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of
RESEARCH PROGRESS
1964

Mineral Industry Research Laboratory
University of Alaska
College, Alaska 99735

One of the most urgent problems facing the State of Alaska is development of a technology, sufficient to allow rational development and use of its resources by future generations.

MINERAL INDUSTRY RESEARCH LABORATORY

Annual Report of Research Progress 1964

The University of Alaska

College, Alaska

FOREWORD

Research that will lead to the utilization of Alaska's mineral resources and hence create new wealth must be continued at an increased rate in the future if a strong mineral industry is to be developed and maintained. Current investment in minerals research is a judicious practice that will pay dividends to the State in the future.

The Engineering Council for Professional Development, in their 1964 report which continued the accreditation of the engineering curricula at the University of Alaska, emphasized this concept when they stated: "Regardless of the mining industry's present size, the State clearly needs a mining center in its State University not only for teaching but also for research and for service to prospectors and mine operators."

The Mineral Industry Research Laboratory is dedicated to those objectives of research, instruction and service which will help build the mineral economy of Alaska.

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Mineral Industry Research Laboratory
University of Alaska

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The Year in Review

Background

The Mineral Industry Research Laboratory was established July 1, 1963 as a result of legislation enacted by the 1963 legislature. (Alaska Statutes, Title 14, Chapter 40, Section 14:40.115.)

The objective of the laboratory is to expand and diversify the mineral economy of the state through a program of applied research in the mineral industries. Such research is conducted along appropriate guidelines to avoid duplication of cost and efforts expended by other State and Federal agencies.

The laboratory was funded by the 1963 and 1964 Legislatures with annual appropriations of $50,000. During the past year the Mineral Industry Research Laboratory was able to increase this appropriation by approximately $16,000 by conducting additional research funded by other sources. While it is hoped that efforts during the current year will result in an increased number of sponsored investigations, it is traditionally difficult to obtain financing for research in the mineral industry from governmental agencies or research foundations. If such research is directed toward the development of a particular geographic area, the financing is characteristically borne by the regulatory bodies of the geographic area involved.

Aspects of Mineral Industry Research

During the past year the Mineral Industry Research Laboratory at the University of Alaska has continued the development and expansion of a strong research program to enable optimum use of Alaska's mineral resources.

Not only has the laboratory advanced its applied research studies in mineral beneficiation, industrial minerals and exploration methods and techniques, but it has completed initial studies in resource economics. Such studies are directed toward the feasibility of use of presently known mineral deposits.

Several sponsored research programs have been undertaken in an effort to more fully serve pertinent governmental agencies and private interests within the State. The annual funding provided by the State has in this manner been doubly productive since additional research funds, attracted to an existing research laboratory, also contribute to the objective of strengthening the mineral component of the State economy.

It should be noted, however, that although great strides have been made during the past year and even more comprehensive programs are planned for the coming year, an inherent time lag exists between completion of research effort and tangible economic benefit. This time lag is especially extended when the initiation of such research comes relatively late in the period of declining production for any mineral resource. While it is encouraging that completed studies concerning the clay products and cement industries are currently serving to allow more rational planning of proposed mineral ventures, several research problems involving longer term study are under investigation which could well result in extremely valuable contributions to the mineral economy. Especially pertinent here are projects concerning the use of Alaskan coals as a base coal in a coking coal mixture, and the separation of heavy minerals from alluvial material.

Influence on Educational Program

It should be stressed that the total benefit of the Mineral Industry Research Laboratory is not limited to accelerating the development of Alaska's mineral production. An important aspect of the existence of the laboratory on the University campus has been its continuing influence in stimulating and improving the graduate and undergraduate courses of study in the Department of Mineral Engineering.

The equipment additions and specialized studies attributable wholly or in part to the laboratory, have served as the nucleus for development of many new educational areas within the total mineral industry discipline. Such curricula development not only allows better guidance of the ambitious student through a challenging and comprehensive educational program, but stimulates the teaching and research effort of a highly motivated faculty.

Facilities

Major progress has been made during the year in obtaining the most advanced instrumentation possible, to more efficiently conduct significant research programs. While some equipment has been purchased from MIRL funds, acquisition of other equipment was obtained through National Science Foundation grants, pooling of University departmental funds, construction by research personnel, and placement of related equipment in the laboratory by other research Institutes. The following equipment has been obtained since the inception of the laboratory:

(1) Spectrograph and Densitometer—Analytical equipment which provides for qualitative, semi-quantitative and quantitative determinations of approximately 70 elements. Since it is most efficient in trace to minor amounts on a quantitative basis, it is ideal for geochemical work. For qualitative purposes it works well in all concentration ranges and gives a permanent photographic record for all types of analysis.

(2) X-Ray Diffractometer and Spectrometer—Complements the spectrograph in that it provides qualitative and quantitative analysis of elements most efficiently in concentration ranges in excess of one percent. When used as a diffractometer the identification of mineral compounds is possible as well as the determination of basic information concerning the crystal structure of minerals and compounds.

(3) Electron Microscope (Geophysical Institute equipment installed in Laboratory)—A research tool which allows visible examination and photographing of minute particles and cell structures not detectable with a conventional microscope.

(4) Low-Intensity Magnetic Separator — A permanent magnet capable of separating highly magnetic minerals from weakly or non-magnetic minerals.

(5) Hi-Intensity Magnetic Separator—A variable electromagnetic separator capable of separating minerals of varying magnetic properties from each other and from non-magnetic minerals.

(6) Franz Isodynamic Separator—A variable field electromagnetic separator capable of separating minerals of small variances in magnetic characteristics on small scale laboratory basis.

(7) Gouy Balance (National Science Foundation Funds)—A sensitively controlled electromagnet and balance system for the determination of magnetic characteristics of minerals.

(8) High-temperature Kiln—A four cubic foot kiln for the study of the bloating characteristics of expanding shales and the firing characteristics of clays.

(9) Centrifuge—High speed separatory apparatus to aid in the sink-float analysis of coal and other mineral products.

(10) Superpanner—A small scale mechanical panning device that allows selective concentration of minerals due to minor variations in their specific gravities.

(11) Heat Conductivity Apparatus—Apparatus fabricated in the laboratory to determine the thermal conductivity of lightweight aggregate concrete block.

(12) Apparatus for Determination of Dielectric Constants—Electronic equipment obtained on a loan basis from the Geophysical Institute to make determinations of dielectric constants of minerals.

(13) Hardgrave Grindability Apparatus—An ASTM test apparatus for determination of the relative grindability or ease of pulverization of coal.

(14) Free Swelling Index Apparatus—An ASTM test apparatus which measures the free swelling properties of coal indicative of coking characteristics.

(15) IBM 1620 Computer—Although not equipment of the Mineral Industry Research Laboratory, the University owned computer has been used to aid in basic research, placer valuation, mapping, statistical analysis and data plotting.

Contributing Agencies

Invaluable contributions to the research effort have been made by many individuals and agencies. Such assistance has frequently taken the form of services which supply indirect financial assistance, property access, and information availability. Major contributions include:

U.S. Bureau of Land Management
Alaska Division of Mines and Minerals
Alaska Department of Economic Development and Planning
U.S. Geological Survey
Usibelli Coal Mines
Evan Jones Coal Mines
Institute of Business, Economics and Government, University of Alaska
U.S. Bureau of Mines
Alaska Railroad
Anchorage Port Authority
U.S. Department of Commerce, Anchorage Field Office
Burgess Construction Company
Bettisworth Masonry Contractors
Anchorage Sand and Gravel
Concrete Products of Alaska
Alaska Brick
Mr. W. F. Buchanan
Cleary Hill Mine Company, Messrs. Howard Spark, Walter Lindgren, Fred Wackwitz, Harold Hassel, Cleary Hill Ski Lodge.

II

Research Progress

This section includes a brief summary of the research progress for each investigation conducted by the Laboratory during the past year. The availability of more detailed final or progress reports is given on page 20.

Geochemical Investigations

Exploration for mineral deposits in Alaska has been hampered by the lack of specialized prospecting techniques adaptable to varying climatic and topographic conditions. Studies concerning the applicability of exploration methods under these conditions are essential to the future development of the mineral industry. It is of prime importance that simple, reliable and inexpensive prospecting techniques are made available to the individual.

1. Applied Geochemistry

Since the validity of any geochemical method can only be established through field testing, a field laboratory was established in the Cleary District in an area of known geology and mineralization. A control traverse with cross lines at 1000 foot intervals was surveyed and soil samples taken at 25 foot intervals along these lines. These samples were then analyzed for individual elements. Computer techniques were employed to statistically analyze and profile the sample values. This data revealed the presence of three distinct anomalous areas within the survey boundary. Check samples were taken over these areas, proving two to be valid anomalies. The most intense anomaly was sampled in detail and analyzed by the University of Alaska total heavy metals method. Analysis of these data indicated the presence of three heavy-metal rich zones.

During the course of the investigation anomalous areas were delineated by both individual element and total heavy metal analytical techniques. Since the latter technique proved to be a more efficient, rapid and economical method of analysis—it is recommended that it be used to locate heavy-metal rich zones and that the element analysis be used only to determine the type of mineralization occurring in a positive heavy-metals sample.

The investigations in the Cleary Hill area are being continued in order to develop a field laboratory for the study of geophysical and geochemical prospecting techniques. Such development entails the establishment of permanent survey stations, their correlation with existing underground surveys, and preparation of accurate large scale maps. Physical examination of the known anomalies will be conducted utilizing trenching or drilling techniques.

2. Laboratory Investigations

Some difficulty has been experienced in obtaining consistent and accurate geochemical analysis in the field. Current laboratory investigations are therefore being conducted to either determine and resolve the factors which introduce error, or to designate more accurate alternative methods.

Figure 1—Portion of the spectrograph unit recently installed in the laboratory.

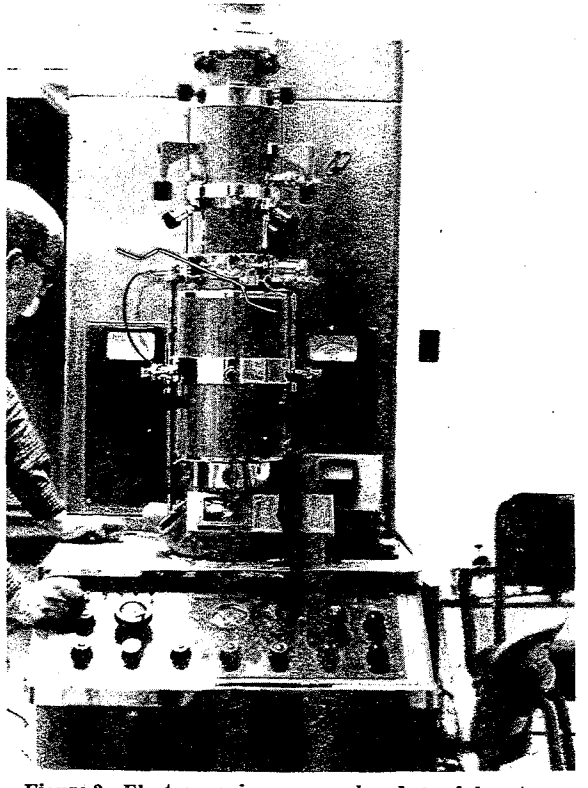

Figure 2—Electron microscope placed in laboratory by the Geophysical Institute

3. Spectrogeochemical Analysis

Recent interest in geochemical methods of exploration for ore reserves has led to the initiation of a program to develop a method for the spectrochemical analysis of trace elements in soils, plants, and related materials. The program is to be conducted in cooperation with the Alaska Division of Mines and Minerals.

Wet chemical methods are currently used for the analysis of geochemical samples. These methods, however, are laborious and time consuming since they require individual sample preparation and analysis for each element of interest. Preparation of samples for spectrochemical analysis involves a much less stringent procedure. A single spectrographic exposure enables qualitative or quantitative analysis of as many as 70 elements. It provides a method for producing a reference of total element content and indicates anomalous values not readily detectable by wet methods. It is anticipated that these new analytical methods will result in decreased analytical time, fewer man-hour requirements, decreased cost, and more comprehensive data.

Beneficiation of Heavy-Mineral Bearing Alluvial Deposits

Mining of alluvial deposits has been curtailed in recent years due to increased mining costs and the fixed price of gold. It is possible, however, that many gold bearing deposits exist which contain sufficient quantities of associated heavy minerals to enable profitable joint extraction. While such recovery is probably contingent upon a shift of marketing centers to a more reasonable shipping radius, it is felt that any information which can be obtained on the potential of these deposits is a contribution to the development of Alaska's mineral resources.

The minerals which occur associated with gold in such deposits are commonly called "heavy-minerals" or "black sands." They may contain cinnabar, cassiterite, scheelite, rutile, ilmenite, chromite, magnetite, zircon, monazite, garnet, columbite-tantalite and radio-active minerals. The deposits have inherent advantages since the minerals have already been liberated and require no grinding, and the high mineral specific gravities allow relatively inexpensive bulk gravity concentration processes. If such deposits are located as beach deposits they allow minimization of transportation costs.

During the past year several samples have been submitted to the Laboratory by private interests for determination of the contained mineral values and the optimum processing technique. Summaries of the tests conducted on these samples follow:

Southeast Alaska Beach Sand

A composite sample of beach sands from the head of the Bradfield Canal was submitted to the Mineral Industry Research Laboratory. The purpose of this investigation was to determine the amount and types of heavy minerals present, methods by which they could be recovered and information as to the feasibility of continued work in the area.

A screen analysis was obtained from a representative fraction of this sample and each size treated as an individual sample in determining the distribution of the heavy mineral content. This information was obtained by sink-float analysis, super panner concentration, magnetic concentration, electrostatic concentration and amalgamation. The tests conducted on the size fractions indicated that the heavy minerals were concentrated in the size range finer than 35 mesh and could be recovered by a combination of sizing, gravity, magnetic and electrostatic techniques. The quantity of valuable minerals, however, was too low to be of economic interest. The sample submitted contained 68 pounds of magnetite per cubic yard of sand as the major heavy mineral constituent. Other valuable minerals included 6 pounds of ilmenite, 0.02 troy ounces of gold and trace amounts of zircon and scheelite. Radio-active tests indicated only trace amounts of equivalent uranium in the ilmenite concentrate.

Beach Sands Near Lituya Bay

A sand sample obtained from a low wave cut beach, north of Lituya Bay between Eagle and Portage Creeks, was submitted for determination of the amount and types of heavy minerals present. Small scale tests were conducted to determine the recoverable heavy minerals by gravity, magnetic and electrostatic concentration techniques on individual size fractions. These tests indicated that 99 percent of the ilmenite, 98 percent of the magnetite and 79 percent of the total heavy mineral content was concentrated in the minus 35 mesh fraction.

The sample submitted contained 138 pounds of ilmenite, 16 pounds of magnetite, 0.01 ounces of gold and trace amounts of zircon and scheelite on a cubic yard basis. Other heavy minerals found primarily in the high-intensity magnetic concentrate in order of decreasing abundance were garnet, pyroxene, amphibole, staurolite, epidote, rutile and sphene. Although the valuable mineral constituents of this sample could be conveniently separated and recovered, their quantities were too low to be of economic value.

Cook Inlet Sands

A sand sample from a submerged shoal off the North-Easterly point of Fire Island was submitted for evaluation and determination of recovery techniques. Combinations of gravity, magnetic, and electrostatic concentration on individual size fractions and a bulk sample indicated that approximately 98 percent of the total magnetite and ilmenite were of minus 65 mesh particle size.

The tests indicated the heavy mineral content to be too low for economic significance with 15.9 pounds of magnetite and 5.2 pounds of ilmenite as the major heavy minerals available on a cubic yard basis. Radio-active tests indicated trace amounts of equivalent uranium in the high intensity magnetic and electrostatic concentrates.

Placer Concentrate

A concentrate from a placer operation was submitted to determine the procedure necessary to separate the magnetite and radio-active minerals from the other heavy mineral constituents. By processes of screening, low-intensity magnetic, high intensity magnetic, and hi-tension electrostatic separations it was possible to reconcentrate this material into a magnetite fraction which represented 18.0 percent of the total concentrate. The radio-active

minerals were concentrated into a fraction which represented 13.0 percent of the total concentrate with a grade of approximately 13.0 percent equivalent uranium content. The non-magnetic heavy minerals in the remaining 69.0 percent of the concentrate had an equivalent uranium content of 0.4 percent.

Nome Off-Shore Beach Deposit

Drill samples from seventeen off-shore drill holes in the Nome area were submitted to the Mineral Industry Research Laboratory for investigation of the heavy mineral potential as well as gold recovery. Work is still progressing on this material, and the results should be available at the close of this fiscal year.

Beneficiation of Camp Creek, Lost River Beryllium Ore

Recent discoveries of extensive non-pegmatitic replacement deposits of beryllium in Alaska, Colorado, Utah, and Nevada have not only greatly stimulated prospecting and exploration for beryllium, but are partly responsible for increased industrial interest in the metal. For this reason the Mineral Industry Research Laboratory has undertaken a program to determine procedures for upgrading the beryllium ore from Camp Creek, Lost River to a marketable concentrate.

Currently the metal is obtained from the mineral beryl, found principally in small quantities in pegmatite deposits. Since beryl has a density near that of its gangue constituents it is concentrated almost entirely through expensive, low recovery, hand processes. In the past these processes have been adequate since the federal government was the principal consumer of the high cost product. Although current production is hampered by lack of large scale occurrence, and high cost recovery, reduction, and fabrication techniques, discoveries of low grade deposits offer tonnage possibilities which should stimulate research for new and improved uses of the metal.

Two large samples of the non-pegmatitic ore from Camp Creek, Lost River have been obtained. These samples are being subjected to gravity and flotation methods of concentration in an attempt to effect economic recovery of the metallic content. If a marketable concentrate cannot be recovered by these techniques, liquid-liquid methods of beneficiation will be investigated.

Coking Coal Research

An investigation was initiated, with National Science Foundation Institutional Grant funds, to determine the correlation between petrographic constitutents and analysis of certain Alaskan coals. This project, with the ultimate view of selective preparation and blending to improve the quality and possible coking potential of these coals, is being continued in the Mineral Industry Research Laboratory.

Coal science technology has been advancing very rapidly in the last two decades. This advance has developed valuable new techniques which rapidly and accurately predict the coke making and coke by-product potential of coals and their blends. With the development and refinement of coal petrography techniques in which the individual organic coal constituents are identified and enumerated by optical means, many correlations were developed which predict the thermal behavior of coals and their blends.

Nine samples, representing coals from the Matanuska Valley and the Nenana District have been under study to determine the effect of

sizing and specific gravity separations on the size and distribution of the coal constituents, and variations in chemical behavior. Methods of crushing and screening have been utilized to produce size consists which are separated into various products by specific gravity separations. These products have been evaluated to determine their proximate analysis, grindability indices and petrographic characteristics.

Since only limited proven quantities of coking coals are presently known to exist in Alaska, the Mineral Industry Research Laboratory has directed its studies toward the blending of large quantities of non-coking coals with small amounts of coking coals to obtain blends capable of being coked. To date a considerable amount of laboratory work, commensurate with facilities and personnel, has been performed and a few Alaskan coals have been blended and coked in a small laboratory kiln. These coke products compare favorably with products produced using a known coking coal (Figure 3). However, lack of adequate laboratory facilities precludes the comprehensive testing required to obtain conclusive results.

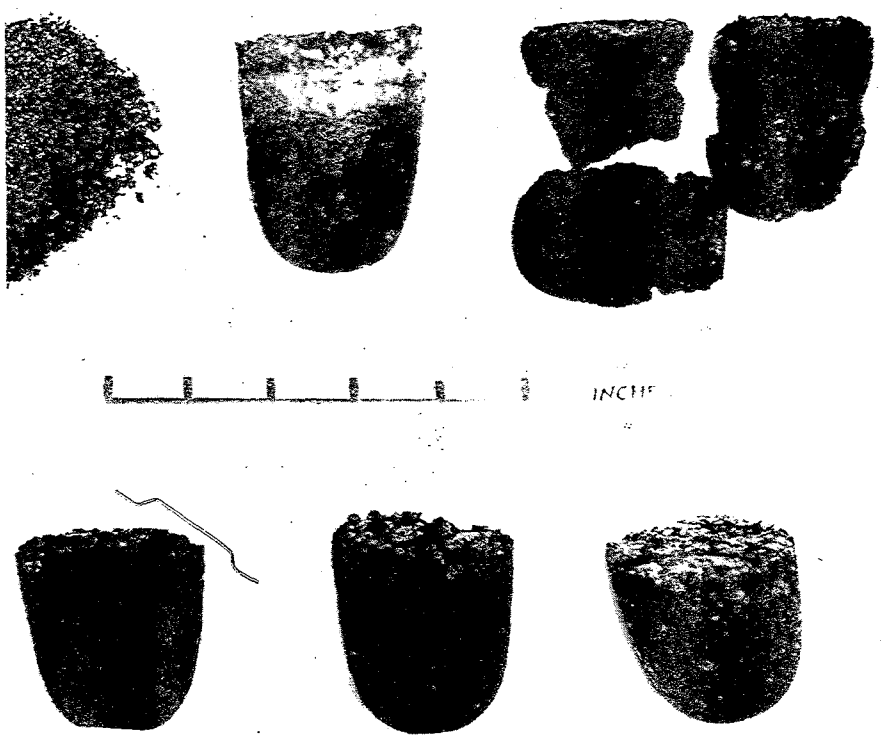

Figure 3—Coke products from selected Alaskan coals (top) and coal blends (bottom)

A detailed summary report will be available June 1, 1965 in which the entire work performed on coal through the period September 1, 1963 to May 1, 1965 will be presented.

Alaskan Cement Markets and Opportunities for Regional Production

The study was completed as an interdisciplinary research effort between the Institute of Business, Economics and Government Research, University of Alaska, and the Mineral Industry Research Laboratory, under contract with the Bureau of Indian Affairs of the U.S. Department of the Interior. The purpose of the investigation was to:

(1) Examine the market for cement in Alaska and the conditions influencing this market.

(2) Identify the current distribution channels through which cement is sold in Alaska and the buyers that constitute the major market.

(3) Determine the feasibility of manufacturing cement at Tyonek, utilizing raw materials from the Iliamna Bay area, as proposed by private interests within the State.

The marketing segment of the report was primarily the responsibility of the Institute of Business, Economics and Government and was accomplished through field inquiry, analysis of consumption data, compilation of consumption statistics, and definition of current and potential consuming sectors. The manufacturing feasibility portion of the study involved review of the pertinent technical literature, summary and evaluation of previous engineering proposals, and limited original design of a quarrying and manufacturing operation based on preliminary field examinations and deposit sampling. This phase was the responsibility of the Mineral Industry Research Laboratory.

The completed investigation indicated that while local manufacture at the designated location, using the specified raw materials, was technologically possible, it was not economically feasible. This conclusion was based chiefly on the possession of better quality and more favorably located deposits by national producers now active in local markets, apparent understatement of requisite plant investment and operating costs by the cement plant proposers, and inherent mining and raw material supply difficulties.

The Market Potential for Alaskan Clay Products

An investigation into the market potential and manufacturing feasibility of selected clay products manufactured from Alaskan clays has recently been completed by the Mineral Industry Research Laboratory under contract with the Alaska Department of Economic Development and Planning.

The wide distribution of clay deposits and the seemingly simple processing procedures involved in the manufacture of clay products is traditionally responsible for the continuing interest in local manufacture of such products. In Alaska the added stimulants of expanding economic activity, accelerated construction programs due to the recent earthquake, and total dependence on imported clay products are present. While several previous attempts to manufacture clay products in the Anchorage area have ended in failure, renewed interest has been shown in re-establishing such an industry. The purposes of the investigation therefore were:

(1) Determination of the entire range of clay products currently marketed domestically.

(2) Identification of major clay products with present or future significance in Alaskan markets.

(3) Description of the current competitive market environment in which these clay products must compete.

(4) Quantitization of the market size under present prices and the market increase to be expected under a more favorable price structure due to local manufacture.

(5) Correlation of the demand for finished products with the necessary quantity of clay production, as an indication of the size of mining operation needed.

(6) Determination of the beneficial effect of such clay recovery on the present production of coal which occurs associated with clay deposits.

Study conclusions identified two clay products with current marketing significance and two uses with appreciable future potential. The manufacture of common building brick along with other structurals was judged to have major significance as was the manufacture of high-quality earthenware and stoneware art-pottery, novelties, and souvenir products with an Alaskan motif. Utilization of clays in petroleum exploration and cement manufacturing operations were shown to have future significance.

Secondary study benefits included quantitization of homeowner attitudes toward building materials and fuels in the Anchorage and Fairbanks area by means of a consumer survey, and the provision of marketing data requisite for use by existing private interests to obtain financial backing for a clay products plant in the Anchorage-Fairbanks area.

The Feasibility of Utilization of Certain Alaskan Shales for Lightweight Aggregates

Construction costs in Alaska are high because of material transportation requirements, high labor costs and insulation requirements. The use of lightweight aggregate concrete has been found to be an effective method of reducing some of these costs in other states by: (1) Reducing the dead load weight of structures which in turn decreases structural and foundation requirements, (2) Reducing handling and transportation costs by utilizing lighter materials, and (3) Reducing the insulation requirements by using material whose insulating value exceeds that of normal weight concrete.

At present no lightweight aggregate is produced in Alaska and current transportation rates have made the importation of this material uneconomical. Consequently, the purposes of this investigation were, (1) Determination of the feasibility of using selected Alaskan shales in the production of lightweight aggregate and, (2) Evaluation of the advantages of using concrete made from the expanded material.

Six shale deposits were investigated to determine their relevant properties; the Houston, Kings River, Sutton, Moose Creek, Lawing, and Livengood. The first four are in the Anchorage area, and the last two are in the Seward and Fairbanks areas respectively. Tests were performed to determine the expansion properties, drying characteristics, crushing characteristics, pelletizing properties, mineral composition, and firing characteristics of samples taken from each of the deposits. Concrete test specimens, utilizing "bloated" shales from three selected deposits as the concrete aggregate, were subjected to compression-strength and thermal conductivity tests.

The total results indicated that the Sutton and Kings River shales were of sufficient quality for utilization as lightweight aggregate and should be tested under commercial conditions. More systematic and intensive sampling is recommended for the other deposits to determine if the samples tested were representative of the total deposit.

Service to Individuals

An important function of the Mineral Industry Research Laboratory is to provide pertinent services to individuals and agencies through its facilities and personnel. This service furnishes aid to prospectors and small scale operators which is not otherwise available within the geographic limits of the State. Examples of the type of functions which have been performed follow:

(1) In conjunction with the Ketchikan Assay Office of the Division of Mines and Minerals, beneficiation studies were conducted on a molybdenum bearing quartz ore from southeastern Alaska. Grinding and flotation tests indicated the production possibility of a concentrate with good recovery of the molybdenum content.

(2) Small scale laboratory and continuous test pilot plant studies were conducted on a gold-bearing quartz ore from the Willow Creek district. These studies gave information to claim holders regarding grinding characteristics, concentration methods and expected recovery values.

(3) Amalgamation studies were performed on several gold-bearing samples from the Prince William Sound area to determine the liberation, recovery values, and recommended procedures for processing the ore.

(4) Assistance was extended to an operating coal mine concerning the proposed installation of supplementary screening equipment. Grinding and screening studies were conducted and recommendations were made for the proposed installation.

(5) A 1,000 pound float sample of high grade silver ore was studied to determine the mineralogical constituents and beneficiation feasibility. Grinding, classification and concentration studies indicated that further processing of the high grade ore was impractical for smelter shipment.

(6) The equipment and facilities of the laboratory have also been made available to individuals for processing concentrates, retorting of amalgam, and other small scale laboratory studies.

Basic Research

The continued depletion of high grade ore reserves and the increasing demand for mineral products necessitates the development of technology enabling the profitable extraction of metals from low grade ore. Basic research, as opposed to applied research, attempts to provide the foundation for technological developments through utilization of basic principles of physics, chemistry and other scientific disciplines. The basic facts derived from such investigation today, often form the basis of future recovery methods and techniques.

A major research project of this type has recently been completed in the Department of Mineral Engineering. This study, financed by the National Science Foundation, concerned the magnetic susceptibilities of a group of aluminum, magnesium, zirconium and beryllium minerals. A proposal has been submitted to the National Science Foundation to continue these studies in the Mineral Industry Research Laboratory.

Another project, initiated through National Science Foundation financing and completed by the Mineral Industry Research Laboratory, has investigated the determination of techniques for precise measurement of the dielectric constants of various minerals and rocks. Although the theory and investigational procedures are too lengthy and complex to be included here, the completed report is on file at the laboratory.

III

Reports Issued by the Mineral Industry Research Laboratory

1. The Market Potential for Alaskan Clay Products

Sponsored investigation for the Alaska Department of Economic Development and Planning, October, 1964.

2. Alaskan Cement Markets and Opportunities for Regional Production

Sponsored investigation in cooperation with the Institute of Business, Economics and Government Research for the Department of the Interior, Bureau of Indian Affairs, November, 1964.

3. The Feasibility of Utilization of Certain Alaskan Bloating Shales for Lightweight Aggregate

Published in thesis form for the Department of Mineral Engineering, May, 1964.

4. Coal Petrography as Related to the Preparation and Production of Coke From Selected Alaskan Coals

Investigation to be published in thesis form by the Department of Mineral Engineering, and as an MIRL report, June, 1965.

5. Preliminary Studies of Alaskan Beach Sands

Studies concerning the mineral content and recovery feasibility of selected beach sand deposits. To be published during the summer of 1965.

6. Spectrochemical Analysis Techniques Applicable for Geochemical Prospecting Programs

Final report to be available during the summer of 1965.