SOUTHWEST CENTER FOR ADVANCED STUDIES

(formerly the Graduate Research Center of the Southwest)

offers

A Short Course for College Teachers

in Earth Sciences

Course Director: Professor Anton L. Hales

EXPERIMENTAL PETROLOGY

GEOCHEMISTRY

ROCK MAGNETISM

August 7 - 25, 1967

at the

Southwest Center for Advanced Studies

Dallas, Texas

Supported by the

NATIONAL SCIENCE FOUNDATION

SOUTHWEST CENTER FOR ADVANCED STUDIES
POST OFFICE BOX 30365
DALLAS, TEXAS 75230

Geosciences Division

ADAMS 1-1471

The Southwest Center for Advanced Studies (formerly the Graduate Research Center of the Southwest) will offer a short course in Earth Sciences for college teachers from August 7 to 25, 1967. The objective of the course is to give teachers of geology, particularly those from smaller colleges, an appreciation of the recent advances which have been made in understanding of the Earth through geophysical and geochemical techniques. Support for the course is from the National Science Foundation.

Applications for participation in the course are invited.

General Information

1. Criteria for admission: Participants will be selected primarily on the basis of academic record. All candidates should have a B.S. degree with geology as a major or minor subject, but preference will be given to those with higher qualifications.

2. Participant support: The terms of the NSF grant provide for travel expenses of 8¢ per mile with a round trip maximum of $80. This money will be paid at the end of the course. A stipend of $75 per week is authorized and will be paid by check at the end of each week.

3. Housing and eating arrangements: Housing accommodations have been reserved at a very nice nearby motel. These consist of rooms with twin beds at $4.00 per person per day. The motel has dining facilities, and swimming pool. Lunches can be purchased at the Center's cafeteria. For those requiring it, transportation between the motel and Center will be provided. A personal automobile would be desirable but is not a necessity.

In selecting individuals for participation and otherwise in the administration of this program, the Southwest Center for Advanced Studies will not discriminate because of the race, creed, color or national origin of any applicant or participant.

The National Science Foundation was established in 1950 by an Act of the Congress as an Agency of the Federal Government. Yearly appropriations are made by Congress to enable the Foundation to carry out its responsibilities to strengthen research and education in science, mathematics and engineering.

A Short Course for College Teachers

in Earth Sciences

PROGRAM

Experimental Petrology

Dr. Ian D. MacGregor
Dr. James L. Carter

An important question in geology is how the crust evolved from the upper mantle. Involved in the answer is an understanding of the chemical evolution of the Earth itself, the present chemistry of the crust and upper mantle, the phase assemblages stable in the upper mantle, and the compositions of lavas derived at various depths in the upper mantle. Various philosophies can contribute data to a full understanding of this problem.

A study of cosmic chemistry and meteorites leads, in conjunction with geophysics, to estimates of average Earth compositions and gross compositional layering. Petrological and geochemical studies of exposed rocks further contribute data on average crustal and possibly upper mantle compositions and indicate processes which may be important in crustal evolution. Experimental studies at a wide range of pressures and temperatures supply calibration or boundary conditions to speculations on the petrogenesis and chemistry of the exposed rocks. In addition experimental conditions help define the present structure of the upper mantle.

It is the object of this course to look particularly at the contributions of petrology, both experimental and chemical, to this problem and to try to integrate its data with that obtained from other philosophies.

Day 1. Morning

(a) Introductory Lecture: Definition of terms, rock names and minerals to be used in course; important concepts of phase equilibria and thermodynamics critical to understanding of subsequent discussions; general applications of high pressure experimental petrology; specific aims of the Center's petrology group.

(b) Lecture 2: Distribution, structure and composition of ultramafic rocks.

Afternoon

(a) Laboratory period and project: Experimentally determine a subsolidus reaction and isomorphic transition.

Day 2. Morning

(a) Lecture 3: Average composition of the Earth and its various components.

(b) Lecture 4: Subsolidus assemblages in the mantle.

Afternoon

Free for reading, outside lectures or project.

Day 3. Morning

(a) Lecture 5: Distribution and composition of basalts; subsolidus assemblages for basaltic rocks.

(b) Lecture 6: Origin of basaltic lavas.

Afternoon

(a) Laboratory and project period: Experimentally extablish a solidus and liquidus.

Day 4. Morning

(a) Lecture 7: Details of petrography and chemistry of spinel peridotite nodule suites.

(b) Lecture 8: Details of petrography and chemistry of garnet peridotite nodule suites.

Afternoon

Free for guest speakers, reading and projects.

Day 5. Morning

(a) Lecture 9: Evolution of crust-mantle system.

Afternoon

Laboratory and project: Experimentally define a solid solution boundary.

Isotope Geochemistry

Dr. Glen H. Riley
Dr. Martin Halpern
Mr. William I. Manton

It is well known that the absolute age of certain mineralogically and chemically suitable rocks can be measured to one or two percent by making use of the natural decay of various radioactive elements contained in them. Over the past twenty years radioactive age measurements have been used to put absolute values on the paleontologist's time scale, to develop an absolute scale for Precambrian time, and to aid in the understanding of the absolute chronologic history of certain geologic provinces where in the past only the relative sequence of events could be described. Isotopic geochemical data has at the same time provided information as to the evolution and growth of some of the continental land masses.

In a sense, geochronology has achieved its initial objectives. Nevertheless there still remain many opportunities for the use of age measurements in unraveling stratigraphic and tectonic problems. Furthermore, recent increases in the precision of measurement have led to the use of isotope geochemistry in the study of some of the major problems of petrogenesis. Studies of this nature will be described during the course.

Day 6. Morning

Introduction to isotope geochemistry and geochronology; structure of the atom; decay schemes.

Afternoon

Laboratory counting experiment using radioactive salts and naturally occurring rock samples.

Day 7. Morning

(a) The function of mass spectrometers in geochronology; solid source and gas machines.

(b) Sample preparation up to the chemical dissolution.

Afternoon

Laboratory techniques for the preparation of mineral concentrates and whole rock samples; use of Frantz, heavy liquids, shaker table, microscopes.

Day 8. Morning

(a) Rb-Sr geochronology: spiking, age calculation; instrumentation and chemistry involved in the preparation of samples.

(b) K-Ar (if machine available). Guest lecturer - Dr. William Burke of Mobil Field Research Laboratory: spiking, age calculation, instrumentation, use of extraction lines.

Afternoon

Laboratory session demonstrating Sr mass spectra; use of extraction line for argon; melt a sample.

Day 9. Morning

Geochronology as a stratigraphic tool: its application in regard to paleomagnetism, continental drift. Age distributions in North America and Antarctica - a continental view.

Afternoon

Rb-Sr, U-Pb, etc. isotopic compositions as related to the genesis and evolution of the Earth.

Day 10. Guest lecturers and/or a trip to the C^{14} dating laboratory in Austin.

Rock Magnetism

Dr. John W. Graham
Dr. Charles E. Helsley

The current interest and concern about the question of continental drift was stirred up during the past fifteen years by the surprising results of rock magnetism. Data from other fields are now beginning to support the earlier conclusions based upon the rock magnetization results, and it now seems possible that definite continental reconstructions can ultimately be made using this data.

The object of this one week course will be to cover the fundamentals of rock magnetism so that the student will be able

to gauge the literature and make reasonable judgments about whether or not magnetizations of geophysical importance and significance are being reported and reasonably interpreted. An effort will be made to adjust the format of the course to fit the backgrounds, aptitudes and interests of the students. Formal lectures, laboratory sessions, reading periods and informal discussions will take place. Among the topics to be covered are the following: (Days 11 - 15)

The physics of magnetic materials

Measurements of magnetic properties

Magnetic minerals and their development in rocks

Tests of magnetic stability

Polarity reversals of rocks and of the Earth's magnetic field

Statistical analysis of observational data

Magnetic polar wandering curves and continental reconstructions

Geological applications of rock magnetism

In the laboratory, students will have an opportunity to become familiar with the following instruments:

Spinner magnetometers

AC demagnetizer

Thermal demagnetizer

Gaussmeter and Helmholtz coils

Curie balance

Magnetic susceptibility bridge

Microscope with vertical illuminator for polished section examination