Introduction to Economic Geology

AKHIL KUMAR DWIVEDI
ASSISTANT PROFESSOR (GEOLOGY)
MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

Course Structure

M. Sc. Geology - Course structure

Under Choice Based Credit System (CBCS)

Department of Geology
Faculty of Earth Sciences, M.L. Sukhadia University

M. Sc. Second Year (Semester III) : 2019-20
GEOLOGY

Course S.No.	Course Code	Title of Course	L-T-P	No. of Credit	Max. Marks		Total
					Univ. Exam	Inter. Exam	
1	M3GEO01-CT09	Core Course –IX **Economic Geology**	3-1-0	4	80	20	100
2	M3GEO02-CT10	Core Course – VI **Igneous Petrology**	3-1-0	4	80	20	100
3	M3GEO03-ET01	Discipline Specific Elective Course – I **Ground Water Geology**	3-1-0	4	80	20	100
4	M3GEO04-ET02	Discipline Specific Elective Course – II **Photo-geology and Remote Sensing**	3-1-0	4	80	20	100
5	M3GEO05-CP05	Core Course PR–V **(Economic Geology & Igneous Petrology)**	0-0-8	4	80	20	100
6	M3GEO06-EP01	Elective PR– I **(Ground Water Geology & Photo-geology and Remote Sensing)**	0-0-8	4	80	20	100
	TOTAL			24	480	120	600

Syllabus

M3GEO01-CT09 Core Course – IX : Economic Geology No. of Credits : 4

Unit – I

Study of ore forming processes: Magmatic concentration, Hydrothermal, Contact metasomatism, Mechanical and Residual concentration, Volcanogenic, Bacteriogenic.

Unit –II

Study of ore forming processes: Oxidation and Supergene Sulphide enrichment, Metamorphism, Evaporation and Sedimentation, MVT type deposits, Skarn deposits. Plate tectonics in relation to ore genesis.

Unit –III

Metallogenic epochs and provinces, Structures and Textures of ores, Wall rock alteration, Control of Mineralization, Classification of ore deposits, Important World Deposits : Porphyry Iron and Copper deposits, Broken Hill deposit of Australiya, Ni-Pt deposit of Ontario, Stassfurt deposit of Germany, Witwaters Sand deposit of South Africa, Kuroko type deposit.

Unit – IV

Study of the following metallic deposits in India with reference to their geographic and geologic distribution mode of occurrence and origin: iron, manganese, aluminum, chromium, gold, copper, lead, zinc and atomic minerals.

Unit – V

Study of the following minerals in India with reference to their geographic and geologic distribution mode of occurrence origin and uses: fertilizer minerals, refractory minerals, glass and ceramic minerals, abrasives, gemstones, cement, building stones, energy & fuel minerals: Coal and petroleum deposits: their distribution, classification, origin and potentialities; Important coal and petroleum fields of India.

Books:

Recommended Books:

Craig, J.M. & Vaughan, D.J., 1981: *ore Petrography and Mineralogy. John Wiley*

Dahlkamp, F.J., 1993: *Uranium Ore Deposits. Springer Verlag*

Evans, A.M., 1993: *Ore Geology and Industrial Mineral. Blackwell*

Guilbert, J.M. and Park, Jr. C.F., 1986: *The Geology of Deposits. Freeman*

Holson, G.D. and Tiratsoo, E.N., 1985: *Introduction to Petroleum Geology. Gulf Publ. Houston, Texas*

Jansen M.L. & Bateman A.M.: 1981*, Economic Mineral Deposits, John Wiley & Sons, Singapore*

Klemm, D.D. and Schneider, H.J., 1977: *Time and Strata Bound Ore Deposits. Springer Verlag*

Mookherjee, A., 2000: *Ore Genesis – a Holistic Approach. Allied Publisher*

Selley, R.C., 1998*: Elements of Petroleum Geology. Academic Press*

Singh, M.P.(Ed.), 1998: *Coal and Organic Petrology. Hindustan Publ., New Delhi*

Course Management & Delivery:

- Google Classroom (Attendance, Lecture Notes, PPT's, PDF's, Assignments, Quizes & May be exams also?)

- Google Meet: Adopting the flipped classroom approach

Objectives & Outcomes:

The course is aimed to inculcate a wider perspective of ore deposits, their genesis in light of various ore forming process under prevailing tectonics through geologic ages. The learner will also come to know about geologic and geographic distribution of important metallic and non metallic minerals in Indian subcontinent.

Some Basics:

- Ore
- Gangue
- Tenore
- Metallic Minerals
- Non Metallic Minerals
- Crustal Abundance
- Concentration Factor

Crustal Abundance of Economically Important Elements

Name	*Chemical Symbol*	*Atomic Number*	*Crustal Abundance (Percent by weight)*
Aluminum	Al	13	8.00
Iron	Fe	26	5.8
Magnesium	Mg	12	2.77
Potassium	K	19	1.68
Titanium	Ti	22	0.86
Hydrogen	H	1	0.14
Phosphorus	P	15	0.101
Manganese	Mn	25	0.100
Fluorine	F	9	0.0460
Sulfur	S	16	0.030
Chlorine	Cl	17	0.019
Vanadium	V	23	0.017
Chromium	Cr	24	0.0096
Zinc	Zn	30	0.0082
Nickel	Ni	28	0.0072
Copper	Cu	29	0.0058
Cobalt	Co	27	0.0028
Lead	Pb	82	0.00010
Boron	B	5	0.0007
Beryllium	Be	4	0.00020
Arsenic	As	33	0.00020
Tin	Sn	50	0.00015
Molybdenum	Mb	42	0.00012
Uranium	U	92	0.00016
Tungsten	W	74	0.00010
Silver	Ag	47	0.000008
Mercury	Hg	80	0.000002
Platinum	Pt	78	0.0000005
Gold	Au	79	0.0000002

Table 1 Average crustal abundances for selected metals and typical concentration factors that need to be achieved in order to produce a viable ore deposit

	Average crustal abundance	Typical exploitable grade	Approximate concentration factor
Al	8.2%	30%	×4
Fe	5.6%	50%	×9
Cu	55 ppm	1%	×180
Ni	75 ppm	1%	×130
Zn	70 ppm	5%	×700
Sn	2 ppm	0.5%	×2500
Au	4 ppb	5 g t^{-1}	×1250
Pt	5 ppb	5 g t^{-1}	×1000

Note: 1 ppm is the same as 1 g t^{-1}.

Metal	*Ore Mineral*	*Composition*	*Percent Metal*
Gold	Native gold	Au	100
	Calaverite	$AuTe_2$	39
	Sylvanite	$(Au,Ag)Te_2$	—
Silver	Native silver	Ag	100
	Argentite	Ag_2S	87
	Cerargyrite	AgCl	75
Iron	Magnetite	$FeO \cdot Fe_2O_3$	72
	Hematite	Fe_2O_3	70
	"Limonite"	$Fe_2O_3 \cdot H_2O$	60
	Siderite	$FeCO_3$	48
Copper	Native copper	Cu	100
	Bornite	Cu_5FeS_4	63
	Brochantite	$CuSO_4 \cdot 3Cu(OH)_2$	62
	"Chalcocite"	Cu_2S	80
	Chalcopyrite	$CuFeS_2$	34
	Covellite	CuS	66
	Cuprite	Cu_2O	89
	Digenite	Cu_9S_5	78
	Enargite	$3Cu_2S \cdot As_2S_5$	48
	Malachite	$CuCO_3 \cdot Cu(OH)_2$	57
	Azurite	$2CuCO_3 \cdot Cu(OH)_2$	55
	Chrysocolla	$CuSiO_3 \cdot 2H_2O$	36

Lead	Galena	PbS	86
	Cerussite	$PbCO_3$	77
	Anglesite	$PbSO_4$	68
Zinc	Sphalerite	ZnS	67
	Smithsonite	$ZnCO_3$	52
	Hemimorphite	H_2ZnSiO_5	54
	Zincite	ZnO	80
Tin	Cassiterite	SnO_2	78
	Stannite	$Cu_2S \cdot FeS \cdot SnS_2$	27
Nickel	Pentlandite	$(Fe,Ni)S$	22
	Garnierite	$H_2(Ni,Mg)SiO_3 \cdot H_2O$	—
Chromium	Chromite	$FeO \cdot Cr_2O_3$	68
Manganese	Pyrolusite	MnO_2	63
	Psilomelane	$Mn_2O_3 \cdot xH_2O$	45
	Braunite	$3Mn_2O_3 \cdot MnSiO_3$	69
	Manganite	$Mn_2O_3 \cdot H_2O$	62
Aluminum	Bauxite	$Al_2O_3 \cdot 2H_2O$	39
Antimony	Stibnite	Sb_2S_3	71
Bismuth	Bismuthinite	Bi_2S_3	81
Cobalt	Smaltite	$CoAs_2$	28
	Cobaltite	$CoAsS$	35
Mercury	Cinnabar	HgS	86
Molybdenum	Molybdenite	MoS_2	60
	Wulfenite	$PbMoO_4$	39
Tungsten	Wolframite	$(Fe,Mn)WO_4$	76
	Huebnerite	$MnWO_4$	76
	Scheelite	$CaWO_4$	80
Uranium	Uraninite	Combined UO_2	50–85
	Pitchblend	and UO_3	
	Coffinite	$USiO_4$	75
	Carnotite	$K_2O \cdot 2U_2O_3 \cdot V_2O_5 \cdot nH_2O$	60 U_3O_8

Any Questions??

Thank You !!!