PEARSON CONCEPT

1. HSAB concept

HSAB is the acronym for hard and soft acids and bases.
In 1958 **Ahrland** classified metal cations as Type A and Type B, where:

Type A metal cations included:

Alkali metal cations: Li^+ to Cs^+,
Alkaline earth metal cations: Be^{2+} to Ba^{2+}
Lighter transition metal cations in higher oxidation states: Ti^{4+}, Cr^{3+}, Fe^{3+}, Co^{3+},
The proton, H^+

Type B metal cations include:

Heavier transition metal cations in lower oxidation states: Cu^+, Ag^+, Cd^{2+}, Hg^+, Ni^{2+}, Pd^{2+}, Pt^{2+}

In 1960, Ralph **Pearson** developed the Type A and Type B and classified Lewis acids and Lewis bases as hard, borderline or soft.

Hard acid: A Lewis acid with an acceptor centre of low polarizability, high positive charge, small size.
Soft Acids: A Lewis acid with an acceptor centre of high polarizability, low positive charge, large size.
Hard Bases: A Lewis base with a donor centre of low polarizability, high electron negativity, small size, no low energy empty d-orbitals.
Soft base: A Lewis base with a donor centre of high polarizability, low electron negativity, large size, low energy empty d orbitals

HSAB principle: Hard (Lewis) acids prefer to bind to hard (Lewis) bases
Soft (Lewis) acids prefer to bind to soft (Lewis) bases

2. example

Hard acid Al^{3+},the binding strength increases as the electrostatic parameter, $\xi = \frac{z^2}{r}$

Soft acid Hg^{2+}, the binding strength increases with increasing polarizability of the anion.

3. chemical consequences of hardness

The tendency of soft acids to bond to soft bases and of hard acids to bond to hard bases explains certain aspects of the Goldschmidt classification of the elements into 4 type. (2 of the classes are the lithophile elements and the chalcophile elements.)
l
lithophile elements: Li, Mg, Ti, Al, Cr (hard cations which are found in association to the hard base O^{2-})
chalcophile elements: Cd, Pb, Bi, Ag (soft cations, which are found in associaion with the soft bases $S^{2-,}$ Se^{2-})