[redacted]

REGIONAL RECONNAISSANCE FOR RADIOACTIVE MATERIALS IN EASTERN IMPERIAL COUNTY, CALIFORNIA

By George W. Walker

Trace Elements Memorandum Report 674

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

[redacted]

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D.C.

JUL 30 1953

AEC - 1355/3

Dr. Phillip L. Merritt, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

Transmitted herewith are six copies of TEM-674, "Regional reconnaissance for radioactive materials in eastern Imperial County, California", by George W. Walker, June 1953.

Sincerely yours,

Dwight M. Lemmon

for W. H. Bradley
Chief Geologist

When separated from enclosures, handle this document as UNCLASSIFIED.

Geology and Mineralogy

This document consists of 13 pages.

Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

REGIONAL RECONNAISSANCE FOR RADIOACTIVE MATERIALS IN EASTERN IMPERIAL COUNTY CALIFORNIA*

By

George W. Walker

June 1953

Trace Elements Memorandum Report 674

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission

GEOLOGY AND MINERALOGY

Distribution (Series A)	No. of copies
American Cyanamid Company, Winchester	1
Argonne National Laboratory	1
Atomic Energy Commission, Washington	1
Battelle Memorial Institute, Columbus	1
Carbide and Carbon Chemicals Company, Y-12 Area	1
Division of Raw Materials, Grants	1
Division of Raw Materials, Denver	1
Division of Raw Materials, Hot Springs	1
Division of Raw Materials, New York	6
Division of Raw Materials, Salt Lake City	1
Division of Raw Materials, Richfield	1
Division of Raw Materials, Butte	1
Division of Raw Materials, Washington	3
Dow Chemical Company, Pittsburg	1
Exploration Division, Grand Junction Operations Office	1
Grand Junction Operations Office	1
Technical Information Service, Oak Ridge	6
Tennessee Valley Authority, Wilson Dam	1
U. S. Geological Survey:	
Mineral Deposits Branch, Washington	2
Geochemistry and Petrology Branch, Washington	1
Geophysics Branch, Washington	1
Alaskan Geology Branch, Washington	1
Fuels Branch, Washington	1
D. M. Lemmon, Washington	1
L. R. Page, Denver	2
R. P. Fischer, Grand Junction	1
A. E. Weissenborn, Spokane	1
C. B. Hunt, Plant City	1
J. F. Smith, Jr., Denver	1
N. M. Denson, Denver	1
R. W. Swanson, Spokane	1
L. S. Gardner, Albuquerque	1
J. D. Love, Laramie	1
A. H. Koschmann, Denver	1
E. H. Bailey, San Francisco	1
J. R. Cooper, Denver	1
W. P. Williams, Joplin	1
C. E. Dutton, Madison	1
R. A. Laurence, Knoxville	1
R. J. Roberts, Salt Lake City	1
Q. D. Singewald, Beltsville	1
M. R. Klepper, Washington	1
TEPCO, Washington:	
Resource Compilation Section	2
Reports Processing Section (Including master)	2
	60

CONTENTS

ILLUSTRATION

REGIONAL RECONNAISSANCE FOR RADIOACTIVE MATERIALS IN EASTERN IMPERIAL COUNTY, CALIFORNIA

by George W. Walker

ABSTRACT

Mineralized areas, placer concentrates, and bedrock exposures in eastern Imperial County, California, were investigated in February 1953, to determine whether the region contained economic deposits of radioactive material. A total of 32 mine properties and prospects, lying to the east and southeast of Salton Sea, were tested for radioactivity. The Lucky Star claim, which was originally examined in April 1952, is the only property examined that contains an appreciable concentration of uranium minerals. Assays of samples collected on the claim range from 0.021 to 0.12 percent uranium. Placer concentrations of dark minerals, which are common in many of the dry washes of the region, were tested for anomalous radioactivity; selected samples of the placer concentrates were further concentrated and checked for radioactive minerals in the laboratory. Various types of bedrock, including exposures of schist, gneiss, quartzite, plutonic crystalline rocks, and Tertiary volcanic rocks were also checked for anomalous gamma-radioactivity. Locally, some exposures of felsic volcanic intrusives are weakly radioactive; however, none of the bedrock gave Geiger counter readings more than 1½-times background.

From data gathered during the course of this reconnaissance it seems unlikely that economic deposits of radioactive material occur in

eastern Imperial County. Although some exposures of felsic volcanic rocks are very weakly radioactive and minor concentrations of secondary uranium minerals occur on the Lucky Star claim, neither of these represent a potential source of uranium under present conditions.

INTRODUCTION

Regional reconnaissance for radioactive materials in eastern Imperial County, California, was undertaken because the region contains extensive exposures of Tertiary volcanic rocks which, in other parts of California and elsewhere, commonly contain weak concentrations of uranium minerals and because one of the best showings of secondary uranium minerals in California is in volcanic rocks in the region. The region is remote and much of it is comparatively inaccessible, so that probably little systematic checking for radioactivity has been done. In addition, the region contains a wide variety of mineral deposits: copper, silver, gold, lead, manganese, kyanite, talc, and sericite; some of the mineral deposits are in the volcanic rocks, whereas others are in crystalline bedrock or in Quaternary placers.

The field investigation was carried on intermittently from February 11, to February 22, 1953, by George W. Walker of the U. S. Geological Survey. The Lucky Star claim, which is the one known concentration of uranium minerals in the region, was examined in April 1952 by Walker and Luther H. Baumgardner. The investigation, which was made on behalf of the U. S. Atomic Energy Commission, consisted of an examination of the geology and radioactivity of the Lucky Star claim, examination of the

radioactivity of many of the mines and prospects of the region, and checks of the radioactivity of numerous exposures of bedrock with particular emphasis on exposures of volcanic rocks where intrusive relationships could be ascertained. Three samples, collected in April 1952, were assayed for their equivalent uranium and uranium content (Walker and Baumgardner, PRR D-423). In addition, 13 samples were collected in February 1953 from natural placer concentrations of black sand, principally to check the occurrence and distribution of radioactive minerals in the crystalline bedrock.

GEOLOGY

Geologic mapping in Imperial County has consisted almost entirely of large-scale reconnaissance studies; consequently, the detailed geology of the region and the distribution of the various rock types is but little known. Reconnaissance studies by Blake (1857) and Brown (1923) and detailed studies by Henshaw (1942) and Hadley (1942) indicate that the eastern part of Imperial County consists essentially of a pre-Cambrian (?) basement complex of crystalline rocks overlain by Tertiary volcanic rocks, and Tertiary and Quaternary fanglomerates and alluvium.

The basement rocks, which are extensively exposed in the Chocolate Mountains, Cargo Muchacho Mountains, and the Little Chuckwalla Mountains, consist dominantly of gneiss, schist, and quartzite of pre-Cambrian (?) age, and intrusive granitic rocks of Mesozoic (?) age. Sericite schist, quartz-mica schist, quartzite, hornblends schist, kyanite-bearing quartz-mica schist or quartzite, slate, and hornblende gneiss are the dominant rock types in the old metamorphic sequence. The metamorphic rocks have

been intruded by quartz diorite, quartz monzonite, various kinds of granite, and aplite and pegmatite dikes. Tertiary volcanic rocks of compositions ranging from rhyolite to basalt are widely distributed throughout the region (fig. 1). The most extensive exposures of volcanic rocks consist of flows and tuffs. The more mafic volcanic rocks occur principally as flows and agglomerates; the felsitic volcanic rocks are mainly tuffs. Locally, rocks identical in hand-specimen to both the mafic and felsitic volcanics intrude the basement rocks. The felsitic intrusives usually occur as near-surface sills, dikes, and plugs. Some of the intrusive masses are perlite or obsidian of either rhyolitic or dacitic composition.

Locally, for example at the Lucky Star claim, the basement rocks and the volcanic intrusives are hydrothermally altered. Elsewhere, in areas where no volcanic rocks are exposed, the basement rocks are also hydrothermally altered.

The alluvial deposits, which have the largest areal extent of all the rock formations in the region, range in age from Tertiary (?) to recent. They are composed of well-indurated fanglomerates, some cross-bedded sandstone, and poorly consolidated material made up of sand, clay, and rock fragments.

CONCENTRATES FROM DRY WASHES

A total of 13 samples of dark minerals from natural placer concentrations were collected to check the occurrence and distribution of radioactive minerals in areas underlain by the crystalline basement rocks.

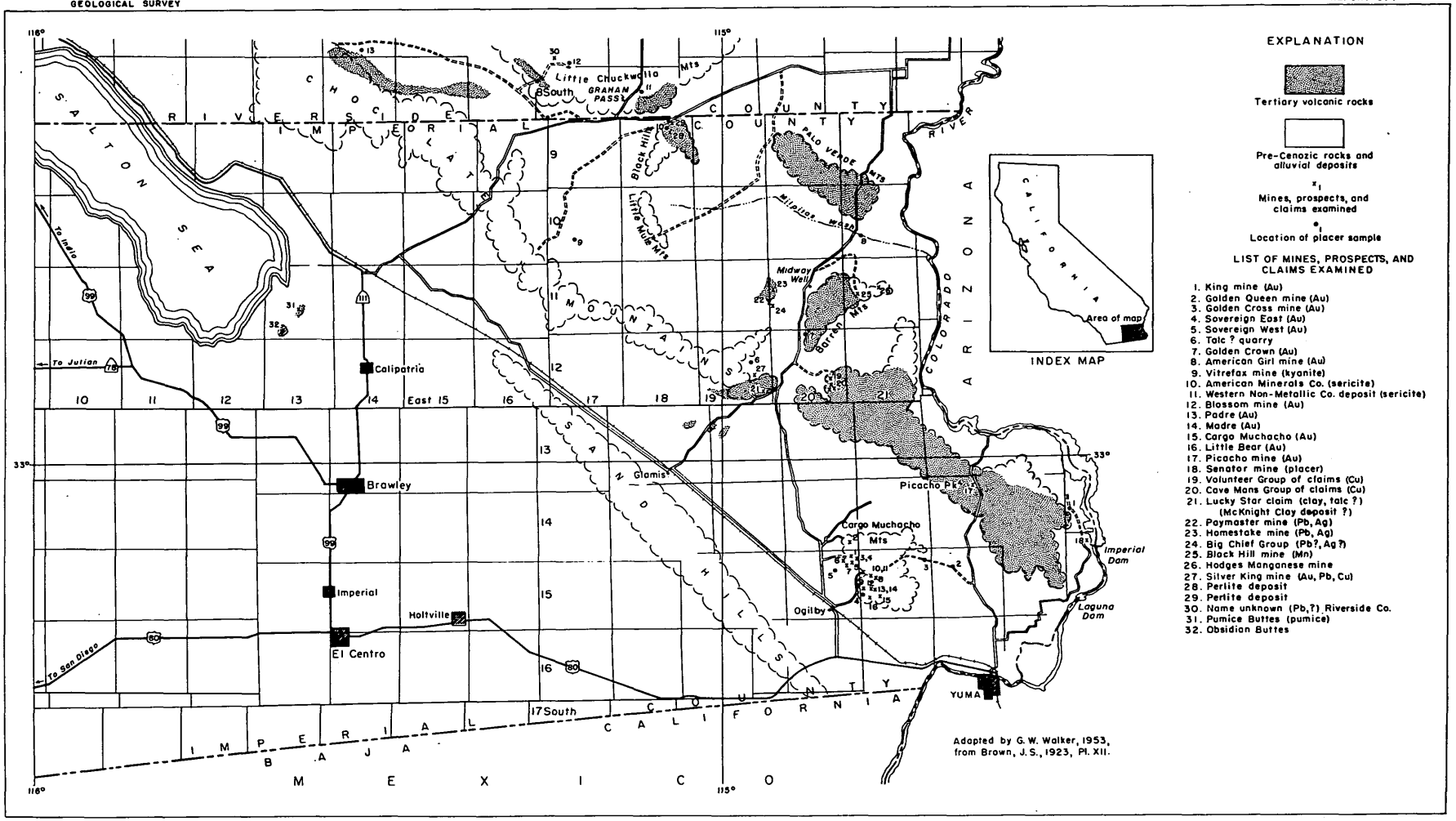

Figure 1

SKETCH MAP SHOWING APPROXIMATE DISTRIBUTION OF TERTIARY VOLCANIC ROCKS, LOCATION OF PLACER SAMPLES, AND MINE PROPERTIES EXAMINED, IMPERIAL AND RIVERSIDE COUNTIES, CALIFORNIA

The samples were collected from widely separated localities within the region (fig. 1), from washes that drain the Cargo Muchacho Mountains, the Chocolate Mountains, and the Little Chuckwalla Mountains. Most of the samples consisted of approximately 20 pounds of sand and were panned and further concentrated by heavy liquids and electromagnetic separations.

Brief mineralogic studies in the laboratory indicate that the placer concentrates are composed largely of quartz, feldspar, mica, magnetite, ilmenite, hornblende, and considerably lesser amounts of epidote, olivine, sphene, garnet, biotite, apatite, tourmaline, zircon, rutile, kyanite, zoisite, (?), anatase, chlorite, hematite, leucoxene, green spinel (?), monazite (?), and metamict thorite (?). The last three minerals listed are so rare--not more than one or two grains of each were observed--that positive identification was not made.

RADIOACTIVITY

Tests for radioactivity were made with a Geiger counter of a number of selected mine properties, of natural placer concentrations in washes, and of the various types of bedrock exposed in the region. Special emphasis was placed not only on known mineralized areas, but also on mines and prospects located in areas of volcanic bedrock.

Tests of mines and prospects

Testing for radioactivity of mine properties consisted essentially of readings of gamma-radioactivity taken on dumps, in underground workings, in surface cuts and pits, and on selected ore specimens. Many mines and

prospects in the region were not examined due to lack of time or inaccessibility of the property. An attempt was made, therefore, to examine mines that were representative of other mineralized areas in the region. Radioactivity was measured at 32 mine properties, including properties that have been worked for copper, silver, gold, lead, manganese, kyanite, talc (?), clay, pumice, and sericite, and a few properties that have been prospected for perlite (fig. 1). Many small prospect pits not associated with larger mine properties were also tested.

The only significant occurrence of anomalous radioactivity was found on the Lucky Star claim (no. 21, fig. 1). At this locality felsic dikes, sills, and small volcanic necks or plugs have intruded a crushed and faulted zone in quartzite and quartz-mica schist. The metamorphic rocks, as well as the felsic intrusives, are locally bleached and hydrothermally altered. The areas of hydrothermal alteration contain, in addition to various clay minerals and quartz, notable quantities of talc, gypsum, calcite, and some autunite, carnotite, psilomelane, and hydrated iron oxide. Most of the carnotite occurs in the altered felsic intrusives, and most of the autunite in the altered metamorphic rocks. Assays of three samples collected on the property indicate an equivalent uranium content of 0.028, 0.077, and 0.097 percent and a uranium content of 0.021, 0.076, and 0.12 percent, respectively.

No significant amount of radioactive material was found in any of the other properties that were examined. Weak radioactivity, not exceeding 1½-times background, was found locally at the Black Hill mine (no. 25, fig. 1) and in two prospect pits at the north end of the Chocolate Mountains.

Tests of concentrates

Placer concentrates of dark minerals are relatively numerous in parts of eastern Imperial County. Testing for radioactivity of the concentrates is readily accomplished because the dark minerals commonly occur as discontinuous surface layers on alluvium in the dry washes. Survey-meter readings on numerous occurrences of black sand showed radioactivity the same as, or only slightly above, background.

As a final check to the apparent lack of radioactive minerals in placer concentrates, 13 samples were collected and further concentrated in the laboratory. The placer concentrates were found to contain a flood of magnetic iron ore, abundant ilmenite, hornblende, and biotite; laboratory tests indicate that none of these minerals are radioactive. The heavy-mineral fractions (heavier than bromoform; G 23° = 2.84) commonly represented less than 0.1 percent of the original placer concentrate and were only very weakly radioactive. Heavy-mineral fractions from samples 2, 4, 11, and 13 (fig. 1) were slightly more radioactive than comparable fractions from the other samples; these fractions consisted of zircon, which commonly contains abundant unidentified inclusions, sphene, apatite, tourmaline, hematite, leucoxene, thorite (?), and other unidentified minerals in order of decreasing abundance.

No qualitative tests were made to determine which of these minerals contributed most to the radioactivity; probably thorite (?) and zircon are the principal source of the gamma-radioactivity, although sphene and apatite may also contribute. The radioactive minerals occur in such

small amounts in the placer concentrations that it was not feasible to determine the equivalent uranium content and the relative abundance of the constituent minerals.

Tests of the bedrock

Various types of bedrock exposed in the region, including exposures of all types of metamorphic rocks, intrusive plutonic rocks, and more specifically the volcanic rocks, were tested for gamma-radioactivity. Although no significant concentrations of radioactive minerals were found in any of the rocks exposed in the region, local exposures of intrusive rhyolite, or dacite, in the vicinity of Graham Pass, are very weakly radioactive.

CONCLUSIONS

Although many parts of eastern Imperial County contain metalliferous deposits and extensive outcrops of volcanic rocks, it seems unlikely that significant concentrations of uranium minerals will be found in the region. Secondary uranium minerals occur in small quantities on the Lucky Star claim, and locally some felsic volcanic intrusives are weakly radioactive. None of these, however, represent a potential source of uranium. No concentration of radioactive material was found in other types of bedrock exposed in the region, nor were placer concentrates appreciably radioactive.

REFERENCES CITED

Blake, Wm. P., 1857, Geological Report (Williamson's reconnaissance in California): U. S. Pacific R. R. Expl. (33d Cong., 2d sess., S. Doc. 78 and H. Doc. 91) vol. 5, pt. 2.

Brown, J. S., 1923, The Salton Sea Region, California: U. S. Geol. Survey Water-Supply Paper 497, 292 pp., 18 figs., 19 pls.

Hadley, J. B., 1942, Manganese deposits in the Paymaster mining district, Imperial County, California: U. S. Geol. Survey Bull. 931-S, p. iii, 459-473, 3 pls., 5 figs.

Henshaw, P. C., 1942, Geology and mineral deposits of the Cargo Muchacho Mountains, Imperial County, California: California Jour. Mines and Geology, vol. 38, no. 2, p. 147-196, 2 pls., 15 figs.

UNPUBLISHED REPORT

Walker, G. S., and Baumgardner, L. H., Lucky Star claim, Imperial County, California: U. S. Geol. Survey, Prelim. Recon. Rept. D-423.