United States Department of the Interior

U.S. Geological Survey

Progress Report on the Investigations of Bauxite Deposits in the Eastern Part of Kauai, Hawaii

by

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OPEN FILE REPORT
This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

CONTENTS

	Page
Introduction	1
Objectives of the investigations	3
The bauxite deposits	4
Methods of investigation	6
Progress of the investigations	9
Bibliography	12

ILLUSTRATIONS

Figure 1.	Areas in eastern part of Kauai where bauxite deposits are to be investigated	5
2.	Jeep mounted mobile auger used in drilling for bauxite.	7
3.	Sketch map of auger hole locations near Hanalei, Kauai.	10
4.	Sketch map of auger hole locations near Kilohana crater, Kauai	11

PROGRESS REPORT ON THE INVESTIGATIONS OF BAUXITE DEPOSITS IN THE EASTERN PART OF KAUAI, HAWAII

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INTRODUCTION

Investigations of bauxite deposits on Kauai by the U. S. Geological Survey in cooperation with the State of Hawaii were begun July 1, 1959. The investigations, as planned, are to consist of two phases, each of two years duration. The geological investigations of the bauxite and associated rocks in the field and a considerable amount of chemical and mineralogical work in the laboratory are planned for completion during the first two years of the project. During this phase, a geologist and an assistant will be working on Kauai and geologists, mineralogists, and chemists will be analyzing and studying samples of the bauxite in laboratories of the Geological Survey at Beltsville, Maryland, and Washington, D. C. The work during the second phase of the investigations will be carried on at Beltsville and Washington and will consist of completion of chemical and mineralogical investigations, compilation of maps, analysis of field and laboratory data including determination of the size and quality of the bauxite deposits in the eastern part of Kauai, mineralogical research on bauxite samples, and preparation of a final geological report.

The investigations of the bauxite deposits on Kauai are in accordance with recommendations in a preliminary report of bauxite in Hawaii by Mr. James B. Cathcart (1958) of the U. S. Geological Survey. This work was done in April, 1958, in behalf of the Territory of Hawaii.

Cathcart very tentatively estimated that 196 million tons of bauxitic soil containing 58 million tons of bauxite was present on Kauai. Much larger deposits of bauxitic soil are present on the island of Hawaii, but the grade of these deposits is appreciably lower than those on Kauai. Deposits of bauxitic soil in western Maui are of higher grade than those on Kauai, but the western Maui deposits were estimated by Cathcart to contain only 9 million tons of bauxite. When both size and grade factors are considered, the bauxitic soil deposits of Kauai are clearly the most favorable ones in the state of Hawaii for large scale bauxite mining. For this reason the deposits on Kauai were selected for investigation.

OBJECTIVES OF THE INVESTIGATIONS

The objectives of the investigation are primarily to gain sufficient knowledge of the economic geology of the deposits to adequately appraise the bauxite resources in the eastern part of Kauai. The economic geology will be concerned chiefly with the size, quality, and location of bauxite bodies and the mineralogy of the bauxite and associated rocks, including types and amounts of minerals containing iron, titanium, and other metals that might possibly serve as a by-product if the bauxite were mined. Particular attention will be given to the clay minerals associated with the bauxite. These minerals are present in very large amounts, and inasmuch as they also contain alumina, they may have ultimately a greater potential than bauxite as a source of aluminum. A second goal of the investigations is to increase our knowledge of the general geology of the eastern part of Kauai. Such things as the weathering processes which formed the bauxite will be investigated. Studies of this type may have little apparent relationship to economics; however, knowledge of bauxite forming processes could lead to improved methods of extracting alumina from it.

THE BAUXITE DEPOSITS

The bauxite deposits on the island of Kauai, as described by Cathcart (1958) and Sherman (1958) are in three areas in the eastern half of the island (figure 1). One area is located in the northern part of the island in the vicinities of Hanalei and Kilauea. The second area is west of Anahola, and the third extends from a point west of Kapaa to near Koloa. The deposits extend discontinuously over areas of approximately 10 square miles near Hanalei and Kilauea, 4 square miles near Anahola, and 30 square miles between Kapaa and Koloa.

The bauxite occurs at and near the surface in ferruginous laterite and thoroughly weathered volcanic rocks in the subsoil. The chief bauxite forming mineral is gibbsite ($Al(OH)_3$) which occurs as gray, brown, red, and yellow colored nodules, concretions, veinlets, and irregular masses irregularly distributed throughout the laterite and weathered rock. The gibbsite particles range in size from concretions several inches in diameter to clay size grains too small to be seen even with the aid of a microscope. Minerals associated with the gibbsite are chiefly the iron oxides, hematite (Fe_2O_3), goethite ($HFeO_2$), and magnetite (Fe_3O_4) and the clay minerals kaolinite ($Al_4(Si_4O_{10})(OH)_8$) and halloysite ($Al_4(Si_4O_{10})(OH)_8 4H_2O$). Hydrous aluminum and iron gels are also probably present in many of the deposits. At most places the amount of gibbsite decreases and the proportion of clay minerals increases sharply with depth. The most favorable deposits are within 15 feet of the surface and only in a very few places is gibbsite present in sufficient amounts at depths as great as 25 feet to be considered as a possibility for mining. In a general way the bauxite deposits are restricted to gently rolling uplands and flat ridge tops,

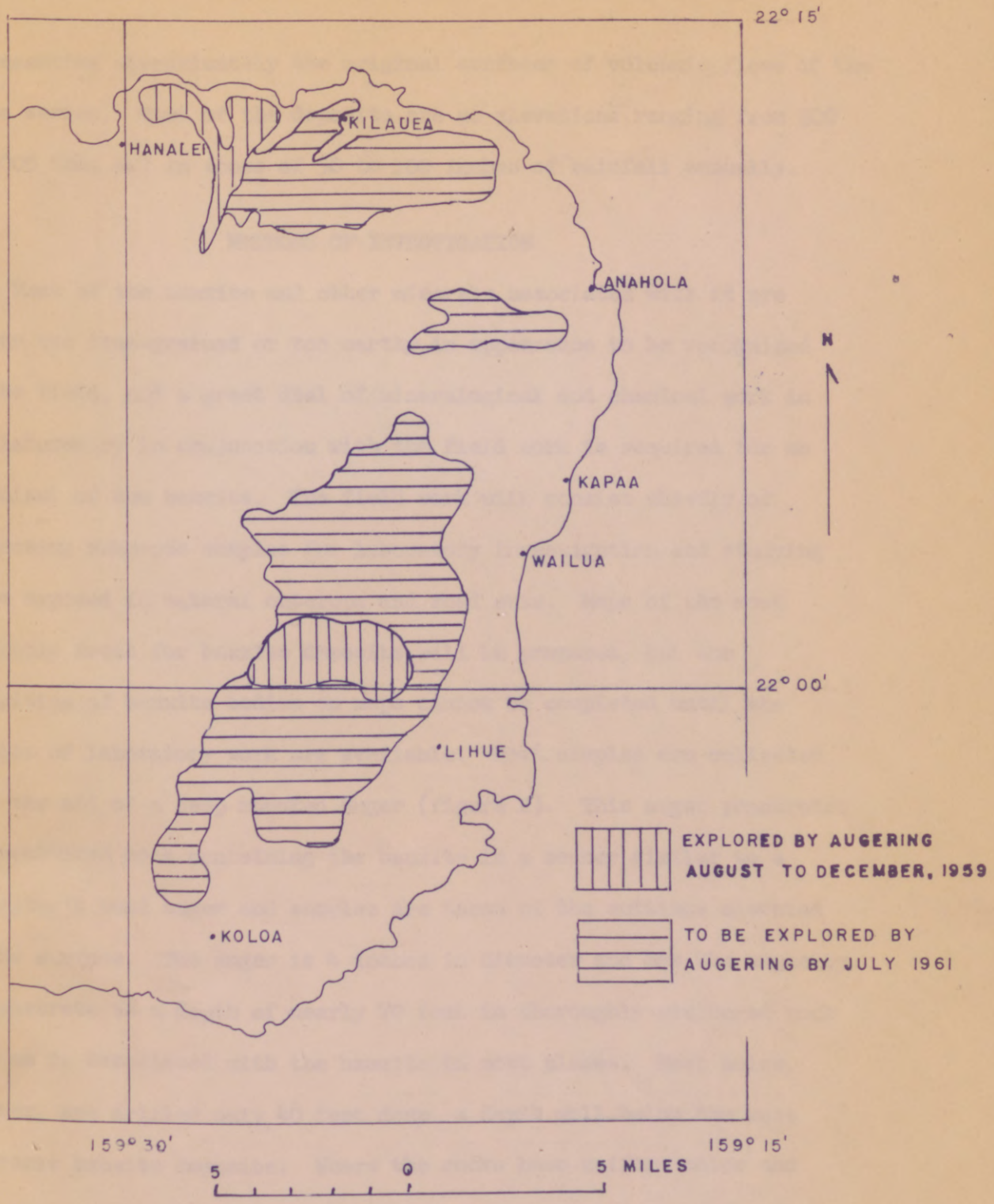

Figure 1. AREAS IN EASTERN PART OF KAUAI WHERE BAUXITE DEPOSITS ARE TO BE INVESTIGATED

representing approximately the original surfaces of volcanic flows of the Koloa series. Most of the deposits are at elevations ranging from 300 to 1000 feet and in zones of 50 to 100 inches of rainfall annually.

METHODS OF INVESTIGATION

Most of the bauxite and other minerals associated with it are either too fine-grained or too earthy in appearance to be recognized in the field, and a great deal of mineralogical and chemical work in the laboratory in conjunction with the field work is required for an appraisal of the bauxite. The field work will consist chiefly of collecting numerous samples for laboratory investigation and studying rocks exposed in natural outcrops and road cuts. Maps of the most favorable areas for bauxite deposits will be prepared, but the delimiting of bauxite bodies on maps cannot be completed until the results of laboratory work are available. Most samples are collected with the aid of a jeep mounted auger (figure 2). This auger penetrates the weathered rock containing the bauxite in a manner similar to a carpenter's wood auger and samples are taken of the cuttings elevated to the surface. The auger is 4 inches in diameter and has the capacity to penetrate to a depth of nearly 70 feet in thoroughly weathered rock such as is associated with the bauxite in most places. Most holes, however, are drilled only 40 feet deep, a depth well below the most favorable bauxite deposits. Where the rocks have uniform color and texture, a sample is taken of the cuttings from each 5 feet of rock down to a depth of 25 feet and thereafter at 10 foot intervals. Where distinct color and textural units are present in the rocks, samples are taken of each unit.

Figure 2. Jeep mounted mobile auger used in drilling for bauxite.

A portable differential thermal analysis apparatus is used in the field office to make semi-quantitative determinations of the amounts of gibbsite and clay minerals present in samples. This apparatus is designed to measure the heat that is absorbed or given off by reactions that take place when a rock material is heated. The reactions in gibbsite are distinctly different from those in clay minerals, and the measurement of the intensity of these reactions provides information on the proportions of these minerals present. The results obtained with this equipment serve as a guide as to what rocks should be considered as having possibilities for bauxite and what ones should not.

Laboratory work at Beltsville, Maryland, and Washington, D. C., will be concerned chiefly with identification and quantitative determinations of the bauxite and associated minerals and chemical analyses. Studies will also be made of the particle sizes of the aluminous and other minerals present in the bauxite. Mineralogical investigations will be done by X-ray, differential thermal, electron microscope, and petrographic microscope technques. Both chemical and spectrographic analyses will be made.

PROGRESS OF THE INVESTIGATIONS

At the time this report was written (December 1, 1959), bauxite deposits near Hanalei (figures 1 and 3) and in the vicinity of the Kilohana crater, northwest of Lihue (figures 1 and 4) had been explored and sampled by augering. The area explored near Hanalei is approximately 5 square miles and the one in the vicinity of the Kilohana crater is about 10 square miles. Samples and measurements of bauxite bearing rock units had also been taken at nine scattered auger holes in the Kapaa and Wailua homesteads area and from several natural rock outcrops and road cuts. Three holes had been drilled in the bottom land west of the Hanalei River (figure 3) and two samples had been taken from the bottom of Nawiliwili Bay to check the possibility that bauxite had been transported by streams and deposited in low areas. One hundred and seven auger holes had been drilled and the total drill footage was 4,143 feet. Forty-two of the holes were located in the area between the Hanalei and Kalihiwai Rivers (figure 3), and 53 holes were located in the vicinity of the Kilohana crater (figure 4). Six hundred and fifty samples had been shipped to laboratories at Beltsville, Maryland and Washington, D. C., and an additional 125 samples were prepared for shipment. Approximately 225 samples had been examined by the portable differential thermal analysis technique in the field office.

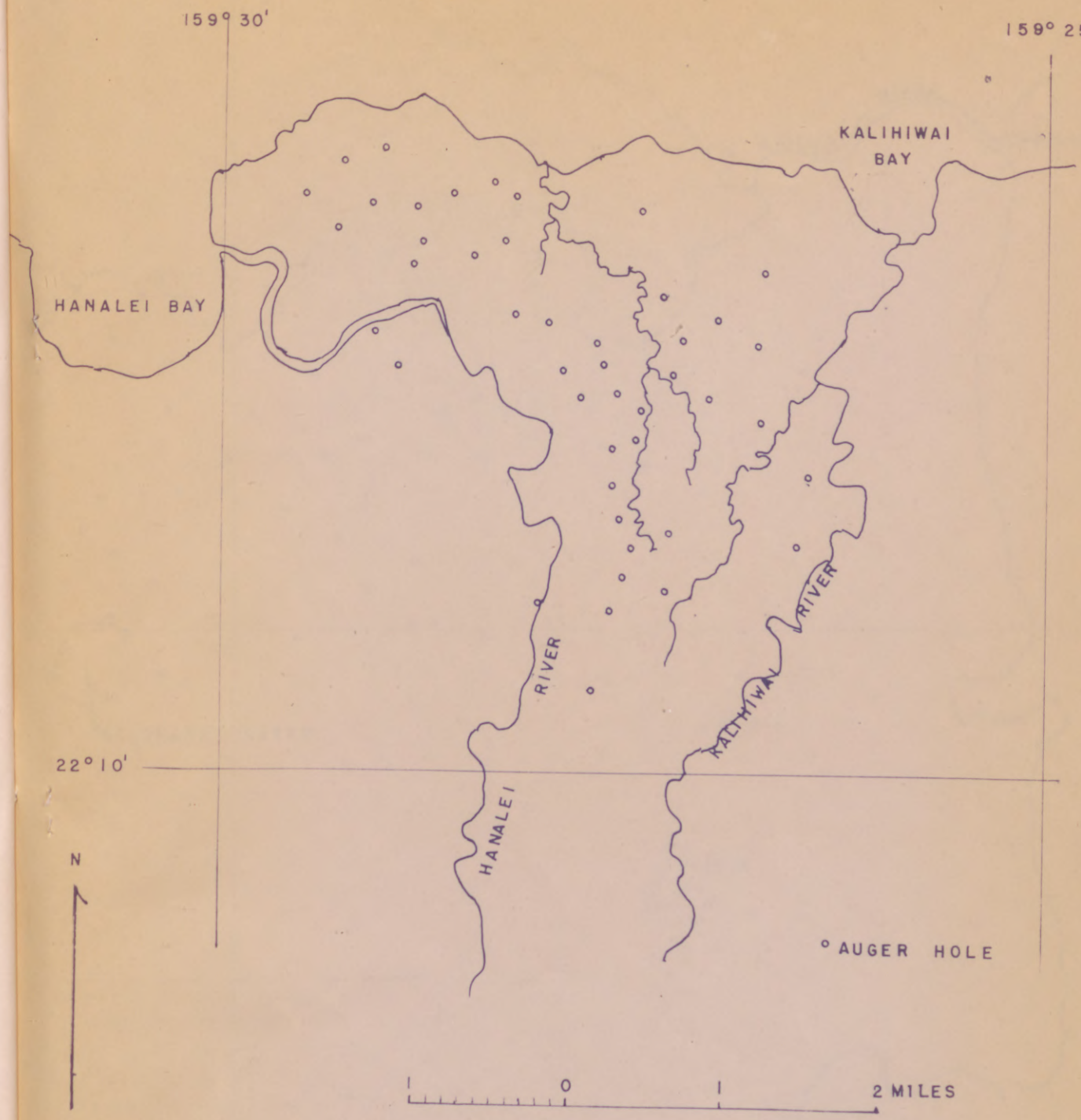

Figure 3. SKETCH MAP OF AUGER HOLE LOCATIONS NEAR HANALEI, KAUAI

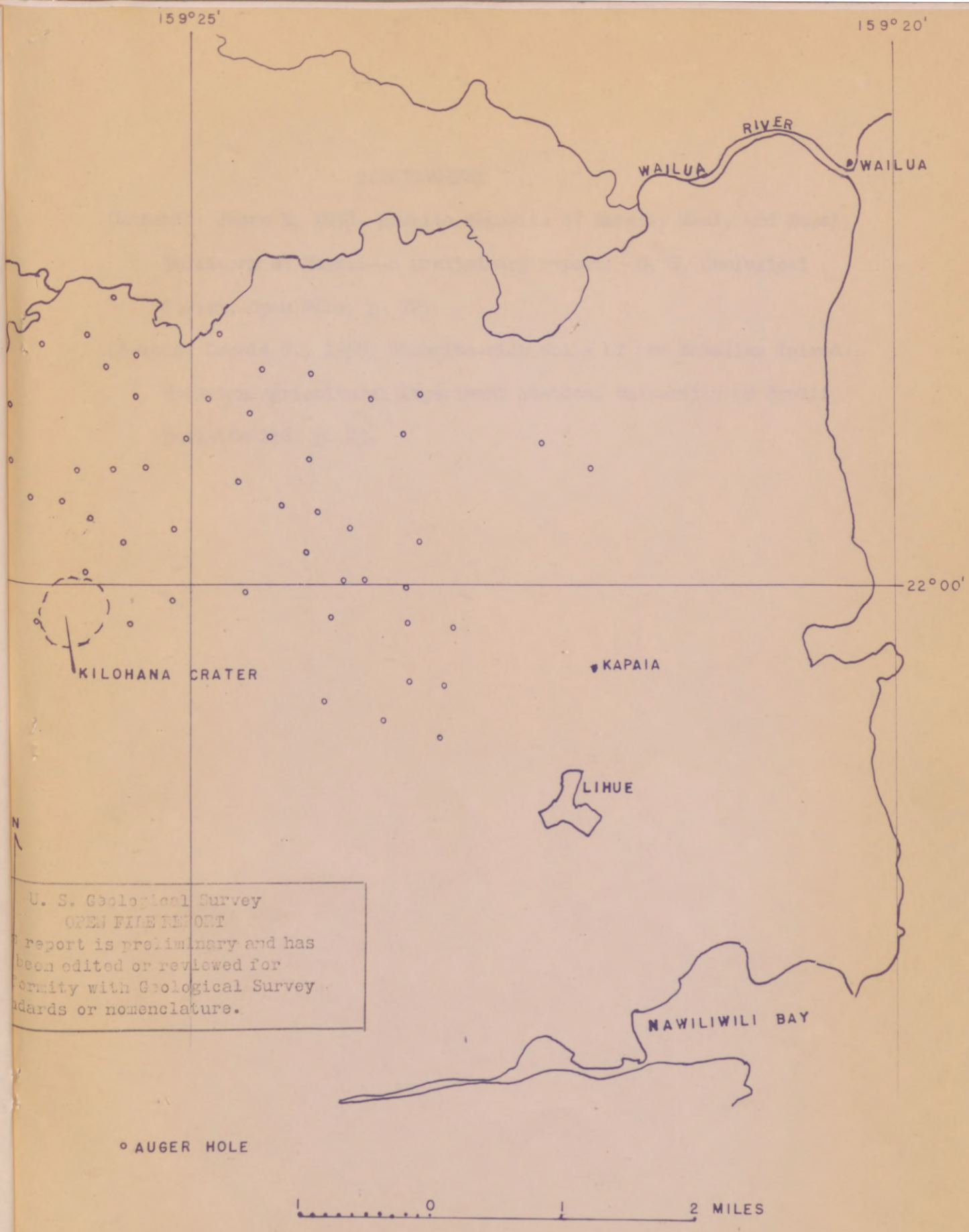

Figure 4. SKETCH MAP OF AUGER HOLE LOCATIONS NEAR KILOHANA CRATER, KAUAI

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Weld - Int. 5278

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Washington, D. C.

For Release JANUARY 15, 1960

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1. Progress report on the investigations of bauxite deposits in the eastern part of Kauai, Hawaii, by S. H. Patterson. 12 p., 4 figs. On file with Ground Water Branch, Geological Survey, Room 333, P. O. Bldg., Honolulu, Hawaii; Office of the Governor, Honolulu, Hawaii; and Univ. of Hawaii Library, Honolulu, Hawaii.

2. The copper-cobalt deposits of the Quartzburg district, Grant County, Oregon, by John S. Vhay. 20 p., 3 pl. On file with Dept. of Geology and Mineral Industries, State Office Bldg., Portland, Oreg.; and in the Geological Survey office, So. 157 Howard St., Spokane, Wash.; 232 Appraisers Bldg., San Francisco, Calif.; and 504 Federal Bldg., Salt Lake City, Utah.

3. Experimental drill hole logging in potash deposits of the Carlsbad district, New Mexico, by C. L. Jones, C. G. Bowles, and K. C. Bell. 22 p., 5 figs. On file with the New Mexico Bureau of Mines and Mineral Resources, Socorro, N. Mex., and in Geological Survey offices, 468 New Custom House, Denver, Colo.; 602 Thomas Bldg., Dallas, Texas; and 504 Federal Bldg., Salt Lake City, Utah.

The following report is available for consultation in the Geological Survey library, 1033 General Services Administration Bldg., Washington, D. C.:

4. Geology of the Grosvenor quadrangle, Texas, and petrology of some of its Pennsylvanian limestones, by R. T. Terriere. 171 p., 38 illus., 4 tbls.

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