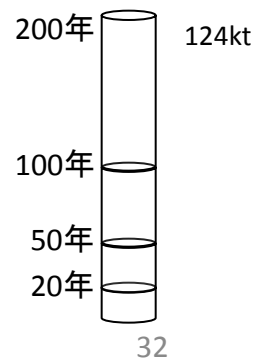
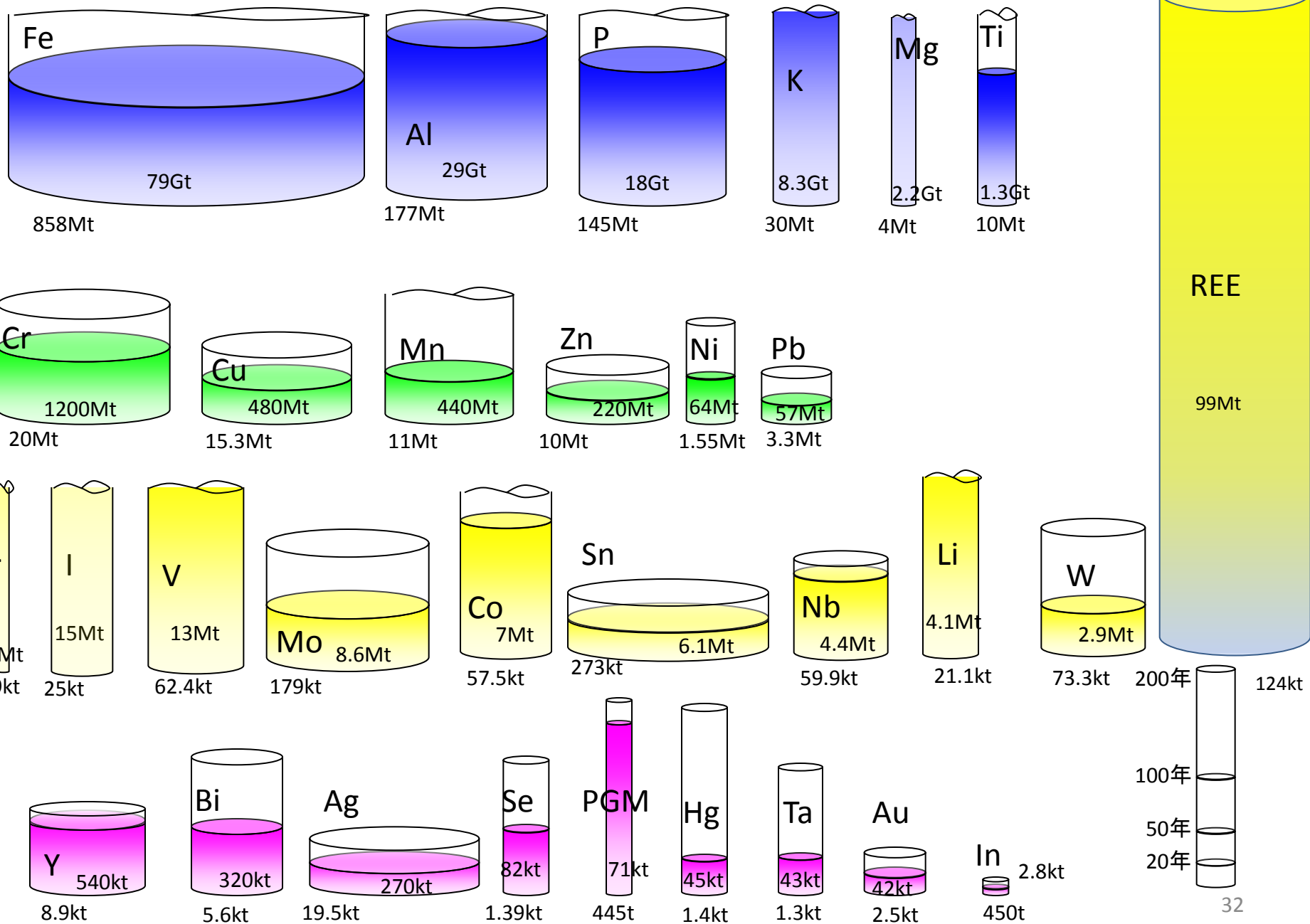
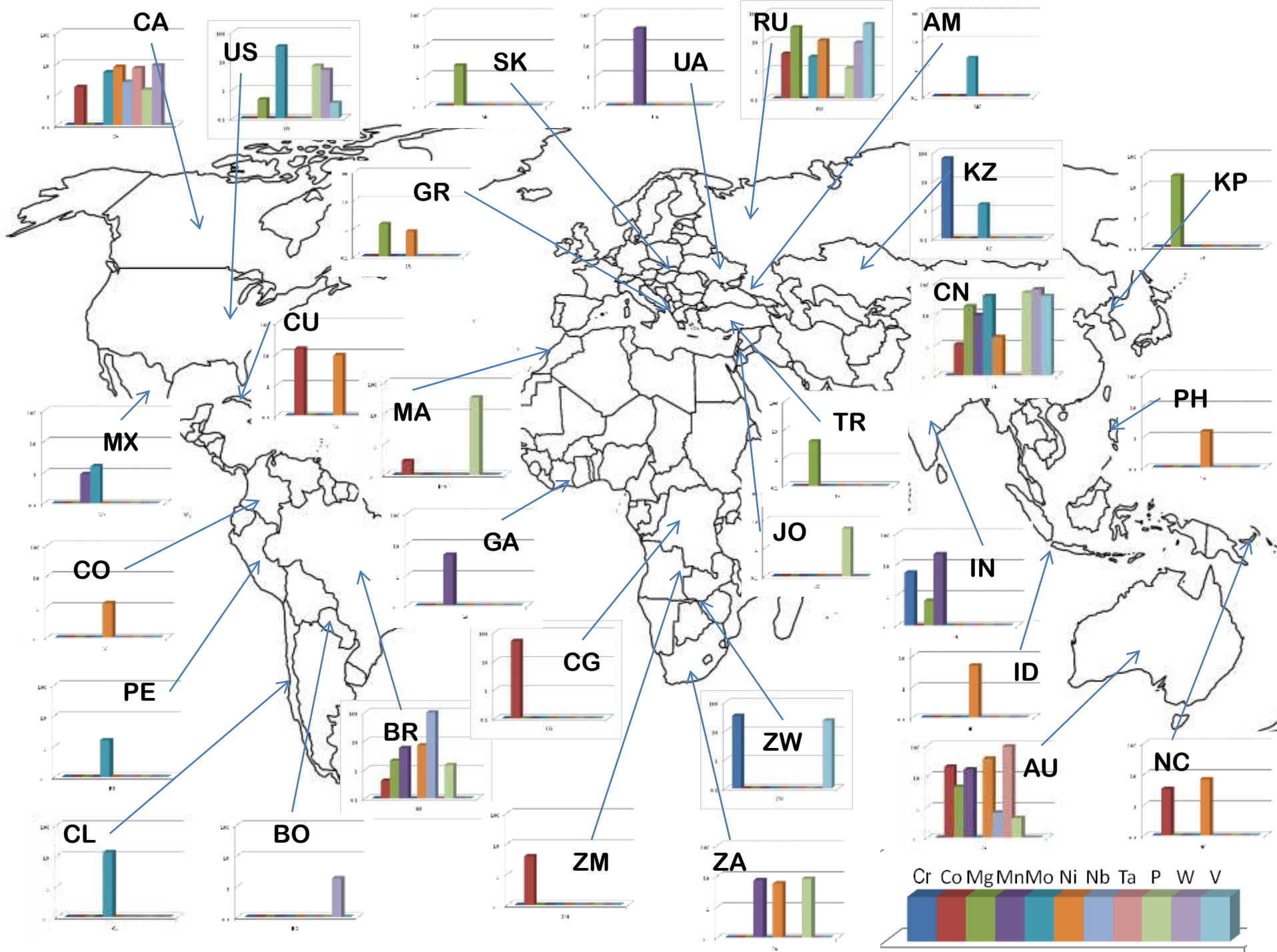


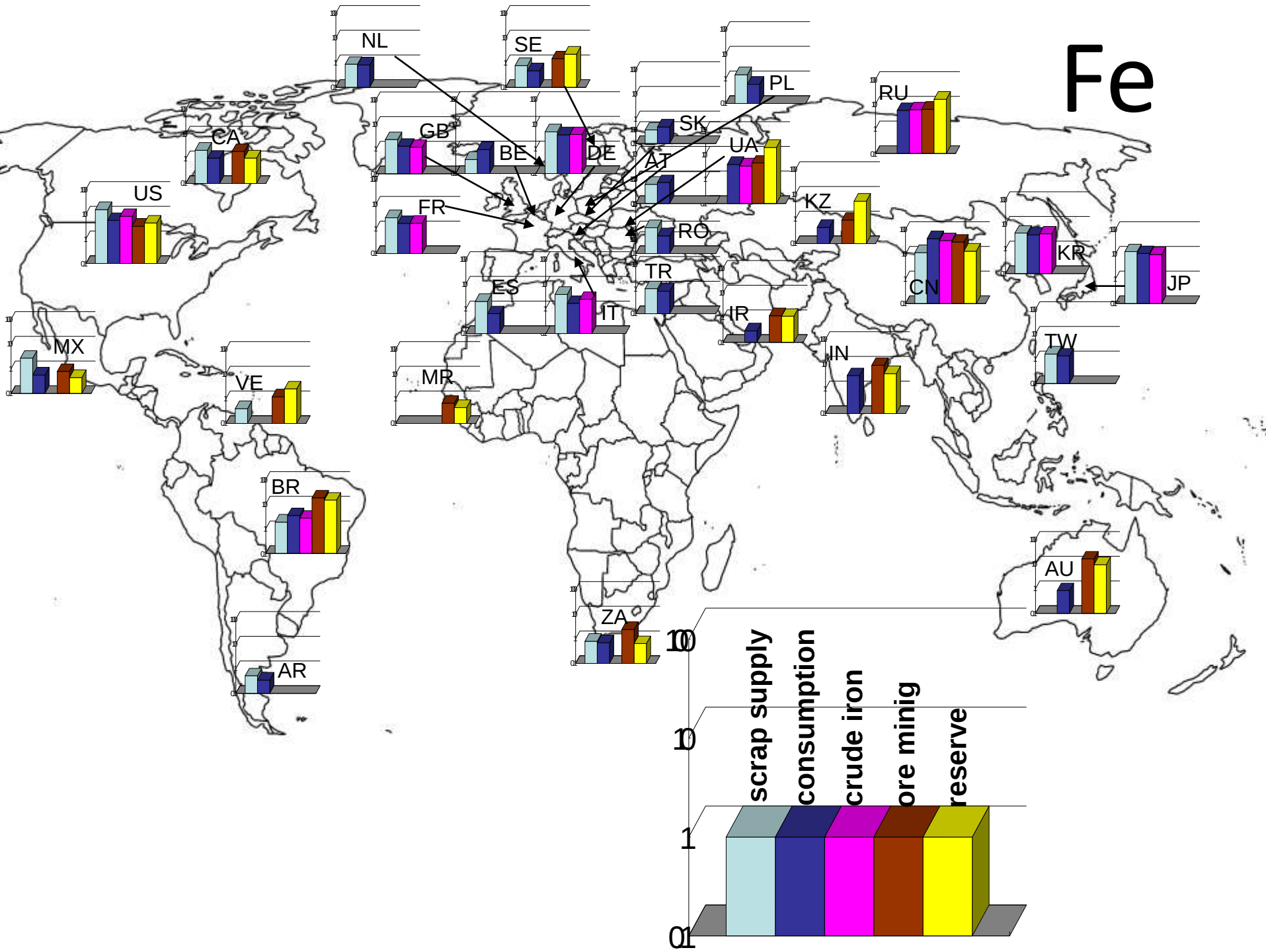
資源と利用の現状

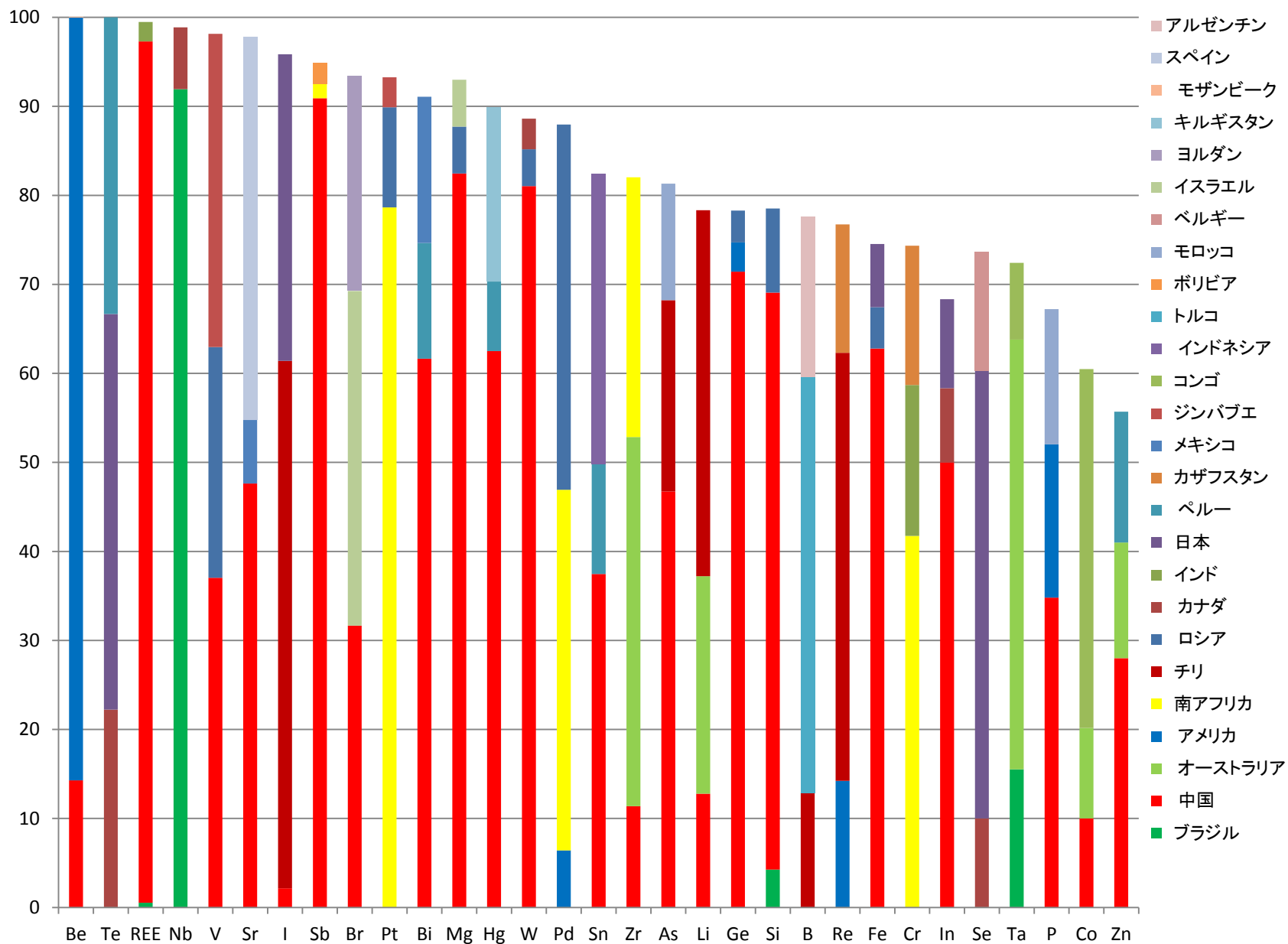
Ver. 11CK

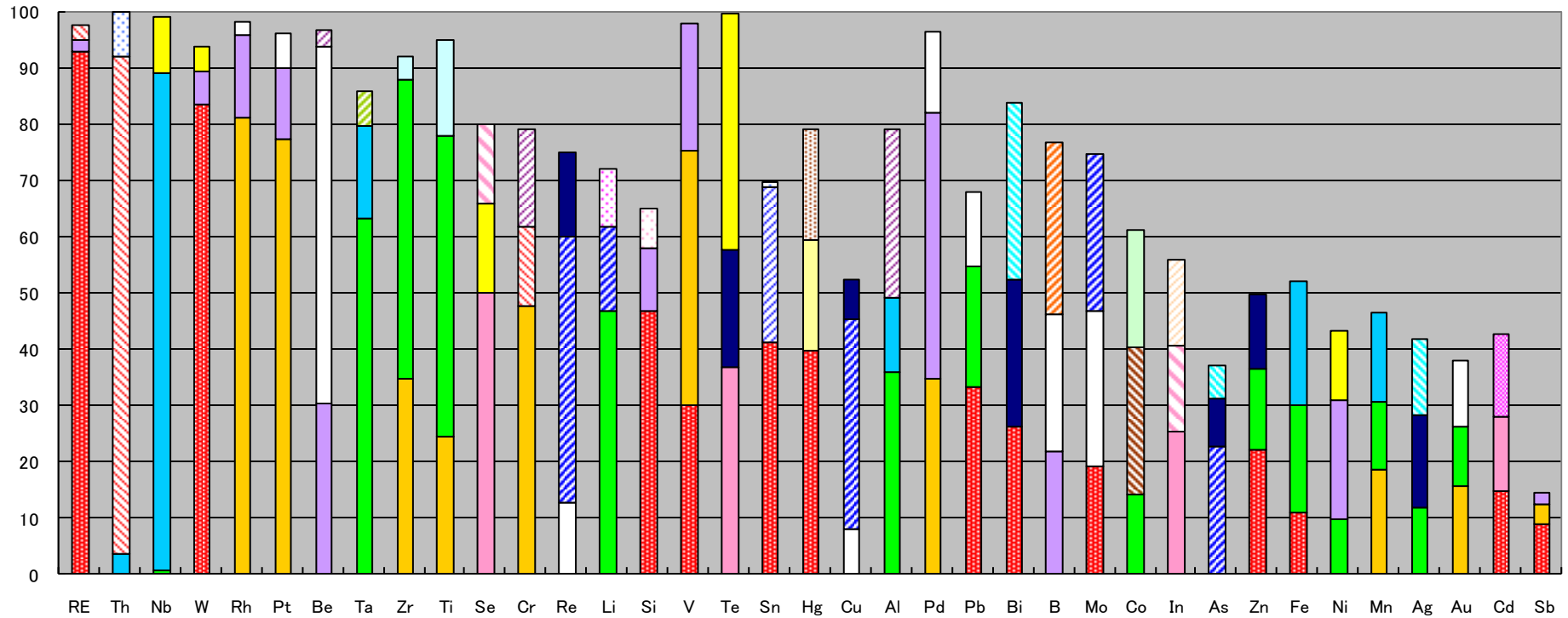
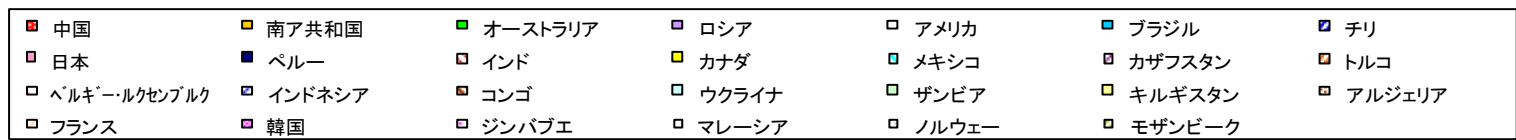




Fe



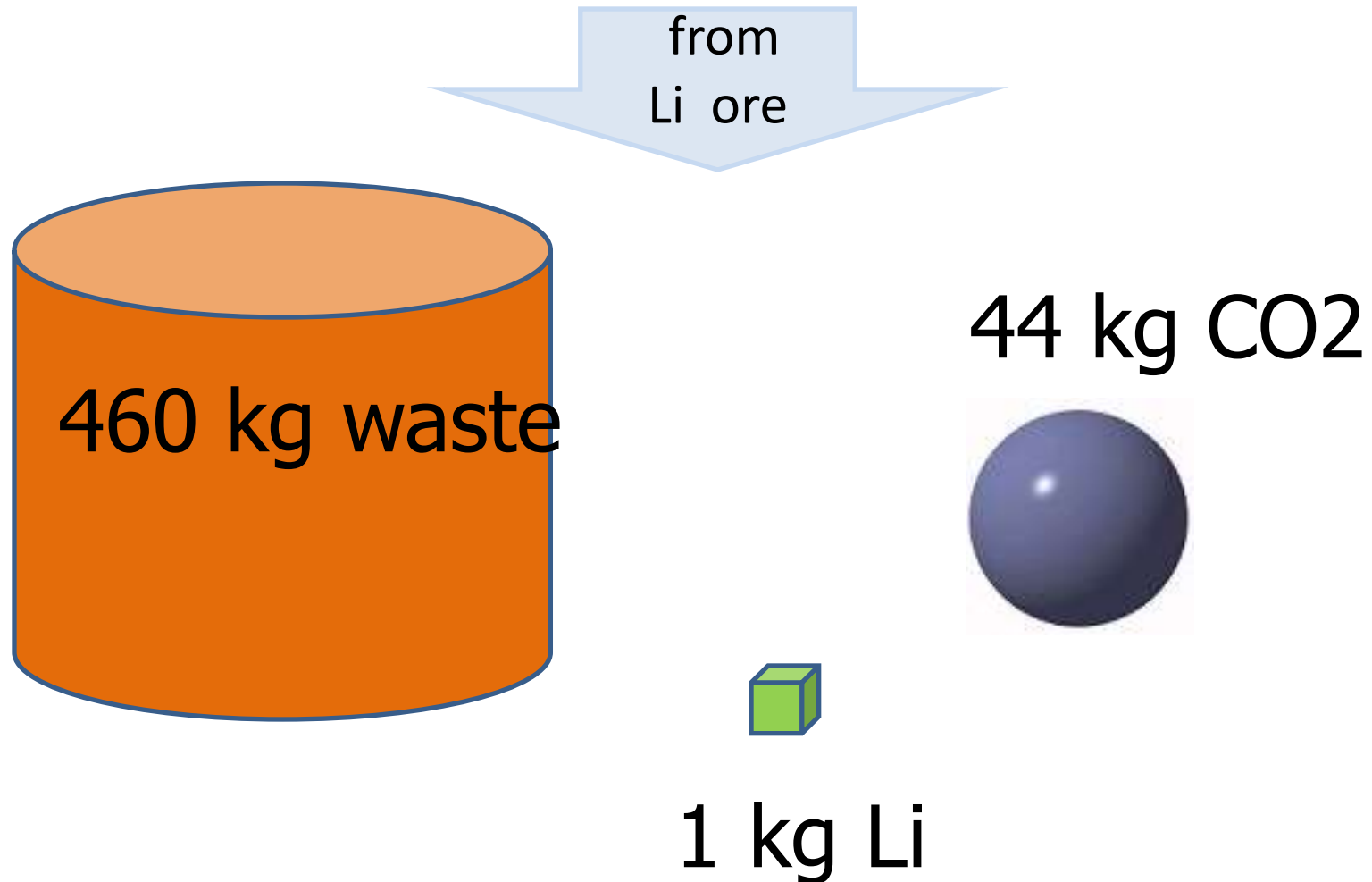


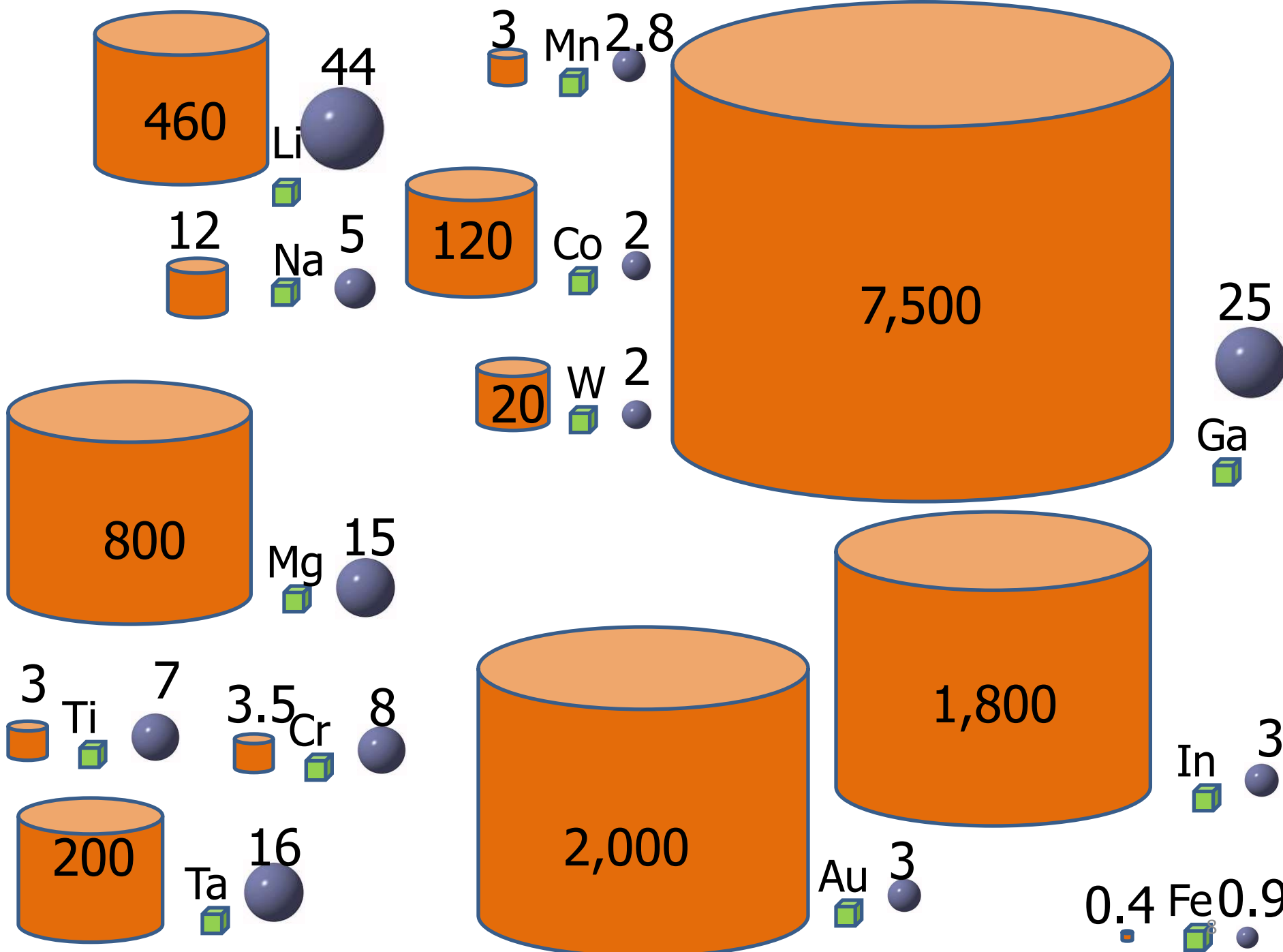


一カ国の生産シェア 75%以上 : レアアース、Th,Nb,タングステン、Rh、白金

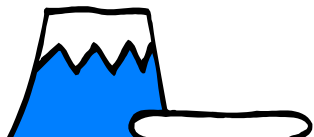
三カ国の生産シェア 80%以上 : パラジウム、Te、V, Ta, Be, Zr, Ti, Bi

Producing Rare Metals liberates great amount of wastes and CO₂

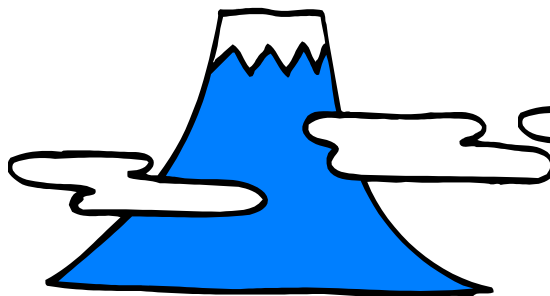




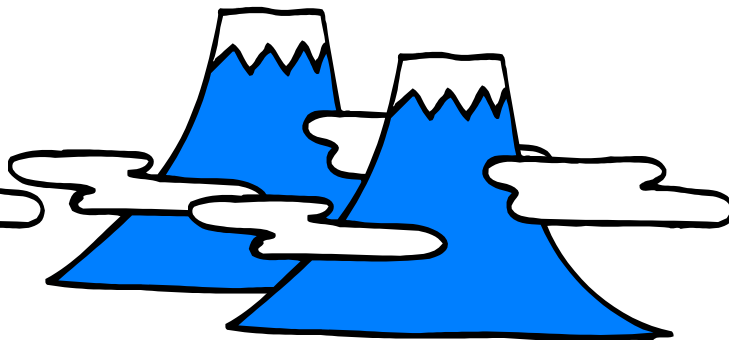
Mined material
(resource end)



Top of mount Fuji
10Gton



mount Fuji
100Gton



two mount Fijis
215Gton

Extracted metal
(consumer end)



A 25m pool



An Olympic pool

Au



1500 Pentagons

Fe

1,100,00kg



金 1kg

8kg



鉄 1kg

530,00kg



白金 1kg

1,200kg



インジウム 1kg

32,00kg



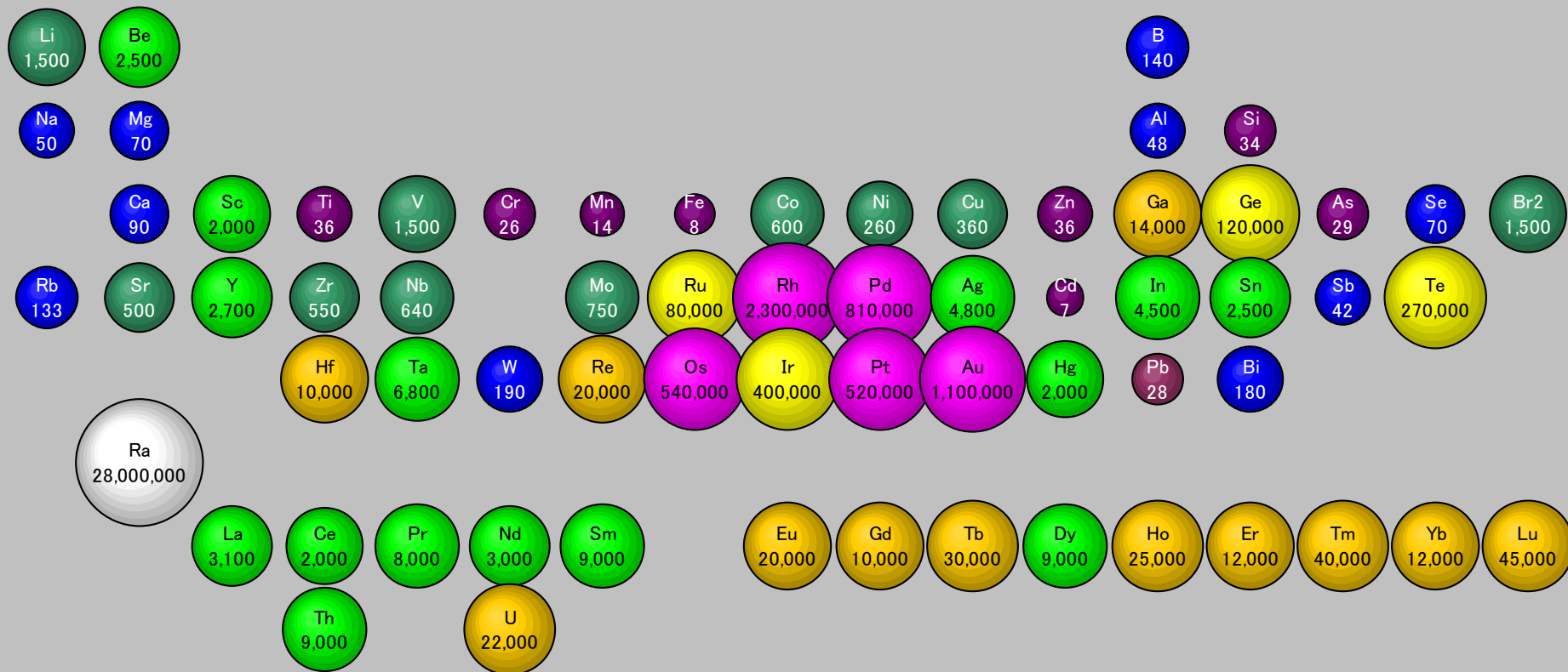
ゲルマニウム 1kg

7,00kg



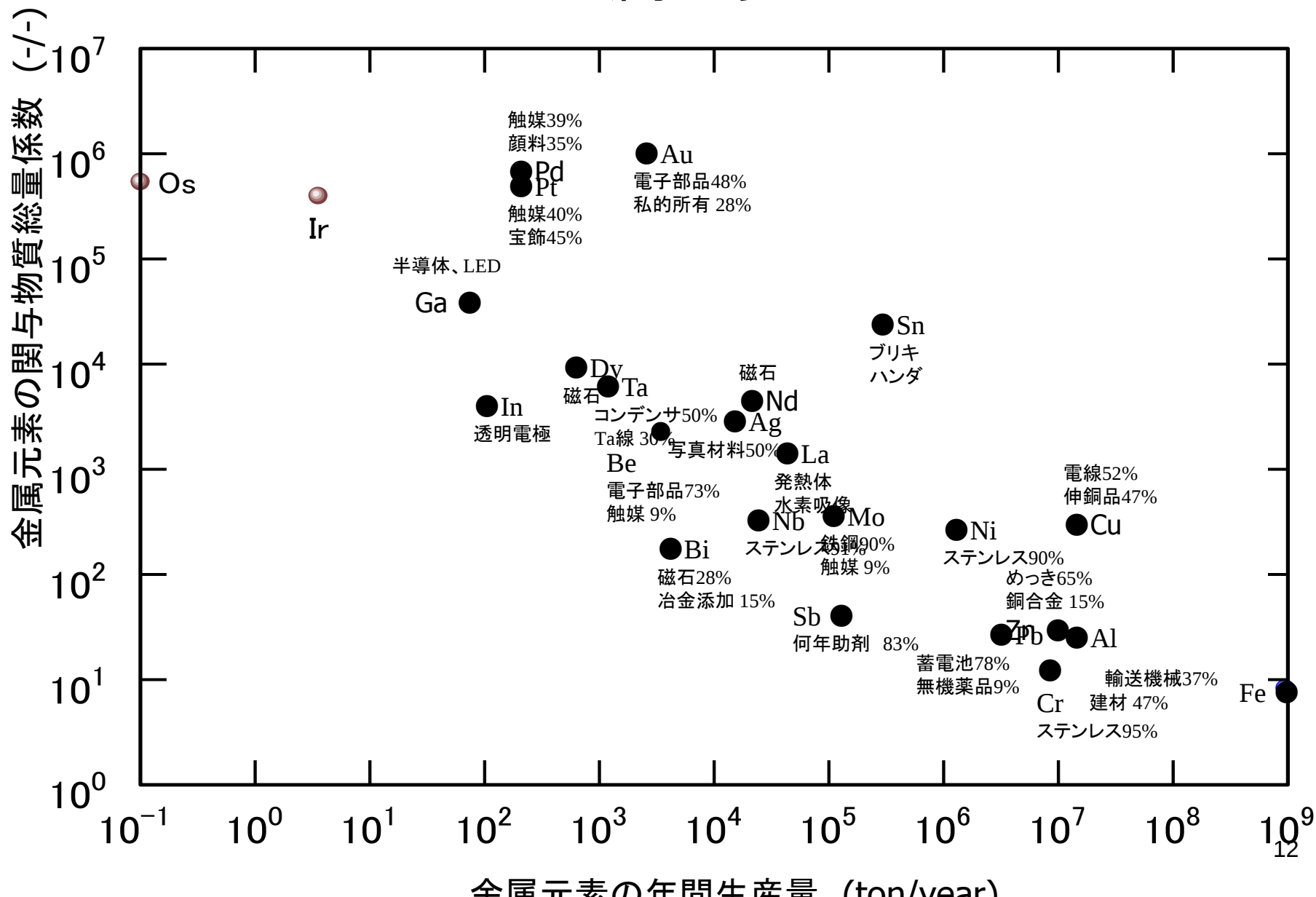
タンタル 1kg

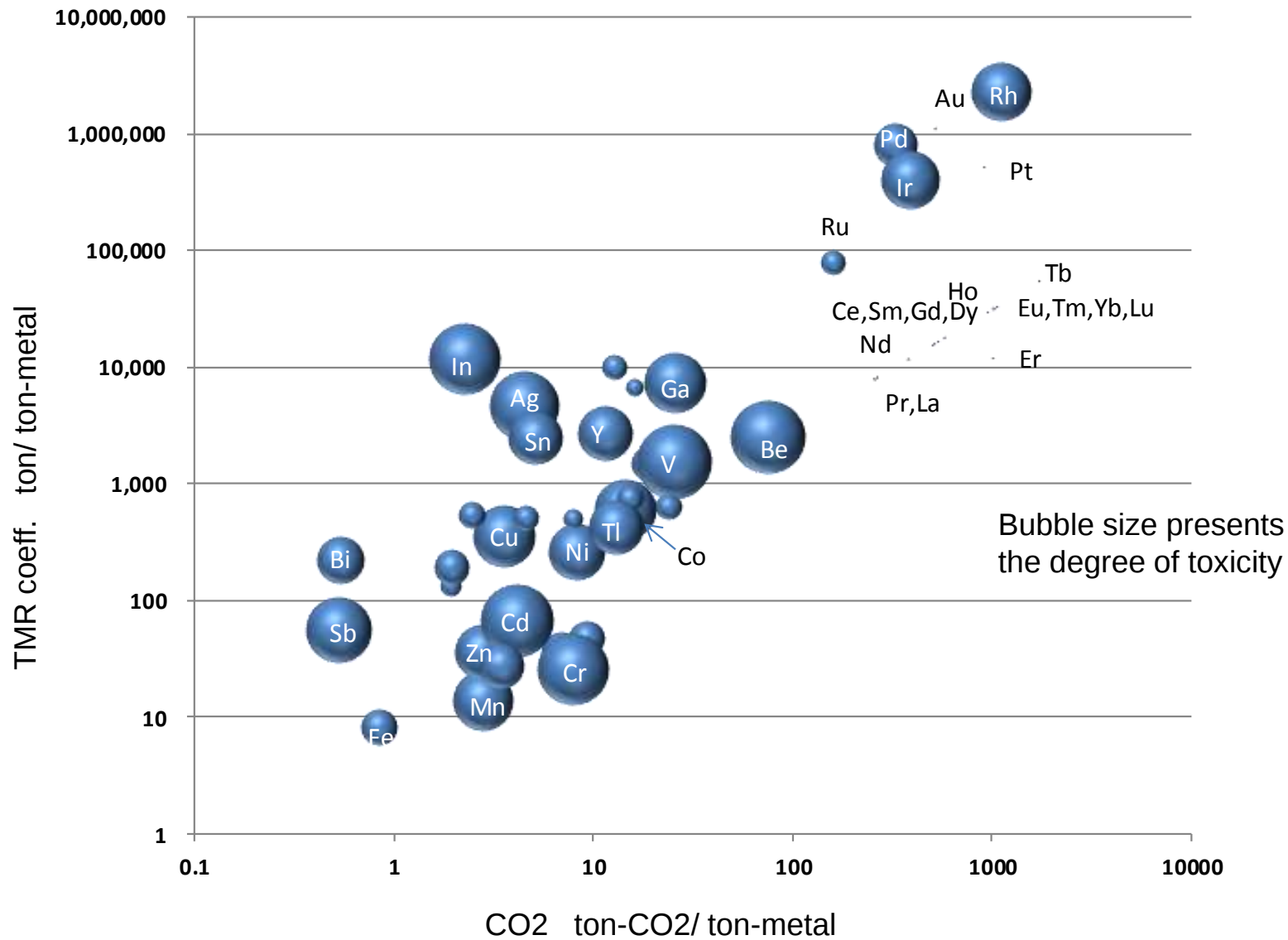
天然のレアメタル類の鉱石の背後には大きな環境背後霊が隠れている

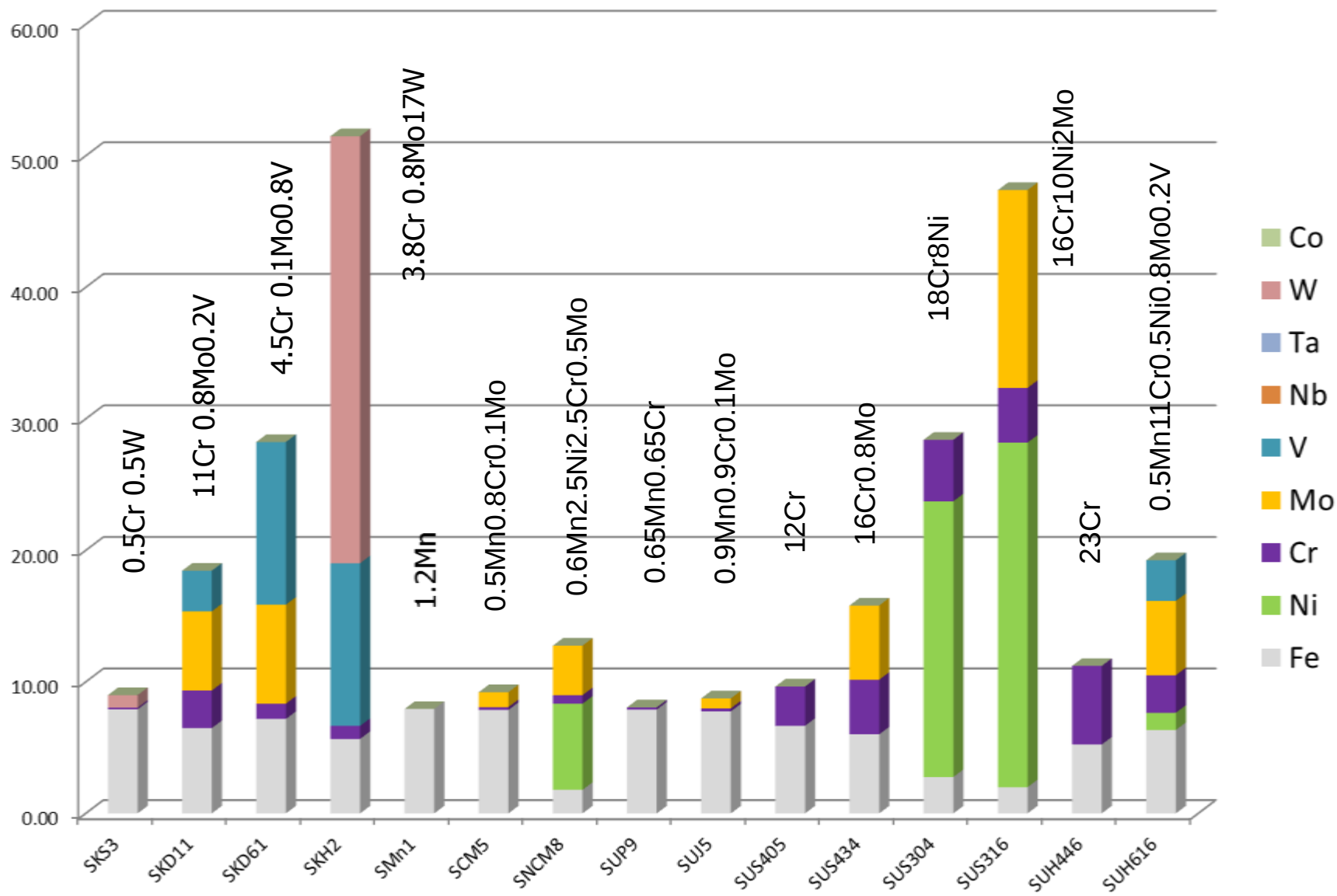


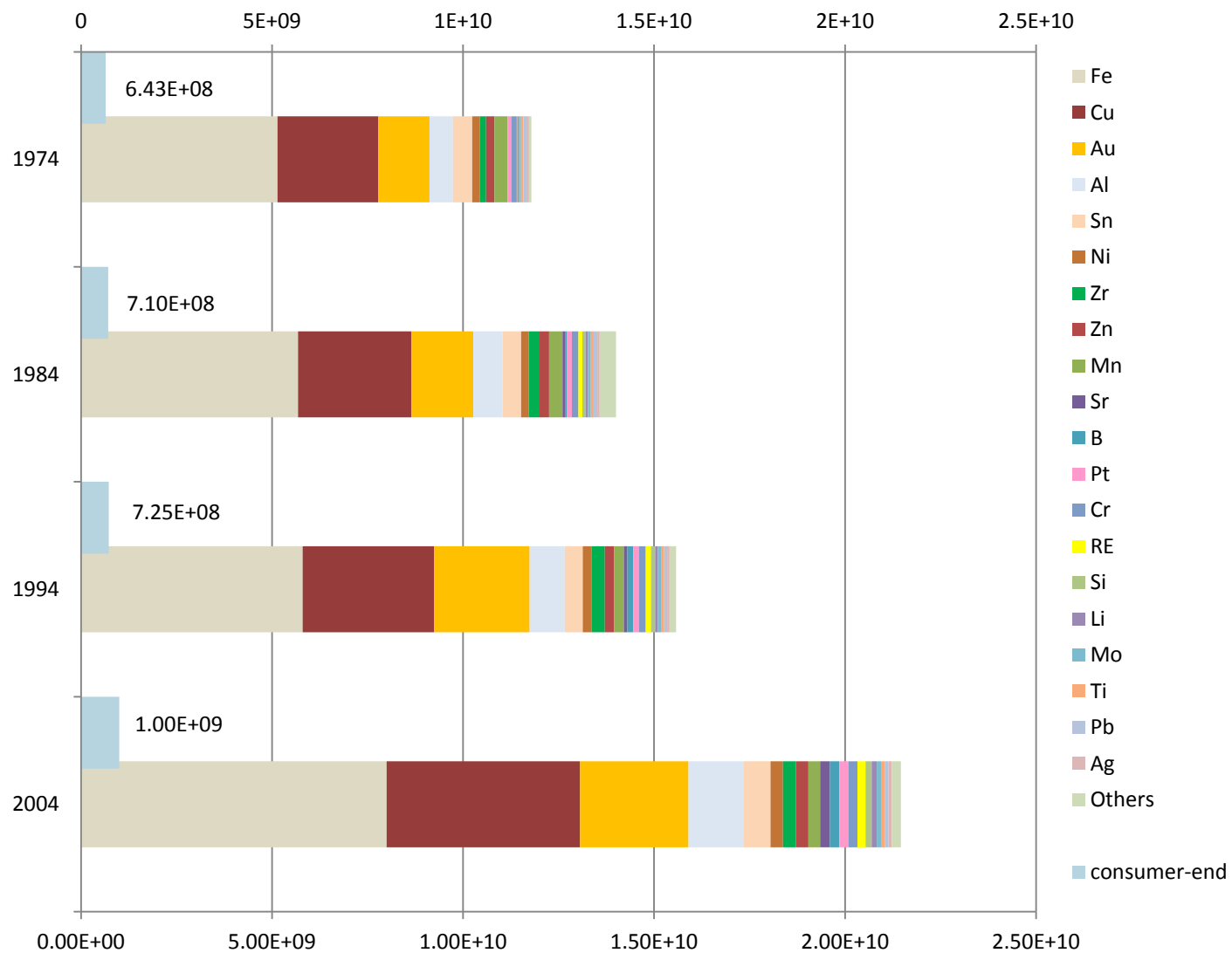
TMR of metals plotted on the periodic table

補足: 最近注目されている金属は資源端量の 大きな金属が多い









He

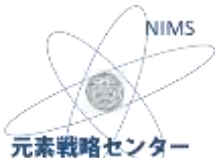
Ne

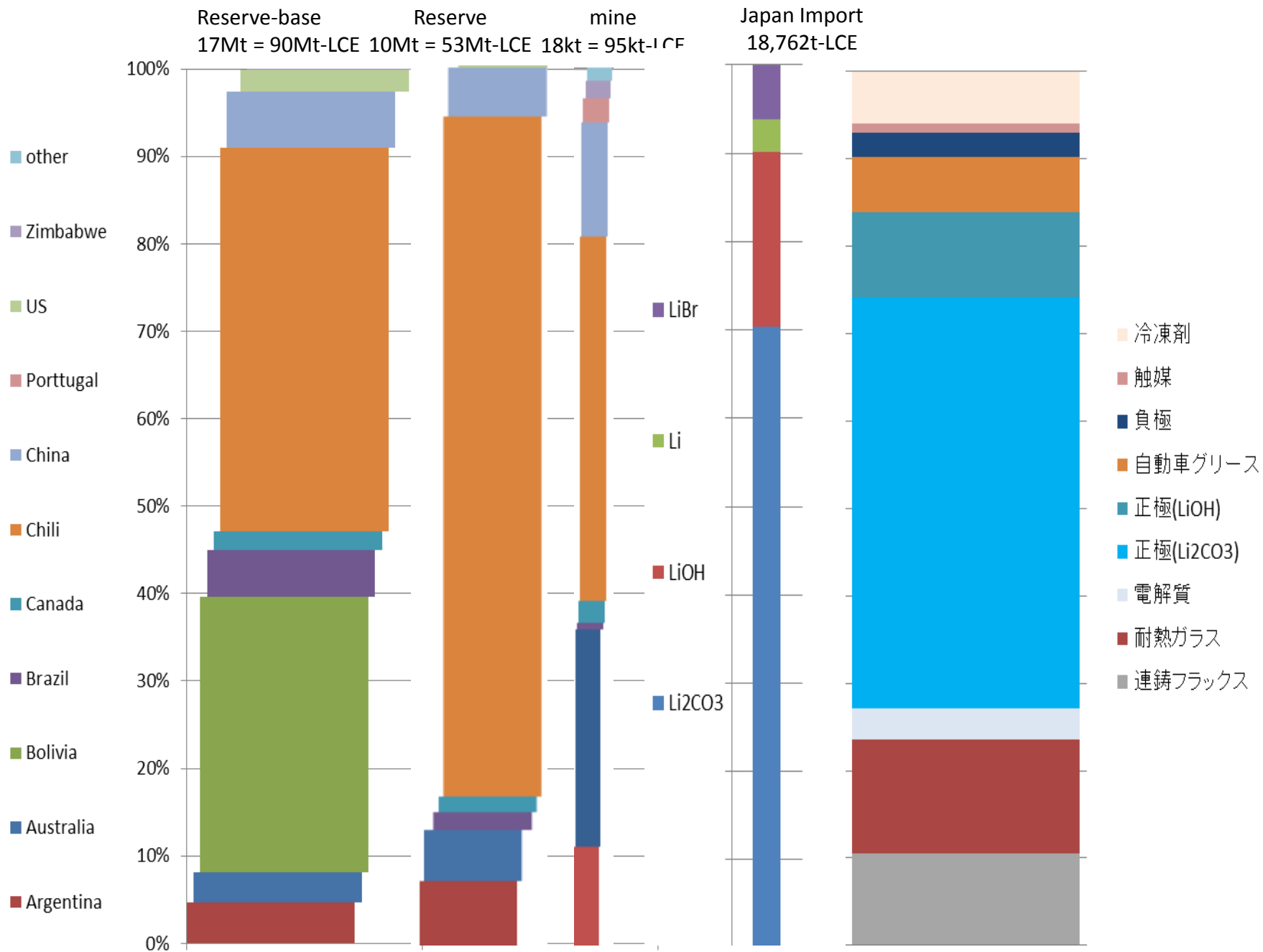
 B 60 0.14 47TK 101	C	N	O	F	Ne
 Al 9.2 0.05 31CN 163	 Si 7.2 0.03 65CN 169	 P 35CN 114	S 126	Cl 130	Ar
 Ga  26 7.3 157	 Ge  3.7 32 71CN 241	 As   0.03 47 129	 Se 2.3 0.45 50JP 119	 Br 38IL 86	Kr
 In   2.3 1.2 50CN 250	 Sn  5.1 2.5 37CN 153	 Sb   0.52 0.06 91CN 136	 Te  0.29 10 44JP 88	 I 59CL 159	Xe
Tl 13 0.4 67	 Pb   3.4 0.03 43CN 128	 Bi  0.53 0.02 62CN 221	Po	At	Rn

n

Ac	Th	Pa	U 2.0 22
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「概説 資源端重量」 NIMS-EMC 材料環境情報データ No.18

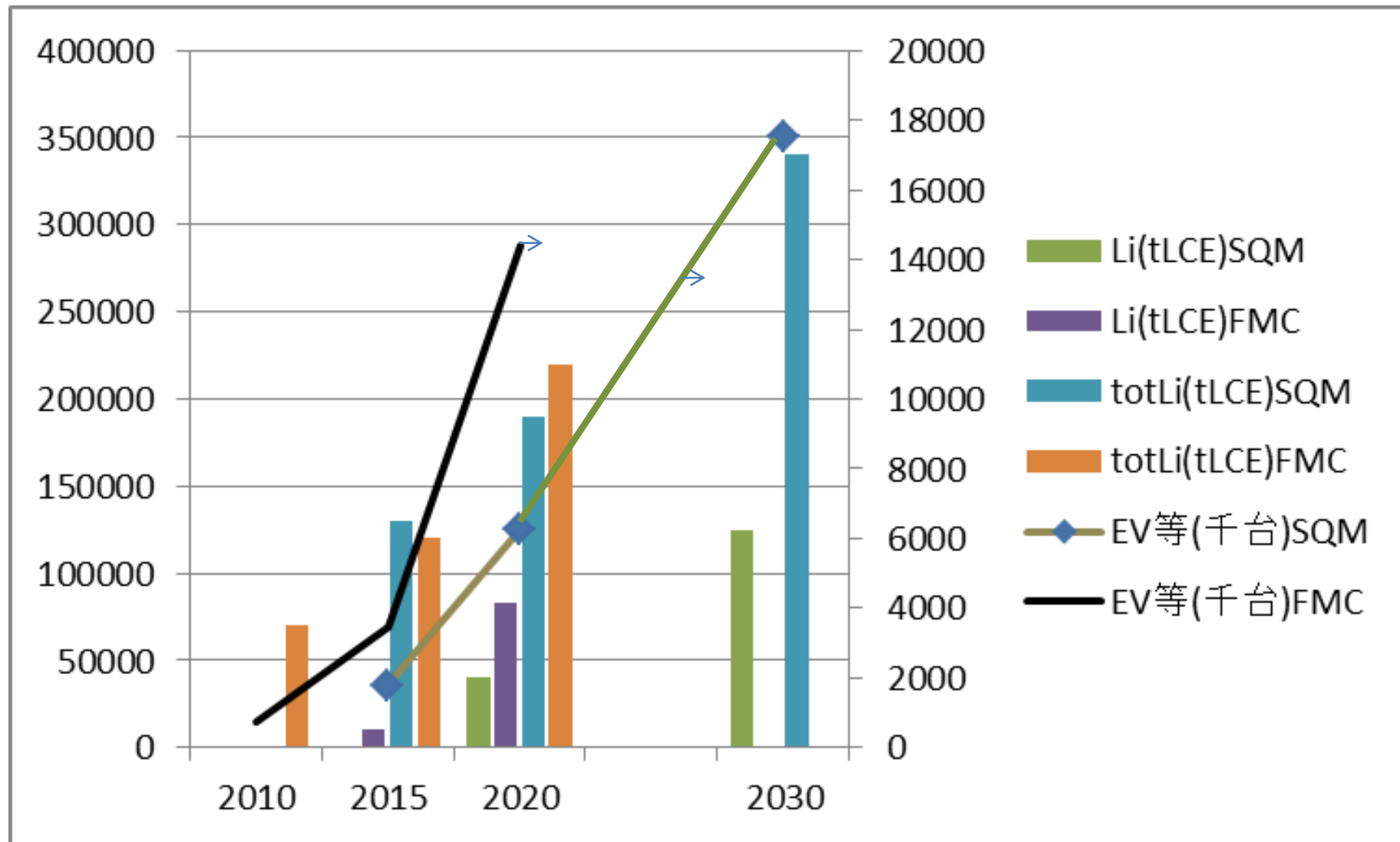




2010の耐用年数 $\{53000\}/95=557$

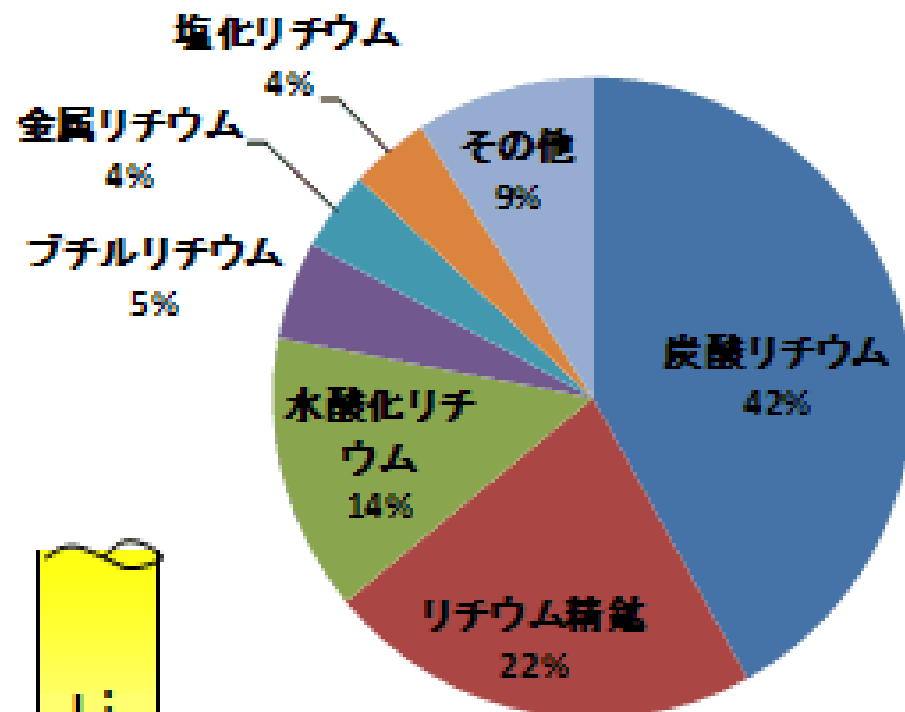
2030の耐用年数 $\{53000-(95+350)*20/2\}/350=138$

2050の耐用年数 $\{53000-(95+(350-95)*2)*40/2\}/\{(350-95)*2+95\}=67$



HEV 0.2kg/car PHEV 6kg/car EV 12kg/car

製品別



用途別

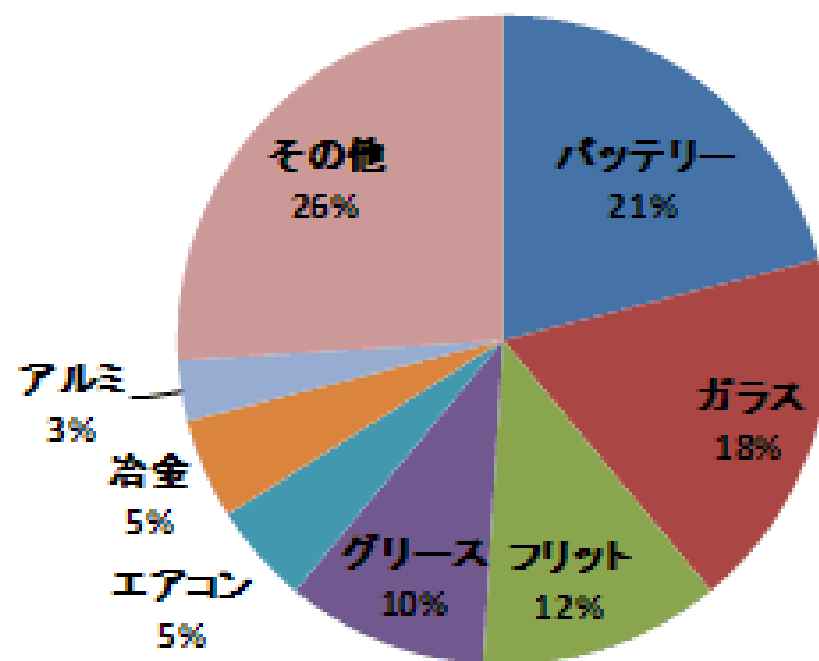
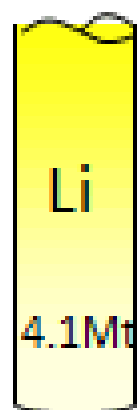
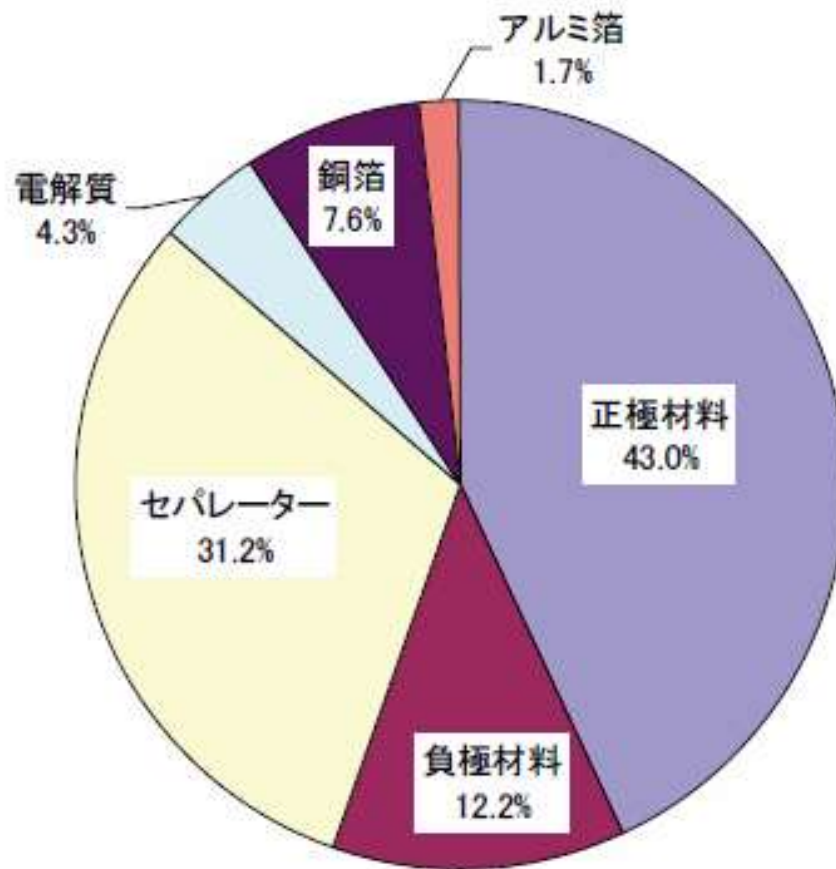


図1. 2009年製品別、用途別Li需要(出典: SQM)



21.1kt



Iron ore



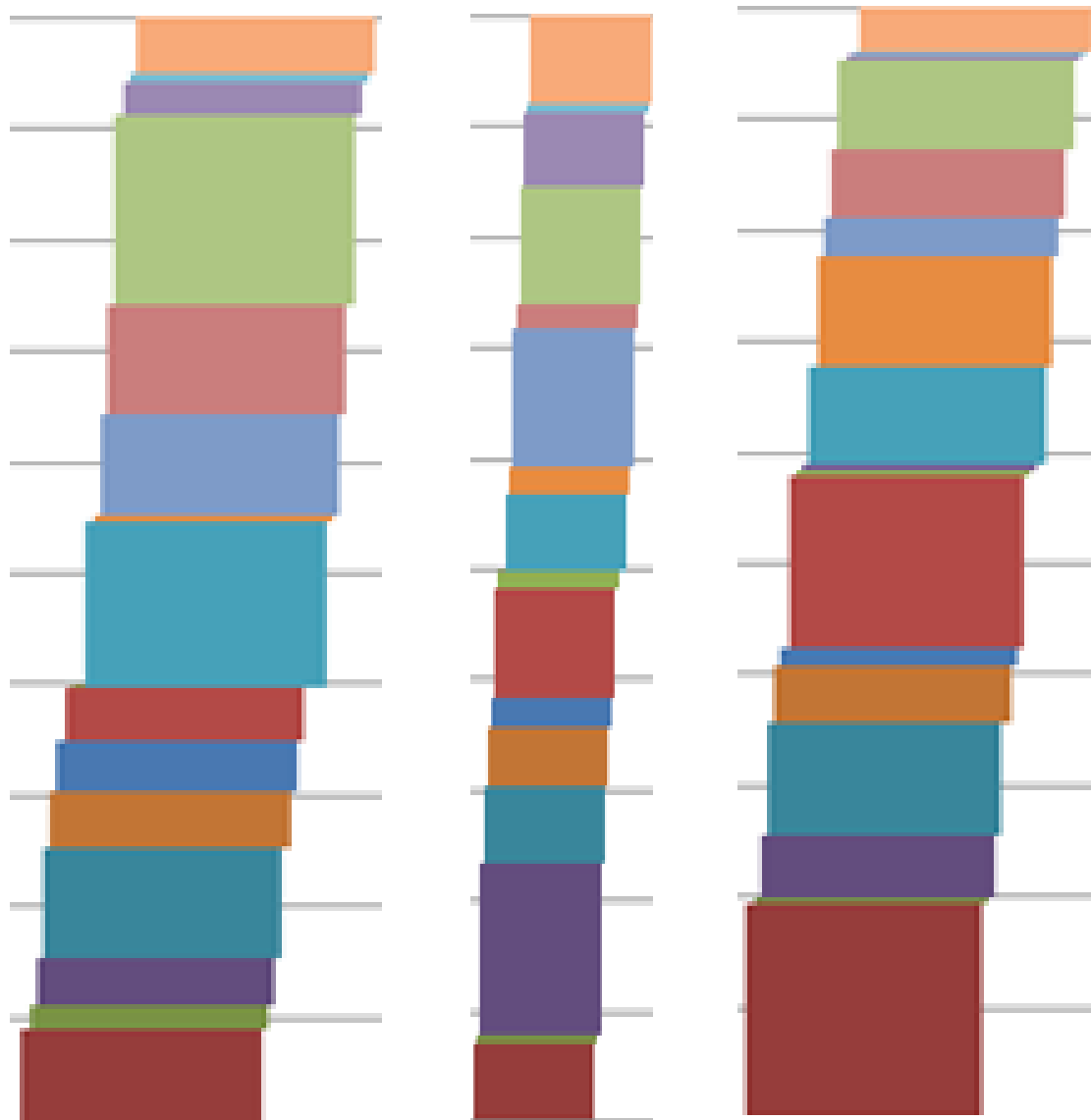
mine 2.4G, reserve 180G, reserve base 350G

Mn

- Other
- Ukraine
- South Africa
- Mexico
- India
- Gabon
- China
- Brazil
- Australia

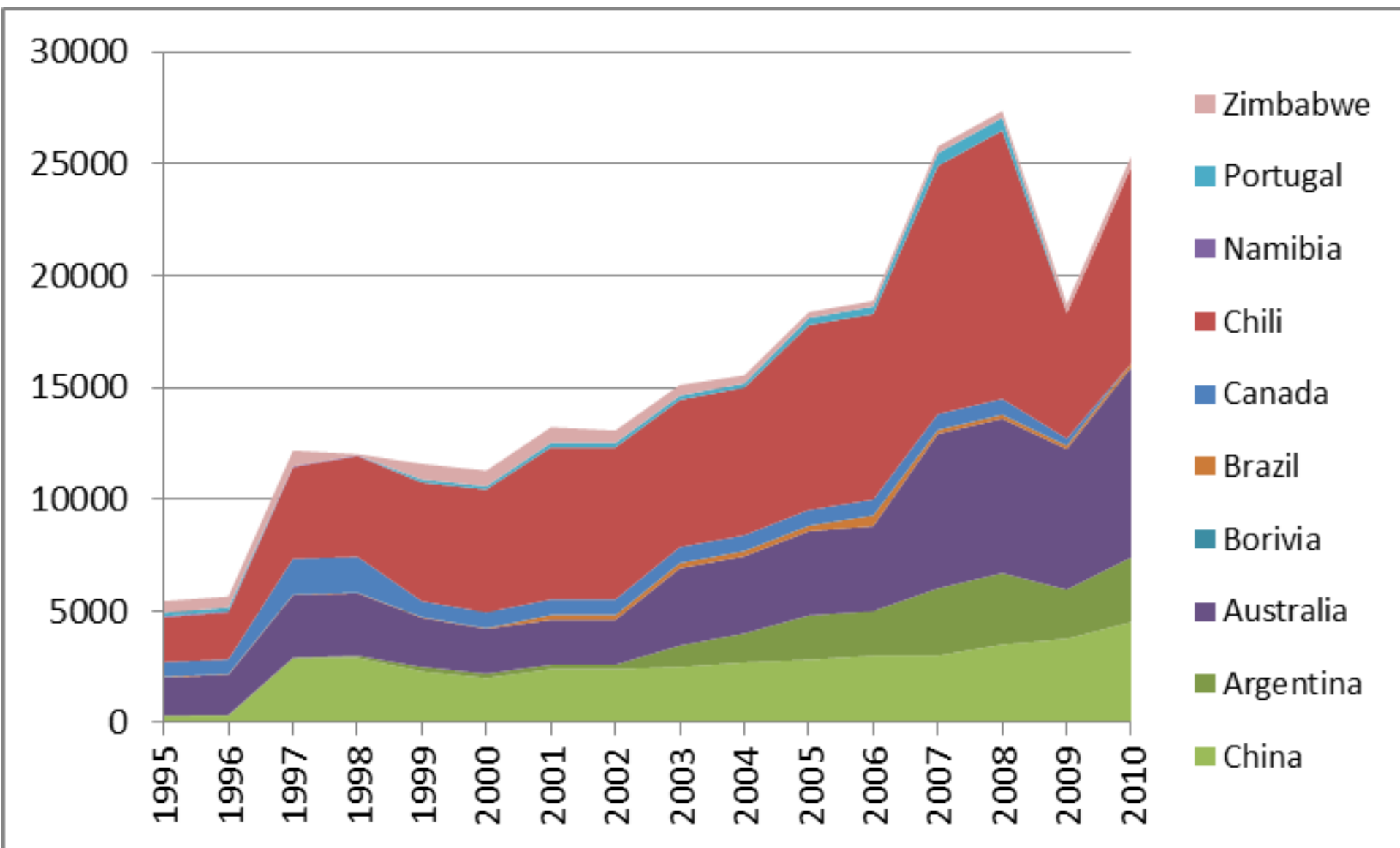
mine 13M, reserve 630M, reserve base 5.2G

Ni

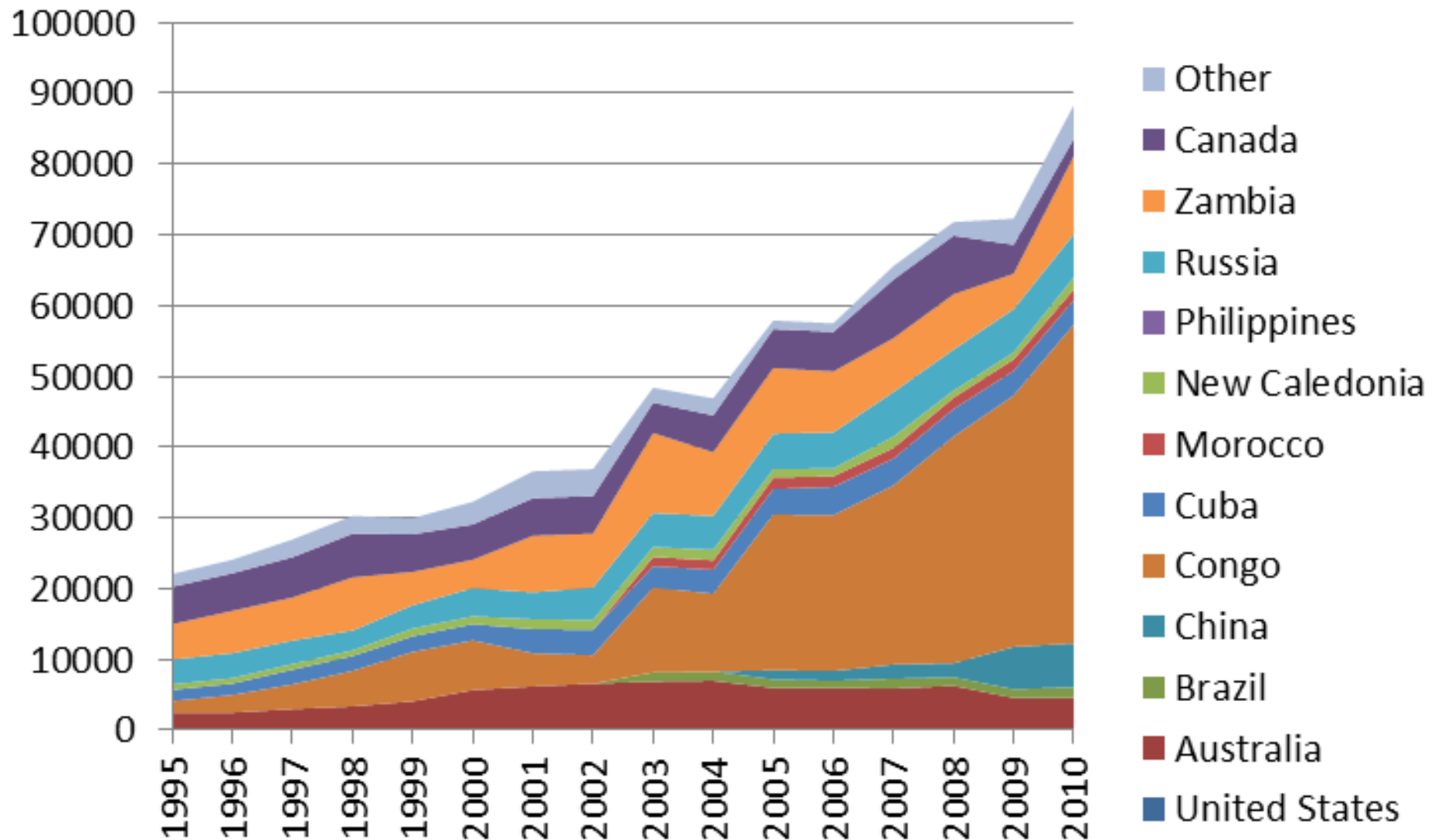


mine 1.55M, reserve 76M, reserve base 150M

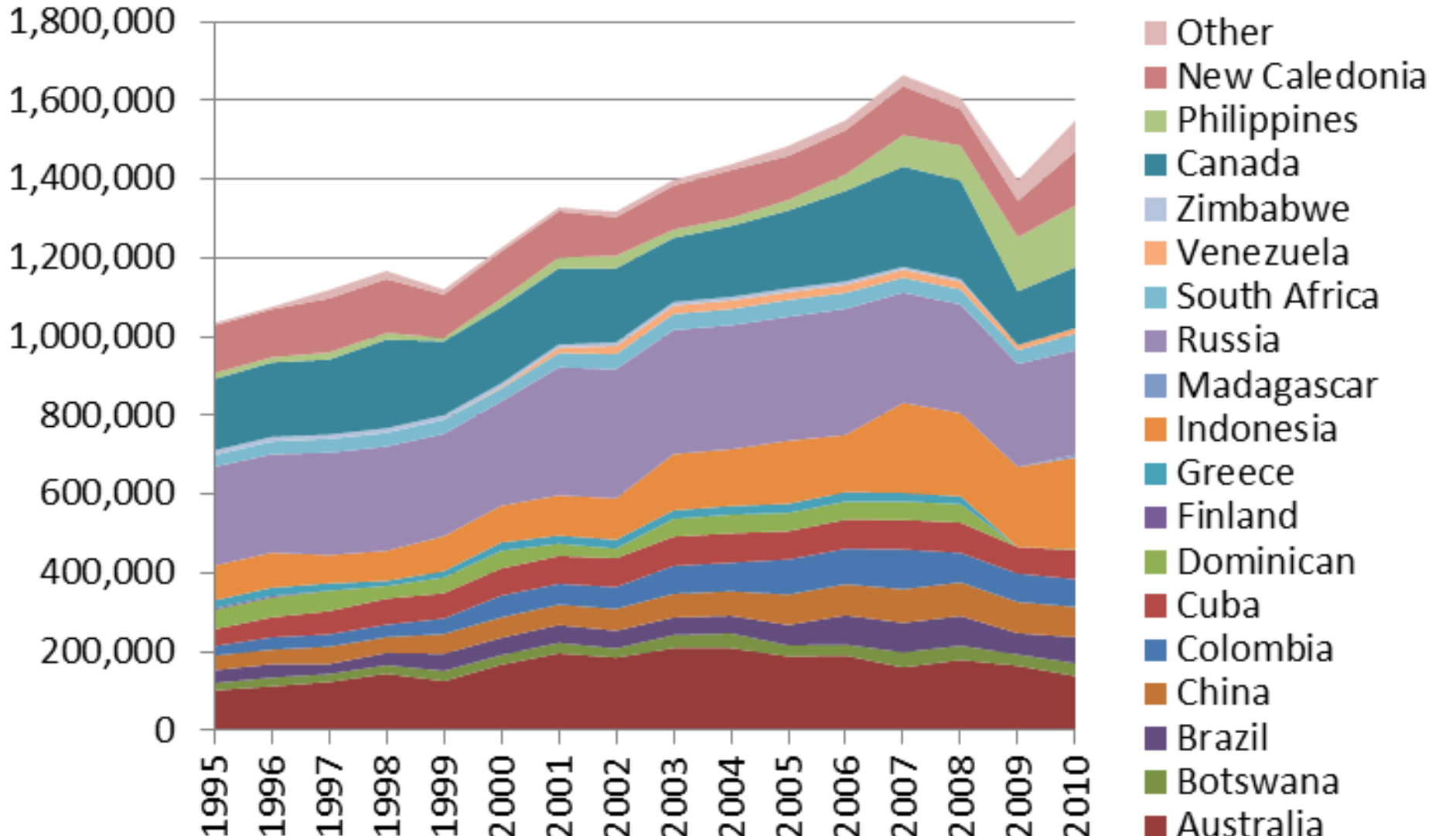
Li mine



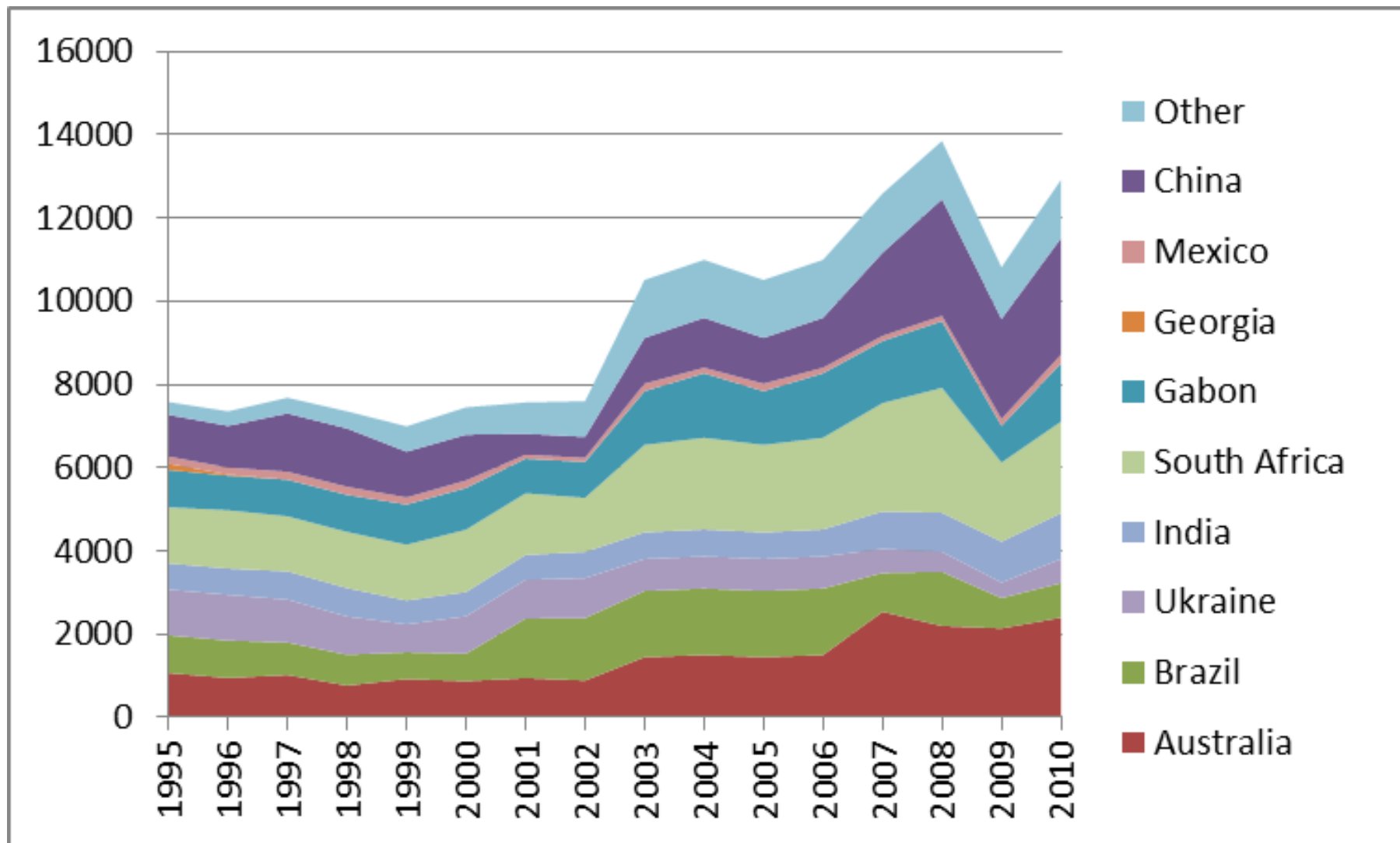
Co

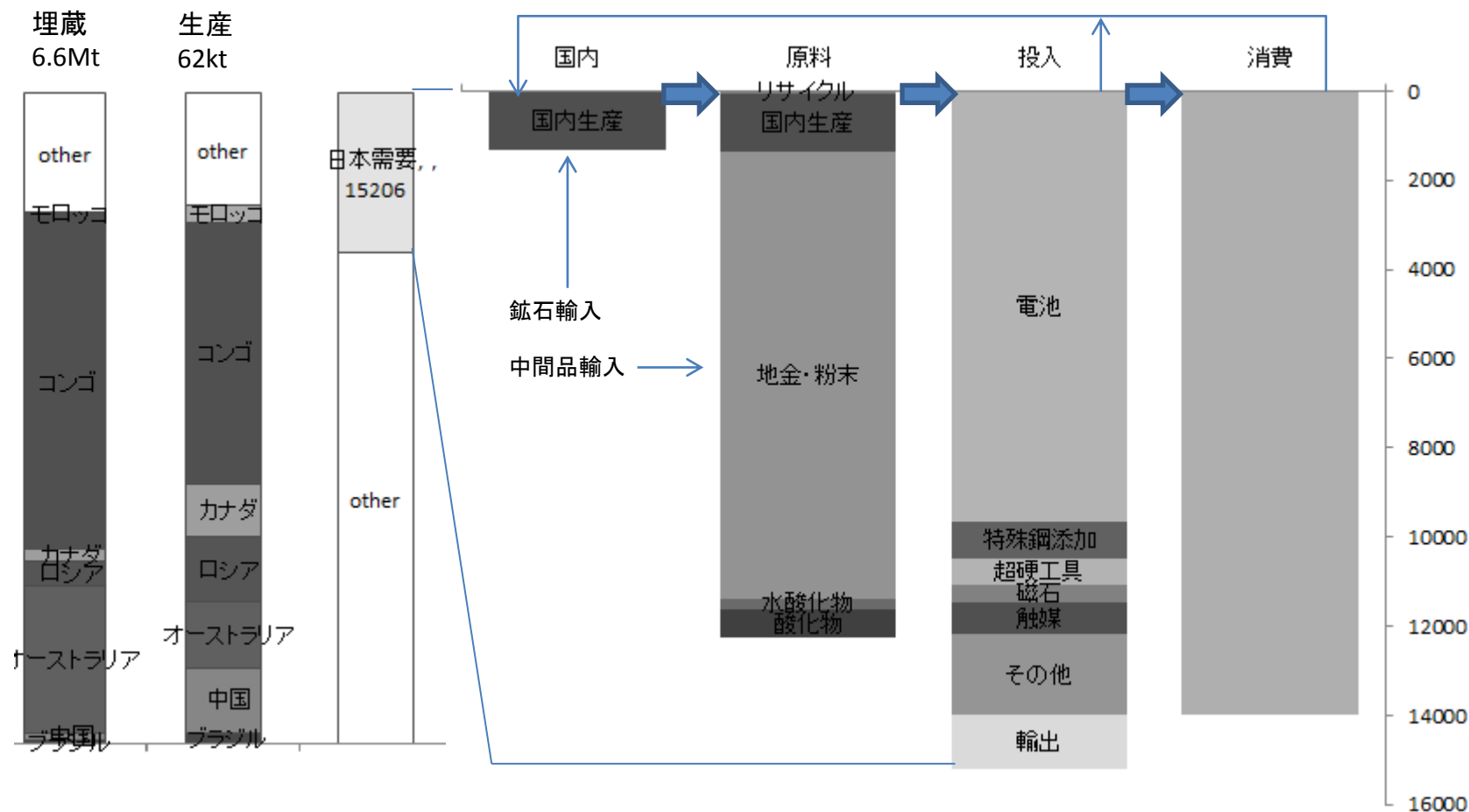


Ni



Mn





Co

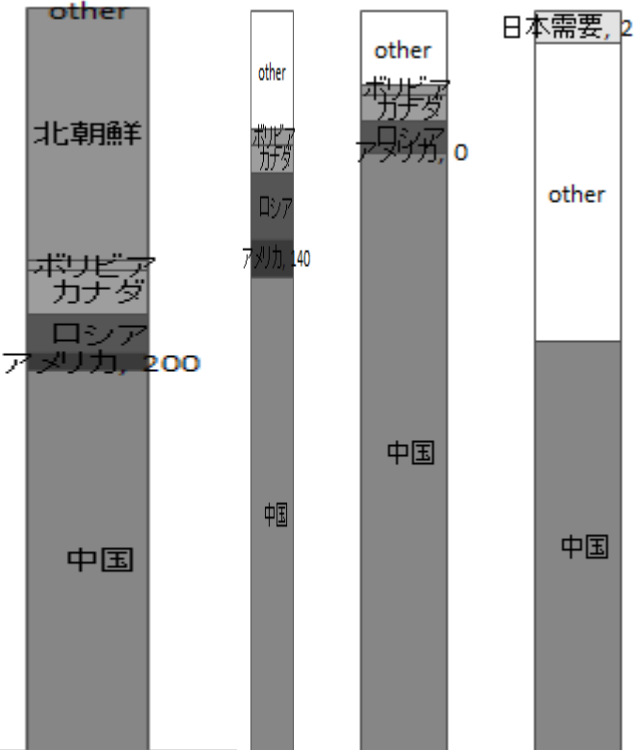
リサイクルの統計資料はない。触媒から46t程度が回収されている。使用先は特殊鋼添加物が多い。電池からのリサイクルは今後の課題。

埋蔵量
ベース
8.2Mt

埋蔵量
2.8Mt

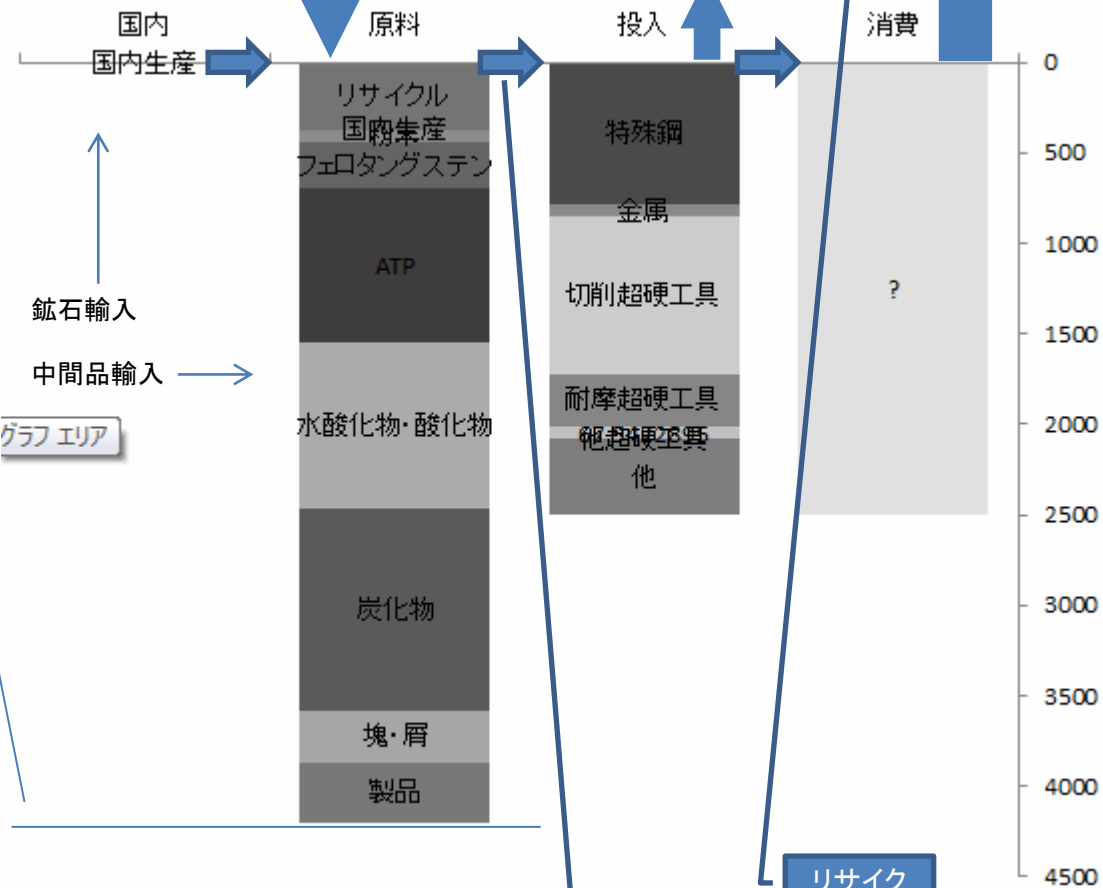
産出量
58kt

日本需要, 2.1



産出量
の100倍
を同じ幅
にした

産出量
の200倍
を同じ幅
にした



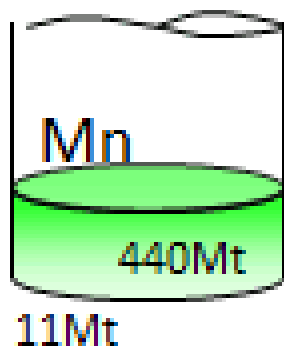
リサイク
ル量と同
じ幅にし
た

太さに意
味はない

グラフエリア

1000 ton 491.23

普通鋼	353.31
特殊鋼	110.92
アルミ合金	5.00
二酸化マンガン	22.00



建設	56.69
産業機械	13.01
電気機械	8.55
家庭用業務用機械	3.36
船舶	15.74
自動車	58.60
鉄道	0.24
他輸送機械	0.24
容器	6.57
その他	107.77
アルミ飲料缶	5.00
フェライト	22.00

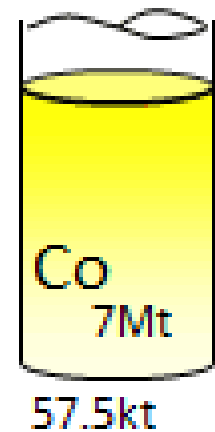
1000 ton 292.28

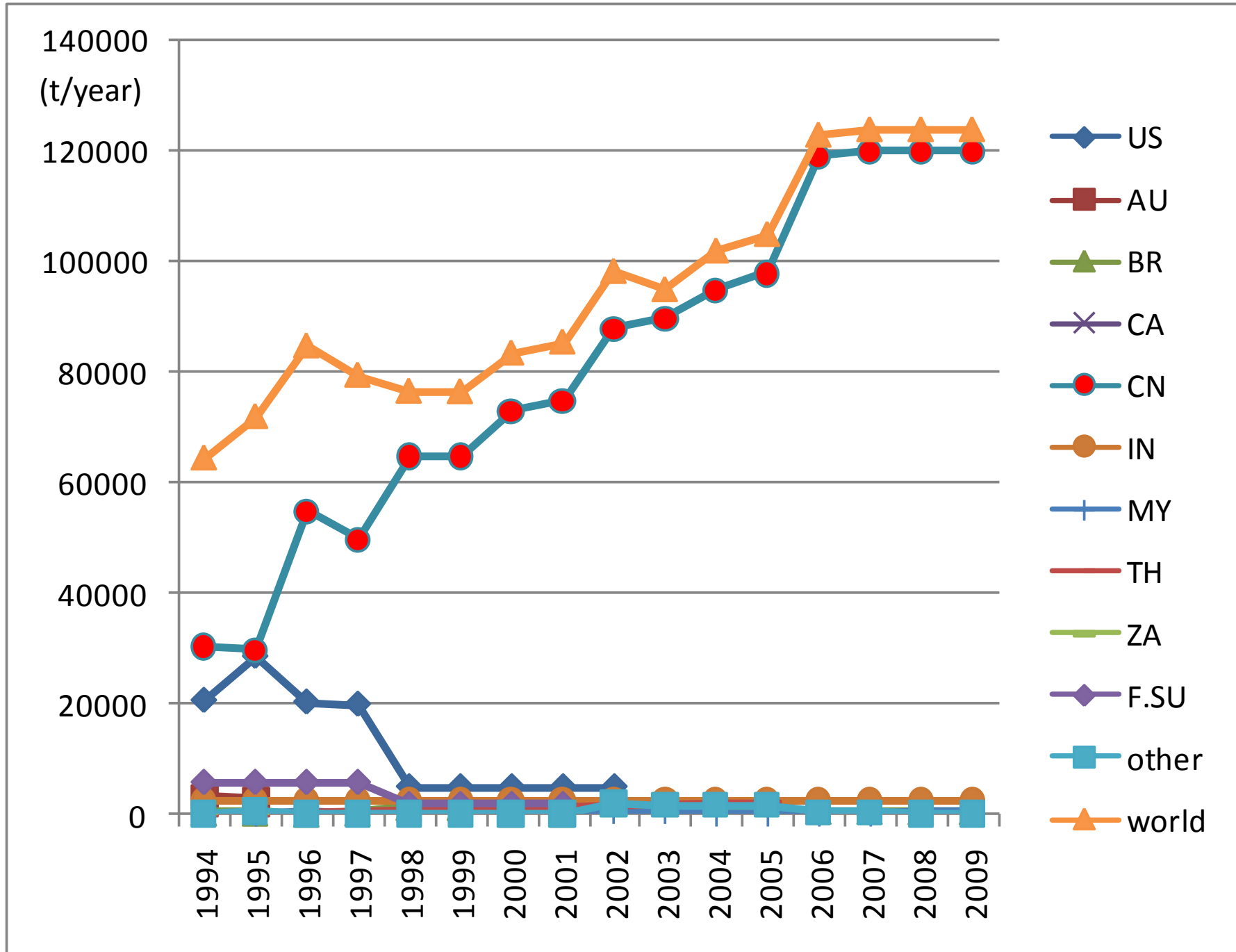
ステンレス鋼・スーパーアロイ	269.00
メッキ	10.00
触媒	1.32
磁性材料	1.84
非鉄合金	1.30
電池	6.26
その他	2.56

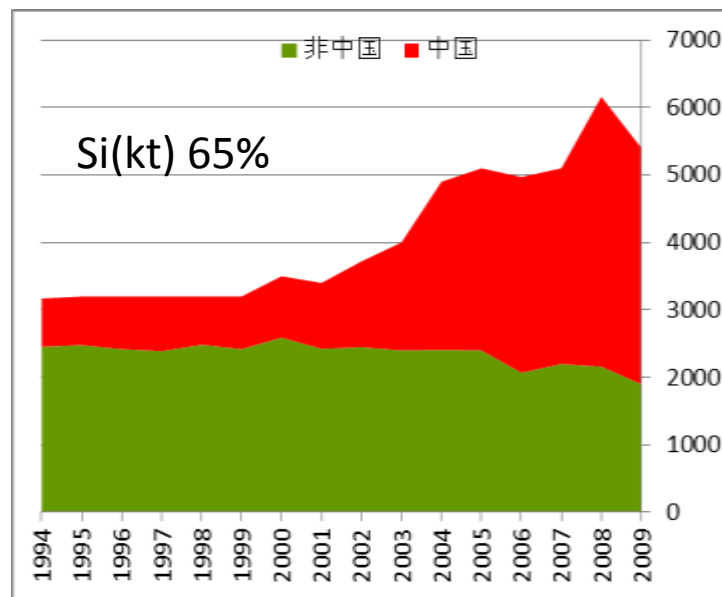
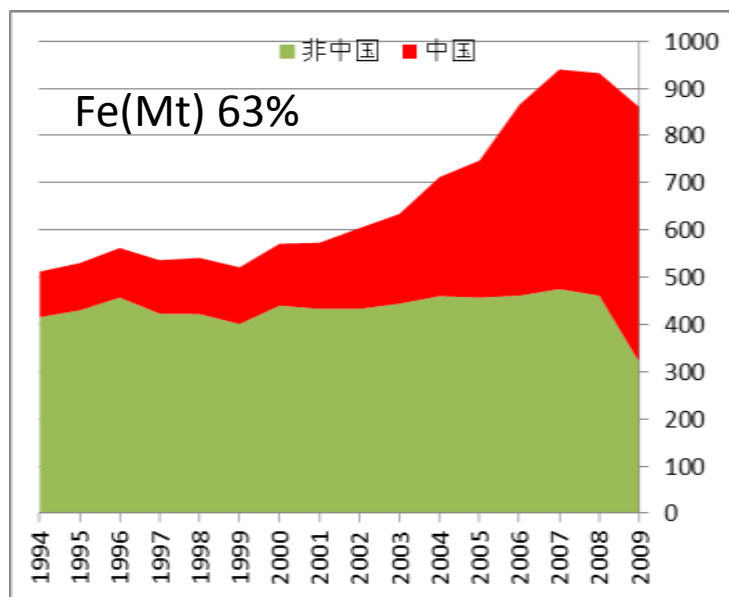
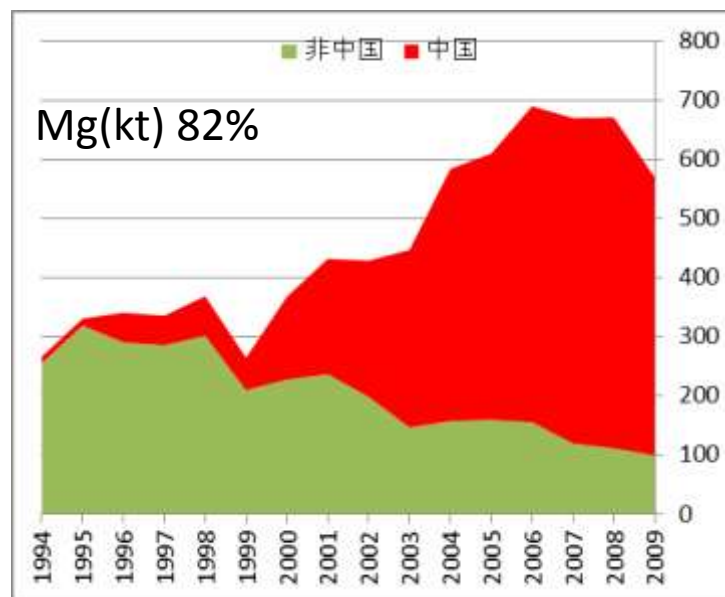
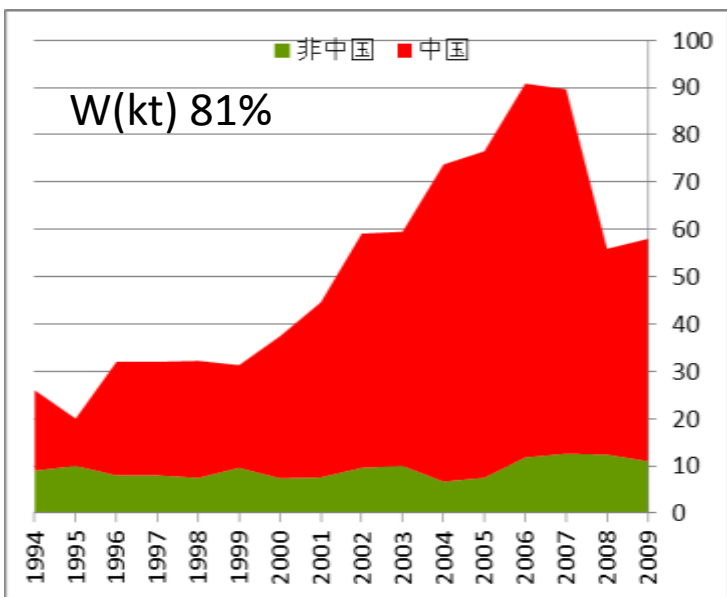
Ni
64Mt
1.55Mt

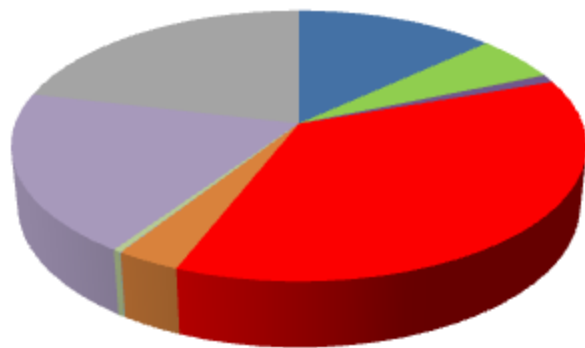
1000 ton	14.24
触媒	0.26
電池	10.70
特殊鋼	1.04
磁性材料	0.17
管板棒線	0.40
超硬工具	0.31
その他	1.36

携帯電話
 ノートパソコン
 デジタルカメラ
 電動工具
 航空機
 切削工具
 電子機器
 自動車
 石油化学
 自動車タイヤ
 VTR
 印刷・窯業
 磁気記録媒体









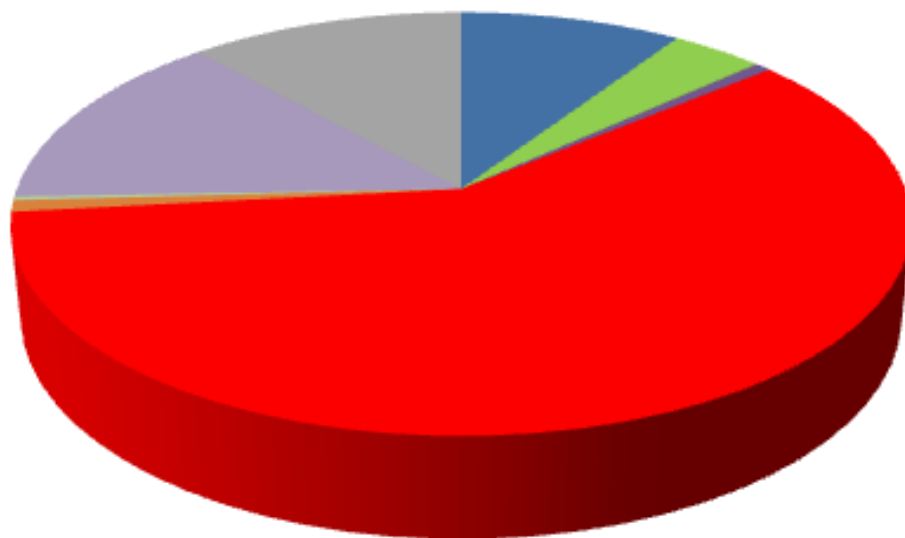
埋蔵量 99,000,000 ton

US
AU
BR
CA
CN
IN
MY
TH
ZA
F.SU
other

年間消費量

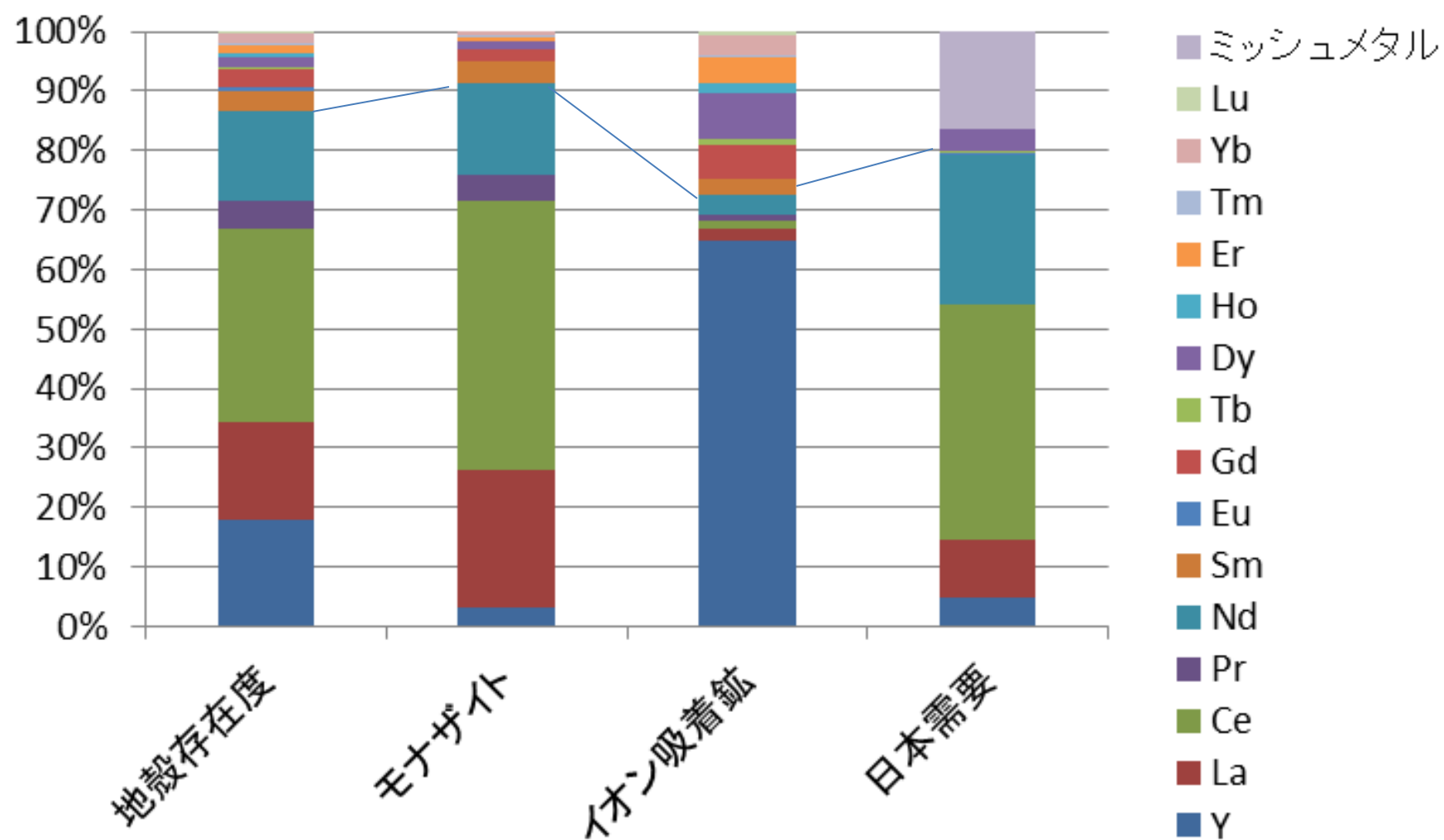
1994年 64,500ton

2009年 124,000 ton

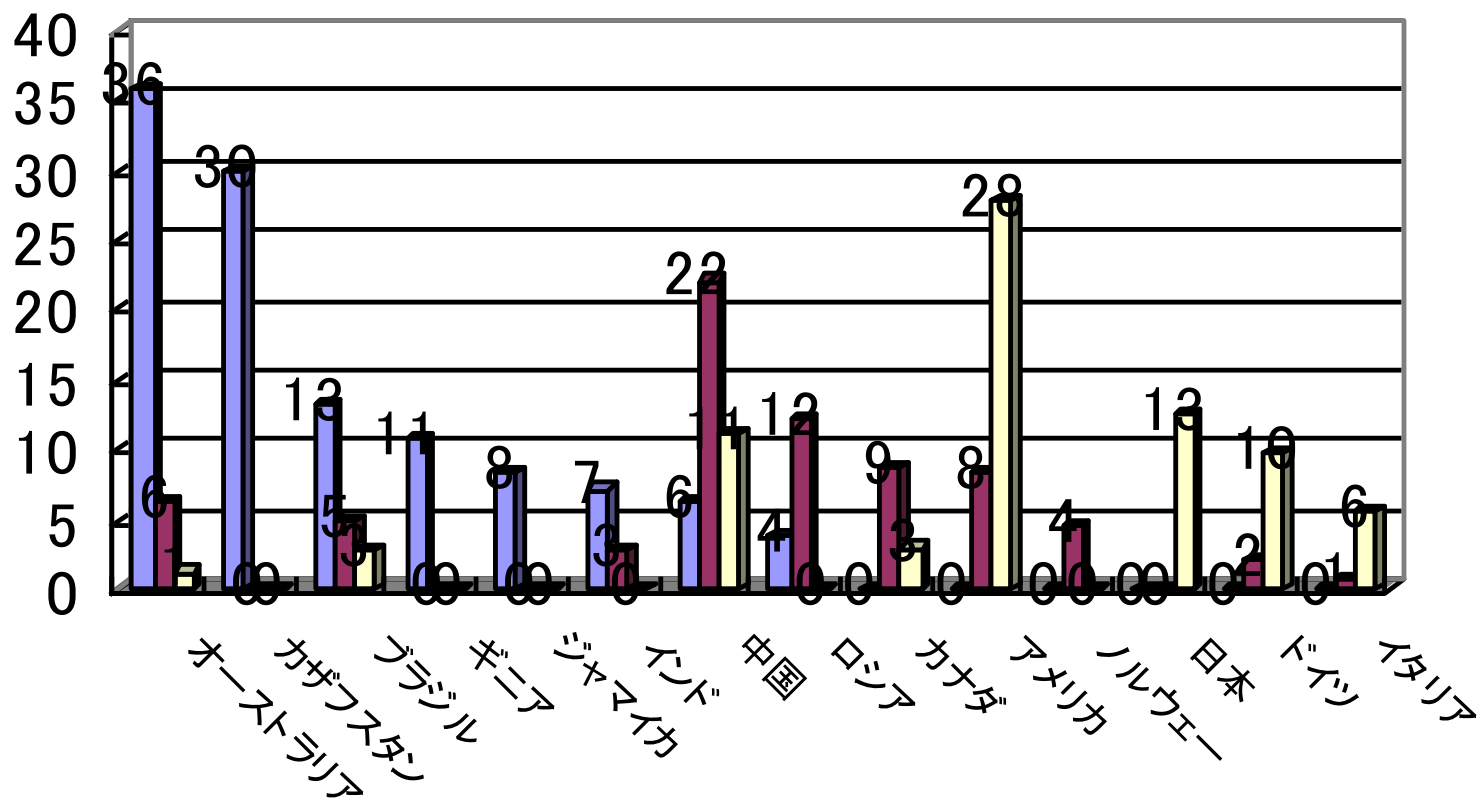


埋蔵量ベース 150,000,000 ton

US
AU
BR
CA
CN
IN
MY
TH
ZA
F.SU
other

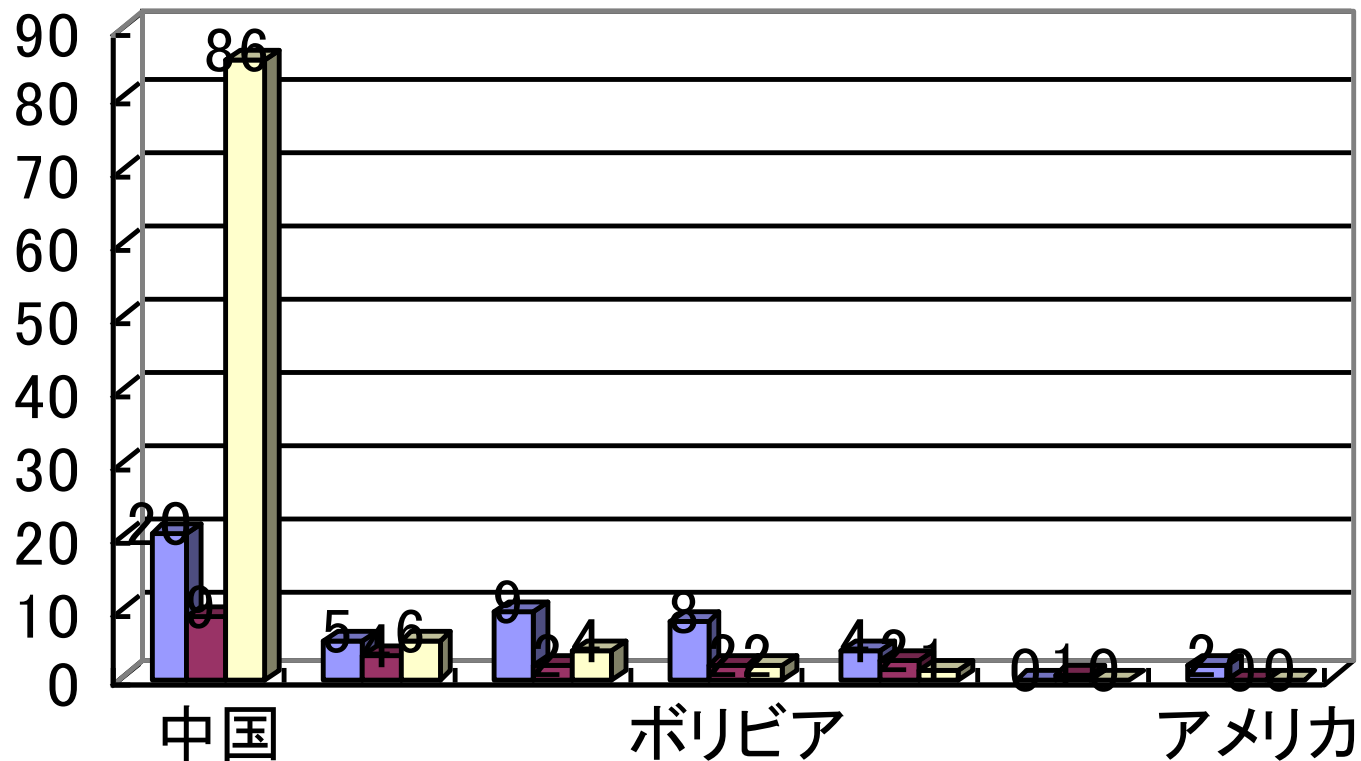


Al



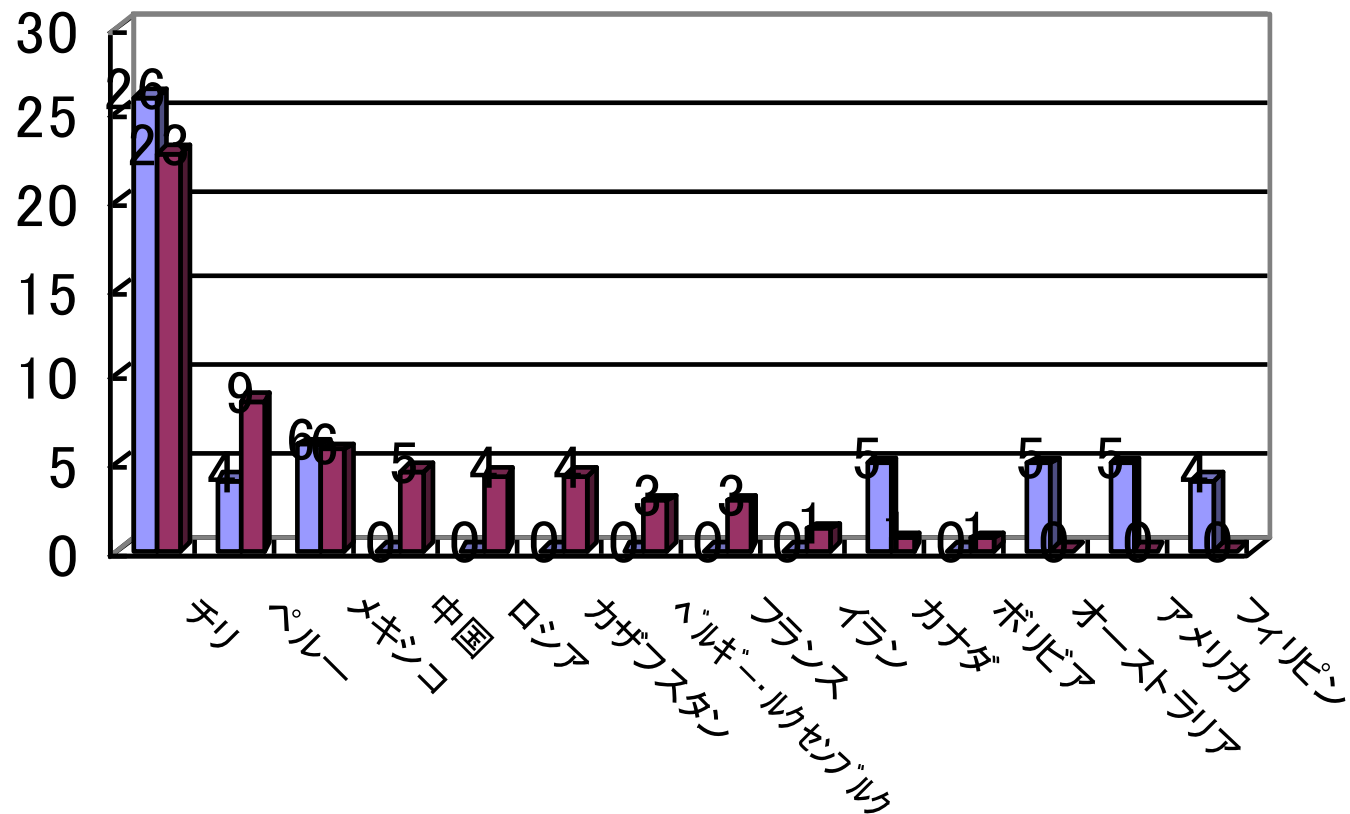
Sb

resB ore metal



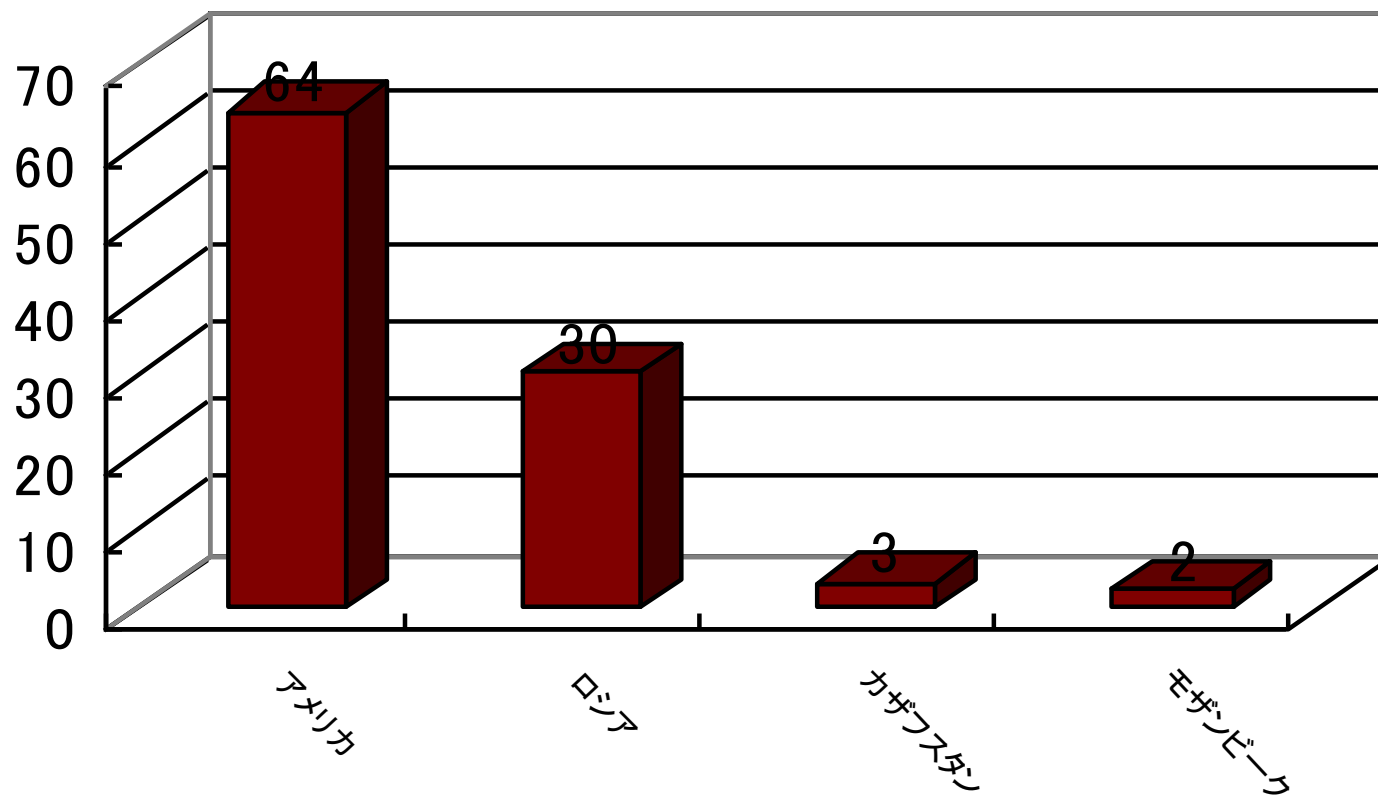
As

res As₂O₃

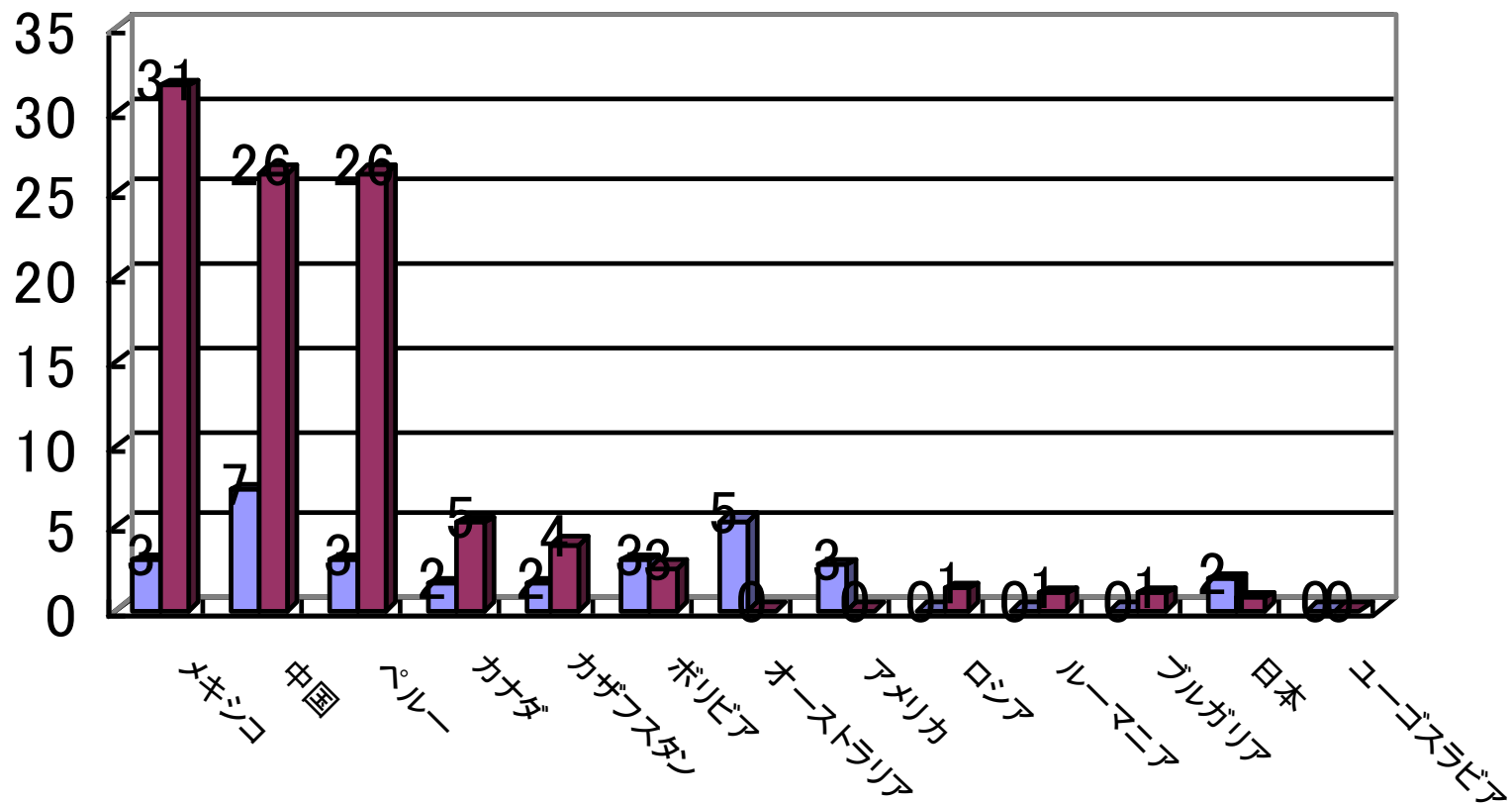


Be

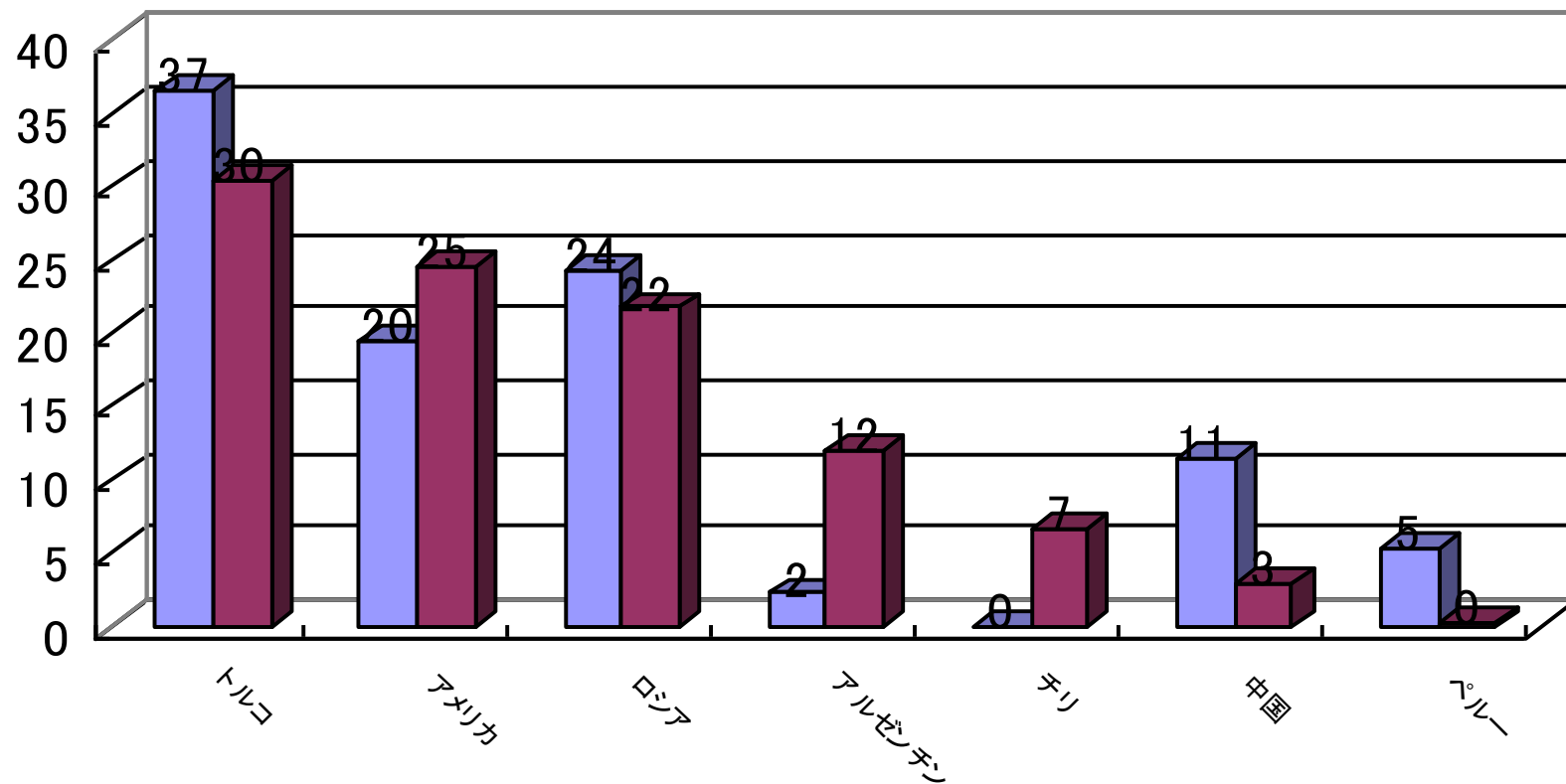
■ Beryl



Bi

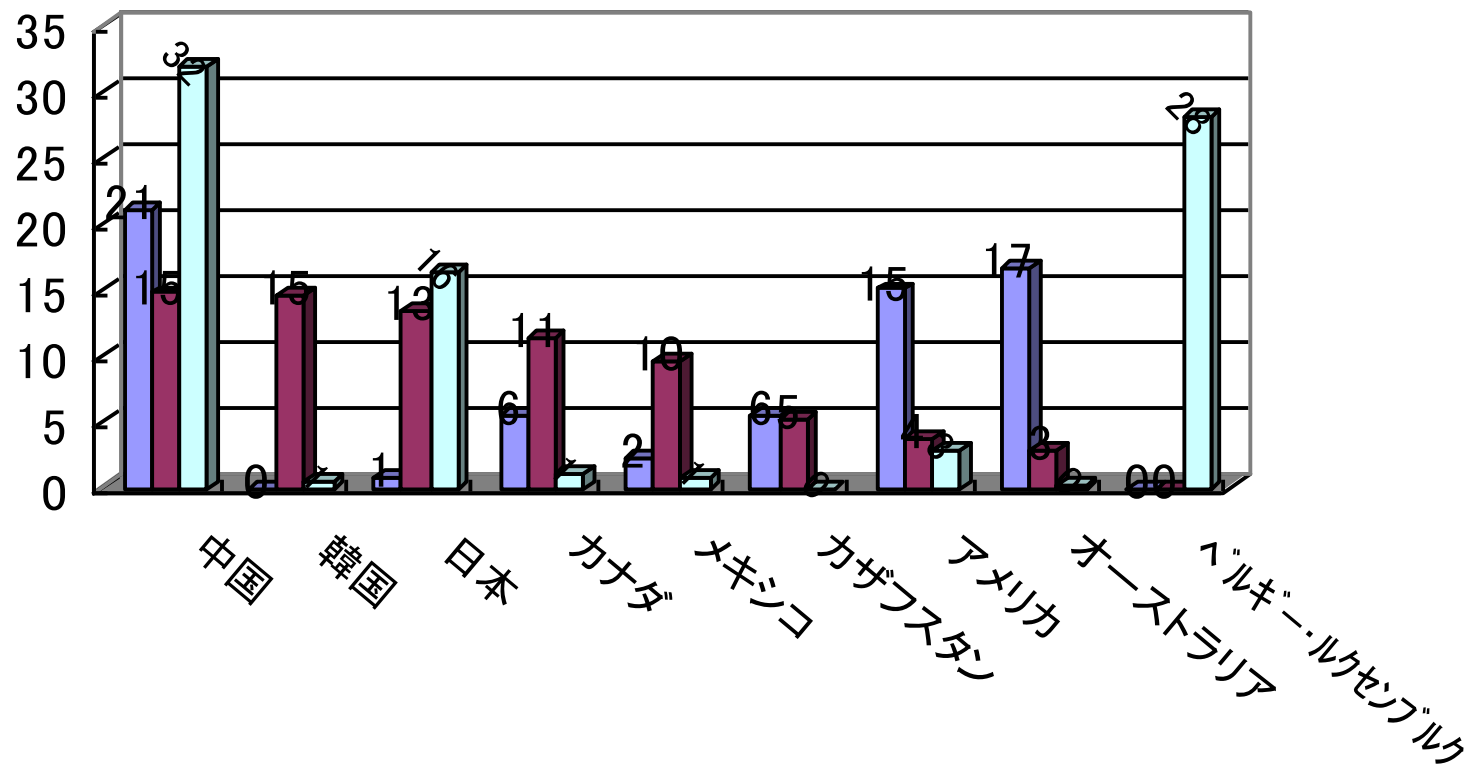


B



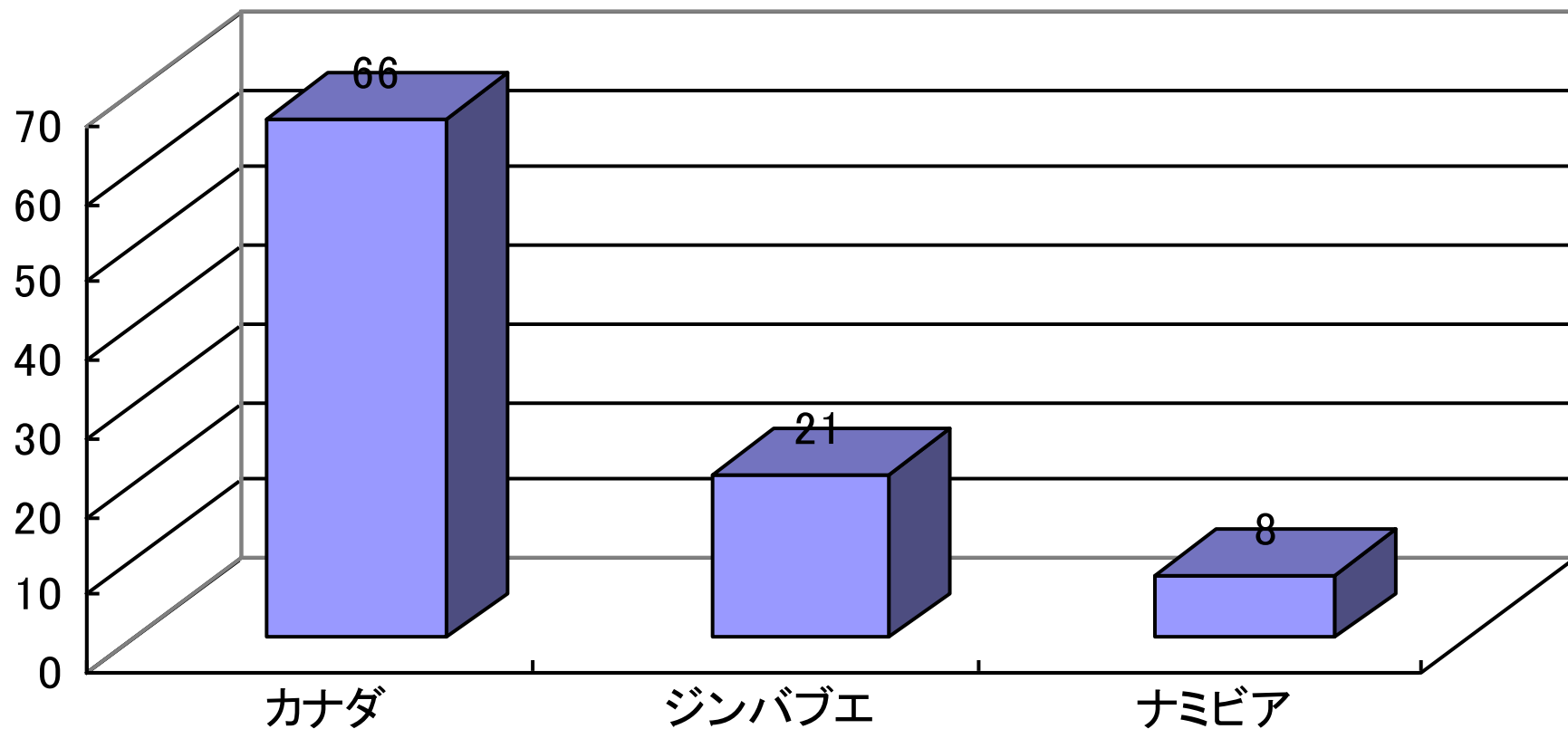
Cd

resB prd csm



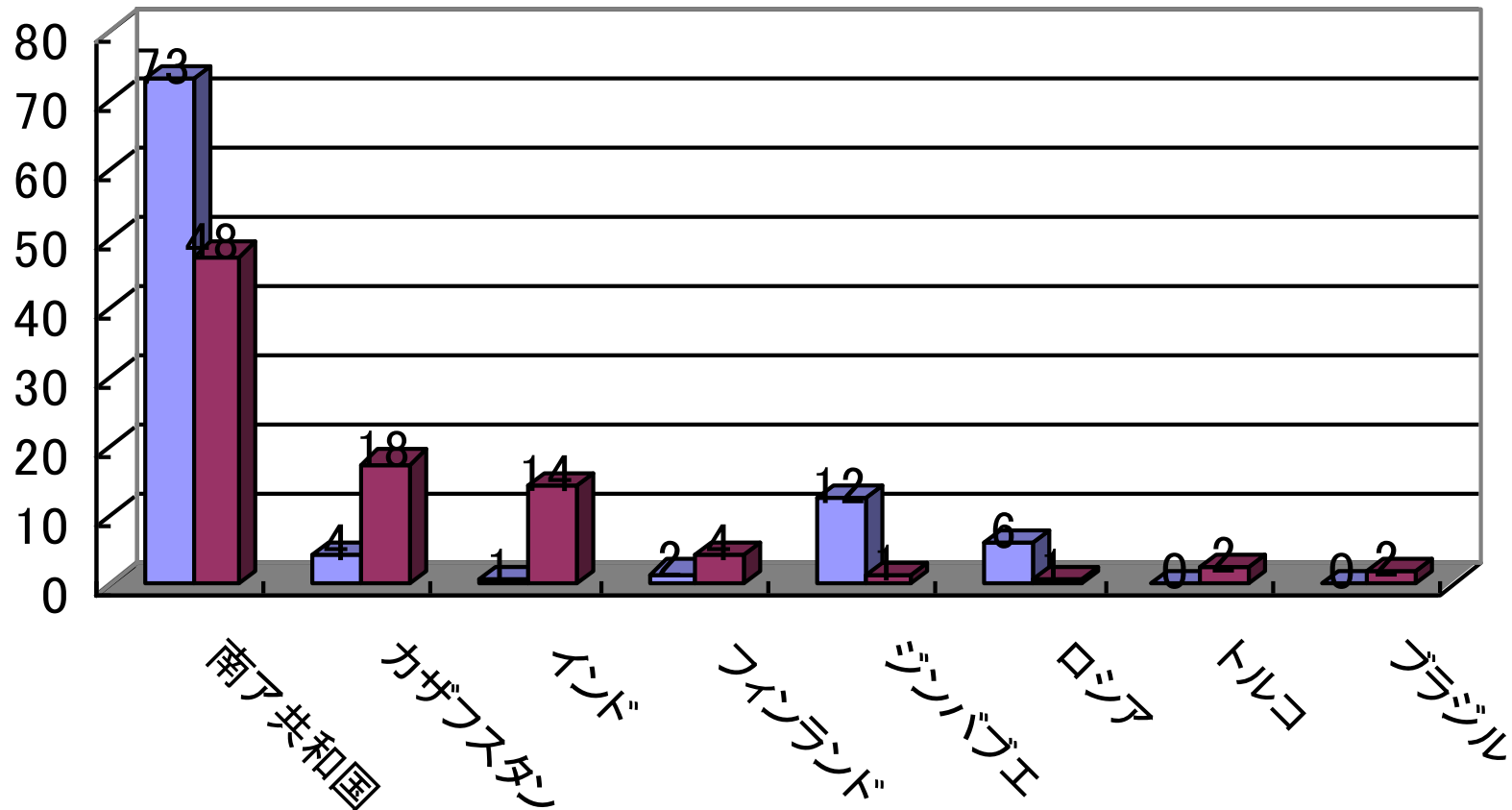
■ resB

Cs

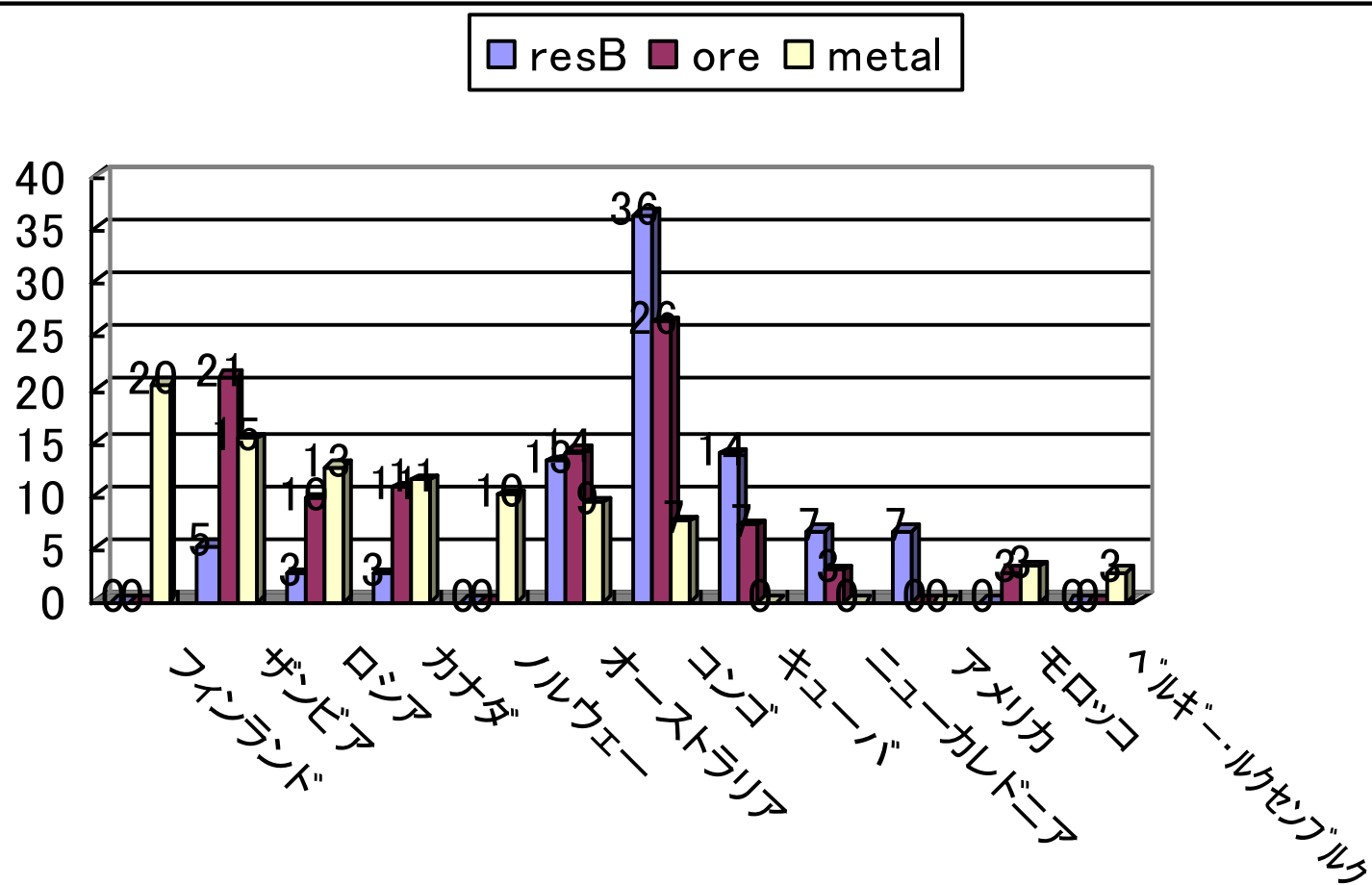


Cr

resB Ore

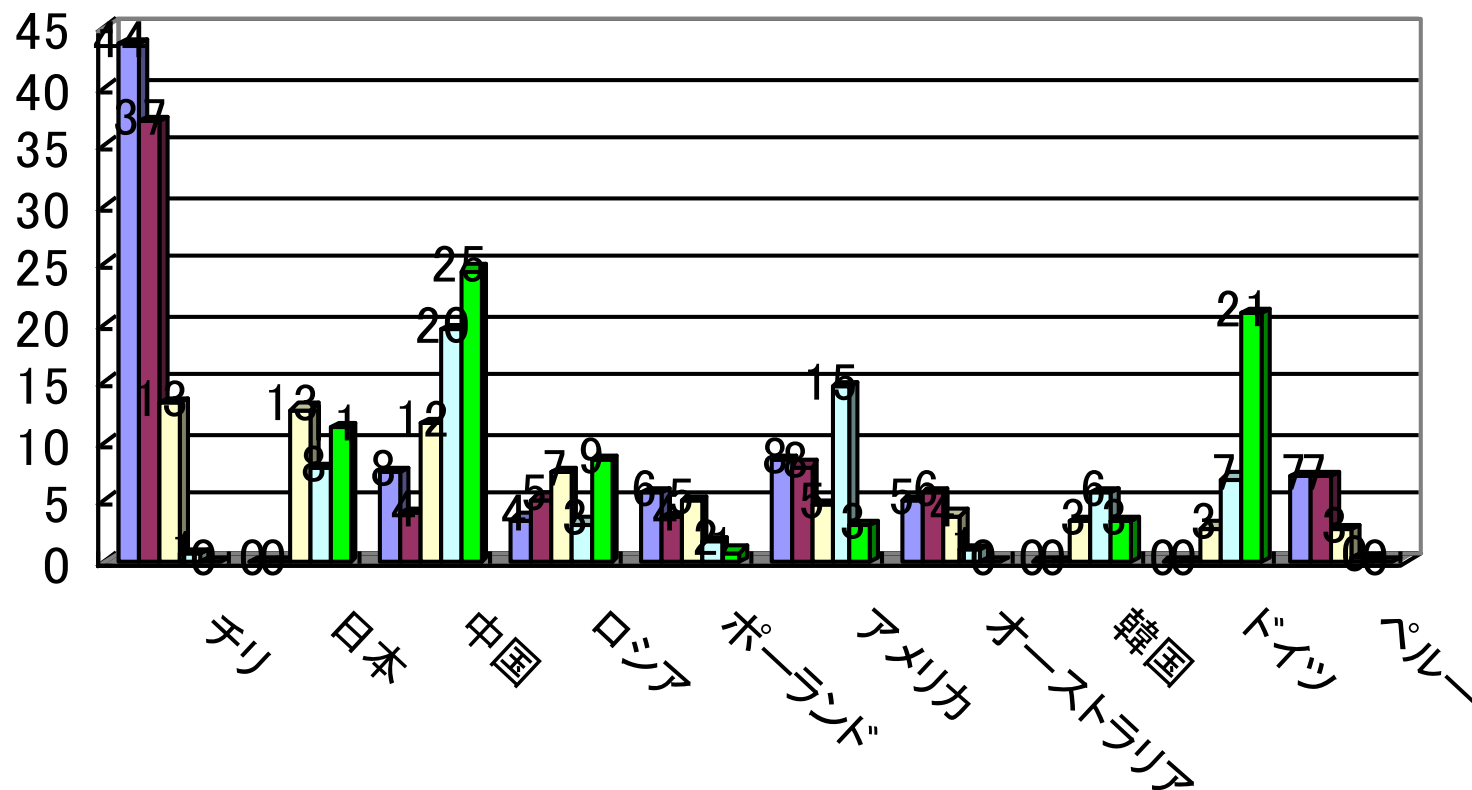


Co



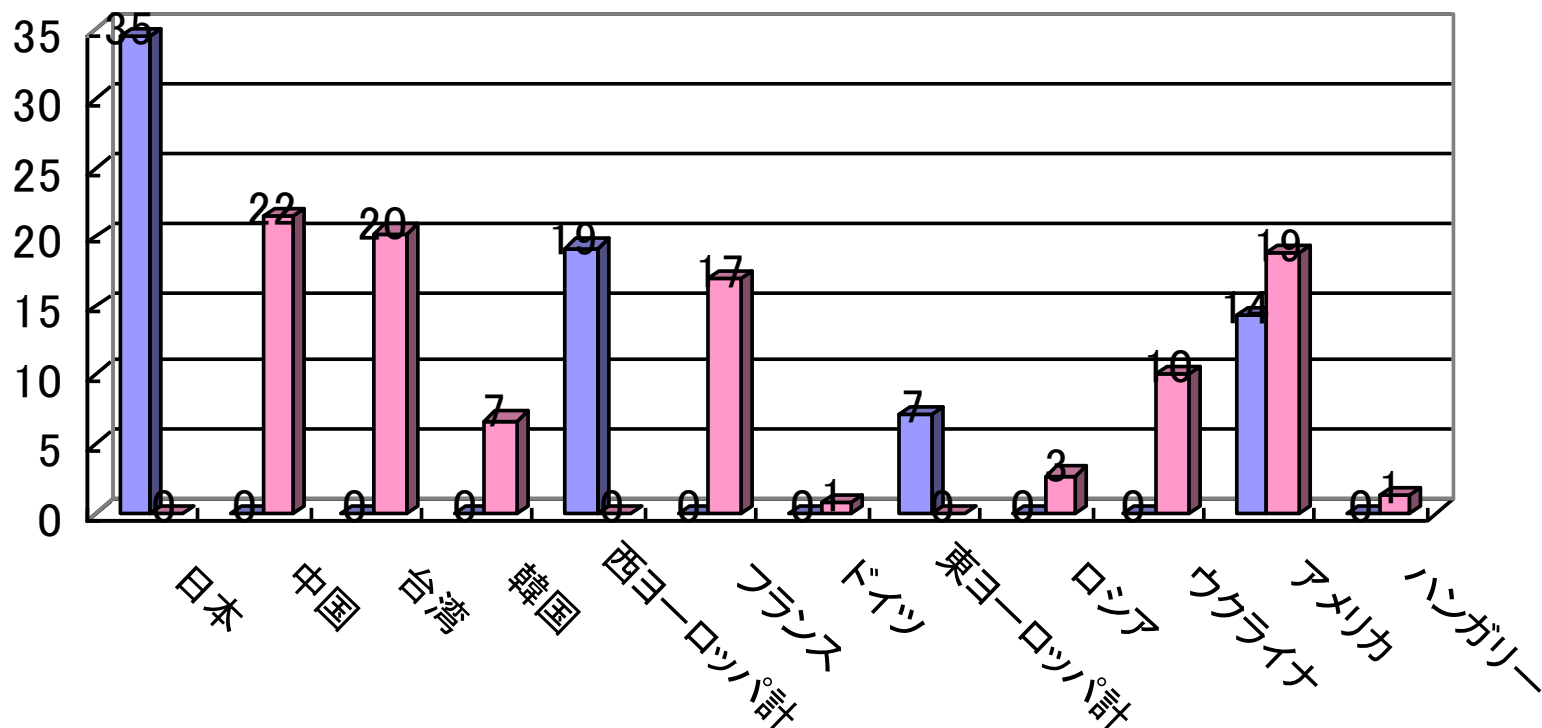
Cu

resB ore metal csmp scrap

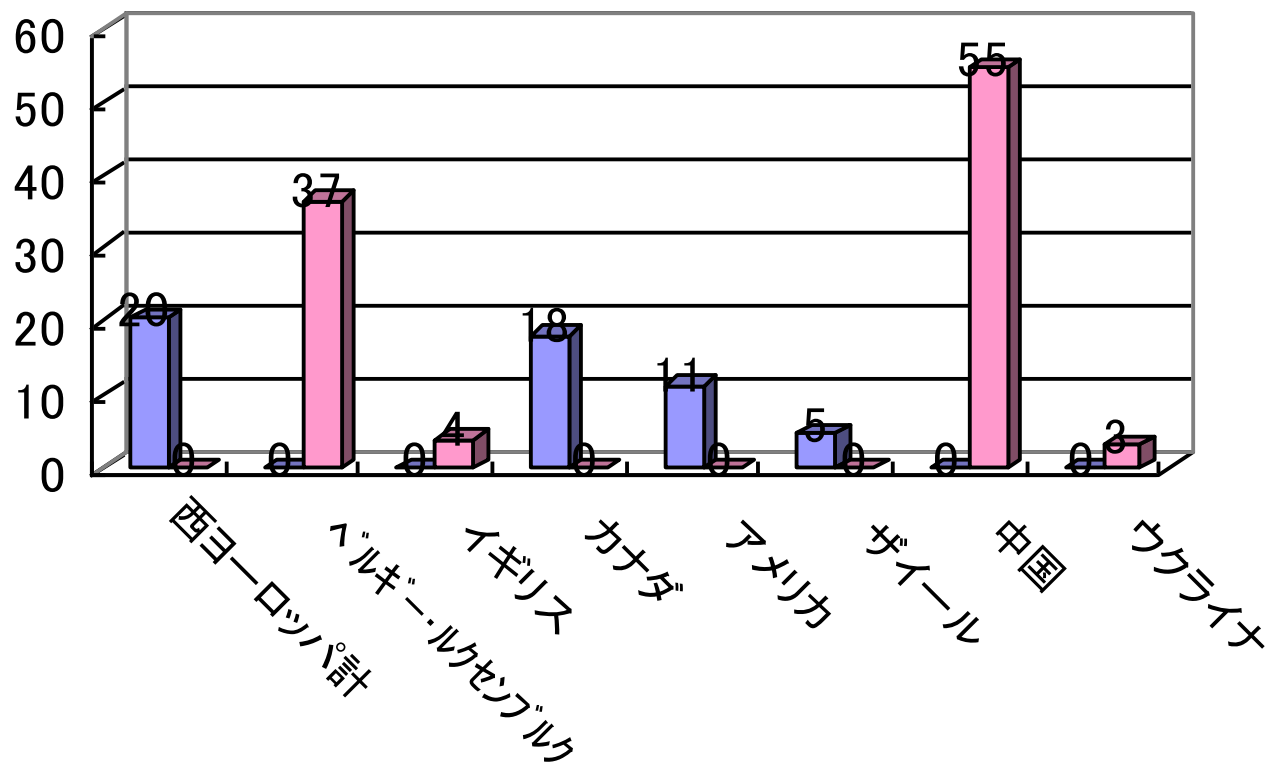


prod impt

Ga

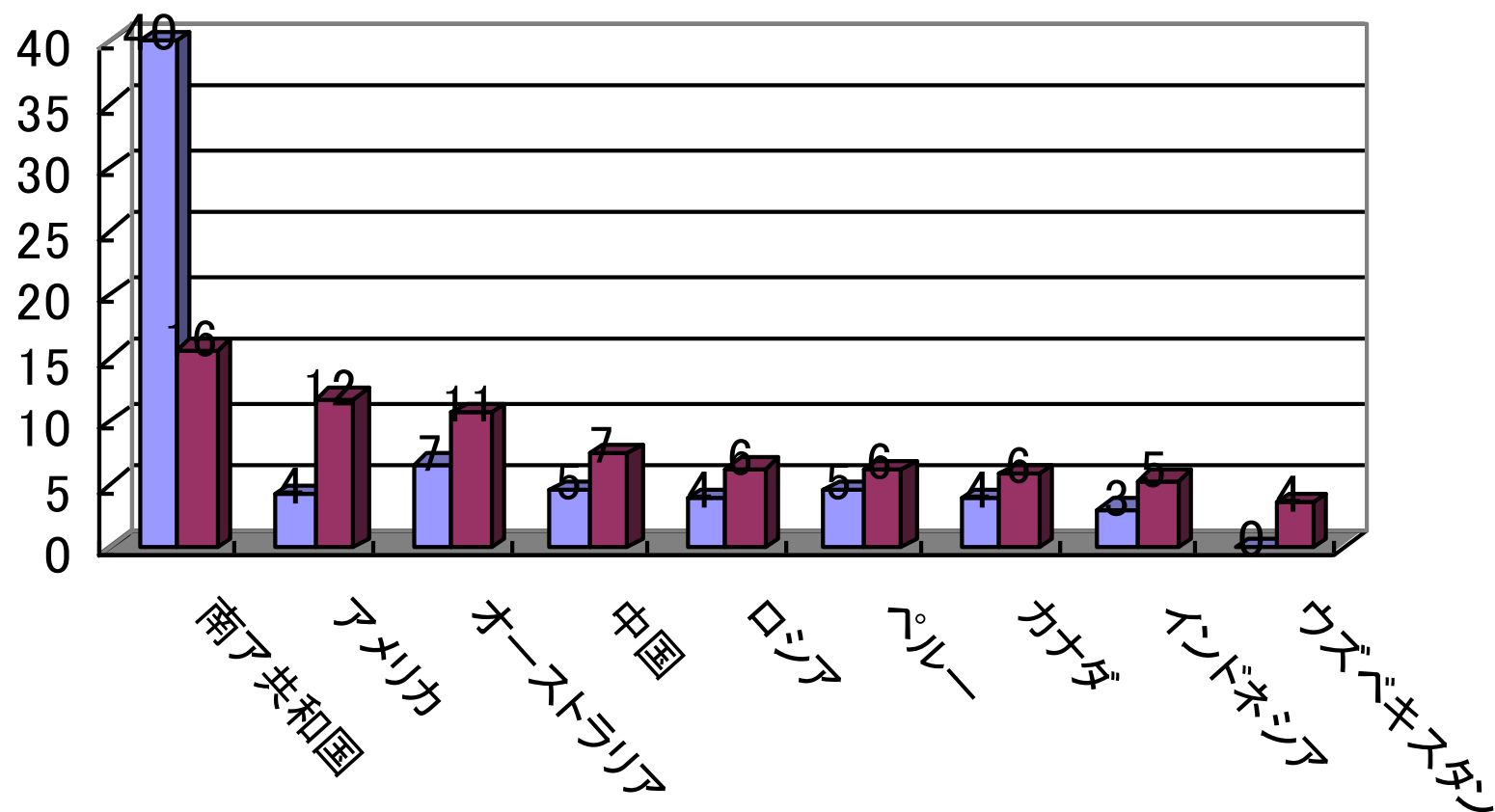


Ge

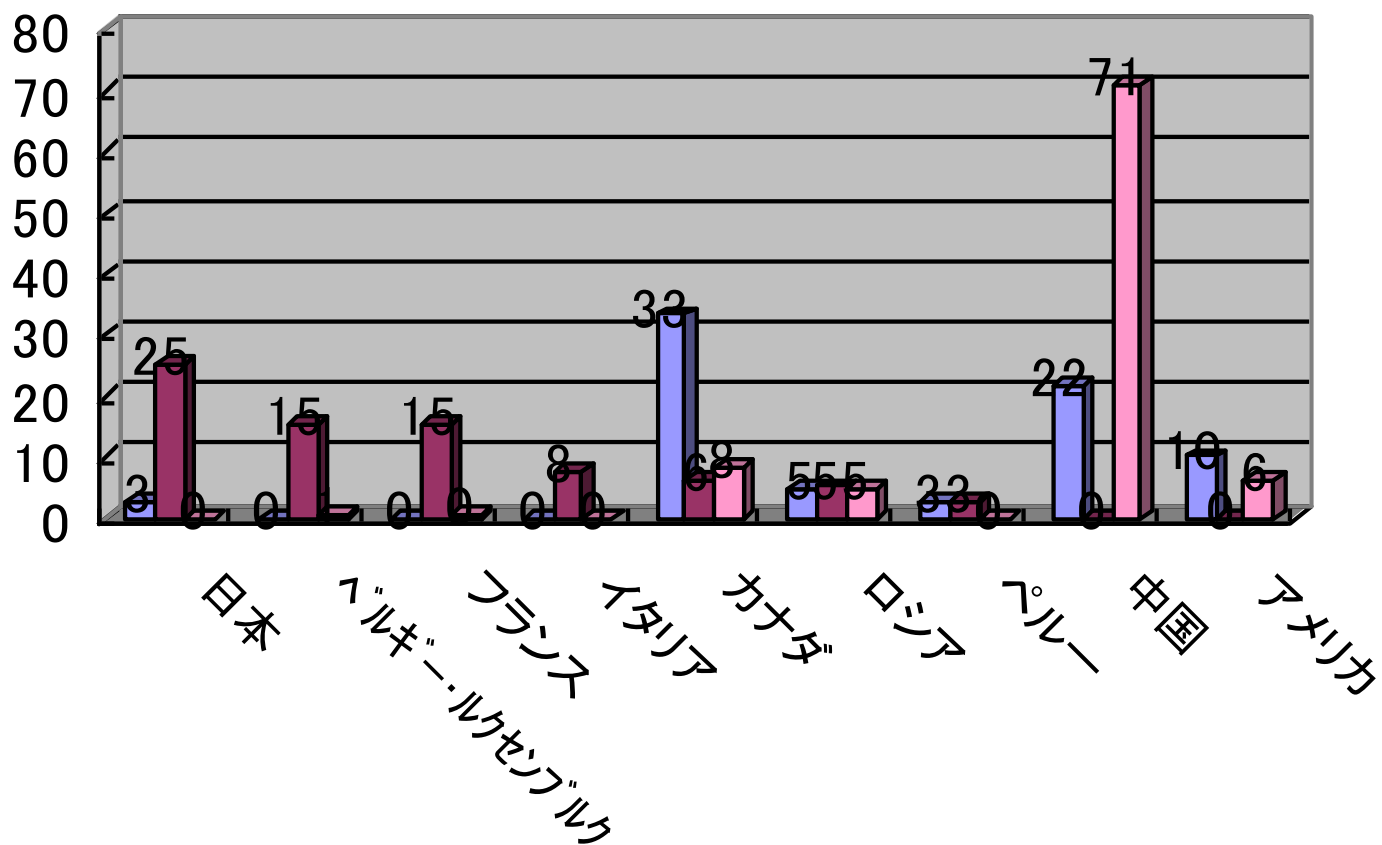


Au

resB ore

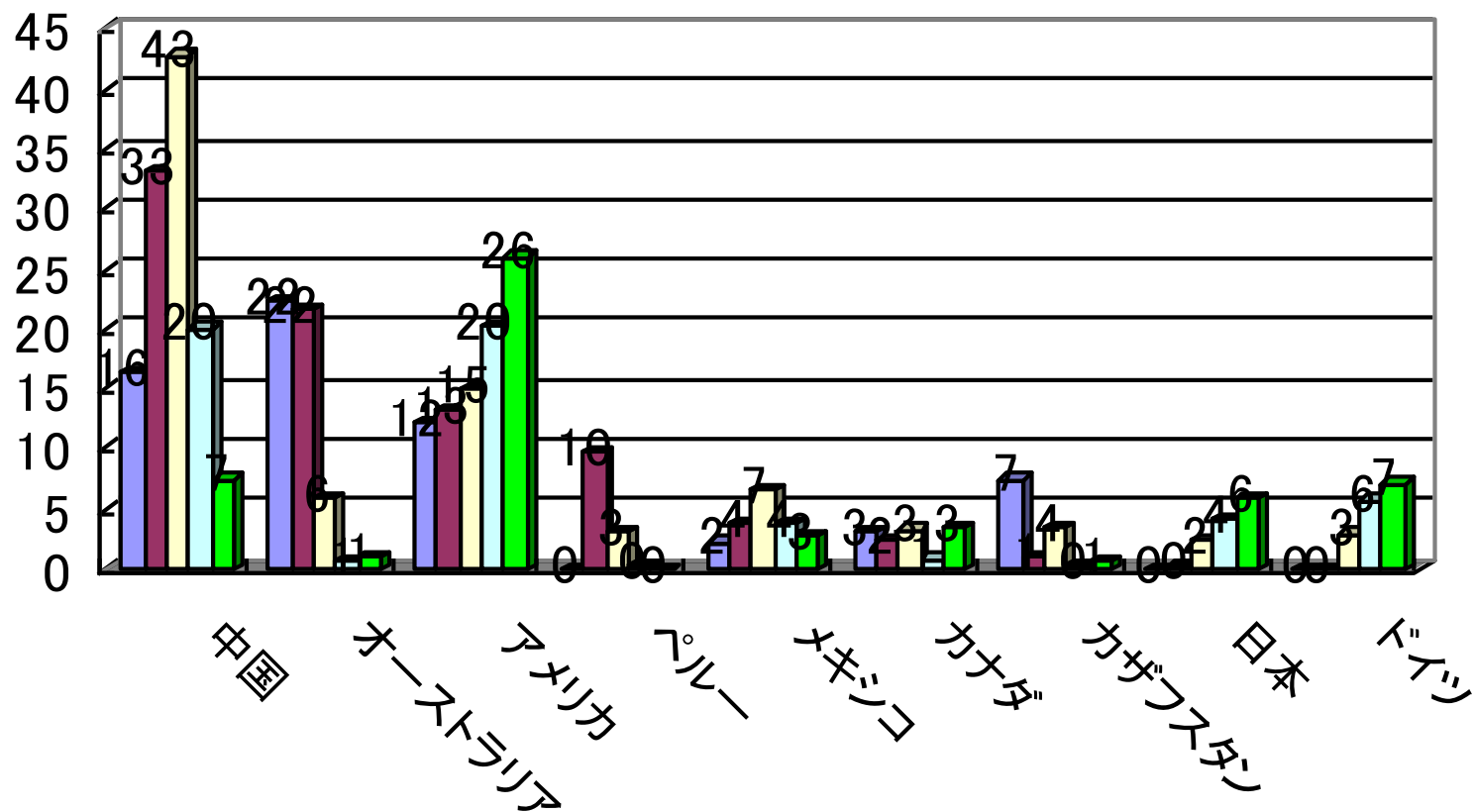


ln

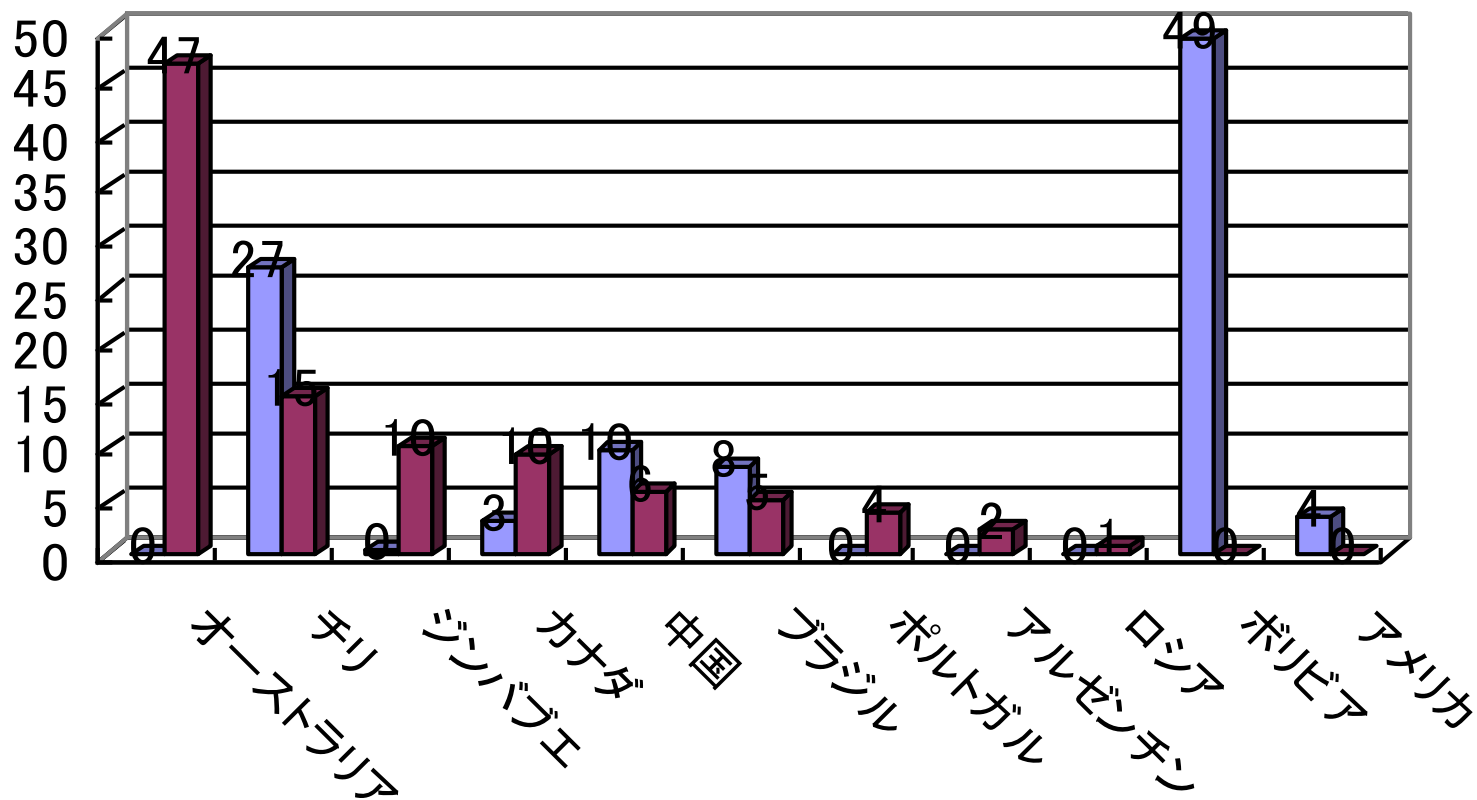


Pb

res ore metal csmp scrap

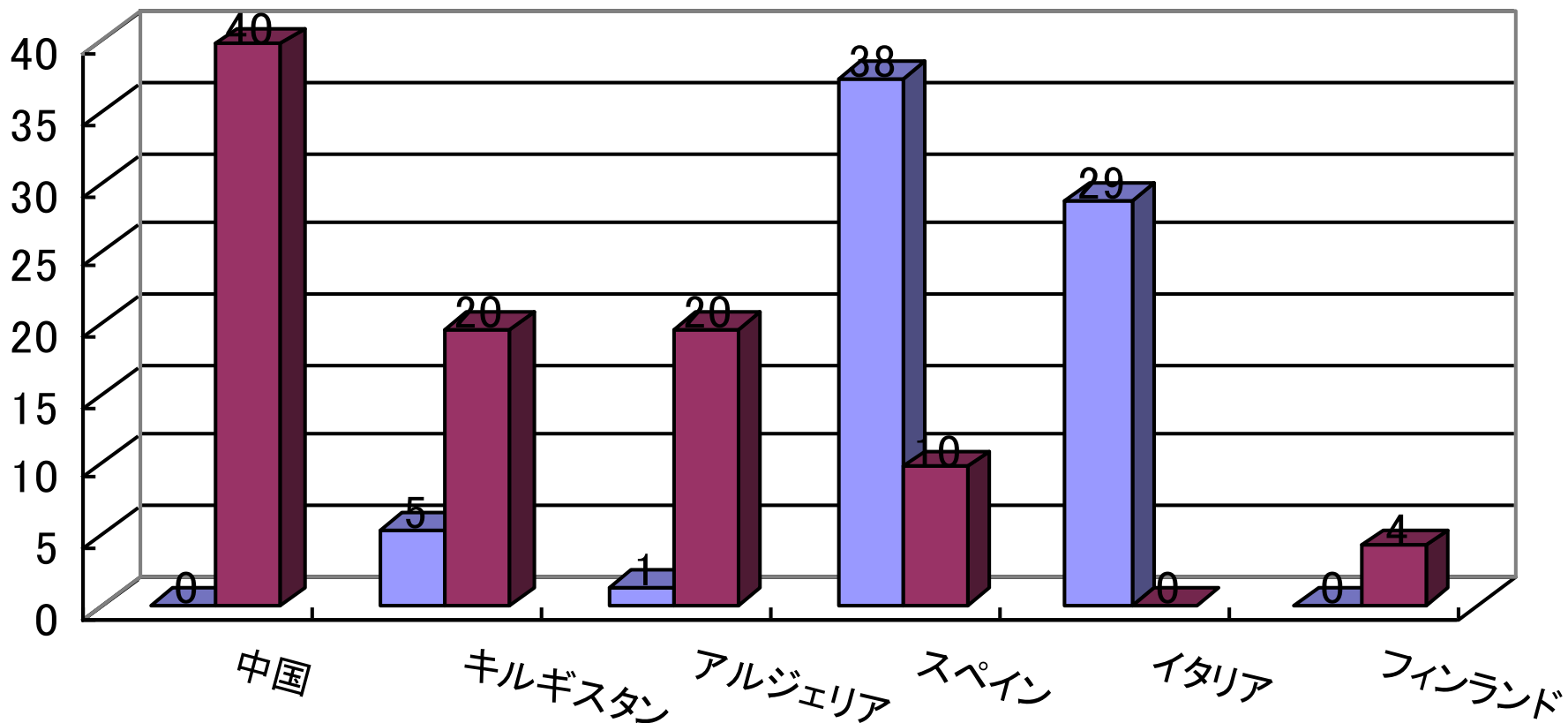


Li



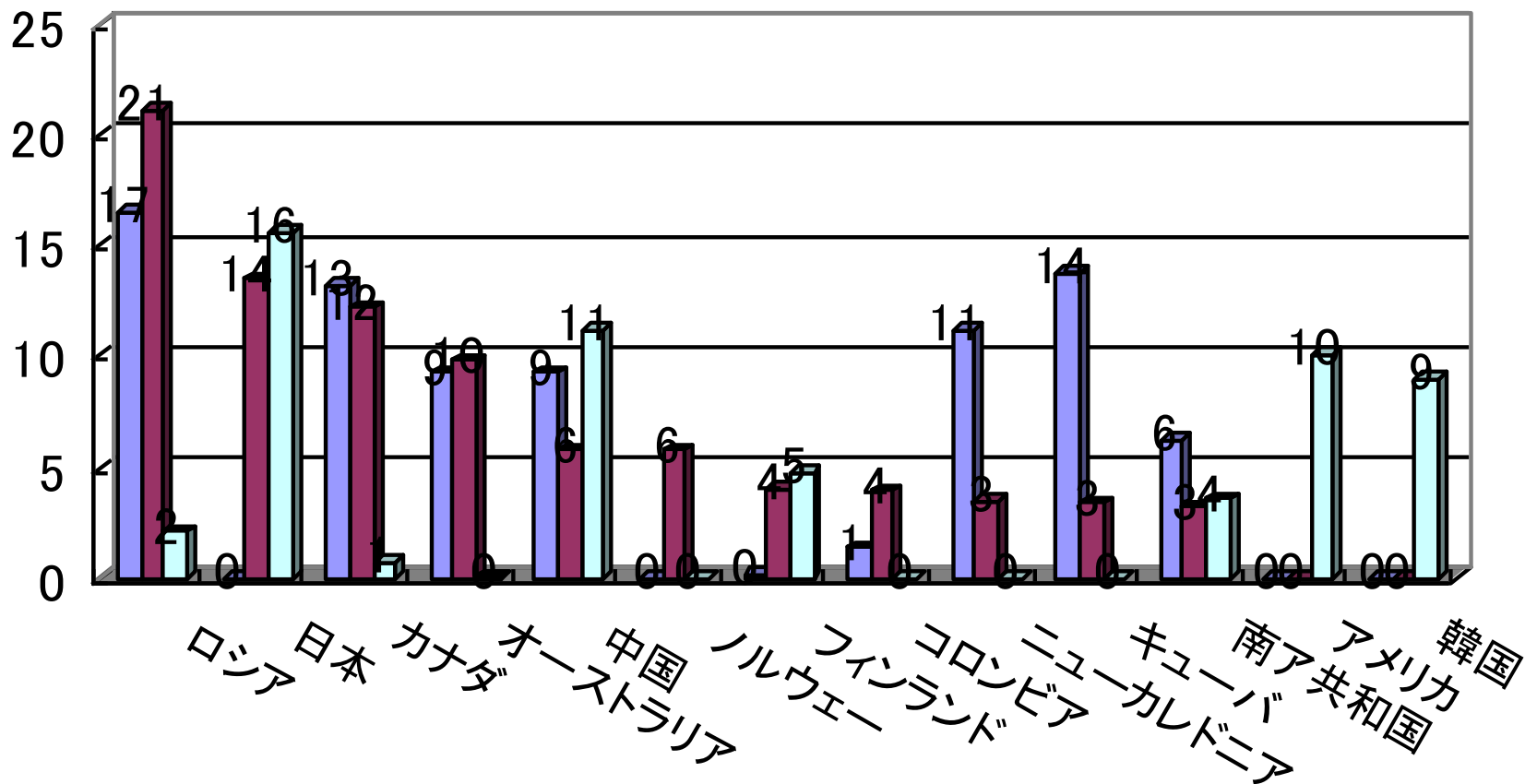
Hg

resB prd



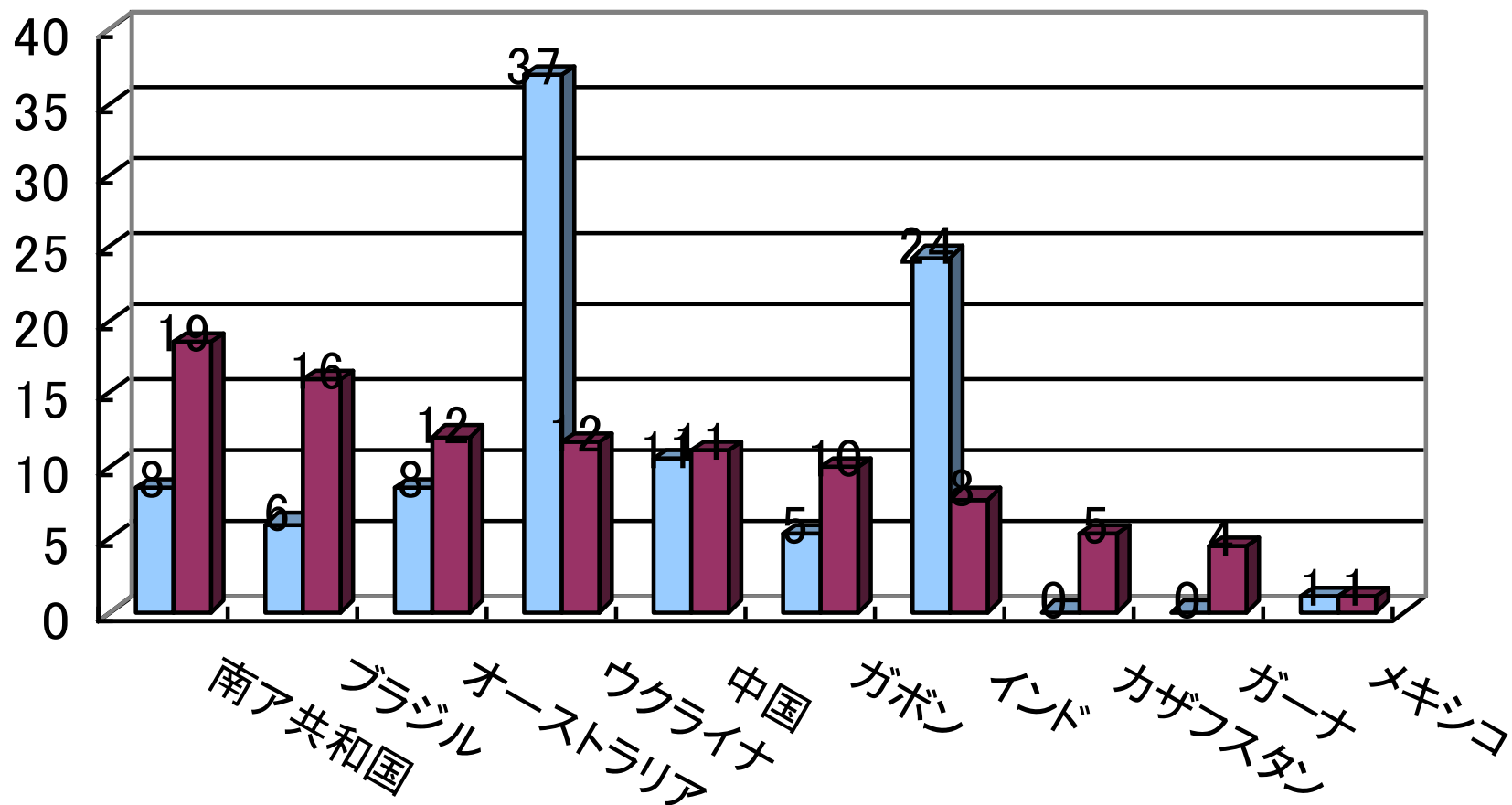
Ni

res prod csmg



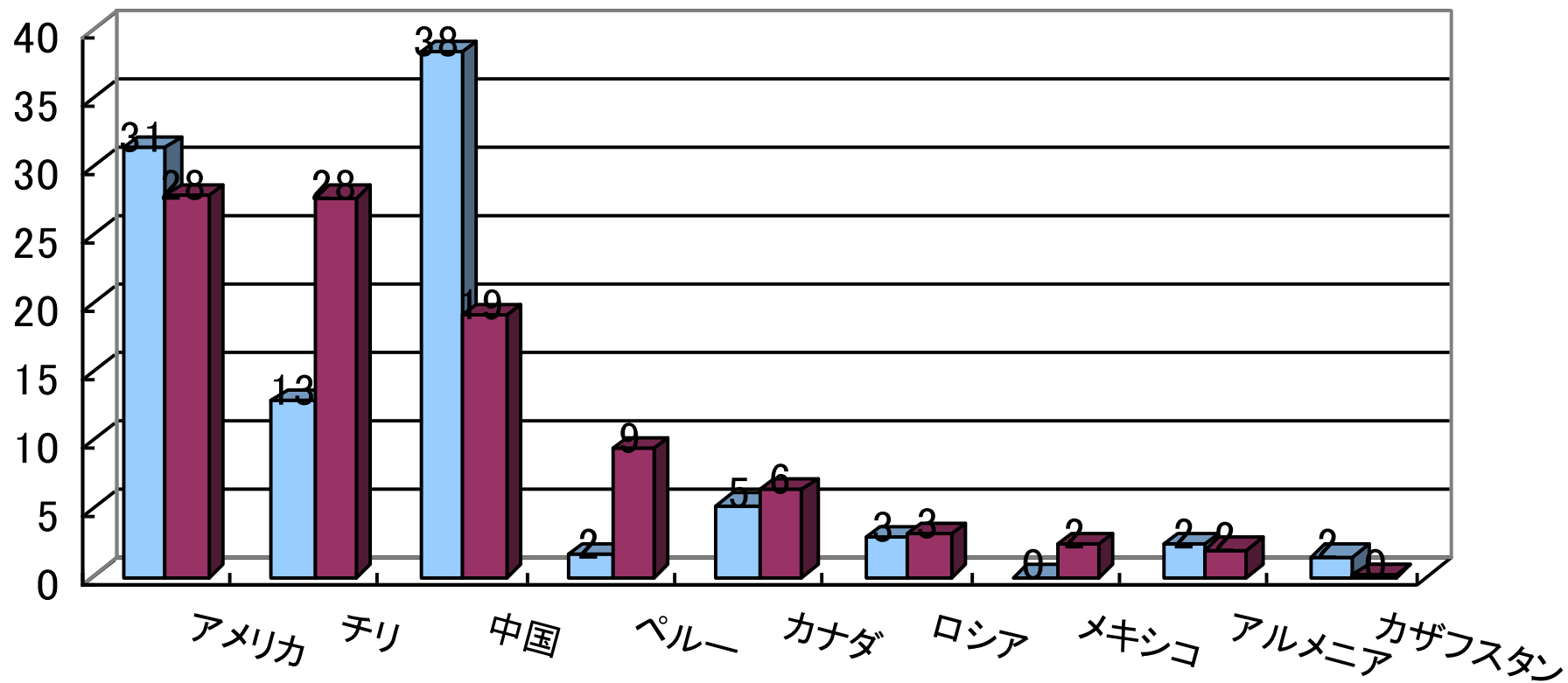
Mn

res ore



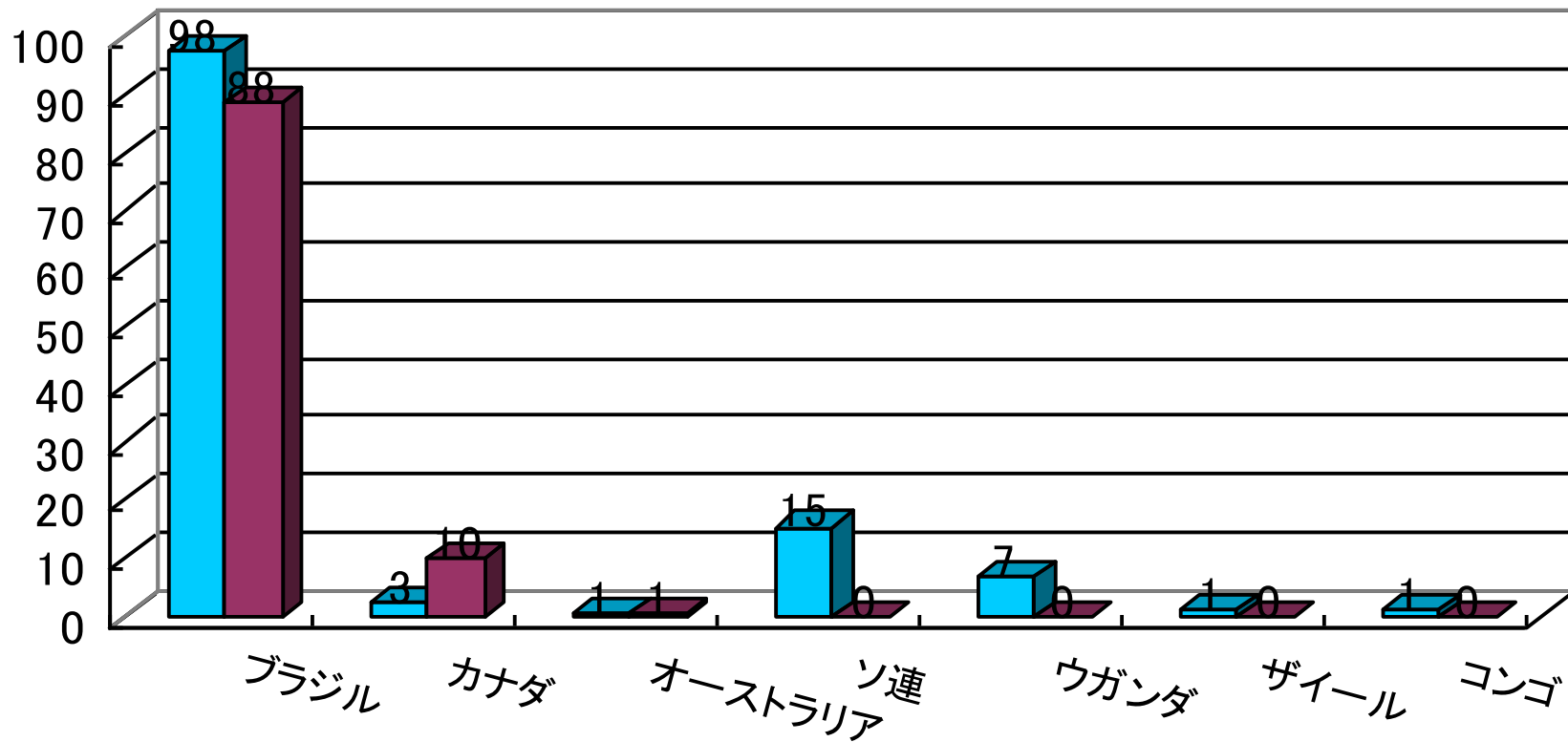
Mo

res prod



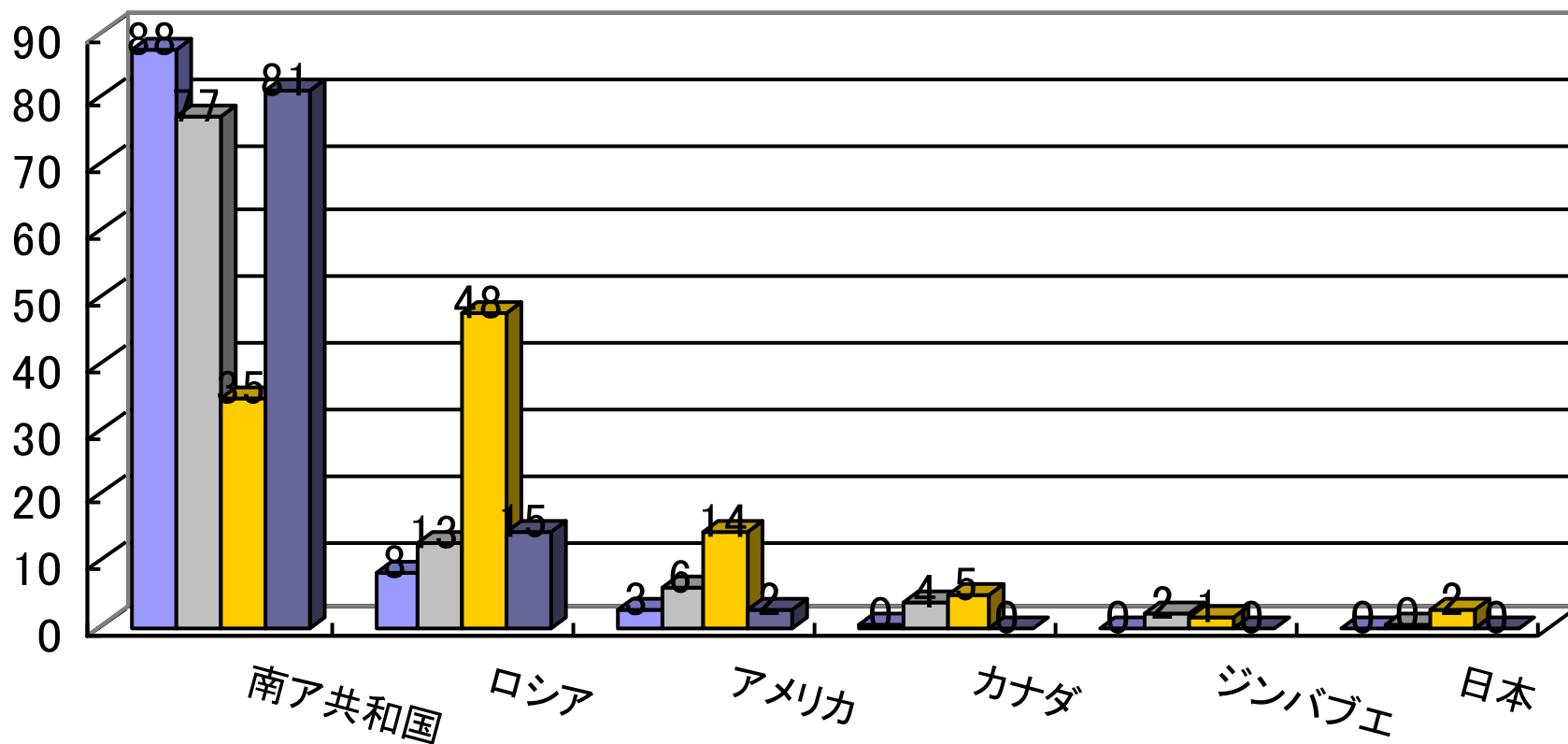
Nb

res ore



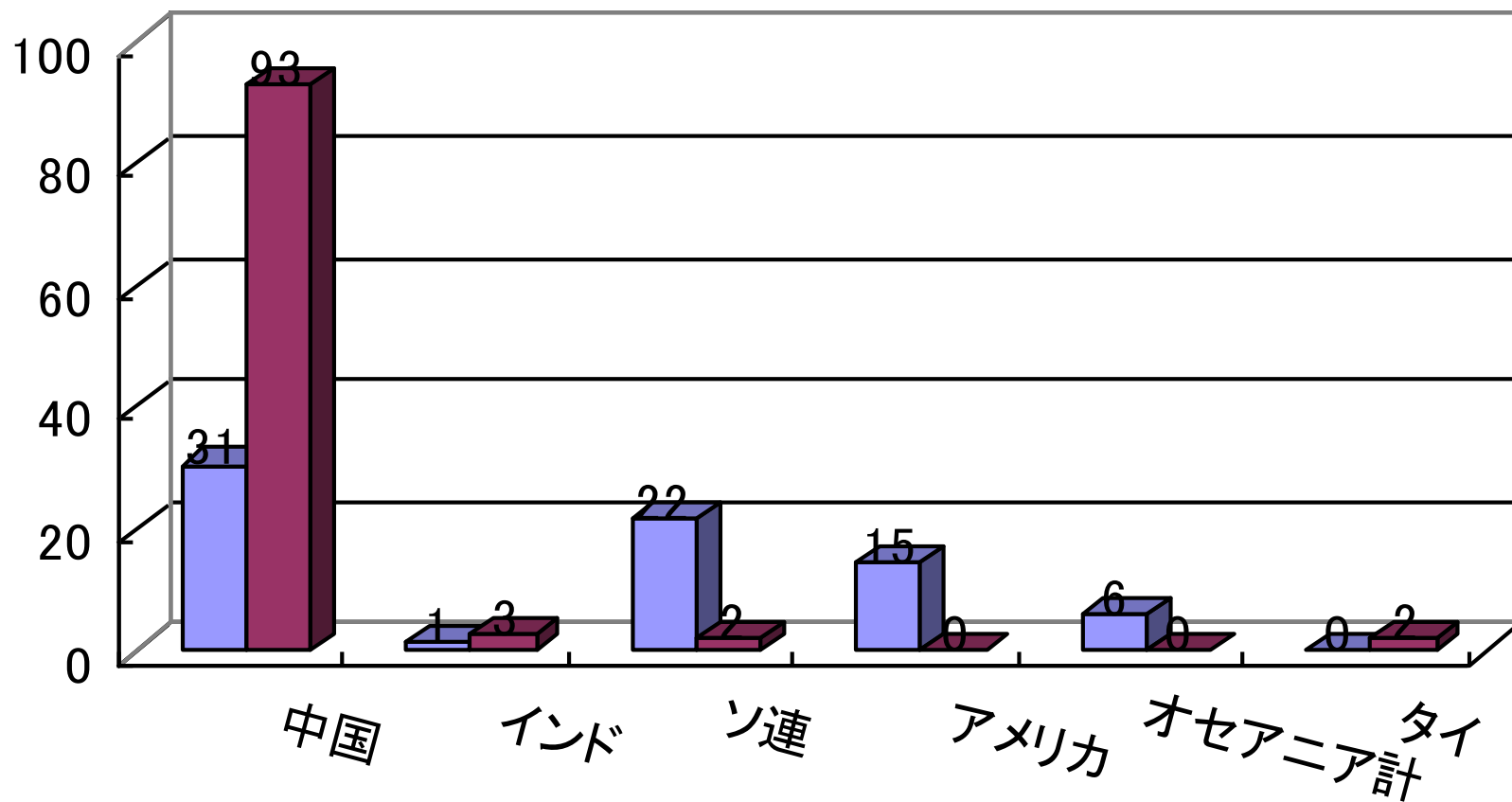
Pt G

resB Pt-prd Pd-prd Rh-prd



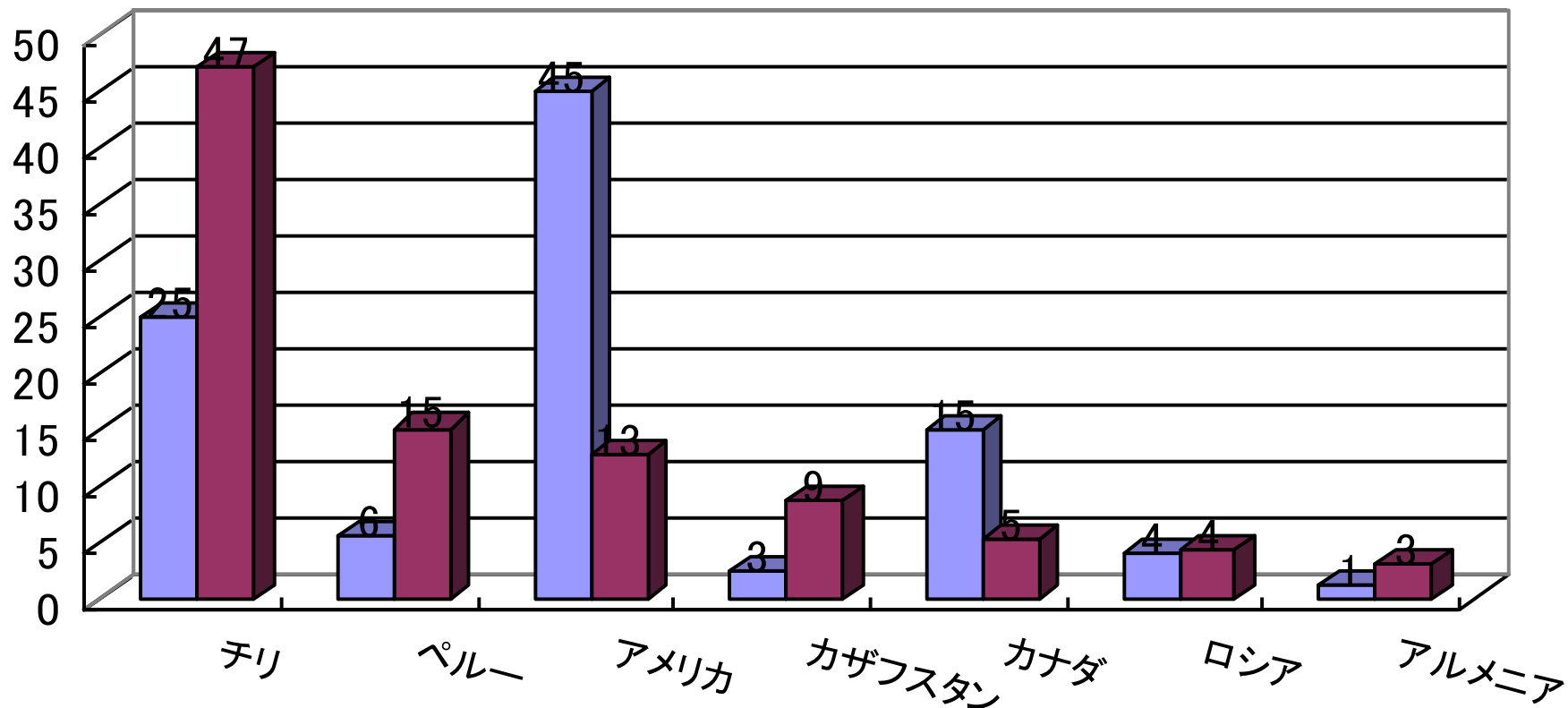
R.E.

res prod

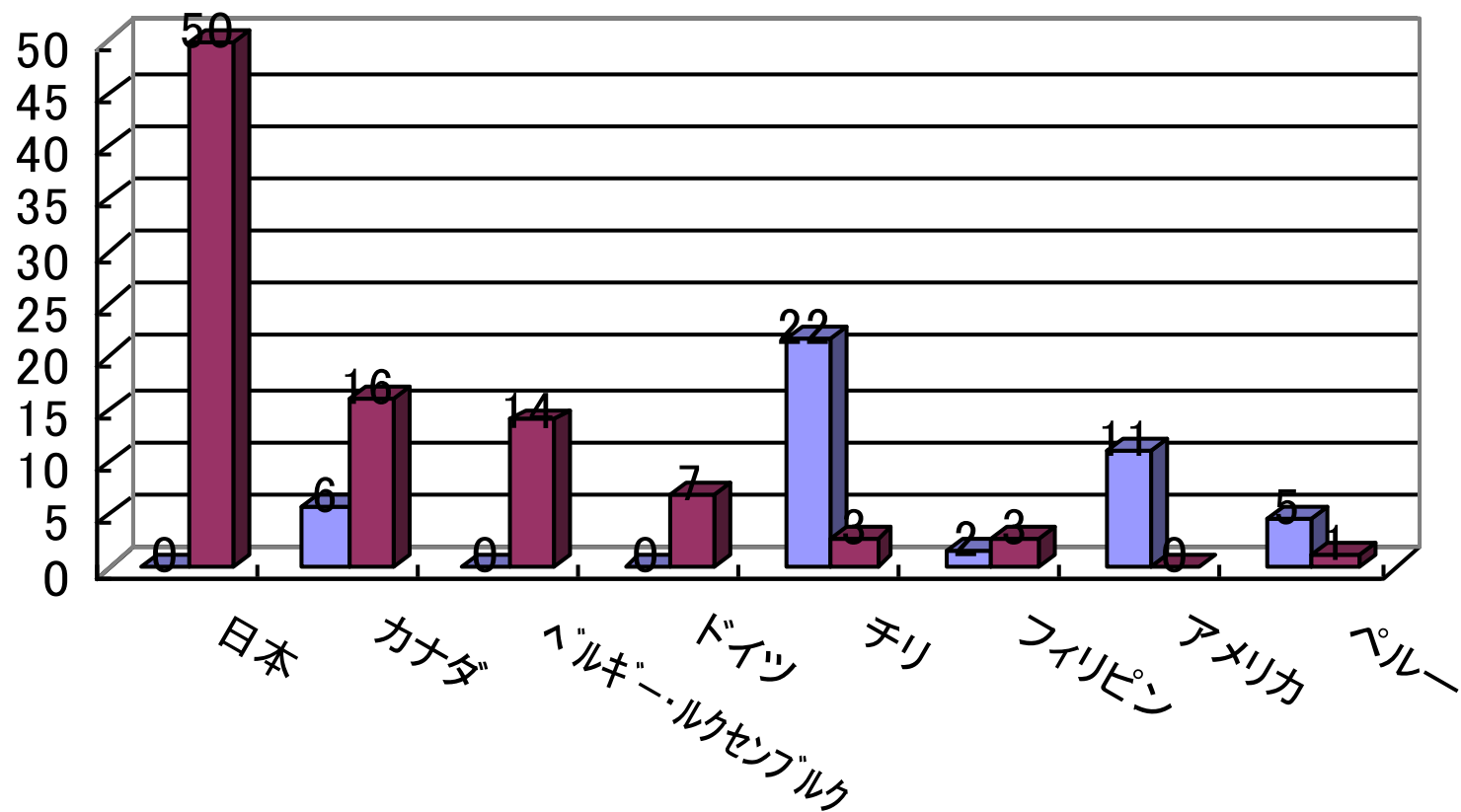


Re

resB ore

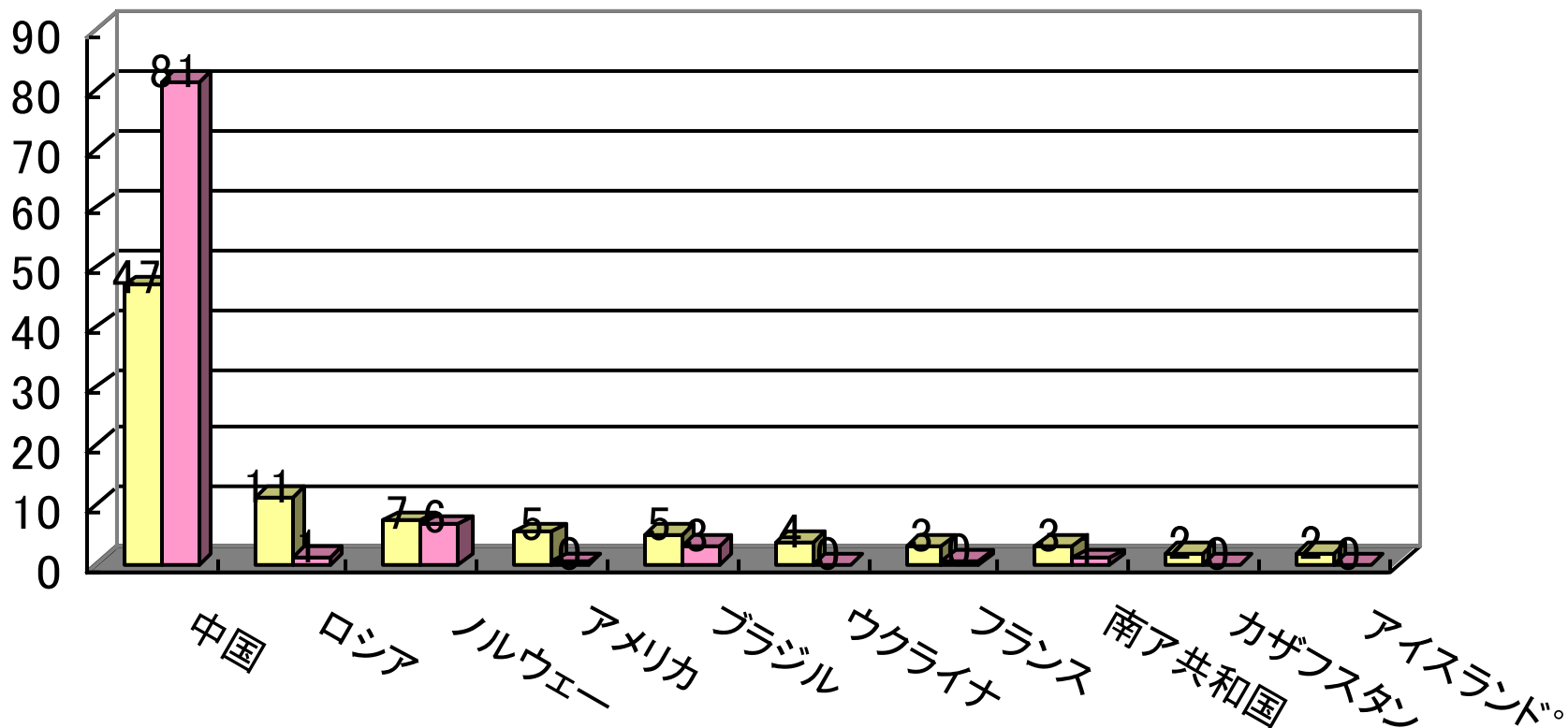


Se



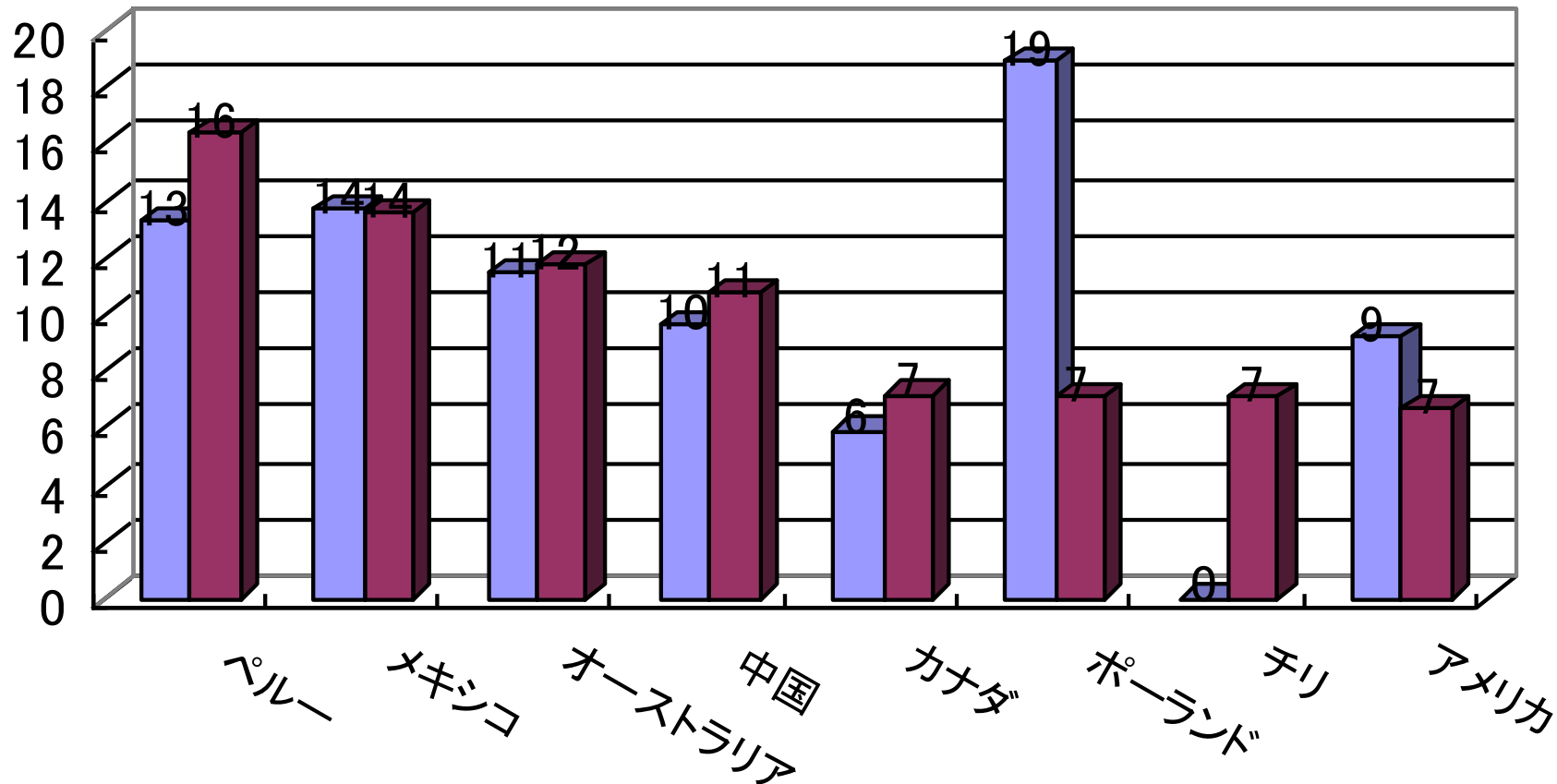
Si

prd impt



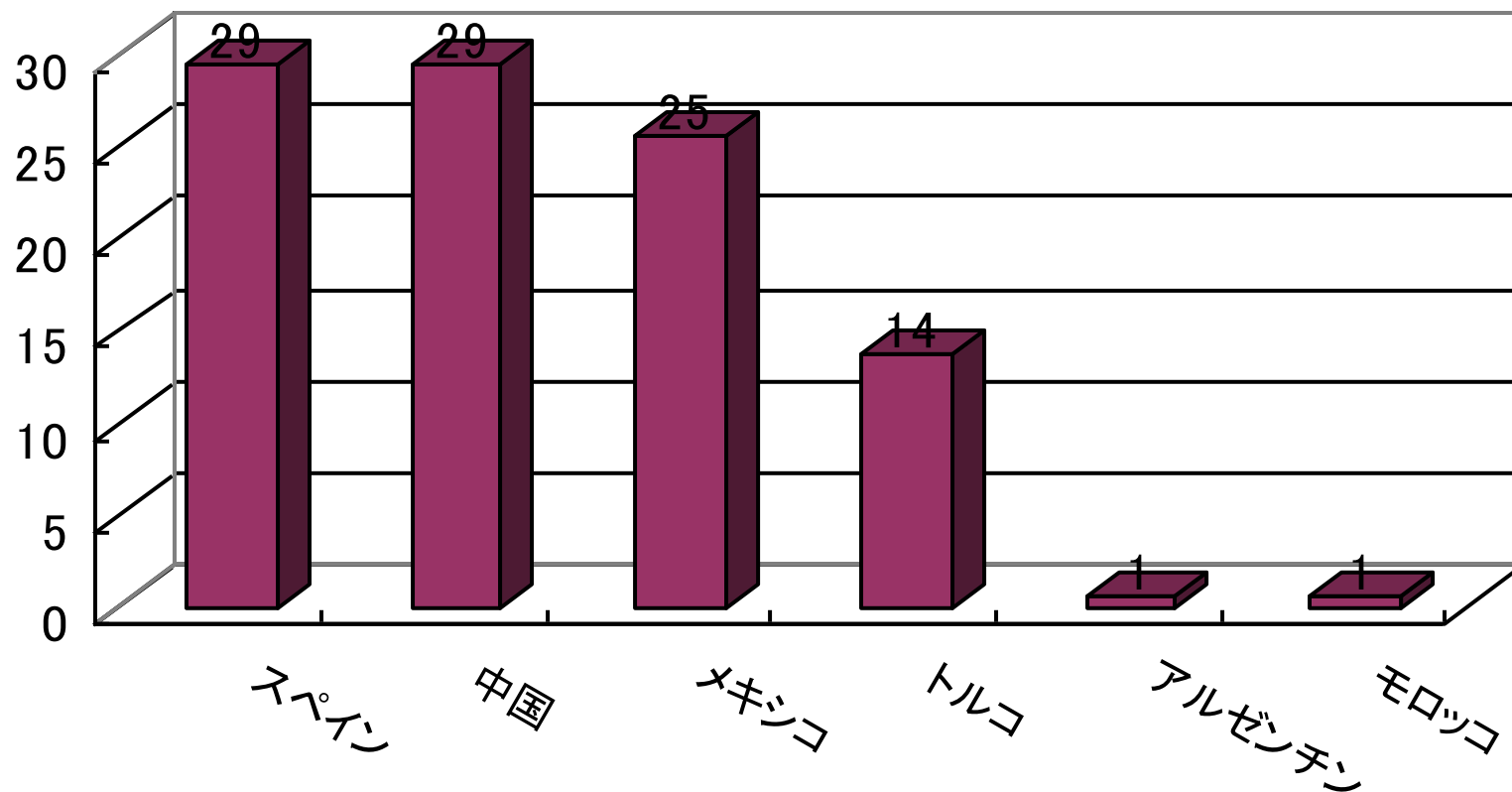
Ag

res ore



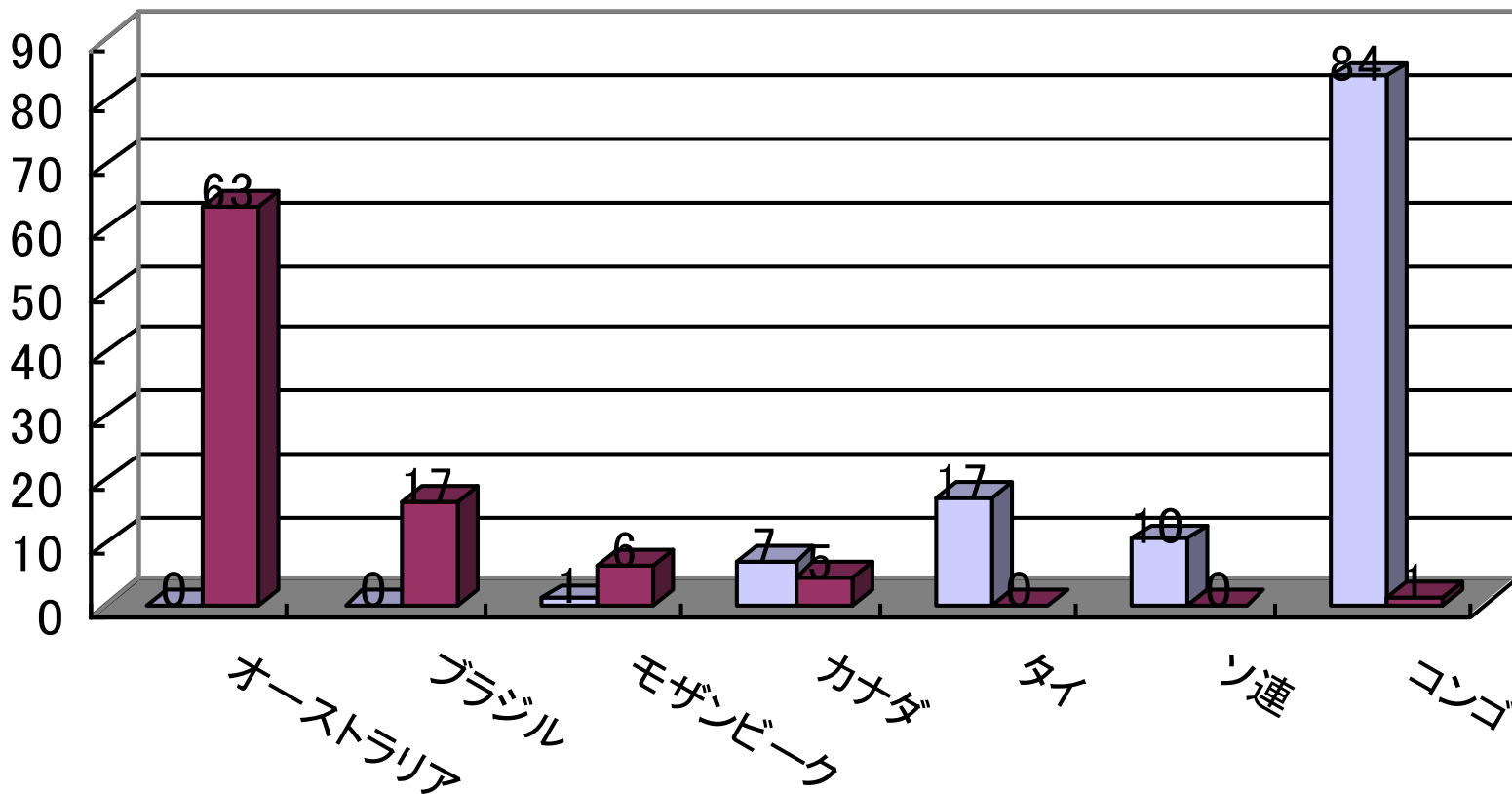
Sr

ore



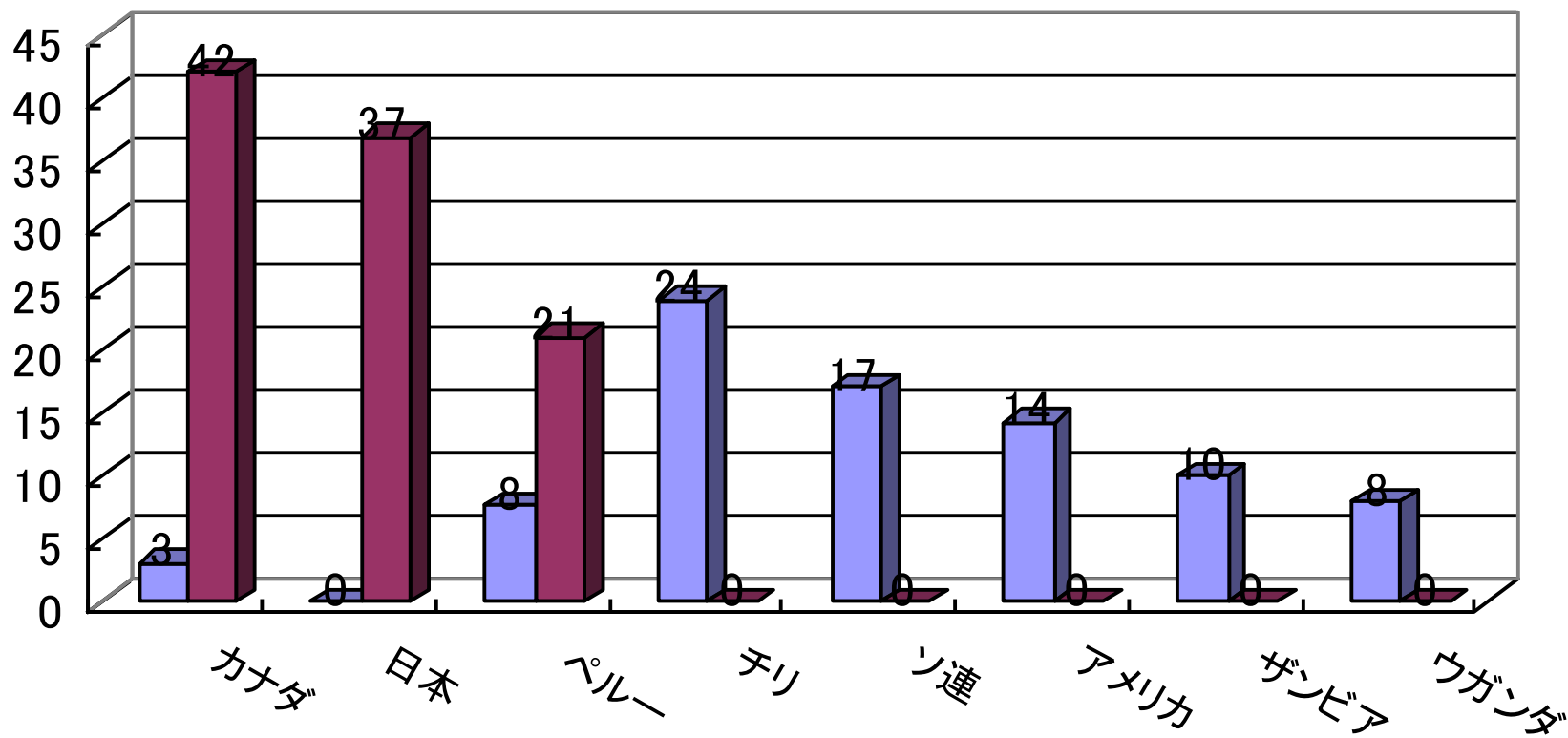
Ta

res ore

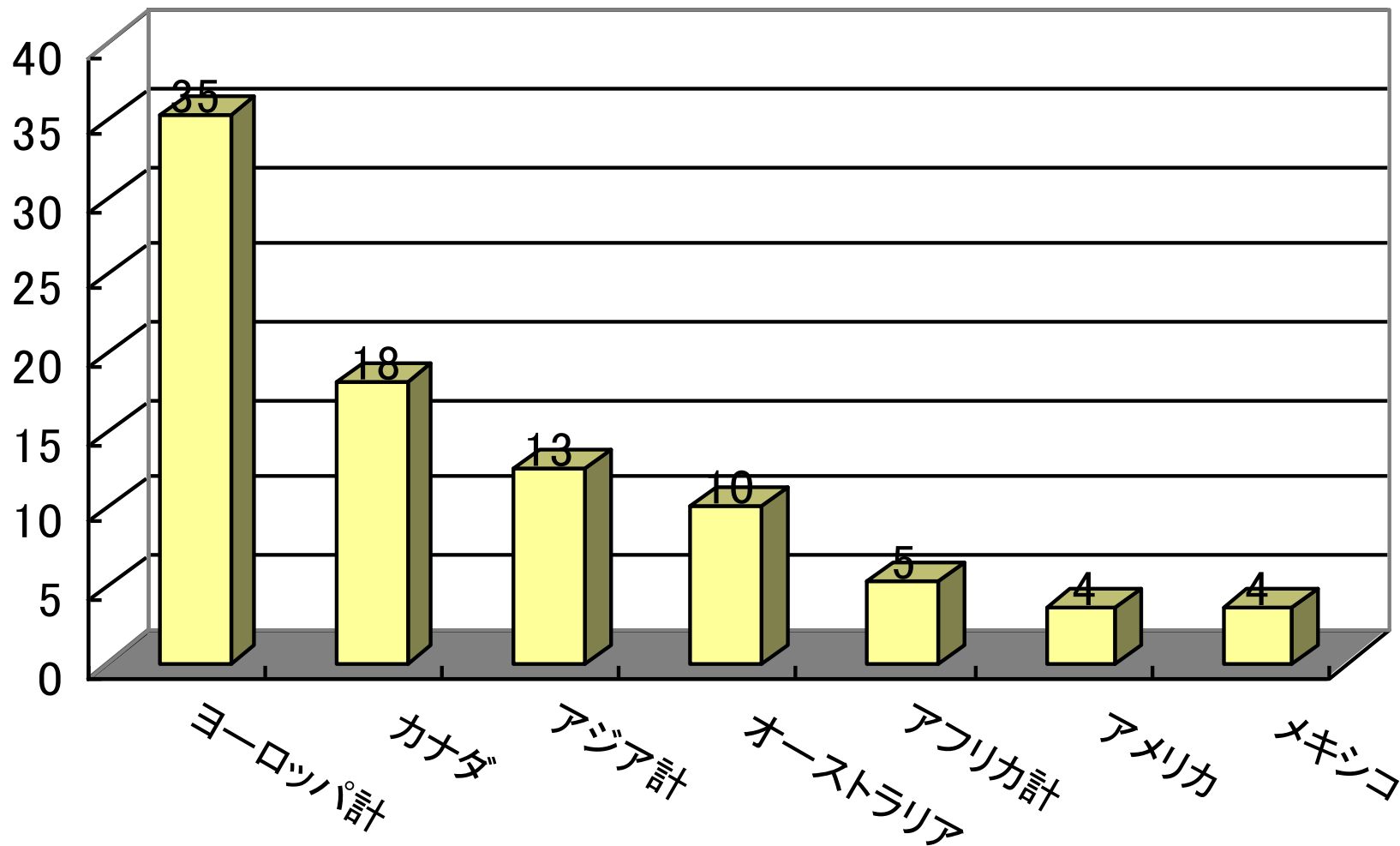


Te

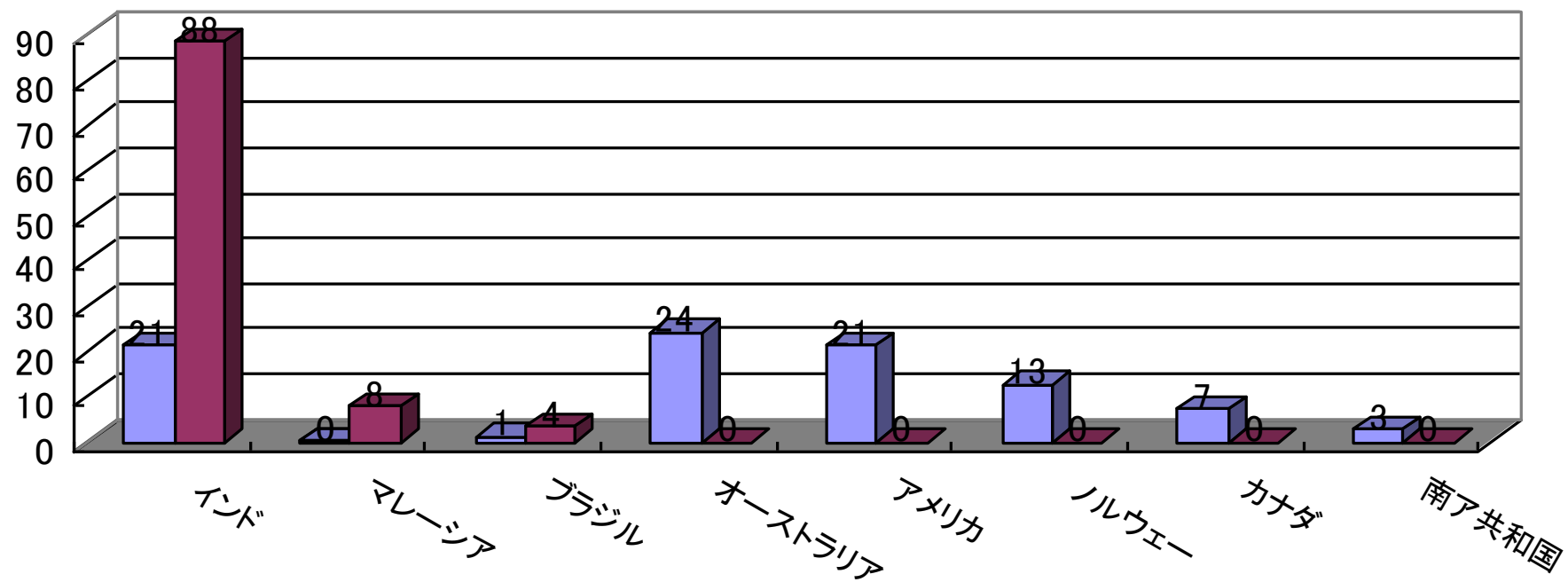
res prod



TI

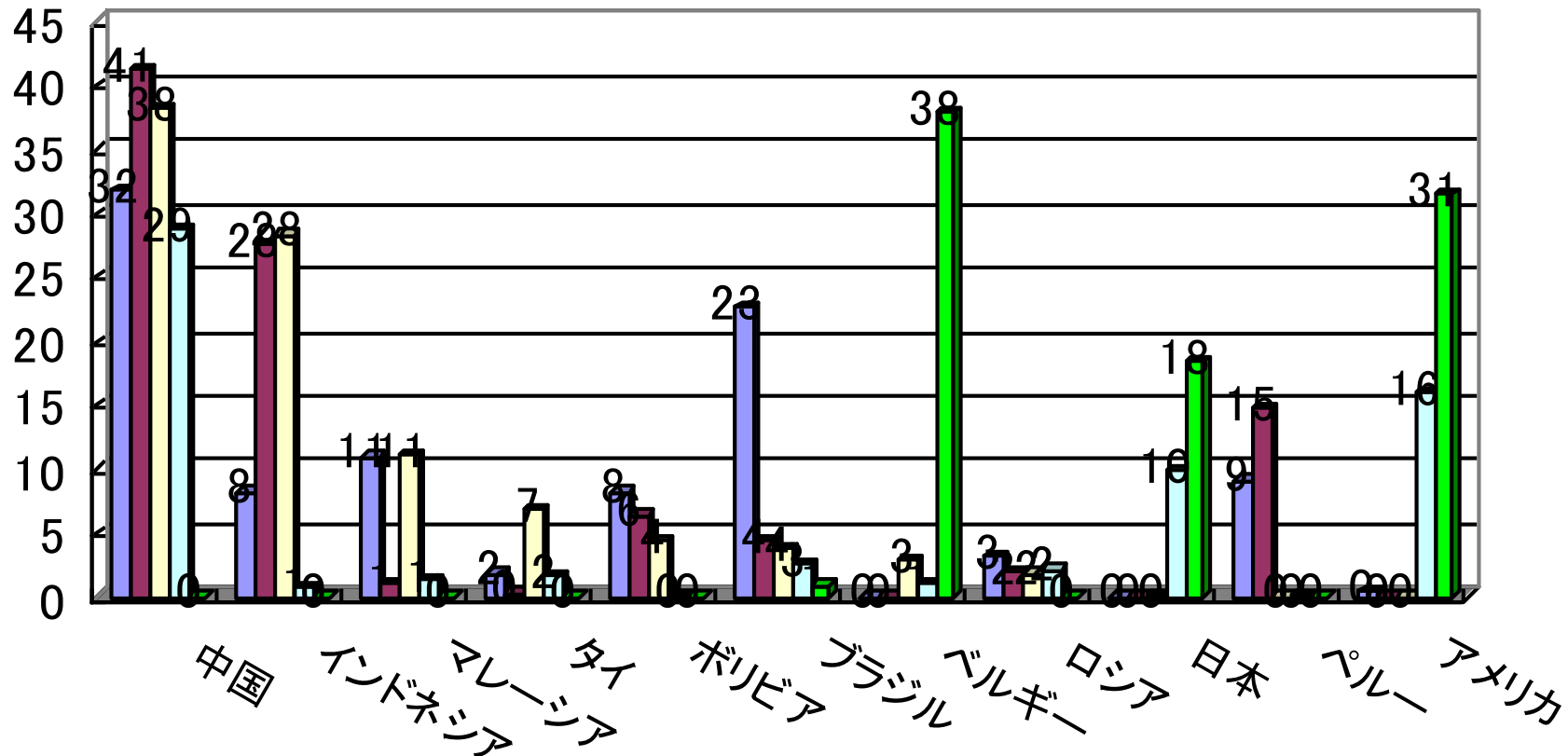


Th



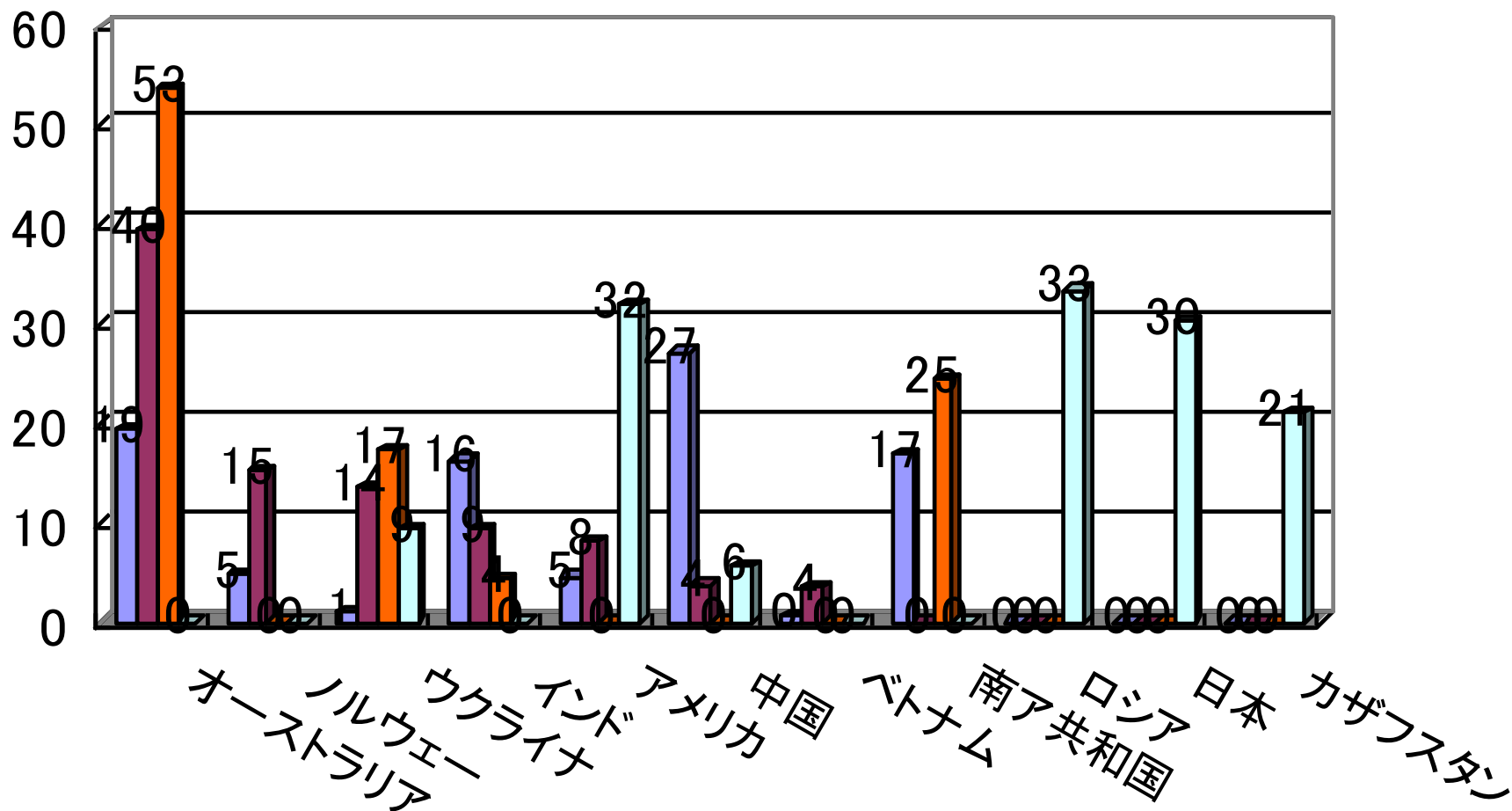
Sn

resB ore metal consumpt scrap



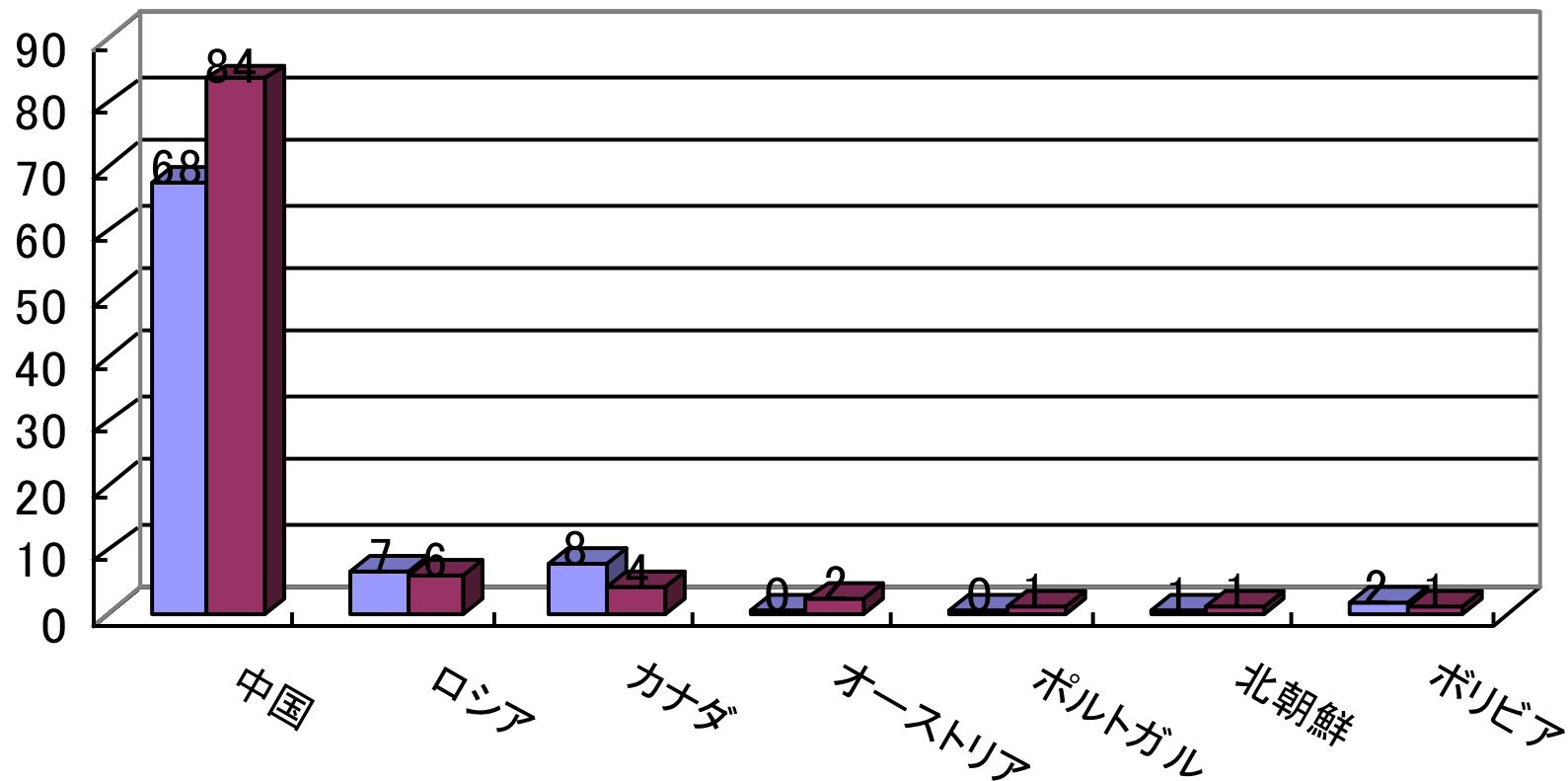
Ti

resB-Illumenite ore-Illumenite ore-Rutile metal



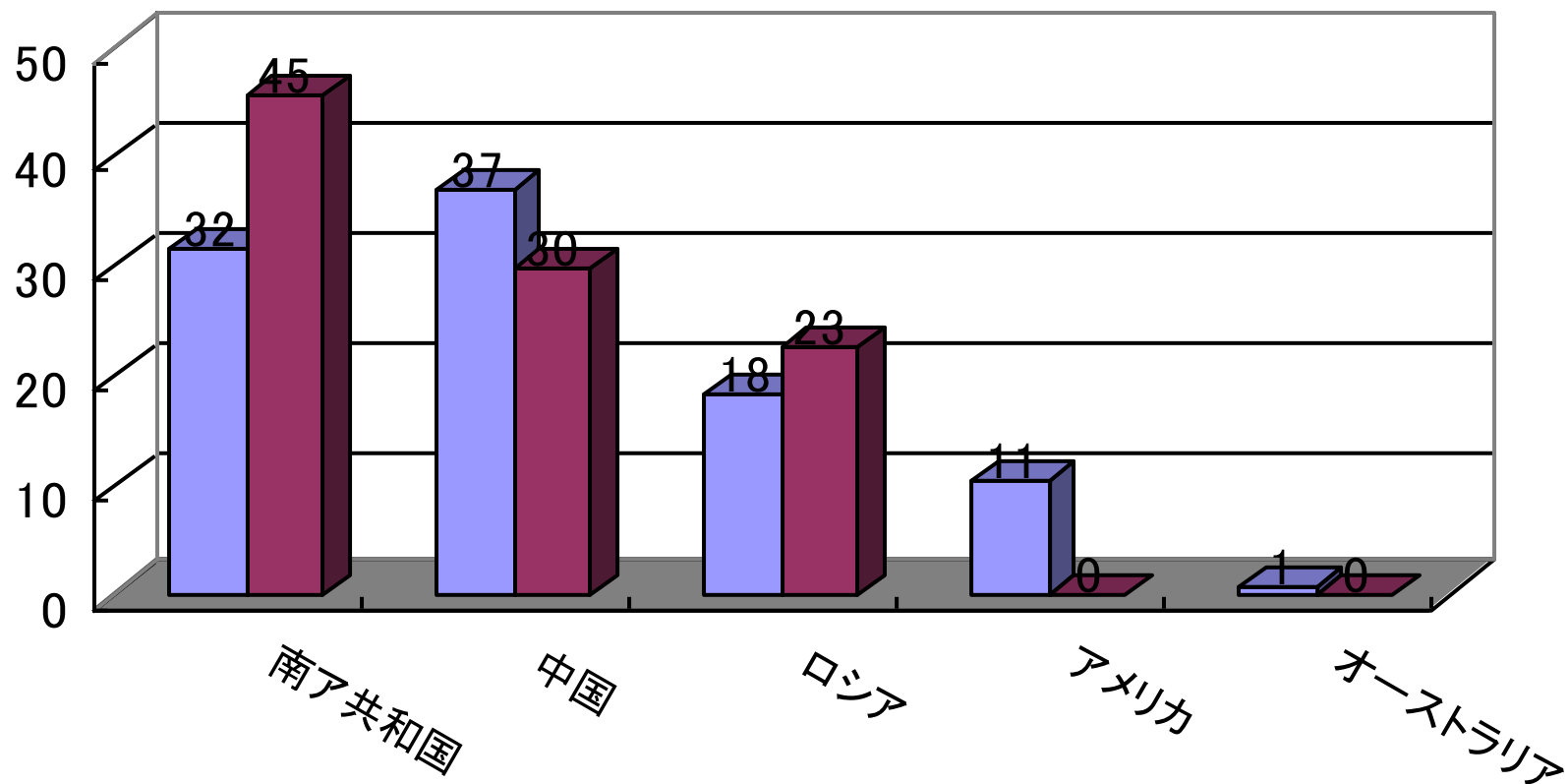
W

resB ore



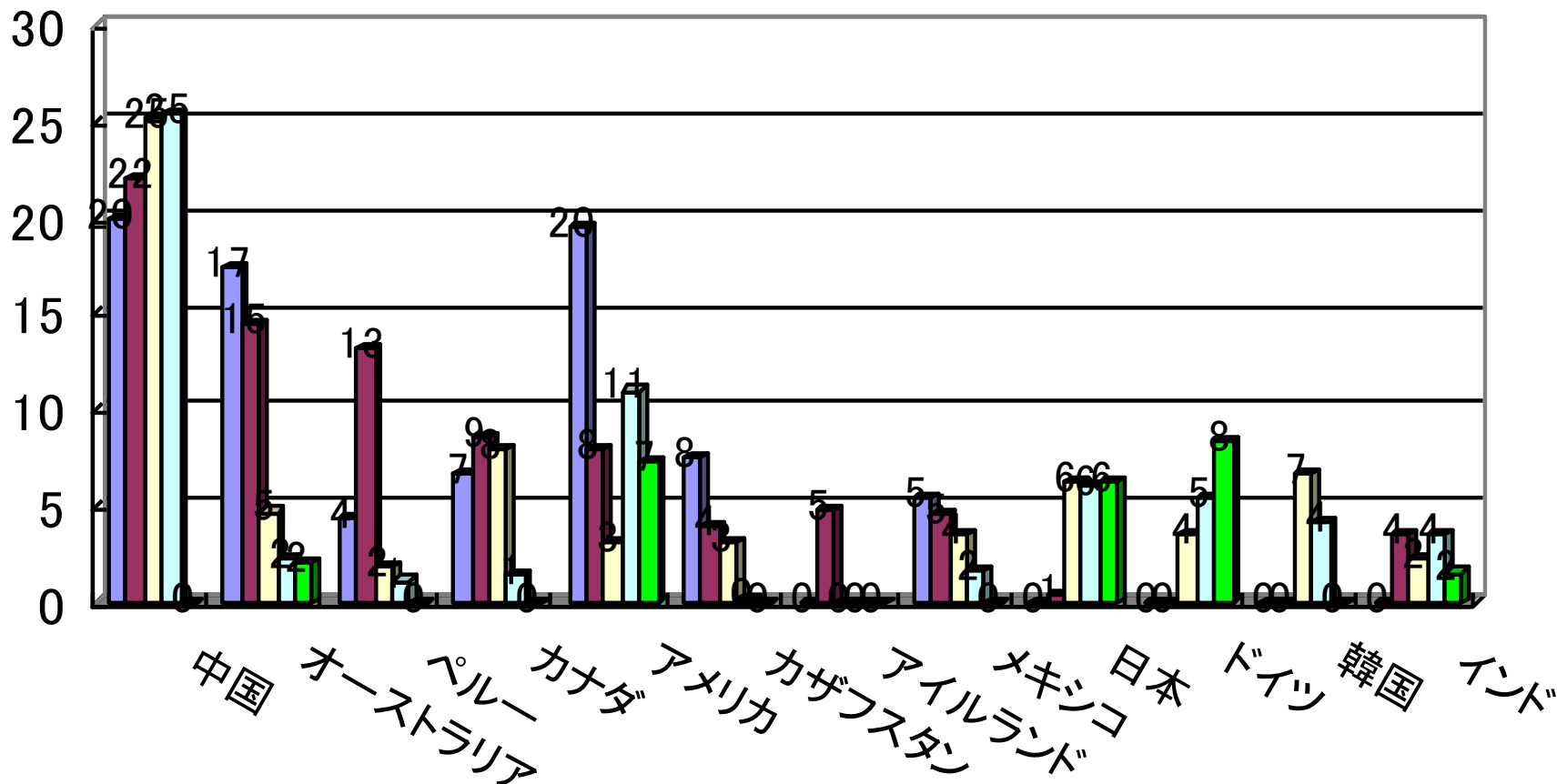
V

resB ore



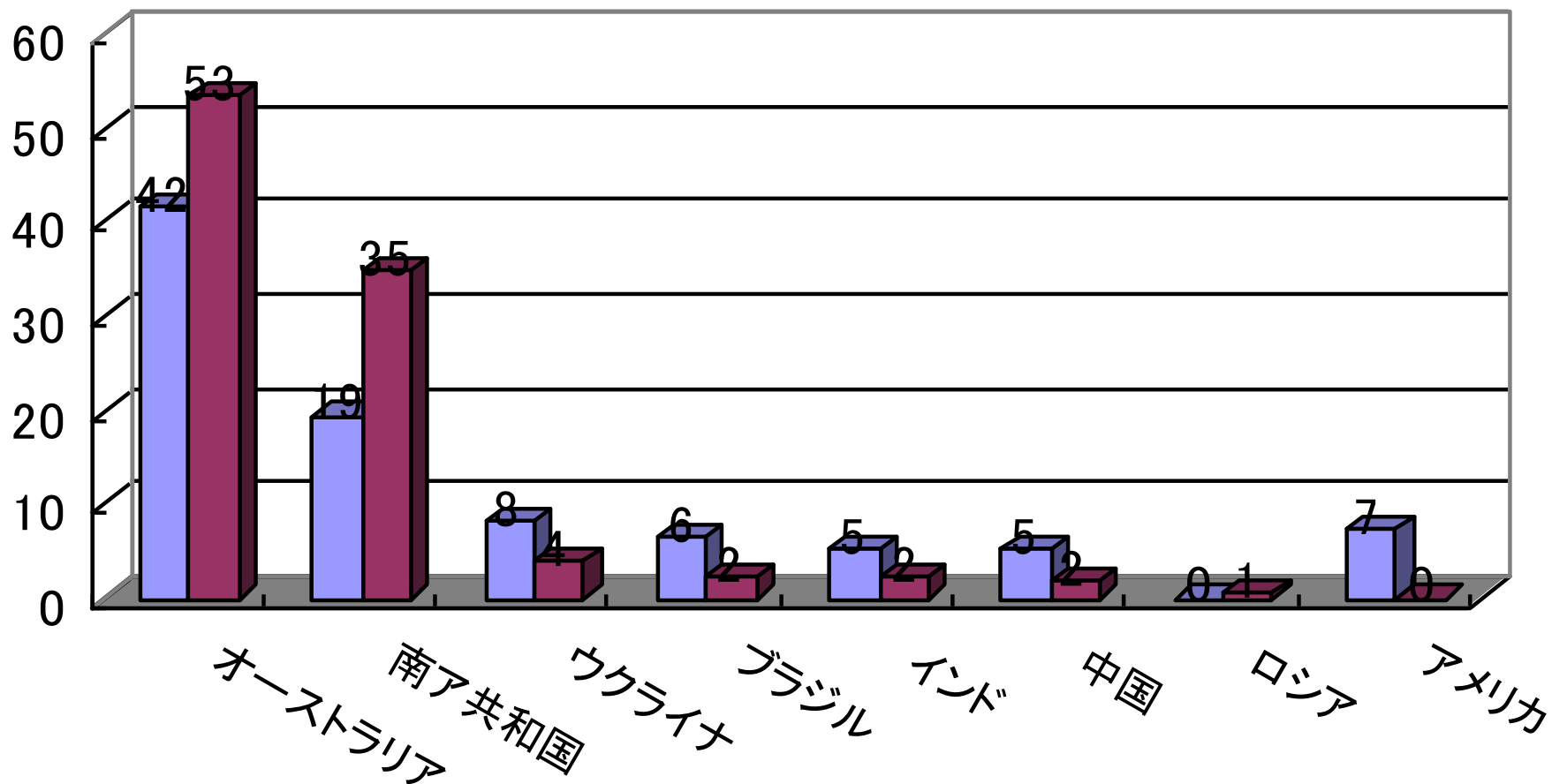
Zn

resB ore metal consumpt scrap



Zr

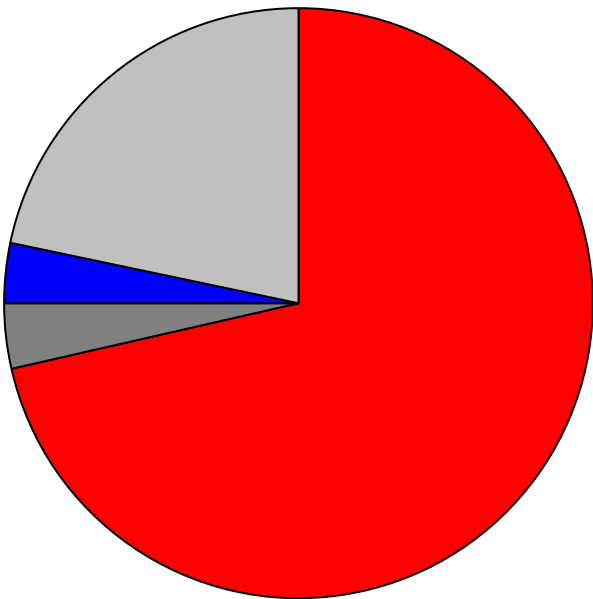
resB ore



Germanium

Ge Refinery 140,000kg (2009)

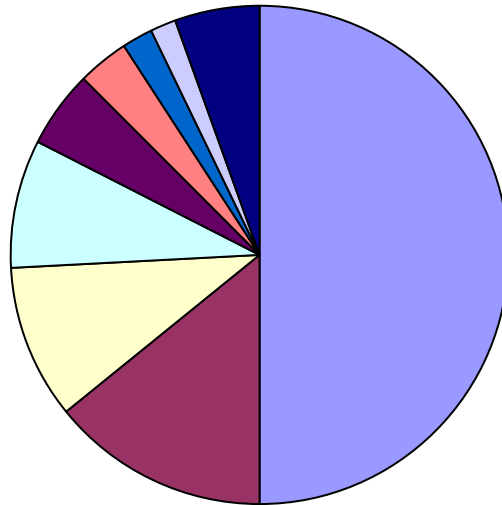
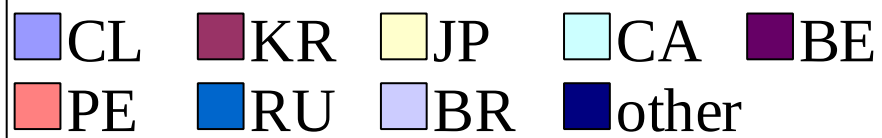
■ CN ■ RU ■ US ■ other



- The available resources of germanium are associated with certain zinc and lead-zinc-copper sulfide ores.
- Significant amounts of germanium are contained in ash and flue dust generated in the combustion of certain coals for power generation.
- Reserves exclude germanium contained in coal ash.

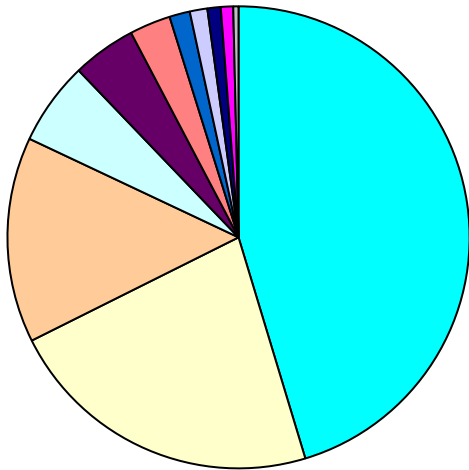
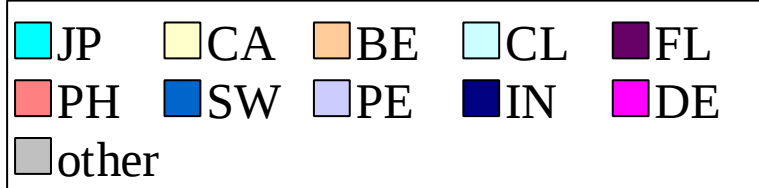
Indium

In Production 600ton (2009)

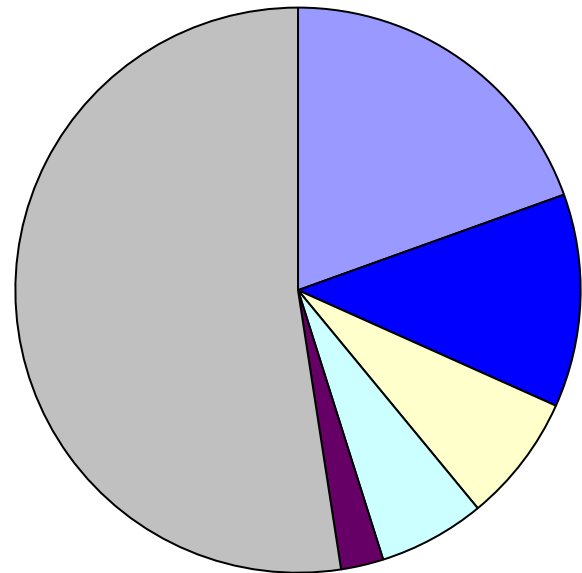


Selenium

Se Production 1,390

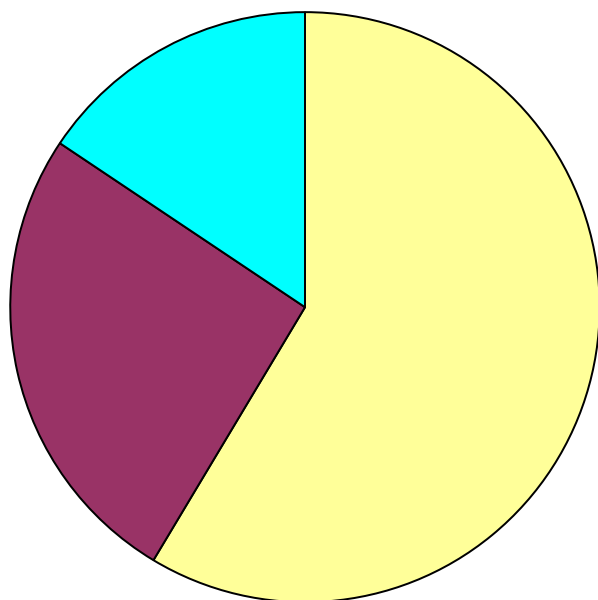


Se Reserve 82,000

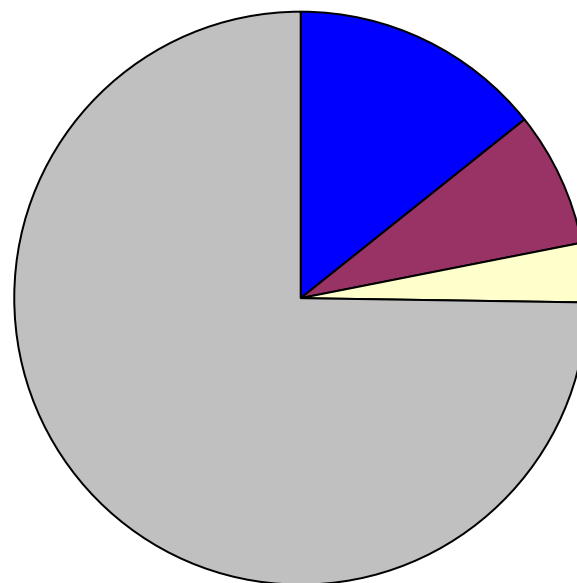


Tellurium

Te Production 128ton (2006)

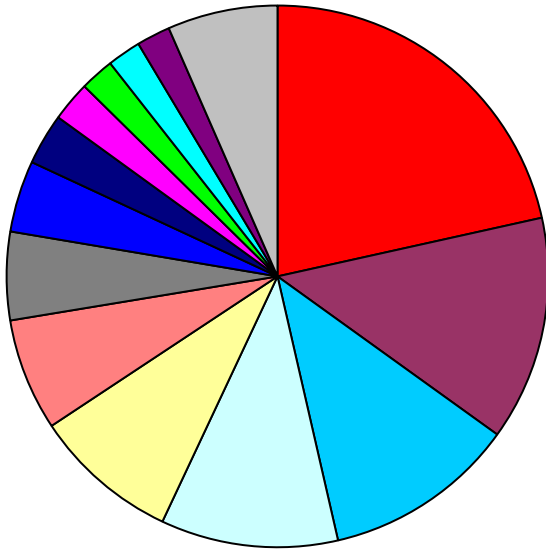
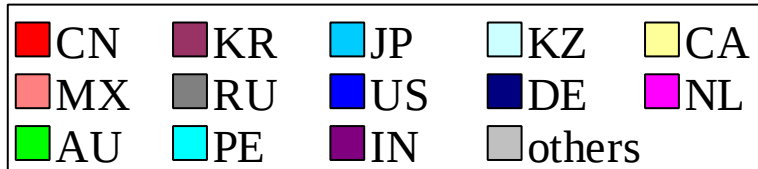


Te Reserve 21,000ton (2006)

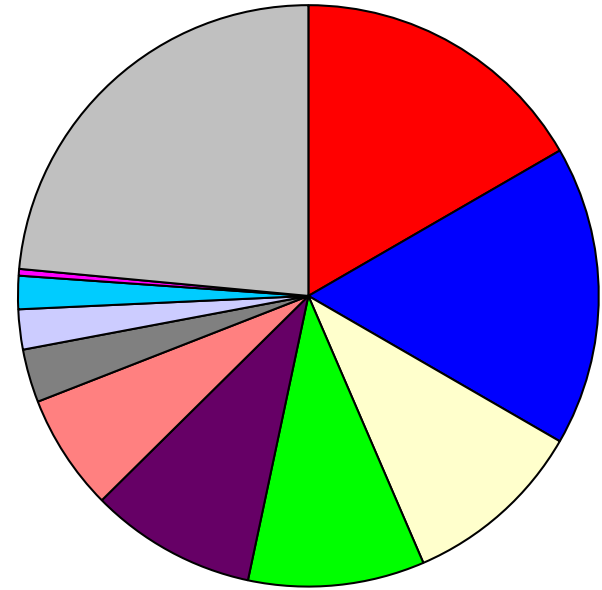
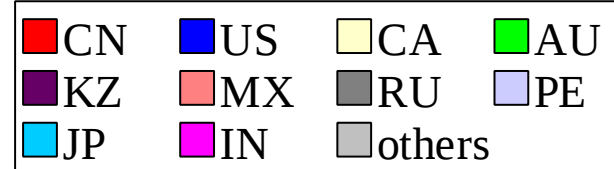


Cadmium

Cd refinery

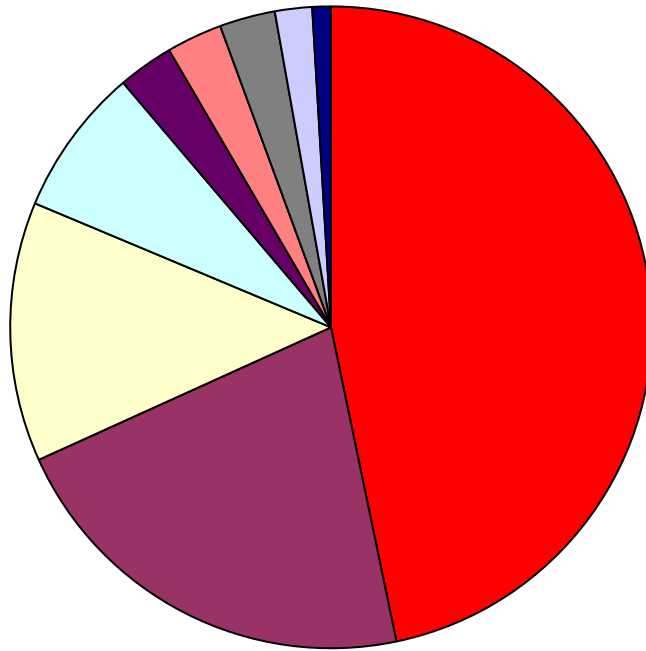
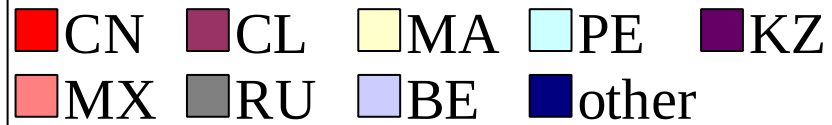


Cd reserve



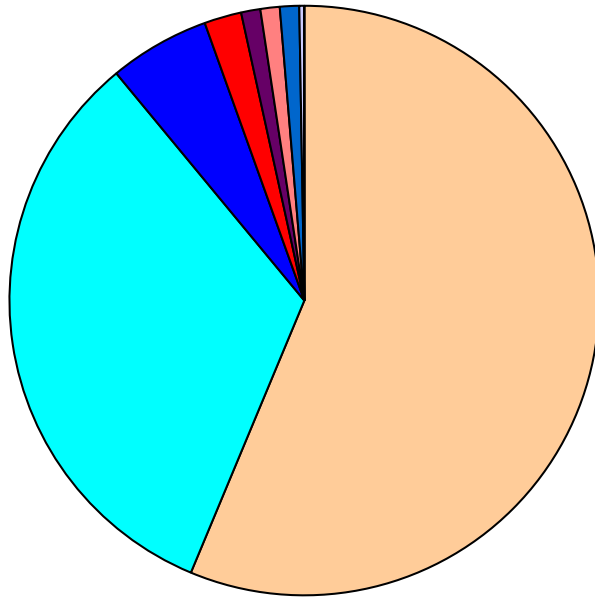
Arsenic

As₂O₃ Production 53,500ton (2009)

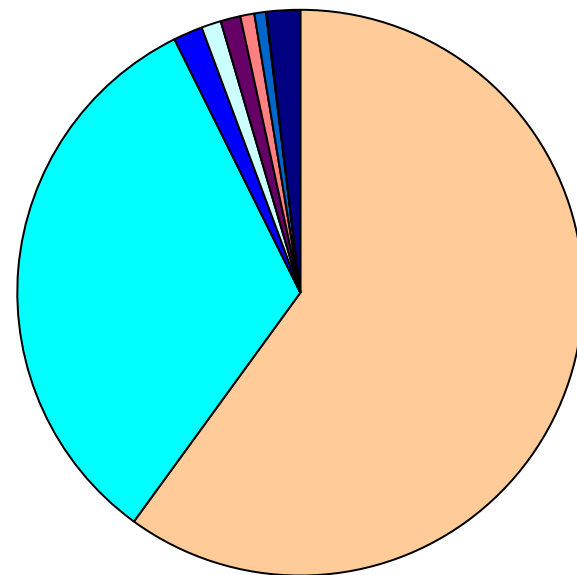
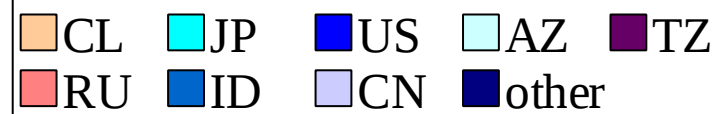


Iodin

I Production 27,000ton (2009)

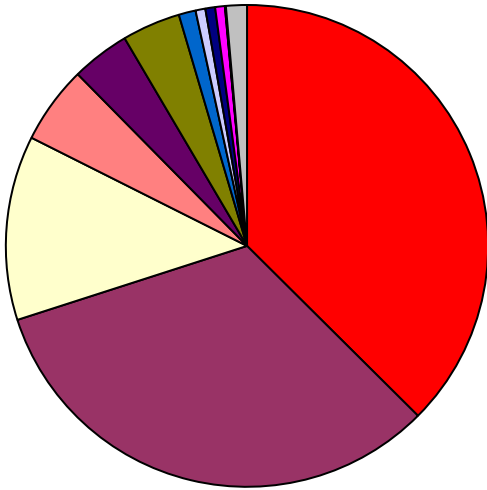
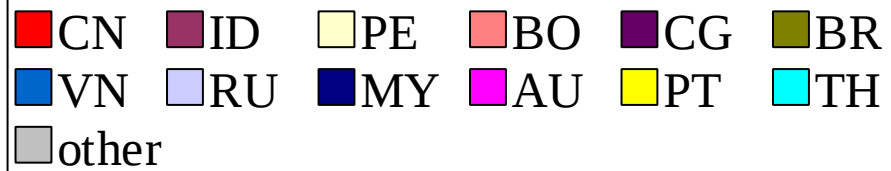


I Reserve 15Mton (2009)

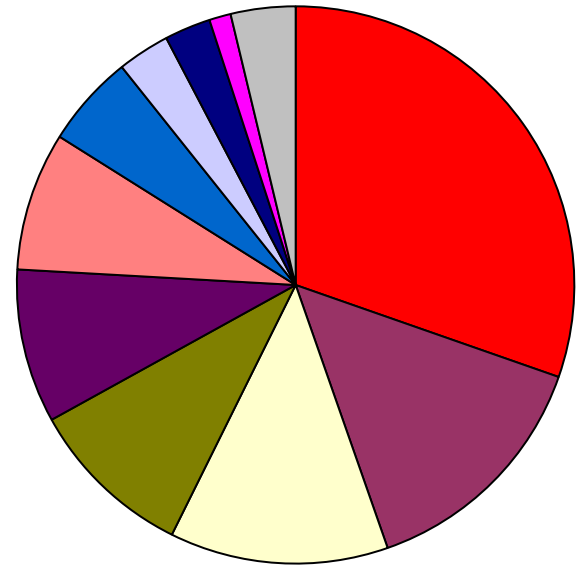
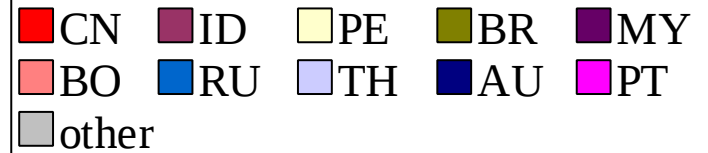


Tin

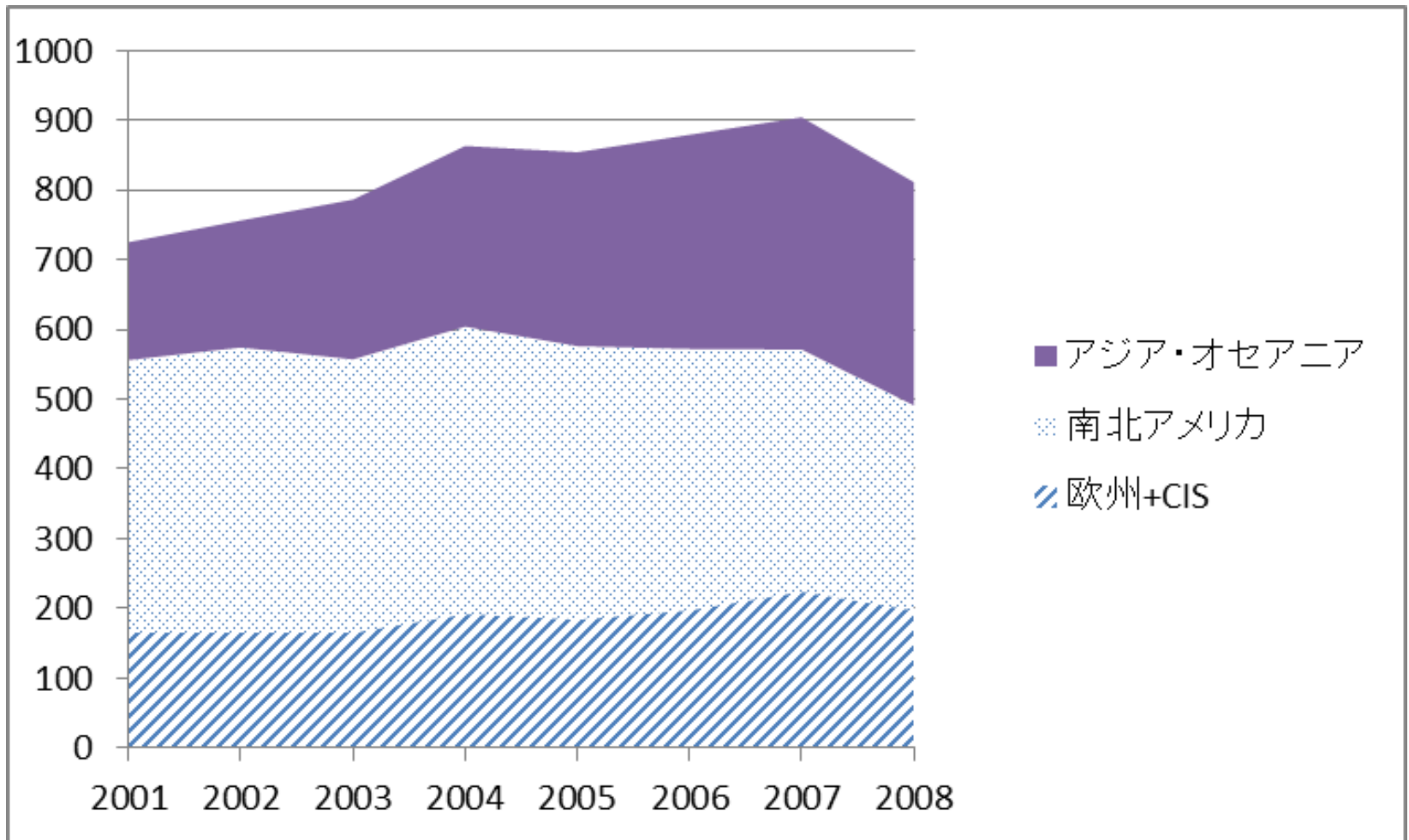
Sn Mine 307,000ton (2009)



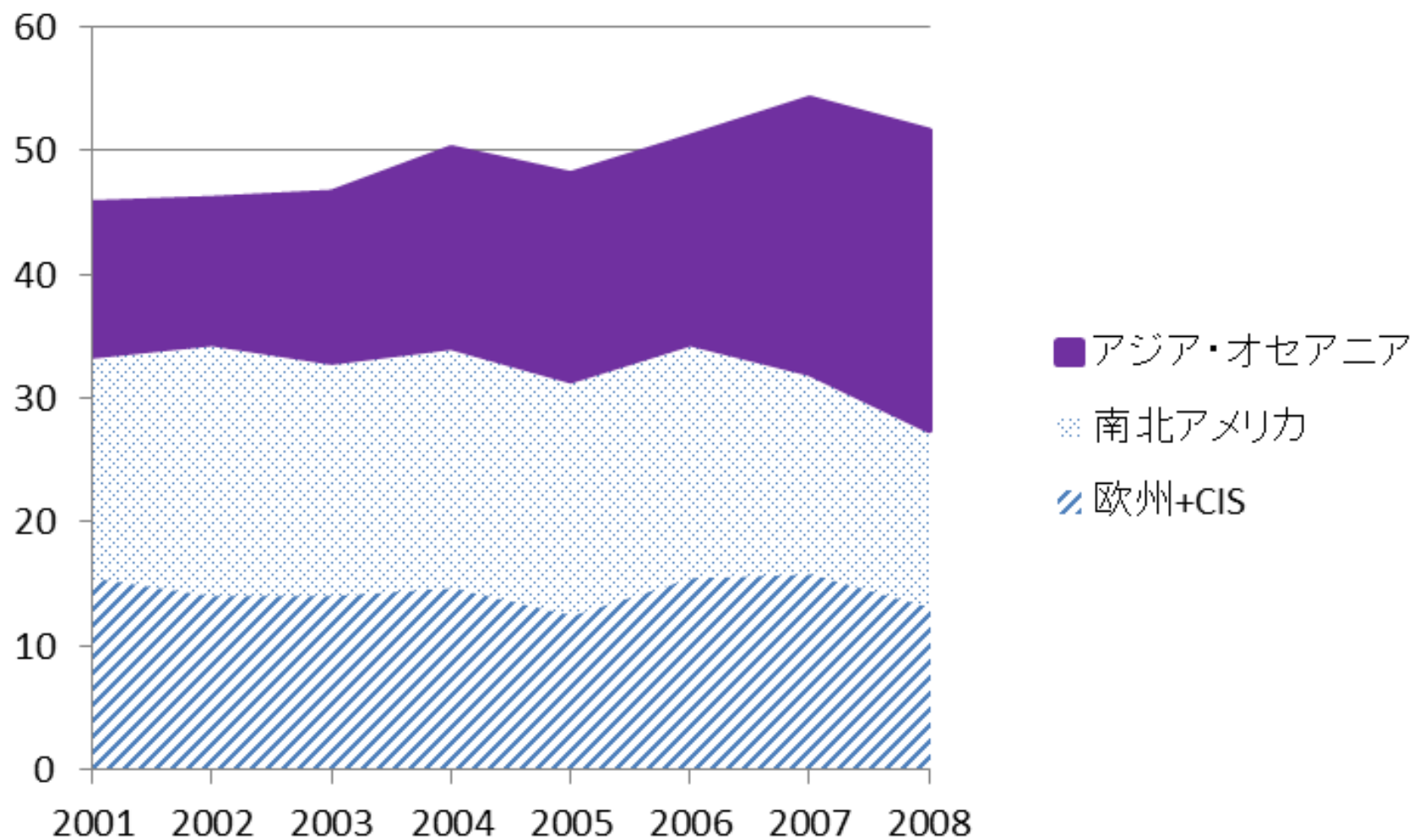
Sn Reserve 5,600,000



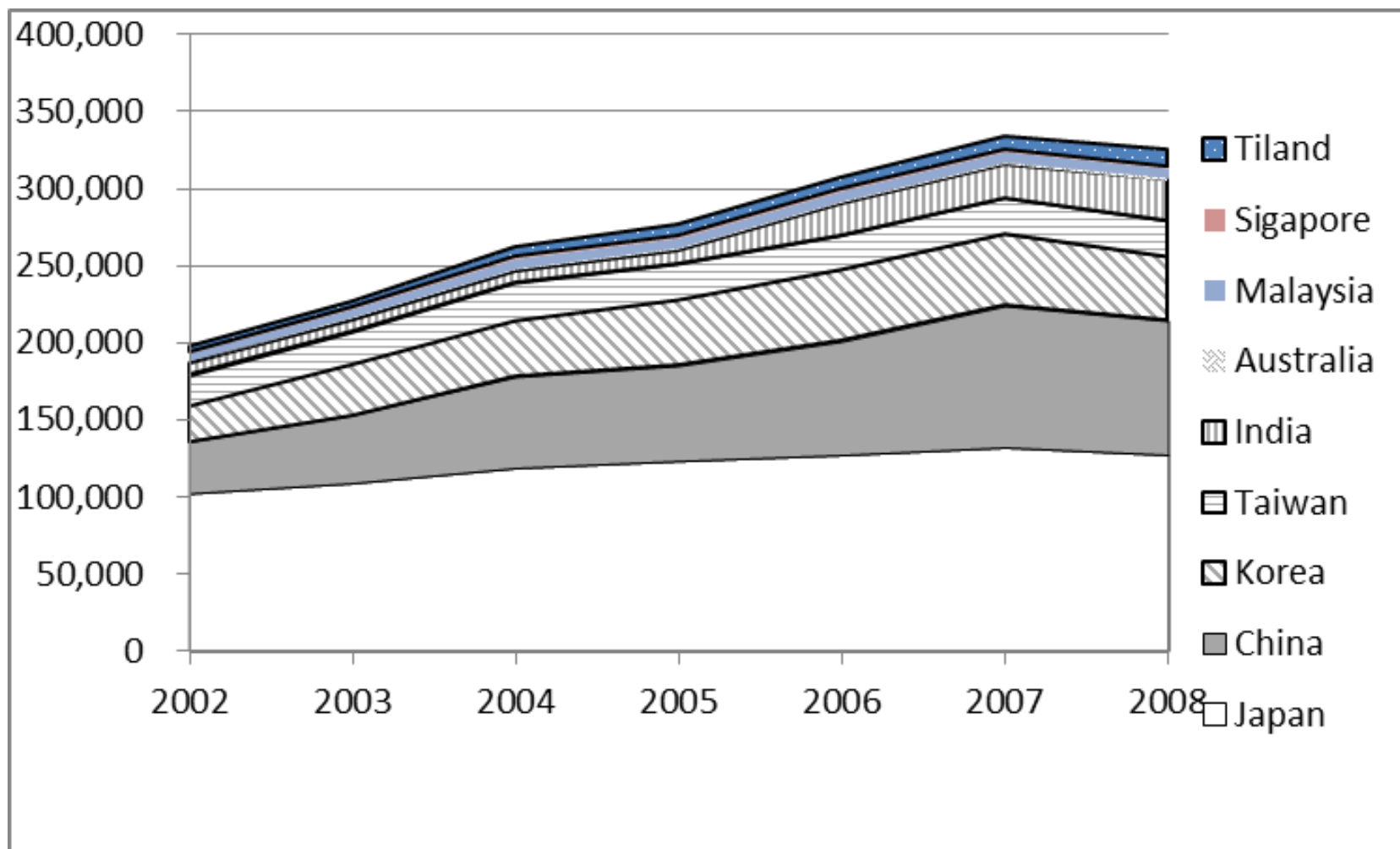
鉄粉の生産(kt)



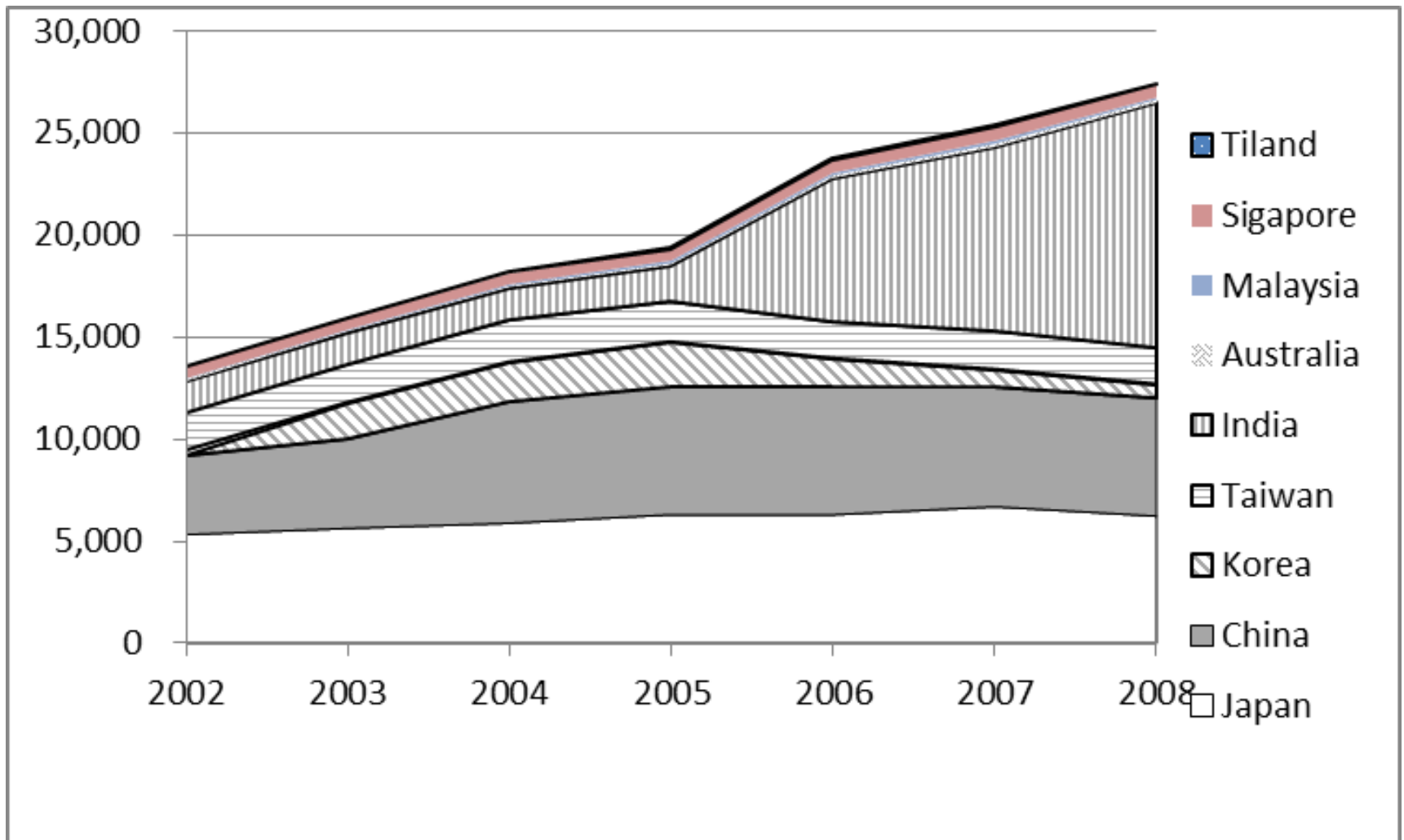
銅粉の生産(kt)



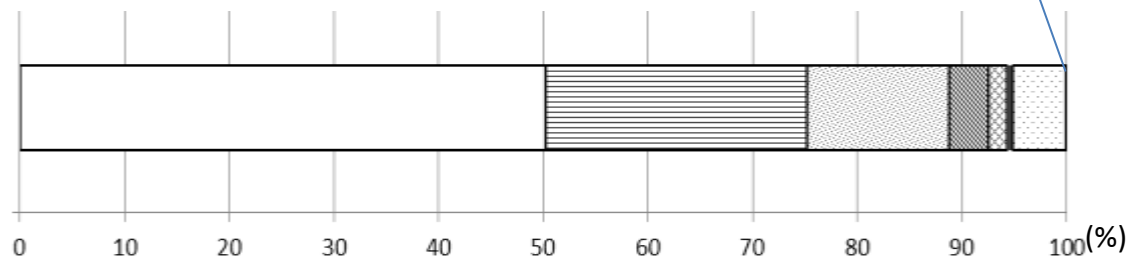
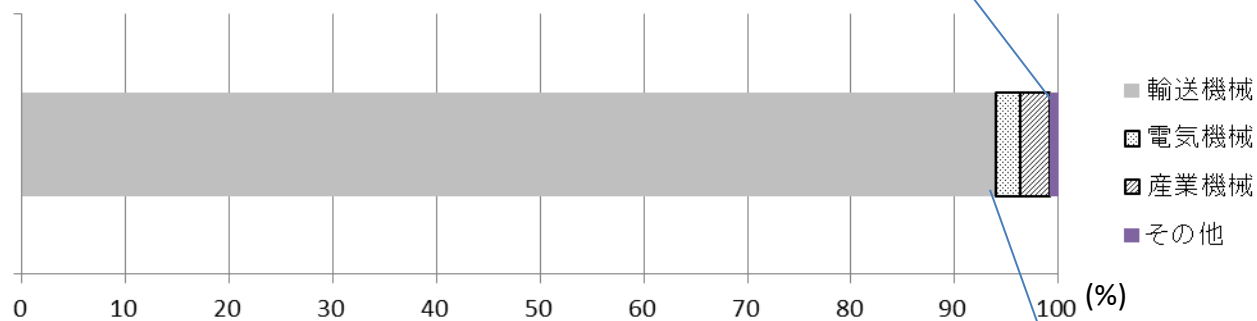
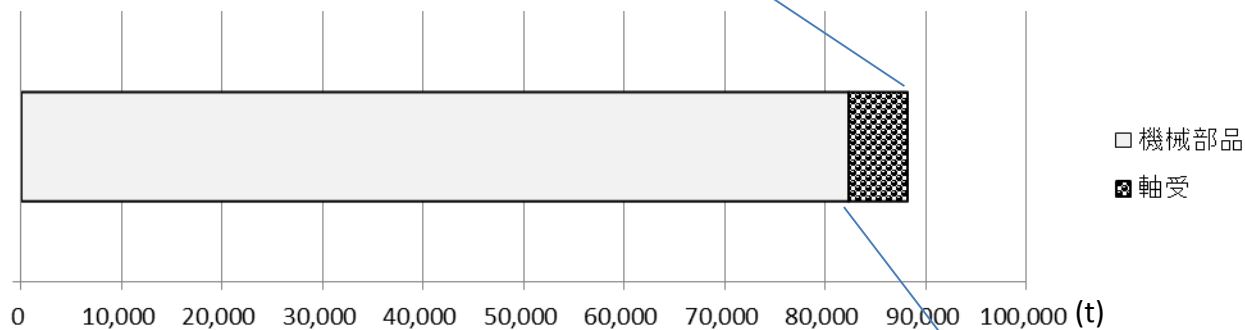
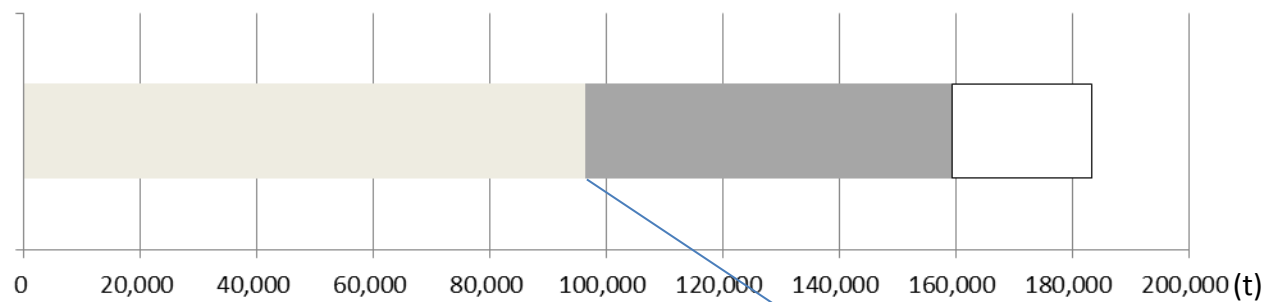
鉄粉の生産 (アジア)(t)



銅粉の生産 (アジア)(t)

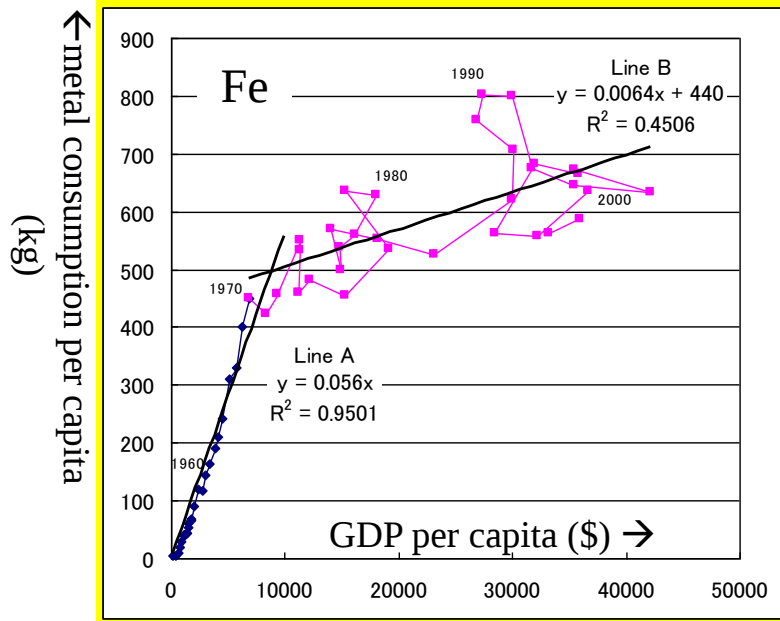


■ 粉末冶金用 ■ その他用 □ 輸出

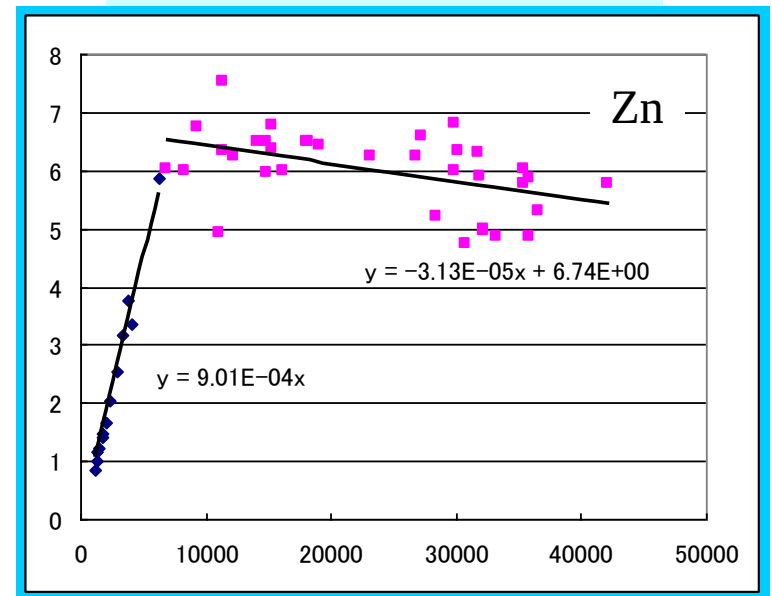


□ エンジン ■ 駆動 ■ シャーシ ■ 電装品 ■ ボディー ■ フューエル □ その他

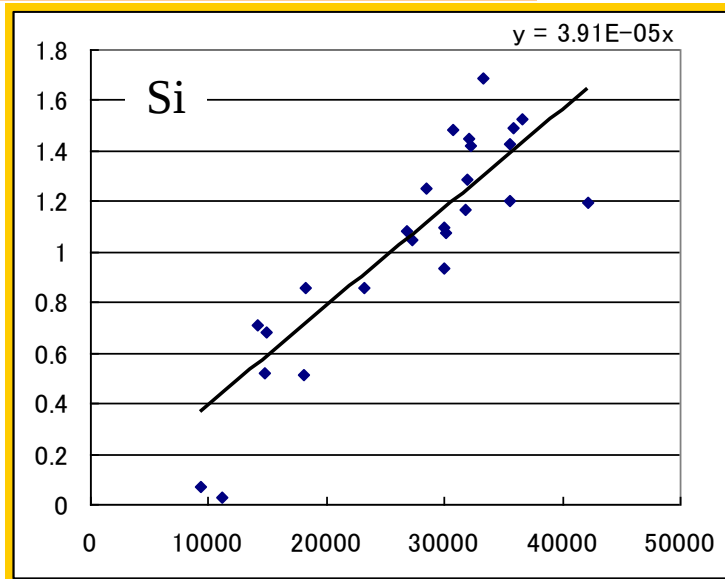
Fe-type: weakly de-coupled
Al, Ni, Mo, Ag, Sb



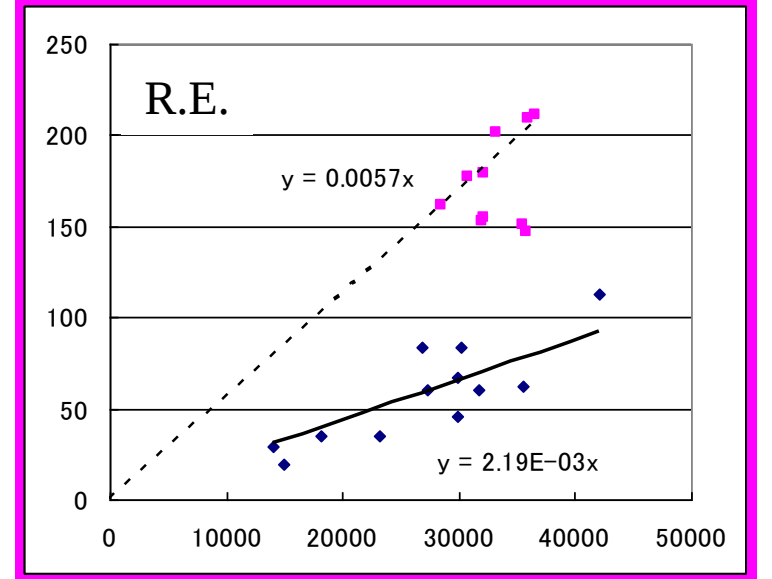
Zn-type: de-coupled
Cu, Sn, Pb, W, Cr, Mn, Au



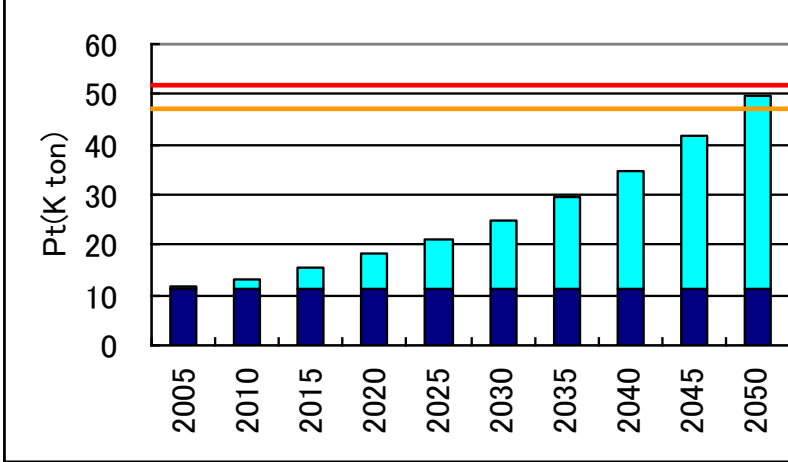
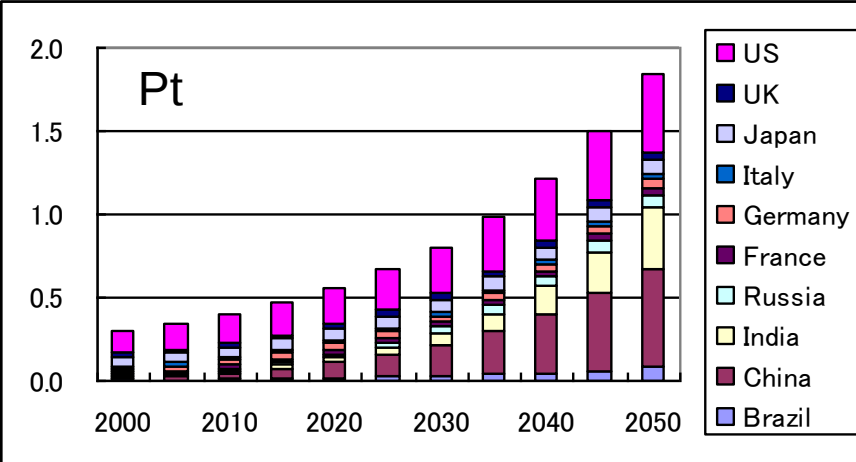
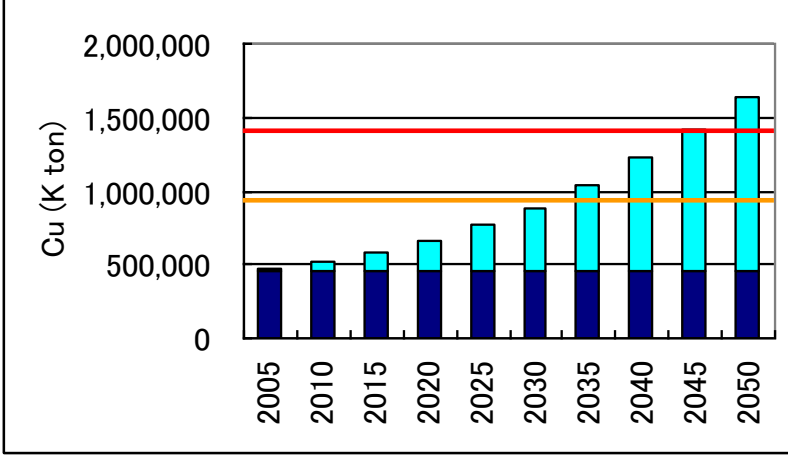
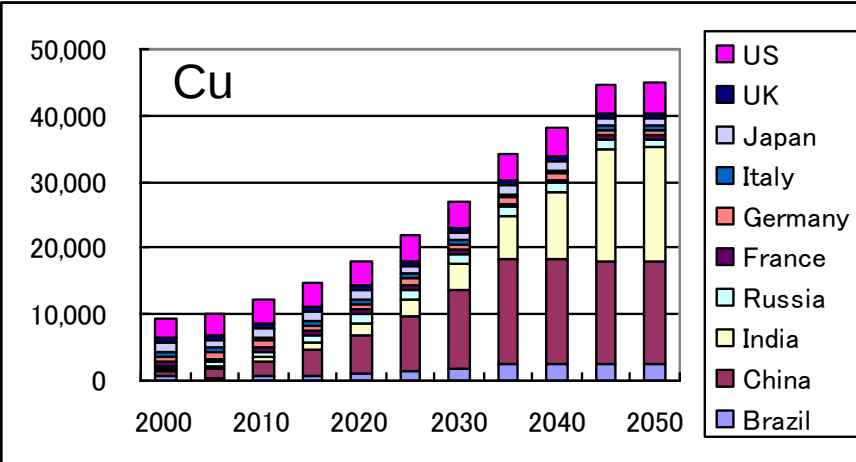
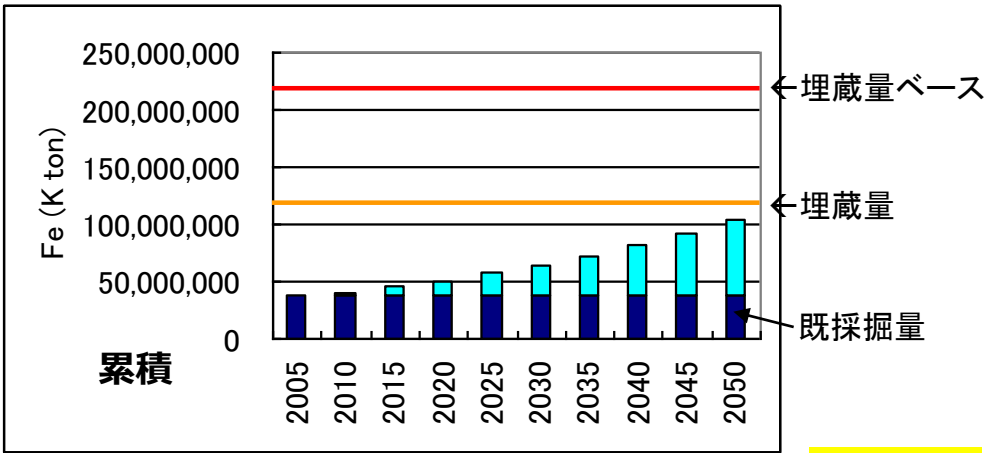
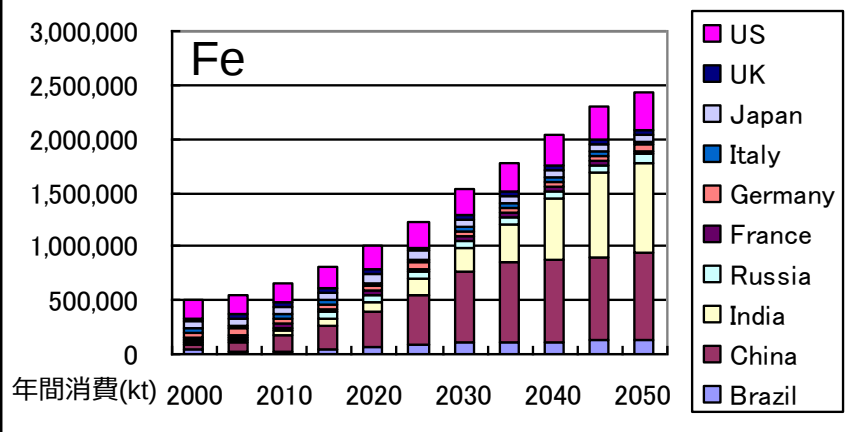
Si-type: still coupling Pt, Co



R.E.-type: further coupling Li, In, Ga



Four types of the two step line model of metal consumption v.s. GDP per capita



比較的豊富な鉄でさえ現有埋蔵量をほぼ消費
銅は埋蔵量の数倍必要で、埋蔵量ベースさえ超える需要
枯渇にはほど遠いとされていた白金も埋蔵量を超過

Several times amount of resources will be required by 2050.

It will be close to the amount of reserve by 2050:

Fe, Mo, W, Co, Pt, Pd

It will require several times amount of reserve by 2050:

Ni, Mn, Li, In, Ga

It will run over the amount of reserve base by 2050:

Cu, Pb, Zn, Au, Ag, Sn

