

SAULT COLLEGE
of Applied Arts and Technology
Sault Ste. Marie

COURSE OUTLINE

FORMATION OF MINERAL DEPOSITS

GEO 279-4

revised January 1983 by J. Giguere

Formation of Mineral Deposits

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OBJECTIVES:

1. The course is designed to give the student a basic understanding of how mineral deposits are formed.
2. The processes taught in the course are an expansion of topics already introduced in physical geology but in more depth.
3. During the course the student will visit several operating mines and take samples and notes. He will already have examined many metal prospects during his Field Geology course in the third semester. The student will also be given the chance to examine many suites of ores from various mines. The Instructor should attempt to correlate the theoretical aspects of the course with these more practical aspects, that the student may have a better understanding of where ore is prospected for or located.
4. In order to allow the course to have a broad objective base the semester will be terminated by a series of student papers dealing with the genesis of a Canadian ore deposit or the method of discovery. The report will involve a half hour class presentation.

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Topic Number	Suggested Periods	Topic Description	Reference
1	2	<u>Introduction</u> - Basic Definitions - ore, waste, gangue, native metals, simple ore, complex ore, hypogene, supergene, refractory, tenor, etc.	
2	2	<u>Relationship of Mineral Deposits to Igneous Activity</u> - Igneous rocks as ores - Relationship of specific ores to certain rock types - Relationships to volcanoes - Fumeroles, hot springs - Mineral zoning, age of deposits, spatial distribution - Metallogenic provinces and epochs	
3	14	<u>Magmas and Crystallization</u> - Crystallization - Differentiation - Magmatic Processes (early and late) - Endogenetic and exogenetic ores - Formation of pegmatites	
4	14	<u>Hydrothermal Solutions</u> - Geologic Thermometry - Lengren's classification - Rock openings - Movement of Solutions - Factors affecting deposition	
5	10	<u>Sedimentary Processes</u> - Cycle of: iron, manganese, copper uranium, vanadium - Case histories	
6	10	<u>Weathering Processes</u> - Residual Concentration of iron, manganese, bauxite, nickel - Minerals concentrated in placers - Supergene enrichment - Case Histories	

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Topic Number	Suggested Periods	Topic Description	Referenc
7	3	<u>Metamorphic Processes</u> - Formation of asbestos - Case histories	
9	2	<u>Research Report</u> - A research report on a Canadian Mineral Deposit relating to ore genesis or methods of discovery.	

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SPECIFIC OBJECTIVES

Upon completion of the following objectives the student will be able to:

1. State the subject matter that economic geology concerns itself with.
2. Define term gangue.
3. Define term ore.
4. Define native metal.
5. Define a simple ore.
6. Define complex ore.
7. Define hypogene mineral.
8. Define supergene mineral.
9. State the factors upon which profit depends.
10. Define refractory ore.
11. Define the term ore tenor.
12. State the materials that metals may combine with..
13. State 10⁺ relationships that indicate that metals originate from magmatic activity.
14. State 8 examples of certain ore minerals being associated with particular rock types.
15. State the chemical composition of a magma with relation to silicates, silica, oxides and volatiles.
16. Describe where magmas form.
17. Identify on diagrams different types of igneous bodies.
18. Describe the process of gravitational differentiation by crystallization.
19. Describe the process of filter pressing.
20. Describe the process of liquid separation differentiation.
21. Describe the basic differences between early and late magmatic processes.
22. Describe the process of convection and diffusion in magmas.
23. Describe how a magma may change its chemical composition by the assimilation of foreign material.
24. Describe the process of gaseous transfer.
25. Classify magmatic processes as early or late.

26. Define the terms exogenetic and endogenetic.
27. Give examples of early and late magmatic deposits.
i.e. Kiruna, Sudbury Basin, Palasades
28. Describe the process of forming Pegmatites.
29. State the composition of a magma that would form a pegmatite.
30. State the affect of volatiles in the pegmatilic process.
31. Define the terms complex and simple pegmatites.
32. List the minerals of economic value that might be formed in complex pegmatites.
33. Draw a diagram of the zoning in a complex pegmatite, labeling the minerals that would form in each zone.
34. Describe the pneumatolitic stage.
35. State the temperatures at which the hydrothermal stage occurs.
36. Define the term geological thermometer.
37. State Lengren's classification of hydrothermal deposits.
38. Draw a chart explaining why erosion in the shield has caused the removal of most epithermal deposits.
39. State the factors affecting the deposition of ores under the following topics (Temperature, Pressure, Heat Loss, Composition of Wall Rocks)
40. Describe 5 types of alteration that are commonly associated with hydrothermal activity.
41. Define Paragenesis.
42. Define the terms crustified vein and cockade ore.
43. Define the term fissure vein.
44. Describe how fissure veins form.
45. Draw sketches of five types of fissure veins.
46. List six primary and secondary type of openings where metals may be deposited.
47. Describe how the following types of deposits are formed: shearzones, stockworks, saddle reefs, ladder veins, pitches and flats, breccia filling deposits, solution cavity fillings, pore space fillings, vesicular fillings, gash veins.
48. Describe the case history of various Canadian mines associated with fissure veins.
49. Write out chemical formula for 40 ore minerals.
50. State the difference between metamorphism and metasomatism.

51. List the factors that affect the susceptibility of a rock to metamorphism other than temperature.
52. Describe the procedure of substitution during the replacement process.
53. Draw diagrams to show three methods of replacement.
54. List the agencies of replacement.
55. List 5 criteria for recognizing replacement.
56. Describe the effects of replacement in the ore bodies of Kirkland Lake, Ontario and Noranda, Quebec.
 - (A) Describe those features of replacement that are associated with large igneous bodies such as stocks and Batholiths
 - (B) Define the terms syngenetic and diagenetic
57. Describe the conditions necessary for the formation of sedimentary deposits.
58. List 10 minerals that may be deposited by sedimentary means.
59. List the percent of iron manganese, aluminum and silica in the earth's crust.
60. Describe the sedimentary cycle of iron and manganese.
61. List the types of iron formation presently occurring in the Canadian Shield.
62. State the relative ages of the iron formations in Ontario, Labrador, Michigan and Clinton Alabama.
63. State the average grade of most iron and manganese deposits.
64. Describe the terms miogeosyncline and eugeosyncline.
65. Define the term protore.
66. Describe the genesis of the following mining areas:
 - (a) Labradore Trough
 - (b) Lake Superior Ores
 - (c) Steep Rock Iron Mines
 - (d) Helen Mine
 - (e) Tchiaturi Deposits of Russia
67. Describe the sedimentary cycle of Uranium and Vanadium.
68. State the sources of uranium and vanadium.
69. State the uranium content of the earths crust.
70. List the ore minerals of uranium and vanadium.
71. Compare the paragenesis of the Blind River uranium deposits with the uranium deposits of Vocabina, Brazil and Whitwaters Rand in South Africa.
72. List the major mining camps in Canada associated with active Ores.
73. Define stratiform ore.
74. Describe the sedimentary cycle of copper.

(b) the White Pine Deposit - Michigan
(c) the Mufulira Deposit - South Africa
asbestosous occurs as.

80. Describe the geology of the Thetford Mines deposit.
81. List 4 types of placer deposits.
82. State the physical and chemical characteristics of a mineral in order for it to be preserved in a placer deposit.
83. List 6 minerals that are mined in placer deposits.
84. State what is meant by the "fineness of gold".
85. State the significance of "Jigging Action" in the relationship of deposition of gold in placers.
86. State what percent of the world's gold, diamond and tin supply is mined in placers.
87. State and confirmates: weathering of iron.
88. Define the term residual weathering.
89. Define the term laterite.
90. Describe the process of the formation of lateritic iron.
91. Describe the process of the formation of lateritic nickel.
92. Describe the process of the formation of Bauxite.
93. List 10 residual products that are of economic importance.
94. List the types of rocks that will weather to form bauxite.
95. List 2 areas where bauxite is mined.
96. List 2 areas where lateritic nickel is mined.
97. Write the chemical formulas of three types of bauxite ores.
98. List two major products that result from the weathering of sulfides.
99. State in regard to the formation of laterites the types of weathering products in tropical and temperate climates.
100. Draw a diagram of a section of the ground to show supergene enrichment. On the diagram the zones that would be encountered above and below the water table.
101. Describe the chemical role of pyrite in the process of supergene enrichment.
- 102.

103. State the effect of the water table on the chemistry of supergene enrichment.
104. Describe the terms indigenous limonite and transported limonite.
105. List the colour of gossans formed from different type ores.
106. List the factors which control and limit oxidization.
107. List 10 metals in order of their solubilities.

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EVALUATION:

Grades will be based on 3 tests during the semester.

Pass grade will be 60 percent average over the 3 tests.

A supplemental test will be available for students with a grade at or in excess of 50 percent or under 60 percent.

Below 60 percent is a failure.