





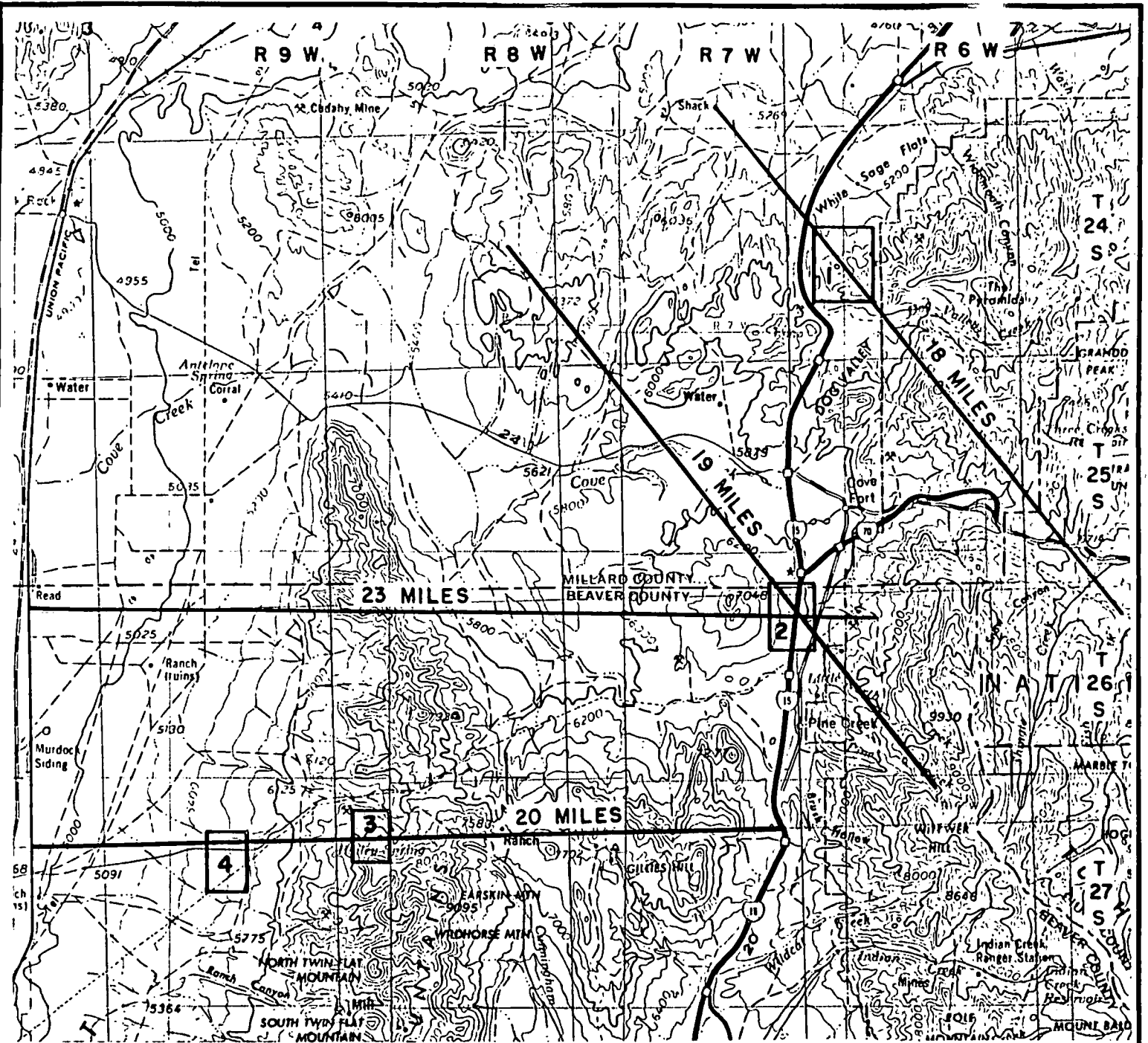
SENTURION SCIENCES' RESPONSE TO  
REQUEST FOR PROPOSAL NO. EY-R-08-0007  
GEOHERMAL RESERVOIR ASSESSMENT CASE STUDY

*SENTURION SCIENCES, INC.*

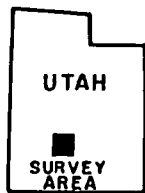
TULSA, U.S.A.

SENTURION SCIENCES' RESPONSE TO  
REQUEST FOR PROPOSAL NO. EY-R-08-0007  
GEOHERMAL RESERVOIR ASSESSMENT CASE STUDY

- A. Senturion Sciences, Inc.  
Post Office Box 15447  
Tulsa, Oklahoma 74112
  
- B. Technical Proposal
  - 1. Investigation Area
    - a. T. 24-27 S., R 6-10 W., Utah
    - b. Data acquisition to be performed
    - c. The survey area is in the Cove Fort-Roosevelt KGRA along the Cordilleran "hingeline" of Central Utah (Figure 1).
    - d. To detail potential geothermal anomalies mapped by a previous survey which used microearthquake, magneto-telluric, and groundmotion techniques (Figure 1).
  - 2. Program Data Offered
    - a. Surface--Senturion proposes to fly four MultiLevel magnetic profiles at six altitudes over potential geothermal anomalies (Figure 1).
  - 3. Program Description
    - a. Surface Investigation
      - (1) New investigation
      - (2) This is a magnetic investigation using observed vertical gradients. The land traverses are flown six times at different altitudes which permits the calculation of the vertical changes in the magnetic field from levels separated by 500 to 1000 feet vertically. Euler's equations are used to describe the relationship between magnetic vectors and total amplitude of a simple magnetic anomaly (see Appendix



## GEOTHERMAL RESERVOIR ASSESSMENT CASE STUDY



### ANOMALY

- 1 DOG VALLEY
- 2 PINE CREEK
- 3 BAILEY SPRINGS
- 4 ROOSEVELT

### DEFINITION

MICROEARTHQUAKE 1, 3, 4  
 GROUND MOTION 1, 2, 4  
 MAGNETOTELLURICS 1, 4

— MULTILEVEL PROFILE LOCATIONS

for more detail). Each ground mile of profile contains 108 magnetic measurements. The magnetic anomalies are interpreted as to meaningful geologic causes. The geology is drafted on the computer-plotted and -printed profile and accompanied with a geologic report. Raw data and uninterpreted profiles will also be provided. An example of a three-level profile with description over the western rim of the Island Park Caldera is in the Appendix.

4. Schedule--The proposed four profiles will require four survey days, which will necessitate four to ten days in the field. The interpretations and report will be available to ERDA within two months after flying.
5. Environmental Evaluation
  - a. The survey will be in the air; thus the environment will not be disturbed.
  - b. There will be no environment impact.
  - c. There will be no conflicts with existing land use patterns and programs.

C. Costs

1. Actual total cost for 80 miles of six congruent levels of aeromagnetics (one ground mile represents 11 air miles; because of heading effect of the aircraft, profiles must be flown in the same direction):

Mobilization at \$2 per mile (plane, pilot, and engineer); approximately 950 miles from Tulsa to survey site -----	\$ 3,800
Amortization and maintenance of aircraft and data acquisition equipment (\$400,000) -----	2,300
Computer and software use -----	2,800
Per diem (two persons for six days; may not be able to fly all the time) -----	1,200
Salaries (pilot and engineer) -----	2,000
Data processing (reconciling the data; two technicians for three days) -----	600
Drafting -----	250
Secretarial -----	200
Geophysicist (six days at \$300 per day) -----	1,800

Magnetic tape -----	120
Paper record costs -----	40
	<hr/>
	\$ 15,110
Service company (G&A) -----	21,909
Fee (10%) -----	2,190
	<hr/>
	\$ 24,099

D. Business and Management

1. Experience-- Senturion personnel have a total of near 40 man-years of experience in MultiLevel profiling. Profiling for the past eight years has been mainly in oil and gas exploration. Recently however, profile mapping has been done successfully over the Island Park Caldera, Idaho, and Beowawe, Nevada.
2. Principal Project Personnel--Edwin K. Hiserodt, M. D. Quigley, Robert B. Robinson (resumes included).
3. The aircraft and crew would operate out of Filmore, Utah. Survey can only be flown in calm air. This is usually present only for a few hours after sunrise; therefore, four survey days are necessary, which will require seven to ten days in the area. Magnetic tapes will be computer-processed and interpreted at Senturion's facilities in Tulsa.
4. Business and Technical Contacts
  - a. T. C. Wesson; Energy Research and Development Administration, Post Office Box 1398; Bartlesville, Oklahoma 74003; Phone 918-336-2400. (ERDA-Senturion article in Appendix).
  - b. William J. Zwart; Amerada Hess Corporation; Post Office Box 2040; Tulsa, Oklahoma 74105; Phone 918-584-5554.
  - c. Stephen B. Evans; Rainbow Resource, Inc.; 10 Lakeside Lane; Denver, Colorado 80212; Phone 303-458-5663.
  - d. Robert C. Roesch; Energy Reserve Group, Inc.; Suite 3200, First of Denver Plaza; Denver, Colorado 80202; Phone 303-572-3323
  - e. Ronald C. Barr; Earth Power Corporation; Post Office Box 1566; Tulsa, Oklahoma 74101; Phone 918-587-9704.
  - f. Richard F. Dondanville; Union Oil Company of California; Post Office Box 7600; Los Angeles, California 90051; Phone 213-486-6600

- g. Robert C. Edmiston; Chevron Oil Company; Post Office Box 7643; San Francisco, California 94120; Phone 415-894-0673.
  - h. Gary W. Crosby; Phillips Petroleum Company; Post Office Box 752; Del Mar, California 94120; Phone 715-755-0131.
  - i. Milton McKenzie; Viking Petroleum, Inc.; 2805 East Skelly Drive, Suite 806; Tulsa, Oklahoma 74105; Phone 918-749-2296.
5. Senturion accepts the "General Contract Provisions."
  6. The "Program Technical Scope" set forth in RFP No. EY-R-08-0007 has been reviewed, and all data which will be furnished pursuant to a contract may be published.
  7. Senturion Sciences is a closed corporation and does not prepare a certified financial statement. Senturion's financial capability to carry out this program is evidenced by being in business for five years and the list of satisfied clients included under section 4 of this proposal.
  8. GSA Form 19B, "Representation and Certifications," is enclosed. There is no proprietary information in this proposal.

REPRESENTATIONS  
AND CERTIFICATIONS  
(Construction Contract)  
(For use with SF 19 and 21)

REFERENCE (Enter same No.(s) as on SF 19/21)  
APPROP. NO. EY-R-08-0007  
PROJECT NO.  
CONTRACT NO.

NAME AND ADDRESS OF BIDDER (No., Street, City, State, and ZIP Code)

Senturion Sciences, Inc.  
1539 No. 105th E. Ave., Post Office Box 15447  
Tulsa, Oklahoma 74112

DATE OF BID

May 27, 1977

DATE OF INVITATION

March 25, 1977

*In negotiated procurements, "bid" and "bidder" shall be construed to mean "offer" and "offeror."*

The bidder makes the following representations and certifications as a part of the bid identified above. (Check appropriate boxes.)

1. SMALL BUSINESS

He  is,  is not, a small business concern. (For this purpose, a small business concern is a business concern, including its affiliates, which (a) is independently owned and operated, (b) is not dominant in the field of operation in which it is bidding on Government contracts, and (c) had average annual receipts for the preceding 3 fiscal years not exceeding \$7,500,000. For additional information see governing regulations of the Small Business Administration.)

2. CONTINGENT FEE

(a) He  has,  has not, employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and (b) he  has,  has not, paid or agreed to pay any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract; and agrees to furnish information relating to (a) and (b) above as requested by the Contracting Officer. (For interpretation of the representation, including the term "bona fide employee," see Code of Federal Regulations, Title 41, Subpart 1-1.5.)

3. TYPE OF ORGANIZATION

He operates as an  individual,  partnership,  joint venture,  corporation, incorporated in State of Delaware.

4. INDEPENDENT PRICE DETERMINATION

(a) By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with this procurement:

(1) The prices in this bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;

(2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and

(3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.

(b) Each person signing this bid certifies that:

(1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3) above; or

(2) (i) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a) (1) through (a) (3) above, and as their agent does hereby so certify; and (ii) he has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3) above.

(c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.

(d) A bid will not be considered for award where (a) (1), (a) (3), or (b) above, has been deleted or modified. Where (a) (2) above, has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS \$10,000 IN AMOUNT.

5. EQUAL OPPORTUNITY

He  has,  has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he  has,  has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards. (The above representation need not be submitted in connection with contracts or subcontracts which are exempt from the clause.)

NOTE.—Bids must set forth full, accurate, and complete information as required by this invitation for bids (including attachments). The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.



6. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER


Each bidder shall furnish the following information by filling in the appropriate blocks:

(a) Is the bidder owned or controlled by a parent company as described below?  Yes  No. (For the purpose of this bid, a parent company is defined as one which either owns or controls the activities and basic business policies of the bidder. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the bidder, such other company is considered the parent company of the bidder. This control may be exercised through the use of dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)

(b) If the answer to (a) above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY	MAIN OFFICE ADDRESS (No., Street, City, State, and ZIP Code)
------------------------	--

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) (Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941), or, if he has a parent company, the E.I. No. of his parent company.

EMPLOYER IDENTIFICATION NUMBER OF	 PARENT COMPANY Senturion Sciences, Inc.	BIDDER E.I. #73-0800505
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7. CERTIFICATION OF NONSEGREGATED FACILITIES

(Applicable to (1) contracts, (2) subcontracts, and (3) agreements with applicants who are themselves performing federally assisted construction contracts, exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

8. The bidder, its officers or agents,  have,  have not, refused to furnish to any Government agency or any establishment in the legislative or judicial branch of the Government information or records reasonably pertinent to any Government contract in connection with which the bidder has performed work or furnished materials or supplies or undertaken to do so.

APPENDIX

## MULTILEVEL MAGNETIC PROFILING

over the

### ISLAND PARK CALDERA, IDAHO.

Senturion Sciences flew a MultiLevel magnetic profile at altitudes of 8000, 9000, and 10,000 feet over the eastern portion of the Snake River Downwarp. This profile was flown in conjunction with other surveys to demonstrate the resolving power of Senturion's synergistic exploration approach in lava-covered areas. The optically pumped helium magnetometer used on this survey is an extremely sensitive instrument. It can look at magnetic susceptibilities in the sedimentary section as well as the interface between basement rock and sedimentary rock and igneous rocks of differing temperature.

This portion of the profile is over the western rim of the Island Park Caldera (Figure 1). Directly over the rim, the magnetic values are abnormally low on all three levels as compared to the adjacent magnetic highs on either side. Also, the vertical magnetic gradients are reversed; that is, the normally higher value (8000-foot level) is now a lower value, and a normally lower value (10,000-foot level) is now the higher value. This is a strong negative magnetic pole which could be created by rocks above their Curie Point temperature (Bhattacharyya and Leu, 1975\*).

Although limited survey has been designed with this theory in mind, this approach has great potential. Senturion is actively pursuing this type of survey in geothermal exploration.

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\* *Analysis of Magnetic Anomalies over Yellowstone National Park: Mapping of Curie Point Isothermal Surface for Geothermal Reconnaissance; Journal of Geophysical Research, November 10, 1975.*

PROFESSIONAL RECORDHISERODT, EDWIN K.

Executive Vice President

Years Actively Engaged in Profession

1952 - Present

Academic Training:

Iowa State University

B.S. Geology

1952

Employment Record

1975 - Present

Senturion Sciences, Inc.

1966 - 1975

Hiroca Corporation

1952 - 1966

Sinclair Research Laboratories, Inc.

Professional Experience:Senturion Sciences, Inc.

Executive Vice President and Manager of Airborne Geophysics

Hiroca Corporation

President. Engaged in Aeromagnetic Exploration using the Helium Magnetometer through a license agreement with Sinclair-Atlantic Richfield.

Sinclair Research Laboratories, Inc.

Director of Potential Field Methods Research. Gravity - Detection of flame front in fireflood recovery, sulfur exploration - Pecos and Cubberson Counties, Texas. Magnetics - developed helium magnetometer for Sinclair as well as various computer programs for interpretation of magnetic data.

Director of Unorthodox Geophysical Methods Research including radio frequency, magneto telluric, radio activity, and thermal measurements.

In charge of radio frequency exploration research group in Petroleum exploration - Pauls Valley Uplift, Menaha Ridge, Delaware Basin, Powder River Basin, Shirley Basin, Casper Arch and Wind River Basin.

Surface Electrical Resistivity - research assistant petroleum exploration - Ouachita Mountains - ground water studies - central Oklahoma.

Seismic research field crew in Gulf Coast, Edwards Plateau, Plainview Basin, Central Basin Platform and Lovington Basin developing field techniques for record improvement.

Professional Affiliations:

Aircraft Owners and Pilots Association

PROFESSIONAL RECORDQUIGLEY, M. DARWIN

Senior Geophysicist

Years Actively Engaged in Profession:

1941 - Present

Academic Training:

Michigan State College	B.S. Geology	1941
Northwestern University	M.S. Geology	1947
California Institute of Technology	PhD	1950

Employment Record:

1975 to Present	Senturion Sciences, Inc.
1971 - 1975	Hiroca Corporation
1969 - 1971	Exploration Surveys, Inc.
1966 - 1969	Sinclair Oil Corporation
1962 - 1966	Pacific Natural Gas
1959 - 1962	English Oil Company
1958 - 1959	Horizon Oil & Gas Company
1956 - 1958	Utah Southern Oil Company
1954 - 1956	Price Exploration Company
1952 - 1954	Sinclair Research Lab, Inc.
1948 - 1952	Sinclair Oil & Gas Company
1942 - 1945	U.S. Naval Bureau of Ord.
1941 - 1942	Magnolia Petroleum Corporation

Professional Experience:Senturion Sciences, Inc.

Senior Geophysicist and Vice-President of Geology and potential field data interpretation.

Hiroca Corporation

Interpretation of potential field data

Exploration Surveys, Inc.

Manager, Airborne Division. Acquisition and interpretation of high sensitive helium magnetometer data.

Sinclair Oil Corporation

Manager, Airborne Magnetics. Development and application of Sinclair's high sensitive airborne helium magnetometer.

Pacific Natural Gas

Chief Geologist and member of management committee in charge of geological and geophysical exploration work for oil and gas.

English Oil Company

Vice President and Chief Geologist. Responsible for all oil and gas and mining efforts of company.

Horizon Oil and Gas Company

Division Geologist. Responsible for geological studies of Book Cliffs and Douglas Arch areas in search for new gas reserves.

Utah Southern Oil Company

Chief Geologist in charge of exploration activities from Montana to Oklahoma.

Price Exploration Company

Geologist and Partner Uranium exploration and mining operations in the Colorado Plateau.

Sinclair Research Lab, Inc.

Geologist-Engineer. Investigation and analysis of unorthodox methods of exploration.

Sinclair Oil and Gas Company

District Geologist - Geologic exploration for oil and gas in western Wyoming, Utah, Idaho, eastern Nevada and eastern Oregon.

U.S. Naval Bureau of Ord., Washington, D.C.

Physicist P3 - Demagnetization of ships to insure their protection against magnetic mines at Pearl Harbor, T.H.

Magnolia Petroleum Corporation

Junior Geologist and Oil Scout. Oil scouting and survey work on well locations.

Technical Papers:

*Correlation of the Dakota-Cedar Mountain Sequence along the Douglas Arch, Symposium on Cretaceous Rocks of Colorado and adjacent areas, Rock Mountain Association of Geologists pp 33-36.*

*Ferron Gas Field, Emery County, Utah. Oil and Gas Fields of Utah, Intermountain Association of Petroleum Geologists.*

*Green River Oil Shale Potential in Utah, Oil and Gas Possibilities of Utah*, Utah Geological and Mineralogical Survey, pp 207-214

*Geologic History of the Piceance Creek-Eagle Basins, Colorado*, Bulletin of American Association of Petroleum Geologists A.A.P.G. Bull.

Professional Affiliations

American Association of Petroleum Geologists  
Society of Exploration Geophysicists  
Intermountain Association of Petroleum Geologists  
Tulsa Geological Society  
Geophysical Society of Tulsa

PROFESSIONAL RECORDROBINSON, ROBERT B.

Geologist

Years Actively Engaged in Profession

1952 - Present

Academic Training:

University of Nebraska	B.S. Geology	1951
University of Nebraska	M.S. Geology	1957

Employment Record

1975 - Present	Senturion Sciences, Inc.
1966 - 1975	Hiroca Corporation
1963 - 1966	Sinclair Research, Inc.
1961 - 1963	Sinclair Somal Corporation
1952 - 1961	Sinclair Research, Inc.

Professional Experience:Senturion Sciences, Inc.

Geologist responsible for all geological support to all geophysical surveys.

Hiroca Corporation

Secretary-Treasurer. Technically operate airborne magnetic surveys and reduction of data into profile and map form. Also consulting practice in reservoir geology and hydrodynamics.

Sinclair Research, Inc.

Research Geologist. Porosity development in carbonate rock. Developed laboratory studies in porosity and diagenesis alteration and carried on field research in these areas in Recent sedimentation in the Bahama Islands and southern Florida and in ancient rock in the Sacramento and Delaware Mountains, Black Hills and Powder River Basin.

Sinclair Somal Corporation

Worked directly under the general manager. Duties included: supervision of one drilling rig, two seismic crews and company exploration staff. Developed exploration program with staff and responsible for its being carried out. Took over general manager responsibilities when absence from the country. Sinclair's concession in Somalia was almost 100,000 square miles.

Sinclair Research, Inc.

Field work in developing techniques for improving record quality in areas of Edwards Plateau, Central Basin Platform, Lovington Basin, Midland Basin and the Mississippi Embayment.



Geological Engineer in geophysical exploration research. Instrumentation and field studies in scintillometer, radio frequency, tellurics and resistivity methods in Marfa Basin, Pauls Valley Uplift, Central Oklahoma Platform and Delaware Basin.

In charge of hydrodynamic research and petrology. Liaison between Sinclair Oil & Gas and Petroleum Research Corporation, Denver, (contractor in hydrodynamics to Sinclair). Developed new and patentable method of hydrodynamic analog modeling, instigated and furthered throughout the company the gathering of geologic data for hydrodynamic studies and advanced the use of hydrodynamics in exploration. Through these efforts, geologic research at Sinclair was instigated, stressing reservoir as well as basin studies.

Technical Paper:

*Classification of Reservoir Rocks by Surface Texture:* Am. Assoc. Petroleum Geologists Bulletin 1966, V.50, p. 547-559.

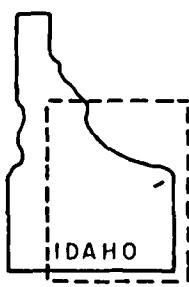
*Diagenesis and Porosity Development in Recent and Pleistocene Oolites from Southern Florida and the Bahamas:* Journal Sedimentary Petrology, 1967, V.37, p. 355-364.

Professional Affiliations:

American Association of Petroleum Geologists  
Society of Exploration Geophysicists  
Tulsa Geological Society  
Certified Petroleum Geologist



ISLAND PARK CALDERA



DUBOIS , IDAHO

AIR MAGNETIC PROFILES

SCALE: 1: 2,500,000

FIGURE 1 SENTURION SCIENCES , INC.

~~CONFIDENTIAL~~