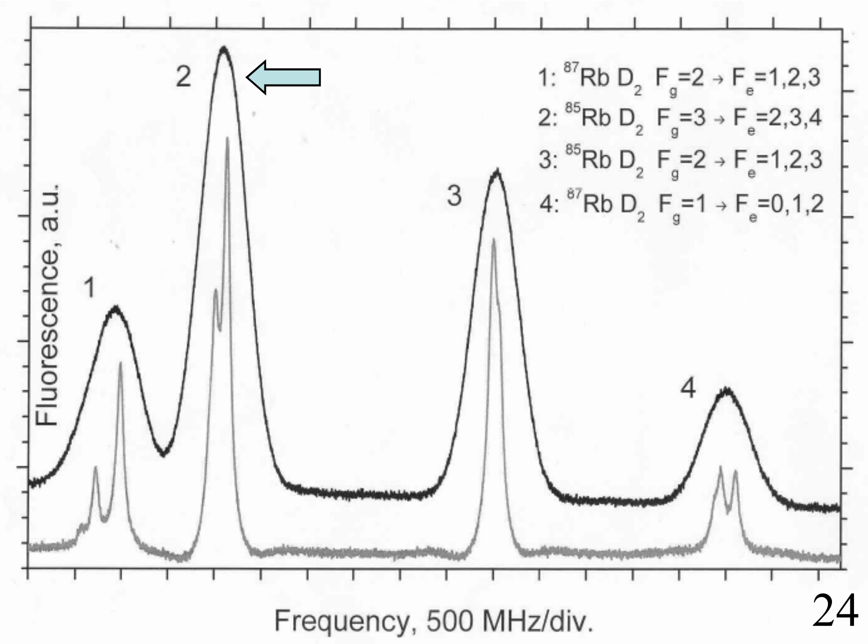
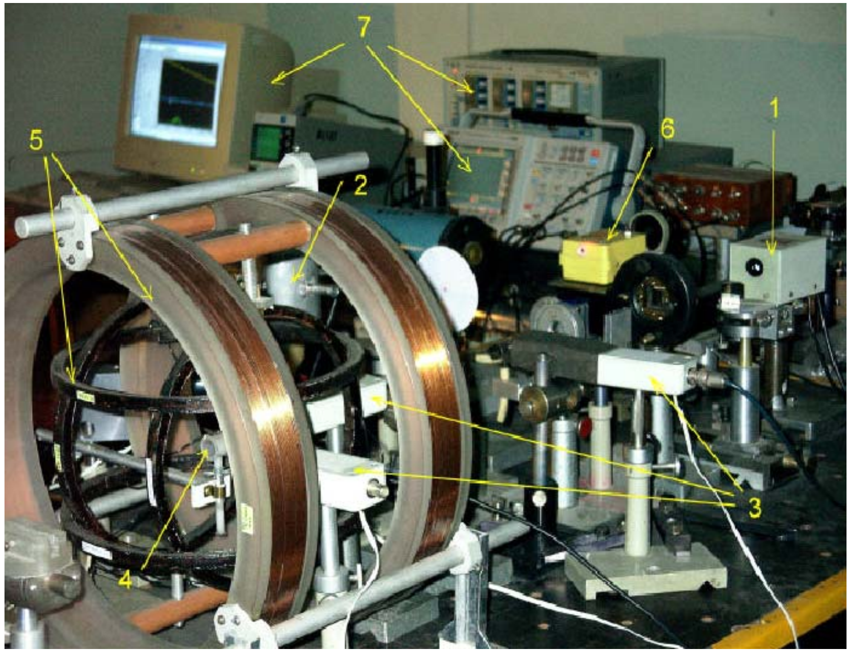
$$2\,^{85}Rb^* + H_2 \rightarrow {}^{85}Rb + {}^{85}RbH + H$$



# レーザー化学法 (LCIS) によるアルカリ金属の同位体分離

| Item | Figure |
|---|---|
| Rb vapor density | $5\times10^{14}$atom/$cm^3$ |
| $H_2$ density (converted into pressure) | 5Torr |
| Cell temperature | 220～240℃ |
| Laser power, Irradiation time | 50mW, 30min～2.5hour |
| $^{85}$Rb ratio | 72% (Before exp.) 98.4% (After two exps.) |
| $^{87}$Rb ratio | 28% (Before exp.) 1.6% (After two exps.) |

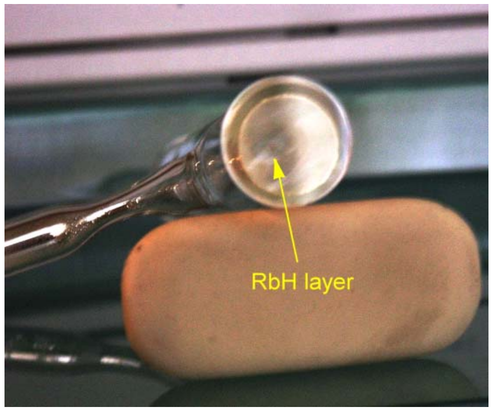



Desk-top LCIS Equipments

1；波長可変ダイオードレーザー、2；Rb(Cs)セル、3：発光ダイオード、5；交互直交ヘルムフォルツコイル

$$\frac{Y/(1-Y)}{X/(1-X)}$$

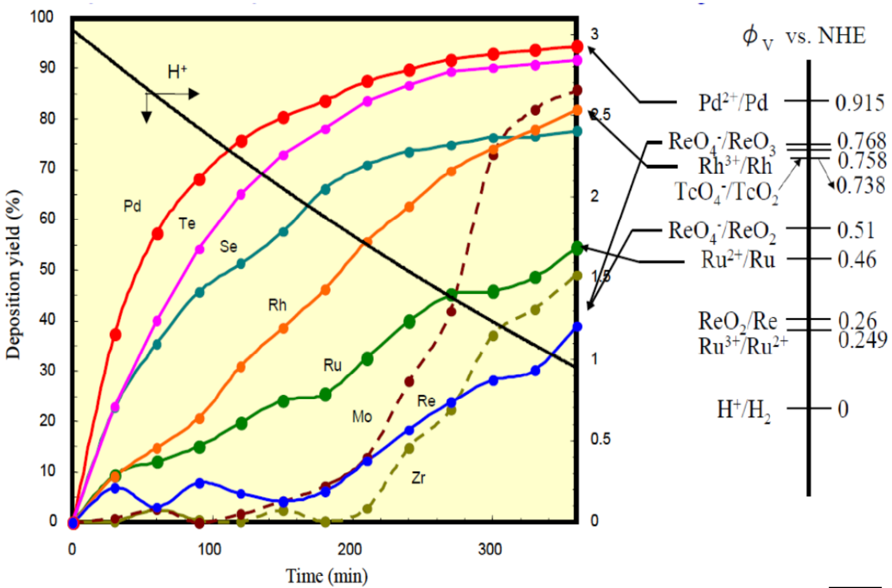
⇨ Head Separation Factor was 2.99 (1st), and 23.9 (2nd)



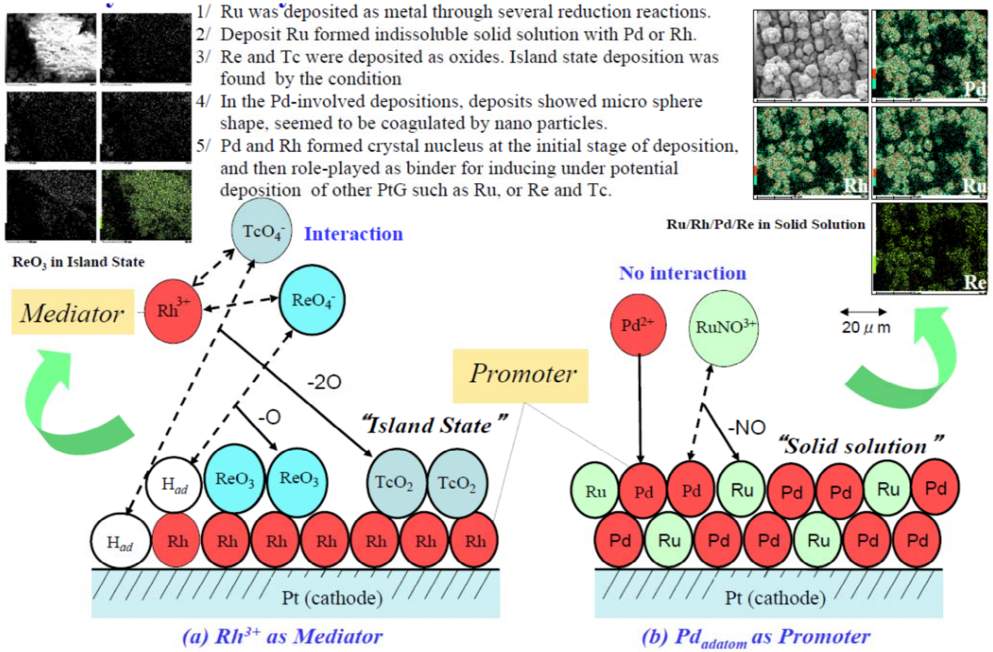

$^{85}$RbH Deposits at the Cell Window

# 触媒的電解採取法によるレアメタルの分離 *UPD-enhanced CEE*

## ●Basis of *CEE* (Catalytic Electrolytic Extraction) utilizing UPD (Under Potential Deposition)



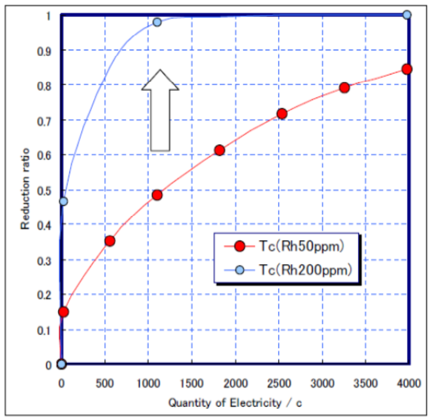

**Separation of RMFP from Simulated HLLW**

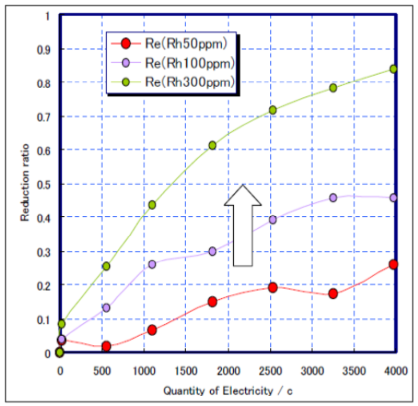



## ●Extension of *CEE* in HCl Media

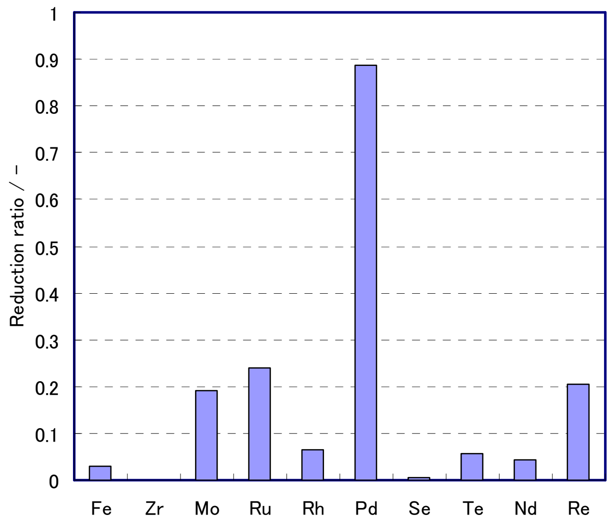
CEE Conditions

- Electrodes; Smooth Pt , Cathode (2cm²) , Anode (8cm²) , Ag/AgCl
- Catholyte; 0.5MHCl
- 50 ℃
- Ic; 2.5mA/cm² (1hr) → 75mA/cm² (2hr) → 100 mA/cm² (4hr)

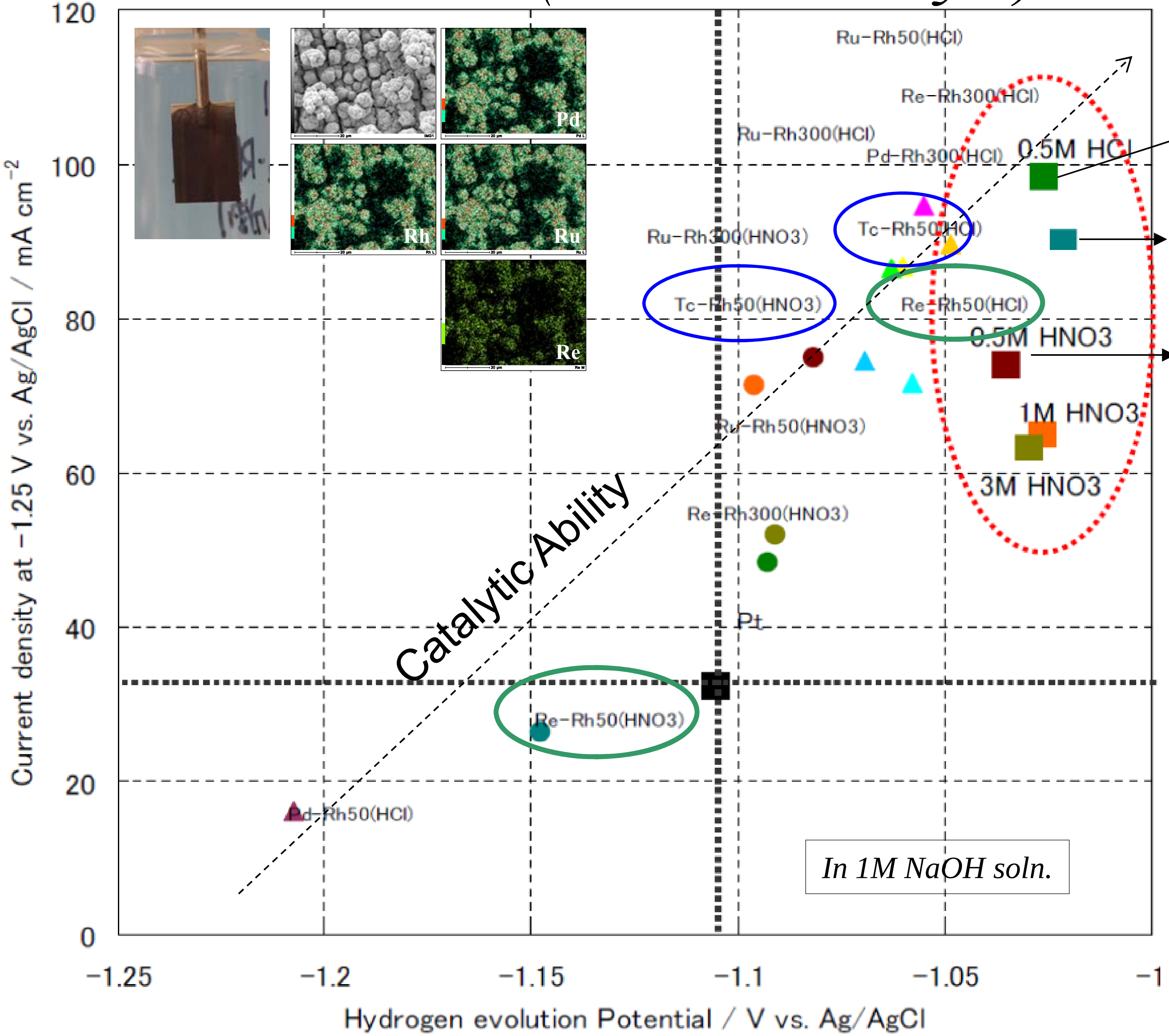


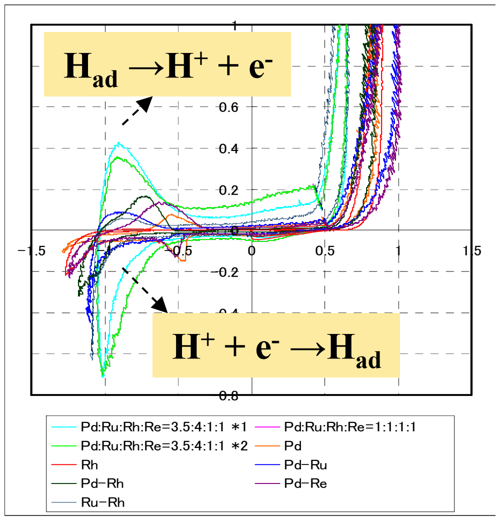




## ●Application of *CEE* in Simulated HLLW($HNO_3$)



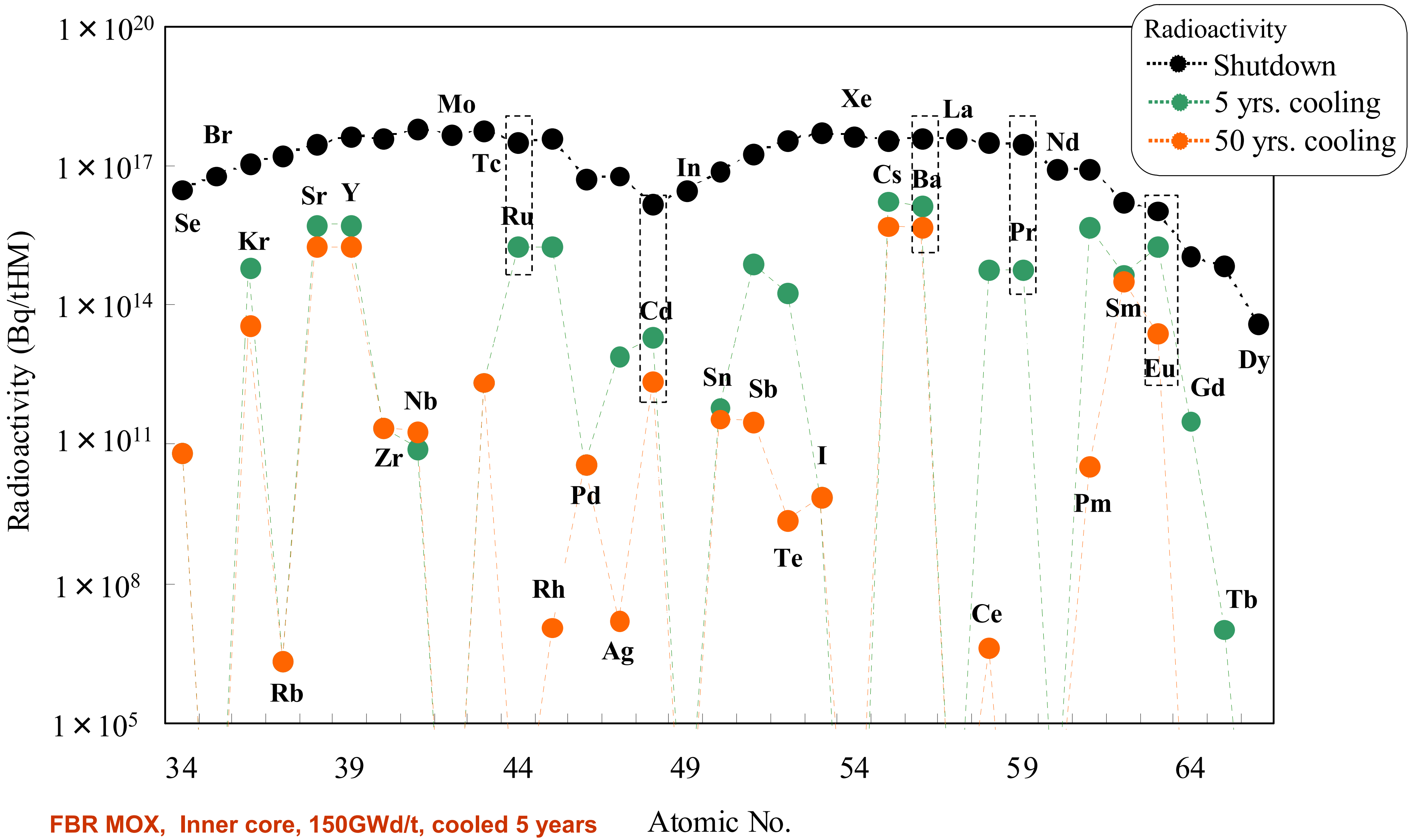
# *PGM, Tc, Re-Deposits as Catalysts for Electrolytic $H_2$ Production (Adv.-ORIENT Cycle)*




**CV on NRM-deposit Electrodes**

# *Radioactivity of NRM*
# *As a Function of Cooling time for 50 years*




FBR MOX, Inner core, 150GWd/t, cooled 5 years

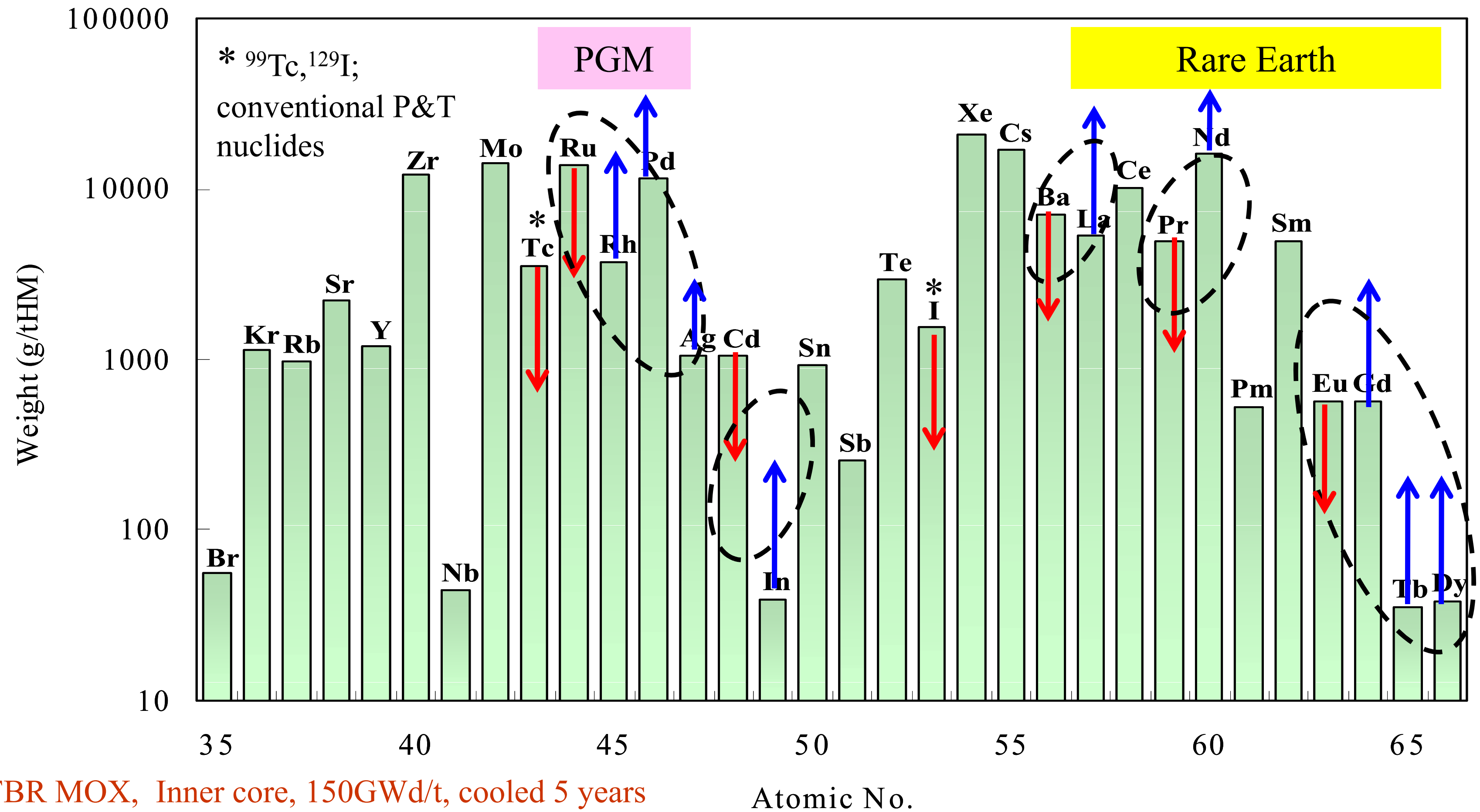
## *Après ORIENT* (*Nuclear Creation of Rare Metal*)

①P&T : Transmutation of MA ($^{241}$Am,etc), LLFP ($^{99}$Tc, $^{129}$I, etc)

⇔ Decrease of HLW Radioactivity, Increase of Proliferation Resistance of Pu

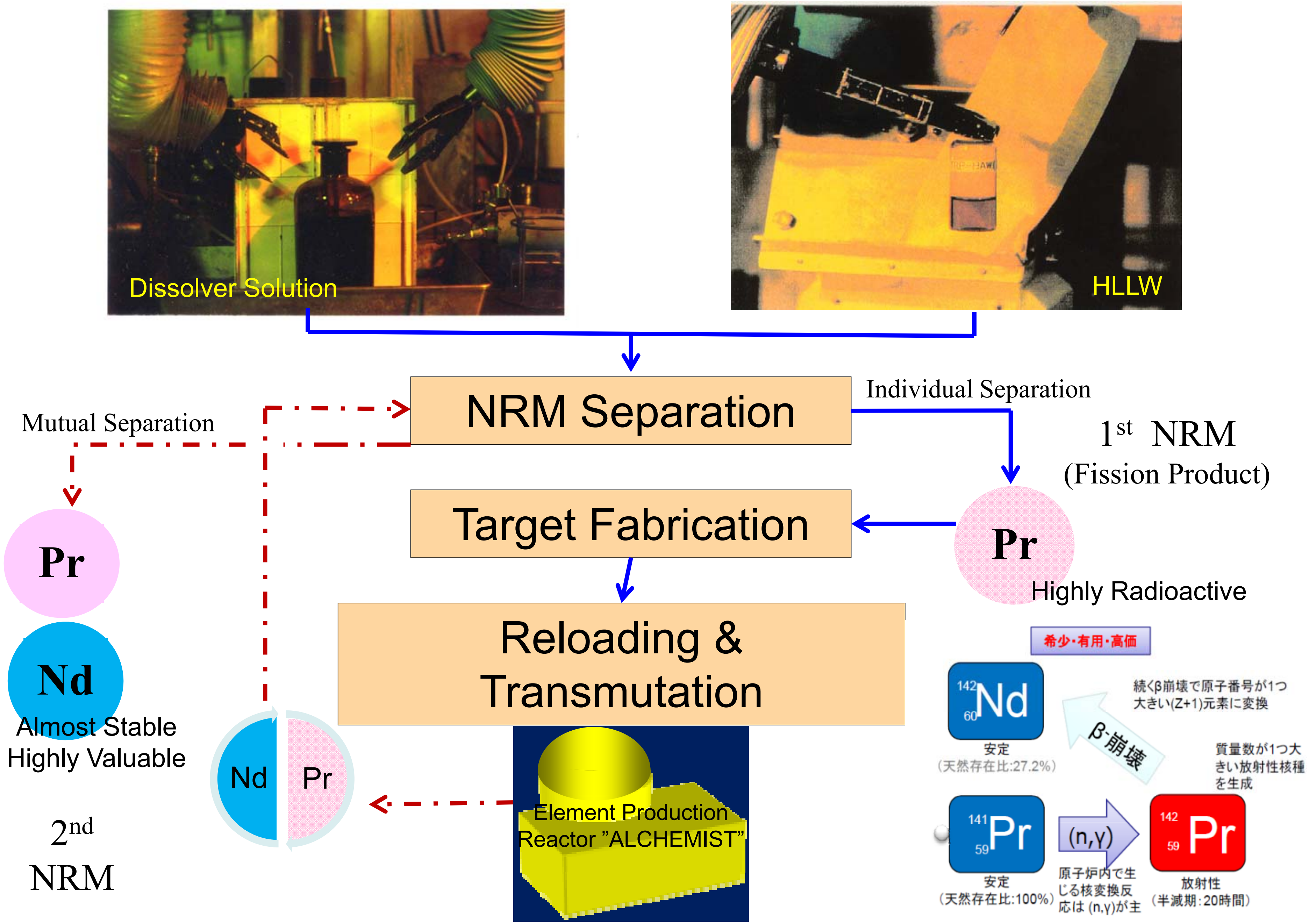
②Positive P&T : Transmutation of Radioactive FPs to Highly Valuable Rare Metal

⇔ Element Strategy, Increase of Proliferation Resistance




FBR MOX, Inner core, 150GWd/t, cooled 5 years

# *From "Separation" to "Creation" (Après ORIENT)*



# *Irradiation Conditions for Calculation*

## *Composition of Actinides ,etc*

Reloading: FBR Inner core
Irradiation: 800day/cycle * 4cycle
Inter-cycle inspection: 45.5days

Economy tipe core (B.R. = 1.03)
O/M ratio = 1.05
Loaded fuel (kg/batch)

| Region | Pu content (%) | U235 (kg) | U238 (kg) | Pu238 (kg) | Pu239 (kg) | Pu240 (kg) | Pu241 (kg) | Pu242 (kg) | Np237 (kg) | Am241 (kg) | Am243 (kg) | Cm244 (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inner core | 18.3 | 22.3 | 7407.5 | 19.4 | 955 | 566.5 | 75.9 | 68.9 | 8.8 | 35.3 | 17.6 | 17.7 |
| Outer core | 21.1 | 20.5 | 6802.5 | 21.3 | 1048 | 621.8 | 83.3 | 75.6 | 9.7 | 38.8 | 19.4 | 19.4 |
| Axial Blanket | 0 | 20.7 | 6885 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table Operation condition of Japanese fast reactor

| | JOYO MK-II core | MONJU | Commercial Reactor |
|---|---|---|---|
| Thermal output (MWt) | 100 | 714 | 3570 |
| Power fraction | 0.95 | 0.53 | 0.50 |
| Number of subassembly | 67 | 108 | 288 |
| Lattice pitch (mm) | 81.5 | 115.6 | 206.0 |
| Stack length (mm) | 550 | 930 | 1000 |
| Active core volume (cc) | 211974 | 1162393 | 10584188 |
| Power density (W/cc) | 448 | 326 | 168 |
| Neutron flux ($n \cdot cm^{-2}s^{-1}$) ($E \geqq$ 0.1 MeV) | $3.05\times10^{15}$ | $4.09\times10^{15}$ | $2.27\times10^{15}$ |

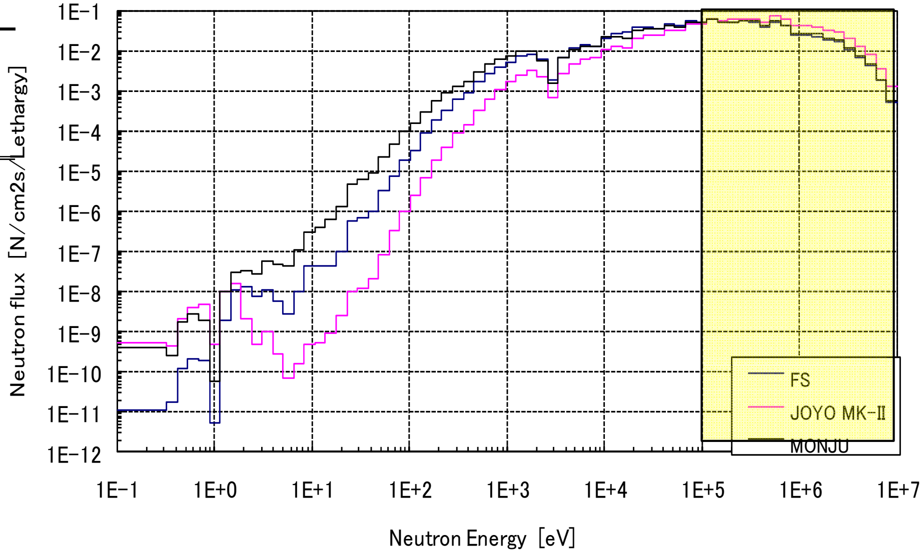
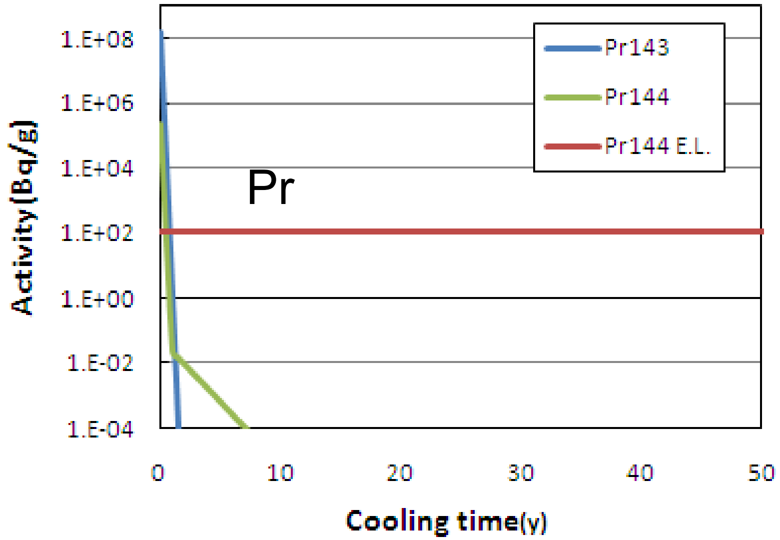
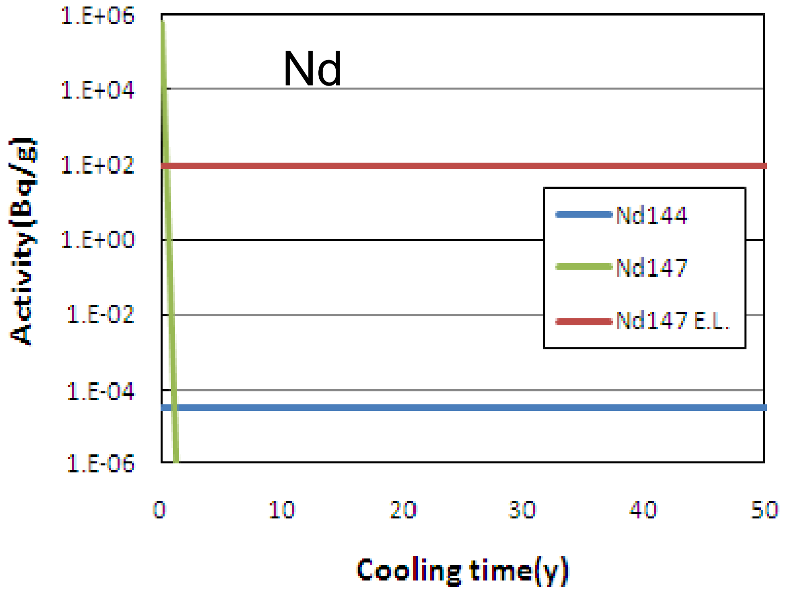



Fig. Neutron energy spectra at inner core

# *Transmutation of FP Pr*

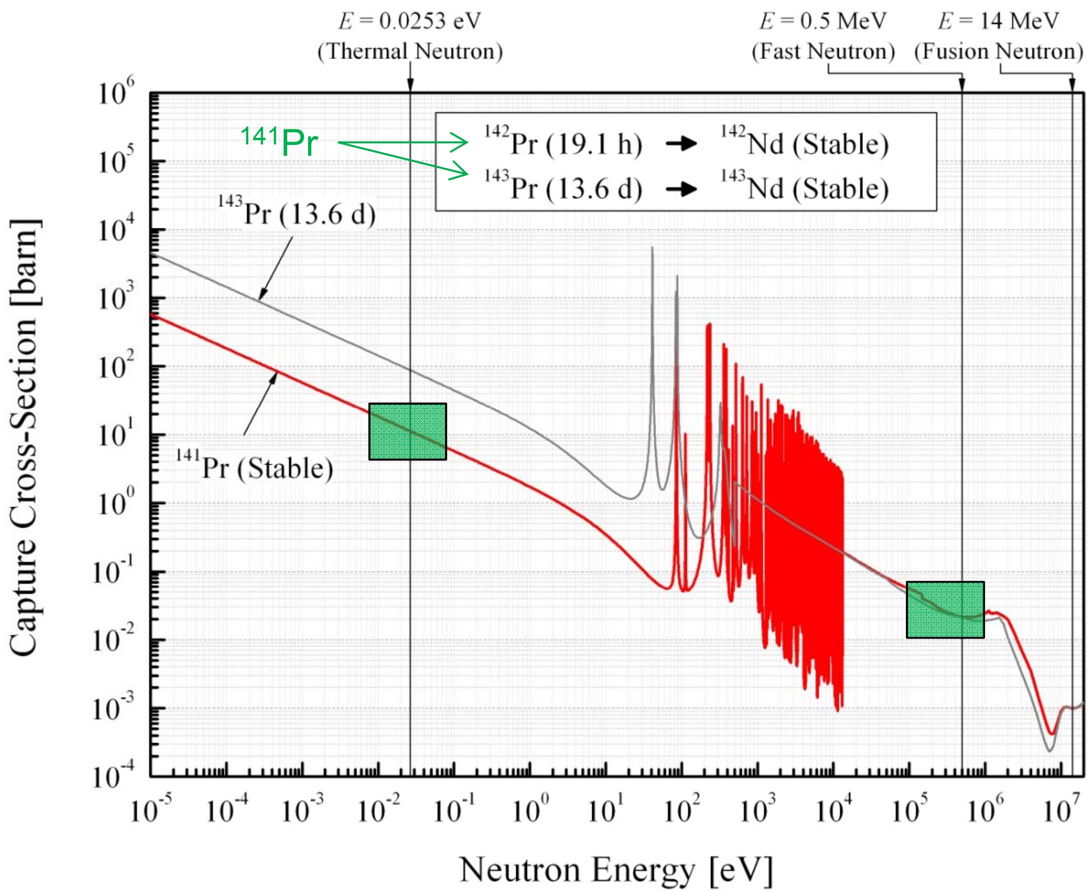
Radio-activities of re-irradiated FP Pr
(Pr, Nd products)



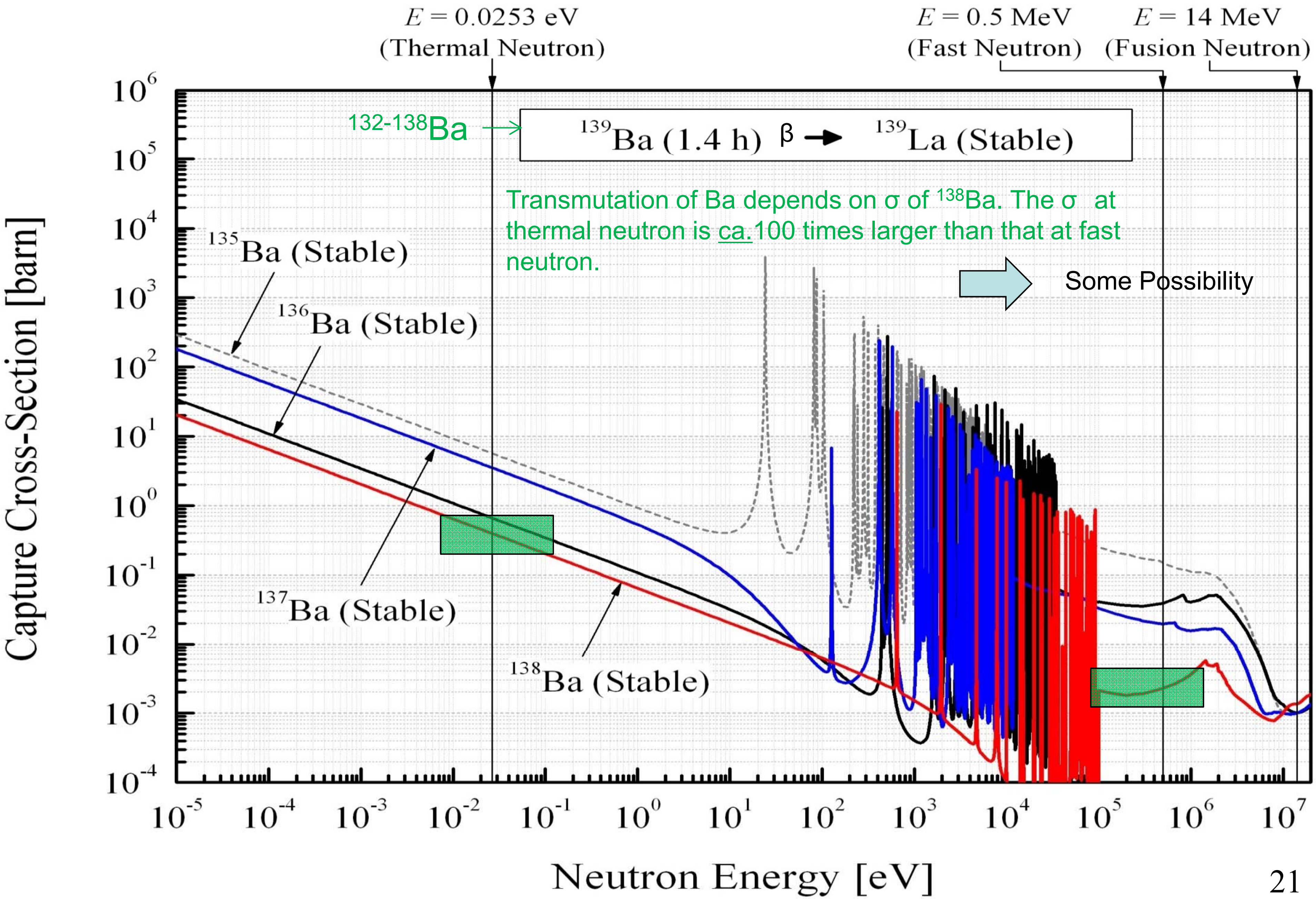

Loading Pr: 48.4kg (Pr-141:100%)
Shutdown: Pr 43.6kg, Nd 4.84kg
Transmutation ratio:10.0%

→ High Possibility



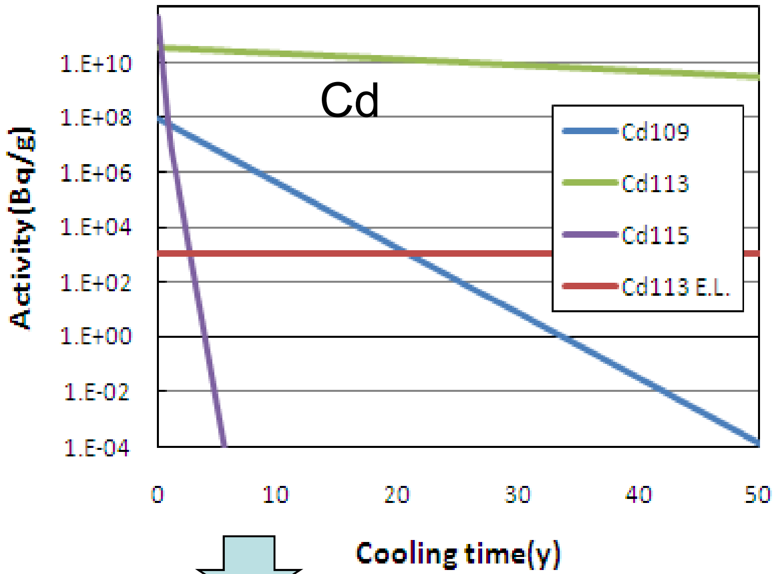

Transmutation of Pr depends on σ of $^{141}$Pr. The σ at thermal neutron is ca.1,000 times larger than that at fast neutron.

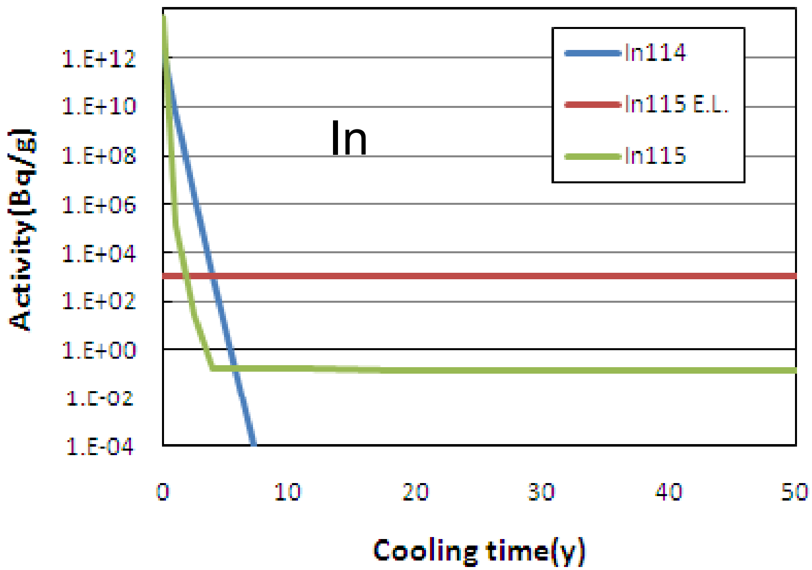
# *Transmutation of FP Ba*



# *Transmutation of FP Cd*

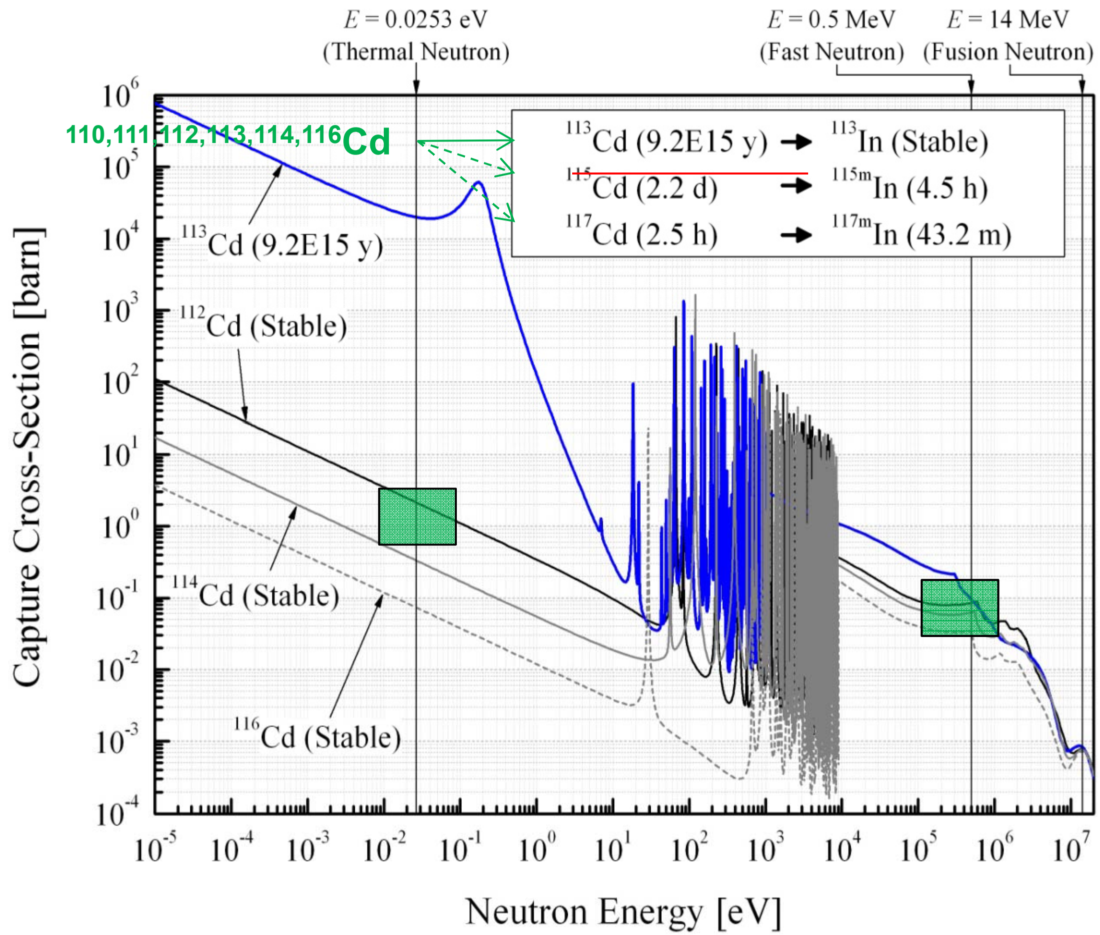
Radio-activities of Irradiated FP Cd
(Cd, In products)




Loading Cd: 10.3kg
Shutdown: Cd 10.0kg, In $8.1*10^{-2}$kg
Transmutation ratio:0.8%

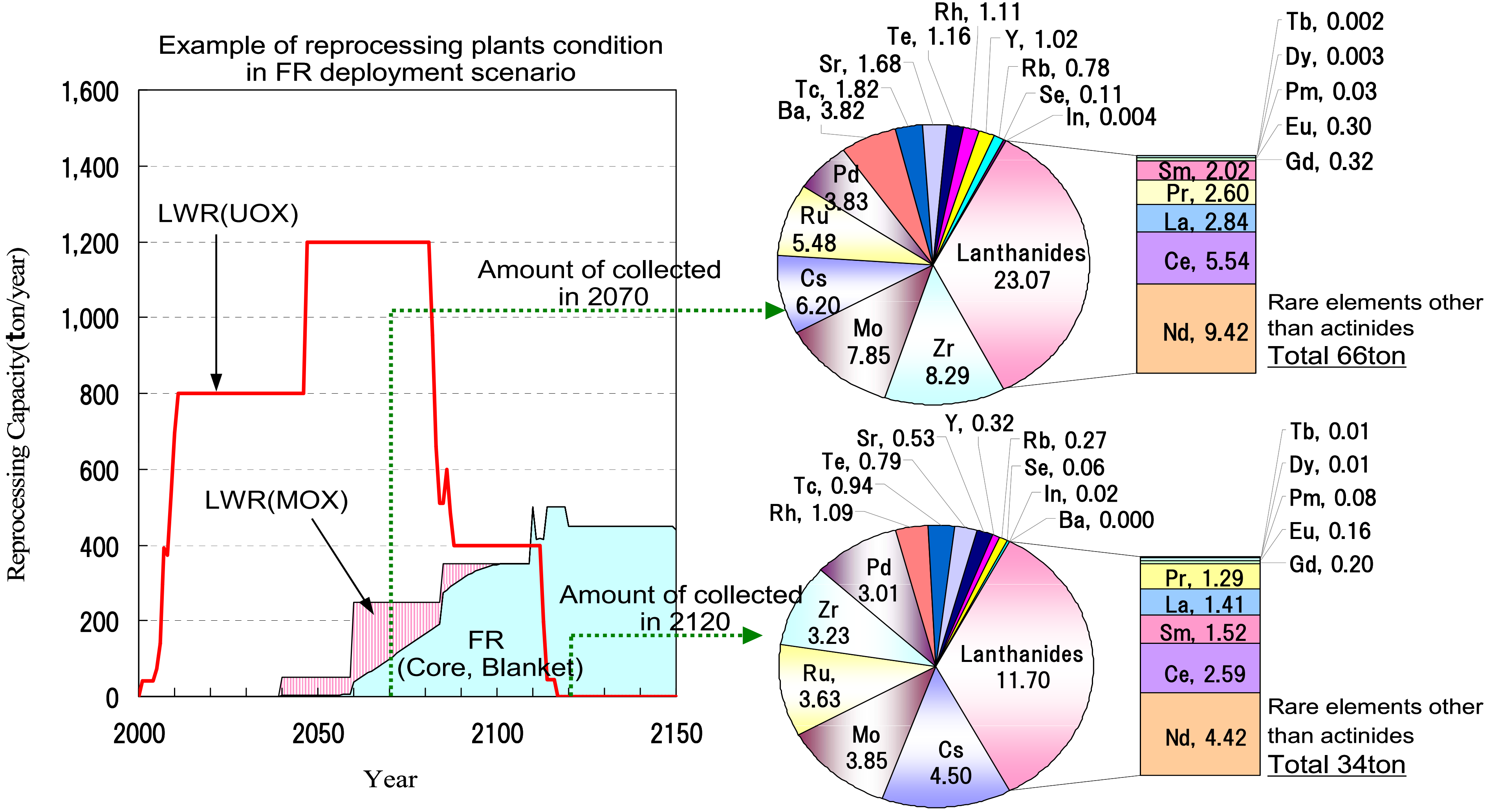
→ Less Possibility




Transmutation of Cd depends on σ of $^{112}$Cd. However once $^{113}$Cd created, transmutation to In will not proceed because of long-lived property of $^{113}$Cd.

# *If NRM will be recovered in Adv.-ORIENT cycle・・・Japan's case*

- National Demands of PGM in Japan (FY2006) ; Ru:3.7t, Rh:2.7t, Pd:50.6t
- In Estimating Nuclear Fuel Cycle Capacity in FY2070 in Japan, it can cover ca.100% of Ru, ca.40% of Rh and ca.7% of Pd against the national demands in FY2006.




* Previous Scenario until 3.11

*assume 99% as recovery ratio

# 下水から金（Au）の回収

長野県（諏訪建設事務所）プレスリリース　平成 21 年（2009 年）1 月 28 日

**諏訪湖流域下水道において汚泥焼却灰から『金』の回収を始めました。**

諏訪湖流域下水道豊田終末処理場（愛称：クリーンレイク諏訪）の下水汚泥焼却灰等には金が含まれています。金が含まれている焼却灰は売却が可能であることから、平成20年10月から売却を始め、今月末に初めての売却収入があります。売却収入については、流域下水道の維持管理のために活用し、流域下水道を利用する皆様へのサービス向上を図ってまいります。金の回収の概要は、下記のとおりです。

**実施前（今まで）**

当処理場の汚泥焼却灰の中にはヒ素が多く含まれており、これの溶出を防ぐため溶融結晶化処理をして人工骨材として有効利用していますが、下記については骨材化が不可能なため、特別管理産業廃棄物として処分していました。

1　溶融飛灰（焼却灰を溶融結晶化する過程で発生するばいじん）
2　年１回の定期修繕に伴う溶融結晶化炉停止時の焼却灰
3　溶融過程で発生する不良スラグ

⬇

**実施後（これから）**

溶融飛灰等の金の含有量試験により、一定の含有が認められる場合、有価物として金属製錬会社へ売却します。

【平成 20 年 10 月分】

**売却収益　約 500 万円**（溶融飛灰　約 500 万円、焼却灰　0 円 ）

| | | |
|---|---|---|
| 排出量 | 溶融飛灰　1.4t | 焼却灰　19t |
| 金の含有量 | 溶融飛灰　約 1,890g/t | 焼却灰　約 35g/t |

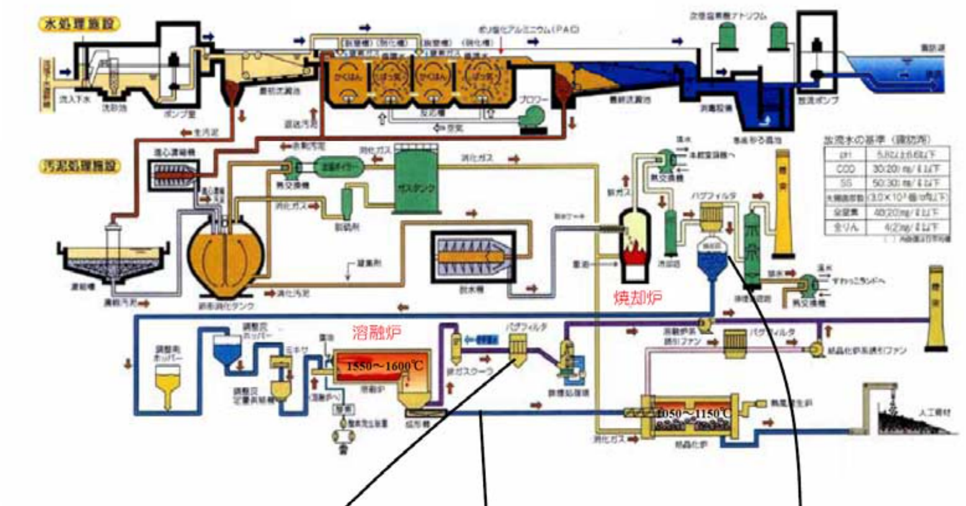
参考）平成 20 年度年間売却予想数量（金の市場価格及び含有量により変動します。）

溶融飛灰　　5t
焼却灰　　60t


諏訪建設事務所流域下水道課
（課長）中山　幹英　　（担当）小松　英雄
電話：0266-57-2945（直通）
0266-53-6000（代表）内線 2461


**1890g x 5t x 約3500円(金)/g ≒ 3,300万円/年**

豊田終末処理場　処理フロー







## 金の回収の概要

平成 19 年 10 月から平成 20 年 12 月までに発生した溶融飛灰等を処分する中で、10 月に搬出した溶融飛灰 1.4t と焼却灰 19t に金が含有しており、約 500 万円の売却収益がありました。残りの溶融飛灰等についても 3 月までに順次、売却収益額が確定します。

## 飛灰とは？

溶融炉で溶融処理する際、排ガスの中に飛んでいる灰で、バグフィルタで捕集されます。

## 処理場の運転経費

・処理場全体：約 14 億３千万円
・溶融炉　　：約１億７千万円

# 原子炉で現代の錬金術を実現（*Après ORIENT*）

- レアメタルは先端産業に直結した重要元素で、我国のGDPを制する。白金族、希土類及びレニウムなどは、資源が局在化しており、 戦略物質として取り扱われる可能性が極めて高い。

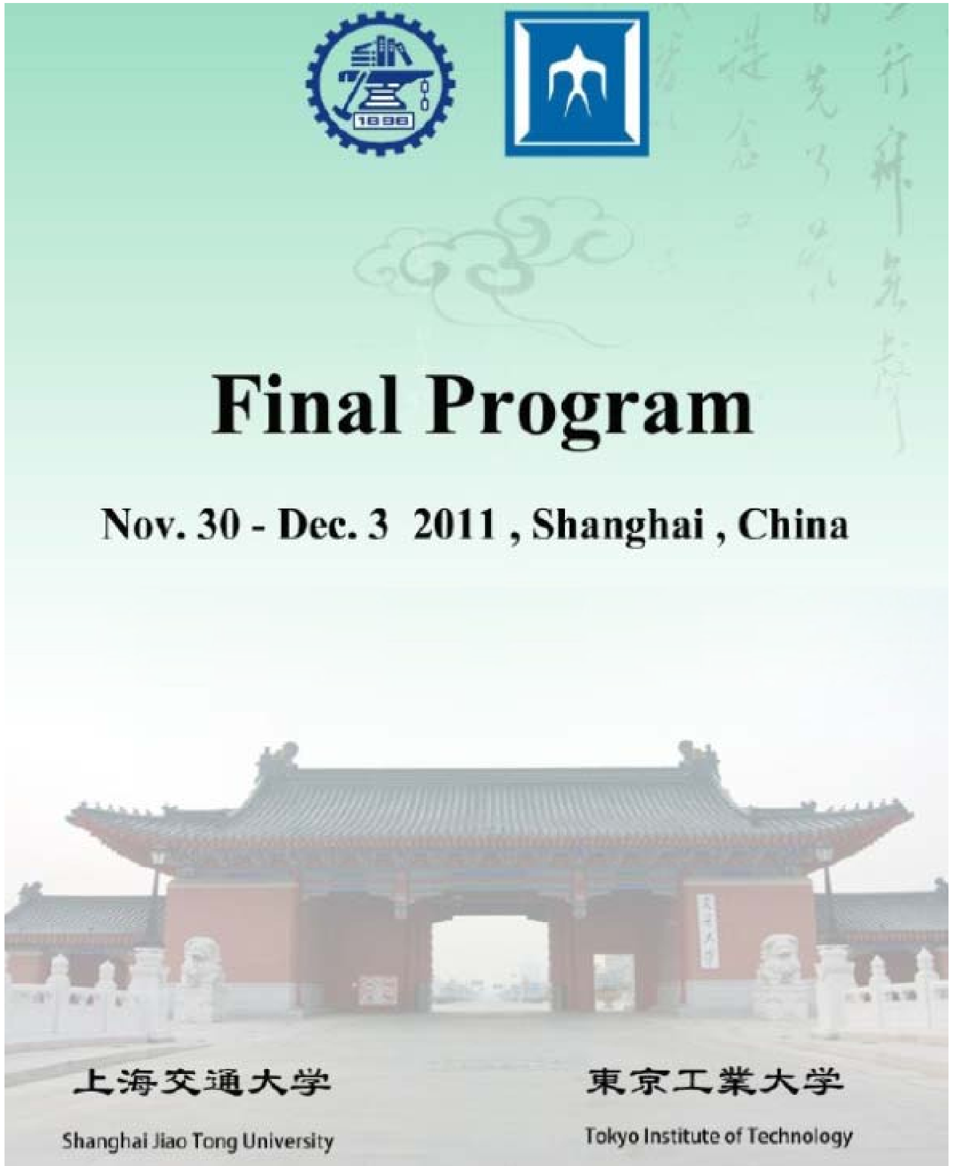
- 核分裂反応はエネルギーの生産とともに31種を超えるレアメタルを創生する。使用済み燃料や高レベル放射性廃液を“廃棄物”ではなく“人工資源・鉱脈”として捉える発想（戦略）の転換と戦術の構築が必要である。

- 原子炉は新たな物質供給源（人工鉱山）として、資源小国である日本の資源確保戦略に寄与する可能性がある。

- 放射性レアメタルの核変換（n,γ反応）では、高価値レアメタル（例えば、Ru→Rh）の創成、あるいは低放射性元素（例えば、Eu→Gd）への転換、の可能性が認められた。
  今後、全アクチニド及びFPの核変換特性を評価するとともに“元素創成 ”原子炉を視野においた検討を進める。

$$ {}_{Z}\mathrm{FP}^{A}\,(n,\gamma)\;{}_{Z}\mathrm{FP}^{A+1} \rightarrow {}_{Z+1}\mathrm{FP}^{A+1} + \beta^{-} $$

- Higher possibility can be expected by neutron capture cross sections (σ) even at the fast neutron energy spectrum (*i.e.*, >0.1MeV) conditions for Φ2.27x$10^{15}$n/cm$^2$/s and 8.8years irradiation; Ru→Rh(t.r.3.5%)/Pd(3.7%) , Pr→Nd(10.0%), Ba→La, Eu →Gd(64.8%), Gd →Tb, Tb →Dy. On the other hand, less possibility was recognized for; Cd →In(0.8%).
- Softer spectrum condition should be considered with expecting higher σ .
  FBR-based feasibility calculation study will be made for target NRM subassembly with proper neutron moderators as $ZrH_{1.65}$, Be metal, etc.




日本国驻上海总领事馆

CONSULATE GENERAL OF JAPAN
SHANGHAI

东京工业大学原子炉工学研究所
小泽　正基
上海交通大学核科学与工程学院
书　悦周

关于“东京工业大学以及上海交通大学”

使用本馆名义作后援的许可

关于 2011 年 8 月 1 日申请的本案，现予以许可。

如该活动计划有所更改，须及时报告，请求许可的同时，请提出本活动开展后的结果报告书。

日本国驻上海总领事

泉 裕泰

2011 年 8 月 19 日

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电话（86-21）5257-4766 传真（86-21）6278-8988

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# Summary report of 1st ASNFC2011

## 1. Summary

The 1st Academic Symposium on Nuclear Fuel Cycle (ASNFC2011, 11/30-12/3, 2011) was successfully held at Shanghai Jiao Tong University (SJTU) in China. This was the first joint conference of universities between China and Japan, focusing on basic chemistry and physics for nuclear fuel cycle. At the plenary session, a message was given by prof. Zhang Jie, president of SJTU (上海交通大学学長　張杰教授).

About **100** scientists from **25** universities and institutions attended, including about **40** young students from the both countries. Totally **42** high quality papers were presented, and very useful discussions were exchanged. In this time, three invited lectures were given from United States, Russia and Sweden.

Organizing committee thanks to the sponsors from China and Japan, and expresses the highest appreciation to the international advisory and the technical program committee members, especially for the local committee at SJTU.

The organization committee would like to propose Tokyo Institute of Technology, Japan as the next host organization university for the 2nd symposium, probably November of 2012.

2nd ASNFC; Nov. 2012, Tokyo Tech. (Japan) 東京工業大学
（Tentatively）
3rd ASNFC; Nov.2013, Peking Univ. (China) 北京大学
4th ASNFC ; Nov.2014, Tohoku Univ.(Japan) 東北大学
以降、四川大（中国）、清华大（中国）・・・

The committee is also discussing to expand academic topics and universities to in-Asia (Korea, India, etc.) and also ex-Asia (United States, Russia and Europe),

## 2. Award announcement

The Best Presentation Award (student) for 4 students (CHN 2, JPN 2).

Kei Yamanishi (Tohoku Univ.) 東北大学
Masahiko Nakase (Tokyo Institute of Technology) 東京工業大学
Ying Dai (Zhejiang University) 浙江大学
Fuwan Zhai(Sichuan University) 四川大学

第2回日中大学間核燃料サイクル学術討論会
(2nd ASNFC 2012)
2012年秋 於東工大

百家争鳴 一律平等の議論！
熱烈歓迎 来たれ若者