MINERAL RESOURCES

Introduction: The course reviews the principal types of mineral resources, their distribution and genesis, with particular emphasis on deposits of metals. The first part of the course deals with the basic principles of ore deposits and methods for deciphering their genetic evolution. Following discussion of how deposits can be classified according to commodity and formation mechanisms, the most common types of deposits will be reviewed with respect to their main features and the geological environments in which they occur. The latter part of the course will focus on the underlying reasons for the distribution of ore deposits within a plate tectonic framework, and go on to discuss the economic principles of mining and the current character of the global metal mining industry and the sequence of events from the selection of areas for potential discovery of ore deposits, prospecting and development.

Contents (10 credit points): Society’s demand for mineral resources, crystallisation processes, paragenetic sequences, phase diagrams and thermodynamics of ore-forming processes, hydrostatic and lithostatic pressure, fluid inclusions, physical/chemical conditions of ore formation (e.g., pH, Eh / redox, buffers, metal complexation in solutions), mineral stabilities, mineral transformation, stable isotopes (H, O, C, S), lead-isotopes in ore genesis studies. Formation of ore deposits via magmatic, metamorphic, metasomatic, sedimentary, diagenetic, hydrothermal, pneumatolytic and supergene genesis. Metallogeny. Non-metallic resources, industrial minerals. Mineral resources of Norway, the Nordic countries; global resources. Introduction to ore mineralogy and microscopy. Mining laws. Exploration. Environmental considerations.

Goals: To provide an introduction to the geological processes (chemical and physical) that contribute to the formation of the major types of mineral deposits.

Previous course requirements/restrictions: None

A good understanding of mineralogy and petrology and the basic principles of geochemistry is recommended.

Teaching format and regularity: two-week intensive course, including obligatory field study course, including 30 hours of lectures plus obligatory laboratory exercise. Language: English or Norwegian depending on students enrolled.

Exam: Oral examination at end of course (80% of total mark), plus evaluation of written and laboratory exercises (10%) and field study course (10%).

Course description:

1. Course structure; Curriculum; lectures, assignments, field course; Introduction, definitions, society's demand for mineral resources, economic foundation.

2. Crystallisation, morphology, textures; paragenetic sequences, zoning; states, phases, components; state diagram for water; hydrostatic and lithostatic pressure. Assignments. Fluid inclusions.

3. Fluid inclusions (continues); chemical equilibrium, law of mass action; protolysis of water, pH as a function of temperature and pressure, redox reactions, Eh, different mineral buffers (buffering of temperature, pressure, concentration); mineral stabilities, wall-rock reactions.

4. Stable isotopes and lead isotopes as geochemical tools; interpretations of isotope data.

5. Classification of mineral deposits; main criteria for classification; introduction to ore formation and genetic models.

6. FIELD COURSE 4 DAYS – MANDATORY. Skarn, massive sulphide, wall-rock reactions, hydrothermal deposits, granites, pegmatite, carbonatite, apatite, larvikite.
7. Magmatic mineral forming processes; Cu-Ni-PGE deposits, chromite deposits, pegmatite deposits.

9. Hydrothermal mineral forming processes: Processes at mineral dissolution, transport, deposition; 'high' and 'low' sulphidation epithermal deposits, porphyry deposits, hydrothermal deposits on the sea floor (VHMS deposits), and more.

10. Sedimentary and diagenetic mineral forming processes; supergene (surface) mineral forming processes (SEDEX deposits, iron deposits, and more).

11. Metamorphic and metasomatic mineral forming processes; development of new ideas and models in ore geology – e.g. 'orogenic gold' and 'IOCG' (Iron Oxide Copper Gold) deposits.


14. (a) Economic aspects of mining industry – what makes a deposit economic? Globalisation of the world's mining industry; (b) Norway's, the Nordic Countries', Europe's and the world's most important mineral resources.

15. (a) Mining laws; (b) Prospecting methods – geochemical, geophysical, evaluation of ore deposits; (c) From prospect to mine – mine development.

**Examination requirements / individual learning:**


+ handouts and scientific publications

**Note:** the curriculum consists of book chapters (individual learning) + lectures + assignments + field course

**Instructors:**

Tom V. Segalstad (NHM)
Nigel J. Cook (NHM)