I. **Catalog Description and Credit Hours of Course:**

Application of chemical principles to the study of near surface environments. (3) Two lectures, 1 two-hour laboratory.

II. **Prerequisites:**

CH186 General Chemistry II or equivalent.

III. **Objectives of the Course:**

A. To become familiar with solubility, acid-base, complexation and oxidation-reduction behaviors of earth materials.
B. To become familiar with the chemical composition of natural waters.
C. To become familiar with the solid-solution interface (adsorption).
D. To become familiar with isotope techniques and their application.
E. To become familiar with clay structures and their reactivity.

IV. **Expectations of the Student:**

A. Prepare for and attend all classes.
B. Content mastery as revealed by successful completion of problem assignments and examinations.
C. Successful use of software to model and predict chemical behavior.
D. Successful development and professional presentation of a case study involving the application of low temperature geochemistry.
E. Graduate students will write a manuscript, nearly suitable for publication, concerning their project.

V. **Content of Course:**

Lecture

Introduction to geochemistry and thermodynamics (4 lectures)

Acids - Bases (2 lectures)

- Nature and strengths of acids - bases, (humic and fulvic acids)
- Activity and pH scales
- Numerical equilibrium calculations using MinteqA2

Carbon dioxide and weathering in sediments (2 lectures)

Hour Examination (#1) (one lecture)
Precipitation - Dissolution (2 lectures)
   Solubility of Al, Fe, and Mn Oxides/hydroxide
   Carbonates
   Activity of the solid phase in soil systems
   Effect of inert electrolyte on solubility
   Crystal formation

**Hour Examination (#2) (one lecture)**

Metal ions in aqueous solution (3 lectures)
   Stability of hydrolysis species
   Metal ions and ligands
   Complex formation and the solubility of solids
   Chelation and inorganic complexes in natural waters

Oxidation - Reduction (4 lectures)
   Redox equilibria and electron activity
   The electrical potential: Peters - Nernst equation
   pe - pH diagrams with particular reference to submerged soils
   Sulfur-sulfide chemistry and uranium, iron systems

Solid - Solution Interface (2 lectures)
   Forces at interfaces
   The electric double layer
   Surface chemistry of oxides
   Ion exchange involving K-Ca with clay minerals

**Hour Examination (#3) (one lecture)**

Clay Mineralogy and Clay Reactivity (7 lectures)

**Hour Examination (#4) (one lecture)**

Laboratory (15 hours)

The laboratory component will involve group and individual projects. The laboratory will provide procedures and instrumentation covering the determination of cationic and anionic species in water, phosphate adsorption, acid-base activities of oxides, and oxidation-reduction of chromium compounds, plus complexation of transition metals. All systems will involve earth and soil materials collected from completely sampled and classified sites.
VI. Textbook and References:


References: Various other materials will be supplied.

VII. Basis of Student Evaluation:

A. Hour examinations (4) 400 points
B. Computer software mastery and assigned problems 100 points
C. Final Examination 100 points
D. Laboratory Activities 100 points
E. Project manuscript writing *(Graduate only)* 100 points

Total Possible Points
Undergraduate 700 points
Graduate 800 points

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<tr>
<th>Grade Scale</th>
<th>Undergraduate</th>
<th>Graduate</th>
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<tr>
<td>A</td>
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<td>F</td>
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The weight of evaluation criteria may vary at the discretion of the instructor and will be indicated at the beginning of each course.

VIII. Policy on Academic Honesty:

This course will adhere to the statement of academic policy as written in the 2004-2005 Southeast Missouri State University Undergraduate Bulletin (page 17-19). This statement includes student expectations concerning cheating and plagiarism. Graduate students are asked to review the same policy in the 2004-2005 Southeast Missouri State University Graduate Bulletin.