DSPMU UNIVERSITY, RANCHI.

DEPARTMENT OF GEOLOGY

SEMESTER-II

PAPER CODE- GLGC203 **DATE-17/04/2020**

FACULTY- ***Dr. Melvin A. Ekka.***

GEOCHEMICAL CLASSIFICATION OF ELEMENTS

Elements may be classified in a number of ways that are useful in geochemical investigations. The most significant of these classification schemes is that developed by V.M. Goldschmidt based on the affinity of elements to form various types of compounds and is relevant to how elements distribute themselves between the Earth's major geochemical reservoirs: the core, the mantle and crust, and the hydrosphere and atmosphere.

In Goldschmidt's classification the chemical elements are divided into four groups-

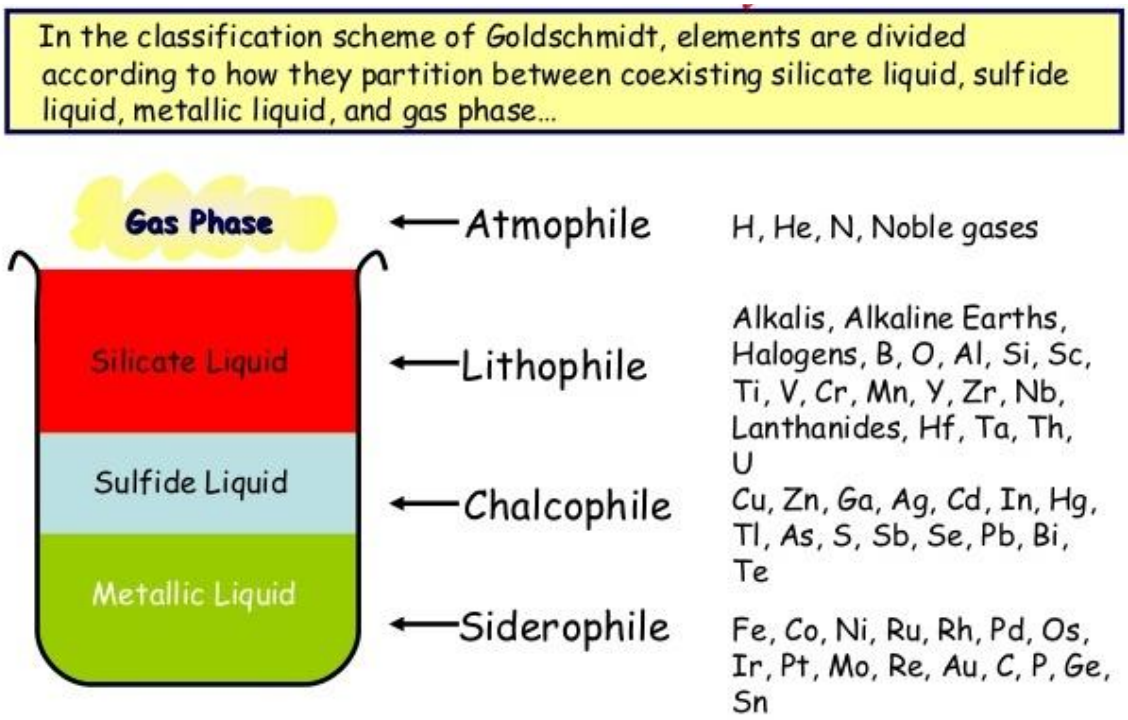
- Lithophile,
- Chalcophile,
- Siderophile,
- Atmophile.

Lithophile elements ("rock loving") are preferentially partitioned into silicate minerals.These include cations that commonly form oxides, such as Ca, Mg, Mn, Ti, Na, K, U, Th, Si, and Fe in its oxidized states. They are difficult to reduce to the elementary state and compounds with oxygen are most characteristic of them. An overwhelming majority of these elements are components of silicates in rocks. Lithophile elements also occur naturally as oxides, halides, phosphates, sulfates, and carbonates and are concentrated in the silicate portion (i.e. crust and mantle) of the earth.

Chalcophile elements are those metals and heavier non-metals that have a low affinity for oxygen and prefer to bond with sulphur to form sulphide type minerals or highly insoluble sulphides. These include Cu, Pb, Zn, Cd, Mo, Hg, Sb, Sn, Tl, Te, As etc. Because these sulfides are much denser than the silicate minerals formed by lithophile elements, chalcophile elements separated below the lithophiles at the time of the crystallization and differentiation of the Earth's crust.

Siderophile elements ("iron loving") are those that are preferentially partitioned into the metallic core, typically in the form of alloys with Fe. Thus,they are depleted in the silicate portion of the earth and presumably concentrated in the core. Elements exhibiting metallic behavior include the noble metals (Pt, Pd, Ir, Ru, Rh, and Os) as well as W, Ni, and Co. Some elements in their reduced states or at high enough pressures to impart metallic behavior can alloy with Fe metal; these include Si, C, and some high field strength elements like Nb. Sulfur may dissolve in the core as a sulfide complex and, under these conditions, is also considered siderophile.

Atmophile elements are those that readily form volatile (e (i.e., they form gases or liquids at the surface of the Earth) compounds at relatively low temperatures (<300 K) many of which are preferentially concentrated in planetary atmosphere. Atmophile elements include C, O, H, N, S, and the noble gases.



Geochemical Classification of Elements

Siderophile	Chalcophile	Lithophile	Atmophile
Fe* Co* Ni*	(Cu) Ag	Li Na K Rb Cs	(H) (C) N (O)
Ru Rh Pd	Zn Cd Hg	Be Mg Ca Sr Ba	(Cl) (Br) (I)
Os Ir Pt	Ga In Tl	B Al Sc Y REE	He Ne Ar
Au Re+ Mo+	(Ge) (Sn) Pb	Si Ti Zr Hf Th	Kr Xe
Ge* Sn* W++	(As) (Sb) Bi	P V Nb Ta	
C++ Cu* Ga*	S Se Te	O Cr U	
(P) As+ Sb+	(Fe) Mo (Os)	H F Cl Br I	
	(Ru) (Rh) (Pd)	(Fe) Mn (Zn) (Ga)	

* Elements are chalcophile and lithophile in the earth's crust.
\+ Elements are chalcophile in the earth's crust
++ Elements are lithophile in the earth's crust
() Elements show affinity for more than one group. Secondary group(s) are shown in parentheses.
After Mason and Moore (1982); Brownlow (1979)

Goldschmidt's Classification