UG1 part (II) (Hons) & (Subsi)

Discovery, occurence and extraction of first transition series elements.

T.M Discovered or first isolated.	Abundance	Major ores / minerals, location	Method of Extraction
Ti Gregor 1791	6320ppm 9th overall	$FeTiO_3$, Timentite Canada, Australia TiO_2, Rutile Australia	In the KROLL Process Rutile or Timenite is first treated with Cl_2 and then $TiCl_4$ is reduced with Mg under Ar
V del Rio 1801	136 ppm 19th overall	>60 minerals, eg. $PbCl_2 \cdot 3Pb_3(VO_4)_2$ Vanadite $K(UO_2)(VO_4)1.5H_2O$	Roast the crushed ore, acidify them at 700°C Reduction in electric furnace with Al or Ferrosilicon to give Fe/V alloys.
Cr Vauquelin 1797	122 ppm 21st overall	$FeCr_2O_4$, chromite 96% of the world's reserves are in South Africa	Ferrochrome produced by reduction of chromite with coke in an electric furnace. Cr metal is extracted by reduction of Cr_2O_3
Mn Gahn 1774	1060 ppm 12th overall	>300 minerals e.g MnO_2, pyrolusite Mn_3O_4 Hausmannite	Ferromanganese produced by reduction of MnO_2 and Fe_2O_3 with coke in blast furnace
Fe Prehistoric	62000ppm 4th overall	Fe_2O_3 · Haematite Fe_3O_4 - Magnetite $FeCO_3$ - Siderite	Reduction of iron in a blast furnace $2Fe_2O_3 + 3C \rightarrow 2Fe + 3CO_2$ actual reducing agent is mainly CO Steel produced by BOS

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Co Brandit 1735	29 ppm 30th overall.	>200 minerals eg $CoAs_2$, Smaltite, Co_3S_4, Linnaeite. Africa, Canada.	Production usually subsidiary to Cu, Ni or Pb. Roast to give 'speiss' of mixed metals and oxides. Leach with H_2SO_4 then treat with OCl^-.
Ni Cronstedit 1751	99 ppm 22nd overall	$(NiMg)_6Si_4O_{10}(OH)_8$ laterites $(NiFe)_9S_8$ Sulphides Sadbury, Canada	Ni and Cu sulfides are roasted and mechanically separated. Ni_3S_2 roasted to oxide used in Steel. Pure Ni from MOND's Process re $Ni + 4CO \rightarrow Ni(CO)_4$
Cu Prehistoric —	68 ppm 25th overall	$CuFeS_2$, Copper pyrites. $Cu_2CO_3(OH)_2$ Malachite	From Cu/Fe sulphide ores $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$ Some oxides ores are directly reduced with coke.

Some Special Alloy steels

Name	composition	Properties	uses
1. Chrome Steel	2-4 % Chromi- um.	High tensile Strength	Ball bearings, cutting tools such as files
2. Tungsten steel	10-20% Tungsten	Retains hardness even at high temperatures.	cutting tools for high speed lathes
3. Stainless Steel	18% Chromium and Nickel	Resists corrosion	Utensils, ornamental pieces
4. Manganese Steel	10-18% Mag	Very hard and resistant to wear	Grinding machinery, Safes.
5. Nickel steel.	2.5-5% Nickel	Resists corrosion, hard and elastic	Wire cables, gears, drive shafts
6. Molybdenum Steel	0.3-3% Molybdenum	Resists corrosion even at high temperatures	cutting tools and axles.
7. Invar	36% Nickel	Practically no coefficient of expansion.	Meter Scales and pendulum rods.
8. Silicon Steel	15% Silicon	Extremely hard and ressistant to acids	Pumps and pipes for carrying acids.