

# Phase Equilibria, Crystallographic and Thermodynamic Data of Binary Alloys

## List of Alloys (ordered alphabetically)

|           |       |       |           |       |       |       |           |           |       |
|-----------|-------|-------|-----------|-------|-------|-------|-----------|-----------|-------|
| <b>Ac</b> | Ag-Cr | Ag-Mo | Ag-Se     | Al-Au | Al-Ho | Al-Pu | Al-Y      | Am-Rh     | As-Cu |
| Ac-Au     | Ag-Cs | Ag-N  | Ag-Si     | Al-B  | Al-In | Al-Re | Al-Yb     | Am-Ru     | As-Dy |
| Ac-B      | Ag-Cu | Ag-Na | Ag-Sm     | Al-Ba | Al-Ir | Al-Rh | Al-Zn     | Am-S      | As-Er |
| Ac-Cr     | Ag-Dy | Ag-Nb | Ag-Sn     | Al-Be | Al-K  | Al-Ru | Al-Zr     | Am-Sb     | As-Eu |
| Ac-H      | Ag-Er | Ag-Nd | Ag-Sr     | Al-Bi | Al-La | Al-S  | <b>Am</b> | Am-Se     | As-Fe |
| Ac-Mo     | Ag-Eu | Ag-Ni | Ag-Ta     | Al-C  | Al-Li | Al-Sb | Am-B      | Am-Si     | As-Ga |
| Ac-O      | Ag-Fe | Ag-O  | Ag-Tb     | Al-Ca | Al-Lu | Al-Sc | Am-Be     | Am-Te     | As-Gd |
| Ac-Pt     | Ag-Ga | Ag-Os | Ag-Te     | Al-Cd | Al-Mg | Al-Se | Am-C      | <b>Ar</b> | As-Ge |
| Ac-S      | Ag-Gd | Ag-P  | Ag-Th     | Al-Ce | Al-Mn | Al-Si | Am-Co     | Ar-Mo     | As-H  |
| <b>Ag</b> | Ag-Ge | Ag-Pb | Ag-Ti     | Al-Co | Al-Mo | Al-Sm | Am-Cr     | <b>As</b> | As-Hf |
| Ag-Al     | Ag-H  | Ag-Pd | Ag-Tl     | Al-Cr | Al-N  | Al-Sn | Am-Fe     | As-Au     | As-Hg |
| Ag-As     | Ag-Hf | Ag-Pm | Ag-Tm     | Al-Cs | Al-Na | Al-Sr | Am-H      | As-B      | As-Ir |
| Ag-Au     | Ag-Hg | Ag-Po | Ag-U      | Al-Cu | Al-Nb | Al-Ta | Am-Ir     | As-Ba     | As-K  |
| Ag-B      | Ag-Ho | Ag-Pr | Ag-V      | Al-Dy | Al-Nd | Al-Tb | Am-La     | As-Be     | As-La |
| Ag-Ba     | Ag-In | Ag-Pt | Ag-W      | Al-Er | Al-Ni | Al-Tc | Am-Mo     | As-Bi     | As-Li |
| Ag-Be     | Ag-Ir | Ag-Pu | Ag-Y      | Al-Eu | Al-Np | Al-Te | Am-N      | As-C      | As-Lu |
| Ag-Bi     | Ag-K  | Ag-Rb | Ag-Yb     | Al-Fe | Al-O  | Al-Th | Am-Ni     | As-Ca     | As-Mg |
| Ag-C      | Ag-Kr | Ag-Re | Ag-Zn     | Al-Ga | Al-Os | Al-Ti | Am-O      | As-Cd     | As-Mn |
| Ag-Ca     | Ag-La | Ag-Rh | Ag-Zr     | Al-Gd | Al-P  | Al-Tl | Am-Os     | As-Ce     | As-Mo |
| Ag-Cd     | Ag-Li | Ag-Ru | <b>Al</b> | Al-Ge | Al-Pb | Al-Tm | Am-Pd     | As-Co     | As-N  |
| Ag-Ce     | Ag-Lu | Ag-S  | Al-Am     | Al-H  | Al-Pd | Al-U  | Am-Pt     | As-Cr     | As-Na |
| Ag-Co     | Ag-Mg | Ag-Sb | Al-As     | Al-Hf | Al-Pr | Al-V  | Am-Pu     | As-Cs     | As-Nb |
|           | Ag-Mn | Ag-Sc |           | Al-Hg | Al-Pt | Al-W  |           |           |       |

|       |           |       |       |          |      |      |           |       |           |
|-------|-----------|-------|-------|----------|------|------|-----------|-------|-----------|
| As-Nd | As-Te     | Au-Cu | Au-Ni | Au-Tc    | B-Eu | B-Pa | B-V       | Ba-La | Ba-Sr     |
| As-Ni | As-Th     | Au-Dy | Au-Np | Au-Te    | B-Fe | B-Pb | B-W       | Ba-Li | Ba-Tb     |
| As-Np | As-Ti     | Au-Er | Au-O  | Au-Th    | B-Ga | B-Pd | B-Y       | Ba-Mg | Ba-Te     |
| As-O  | As-Tl     | Au-Eu | Au-Os | Au-Ti    | B-Gd | B-Pm | B-Yb      | Ba-Mn | Ba-Ti     |
| As-Os | As-Tm     | Au-Fe | Au-P  | Au-Tl    | B-Ge | B-Pr | B-Zn      | Ba-Mo | Ba-Tl     |
| As-P  | As-U      | Au-Ga | Au-Pa | Au-Tm    | B-H  | B-Pt | B-Zr      | Ba-N  | Ba-Tm     |
| As-Pa | As-V      | Au-Gd | Au-Pb | Au-U     | B-Hf | B-Pu | <b>Ba</b> | Ba-Na | Ba-V      |
| As-Pb | As-W      | Au-Ge | Au-Pd | Au-V     | B-Hg | B-Re | Ba-Be     | Ba-Nd | Ba-Y      |
| As-Pd | As-Y      | Au-H  | Au-Po | Au-W     | B-Ho | B-Rh | Ba-Bi     | Ba-Ni | Ba-Yb     |
| As-Pr | As-Yb     | Au-He | Au-Pr | Au-Y     | B-In | B-Ru | Ba-Br     | Ba-O  | Ba-Zn     |
| As-Pt | As-Zn     | Au-Hf | Au-Pt | Au-Yb    | B-Ir | B-S  | Ba-C      | Ba-P  | <b>Be</b> |
| As-Pu | As-Zr     | Au-Hg | Au-Pu | Au-Zn    | B-La | B-Sb | Ba-Ca     | Ba-Pb | Be-Bi     |
| As-Rb | <b>Au</b> | Au-Ho | Au-Rb | Au-Zr    | B-Li | B-Sc | Ba-Cd     | Ba-Pd | Be-C      |
| As-Re | Au-B      | Au-In | Au-Re | <b>B</b> | B-Lu | B-Se | Ba-Cl     | Ba-Po | Be-Ca     |
| As-Rh | Au-Ba     | Au-Ir | Au-Rh | B-Ba     | B-Mg | B-Si | Ba-Cs     | Ba-Pr | Be-Cd     |
| As-Ru | Au-Be     | Au-K  | Au-Ru | B-Be     | B-Mn | B-Sm | Ba-Cu     | Ba-Pt | Be-Ce     |
| As-S  | Au-Bi     | Au-La | Au-S  | B-Bi     | B-Mo | B-Sn | Ba-Eu     | Ba-Pu | Be-Cm     |
| As-Sb | Au-Br     | Au-Li | Au-Sb | B-C      | B-N  | B-Sr | Ba-F      | Ba-Rb | Be-Co     |
| As-Sc | Au-C      | Au-Lu | Au-Sc | B-Ca     | B-Na | B-Ta | Ba-Ga     | Ba-Rh | Be-Cr     |
| As-Se | Au-Ca     | Au-Mg | Au-Se | B-Cd     | B-Nb | B-Tb | Ba-Fe     | Ba-S  | Be-Cs     |
| As-Si | Au-Cd     | Au-Mn | Au-Si | B-Ce     | B-Nd | B-Tc | Ba-Ga     | Ba-Sb | Be-Cu     |
| As-Sm | Au-Ce     | Au-Mo | Au-Sm | B-Co     | B-Ni | B-Th | Ba-Ge     | Ba-Sc | Be-Dy     |
| As-Sn | Au-Cl     | Au-N  | Au-Sn | B-Cr     | B-Np | B-Ti | Ba-H      | Ba-Se | Be-Er     |
| As-Sr | Au-Co     | Au-Na | Au-Sr | B-Cu     | B-O  | B-Tl | Ba-Hg     | Ba-Si | Be-Eu     |
| As-Ta | Au-Cr     | Au-Nb | Au-Ta | B-Dy     | B-Os | B-Tm | Ba-I      | Ba-Sm | Be-Fe     |
| As-Tb | Au-Cs     | Au-Nd | Au-Tb | B-Er     | B-P  | B-U  | Ba-In     | Ba-Sn | Be-Fe     |
|       |           |       |       |          |      |      | Ba-K      |       | Be-Ga     |

|       |       |           |       |       |           |      |      |           |       |
|-------|-------|-----------|-------|-------|-----------|------|------|-----------|-------|
| Be-Gd | Be-Pm | Be-Y      | Bi-I  | Bi-Rh | <b>Bk</b> | C-Dy | C-Po | C-Zn      | Ca-Lu |
| Be-Ge | Be-Po | Be-Yb     | Bi-In | Bi-Ru | Bk-H      | C-Er | C-Pr | C-Zr      | Ca-Mg |
| Be-H  | Be-Pr | Be-Zn     | Bi-Ir | Bi-S  | Bk-Mo     | C-Eu | C-Pt | <b>Ca</b> | Ca-Mn |
| Be-Hf | Be-Pt | Be-Zr     | Bi-K  | Bi-Sb | Bk-Pt     | C-Fe | C-Pu | Ca-Cd     | Ca-Mo |
| Be-Hg | Be-Pu | <b>Bi</b> | Bi-La | Bi-Sc | <b>Br</b> | C-Gd | C-Rb | Ca-Ce     | Ca-N  |
| Be-Ho | Be-Re | Bi-Br     | Bi-Li | Bi-Se | Br-Ca     | C-Ge | C-Re | Ca-Cl     | Ca-Na |
| Be-In | Be-Rh | Bi-Ca     | Bi-Lu | Bi-Si | Br-Cd     | C-Hf | C-Rh | Ca-Co     | Ca-Nb |
| Be-Ir | Be-Ru | Bi-Cd     | Bi-Mg | Bi-Sm | Br-Cf     | C-Hg | C-Ru | Ca-Cr     | Ca-Nd |
| Be-K  | Be-S  | Bi-Ce     | Bi-Mn | Bi-Sn | Br-Cs     | C-Ho | C-Sb | Ca-Cs     | Ca-Ni |
| Be-La | Be-Sb | Bi-Cl     | Bi-Mo | Bi-Sr | Br-Cn     | C-Ir | C-Sc | Ca-Cu     | Ca-O  |
| Be-Li | Be-Sc | Bi-Cm     | Bi-N  | Bi-Ta | Br-In     | C-K  | C-Se | Ca-Dy     | Ca-P  |
| Be-Lu | Be-Se | Bi-Co     | Bi-Na | Bi-Tb | Br-K      | C-La | C-Si | Ca-Er     | Ca-Pb |
| Be-Mg | Be-Si | Bi-Cr     | Bi-Nb | Bi-Te | Br-Mo     | C-Li | C-Sm | Ca-Eu     | Ca-Pd |
| Be-Mn | Be-Sm | Bi-Cs     | Bi-Nd | Bi-Th | Br-Na     | C-Lu | C-Sr | Ca-F      | Ca-Pm |
| Be-Mo | Be-Sn | Bi-Cu     | Bi-Ni | Bi-Ti | Br-Rb     | C-Mg | C-Ta | Ca-Fe     | Ca-Po |
| Be-N  | Be-Sr | Bi-Dy     | Bi-O  | Bi-Tl | Br-Sc     | C-Mn | C-Tb | Ca-Ga     | Ca-Pr |
| Be-Na | Be-Ta | Bi-Er     | Bi-Os | Bi-Tm | Br-Sr     | C-Mo | C-Tc | Ca-Gd     | Ca-Pt |
| Be-Nb | Be-Tb | Bi-Eu     | Bi-P  | Bi-U  | Br-Te     | C-Na | C-Th | Ca-Ge     | Ca-Pu |
| Be-Nd | Be-Tc | Bi-Fe     | Bi-Pb | Bi-V  | <b>C</b>  | C-Nb | C-Ti | Ca-H      | Ca-Rb |
| Be-Ni | Be-Te | Bi-Ga     | Bi-Pd | Bi-W  | C-Ca      | C-Nd | C-Tl | Ca-Hg     | Ca-Rh |
| Be-Np | Be-Th | Bi-Gd     | Bi-Po | Bi-Xe | C-Cd      | C-Ni | C-Tm | Ca-I      | Ca-S  |
| Be-O  | Be-Ti | Bi-Ge     | Bi-Pr | Bi-Y  | C-Ce      | C-Np | C-U  | Ca-In     | Ca-Sb |
| Be-Os | Be-Tm | Bi-H      | Bi-Pt | Bi-Yb | C-Co      | C-Os | C-V  | Ca-Ir     | Ca-Sc |
| Be-P  | Be-U  | Bi-Hf     | Bi-Pu | Bi-Zn | C-Cr      | C-Pa | C-W  | Ca-K      | Ca-Se |
| Be-Pa | Be-V  | Bi-Hg     | Bi-Rb | Bi-Zr | C-Cs      | C-Pb | C-Y  | Ca-La     | Ca-Si |
| Be-Pd | Be-W  | Bi-Ho     | Bi-Re |       | C-Cu      | C-Pd | C-Yb | Ca-Li     | Ca-Sm |

|           |       |       |           |       |           |           |           |       |           |
|-----------|-------|-------|-----------|-------|-----------|-----------|-----------|-------|-----------|
| Ca-Sn     | Cd-Ge | Cd-Po | Cd-Zr     | Ce-N  | Ce-Tb     | Cl-K      | Cm-Si     | Co-Nd | Co-Th     |
| Ca-Sr     | Cd-H  | Cd-Pr | <b>Ce</b> | Ce-Na | Ce-Te     | Cl-La     | <b>Co</b> | Co-Ni | Co-Ti     |
| Ca-Tb     | Cd-Hf | Cd-Pt | Ce-Cl     | Ce-Nb | Ce-Th     | Cl-Mo     | Co-Cr     | Co-Np | Co-Tl     |
| Ca-Te     | Cd-Hg | Cd-Pu | Ce-Co     | Ce-Nd | Ce-Ti     | Cl-Na     | Co-Cu     | Co-O  | Co-Tm     |
| Ca-Ti     | Cd-Ho | Cd-Rb | Ce-Cr     | Ce-Ni | Ce-Tl     | Cl-Nd     | Co-Dy     | Co-Os | Co-U      |
| Ca-Tl     | Cd-I  | Cd-Rh | Ce-Cu     | Ce-O  | Ce-Tm     | Cl-Ni     | Co-Er     | Co-P  | Co-V      |
| Ca-Tm     | Cd-In | Cd-S  | Ce-Dy     | Ce-Os | Ce-U      | Cl-Pd     | Co-Fe     | Co-Pb | Co-W      |
| Ca-U      | Cd-K  | Cd-Sb | Ce-Er     | Ce-P  | Ce-V      | Cl-Rb     | Co-Ga     | Co-Pd | Co-Y      |
| Ca-V      | Cd-Kr | Cd-Sc | Ce-Eu     | Ce-Pb | Ce-Y      | Cl-Sc     | Co-Gd     | Co-Pr | Co-Yb     |
| Ca-W      | Cd-La | Cd-Se | Ce-F      | Ce-Pd | Ce-Yb     | Cl-Sn     | Co-Ge     | Co-Pt | Co-Zn     |
| Ca-Y      | Cd-Li | Cd-Si | Ce-Fe     | Ce-Pm | Ce-Zn     | Cl-Sr     | Co-H      | Co-Pu | Co-Zr     |
| Ca-Yb     | Cd-Lu | Cd-Sm | Ce-Ga     | Ce-Po | Ce-Zr     | Cl-Te     | Co-Hf     | Co-Re | <b>Cr</b> |
| Ca-Zn     | Cd-Mg | Cd-Sn | Ce-Gd     | Ce-Pr | <b>Cf</b> | Cl-Th     | Co-Hg     | Co-Rh | Cr-Cs     |
| <b>Cd</b> | Cd-Mn | Cd-Sr | Ce-Ge     | Ce-Pt | Cf-Mo     | Cl-Tl     | Co-Ho     | Co-Ru | Cr-Cu     |
| Cd-Ce     | Cd-Mo | Cd-Tb | Ce-H      | Ce-Pu | Cf-O      | Cl-Tm     | Co-In     | Co-S  | Cr-Dy     |
| Cd-Cl     | Cd-N  | Cd-Tc | Ce-Hf     | Ce-Re | Cf-Pt     | Cl-Y      | Co-Ir     | Co-Sb | Cr-Er     |
| Cd-Co     | Cd-Na | Cd-Te | Ce-Hg     | Ce-Rh | Cf-S      | Cl-Yb     | Co-K      | Co-Sc | Cr-Eu     |
| Cd-Cr     | Cd-Nb | Cd-Th | Ce-Ho     | Ce-Ru | Cf-Sb     | <b>Cm</b> | Co-La     | Co-Se | Cr-Fe     |
| Cd-Cs     | Cd-Nd | Cd-Ti | Ce-I      | Ce-S  | <b>Cl</b> | Cm-Cr     | Co-Li     | Co-Si | Cr-Ga     |
| Cd-Cu     | Cd-Ni | Cd-Tl | Ce-In     | Ce-Sb | Cl-Cs     | Cm-Ir     | Co-Lu     | Co-Sm | Cr-Gd     |
| Cd-Dy     | Cd-Np | Cd-Tm | Ce-Ir     | Ce-Sc | Cl-Dy     | Cm-Mo     | Co-Mg     | Co-Sn | Cr-Ge     |
| Cd-Er     | Cd-O  | Cd-U  | Ce-La     | Ce-Se | Cl-Er     | Cm-N      | Co-Mn     | Co-Sr | Cr-H      |
| Cd-Eu     | Cd-P  | Cd-V  | Ce-Lu     | Ce-Si | Cl-Gd     | Cm-O      | Co-Mo     | Co-Ta | Cr-Hf     |
| Cd-Fe     | Cd-Pb | Cd-Y  | Ce-Mg     | Ce-Sm | Cl-Hg     | Cm-Pd     | Co-N      | Co-Tb | Cr-Hg     |
| Cd-Ga     | Cd-Pd | Cd-Yb | Ce-Mn     | Ce-Sn | Cl-In     | Cm-Pt     | Co-Na     | Co-Tc | Cr-Ho     |
| Cd-Gd     | Cd-Pm | Cd-Zn | Ce-Mo     | Ce-Ta |           | Cm-Rh     | Co-Nb     | Co-Te | Cr-I      |

|       |           |       |           |       |       |           |       |           |       |
|-------|-----------|-------|-----------|-------|-------|-----------|-------|-----------|-------|
| Cr-In | Cr-Rh     | Cs-Fe | Cs-S      | Cu-K  | Cu-Re | <b>Dy</b> | Dy-Po | Dy-Zn     | Er-Pb |
| Cr-Ir | Cr-Ru     | Cs-Ga | Cs-Sb     | Cu-La | Cu-Rh | Dy-Er     | Dy-Pr | Dy-Zr     | Er-Pd |
| Cr-K  | Cr-S      | Cs-Ge | Cs-Se     | Cu-Li | Cu-Ru | Dy-Fe     | Dy-Pt | <b>Er</b> | Er-Pm |
| Cr-La | Cr-Sb     | Cs-H  | Cs-Sn     | Cu-Lu | Cu-S  | Dy-Ga     | Dy-Pu | Er-Fe     | Er-Po |
| Cr-Li | Cr-Sc     | Cs-Hf | Cs-Sr     | Cu-Mg | Cu-Sb | Dy-Gd     | Dy-Re | Er-Ga     | Er-Pr |
| Cr-Lu | Cr-Se     | Cs-Hg | Cs-Te     | Cu-Mn | Cu-Sc | Dy-Ge     | Dy-Rh | Er-Gd     | Er-Pt |
| Cr-Mg | Cr-Si     | Cs-I  | Cs-Ti     | Cu-Mo | Cu-Se | Dy-H      | Dy-Ru | Er-Ge     | Er-Pu |
| Cr-Mn | Cr-Sm     | Cs-In | Cs-Tl     | Cu-N  | Cu-Si | Dy-Hg     | Dy-S  | Er-H      | Er-Re |
| Cr-Mo | Cr-Sn     | Cs-Ir | Cs-V      | Cu-Na | Cu-Sm | Dy-Ho     | Dy-Sb | Er-Hf     | Er-Rh |
| Cr-N  | Cr-Ta     | Cs-K  | Cs-Zn     | Cu-Nb | Cu-Sn | Dy-I      | Dy-Se | Er-Hg     | Er-Ru |
| Cr-Na | Cr-Tb     | Cs-Li | Cs-Zr     | Cu-Nd | Cu-Sr | Dy-In     | Dy-Si | Er-Ho     | Er-S  |
| Cr-Nb | Cr-Tc     | Cs-Mg | <b>Cu</b> | Cu-Ni | Cu-Ta | Dy-Ir     | Dy-Sm | Er-I      | Er-Sb |
| Cr-Nd | Cr-Te     | Cs-Mo | Cu-Dy     | Cu-Np | Cu-Tb | Dy-La     | Dy-Sn | Er-In     | Er-Sc |
| Cr-Ni | Cr-Th     | Cs-N  | Cu-Er     | Cu-O  | Cu-Tc | Dy-Lu     | Dy-Ta | Er-Ir     | Er-Se |
| Cr-Np | Cr-Ti     | Cs-Na | Cu-Eu     | Cu-Os | Cu-Te | Dy-Mg     | Dy-Tb | Er-La     | Er-Si |
| Cr-O  | Cr-Tm     | Cs-Nb | Cu-Fe     | Cu-P  | Cu-Th | Dy-Mn     | Dy-Tc | Er-Lu     | Er-Sm |
| Cr-Os | Cr-U      | Cs-O  | Cu-Ga     | Cu-Pa | Cu-Ti | Dy-Mo     | Dy-Te | Er-Mg     | Er-Sn |
| Cr-P  | Cr-V      | Cs-Os | Cu-Gd     | Cu-Pb | Cu-Tl | Dy-N      | Dy-Th | Er-Mn     | Er-Ta |
| Cr-Pb | Cr-W      | Cs-P  | Cu-Ge     | Cu-Pd | Cu-Tm | Dy-Nd     | Dy-Ti | Er-Mo     | Er-Tb |
| Cr-Pd | Cr-Y      | Cs-Pb | Cu-H      | Cu-Pm | Cu-U  | Dy-Ni     | Dy-Tl | Er-N      | Er-Tc |
| Cr-Pr | Cr-Yb     | Cs-Pd | Cu-Hf     | Cu-Po | Cu-V  | Dy-O      | Dy-Tm | Er-Nb     | Er-Te |
| Cr-Pt | Cr-Zn     | Cs-Pr | Cu-Hg     | Cu-Pr | Cu-W  | Dy-Os     | Dy-U  | Er-Nd     | Er-Th |
| Cr-Pu | Cr-Zr     | Cs-Pt | Cu-Ho     | Cu-Pt | Cu-Y  | Dy-P      | Dy-V  | Er-Ni     | Er-Ti |
| Cr-Ra | <b>Cs</b> | Cs-Rb | Cu-I      | Cu-Pu | Cu-Yb | Dy-Pb     | Dy-W  | Er-O      | Er-Tl |
| Cr-Rb | Cs-Cu     | Cs-Rh | Cu-In     | Cu-Ra | Cu-Zn | Dy-Pd     | Dy-Y  | Er-Os     | Er-Tm |
| Cr-Re | Cs-F      | Cs-Ru | Cu-Ir     | Cu-Rb | Cu-Zr | Dy-Pm     | Dy-Yb | Er-P      | Er-U  |

|           |       |           |       |           |           |       |           |       |           |
|-----------|-------|-----------|-------|-----------|-----------|-------|-----------|-------|-----------|
| Er-V      | Eu-Ni | Eu-Zn     | Fe-Kr | Fe-S      | <b>Fr</b> | Ga-O  | Ga-Tl     | Gd-O  | Gd-Tl     |
| Er-W      | Eu-O  | Eu-Zr     | Fe-La | Fe-Sb     | Fr-Mg     | Ga-Os | Ga-Tm     | Gd-Os | Gd-Tm     |
| Er-Y      | Eu-P  | <b>F</b>  | Fe-Li | Fe-Sc     | Fr-Mo     | Ga-P  | Ga-U      | Gd-P  | Gd-U      |
| Er-Yb     | Eu-Pb | F-In      | Fe-Lu | Fe-Se     | <b>Ga</b> | Ga-Pb | Ga-V      | Gd-Pb | Gd-V      |
| Er-Zn     | Eu-Pd | F-K       | Fe-Mg | Fe-Si     | Ga-Pd     | Ga-Pd | Ga-W      | Gd-Pd | Gd-W      |
| Er-Zr     | Eu-Po | F-Li      | Fe-Mn | Fe-Sm     | Ga-Gd     | Ga-Pm | Ga-Y      | Gd-Pm | Gd-Y      |
| <b>Es</b> | Eu-Pt | F-Mg      | Fe-Mo | Fe-Sn     | Ga-Ge     | Ga-Pr | Ga-Yb     | Gd-Po | Gd-Yb     |
| Es-Mo     | Eu-Pu | F-Mo      | Fe-N  | Fe-Sr     | Ga-Hf     | Ga-Pt | Ga-Zn     | Gd-Pr | Gd-Zn     |
| Es-O      | Eu-Re | F-Na      | Fe-Na | Fe-Ta     | Ga-Hg     | Ga-Pu | Ga-Zr     | Gd-Pt | Gd-Zr     |
| <b>Eu</b> | Eu-S  | F-Ni      | Fe-Nb | Fe-Tb     | Ga-Ho     | Ga-Rb | <b>Gd</b> | Gd-Pu | <b>Ge</b> |
| Eu-Fe     | Eu-Sb | F-Rb      | Fe-Nd | Fe-Tc     | Ga-I      | Ga-Re | Gd-Ge     | Gd-Re | Ge-H      |
| Eu-Ga     | Eu-Sc | F-Sm      | Fe-Ni | Fe-Te     | Ga-In     | Ga-Rh | Gd-H      | Gd-Rh | Ge-Hf     |
| Eu-Ge     | Eu-Se | F-Sn      | Fe-Np | Fe-Th     | Ga-Ir     | Ga-Ru | Gd-Hg     | Gd-Ru | Ge-Hg     |
| Eu-H      | Eu-Si | F-Sn      | Fe-O  | Fe-Ti     | Ga-K      | Ga-S  | Gd-Ho     | Gd-S  | Ge-Ho     |
| Eu-Hf     | Eu-Sm | F-Yb      | Fe-Os | Fe-Tl     | Ga-La     | Ga-Sb | Gd-I      | Gd-Sb | Ge-I      |
| Eu-Hg     | Eu-Sn | <b>Fe</b> | Fe-P  | Fe-Tm     | Ga-Li     | Ga-Sc | Gd-In     | Gd-Sc | Ge-In     |
| Eu-Ho     | Eu-Ta | Fe-Ga     | Fe-Pb | Fe-U      | Ga-Lu     | Ga-Se | Gd-Ir     | Gd-Se | Ge-Ir     |
| Eu-In     | Eu-Te | Fe-Gd     | Fe-Pd | Fe-V      | Ga-Mg     | Ga-Si | Gd-La     | Gd-Si | Ge-K      |
| Eu-Ir     | Eu-Th | Fe-Ge     | Fe-Pm | Fe-W      | Ga-Mn     | Ga-Sm | Gd-Lu     | Gd-Sm | Ge-La     |
| Eu-La     | Eu-Ti | Fe-H      | Fe-Pr | Fe-Y      | Ga-Mo     | Ga-Sn | Gd-Mg     | Gd-Sn | Ge-Li     |
| Eu-Mg     | Eu-Tl | Fe-Hf     | Fe-Pt | Fe-Yb     | Ga-N      | Ga-Sr | Gd-Mn     | Gd-Ta | Ge-Lu     |
| Eu-Mn     | Eu-U  | Fe-Hg     | Fe-Pu | Fe-Zn     | Ga-Na     | Ga-Ta | Gd-Mo     | Gd-Tb | Ge-Mg     |
| Eu-Mo     | Eu-V  | Fe-Ho     | Fe-Rb | Fe-Zr     | Ga-Nb     | Ga-Tb | Gd-N      | Gd-Tc | Ge-Mn     |
| Eu-N      | Eu-W  | Fe-In     | Fe-Re | <b>Fm</b> | Ga-Nd     | Ga-Te | Gd-Nb     | Gd-Te | Ge-Mo     |
| Eu-Nb     | Eu-Y  | Fe-Ir     | Fe-Rh | Fm-Mo     | Ga-Ni     | Ga-Th | Gd-Nd     | Gd-Th | Ge-N      |
|           | Eu-Yb | Fe-K      | Fe-Ru |           | Ga-Np     | Ga-Ti | Gd-Ni     | Gd-Ti | Ge-Na     |

|       |          |      |           |       |           |       |           |       |           |
|-------|----------|------|-----------|-------|-----------|-------|-----------|-------|-----------|
| Ge-Nb | Ge-Th    | H-Nd | H-Tl      | Hf-Na | Hf-U      | Hg-Pd | Hg-V      | Ho-Pt | I         |
| Ge-Nd | Ge-Ti    | H-Ni | H-Tm      | Hf-Nb | Hf-V      | Hg-Po | Hg-W      | Ho-Pu | I-In      |
| Ge-Ni | Ge-Tl    | H-Np | H-U       | Hf-Ni | Hf-W      | Hg-Pr | Hg-Y      | Ho-Re | I-K       |
| Ge-O  | Ge-Tm    | H-Os | H-V       | Hf-O  | Hf-Y      | Hg-Pt | Hg-Yb     | Ho-Rh | I-La      |
| Ge-Os | Ge-U     | H-Pa | H-W       | Hf-Os | Hf-Yb     | Hg-Pu | Hg-Zn     | Ho-Ru | I-Mg      |
| Ge-P  | Ge-V     | H-Pb | H-Y       | Hf-P  | Hf-Zn     | Hg-Rb | Hg-Zr     | Ho-S  | I-Mo      |
| Ge-Pb | Ge-W     | H-Pd | H-Yb      | Hf-Pd | Hf-Zr     | Hg-Re | <b>Ho</b> | Ho-Sb | I-Na      |
| Ge-Pd | Ge-Y     | H-Po | H-Zn      | Hf-Po | <b>Hg</b> | Hg-Rh | Ho-I      | Ho-Sc | I-Nd      |
| Ge-Pr | Ge-Yb    | H-Pr | H-Zr      | Hf-Pr | Hg-Ho     | Hg-Ru | Ho-In     | Ho-Se | I-Ni      |
| Ge-Pt | Ge-Zn    | H-Pt | <b>He</b> | Hf-Pt | Hg-In     | Hg-S  | Ho-Ir     | Ho-Si | I-Pr      |
| Ge-Pu | Ge-Zr    | H-Pu | He-K      | Hf-Pu | Hg-Ir     | Hg-Sb | Ho-La     | Ho-Sm | I-Rb      |
| Ge-Rb | <b>H</b> | H-Rb | He-Li     | Hf-Rb | Hg-K      | Hg-Sc | Ho-Lu     | Ho-Sn | I-Se      |
| Ge-Re | H-Hf     | H-Re | He-Mo     | Hf-Re | Hg-La     | Hg-Se | Ho-Mg     | Ho-Ta | I-Sr      |
| Ge-Rh | H-Hg     | H-Rh | He-Na     | Hf-Rh | Hg-Li     | Hg-Si | Ho-Mn     | Ho-Tb | I-Tb      |
| Ge-Ru | H-Ho     | H-Ru | He-Ni     | Hf-Ru | Hg-Lu     | Hg-Sm | Ho-Mo     | Ho-Tc | I-Te      |
| Ge-S  | H-In     | H-Sb | <b>Hf</b> | Hf-S  | Hg-Mg     | Hg-Sn | Ho-N      | Ho-Te | I-Th      |
| Ge-Sb | H-Ir     | H-Sc | Hf-Hg     | Hf-Sb | Hg-Mn     | Hg-Sr | Ho-Nd     | Ho-Th | I-Tl      |
| Ge-Sc | H-K      | H-Se | Hf-In     | Hf-Sc | Hg-Mo     | Hg-Ta | Ho-Ni     | Ho-Tl | I-W       |
| Ge-Se | H-La     | H-Si | Hf-Ir     | Hf-Se | Hg-N      | Hg-Tb | Ho-O      | Ho-Tm | I-Y       |
| Ge-Si | H-Li     | H-Sm | Hf-K      | Hf-Si | Hg-Na     | Hg-Tc | Ho-Os     | Ho-U  | <b>In</b> |
| Ge-Sm | H-Lu     | H-Sn | Hf-Li     | Hf-Sn | Hg-Nb     | Hg-Te | Ho-P      | Ho-V  | In-Ir     |
| Ge-Sn | H-Mg     | H-Sr | Hf-Mg     | Hf-Ta | Hg-Nd     | Hg-Th | Ho-Pb     | Ho-W  | In-K      |
| Ge-Sr | H-Mn     | H-Ta | Hf-Mg     | Hf-Tc | Hg-Ni     | Hg-Ti | Ho-Pd     | Ho-Y  | In-Kr     |
| Ge-Ta | H-Mo     | H-Tb | Hf-Mn     | Hf-Te | Hg-O      | Hg-Tl | Ho-Pm     | Ho-Yb | In-La     |
| Ge-Tb | H-Na     | H-Th | Hf-Mo     | Hf-Th | Hg-Os     | Hg-Tm | Ho-Po     | Ho-Zn | In-Li     |
| Ge-Te | H-Nb     | H-Ti | Hf-N      | Hf-Ti | Hg-Pb     | Hg-U  | Ho-Pr     | Ho-Zr |           |

|       |           |       |          |           |           |           |       |           |           |
|-------|-----------|-------|----------|-----------|-----------|-----------|-------|-----------|-----------|
| In-Lu | In-Si     | Ir-N  | Ir-Sn    | K-Pb      | Kr-Sn     | La-Si     | Li-Os | <b>Lr</b> | Lu-Si     |
| In-Mg | In-Sm     | Ir-Na | Ir-Sr    | K-Pd      | <b>La</b> | La-Sm     | Li-P  | Lr-Mo     | Lu-Sm     |
| In-Mn | In-Sn     | Ir-Nb | Ir-Ta    | K-Pu      | La-Lu     | La-Sn     | Li-Pb | <b>Lu</b> | Lu-Sn     |
| In-Mo | In-Sr     | Ir-Nd | Ir-Tb    | K-Rb      | La-Mg     | La-Ta     | Li-Pd | Lu-Mg     | Lu-Ta     |
| In-N  | In-Ta     | Ir-Ni | Ir-Tc    | K-Rh      | La-Mn     | La-Tb     | Li-Pt | Lu-Mn     | Lu-Tb     |
| In-Na | In-Tb     | Ir-Np | Ir-Te    | K-Ru      | La-Mo     | La-Te     | Li-Pu | Lu-Mo     | Lu-Tc     |
| In-Nb | In-Te     | Ir-O  | Ir-Th    | K-S       | La-N      | La-Th     | Li-Rb | Lu-N      | Lu-Te     |
| In-Nd | In-Th     | Ir-Os | Ir-Ti    | K-Sb      | La-Nb     | La-Ti     | Li-Re | Lu-Nd     | Lu-Th     |
| In-Ni | In-Ti     | Ir-P  | Ir-Tm    | K-Se      | La-Nd     | La-Tl     | Li-Rh | Lu-Ni     | Lu-Ti     |
| In-O  | In-Tl     | Ir-Pa | Ir-U     | K-Si      | La-Ni     | La-Tm     | Li-Ru | Lu-O      | Lu-Tl     |
| In-Os | In-Tm     | Ir-Pb | Ir-V     | K-Sn      | La-O      | La-U      | Li-S  | Lu-Os     | Lu-Tm     |
| In-P  | In-U      | Ir-Pd | Ir-W     | K-Sr      | La-Os     | La-V      | Li-Sb | Lu-P      | Lu-U      |
| In-Pb | In-V      | Ir-Pm | Ir-Y     | K-Ta      | La-P      | La-W      | Li-Se | Lu-Pb     | Lu-V      |
| In-Pd | In-W      | Ir-Pr | Ir-Yb    | K-Te      | La-Pb     | La-Y      | Li-Si | Lu-Pd     | Lu-W      |
| In-Pm | In-Y      | Ir-Pt | Ir-Zr    | K-Th      | La-Pd     | La-Yb     | Li-Sn | Lu-Pm     | Lu-Y      |
| In-Pr | In-Yb     | Ir-Pu | <b>K</b> | K-Ti      | La-Pm     | La-Zn     | Li-Sr | Lu-Po     | Lu-Yb     |
| In-Pt | In-Zn     | Ir-Rb | K-Li     | K-Tl      | La-Pr     | La-Zr     | Li-Ta | Lu-Pr     | Lu-Zn     |
| In-Pu | In-Zr     | Ir-Re | K-Mg     | K-U       | La-Pt     | <b>Li</b> | Li-Tc | Lu-Pt     | Lu-Zr     |
| In-Rb | <b>Ir</b> | Ir-Rh | K-Mo     | K-V       | La-Pu     | Li-Mg     | Li-Te | Lu-Pu     | <b>Md</b> |
| In-Re | Ir-K      | Ir-Ru | K-N      | K-W       | La-Re     | Li-Mn     | Li-Ti | Lu-Re     | Md-Mo     |
| In-Rh | Ir-La     | Ir-S  | K-Na     | K-Zn      | La-Rh     | Li-Mo     | Li-Tl | Lu-Rh     | <b>Mg</b> |
| In-Ru | Ir-Li     | Ir-Sb | K-Nb     | K-Zr      | La-Ru     | Li-N      | Li-U  | Lu-Ru     | Mg-Mn     |
| In-S  | Ir-Lu     | Ir-Sc | K-Ni     | <b>Kr</b> | La-S      | Li-Na     | Li-V  | Lu-S      | Mg-Mo     |
| In-Sb | Ir-Mg     | Ir-Se | K-O      | Kr-Mo     | La-Sb     | Li-Nb     | Li-W  | Lu-Sb     | Mg-N      |
| In-Sc | Ir-Mn     | Ir-Si | K-Os     | Kr-Na     | La-Sc     | Li-Ni     | Li-Zn | Lu-Se     | Mg-Na     |
| In-Se | Ir-Mo     | Ir-Sm | K-P      | Kr-Pb     | La-Se     | Li-O      | Li-Zr |           |           |



|       |           |       |           |       |          |           |           |           |       |
|-------|-----------|-------|-----------|-------|----------|-----------|-----------|-----------|-------|
| Mg-Nb | Mg-Sn     | Mn-Pb | Mn-V      | Mo-Ra | Mo-Y     | N-Th      | Na-Sb     | Nb-Re     | Nd-Os |
| Mg-Nd | Mg-Sr     | Mn-Pd | Mn-W      | Mo-Rb | Mo-Yb    | N-Ti      | Na-Se     | Nb-Rh     | Nd-P  |
| Mg-Ni | Mg-Ta     | Mn-Pm | Mn-Y      | Mo-Re | Mo-Zn    | N-Tl      | Na-Si     | Nb-Ru     | Nd-Pb |
| Mg-Np | Mg-Tb     | Mn-Pr | Mn-Yb     | Mo-Rh | Mo-Zr    | N-Tm      | Na-Sn     | Nb-S      | Nd-Pd |
| Mg-O  | Mg-Tc     | Mn-Pt | Mn-Zn     | Mo-Rn | <b>N</b> | N-U       | Na-Sr     | Nb-Sb     | Nd-Pm |
| Mg-Os | Mg-Te     | Mn-Pu | Mn-Zr     | Mo-Ru | N-Na     | N-V       | Na-Ta     | Nb-Sc     | Nd-Pr |
| Mg-P  | Mg-Th     | Mn-Re | <b>Mo</b> | Mo-S  | N-Nb     | N-W       | Na-Te     | Nb-Se     | Nd-Pt |
| Mg-Pa | Mg-Ti     | Mn-Rh | Mo-N      | Mo-Sb | N-Nd     | N-Y       | Na-Th     | Nb-Si     | Nd-Pu |
| Mg-Pb | Mg-Tl     | Mn-Ru | Mo-Na     | Mo-Sc | N-Ni     | N-Yb      | Na-Ti     | Nb-Sm     | Nd-Re |
| Mg-Pd | Mg-Tm     | Mn-S  | Mo-Nb     | Mo-Se | N-Np     | N-Zn      | Na-Tl     | Nb-Sn     | Nd-Rh |
| Mg-Pm | Mg-U      | Mn-Sb | Mo-Nd     | Mo-Si | N-Os     | N-Zr      | Na-U      | Nb-Ta     | Nd-Ru |
| Mg-Po | Mg-V      | Mn-Sc | Mo-Ne     | Mo-Sm | N-Pa     | <b>Na</b> | Na-V      | Nb-Tc     | Nd-S  |
| Mg-Pr | Mg-W      | Mn-Se | Mo-Ni     | Mo-Sn | N-Pb     | Na-Nb     | Na-W      | Nb-Te     | Nd-Sb |
| Mg-Pt | Mg-Y      | Mn-Si | Mo-No     | Mo-Sr | N-Pd     | Na-Ne     | Na-Zn     | Nb-Th     | Nd-Sc |
| Mg-Pu | Mg-Yb     | Mn-Sm | Mo-Np     | Mo-Ta | N-Pr     | Na-Ni     | Na-Zr     | Nb-Ti     | Nd-Se |
| Mg-Ra | Mg-Zn     | Mn-Sn | Mo-O      | Mo-Tb | N-Pu     | Na-O      | <b>Nb</b> | Nb-Tl     | Nd-Si |
| Mg-Rb | Mg-Zr     | Mn-Sr | Mo-Os     | Mo-Tc | N-Rb     | Na-Os     | Nb-Nd     | Nb-U      | Nd-Sm |
| Mg-Re | <b>Mn</b> | Mn-Ta | Mo-P      | Mo-Te | N-Re     | Na-Pb     | Nb-Ni     | Nb-V      | Nd-Sn |
| Mg-Rh | Mn-Mo     | Mn-Tb | Mo-Pa     | Mo-Th | N-Sc     | Na-Pd     | Nb-O      | Nb-W      | Nd-Sr |
| Mg-Ru | Mn-N      | Mn-Tc | Mo-Pb     | Mo-Ti | N-Se     | Na-Po     | Nb-Os     | Nb-Y      | Nd-Ta |
| Mg-S  | Mn-Nb     | Mn-Te | Mo-Pd     | Mo-Tl | N-Si     | Na-Pt     | Nb-P      | Nb-Yb     | Nd-Tb |
| Mg-Sb | Mn-Nd     | Mn-Th | Mo-Pm     | Mo-Tm | N-Sm     | Na-Pu     | Nb-Pb     | Nb-Zn     | Nd-Te |
| Mg-Sc | Mn-Ni     | Mn-Ti | Mo-Po     | Mo-U  | N-Sn     | Na-Rb     | Nb-Pd     | Nb-Zr     | Nd-Th |
| Mg-Se | Mn-Np     | Mn-Tl | Mo-Pr     | Mo-V  | N-Sr     | Na-Rh     | Nb-Pt     | <b>Nd</b> | Nd-Ti |
| Mg-Si | Mn-O      | Mn-Tm | Mo-Pt     | Mo-W  | N-Ta     | Na-Ru     | Nb-Pu     | Nd-Ni     | Nd-Tl |
| Mg-Sm | Mn-P      | Mn-U  | Mo-Pu     | Mo-Xe | N-Te     | Na-S      | Nb-Rb     | Nd-O      | Nd-Tm |

|           |           |          |           |       |          |           |           |       |           |
|-----------|-----------|----------|-----------|-------|----------|-----------|-----------|-------|-----------|
| Nd-U      | Ni-Sm     | Np-Rh    | O-Sb      | Os-Pt | Os-Zr    | P-Tl      | Pb-S      | Pd-Re | <b>Pm</b> |
| Nd-V      | Ni-Sn     | Np-Ru    | O-Sc      | Os-Pu | <b>P</b> | P-Tm      | Pb-Sb     | Pd-Rh | Pm-Po     |
| Nd-W      | Ni-Sr     | Np-S     | O-Se      | Os-Rb | P-Pa     | P-U       | Pb-Sc     | Pd-Ru | Pm-Pr     |
| Nd-Y      | Ni-Ta     | Np-Sb    | O-Si      | Os-Re | P-Pb     | P-V       | Pb-Se     | Pd-S  | Pm-Pu     |
| Nd-Yb     | Ni-Tb     | Np-Se    | O-Sm      | Os-Rh | P-Pd     | P-W       | Pb-Si     | Pd-Sb | Pm-Rh     |
| Nd-Zn     | Ni-Tc     | Np-Si    | O-Sn      | Os-Ru | P-Pr     | P-Y       | Pb-Sm     | Pd-Sc | Pm-Ru     |
| Nd-Zr     | Ni-Te     | Np-Sn    | O-Sr      | Os-S  | P-Pt     | P-Yb      | Pb-Sn     | Pd-Se | Pm-Sm     |
| <b>Ni</b> | Ni-Th     | Np-Te    | O-Ta      | Os-Sb | P-Pu     | P-Zn      | Pb-Sr     | Pd-Si | Pm-Tb     |
| Ni-Np     | Ni-Ti     | Np-Tl    | O-Tb      | Os-Sc | P-Rb     | P-Zr      | Pb-Tb     | Pd-Sm | Pm-Th     |
| Ni-O      | Ni-Tl     | Np-U     | O-Tc      | Os-Se | P-Re     | <b>Pa</b> | Pb-Te     | Pd-Sn | Pm-Tl     |
| Ni-Os     | Ni-Tm     | Np-W     | O-Te      | Os-Si | P-Rh     | Pa-Pt     | Pb-Th     | Pd-Sr | Pm-Tm     |
| Ni-P      | Ni-U      | Np-Zr    | O-Th      | Os-Sm | P-Ru     | Pa-Rh     | Pb-Ti     | Pd-Ta | Pm-V      |
| Ni-Pb     | Ni-V      | <b>O</b> | O-Ti      | Os-Sn | P-S      | Pa-Sb     | Pb-Tl     | Pd-Tb | Pm-W      |
| Ni-Pd     | Ni-W      | O-Os     | O-Tl      | Os-Ta | P-Sb     | Pa-Th     | Pb-Tm     | Pd-Tc | Pm-Y      |
| Ni-Pm     | Ni-Y      | O-Pa     | O-Tm      | Os-Tb | P-Sc     | Pa-W      | Pb-U      | Pd-Te | <b>Po</b> |
| Ni-Pr     | Ni-Yb     | O-Pb     | O-U       | Os-Tc | P-Se     | <b>Pb</b> | Pb-V      | Pd-Th | Po-Pr     |
| Ni-Pt     | Ni-Zn     | O-Pd     | O-V       | Os-Te | P-Si     | Pb-Pd     | Pb-W      | Pd-Ti | Po-Pt     |
| Ni-Pu     | Ni-Zr     | O-Pm     | O-W       | Os-Th | P-Sm     | Pb-Pm     | Pb-Yb     | Pd-Tl | Po-S      |
| Ni-Re     | <b>Np</b> | O-Po     | O-Y       | Os-Ti | P-Sn     | Pb-Po     | Pb-Zn     | Pd-Tm | Po-Sc     |
| Ni-Rh     | Np-O      | O-Pr     | O-Yb      | Os-Tm | P-Sr     | Pb-Pr     | Pb-Zr     | Pd-U  | Po-Sm     |
| Ni-Ru     | Np-Os     | O-Pt     | O-Zn      | Os-U  | P-Ta     | Pb-Pt     | <b>Pd</b> | Pd-V  | Po-Sr     |
| Ni-S      | Np-P      | O-Pu     | O-Zr      | Os-V  | P-Tb     | Pb-Pu     | Pd-Pr     | Pd-W  | Po-Ta     |
| Ni-Sb     | Np-Pd     | O-Rb     | <b>Os</b> | Os-W  | P-Tc     | Pb-Rb     | Pd-Pt     | Pd-Y  | Po-Tb     |
| Ni-Sc     | Np-Pt     | O-Re     | Os-P      | Os-Y  | P-Te     | Pb-Rh     | Pd-Pt     | Pd-Yb | Po-Ti     |
| Ni-Se     | Np-Pu     | O-Rh     | Os-Pd     | Os-Yb | P-Th     | Pb-Ru     | Pd-Pu     | Pd-Zn | Po-Tm     |
| Ni-Si     | Np-Re     | O-Ru     | Os-Pr     | Os-Zn | P-Ti     |           | Pd-Rb     | Pd-Zr |           |

|           |           |           |           |           |           |           |           |           |           |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Po-W      | Pr-W      | Pt-V      | Pu-V      | Rb-Zr     | <b>Rh</b> | <b>Ru</b> | S-Se      | Sb-Ta     | Sc-V      |
| Po-Y      | Pr-Y      | Pt-W      | Pu-W      | <b>Re</b> | Rh-Ru     | Ru-S      | S-Si      | Sb-Tb     | Sc-W      |
| Po-Yb     | Pr-Zn     | Pt-Y      | Pu-Y      | Re-Rh     | Rh-S      | Ru-Sb     | S-Sm      | Sb-Te     | Sc-Y      |
| Po-Zn     | <b>Pt</b> | Pt-Yb     | Pu-Yb     | Re-Ru     | Rh-Sb     | Ru-Sc     | S-Sn      | Sb-Th     | Sc-Yb     |
| Po-Zr     | Pt-Pu     | Pt-Zn     | Pu-Zn     | Re-S      | Rh-Sc     | Ru-Se     | S-Sr      | Sb-Ti     | Sc-Zn     |
| <b>Pr</b> | Pt-Rb     | Pt-Zr     | Pu-Zr     | Re-Sb     | Rh-Se     | Ru-Si     | S-Ta      | Sb-Tl     | Sc-Zr     |
| Pr-Pt     | Pt-Re     | <b>Pu</b> | <b>Ra</b> | Re-Sc     | Rh-Si     | Ru-Sm     | S-Tb      | Sb-Tm     | <b>Se</b> |
| Pr-Pu     | Pt-Rh     | Pu-Re     | Ra-S      | Re-Se     | Rh-Sm     | Ru-Sn     | S-Tc      | Sb-U      | Se-Si     |
| Pr-Re     | Pt-Ru     | Pu-Rh     | Ra-Se     | Re-Si     | Rh-Sn     | Ru-Ta     | S-Te      | Sb-V      | Se-Sm     |
| Pr-Rh     | Pt-S      | Pu-Ru     | Ra-W      | Re-Sm     | Rh-Sr     | Ru-Tb     | S-Th      | Sb-W      | Se-Sn     |
| Pr-Ru     | Pt-Sb     | Pu-S      | <b>Rb</b> | Re-Sn     | Rh-Ta     | Ru-Tc     | S-Ti      | Sb-Y      | Se-Sr     |
| Pr-S      | Pt-Sc     | Pu-Sb     | Rb-Rh     | Re-Ta     | Rh-Tb     | Ru-Te     | S-Tl      | Sb-Yb     | Se-Ta     |
| Pr-Sb     | Pt-Se     | Pu-Sc     | Rb-Ru     | Re-Tb     | Rh-Tc     | Ru-Th     | S-Tm      | Sb-Zn     | Se-Tb     |
| Pr-Se     | Pt-Si     | Pu-Se     | Rb-S      | Re-Tc     | Rh-Te     | Ru-Ti     | S-U       | Sb-Zr     | Se-Te     |
| Pr-Si     | Pt-Sm     | Pu-Si     | Rb-Sb     | Re-Te     | Rh-Th     | Ru-Tm     | S-V       | <b>Sc</b> | Se-Th     |
| Pr-Sm     | Pt-Sn     | Pu-Sm     | Rb-Se     | Re-Th     | Rh-Ti     | Ru-U      | S-W       | Sc-Se     | Se-Ti     |
| Pr-Sn     | Pt-Sr     | Pu-Sn     | Rb-Si     | Re-Ti     | Rh-Tm     | Ru-V      | S-Y       | Sc-Si     | Se-Tl     |
| Pr-Ta     | Pt-Ta     | Pu-Sr     | Rb-Sn     | Re-Tm     | Rh-U      | Ru-W      | S-Yb      | Sc-Sn     | Se-Tm     |
| Pr-Tb     | Pt-Tb     | Pu-Ta     | Rb-Sr     | Re-U      | Rh-V      | Ru-Y      | S-Zn      | Sc-Sr     | Se-U      |
| Pr-Te     | Pt-Tc     | Pu-Tb     | Rb-Te     | Re-V      | Rh-W      | Ru-Yb     | S-Zr      | Sc-Ta     | Se-V      |
| Pr-Th     | Pt-Te     | Pu-Te     | Rb-Ti     | Re-W      | Rh-Y      | Ru-Zn     | <b>Sb</b> | Sc-Tb     | Se-W      |
| Pr-Ti     | Pt-Th     | Pu-Th     | Rb-Tl     | Re-Y      | Rh-Yb     | Ru-Zr     | Sb-Se     | Sc-Tc     | Se-Y      |
| Pr-Tl     | Pt-Ti     | Pu-Ti     | Rb-V      | Re-Yb     | Rh-Zn     | <b>S</b>  | Sb-Si     | Sc-Te     | Se-Yb     |
| Pr-Tm     | Pt-Tl     | Pu-Tl     | Rb-W      | Re-Zn     | Rh-Zr     | S-Sb      | Sb-Sm     | Sc-Th     | Se-Zn     |
| Pr-U      | Pt-Tm     | Pu-Tm     | Rb-Zn     | Re-Zr     |           | S-Sc      | Sb-Sn     | Sc-Ti     | Se-Zr     |
| Pr-V      | Pt-U      | Pu-U      |           |           |           |           | Sb-Sr     | Sc-U      |           |

**Si**

Si-Sm  
Si-Sn  
Si-Sr  
Si-Ta  
Si-Tb  
Si-Tc  
Si-Te  
Si-Th  
Si-Ti  
Si-Tl  
Si-Tm  
Si-U  
Si-V  
Si-W  
Si-Y  
Si-Yb  
Si-Zn  
Si-Zr

**Sm**

Sm-Sn  
Sm-Ta  
Sm-Tb  
Sm-Te  
Sm-Th  
Sm-Tl  
Sm-U  
Sm-V  
Sm-W  
Sm-Y  
Sm-Zn  
Sm-Zr  
**Sn**  
Sn-Sr  
Sn-Ta  
Sn-Tb

Sn-Tc  
Sn-Te  
Sn-Th  
Sn-Ti  
Sn-Tl  
Sn-Tm  
Sn-U  
Sn-V  
Sn-W  
Sn-Yb  
Sn-Zn  
Sn-Zr  
**Sr**  
Sr-Te  
Sr-Ti  
Sr-Tl  
Sr-U  
Sr-V

Sr-W  
Sr-Y  
Sr-Zn  
**Ta**  
Ta-Tb  
Ta-Tc  
Ta-Te  
Ta-Th  
Ta-Ti  
Ta-Tl  
Ta-Tm  
Ta-U  
Ta-V  
Ta-W  
Ta-Y  
Ta-Yb  
Ta-Zn  
Ta-Zr

**Tb**

Tb-Tc  
Tb-Te  
Tb-Th  
Tb-Ti  
Tb-Tl  
Tb-Tm  
Tb-V  
Tb-W  
Tb-Y  
Tb-Yb  
Tb-Zn  
Tb-Zr  
**Tc**  
Tc-Te  
Tc-Th  
Tc-Ti  
Tc-U

Tc-V  
Tc-W  
Tc-Y  
Tc-Zn  
Tc-Zr  
**Te**  
Te-Th  
Te-Ti  
Te-Tl  
Te-Tm  
Te-U  
Te-V  
Te-W  
Te-Y  
Te-Yb  
Te-Zn  
Te-Zr

**Th**

Th-Ti  
Th-Tl  
Th-Tm  
Th-U  
Th-V  
Th-W  
Th-Y  
Th-Yb  
Th-Zn  
Th-Zr  
**Ti**  
Ti-Tm  
Ti-U  
Ti-V  
Ti-W  
Ti-Y  
Ti-Yb

Ti-Zn  
Ti-Zr  
**Tl**  
Tl-Tm  
Tl-U  
Tl-V  
Tl-W  
Tl-Y  
Tl-Yb  
Tl-Zn  
Tl-Zr  
**Tm**  
Tm-U  
Tm-V  
Tm-W  
Tm-Y  
Tm-Yb  
Tm-Zn

Tm-Zr  
**U**  
U-V  
U-W  
U-Y  
U-Yb  
U-Zn  
U-Zr  
**V**  
V-W  
V-Y  
V-Yb  
V-Zn  
V-Zr  
**W**  
W-Y  
W-Yb  
W-Zn

W-Zr  
**Y**  
Y-Yb  
Y-Zn  
Y-Zr  
**Yb**  
Yb-Zn  
Yb-Zr  
**Zn**  
Zn-Zr