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GLASSBORO STATE COLLEGE

DEPARTMENT OF PHYSICAL SCIENCES

COURSE PROPOSAL

1914.425

COURSE TITLE: Stratigraphy and Sedimentation

DEPARTMENT: Physical Sciences

SPONSOR: Dr. Donald W. Zalusky

LEVEL: Undergraduate; 400, 4 Cr. Hrs. (Lecture and Laboratory)

PREREQUISITES: Geology I, Geology II (1914.100 and 1914.101)

In addition to the preparation of Earth Science teachers, the Physical Sciences Department Concentration in Earth Science currently serves as a springboard to the profession of Geology for those desiring this vocation. Upon completion of the required core courses of the Earth Science Concentration, students may select additional offerings in geology which permit them to achieve the same course background generally proscribed in institutions which grant a Liberal Arts degree in Geology with the exception of a course in sedimentation and stratigraphy. The addition of this course will permit a G.S.C. student to achieve the broad background in the various branches of geology required by most graduate schools, or permit entry level into the profession of geology.

We are capable of presenting this course upon approval; and, therefore, if approved, would offer it in the Spring of 1980 and on a continuing basis once each academic year thereafter. It is anticipated that the initial class enrollment would be from eight to twelve students and future growth is not seen to exceed one section.

Dr. Donald Zalusky, the proposer, will teach this course and is well acquainted with the theory, practices, and techniques of sedimentation and stratigraphy. With the exception of some minor pieces of equipment the resources

to teach this course are on hand inasmuch as the items required are also utilized in other geology/oceanography courses in the present curriculum.

An additional need is more computer terminal access which should, as we understand the situation, follow demonstrated usage and need.

Library holdings in this field are adequate for the undergraduate level; journal holdings and other specialized books of Dr. Zalusky will supplement the library. Naturally, annual acquisition of pertinent books must be maintained. Due to the multitude of Earth Science offerings taught in one classroom/laboratory the Physical Sciences Department is currently converting a small room into a laboratory for allied type courses which could also accommodate Sedimentation and Stratigraphy.

The majority of rocks exposed at the surface of the earth, terrestrial and marine, are stratified sedimentary rocks. The majority of geologic endeavor involves the study and analysis of the sediment types, their origin, correlation and geologic history. Their importance leads to an early introduction (Geology I) to the physical processes inherent in the origin of the various sedimentary types. Much further consideration is given (Geology II) to the role of the age relationships of strata and the techniques for interpreting the earth's history recorded in the sedimentary strata. Although both sedimentation and stratigraphy are subdisciplines of geology with their own corps of specialists, all generalists must possess considerable knowledge of these two fields in order to perform most geological tasks. The majority of all geologists habitually are called upon to perform tasks requiring a thorough grounding in sedimentation and stratigraphy.

The processes, in broad terms, of weathering, erosion, transport and deposition of sediments which result in the stratified rocks is a continuum of nature and permits the rational combination of these two topics into one course, and is the modus operandi of most colleges and universities at the undergraduate level.

The inclusion of Sedimentation and Stratigraphy in the Earth Science curriculum closes a gap in our program to provide well rounded Earth Science teachers or professional training for those pursuing a career in geology.

Evaluation of student accomplishment will involve conventional testing of theoretical knowledge and demonstration of sound laboratory techniques and practices by "lab practicals".

Specific objectives of the course are to:

1. Develop an understanding of the clastic and nonclastic sediments, their origin, mode and method of transport, deposition, diagenesis and lithification.
2. Develop the ability to analyze and classify sedimentary rocks through laboratory activities.
3. Develop the ability to reconstruct environments of deposition.
4. Utilize the preceding objectives to correlate rocks and interpret earth history.
5. Provide field experience as an actualistic component to supplement and reinforce lecture and laboratory experiences.
6. Provide an entry to geologic literature, scientific investigation and the scientific method.
7. To introduce the student to the techniques of quantifying natural phenomena and utilization of the computer to model and interpret data.

As indicated earlier, the addition of Stratigraphy and Sedimentation to the Earth Science offerings completes the list of offerings generally required in most Geology degree programs. This course will permit the preparation of career bound students either to graduate programs or entry level in the profession. To the student committed to a career in the education field this course is a very valuable complement to previous courses in Geology as it not only presents new

information and concepts but unifies much of what has gone before.

Professor Paul Dike of the Physical Sciences Department was consulted about the wisdom of unifying Stratigraphy and Sedimentation into one course and agrees that this is a natural marriage and one that has ample successful precedent.

The need for this course has been reviewed by the Earth Science Section of the Physical Sciences Department and received unanimous support.

TOPICAL OUTLINE

1. Introduction

   Scope of Stratigraphy and Sedimentation

2. The Stratigraphic Column

   Evolution of Stratigraphic Classification
   Present-day Classification
   The Stratigraphic Commission

3. Stratigraphic Procedures

   Outcrop Procedures
   Subsurface Procedures

4. Properties of Sedimentary Rocks

   Texture of Sedimentary Rocks
   Texture of Clastic Rocks
   Textural Elements of Nonclastic Rocks
   Mass Properties of Sedimentary Aggregates
   Color of Sediments
   Sedimentary Structures
   Composition of Sedimentary Rocks
   Chemical Composition of Sediments

5. Classification and Description of Sedimentary Rocks

   Modern Classifications
   Common Sedimentary Families
   Descriptions of Selected Clastic Sedimentary Rocks
   Nonclastic Sedimentary Rocks

6. Sedimentary Processes

   Weathering
   Transportation
   Classification of Stream Loads
   Selective Transportation and Abrasion
   Deposition of Clastics
   Deposition of Nonclastics
   Process and Response in Sedimentary Transportation and Deposition

7. Sedimentary Environments

   Importance of Sedimentary Environments in Stratigraphy
   Sedimentary Processes and Their Products
   Elements and Factors of the Environment
   Environmental Patterns
   Applications of Environmental Patterns in Stratigraphy
   Classification of Sedimentary Environments
   Post-depositional Changes in Sediments
   Reconstruction of Ancient Environments

8. Stratigraphic Paleontology

Distribution of Organisms in Space
Distribution of Organisms in Time
Classification of Organisms

9. Stratigraphic Relationships

Lithosomes
Vertical Relationships
Lateral Relationships
Facies

10. Principles of Correlation

Correlation of Lithostratigraphic Units
Correlation of Biostratigraphic Units
Time-Stratigraphy Correlation
Correlation Charts

11. Sedimentary Tectonics

Sedimentation and Rate of Subsidence
Epeirogeny and Orogeny
Development of Geosynclinal Theory
Current Geosynclinal Theory
Tectonic Cycles and Associated Igneous Activity
Tectonics and Sedimentary Environments

12. Stratigraphic Maps

Organization of Map Data
Classification of Stratigraphic Maps
Structure Contour Maps
Isopack Maps
Paleogeologic Maps
Facies Maps
Biofacies Maps
Automatic Data Processing in Stratigraphic Maps

13. Stratigraphic Analysis

The Concept of a Stratigraphic Model
Lithologic Associations
Clastic Associations
Nonclastic Associations

81-74
82-74

GLASSBORO STATE COLLEGE

Physical Science Department

TO: Curriculum Committee

FROM: Paul A. Dike, Chairman

SUBJECT: HEGIS and Catalogue numbers, catalogue descriptions of Petrology and Petrography

DATE: January 9, 1974

1914.430

Petrology (lecture)
Prerequisite: 1914.100, 1998.330
A discussion of the theory and significance of the formation and occurrence of the rocks of the earth's crust and its extension to Lunar and Martian materials. Concurrent taking of 1914.431 recommended.

1914.431

Petrography (Laboratory) 2 s.h.
Prerequisite: 1914.100, 1998.330
A study of the classification of the rocks of the earth's crust and the acquiring of the techniques and skills needed for the study of rocks both megascopically and microscopically. Concurrent taking of 1914.430 strongly recommended.

G L A S S B O R O S T A T E C O L L E G E

Department of Physical Science

Paul A. Dike, Chairman

I. Course Proposal - Petrography

II. Course Proposal Sponsor - Paul A. Dike

III. Department Chairman's Statement

A. Position of the course in the departmental curricular structure.

The Liberal Arts and Sciences program, Physical Science with Geology Concentration is developing. Students are signed up for the program and more inquiries are constantly being made. To broaden the geology concentration, and to give the students a more thorough background, Petrography is vitally necessary. This course is fundamental to the knowledge of any person claiming to have a background in geology.

The course would be a senior level, 2 semester hour, laboratory course.

The course could be implemented in the Fall of 1975.

B. Adequacy of Staff and Equipment

It would be desirable, but not absolutely essential, that 2 or 3 more petrographic microscopes be purchased. We can present the course with the petrographic microscopes now available. We have a slabbing rock saw, a polishing lap, a finishing table, the necessary abrasives. The only items necessary to purchase are certain oils for immersion work (a total of about $5.00) and replacing the blank petrographic glass slides which have been used in Geology I for hardness tools (not more than $20.00). We have three systematic rock collections totaling 300 specimens. One of the systematic collections of 100 specimens has demonstratio display specimens, student specimens thin-sections and a fully descriptive catalogue There are over 1500 thinsections available for study as the result of a gift.

Mr. Dike has presented this course at the University of Pennsylvania and Temple University besides having training in the principles of this material at Johns Hopkins University,Bryn Mawr College, and Rutgers University.

IV. Objectives of the Course

To provide the student with a knowledge of, and a certain expertise in, the various techniques, both megascopic and microscopic, used in the examination of the rocks.

To provide hands-on experience to accompany Petrology.

To familiarize the student with the physical characteristics of some of the mor common rocks.

To give a solid basis for the classification of rocks.

V. Prerequisites

Geology I and II, Mineralogy. The student would be expected, although not required, to take Petrology concurrently. A color blind person will be badly handicapped, although it can be done.

VI. Details of Proposal (Course Description)

Lectures would be kept at an absolute minimum. At the beginning of the course lectures on light theory and the behavior of light in the petrographic microscope and in minerals would have to be given before the students tried to use the microscopes. An occasional brief lecture would be generated by questions not covered in Petrology.

Demonstrations of techniques would be vitally necessary to acquaint the student with the petrographic microscope and the 10X handlens.

Hands-on experience would form the main body of the course. The materials covered in this course can be learned only by personal contact and manipulation after the theory of the techniques involved have been discussed and demonstrated.

Evaluation would be based on tests involving both megascopic and microscopic examination and identification of rocks. A test would be conducted at the conclusion of each rock unit and a final general test would cover the work of the entire semester. A part of the grade would be based on the study of a thin section ground by the student.

VII. Rationale

Petrography constitutes the "practical" approach to the study of rocks. Rocks constitute the crust and interior of the earth and moon. Petrology permits one to formulate theories and conclusions regarding the significance of rocks. Petrography permits one to identify, describe and classify the rocks. Without this knowledge no theories or conclusions can be formulated which are of any value whatsoever.

The techniques learned in this course will be of use in many subsequent courses, both undergraduate and graduate. These techniques could also be vital to industrial and government work.

VIII. Textbooks

Dike, Paul A., Examination of the Minerals with the Petrographic Microscope, (Private Pub. 1962).

Larsen, Eper S. and Harry Berman: The Microscopic Determination of the Nonopaque Minerals, U.S.G.S. Bulletin 848, 1954.

Williams, Howell, Francis J. Turner, and Charles M. Gilbert: Petrography, W. H. Freeman and Co., 1955.

IX. Outline of the Course

A. Introduction to the Petrographic Microscope
1. the parts of the microscope.
2. Nature of light
3. Optical character of Materials
4. Index of Refraction
5. Color and Pleochroism
6. Grain shape
7. Crossed polarization

Extinction
Birefringence
Elongation
8. Conoscopic Examination
Uniaxial Minerals
Biaxial Minerals
Dispersion

B. Review of the Rock Forming Minerals Using the Petrographic Microscope
1. Feldspars
Orthoclase
Microcline
Plagioclase
Oligoclase
Labradorite
Anorthite
2. Quartz
3. Micas
Muscovite
Biotite
Phlogopite
4. Amphiboles
Hornblende
Actinolite
5. Pyroxene
Augite
6. Olivine
7. Chlorite
8. Magnetite
9. Hematite
10. Pyrite
11. Calcite
12. Dolomite

(Note: Section B will be reviewed while becoming acquainted with the items in Section A)

C. Igneous Rocks
Introduction
The Gabbro Clan
The Alkali Gabbro Clan
The Ultramafic Clan and the Lamprophyres
The Diorite, Monzonite and Syenite Clan
The Granodiorite, Adamellite and Granite Clan

D. Metamorphic Rocks
   1. Metamorphism, Its Petrographic Criteria and its Products
   2. Hornfelses and Spotted Slates
   3. Cataclasites, Mylonites and Phyllonites
   4. Slates, Phyllites, and Schists of Low Metamorphic Grade
   5. High-grade Schists, Amphibolites, Granulites and Eclogites

E. Sedimentary Rocks
   1. The Origin of Sedimentary Rocks
   2. The Composition and Texture of Sedimentary Rocks
   3. Sandstones
   4. Argillaceous Rocks
   5. Calcareous Rocks
   6. Miscellaneous Sedimentary Rocks

X. Bibliography

Bouma, Arnold H., 1969: Methods for the Study of Sedimentary Structures, Wiley-Interscience.

Carozzi, Albert V., 1960: Microscopic Sedimentary Petrography, Wiley.

Carrens, Carl Wilhelm, 1969: Introduction to Mineralogy Crystallography, and Petrology, Springer.

Rogers, Austin F. and Paul F. Kerr, 1942: Optical Mineralogy, McGraw-Hill.

Shand, Samuel James, 1947: The Study of rocks, Thomas Murby.

Wahlstrom, Ernest E., 1947: Igneous Minerals and Rocks, Wiley

Wahlstrom, Ernest E., 1955: Petrographic Mineralogy, Wiley.

D. Metamorphic Rocks
   1. Metamorphism, Its Petrographic Criteria and its Products
   2. Hornfelses and Spotted Slates
   3. Cataclasites, Mylonites and Phyllonites
   4. Slates, Phyllites, and Schists of Low Metamorphic Grade
   5. High-grade Schists, Amphibolites, Granulites and Eclogites

E. Sedimentary Rocks
   1. The Origin of Sedimentary Rocks
   2. The Composition and Texture of Sedimentary Rocks
   3. Sandstones
   4. Argillaceous Rocks
   5. Calcareous Rocks
   6. Miscellaneous Sedimentary Rocks

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Rogers, Austin F. and Paul F. Kerr, 1942: Optical Mineralogy, McGraw-Hill.

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Wahlstrom, Ernest E., 1947: Igneous Minerals and Rocks, Wiley

Wahlstrom, Ernest E., 1955: Petrographic Mineralogy, Wiley.

G L A S S B O R O S T A T E C O L L E G E

Department of Physical Science

Paul A. Dike, Chairman

I. Course Proposal - Petrology

II. Course Proposal Sponsor - Paul A. Dike

III. Department Chairman's Statement

A. Position of the course in the departmental curricular structure

The Liberal Arts and Sciences program, Physical Science with Geology Concentration is developing. Students are signed up for the program and more inquiries ar constantly being made. To broaden the geology concentration, and to give the students a more thorough background, Petrology is vitally necessary. This course is fundamental to the knowledge of any person claiming to have a background in geology.

The course would be a senior level 3 semester hour lecture course.

The course could be implemented in the Fall of 1975.

B. Adequacy of Staff and Equipment

No additional equipment would be needed for this purely lecture course. Petrology is the study of the theory of rocks, their origin and mode of formation, the interpretation of laboratory and field evidence.

The present staff is adequately prepared to teach the course. Mr. Dike has taught the course at The University of Pennsylvania and Temple University. The materials of the course formed a major part of his work at Bryn Mawr College, and a part of his work at Johns Hopkins University. Mr. Otooni and Mr. Waring have extensive background in the subject matter.

Petrology would be presented concurrently with Petrography, the two courses being offered every other year, alternating with other upper level geology courses. This would thus not put any additional burden on the staff and would give the students the opportunity to obtain a more highly diversified program.

IV. Objectives

To familiarize students with concepts of how rocks are formed.

To provide students with one of the basic keys to geology -- the interpretation of rocks.

To acquaint the students with the broad general descriptions of rocks.

To acquaint the students with the significances of individual rock types and rock relationships .

To acquaint the student with the history of the development of rock classification and theory.

V. Prerequisite

Geology I and II and Mineralogy are necessary for an inderstanding of the rocks.

VI. Details of the Proposal (Course Description)

Lecture sessions will introduce the basic principles of the various phases of petrology.

Student reports will be prepared and presented by the individual students on topics assigned to them. This will give the students an opportunity to delve more deeply into certain areas and force them to become familiar with the literature.

Evaluation will be based on tests and the reports.

VII. Rationale

Geology is concerned with the study of the Earth. A rather vital component of the Earth is rock. A knowledge of the formation of rocks is rather essential for a well rounded student of the Earth.

VIII. Textbook: Walter T. Herang, 1962: Petrology, McGraw-Hill Book Company or some comparable text.

IX. Course Outline

A. Introduction
   1. The Nature and Scope of Petrology
   2. Classification of Rocks
   3. Chemical Composition of the Earth's Crust
   4. Phase Equilibria and the Phase Rule

B. The Igneous Rocks
   1. The Mineral Composition of Igenous Rocks
   2. Characteristics and Classification of Igneous Rocks
      Volcanic and Plutonic Rocks
      Textures and Structures
      Classification of Igneous Rocks
   3. Description of Igneous Rocks
   4. Petrogenesis of the Igneous Rocks
      The Earth's Concentric Zonal Structure
      Magmas
      Factors in Magmetic Evolution
      Stages in Magmatic Consolidation
      Crystallization in Silica Melts
      Variation Diagrams
      Igneous Rock Association

C. The Sedimentary Rocks
   1. Composition, Fabrics, and Bodies of Sedimentary Rocks
   2. Classification and Description of Sedimentary Rocks

3. Sedimentation and Related Processes
   - Formation of Sediments
   - Transportation and Source of Sediments
   - Sedimentary Environments
   - Physicochemical Factors in Sedimentation
   - Diagenisis and Lithification
   - Tectonic Control of Sedimentation and Geosynclinal Cycles

D. The Metamorphic Rocks

1. Scope of Metamorphism
   - Metamorphism and Metamorphic Agents
   - Types of Metamorphism
   - Zones, Grades, and Facies of Metamorphism
2. Classification and Description of Metamorphic Rocks
3. Metamorphism, Magma, and Orogeny
   - Contact Metamorphism
   - Regional Metamorphism
   - The Petrochemical Cycle

X. Bibliography

Barth, Tom, F. W., 1962: Theoretical Petrology, 2nd Edition, Wiley

Blatt, Harvey, Gerard Middleton, Raymond Murray, 1972: Origin of Sedimentary Rocks, Prentice-Hall, Inc.

Bouma, Arnold H., 1969: Methods for the Study of Sedimentary Structures, Wiley-Interscience

Carozzi, Albert V., 1960: Microscopic Sedimentary Petrography, Wiley.

Carver, Robert E., Ed., 1971: Procedures in Sedimentary Petrology, Wiley-Interscience

Degens, Egon T., 1965: Geochemistry of Sediments, A Brief Survey, Prentice-Hall, Inc.

Harker, Alfred, 1932: Metamorphism, E. P. Dutton

Larsen, Gunnar and George V. Chilinger, Editors, 1967: Diagenesis in Sediments Elsivier

Ramberg, Hans, 1952: The Origin of Metamorphic and Metasomatic Rocks, University of Chicago Press.

Shand, S. James, 1947: Eruptive Rocks, Murby

Turner, Frances J., 1948: Mineralogical and Structural Evolution of the Metamorphic Rocks, Geol. Soc. of America, Memoir 30.

Turner Francis J., and John Verhoogen, 1960: Igenous and Metamorphic Petrology McGraw-Hill.

Tyrrell, G. W., 1948: The Principles of Petrology, 9th Ed., Methnen and Co.