

GLOO949

Cover Letter

To: Ms. Elizabeth Bowhan
U. S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Dear Ms. Bowhan:

Transmitted herewith is the final report for Department of Energy Grant No. DE-FG07-86ID12622. Under the terms of this grant the University of Arizona provided state-of-the-art K-Ar age dating services, including sample preparation, analytical procedures, and computations, for forty geologic samples submitted by DOE geothermal researchers.

The final age dates were completed and submitted to DOE on June 30, 1989. The integration of age dates with geologic data and interpretation in terms of geologic significance has been reported separately by the individual DOE State Geothermal team or other DOE geothermal researchers. This report details the samples completed, and final age dates, and is submitted to complete grant reporting requirements.

Sincerely,

Paul E. Damon
Principal Investigator

encl.



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
BUILDING #77
GOULD-SIMPSON BUILDING
TEL. (602) 621-6024
FAX (602) 621-2672

*Rec
3/30/89*

March 27, 1989

Mr. Kenneth Taylor
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

Dear Mr. Taylor:

With reference to instrument no. DE-FG07-861D12622, we are waiting to receive four samples from George R. Priest for completion of the above instrument. We have dated 36 samples and reported 30 of the 40 total samples under the contract. We will report the six already dated following a calibration check next week and the four from George Priest will be expedited upon receipt.

Please take the necessary steps to make modification M003 to instrument No-FG07-861D12622.

Sincerely,

Paul E. Damon

bbm

xc: Ronald King
Howard Ross
Muhammad Shafiqullah

Grant Amt \$29,999.-

15 error range quoted - Jan 28, '88

DAMON SAMPLE STATUS - 40 Samples

	1	2 ORGANIZ.	3	4 SPLS	5 OF -	6 #	7 DATE PROMISED	8 COULD HAVE	9 Completed	10 # left
	1	DLN/BS	JESL/JURI	Ascension		6-8	3-5-86		6	34
	2	Geo. Priest	DOGAMI	Cascades		6	3-7-86		2	
	3	Marshall Reed		Cerrito Prieto Mexico		3-4			2	
	4	Marshall Reed - Joe Morse		Los Azufres Mexico		6	cont. Dec. '89			
	5	Washington	DNR							
	6	Oregon	DOGAMI	Nov. 2A. 0.65 0.47		4			4	
	7									
	8									
	9									
	10									
		ORGANIZATION	SAMPLES OF	#			DATING IN OUT	Inv.	Σ Compl.	Σ left
\$ 1500.	11	Marshall Reed	JNM	Cerrito Prieto, MX	2	✓	3/26/87	00.999	2	38
\$ 1500.	12	George Priest	DOGAMI	Cascades	2	✓	9/16/87	47611	4	34
\$ 4500.	13	Denis Nielson	JURI	Ascension	6	✓	1/27/87 9/16/87	47607	10	30
\$ 4250.	14	Marshall Reed	JNM	Los Azufres, MX	5 @ 750 1 @ 500	✓	12/30/87 4/4/88	46777	16	24
\$ 3000.	15	George Priest	DOGAMI	Cascades	4	✓	11/24/87 2/4/88		20	20
	16									
\$ 750.	17	Dennis Nielson	JURI	Ascension	1	✓	3/25/88 5/4/88		2	19
\$ 15,500.	18	George Priest	DOGAMI	Cascades	5	(+ inc.) correct	4/19/88		26	14
3,750	19									
19,250										
	20	George Priest	DOGAMI	Cascades	(4)					
3,000		Michael Korosec	WA-DNR		(10) 4		Errors 12/29/88	repeated 4/17/89	ck to pay 02/14/90	30
4,500		Michael Korosec	WA-DNR	Synth prod, 1 n.c.	5 complete		4/17/89	ck to pay 07/06/89	ck to pay 02/14/90	36
\$ 26,750		George Priest	DOGAMI	Cascades	(4)		4/28/89	Signed 6/1/89		40
(3000)							6/30/89			0
\$ 29,750										
	25				19,250					
	26				14 @ 750 = 10,500					
	27				29,750					
	27	Korosec (WID)			4 +					
	28	JURI + MR			2 + 6 + 6 - 1 = 15					
	29	Priest Completed			2 + 4 + 5 = 11 (+ 4) = 15					
	30	George Want			2-3 summer mapping 4-5 Serrano Pass.					
	31									

grant completed 6/30/89

U.S. DEPARTMENT OF ENERGY
OFFICE OF FINANCIAL ASSISTANCE AWA
(See Instructions on Reverse)

93-410

Under the authority of Public Law _____ and
 subject to legislation, regulations and policies applicable to *(cite legislative program title):*
Geothermal R&D Act of 1977

1. PROJECT TITLE K-Ar Age Dating of Young Volcanic Rocks	2. INSTRUMENT TYPE <input checked="" type="checkbox"/> GRANT <input type="checkbox"/> COOPERATIVE AGREEMENT
3. RECIPIENT (Name, address, zip code, area code and telephone no.) University of Arizona Department of Geoscience Tucson, Arizona 85721	4. INSTRUMENT NO. DE-FG07-86ID12622
8. RECIPIENT PROJECT DIRECTOR (Name and telephone No.) Dr. Paul E. Damon (602) 621-6024	5. AMENDMENT NO. --
9. RECIPIENT BUSINESS OFFICER (Name and telephone No.) Dr. Paul E. Damon (602) 621-6024	6. BUDGET PERIOD FROM: 2/1/86 THRU: 1/31/87
11. DOE PROJECT OFFICER (Name, address, zip code, telephone No.) Peggy A. M. Brookshier (208) 526-1403 U.S. DOE, Idaho Operations Office 785 DOE Place, Idaho Falls, ID 83402	7. PROJECT PERIOD FROM: 2/1/86 THRU: 1/31/87
12. ADMINISTERED FOR DOE BY (Name, address, zip code, telephone No.) Ronald A. King (208) 526-0790 U.S. Department of Energy Idaho Operations Office 785 DOE Place Idaho Falls, ID 83402	10. TYPE OF AWARD <input checked="" type="checkbox"/> NEW <input type="checkbox"/> CONTINUATION <input type="checkbox"/> RENEWAL <input type="checkbox"/> REVISION <input type="checkbox"/> SUPPLEMENT

Corrected #
 not for use

13. RECIPIENT TYPE

<input type="checkbox"/> STATE GOV'T	<input type="checkbox"/> INDIAN TRIBAL GOV'T	<input type="checkbox"/> HOSPITAL	<input type="checkbox"/> FOR PROFIT ORGANIZATION	<input type="checkbox"/> INDIVIDUAL
<input type="checkbox"/> LOCAL GOV'T	<input checked="" type="checkbox"/> INSTITUTION OF HIGHER EDUCATION	<input type="checkbox"/> OTHER NONPROFIT ORGANIZATION	<input type="checkbox"/> C <input type="checkbox"/> P <input type="checkbox"/> SP	<input type="checkbox"/> OTHER (Specify)

14. ACCOUNTING AND APPROPRIATIONS DATA				15. EMPLOYER I.D. NUMBER/SSN
a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number	
89 x 0224.91	AM 1015100	ID-64-91/410		

16. BUDGET AND FUNDING INFORMATION	
a. CURRENT BUDGET PERIOD INFORMATION (1) DOE Funds Obligated This Action \$ 29,999 (2) DOE Funds Authorized for Carry Over \$ -0- (3) DOE Funds Previously Obligated in this Budget Period \$ -0- (4) DOE Share of Total Approved Budget \$ 29,999 (5) Recipient Share of Total Approved Budget \$ -0- (6) Total Approved Budget \$ 29,999	b. CUMULATIVE DOE OBLIGATIONS (1) This Budget Period {Total of lines a. (1) and a. (3)} \$ 29,999 (2) Prior Budget Periods \$ -0- (3) Project Period to Date {Total of lines b. (1) and b. (2)} \$ 29,999

17. TOTAL ESTIMATED COST OF PROJECT \$ 29,999

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)



b. Applicable program regulations (specify) _____ (Date) _____

c. DOE Assistance Regulations, 10 CFR Part-600, as amended, Subparts A and B (Grants) or C (Cooperative Agreements).

d. Application/proposal dated 3/13/85 as submitted with changes as negotiated

19. REMARKS

This Grant consists of this NFAA, Part I - Budget Plan, Part II - Conditions, Part III - Statement of Work. The DOE Financial Assistance Rules (10 CFR Part 600) and OMB Circulars A-21 and A-110 are incorporated by reference and attached hereto.

20. EVIDENCE OF RECIPIENT ACCEPTANCE  (Signature of Authorized Recipient-Official) (Date)	21. AWARDED BY  (Signature) (Date)
Paul E. Damon Chief Scientist (Name) Laboratory of Isotope (Title) Geochemistry	William C. Drake Contracting Officer (Name) (Title)

BUDGET PLAN

SALARIES

Principal Investigator Paul E. Damon	\$ 3,982
Co-Principal Investigator Muhammad Shafiquallah	6,750
Other Professionals	9,450
Graduate Students 420 hrs. @ \$5.00/hr	2,100
Undergraduate Students 397.5 hrs @ \$4.00/hr	1,590
Clerical 120 hrs @ \$6.25/hr	750
Electrical Technician 60 hrs @ \$	495

TOTAL Salaries

\$25,117

FRINGE BENEFITS

2,355

OTHER DIRECT COSTS

Materials and Supplies	2,325
Communications	202

TOTAL Other Direct

2,527

TOTAL DIRECT

\$29,999

INDIRECT COSTS

-0-

TOTAL PROJECT COSTS

\$29,999

Special Terms and Conditions for Research Grants

The requirements of this attachment take precedence over all other requirements of this grant found in regulations, the general terms and conditions, DOE orders, etc. except requirements of statutory law. Any apparent contradiction of statutory law stated herein should be presumed to be in error until the Grantee has sought and received clarification from the Contracting Officer, whose signature appears on the face page of this award.

1. Payments

- a. The Grantee may request advance payment of cost to be incurred. Such requests should not exceed the expected outlays by the Grantee in the succeeding 30-day period.
- b. Payments to the Grantee shall equal the Federal share of actual allowable costs of performance of this grant, provided however, and notwithstanding any other provision of this grant, that the Government's monetary liability under this grant shall not exceed the Government share of the total approved budget or an amount equal to the Federal share of actual allowable costs, whichever is less. The Grantee shall be obligated to perform under this grant throughout the agreed-upon period of performance, and to bear all costs which DOE has not agreed to pay. However, the Grantee shall have the right to cease to perform when or after the Federal share of actual allowable costs equals or exceeds the Government share of the total approved budget and if prior written notice to that has been provided to DOE.
- c. The Government obligations may be increased unilaterally by DOE by written notice to the Grantee and may be increased or decreased by written agreement of the parties.
- d. Upon termination or expiration of the total period of performance, the Grantee shall promptly refund to DOE (or make such disposition as DOE may in writing direct) any sums paid by DOE to the Grantee under this grant in excess of the cumulative Government allowable cost incurred in performance under the grant.
- e. Applicable Credits. The Grantee agrees that any refunds, rebates, credits, or other amounts (including any interest thereon) accruing to or received by the Grantee or any assignee under this grant shall be paid by the Grantee to the Government, to the extent that they are properly allocable to costs for which the Grantee has been reimbursed by the Government under this grant. Reasonable expenses incurred by the Grantee for the purpose of securing such refund, rebates, credits, or other amounts shall be allowable costs hereunder when approved by the Contracting Officer.

- f. Audit Adjustments. The Contracting Officer may have invoices or vouchers and statements of cost submitted under this grant audited at any time prior to the end of the required retention period for the grant records. Each payment made shall be subject to reduction for amounts included in the related invoice or voucher which are found by the Contracting Officer, on the basis of audit, not to constitute allowable cost. If a final audit of costs has not been performed prior to closeout of the grant, DOE or its successor agency, shall have the right to recover an appropriate amount after fully considering the recommendations on disallowed costs resulting from the final audit when conducted.
- g. Cognizant Office. Invoices should be sent to the individual designated in Block 12. of the Notice of Financial Assistance Award Form. In addition to the initial supply of forms made available with this award, appropriate payment forms and instructions will be provided by that office upon request.

2. Reporting Program Technical Performance

- a. Copies. Copies of reports and all other related data and information generated under this grant shall be submitted in accordance with the attached Federal Assistance Reporting Checklist (DOE Form EIA-459A).
- b. Publication of Results. The Grantee may publish the results of its work. However, publications and reports prepared under this grant shall contain the following acknowledgment statement, "This (material) was prepared with the support of the U.S. Department of Energy (DOE) Grant No. DE-FG07-86ID12622. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of DOE."
- c. Reporting Requirements. The Federal assistance recipient shall prepare and submit (postage prepaid) the plans and reports indicated on the Federal Assistance Reporting Distribution List. Preparation of the specified plans and reports shall be in accordance with the DOE Order 1332.2. The level of detail the recipient provides in the plans and reports shall be commensurate with the scope and complexity of the task and shall be as delineated in Block 4 - Reporting Requirements - and Block 5 - Special Instructions.

All reports delivered to DOE shall be the sole property of the DOE. The Grantee shall not claim that any report contains any trade secrets or commercial or financial information deemed by the Grantee to be privileged or confidential, or that the Grantee has any proprietary interest in any report.

3. Designated Key Personnel

The following individuals are designated key personnel in accordance with General Condition No. 14:

Dr. Paul E. Damon - Principal Investigator

4. Project Completion Date

The project completion date identified in Block 7. of the Notice of Financial Assistance Award includes and additional 90 days for completion of the final report. All R&D effort must be completed 90 days prior to the project completion date. Only costs associated with preparation of the final report will be allowed during the 90 days prior to the project completion date.

5. Technical Data

Except for technical data contained in pages N/A of the recipient's application, dated N/A, which are asserted by the Grantee as being proprietary data, it is agreed that as a condition of this award, and notwithstanding the provisions of any notice appearing on the application, the Government shall have the right to use, duplicate, disclose and have others do so for any purpose whatsoever the technical data not identified in the above blanks contained in the application upon which this award is based.

6. Prior Approval

The following actions or costs specified in the application require prior approval of DOE and are specifically disapproved in accordance with General Condition No. 3:

(To be determined by Contract Specialist)

7. Patent Clauses

The following patent clauses are applicable to this grant award:

Patent Rights (Small Business Firm or Nonprofit Organization) (see 10 CFR Part 600.118(b)(1) attached).

Rights in Technical Data (Short Form) (see 10 CFR Part 600.118(b)(3) attached).

Notice and Assistance Regarding Patent and Copyright Infringement (see 10 CFR Part 600.118(b)(6) attached).

Reporting of Royalties (see 10 CFR Part 600.118(c) attached).

8. Title to Equipment

- a. Title to the following items of equipment shall vest with the Grantee upon completion of this grant:

None.

- b. Title to the following items of equipment shall vest with the Government at the end of the grant project period:

None.

General Terms and Conditions for Research Grants

Table of Contents

<u>Number</u>	<u>Subject</u>	<u>Page</u>
1	Explanation.....	1
2	Grantee Adherence to Grant Terms and Conditions.....	1
3	Definitions.....	1
	- Principal Investigator.....	1
	- Prior Approval.....	1
4	Authorized Grantee Signature for Prior Approval Requests.....	2
5	Allowable Costs/Applicable Cost Principles.....	2
6	Payment.....	3
7	Preward Costs.....	3
8	Reporting Requirements.....	4
9	Cost-Sharing.....	4
10	Continuations, Renewals, and Extensions.....	5
11	Maximum DOE Obligation.....	5
12	Transfers of Funds Between Grants.....	5
13	Property.....	5
	- Real and Tangible Personal Property.....	5
	- Intangible Property.....	6
14	Change or Absence of Principal Investigator or Designated Key Personnel.....	6
15	Changes in Objectives or Scope.....	6
16	Transfer of Substantive Programmatic Effort.....	7
17	General Procurement Prior Approval.....	7
18	Equipment and Other Capital Expenditures.....	7
19	Travel.....	7
	- Foreign.....	7
	- Domestic.....	7
20	Consultant Services.....	7
21	Paperwork Reduction.....	8
22	Generally Applicable Requirements.....	8
	- Animal Welfare.....	8
	- Research Involving Recombinant DNA Molecules.....	8
	- Use of Human Subjects.....	9
23	Nondiscrimination.....	9
24	Public Access to Information.....	9
25	Acknowledgement of Support.....	9
26	National Security.....	9
27	Liabilities and Losses.....	10

General Terms and Conditions for Research Grants

1. Explanation

These general terms and conditions do not restate all the provisions of applicable statutes and regulations nor do they represent an exhaustive listing of all requirements applicable to this grant. Rather they highlight and are consistent with those requirements which are especially pertinent to research grants in general. They are being emphasized by inclusion here either because they are invoked with high frequency, their violation is a matter of especially serious concern (e.g., use of human subjects), and/or they have been restated in the research context to be more easily understood by the research community.

In addition to these general terms and conditions, the grantee must comply with all governing requirements, including those identified in Block 18 of the Notice of Financial Assistance Award and those included in the Special Terms and Conditions attached to this grant award.

2. Grantee Adherence to Grant Terms and Conditions

The grantee's signature on the application and on the Notice of Financial Assistance Award signifies the grantee's agreement to the terms and conditions of award. Should the grantee believe modification of any of the terms and conditions of this award is necessary, an authorized official of the grantee organization or, in the case of an individual, the grantee, must submit a written request on its own behalf or on behalf of any subgrant recipient or applicant to the Contracting Officer named on the face page of this award.

Following this procedure is very important because many of the terms and conditions of this grant are required by statute and must be enforced by the Department of Energy.

3. Definitions

Principal Investigator

As used herein, the scientist or other programmatic expert named in Block 8 of the Notice of Financial Assistance Award designated by the grantee organization to direct the scientific/technical efforts being supported (also called program director or project director/leader).

Prior Approval

A statement in writing, signed by the DOE Contracting Officer, that a cost may be incurred or an action may be taken. The approval may take the form of a letter or of a revision to the grant. If actions or costs requiring prior approval are specified in the application and are not expressly disapproved by DOE in the attached Special Terms and Conditions, the award of the grant constitutes such prior approval.

4. Authorized Grantee Signatures for Prior Approval Requests

All requests for prior approval must be signed by an individual who is authorized to act for the grantee organization. The signature of the Principal Investigator (unless also a corporate officer or otherwise authorized) is insufficient to obtain action on a prior approval request, although countersignature by the Principal Investigator is not discouraged. Requests for budget revisions shall be made on the same budget format as used in applying for this grant and must be supported by a narrative justification. Other prior approval requests may be made by letter. Prior approval requests should be addressed to the Contracting Officer named on the face page of this award.

5. Allowable Costs/Applicable Cost Principles

In accordance with the applicable cost principles cited below and up to the amount shown on the face page of this award for the total approved budget for the current budget period (line 16.a.(6)), the allowable costs of this grant shall consist of the actual allowable direct costs incident to performance of this project plus the allocable portion of the allowable indirect costs, if any, of the organization less applicable credits.

The allowability of costs for work performed under this grant and any subsequent subaward will be determined in accordance with the Federal cost principles applicable to the grantee or subrecipient in effect on the date of award or, for any subaward, in effect as of the date of that subaward, except as modified by other provisions of this grant or the subaward.

The Federal cost principles applicable to specific types of grantees and subrecipients are:

1. Institutions of Higher Education. OMB Circular A-21, Cost Principles Applicable to Grants, Contracts and Other Agreements with Institutions of Higher Education, is applicable to both public and private colleges and universities.
2. State and local governments and Indian tribal governments. OMB Circular A-87, Cost Principles Applicable to Grants, Contracts and other Agreements With State and Local Governments, is applicable to state, local, and Indian tribal governments (and shall also be used to the extent appropriate for foreign governments).
3. Hospitals. 45 CFR Part 74, Appendix E, Principles for Determining Costs Applicable to Research and Development under Grants and Contracts with Hospitals, applies to nonprofit and for-profit hospitals.

4. Other nonprofit organizations and individuals. OMB Circular A-122, Cost Principles Applicable to Grants, Contracts, and other Agreements with Nonprofit Organizations, applies to nonprofit organizations and individuals except for nonprofits specifically exempted by the terms of the circular or those nonprofits covered by the cost principles cited in items 1.-3. above.
5. Commercial firms and certain nonprofit organizations. 48 CFR Subpart 31.2, Contracts with Commercial Organizations, as supplemented by 48 CFR Subpart 931.2, applies to those nonprofit organizations not covered by OMB Circular A-122, as specified by the terms of that circular, and to all commercial organizations other than those covered by the cost principles in item 3. above.

6. Payment

Payments under this award will be made by an advance payment method unless DOE determines that the grantee's financial management system does not meet the requirements of 10 CFR 600.109 or the grantee has not maintained, or demonstrated the willingness and ability to maintain, procedures that will minimize the time elapsing between transfer of funds from the U.S. Treasury and their disbursement for grant-related purposes.

The appropriate advance payment method or the reimbursement method and the cognizant finance office are specified in the attached Special Terms and Conditions.

Advances by the grantee to subgrantee and contractor organizations must conform substantially to the same standards of timing and amount that govern advances made by the Federal Government to the grantee. Excess cash advances erroneously withdrawn from the U.S. Treasury shall be promptly refunded to DOE unless the funds will be disbursed within seven calendar days or the amount is less than \$10,000 and will be disbursed within 30 calendar days.

Interest earned on advance payments to other than state governments or their subgrantees shall be reported on the Report of Federal Cash Transactions (SF-272) and promptly remitted to the cognizant finance office (unless otherwise specified in the attached Special Terms and Conditions) by check payable to the Department of Energy.

7. Preaward Costs

Costs incurred prior to the beginning date of a new or renewal award are allowable only if they were approved in writing, prior to incurrence, by a DOE Contracting Officer. (Note - this provision does not apply to such bid and proposal costs as may be recovered through an indirect cost rate negotiated in accordance with the applicable Federal cost principles.)

8. Reporting Requirements

Attached to this grant award is EIA 459A, a checklist of the reports required under this grant.

The grantee shall submit a technical progress report (also called a performance report) as part of any application for continuation or renewal of DOE grant support. This report shall be in lieu of a separate annual performance report. Upon completion or termination of the project, the final technical report shall be prepared in accordance with the applicable program rule cited on the face page of this award or, in the absence of such program rule coverage, with the technical reporting format specified in the Uniform Reporting System for Federal Assistance (Grants and Cooperative Agreements) (DOE/MA-001).

The grantee shall submit an annual Financial Status Report (SF-269) within 90 days after the close of the budget period shown on the face page of this award. The grantee shall submit a final Financial Status Report within 90 days after the completion or termination of the project period shown on the face page of this award unless the project period is extended. In the latter case, the report for the last budget period of the existing project period shall be considered an annual report.

Instructions concerning reports to be submitted in conjunction with payment under this award are specified in the attached Special Terms and Conditions.

9. Cost-Sharing

Any cost-sharing as shown on the face page of this award shall defray allowable costs of the project only. Allowability of such costs shall be determined in accordance with the statutes, regulations, applicable cost principles, and other terms and conditions governing this award.

Cost-sharing contributions may be in the form of direct or indirect costs, including cash or in-kind contributions, incurred by the grantee, its subgrantees, or contractors. The cost sharing may be in any allowable budget category or combination of categories. When a direct cost item represents some or all of the non-Federal contribution, any associated indirect costs may not be charged to Federal funds but may be counted as part of the cost-sharing. The treatment of a contributed cost as direct or indirect must be consistent with the classification of similar items charged to DOE funds.

Valuation of in-kind contributions and documentation of cost-sharing shall be in accordance with 10 CFR 600.107.

10. Continuations, Renewals, and Extensions

Grantees are responsible for assuring that properly completed applications for continuation awards are received no later than 4 months prior to the expiration date of the current budget period shown on the Notice of Financial Assistance Award.

If a grantee wishes to apply for a renewal award in order to receive funding beyond the scheduled expiration of the existing project period, a properly completed application must be submitted to DOE no later than four months prior to the scheduled expiration date of the project period as shown on the Notice of Financial Assistance Award.

Grantee requests for extensions (modifications extending an existing project period by 18 months or less in order to complete a project) must be submitted prior to the expiration date of the project period as shown on the face page of this award, and must include a budget for the use of any remaining funds or any additional funds requested. Any request for an extension, which includes a request for additional funds and any request for an extension of more than 90 days, should be submitted to DOE no later than four months prior to the scheduled expiration date of the project period.

11. Maximum DOE Obligation

This grant is subject to the requirement that the maximum DOE obligation to the recipient is the amount shown on the Notice of Financial Assistance Award as the amount of DOE funds obligated. DOE shall not be obligated to make any additional, supplemental, continuation, renewal or other award for the same or any other purpose.

12. Transfers of Funds Between Grants

Transfers of funds between DOE grants, and transfers of funds from a DOE grant to a project (or portion of a project) not supported by that grant require the prior approval of DOE. Transfer of funds into a DOE grant-supported project from a grant awarded by another Federal agency does not require DOE prior approval but may, of course, require the approval of the other Federal agency. Funds so transferred from the grant of another Federal agency may not be used to satisfy any cost-sharing requirement on a DOE grant.

13. Property

Real and Tangible Personal Property

No real property may be acquired under this award.

Title to any equipment (an article of tangible personal property that has a useful life of more than 2 years and an acquisition cost of \$500 or more) or supplies acquired by a nonprofit institution of higher education or a nonprofit organization whose primary purpose is the conduct of scientific research shall vest in the grantee and such

equipment shall be exempt from accountability except that DOE has the right to transfer ownership of any item of equipment having a unit acquisition cost of \$1,000 or more under the conditions specified in 10 CFR 600.117(d)(2). This exemption is derived from Public Law 95-224. The Federal Grant and Cooperative Agreement Act of 1977, as amended.

Title to equipment and supplies acquired by all other grantees shall vest in the grantee. However, such grantees shall be accountable for equipment with a unit acquisition cost of \$1,000 or more acquired under this grant as specified in 10 CFR 600.117(d)(2), (3) and (4). For such grantees, supplies need only be accounted for at closeout and then only if they are unused and exceed \$1,000 in total aggregate current fair market value. In this case accountability requires that DOE be compensated in an amount computed in accordance with Section 600.117(e) if the supplies are retained for use on non-Federal activities.

All grantees shall follow property management policies and procedures which provide for adequate control of the acquisition and use of assets acquired under the grant.

Intangible Property

Treatment, including reporting, of patent and data rights and copyrights shall be as specified in the Special Terms and Conditions of this grant.

14. Change or Absence of the Principal Investigator or Designated Key Personnel

Since the DOE decision to fund a project is based, to a significant extent, on the qualifications and level of participation of the Principal Investigator, a change of Principal Investigator or of the level of effort of the Principal Investigator is considered a change in the approved project. The approval of DOE must be obtained prior to any change of the Principal Investigator or, in certain cases, other key personnel who have been identified as key personnel in the Special Terms and Conditions of this grant. In addition, any continuous absence of the Principal Investigator in excess of three months or plans for the Principal Investigator to become substantially less involved in the project than was indicated in the approved grant application requires DOE prior approval. Grantee is encouraged to contact DOE immediately upon becoming aware that any of these changes are likely to be proposed, but in any event must do so and receive DOE prior approval before effecting any such change.

15. Changes in Objectives or Scope

Any change in the objectives or scope of a grant-supported project requires the prior approval of DOE. Such changes include changes in the phenomenon or phenomena under study and in the methodology or experiment if they are a specific objective of the research work as stated in the application approved by DOE.

16. Transfer of Substantive Programmatic Effort

None of the substantive effort of this project may be transferred by contract or subgrant to another organization or person without the prior approval of DOE. This provision does not apply to the procurement of equipment, supplies, materials, or general support services which may, however, be subject to other prior approval requirements as found, for example, in the applicable cost principles or procurement standards.

17. General Procurement Prior Approval Requirements

A grantee must receive prior approval from DOE before entering into any sole source contract or a contract where only one bid or proposal is received when the value of the contract in the aggregate is expected to exceed 1) \$10,000 and the grantee is a state, local, or indian tribal government or 2) \$5,000 for all other grantees.

18. Equipment and Other Capital Expenditures

Expenditures for equipment and other capital assets having a unit acquisition cost of \$500 or more require the prior approval of DOE with one exception. For special purpose equipment, prior approval is required only when the unit acquisition cost is \$1,000 or more. (Special purpose equipment means equipment which is used only for research, medical, scientific, or other technical activities.)

19. Travel

Foreign Travel - DOE prior approval is required for each separate foreign trip. Foreign travel must be directly related to the project objectives. Foreign travel is any travel outside Canada and the United States and its territories and possessions or, for grantees located in another country, travel outside that country.

Domestic Travel - Such costs are allowable to the extent provided in the approved budget. In addition, grantees may exceed the approved budget amount for domestic travel by up to 25% or \$500 whichever is greater, without DOE prior approval. All other expenditures for domestic travel beyond these limits require prior approval.

20. Consultant Services

Costs of consultant services are allowable subject to satisfaction of the requirements of the applicable cost principles, including the requirement that the consultant not be an employee of the grantee organization. There is one exception to the requirement that the consultant not be an employee of the grantee organization which applies to colleges and universities only. For colleges and universities, in unusual cases, and only with the prior approval of DOE, intra-organizational consultation may be permitted where consultation is across departmental lines or involves a separate or remote operation.

21. Paperwork Reduction

This award is subject to the requirements of the Paperwork Reduction Act of 1980 as implemented by the Office of Management and Budget rules, "Controlling Paperwork Burdens on the Public," published at 5 CFR 1320 (48 FR 13666, 3/31/83) if the grantee will collect information from ten or more respondents either:

- A. At the specific request of DOE, or
- B. If the award requires specific DOE approval of the information collection or the collection procedures.

Any proposed sponsored information collection under item 21 B. above shall be submitted by the grantee to the Contracting Officer named on the face page of this award at least 90 days prior to the intended date of information collection. DOE will seek the requisite approval from the Office of Management and Budget and will promptly notify the grantee of the disposition of the request.

22. Generally Applicable Requirements

In accordance with 10 CFR 600.12, this grant is subject to a number of statutory and other generally applicable requirements. Those requirements most pertinent to research projects are highlighted below:

Animal Welfare

Any grantee performing research on warm-blooded animals shall comply with the Laboratory Animal Welfare Act of 1966 (Public Law 89-544, as amended) and the regulations promulgated thereunder by the Secretary of Agriculture at 9 CFR Chapter 1, Subchapter A, pertaining to the care, handling, and treatment of warm-blooded animals held or used for research, teaching, or other activities supported by Federal awards. The grantee is expected to ensure that the guidelines described in Department of Health and Human Services (DHHS) Publication No. [NIH] 78-23, "Guide for the Care and Use of Laboratory Animals," are followed (Copies are available from the Superintendent of Documents, Government Printing Office, Washington, DC 20024, Stock No. 017-040-00427-3).

Research Involving Recombinant DNA Molecules

Any grantee performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules agrees by acceptance of this grant to comply with the National Institutes of Health "Guidelines for Research Involving Recombinant DNA Molecules," June 1983 (48 FR 24556) or such later revision of those guidelines as may be published in the Federal Register.

Use of Human Subjects in Research, Development, and Related Activities

Any DOE grantee performing research, development, or related activities involving any use of human subjects must comply with DOE regulations found at 10 CFR Part 74S "Protection of Human Subjects" and any additional Provisions which may be included in the Special Terms and Conditions of this grant. Such provisions are intended to safeguard the rights and welfare of human subjects at risk of possible physical, psychological, or social injury as a consequence of their participation.

23. Nondiscrimination

This grant is subject to the provisions of 10 CFR Part 1040 "Nondiscrimination in Federally Assisted Programs."

24. Public Access to Information

The Freedom of Information Act, as amended, and the DOE implementing regulations (10 CFR Part 1004) require the release by DOE of certain documents and records regarding grants upon written request by any member of the public. The intended use of the information will not be a criterion for release. These requirements apply to information held by DOE, and do not require grantees, their subgrantees, or their contractors to permit public access to their records.

Records maintained by DOE with respect to grants are subject to the provisions of the Privacy Act and the DOE implementing regulations (10 CFR Part 1008) if those records constitute a "system of records" as defined in the Act and the regulations. Generally, records maintained by grantees, their subgrantees, or their contractors are not subject to these requirements.

25. Acknowledgement of Support

Publication of the results of this grant, subject to any applicable restrictions in 10 CFR 600.118 ("Patents, data, and copyrights"), is encouraged. Any article which is published shall include an acknowledgement that the research was supported, in whole or in part, by a DOE grant (including the grant number), but that such support does not constitute an endorsement by DOE of the views expressed in the article.

26. National Security

It is not expected that activities under this grant will generate or otherwise involve classified information (i.e., Restricted Data, Formerly Restricted Data, National Security Information).

However, if in the opinion of the grantee or DOE such involvement becomes expected prior to the closeout of the grant, the grantee or DOE shall notify the other in writing immediately. If the grantee believes any information developed or acquired may be classifiable, the grantee

shall not provide the potentially classifiable information to anyone, including the DOE officials with whom the grantee normally communicates, except the Director of Classification, and shall protect such information as if it were classified until notified by DOE that a determination has been made that it does not require such handling. Correspondence which includes the specific information in question shall be sent by registered mail to U.S. Department of Energy, Attn: Director of Classification, DP-32, Washington, DC 20545. If the information is determined to be classified the grantee may wish to discontinue the project, in which case the grantee and DOE shall terminate the grant by mutual agreement. If the grant is to be terminated, all material deemed by DOE to be classified shall be forwarded to DOE, in a manner specified by DOE, for proper disposition. If the grantee and DOE wish to continue the grant, even though classified information is involved, the grantee shall be required to obtain both personnel and facility security clearances through the Office of Safeguards and Security. Costs associated with handling and protecting any such classified information shall be negotiated at the time the determination to proceed is made.

27. Liabilities and Losses

DOE assumes no liability with respect to any damages or loss arising out of any activities undertaken with the financial support of this grant.

STATEMENT OF WORK
UNIVERSITY OF ARIZONA

1. Using state-of-the-art sample preparation and analytic procedures, make forty K-Ar age dating analyses for geologic samples from young geologic terrains. The samples will be collected and submitted by researchers funded under other DOE geothermal programs. When different phases of one sample, such as coexisting mica and feldspar, are dated, they will be considered as separate analyses. For each date reported, include three analyses for separate aliquots for potassium and analyses on three aliquots of argon from one fusion.
2. Deliverables will include providing DOE and DOE-funded researchers with letters containing analytic results from each sample dated. If results are required urgently, they will be phoned to the appropriate researcher. Provide a final report, which will include results of all samples dated and other pertinent data, such as geologic unit dated, sample location, and researcher to whom analytic results were delivered.
3. Provide overall project management and complete report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE form EIA 459A, Reporting Requirements Checklist. The original final report for this grant will be due on the original due date.

**U.S. DEPARTMENT OF ENERGY
FEDERAL ASSISTANCE REPORTING CHECKLIST**

FORM EIA-459A
(10/80)

FORM APPROVED
OMB NO. 1900-0127

1. Identification Number: DE-FG07-86ID12622	2. Program/Project Title: Geothermal Research																																				
3. Recipient: University of Arizona																																					
4. Reporting Requirements:	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:30%;">Frequency</th> <th style="width:20%;">No. of Copies</th> <th style="width:50%;">Addressees</th> </tr> </thead> <tbody> <tr> <td colspan="3" style="padding: 5px;">PROGRAM/PROJECT MANAGEMENT REPORTING</td> </tr> <tr> <td style="text-align:center;"><input type="checkbox"/></td> <td style="padding: 5px;">Federal Assistance Milestone Plan</td> <td></td> </tr> <tr> <td style="text-align:center;"><input type="checkbox"/></td> <td style="padding: 5px;">Federal Assistance Budget Information Form</td> <td></td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Federal Assistance Management Summary Report</td> <td style="text-align:center;">Q 1,1,1 A,B,C</td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Federal Assistance Program/Project Status Report</td> <td style="text-align:center;">Q 1,1,1 A,B,C</td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Financial Status Report, OMB Form 269</td> <td style="text-align:center;">Y,F 1,1 A,C</td> </tr> <tr> <td colspan="3" style="padding: 5px;">TECHNICAL INFORMATION REPORTING</td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Notice of Energy RD&D</td> <td style="text-align:center;">Y 1,1 A,E</td> </tr> <tr> <td style="text-align:center;"><input type="checkbox"/></td> <td style="padding: 5px;">Technical Progress Report</td> <td></td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Topical Report</td> <td style="text-align:center;">A* 1,1,1 A,B,D</td> </tr> <tr> <td style="text-align:center;"><input checked="" type="checkbox"/></td> <td style="padding: 5px;">Final Technical Report</td> <td style="text-align:center;">F* 1,1,1 A,B,D</td> </tr> </tbody> </table>	Frequency	No. of Copies	Addressees	PROGRAM/PROJECT MANAGEMENT REPORTING			<input type="checkbox"/>	Federal Assistance Milestone Plan		<input type="checkbox"/>	Federal Assistance Budget Information Form		<input checked="" type="checkbox"/>	Federal Assistance Management Summary Report	Q 1,1,1 A,B,C	<input checked="" type="checkbox"/>	Federal Assistance Program/Project Status Report	Q 1,1,1 A,B,C	<input checked="" type="checkbox"/>	Financial Status Report, OMB Form 269	Y,F 1,1 A,C	TECHNICAL INFORMATION REPORTING			<input checked="" type="checkbox"/>	Notice of Energy RD&D	Y 1,1 A,E	<input type="checkbox"/>	Technical Progress Report		<input checked="" type="checkbox"/>	Topical Report	A* 1,1,1 A,B,D	<input checked="" type="checkbox"/>	Final Technical Report	F* 1,1,1 A,B,D
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FREQUENCY CODES AND DUE DATES: A - As Necessary; within 5 calendar days after events. F - Final; 90 calendar days after the performance of the effort ends. Q - Quarterly; within 30 days after end of calendar quarter or portion thereof. O - One time after project starts; within 30 days after award. X - Required with proposals or with the application or with significant planning changes. Y - Yearly; 30 days after the end of program year. (Financial Status Reports 90 days). S - Semiannually; within 30 days after end of program fiscal half year.																																					
5. Special Instructions: Topical Reports will include, letter reports containing analytic results from each sample dated. <div style="border: 1px dashed black; width: 200px; height: 100px; margin: 20px auto;"></div>																																					
6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date) <div style="text-align: right; font-family: cursive;"> Ronald A. King 12/31/85 </div>																																				

REPORT DISTRIBUTION LIST

DE-FG07-86ID12622

U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

- A ATTN: Peggy Brookshier, Program Manager
 Energy & Technology Division
- B ATTN: Ronald A. King
 Contracts Management Division
- C ATTN: E. G. Jones, Director
 Financial Management Division
- D University of Utah Research Institute
 Earth Science Laboratory
 391 Chipeta Way, Suite A
 Salt Lake City, UT 84108
 ATTN: Duncan Foley
- E U.S. Department of Energy
 Technical Information Center
 P. O. Box 62
 Oak Ridge, TN 37830

U.S. DEPARTMENT OF ENERGY
NOTICE OF FINANCIAL ASSISTANCE AWARD
(See Instructions on Reverse)

Rec 3/17/87

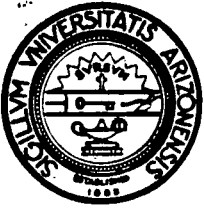
Under the authority of Public Law 93-410 and
subject to legislation, regulations and policies applicable to (cite legislative program title):

Geothermal R&D Act of 1977

1. PROJECT TITLE K-AR Age Dating of Young Volcanic Rocks			2. INSTRUMENT TYPE <input checked="" type="checkbox"/> GRANT <input type="checkbox"/> COOPERATIVE AGREEMENT	
3. RECIPIENT (Name, address, zip code, area code and telephone no.) University of Arizona Department of Geoscience Tucson, AZ 85721			4. INSTRUMENT NO. DE-FG07-86ID12622	
8. RECIPIENT PROJECT DIRECTOR (Name and telephone No.) Dr. Paul E. Damon (602) 621-6024			5. AMENDMENT NO. M001	
9. RECIPIENT BUSINESS OFFICER (Name and telephone No.) Dr. Paul E. Damon (602) 621-6024			6. BUDGET PERIOD FROM: 2/1/87 THRU: 1/31/88	
11. DOE PROJECT OFFICER (Name, address, zip code, telephone No.) Peggy A.M. Brookshier (208) 526-1403 U.S. DOE, Idaho Operations Office 785 DOE Place, Idaho Falls, ID 83402			7. PROJECT PERIOD FROM: 2/1/86 THRU: 3/31/88	
10. TYPE OF AWARD <input type="checkbox"/> NEW <input type="checkbox"/> CONTINUATION <input type="checkbox"/> RENEWAL <input checked="" type="checkbox"/> REVISION <input type="checkbox"/> SUPPLEMENT				
12. ADMINISTERED FOR DOE BY (Name, address, zip code, telephone No.) Ronald A. King (208) 526-0790 U.S. Department of Energy Idaho Operations Office 785 DOE Place Idaho Falls, ID 83402				
13. RECIPIENT TYPE <input type="checkbox"/> STATE GOV'T <input type="checkbox"/> INDIAN TRIBAL GOV'T <input type="checkbox"/> HOSPITAL <input type="checkbox"/> FOR PROFIT ORGANIZATION <input type="checkbox"/> INDIVIDUAL <input type="checkbox"/> LOCAL GOV'T <input checked="" type="checkbox"/> INSTITUTION OF HIGHER EDUCATION <input type="checkbox"/> OTHER NONPROFIT ORGANIZATION <input type="checkbox"/> C <input type="checkbox"/> P <input type="checkbox"/> SP <input type="checkbox"/> OTHER (Specify)				
14. ACCOUNTING AND APPROPRIATIONS DATA				15. EMPLOYER I.D. NUMBER/SSN
a. Appropriation Symbol		b. B & R Number	c. FT/AFP/OC	d. CFA Number
16. BUDGET AND FUNDING INFORMATION				
a. CURRENT BUDGET PERIOD INFORMATION			b. CUMULATIVE DOE OBLIGATIONS	
(1) DOE Funds Obligated This Action \$ -0-			(1) This Budget Period \$ -0-	
(2) DOE Funds Authorized for Carry Over \$ 29,999			[Total of lines a. (1) and a. (3)]	
(3) DOE Funds Previously Obligated in this Budget Period \$ -0-			(2) Prior Budget Periods \$ 29,999	
(4) DOE Share of Total Approved Budget \$ 29,999			(3) Project Period to Date \$ 29,999	
(5) Recipient Share of Total Approved Budget \$ -0-			[Total of lines b. (1) and b. (2)]	
(6) Total Approved Budget \$ 29,999				
17. TOTAL ESTIMATED COST OF PROJECT \$ 29,999 (This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)				
18. AWARD/AGREEMENT TERMS AND CONDITIONS This award/agreement consists of this form plus the following: a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement) b. Applicable program regulations (specify) _____ (Date) _____ c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and <input checked="" type="checkbox"/> B (Grants) or <input type="checkbox"/> C (Cooperative Agreements). d. Application/proposal dated <u>1/29/87</u> <input type="checkbox"/> as submitted <input checked="" type="checkbox"/> with changes as negotiated				
19. REMARKS This document extends the project budget periods to 1/31/88 due to excusable delay at no fault of the grantee 9				
20. EVIDENCE OF RECIPIENT ACCEPTANCE			21. AWARDED BY	
_____ (Signature of Authorized Recipient Official) (Date)			_____ (Signature) (Date)	
_____ (Name)			_____ (Name)	
_____ (Title)			_____ (Title)	

William C. Drake

Contracting Officer



THE UNIVERSITY OF ARIZONA

TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
LABORATORY OF ISOTOPE GEOCHEMISTRY
TEL. (602) 621-6014

November 14, 1985

Mr. Ronald A. King
Department of Energy
785 D.O.E. Place
Idaho Falls, Idaho 83402


Dear Mr. King:

Enclosed is the budget for our proposal entitled "K-Ar Dating of Volcanic Rocks." We have an agreement with the University of Arizona Comptroller's office to negotiate proposals involving primarily analytical work, without University overhead charges, providing individual payments are less than \$5,000 per billing with secretarial and accounting being done by this laboratory. Our accounts of course, are audited by accountants in both the Department of Geosciences and office of the Comptroller.

Checks should be made out to the University of Arizona (Department of Geosciences) and sent to Mr. David Bottomley at this laboratory.

I hope this is satisfactory. We are anxious to begin the work.

Sincerely,


Paul E. Damon
Professor and Chief
Scientist of the Laboratory
of Isotope Geochemistry

cc. A. Long
M. Shafiqullah

Duncan
ESL
3 Dec. '85

SEE INSTRUCTIONS ON REVERSE BEFORE COMPLETING

**SUMMARY
PROPOSAL BUDGET**

DOE	
PROPOSAL NO.	DURATION (MONTHS)
	Proposed Granted
AWARD NO.	

ORGANIZATION
University of Arizona, Tucson, Arizona 85721

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
Paul E. Damon

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	DOE			FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY (IF DIFFERENT)
	CAL.	ACAD	SUMR		
1. Dr. Paul E. Damon	1			\$ 5,310	\$
2. Dr. Muhammad Shafiqullah	3			9,000	
3.					
4.					
5. () OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. () TOTAL SENIOR PERSONNEL (1-5)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. () POST DOCTORAL ASSOCIATES					
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	7			12,600	
3. (1) GRADUATE STUDENTS 560 hrs. @ \$5.00 per hr				2,800	
4. (1) UNDERGRADUATE STUDENTS 530 hrs @ \$4.00 per hr				2,120	
5. (1) SECRETARIAL CLERICAL 160 hrs @ \$6.25 per hr				1,000	
6. (1) OTHER Electrical technician 80 hrs @ 8.25 per hr				660	
TOTAL SALARIES AND WAGES (A+B)				33,490	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) ~ 9.4%				3,140	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				36,630	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$1,000; ITEMS OVER \$10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS \$ _____					
2. TRAVEL _____					
3. SUBSISTENCE _____					
4. OTHER _____					
TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				3,100	
2. PUBLICATION COSTS/PAGE CHARGES					
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER Communications				270	
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (SPECIFY) none, providing expenditures do not exceed \$5,000 per month and paper work is handled by Laboratory of Isotope					
TOTAL INDIRECT COSTS Geochemistry					
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)					
\$ 40,000					

Still wrong amount
 Needs to be 30,000
 (Don't say 100,000)

PI/PD TYPED NAME & SIGNATURE*	DATE	INDIRECT COST RATE VERIFICATION		
Paul E. Damon		Date Checked	Date of Rate Sheet	Initials - DGC
INST REP TYPED NAME & SIGNATURE*	DATE	Program		
Chief Scientist/Laboratory of Isotope Geochem				

*SIGNATURES REQUIRED ONLY FOR REVISED

JUSTIFICATION FOR OTHER THAN FULL
AND OPEN COMPETITION

University of Arizona

K-AR Dating of Volcanic Rocks

I have reviewed the Justification for Other Than Full and Open Competition and DOE Order 4200 1B. This research proposal represents a unique and innovative concept that is not otherwise available to DOE and does not resemble the substance of a pending competitive procurement.

Project Manager


Peggy A. M. Brookshier

Contracting Officer


William C. Drake

U.S. Department of Energy
Procurement Request-Authorization

1. To Awarding Office <u>Contracts Management Div</u>		3. PR Number <u>07-861012622-000</u>
2. From Initiating Office <u>Advanced Technology Div</u>		4. Change/Correction to a PR in Process? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
8. Action Description/Title (180 char. max.) <u>Unsolicited Proposal For K-AP Dating of Volcanic Rocks</u>		5. If Item 4 is yes, enter PR correction Letter _____
		6. <input type="checkbox"/> Procurement <input checked="" type="checkbox"/> Assistance
		7. Consistent with Principal Purpose of Program? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

If award is competitive, has list of sources been attached? Yes No If Non-Competitive, Complete Items 9-11.

9. Name <u>University of Arizona</u>	11. Address <u>Tucson, AZ 85721</u>
10. Division <u>Dept. of Geosciences</u>	
12. For Procurement Actions Only: Product or Service Code _____	
13. For Assistance Actions Only: CFDA Number <u>81.087</u>	14. Cooperative Agreement <input type="checkbox"/>
15. Grant <input checked="" type="checkbox"/>	
16. Controlled Deliverable For All Actions _____	17. Kind of Award Action (Recommended) <u>IA</u>
18. Master Bin _____	19. Desired Award Date Mo Day Year
20. Unsolicited Proposal Number <u>U8507014</u>	21. Project Number _____
22. Government Property <input checked="" type="checkbox"/> F-Furnished, P-Purchased, N-Not involved	

FINANCIAL DATA						
23. Government Share <u>30,000</u>	24. Awardee Share _____	25. Total _____				
FY FUNDS COMMITTED						
26. Approp. Symbol	27. B&R Number	28. Dollar Amt.	29. Allotment	30. Object Class	31. AFP	32. CFA
<u>P9X0224-91</u>	<u>AM101500</u>	<u>10-64-91</u>	<u>10-64-91</u>	<u>410</u>		
From Continuation Sheet				35. Project Period from <u>10/31/85</u>	thru <u>10/31/86</u>	
34. Total Funds this PR <u>30,000</u>				36. Budget Period from <u>10/31/85</u>	thru <u>10/31/86</u>	

PROJECT MANAGER/INITIATOR			
37. Name <u>Peggy A.M. Brookshier</u>	38. Signature <u>Peggy A.M. Brookshier</u>	39. Date <u>10/8/85</u>	40. Office Code
			41. FTS Telephone Number <u>583-403</u>

PROGRAM REVIEWING OFFICIAL		
42. Name <u>Charles E.G. Ilmore</u>	43. Signature <u>Charles E.G. Ilmore</u>	44. Date <u>10-8-85</u>

PROGRAM OFFICE BUDGET OFFICIAL	
45. Name <u>Dennis R. Bell</u>	46. Signature <u>Dennis Bell</u>

CERTIFYING OFFICIAL. I hereby certify that the funds cited in item 34 are available

47. Name <u>Frank S. Smith</u>	48. Signature <u>Frank S. Smith</u>	49. Date <u>10/8</u>
-----------------------------------	--	-------------------------

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

Sept. 24, 1985

MEMORANDUM

TO: Peggy Brookshier
FROM: Duncan Foley
RE: University of Arizona

I have enclosed my evaluation of the proposed program to date young volcanic rocks by the University of Arizona. I have not received resumes for either Paul Damon or M. Shafiqullah, so my comments on their abilities are based on my conversations with a U.S. Geological Survey geochronologist. This geochronologist, who has worked in K-Ar dating for over a decade, felt that the prices were reasonable.

I have not enclosed the generic boilerplate; if you would like me to send it, I would be happy to do so. Please call if you have any questions.

TECHNICAL EVALUATION OF GRANT PROPOSAL

TITLE: K-Ar dating of volcanic rocks

SUBMITTED TO: DOE/ID (via HQ)

SUBMITTED BY: Dr. Paul Damon
Laboratory of Isotope Geochemistry
Department of Geosciences
University of Arizona
Tucson, AZ 85721
602-621-6014

AMOUNT REQUESTED: \$30,000

AMOUNT SUGGESTED: \$30,000

PROPOSED DURATION: one year

PROJECT DESCRIPTION: Provide support to ongoing DOE Division of Geothermal Technology efforts by doing 40 K-Ar dates of young volcanic rocks. The samples will be submitted by other DOE-funded researchers, who are working primarily in high-temperature geothermal systems. The Laboratory of Isotope Geochemistry will be responsible for performing the K-Ar analyses and reporting the data. The other researchers will be responsible for interpretation of the results and integration into their geothermal studies.

GENERAL REMARKS:

1. Work Statement: Adequate as rephrased from the "Proposed Research" section of the proposal.
2. Task Changes: None required.
3. Cost Information: A flat rate of \$750 will be charged for each sample.

SPECIFIC REMARKS

1. Manhours: Included in flat rate.
2. Materials: Included in flat rate.
3. Subcontracts: None.
4. Travel and Per Diem: None.
5. Other Direct Costs: None.

6. Proposers Capability to Meet the Objectives: The laboratory has a good reputation in dating very young rocks; they should be able to date all rocks submitted, if they can be dated at all.

7. Key Personnel Qualifications: Dr. Damon will be P.I., and will oversee the operation of the laboratory. M. Shafiqullah, Co-P.I., will probably be performing the actual analyses. They both have many publications in K-Ar dating in refereed journals, some of which have been written with researchers currently funded by DOE.

8. Anticipated Objectives and Probability of Success: The task of obtaining dates will be a relatively straightforward laboratory effort, with appropriate adjustments for the sample handling procedures for very young rocks. This effort stands a very high chance of success. Some of the rocks submitted by other researchers may, for a variety of reasons, be analytically undatable. Therefore, the success of the program, defined as obtaining 40 good dates, is dependant on the quality of samples submitted by outside researchers. Overall, the program stands a very high probability of success.

SUGGESTED STATEMENT OF WORK
UNIVERSITY OF ARIZONA

1. Using state-of-the-art sample preparation and analytic procedures, make forty K-Ar age dating analyses for geologic samples from young geologic terrains. The samples will be collected and submitted by researchers funded under other DOE geothermal programs. When different phases of one sample, such as coexisting mica and feldspar, are dated, they will be considered as separate analyses. For each date reported, include three analyses for separate aliquots for potassium and analyses on three aliquots of argon from one fusion.
2. Deliverables will include providing DOE and DOE-funded researchers with letters containing analytic results from each sample dated. If results are required urgently, they will be phoned to the appropriate researcher. Provide a final report, which will include results of all samples dated and other pertinent data, such as geologic unit dated, sample location, and researcher to whom analytic results were delivered.
3. Provide overall project management and complete report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE form EIA 459A, Reporting Requirements Checklist. The original final report for this grant will be due on the original due date. The reports required are also summarized as follows:

U.S. DEPARTMENT OF ENERGY
memorandum

11

DATE

ATTN OF

CE-324

Program Letter 9

SUBJECT

FY 1985 OPERATING EXPENSES FOR

Idaho Operations Office

TO

Idaho Operations Office
Idaho Falls, ID

Fred Glatstein,
Budget and Fiscal Management Div.
Conservation and Renewable Energy

This letter authorizes an increase of \$ 72,000 in B/A

and \$ 72,000 in B/O for Idaho Operations Office.

These funds are budgeted under the budget and reporting classification

AM-10. Attachment I of this letter provides guidance for the use

of these funds.

Acting Director
Office of Renewable Technology
Conservation and Renewable Energy

cc: DGHT Program Manager

M. Reed

Idaho Operations Office

<u>B & R Classification</u>	(\$000)	
	<u>FY 1985 Increment</u>	
	<u>B/A</u>	<u>B/O</u>
AM-10-15-10	\$ 72	\$ 72

Program Guidance

Geothermal Reservoir Technology Program

FY 1985 Budget Authority and FY 1985 Cost Authority in the amount of \$30,000 each is provided to fund the project, Potassium-Argon Dating of Young Volcanic Rocks, in the attached unsolicited proposal from University of Arizona. The objective of this project is to extend the dating techniques to very young volcanic rocks in active geothermal areas. This will provide valuable information for understanding the formation and lifetime of geothermal systems.

Geothermal Reservoir Technology Program

FY 1985 Budget Authority and FY 1985 Cost Authority in the amount of \$42,000 each is provided as incremental funding for the project, Geothermal Map of the United States, in the attached unsolicited proposal from Southern Methodist University. The objective of this project is the compilation of all the heat flow and thermal gradient data collected under DOE funded geothermal projects and the preparation of a geothermal map of the U. S. This map is to be published by the Geological Society of America. This project is to work closely with heat flow projects funded by the State Cooperative Geothermal Resource Definition Program. Ownership of the IBM-PC computer needed for this project is to be transferred to Southern Methodist University for its use in future geothermal projects.

Program Manager

M. Reed



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
LABORATORY OF ISOTOPE GEOCHEMISTRY
TEL. (602) 621-6014

13 March 1985

Dr. Marshall Reed
Geothermal and Hydropower Technologies Division
U.S. Department of Energy, C.E. 324
Washington, D.C., 20585

Dear Dr. Reed:

Thank you for the information that I requested in order to submit a proposal to the National Geothermal Program. Three copies of our proposal are enclosed. We would be pleased to have the opportunity to use our expertise and experience in K-Ar dating of young volcanic rocks to further the goals of this important program.

Sincerely,

Paul E. Damon

Professor and Chief
Scientist of the Laboratory
of Isotope Geochemistry

UNSOLICATED PROPOSAL

FOR

K-AR DATING OF VOLCANIC ROCKS

from the Pacific Northwest; Cerro Prieta Area; Baja California, Mexico; Los Azufres Area; Michoacan, Mexico; and other Areas of Interest to the National Geothermal Program

Submitted by:

**Paul E. Damon, Principal Investigator
Muhammad Shafiqullah, Co-Principal Investigator**

To:

**Geothermal and Hydropower Technologies Division,
United States Department of Energy**

A. Experience in Dating Volcanic Rocks Younger Than 0.5 Million Years

The potassium-argon method determines absolute age by measuring the amount of radioactive potassium-40 and the amount of radiogenic argon-40 in a sample. Potassium-argon dating of geologically young samples, particularly late Pleistocene volcanic rocks of low potassium content, requires meticulous attention to detail because of the large amount of atmospheric argon-40 with a half life of about 1.25 billion years. The amount of radiogenic argon produced in a few hundred thousand years is minute, especially in rocks containing less than 1% potassium. Problems of this low signal to noise ratio are compounded by extraneous argon inherited from phenocrysts which did not completely degas on eruption or may have been trapped in chilled zones within the flow.

Atmospheric argon absorbed into the lava following eruption constitutes the major portion of argon-40 found in geologically young samples. It can exceed radiogenic argon by two orders of magnitude in samples less than 100,000 years old. Air argon is "tagged" by its argon-36 content and the "air correction" is made by multiplying the amount of argon-36 by the "air ratio" and subtracting this from the total measured argon-40 to leave the radiogenic argon-40. When atmospheric argon constitutes more than 95% of the total, confidence in the calculation is decreased and the reported experimental error grows to sometimes equal or exceeds the age. Since this atmospheric "noise" is highly variable from place to place within a given flow, the quality of the ages from samples collected from different places in the same flow will vary.

Experience gained by this laboratory over 23 years of dating whole rock samples less than 1 million years old has allowed us to progressively reduce the age of the "youngest datable sample". It is gratifying to note that improvements made by this laboratory are being used by other investigators to extend their capabilities.

A list of publications involving K-Ar dating work in this laboratory is presented in Appendix 1.

B. Laboratory Procedures

1. Sample Preparation

Basalt should be collected from the massive centers of lava flows by dismembering large rocks and collecting the unweathered center material. The chunks are reduced to 2 cm in a large jaw crusher and hand picked to remove discolored material and large phenocrysts. These fragments are reduced to 3mm in a roller crusher, passed through a flat-plate grinder and sieved to collect the -100+150 fraction. This fraction is washed to remove dust.

Heavy liquid of specific gravity 2.52 floats off glass, altered mineral grains and chance organic contaminants. Heavy liquid of 2.95 s.g. allows iron filings from the grinders, olivine, pyroxene, spinel and other potassium-poor minerals to sink thereby leaving a sand-sized concentrate of plagioclase and plagioclase-rich composite grains for further analysis. Pure plagioclase, which might be phenocryst fragments carrying excess or inherited argon, is removed by passage through a Frantz isodynamic separator. This sample is finally leached in 5% HF for 10 minutes to remove the last of the adhering glass, clay and carbonate and then resieved to remove the finer grains. This culled groundmass now devoid of most problem causing constituents is the plagioclase concentrate that we date.

Felsic volcanic rock samples are collected from unweathered rock containing K-feldspars with good crystal face reflections. Biotite is sometimes used but may contain significant amounts of excess argon. Sample preparation is similar except that the heavy liquid s.g. is adjusted to discriminate against plagioclase if it is sufficiently calcic and the Frantz isodynamic separator is used to obtain a pure feldspar concentrate. The high potassium content and low affinity for excess argon makes sanidine a very useful mineral for dating late Pleistocene volcanic rocks. In general, any mineral phase in which potassium is a major component, can be used for K-Ar dating. If a problem of excess argon is suspected, two different minerals can be analyzed to evaluate the magnitude of the excess. The second mineral should contain a much lower potassium content and consequently the apparent age will be much more sensitive to excess argon.

2. Potassium Analysis

The dried sample is split and one part pulverized to -300 mesh for potassium analysis. Four subsamples of this part are weighed into teflon crucibles and taken into solution in HF and H_2SO_4 . The resulting solutions are buffered with $NaCl^{2}$ to suppress ionization of the K and brought to standard volume. Potassium content of the sample solutions is compared to solutions of prepared potassium concentration for a minimum of 6 spot determinations. Each analytical run includes a rock standard, either our own laboratory standards or one of the international standards. The results are rejected if the internal statistical errors exceed 1.5% or the standard K content differs from its accepted value by more than 2%. Our preparation and analytical techniques have changed little in the past few years, except for inclusion of the rock standard in each analytical run which gives control of the accuracy of the results.

3. Argon Analysis

Argon is determined on the gas evolved when 10-30 gms of the sample is fused in a vacuum. The -100+150 mesh concentrate is weighed into molybdenum crucibles which are suspended in 9 cm fusion envelopes. A batch of 4 is mounted each week and the system baked out at 270°C for 20 hours to remove absorbed argon. One sample per day is fused by induction heating using a RF generator. The system is baked again overnight to eliminate the memory effect from the previous sample.

A precisely measured "spike" of argon-38 is introduced into the system during fusion. The spike-gas mixture is cleaned of water and other reactive components in synthetic zeolite molecular sieves, a copper oxide furnace and two titanium foil furnaces. What little reactive components remain are removed by a Sorbac appendage pump prior to argon analysis. The gas is split into three or more aliquots and the isotopic composition is measured in the static mode of a Nier-design 6-inch radius, 60° sector, gas-source mass spectrometer. A OSI 6502 micro computer changes the magnetic field to focus each ion beam, in turn, on a Faraday collector and then measures the voltages generated. Background is measured on both sides of each peak. Seven cycles from mass 36 to 38 to 40 and back constitute a run. Measurements are time regressed to T=0, the time the gas was introduced, using cubic, parabolic, and linear, least squares regression routines on each peak voltage and their ratios. Each reported argon value is the mean of 6 methods of calculation. If the analyses on the different gas aliquots do not agree within statistical limits, another fusion is carried out.

Precision of argon determinations has been determined to be within 1.5% reproducibility. The air ratio of argon-40 to argon-36 in the atmosphere is measured periodically and two argon standards are regularly analysed to monitor the precision of the system and technique.

4. Analyses by the Laboratory on Volcanic Rocks Less Than 500,000 Years Old

Analytical data on fifty volcanic rocks younger than 500,000 years that have been dated in this laboratory are given in Table 1. We have been able to obtain meaningful results consistent with the stratigraphy to latest Pleistocene time. Under favorable conditions meaningful results can be obtained for Holocene samples. For example, we were able to confirm that a basalt sample (UAKA-84-64) that contained less than 1×10^{-14} m/g of radiogenic ^{40}Ar was Holocene in age. We have made continuing efforts to improve the accuracy of our argon analyses. As a consequence, recent results should be more accurate than earlier results.

C. Proposed Research

We propose to make forty analyses for samples from the Cascade Mountains of the Pacific Northwest, Cerro Prieta area of Baja California, Mexico, Los Azufres area of Michoacan, Mexico and other geothermal areas of interest to the National Geothermal Program. When different phases of one sample, such as coexisting mica and feldspar are dated, for reporting purposes they will be considered as different analyses. We will report three analyses on separate aliquots for potassium and analyses on three aliquots of argon from one fusion for each sample. In case results are required urgently, data will be reported by telephone.

D. Duration of Proposed Research

The duration of the proposed research is expected to be one year, starting at the earliest practical date with the possibility of extension if field collections are not complete.

E. Billings

Analytical data along with billings will be forwarded, as the work progresses, in batches of four to six samples. Thus, any bill will not exceed \$4500.00. Checks for the completed work should be made payable to: The University of Arizona (Department of Geosciences) and mailed to the Laboratory of Isotope Geochemistry, Department of Geosciences, University of Arizona, Tucson, Arizona, 85721. Attn: Mrs. Maureen Mackey.

F. Budget

Geologically young samples are quite difficult to analyze and require great care in preparation. The added costs raise our price to \$750.00 per sample. This includes all technical services except transportation and living expenses should field consultation be required. Laboratory overhead is included and University overhead is waived providing individual billings for analyses are less than \$5000.00 and all negotiations are handled through The Laboratory of Isotope Geochemistry, University of Arizona. Our accounts are reviewed by both the Department of Geosciences and The University of Arizona accountants. Forty analyses at \$750.00 per analysis: \$30,000.

Table 1: K-Ar Dates for Fifty Volcanic Rocks
Less Than 500,000 Years Old

Sample No.*	% K	Radiogenic ^{40}Ar $\times 10^{-12}$ m/g	% Atmospheric Argon-40	K-Ar Date m.y.	$\pm\sigma$ m.y.
UAKA 73-113	2.70	2.31	80.1	0.493	0.060
UAKA 77-06	1.054	0.888	94.6	0.486	0.110
UAKA 82-184	1.480	1.247	79.9	0.486	0.029
UAKA 80-04	1.310	1.090	84.4	0.480	0.030
UAKA 77-44	1.227	1.010	80.7	0.475	0.029
UAKA 74-140	2.328	1.910	87.4	0.473	0.055
UAKA 76-121	0.693	0.558	95.8	0.465	0.065
UAKA 75-14	1.017	0.820	89.2	0.465	0.054
UAKA 74-141	1.488	1.12	83.8	0.434	0.031
UAKA 74-34	0.955	0.715	82.8	0.432	0.029
UAKA 79-116	0.935	0.702	94.1	0.430	0.060
UAKA 77-07	1.605	1.17	88.3	0.420	0.059
UAKA 75-121	1.93	1.36	96.6	0.406	0.155
UAKA 74-143	2.12	1.48	84.8	0.404	0.031
UAKA 77-43	0.794	0.509	94.3	0.370	0.040
UAKA 84-136	0.992	0.628	81.0	0.365	0.021
UAKA 84-252	0.584	0.363	91.4	0.359	0.050
UAKA 84-169	7.017	4.33	93.4	0.356	0.061

Table 1: continued

Sample No.*	% K	Radiogenic ^{40}Ar $\times 10^{-12}$ m/g	% Atmospheric Argon-40	K-Ar Date m.y.	$\pm\sigma$ m.y.
UAKA 75-11	0.493	0.291	92.4	0.341	0.065
UAKA 79-181	1.162	0.687	95.5	0.340	0.070
UAKA 75-17	2.40	1.40	97.4	0.336	0.169
UAKA 77-13	2.402	1.37	96.1	0.330	0.087
UAKA 82-195	0.810	0.433	95.0	0.308	0.070
UAKA 75-9	0.822	0.400	95.7	0.281	0.082
UAKA 84-66	1.058	0.504	86.6	0.274	0.020
UAKA 84-65	1.082	0.503	87.6	0.268	0.031
UAKA 71-8	8.942	3.80	93.3	0.245	0.037
UAKA 75-8	0.497	0.192	94.4	0.221	0.050
PED 14-70	9.07	3.42	91.1	0.218	0.021
UAKA 84-253	3.402	1.244	75.7	0.211	0.013
UAKA 74-261	2.28	0.825	87.5	0.209	0.019
UAKA 79-100	1.091	0.376	94.6	0.199	0.050
UAKA 84-135	1.629	0.539	93.9	0.191	0.038
UAKA 84-119	7.122	2.315	97.5	0.187	0.063
UAKA 79-131	1.127	0.359	92.9	0.183	0.030
UAKA 84-118	7.189	2.238	96.7	0.180	0.050

Table 1: continued

Sample No.*	% K	Radiogenic ^{40}Ar $\times 10^{-12}$ m/g	% Atmospheric Argon-40	K-Ar Date m.y.	$\pm\sigma$ m.y.
UAKA 75-16	2.408	0.73	94.2	0.175	0.038
UAKA 75-15	1.224	0.370	97.8	0.174	0.061
UAKA 84-137	2.136	0.635	88.3	0.171	0.016
UAKA 75-20	0.808	0.204	95.9	0.146	0.028
UAKA 75-81	0.785	0.197	95.0	0.145	0.038
UAKA 74-26a	1.20	0.250	96.2	0.120	0.038
UAKA 83-47	0.717	0.107	96.4	0.086	0.022
UAKA 83-44	0.643	0.087	96.7	0.078	0.018
UAKA 83-46	0.751	0.073	98.8	0.056	0.025
UAKA 73-120	2.22	0.210	95.6	0.055	0.014
UAKA 73-121	2.142	0.190	98.9	0.051	0.046
UAKA 84-63	1.389	0.086	96.5	0.036	0.012
UAKA 84-259	3.452	0.088	97.5	0.015	0.019
UAKA 84-64	1.180	0.0097	99.9	0.005	2 **

Table 1: continued

* first two digits in sample number is the year received in the laboratory
last three digits are the order of receipt during the year

** at 2σ confidence level

Constants used:

$$\lambda_{\beta} = 4.963 \times 10^{-10} \text{ yr}^{-1}$$

$$\lambda_e = 0.581 \times 10^{-10} \text{ yr}^{-1}$$

$$\lambda = 5.544 \times 10^{-10} \text{ yr}^{-1}$$

$${}^{40}\text{K}/\text{K} = 1.167 \times 10^{-4} \text{ atom/atom}$$

APPENDIX I

LIST OF PUBLICATIONS RELATED TO THE USE OF EXISTING GAS SOURCE MASS SPECTROMETERS AT THE LABORATORY OF ISOTOPE GEOCHEMISTRY, UNIVERSITY OF ARIZONA, TUCSON, ARIZONA. (Includes only papers coauthored by Lab researchers).

1961

Damon, P. E., and Giletti, 1961, The ages of the basement rocks of the Colorado Plateau and adjacent areas: *Annals of the New York Academy of Science*, v. 91, p. 443-453.

1962

Damon, P. E., Livingston, D. E., and Erickson, R. C., 1962, New K-Ar dates for the Precambrian of Pinal, Gila, Yavapai and Coconino Counties Arizona: *Mogollon Rim Region Guidebook*, 13th Field Conference, New Mexico Geological Society, p. 56-57.

Damon, P. E., Livingston, D. E., Mauger, R. L., Giletti, B. J., and Pantoja Alor, J., 1962, Edad del Precambrico "Anterior" y de otras rocas del Zocalo de la region de Caborca-Altar de la parte Noroccidental del Estado de Sonora, in: *Estudios Geocronologicos de Rocas Mexicanas*, Fries, C., Jr. ed., Instituto de Geologia, Mexico, Boletin 64, parte 2, p. 11-44.

De Cserna, Z., Schmitter, E., Damon, P. E., Livingston, D. E., and Kulp, J. L., 1962, Edades isotopicas de rocas metamorficas del centro y sur de Guerrero y de una monzonita cuarcifera del norte de Sinaloa, in: *Estudios Geocronologicos de Rocas Mexicanas*, Fries, C., Jr., ed., Instituto de Geologia, Mexico, Boletin 64, parte 5, p. 71-84.

Fries, C., Jr., Schmitter, E., Damon, P. E., and Livingston, D. E., 1962, Rocas Precambricas de edad Grenvilliana de la parte Central de Oaxaca en el Sur de Mexico, in: *Estudios Geocronologicos de Rocas Mexicanas*, Fries, C., Jr., ed., Instituto de Geologia, Mexico: Boletin 64, parte 3, p. 45-53.

Fries, C., Jr., Schmitter, E., Damon, P. E., Livingston, D. E., and Erickson, R. C., 1962, Edad de las rocas metamorficas en los canones de la Peregrina y de Caballeros, parte Centro-Occidental de Tamaulipas, in: *Estudios Geocronologicos de Rocas Mexicanas*, Fries, C., Jr., ed., Instituto de Geologia, Mexico, Boletin 64, parte 4, p. 55-69.

1963

Bikerman, M., 1963, Origin of the Cat Mountain Rhyolite: *Arizona Geological Society Digest*, v. 6, p. 83-89.

Damon, P. E., Erickson, R. C., and Livingston, D. E., 1963, K-Ar dating of basin and range uplift, Catalina Mountains, Arizona: Nuclear Geophysics, Woods Hole Conference on Nuclear Geophysics, National Academy of Sciences/National Research Council, no. 1975, p. 113-121.

1964

Damon, P. E., 1964, The present status and future possibilities of geochemistry as applied to paleoecological research, in: The Reconstruction of Past Environments, assembled by J. J. Hester and J. Schoenwetter, Fort Burgwin Research Center, New Mexico p. 77-82.

Damon, P. E., and Bikerman, M., 1964, Potassium-argon dating of post-Laramide plutonic and volcanic rocks within the Basin and Range Province of southeastern Arizona and adjacent areas: Arizona Geological Society Digest, v. VII, p. 63-78.

Damon, P. E., Mauger, R. L., and Bikerman, M., 1964, K-Ar dating of Laramide plutonic and volcanic rocks within the Basin and Range province of Arizona and Sonora: 12th International Geological Congress, India, Part III, Proceedings of Section 3, p. 45-55.

1965

Damon, P. E., 1965, Pleistocene time scales: Science, v. 148, p. 1037.

Mauger, R. L., Damon, P. E., and Giletti, B. J., 1965, Isotopic dating of Arizona ore deposits: Transactions of Society of Mining Engineers, v. 232, p. 81-87.

1966

Bikerman, M., and Damon, P. E., 1966, K-Ar chronology of the Tucson Mountains, Pima County, Arizona: Geological Society of America Bulletin, v. 77, p. 1225-1234.

Damon, P. E., and Mauger, R. L., 1966, Epeirogeny-orogeny viewed from the Basin and Range province: Transactions of Society of Mining Engineers, v. 235, p. 99-112.

1967

Bikerman, M., 1967, Isotopic studies in the Roskrige Mountains, Pima County, Arizona: Geological Society of America Bulletin, v. 78, p. 1029-1036.

Damon, P. E., 1967, Potassium-argon dating of igneous and metamorphic rocks with applications to the Basin Ranges of Arizona and Sonora, in: Radiometric Dating for Geologists, Hamilton, E. I., and Farquhar, R. M., eds., Interscience Publishers: London: J. Wiley and Sons, p. 1-71.

- Damon, P. E., 1967, Review of "Potassium Argon Dating": Schaeffer, O. A., and Zahringer, J., eds., Transactions American Geophysical Union, v. 48, p. 274-276.
- Damon, P. E., Laughlin, A. W., and Percious, J. K., 1967, Problems of excess argon-40 in volcanic rocks, in: Proceedings, International Atomic Energy Agency, Vienna, p. 463-481.
- Livingston, D. E., Damon, P. E., Mauger, R. L., Bennett, R., and Laughlin, A. W., 1967, Argon 40 in cogenetic feldspar-mica mineral assemblages: Journal of Geophysical Research, v. 72, p. 1361-1375.
- 1968
- Bikerman, M., 1968, The geology of the Roskrige Mountains: A brief summary: Southern Arizona Guidebook III, Arizona Geological Society, p. 183-192.
- Damon, P. E., 1968, Application of the potassium-argon method to the dating of igneous and metamorphic rock within the basin and ranges of the southwest: Southern Arizona Guidebook III, Arizona Geological Society, p. 7-20.
- Damon, P. E., 1968, Radioactive dating of Quaternary tephra, in: Means of correlation of quaternary successions, v. 8, Proceedings, VII Congress of the International Association for Quaternary Research, University of Utah Press, p. 195-206.
- Erickson, R. C., 1968, Geology and geochronology of the Dos Cabezas Mountains, Cochise County, Arizona: Arizona Geological Society Guidebook III, p. 193-198.
- Laughlin, A. W., 1968, Excess radiogenic argon in pegmatite minerals: Journal of Geophysical Research, v. 74, no. 27, p. 6684-6689.
- Laughlin, A. W., Damon, P. E., and Watson, B. N., 1968, Potassium-argon dates from Toquepala and Michiquillay, Peru: Economic Geology, v. 63, p. 166-168.
- Livingston, D. E., and Damon, P. E., 1968, The ages of stratified Precambrian rock sequences in central Arizona and northern Sonora: Canadian Journal of Earth Sciences, v. 5, p. 763-772.
- Livingston, D. E., Mauger, R. L., and Damon, P. E., 1968, Geochronology of the emplacement, enrichment, and preservation of Arizona porphyry copper deposits: Economic Geology, v. 63, p. 30-36.
- Marjaniemi, D., 1968, Tertiary volcanism in the northern Chiricahua Mountains, Cochise County, Arizona: Arizona Geological Society, Guidebook III, p. 208-214.

Mauger, R. L., Damon, P. E., and Livingston, D. E., 1968, Cenozoic argon ages on metamorphic rocks from the Basin and Range Province: *American Journal of Science*, v. 226, p. 579-589.

McKee, E. D., Hamblin, W. K., and Damon, P. E., 1968, K-Ar age of Lava Dam in Grand Canyon: *Geological Society of America Bulletin*, v. 79, p. 133-136.

Percious, J. K., 1968, Geology and geochronology of the Del Bac Hills, Pima County, Arizona: *Arizona Geological Society, Guidebook III*, p. 199-207.

Pushkar, P., 1968, Strontium isotope ratios in volcanic rocks of Three Island Arc areas: *Journal of Geophysical Research*, v. 73, p. 2701-2714.

1969

Laughlin, A. W., 1969, Excess radiogenic argon in pegmatite minerals: *Journal of Geophysical Research*, v. 74, p. 6684-6690.

Laughlin, A. W., Lovering, T. S., and Mauger, R. L., 1969, Age of some Tertiary igneous rocks from the East Tintic district, Utah: *Economic Geology*, v. 64, p. 915-922.

Laughlin, A. W., Rehrig, W. A., and Mauger, R. L., 1969, K-Ar chronology and sulfur and strontium isotope ratios at the Questa Mine, New Mexico: *Economic Geology*, v. 64, p. 903-909.

1970

Damon, P. E., 1970, A theory of "real" K-Ar clocks: *Eclogae Geologicae Helveticae*, v. 63, p. 69-76.

1971

Damon, P. E., 1971, The relationship between late Cenozoic volcanism and tectonism and orogenic-epirogenic periodicity, in Turekian, K. K., ed., *Conference on the Late Cenozoic Glacial Ages*, New York, John Wiley, p. 15-35.

1972

Watkinson, D. H., Thurston, P., and Shafiqullah, M., 1972, The Shawmere anorthosite of Archean Age in the Pakuskasing Belt, Ontario: *The Journal of Geology*, v. 80, p. 736-739.

1973

Elston, W. E., Damon, P. E., Coney, P. J., Rhodes, R. C., Smith, E. I., and Bickerman, M., 1973, Tertiary volcanic rocks, Mogollon-Datil Province, New Mexico, and surrounding region: K-Ar dates, patterns of eruption, and periods of mineralization: *Geological Society of America Bulletin*, v. 84, p. 2259-2274.

Livingston, D. E., 1973, A plate tectonic hypothesis for the genesis of porphyry copper deposits of the southern Basin and Range Province: Earth and Planetary Science Letters, v. 20, p. 171-179.

1974

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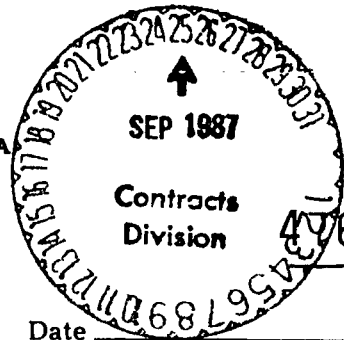
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THE UNIVERSITY OF ARIZONA
Tucson

INVOICE



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Date 26-Aug-87

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1012622

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 DOE place
Idaho Falls, Idaho 83402

Please make check payable to
THE UNIVERSITY OF ARIZONA and mail to Department of: Geosciences / Isotope Geochem.

Total Invoiced \$ _____
Less Amount Withheld \$ _____
Total Approved \$ _____
Payment _____

Analysis of 2 K-Ar samples at \$750 per sample
1. ET-104 UAKA- 87 021
2. HC-180 UAKA- 87 022

CMD Authorized Signature

Work covered by this invoice was performed satisfactorily to the best of my knowledge.

Total \$1500

Approved by: *[Signature]*
Technical Monitor

Prompt Payment Act

Yes
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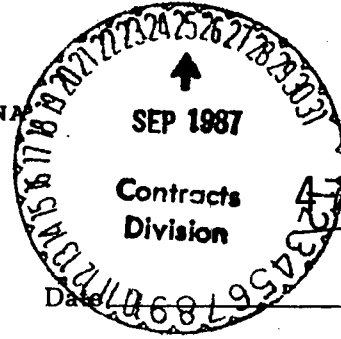
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E. King
126571

4-607

14-Aug-87

Invoice No. _____

Dr Ronald King - DOE, Idaho Falls.

1012622

Dr. Howard P. Ross
University of Utah Research Institute
391 Chipeta Way
Salt Lake City, Utah 84108-1295

Please make check payable to
THE UNIVERSITY OF ARIZONA and mail to Department of:

Geosciences / Isotope Geochem.

\$
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Amount Invoiced
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Total Approved
Payment
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Authorized Signature

Analysis of 6 K-Ar samples at \$750 per sample

- | | | | |
|----|-----------|-------|-------|
| 1. | AI-86-100 | UAKA- | 87 40 |
| 2. | AI-86-102 | UAKA- | 87 41 |
| 3. | AI-86-103 | UAKA- | 87 42 |
| 4. | AI-86-104 | UAKA- | 87 43 |
| 5. | AI-86-105 | UAKA- | 87 44 |
| 6. | AI-86-107 | UAKA- | 87 45 |

Work covered by this invoice was performed
satisfactorily to the best of my knowledge.

Total \$4500

Prompt Payment Act

Yes

No

Approved by: *Anna M. Prutinski*
Technical Monitor

Date: 10/5/87

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Dr. H.P. Ross

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: August 13, 1987

Project: DOE-Ascension Island
HP Ross
DL Nielson

Sample Number

UAKA 87-44

Originator's -AI-86-105

Sample Information

Rhyolite porphyry

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
4.958	4.976	0.458	0.516	95.6	95.1	0.06 ± 0.01
5.031		0.579		94.5		
5.033		0.511		95.1		
4.894		0.515		95.1		
4.965						

Sample Number

UAKA 86-45

Originator's -AI-86-107

Sample Information

Rhyolite, groundmass concentrate

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
3.877	3.891	5.669	5.548	50.7	51.8	0.82 ± 0.02
3.886		5.520		52.0		
3.877		5.516		51.9		
3.925		5.486		52.6		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: August 13, 1987

Project: DOE-Ascension Island
HP Ross
DL Nielson

Sample Number

UAKA 87-42

Originator's -AI-86-103

Sample Information

Rhyolite - groundmass feldspar concentrate

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data for Feldspar phenocrysts

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
2.795	2.752	5.471	5.474	78.2	78.3	1.15 ± 0.04
2.854		5.509		78.2		
2.744		5.489		78.3		
2.613		5.428		78.5		

Analytical Data for Groundmass feldspar concentrate

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
2.664	2.6437	4.221	4.206	64.7	64.8	0.92 ± 0.03
2.629		4.246		64.5		
2.670		4.188		64.9		
2.612		4.169		65.1		

Sample Number

UAKA 87-43

Originator's -AI-86-104

Sample Information

Glass, Obsidian

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
3.968	3.915	6.732	6.746	24.6	23.9	0.99 ± 0.02
3.919		6.746		24.2		
3.860		6.733		23.6		
3.823		6.772		23.3		
4.004						

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: August 13, 1987

Project: DOE-Ascension Island
HP Ross
DL Nielson

Sample Number

UAKA 87-40

Originator's -AI-86-100

Sample Information

Groundmass feldspar concentrate, Basaltic andesite
Dike cuts rhyolite, rhyolite dome, UAKA 87-045

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
2.219	2.250	3.090	3.108	68.0	68.6	0.80 ± 0.03
2.259		2.990		70.0		
2.274		3.191		68.1		
2.246		3.162		68.4		

Sample Number

UAKA 87-41

Originator's -AI-86-102

Sample Information

Groundmass feldspar concentrate, Trachyte

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
3.513	3.464	3.986	3.946	60.0	60.9	0.66 ± 0.02
3.441		3.925		61.1		
3.439		3.927		61.0		
		3.945		61.7		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: May 30, 1987

Project: DOE-OREGON
George Priest
Ronald King

Sample Number

UAKA 87-21 Originator's - ET-104

Sample Information

Basalt - groundmass feldspar concentrate
Glassy pillow lava
USDOE-funded geologic map project,
McKenzie Bridge Quad., Oregon

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
0.350	0.355	1.462	1.446	86.9	86.9	2.35 ± 0.14
0.360		1.344		86.9		
0.354		1.510		86.9		
		1.468		86.9		

Sample Number

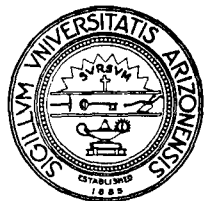
UAKA 87-22 Originator's - HC-180

Sample Information

Basaltic andesite - groundmass feldspar concentrate
USDOE-funded geologic map project,
McKenzie Bridge Quad., Oregon

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
0.785	0.762	6.707	6.563	83.9	83.6	4.96 ± 0.37
0.754		6.575		82.4		
0.743		6.406		84.5		
0.764						



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
BUILDING #77
GOULD-SIMPSON BUILDING
TEL. (602) 621-6024

September 16, 1987

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 D.O.E. Place
Idaho Falls, Idaho 83402

Dear Dr. King:

Enclosed are separate billings for six samples from the Ascension Islands submitted by Howard P. Ross and two samples from Oregon submitted George Priest. George Priest has already received the data sheets for his samples and we are sending date sheets for the six Ascension Island samples forthwith to Howard Ross.

We have now completed 10 of the 40 samples contracted for under Modification No. M001 to contract No. De-FG07 - S861D12622. We will give high priority to any samples submitted by DOE to fulfill the contract.

Sincerely,

Paul E. Damon
Professor

PD:kw

cc: Howard P. Ross
M. Shafiqullah

Department of Geosciences

THE UNIVERSITY OF
ARIZONA
TUCSON ARIZONA

Building #77
Gould-Simpson Building
Tucson, Arizona 85721
Tel. (602) 621-6024
FAX (602) 621-2672

February 28, 1991

Ms. Elizabeth Bowhan
U.S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

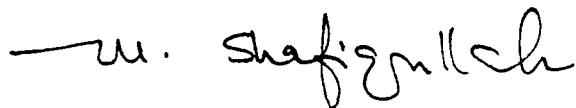
Dear Ms. Bowhan:

Transmitted herewith is the final report for Department of Energy Grant No. DE-FG07-86ID12622. Under the terms of this grant the University of Arizona provided state-of-the-art K-Ar age dating services, including sample preparation, analytical procedures, and computations, for forty two geologic samples submitted by DOE geothermal researchers.

The final age dates were completed and submitted to DOE on June 30, 1989. The integration of K-Ar dates with geologic data and interpretation in terms of geologic significance has been reported separately by the individual DOE State Geothermal team or other DOE geothermal researchers. This report details the samples completed, and final age dates, and is submitted to complete grant reporting requirements.

Sincerely,

Paul E. Damon
Principal Investigator



Muhammad Shafiqullah
Principal Investigator

K-AR DATING OF YOUNG VOLCANIC ROCKS

FINAL REPORT

Prepared for:

The U.S. Department of Energy
Geothermal Technology Division

State Cooperative Geothermal Research
Grant Number: DE-FG07-86ID12622

Prepared by:

Paul E. Damon
Muhammad Shafiqullah

THE UNIVERSITY OF ARIZONA
Department of Geosciences

January 31, 1991

SUMMARY

Potassium-Argon (K-Ar) age dates were determined for forty two young geologic samples by the Laboratory of Isotope Geochemistry, Department of Geosciences, in the period February 1, 1986 to June 30, 1989. Under the terms of Department of Energy Grant No. DE-FG07-86ID12622, The University of Arizona was to provide state-of-the-art K-Ar age dating services, including sample preparation, analytical procedures, and computations, for forty two young geologic samples submitted by DOE geothermal researchers. We billed only for forty samples.

Age dates were determined for geologic samples from five regions with geothermal potential: the Cascade Mountains (Oregon); the Cascade Mountains (Washington); Ascension Island, South Atlantic Ocean; Cerro Prieto, Mexico; and Las Azufres, Mexico. The ages determined varied from 5.92 m.a. to 0.62 m.a. The integration of K-Ar dates with geologic data and the interpretation in terms of geologic and geothermal significance has been reported separately by the various DOE geothermal researchers.

Table 1 presents a detailed listing of all samples dated, general sample location, researcher, researcher's organization, rock type, age, and probably error (1 standard deviation). Additional details regarding the geologic samples may be obtained from the respective geothermal researcher.

K-Ar dating Procedure at the University of Arizona

Sample preparation

For groundmass feldspar concentrate, large phenocrysts, if any, were removed by hand picking. Samples were then ground to 100-150 um. Glass and altered minerals were separated by floatation on a heavy liquid of specific gravity 2.50 -2.55. K-poor minerals such as olivine and pyroxene were separated using a heavy liquid of specific gravity 2.90-2.96. The concentrate of feldspar and feldspar rich composite grains were leached in dilute HF to remove any adhering glass, clay and carbonate and then resieved to remove the finer grains. The resultant culled groundmass was used for K-Ar dating. Pure feldspar was separated using standard magnetic and heavy liquid separation techniques.

K-Analysis

Potassium is analyzed on a Perkin-Elmer model 403 atomic absorption spectrophotometer. Three splits of each sample are taken in solution with HF, buffered with NaCl, and brought to a standard volume. A rock standard is run concurrently with each sample to monitor precision. Analyses are repeated if the spread between extreme measured values exceeded 1.5 % and/or the measured potassium content of the standard differ by more than 2% from the accepted value.

Ar-Analysis

Samples for argon analyses are fused in induction-heated molybdenum crucibles suspended in 90 mm air cooled pyrex fusion envelopes, which have first been evacuated and baked for 2 days at 257°C. The gas resulting from each fusion, after being thoroughly purified, is divided into two or more aliquot for separate analyses by static mode using our 6 inch (15.24 cm), 60° sector field, Nier type gas source mass spectrometer. A dedicated table top micro computer changes the magnetic field to focus each ion beam, in turn, on a Faraday cup collector and then measures and stores the voltages generated. Measurements are time regressed to the time gas is introduced, using both linear and parabolic least squares regression routines, and also on mass intensity ratios. If analyses in different aliquot do not fall within expected statistical limits, additional fusions and analyses are performed until satisfactory results are obtained.

Table 1. Samples dated at the University of Arizona by K-Ar method under DOE Grant No. DE-FGo7-86ID12622

#	Researcher	Sample locality		Sample Number		Reported Date	
		Rock		Researcher	UAKA	Ma	+/-
1	DL Nielson	BA	Ascension Island	AI-86-107	87040	0.80	0.03
2	DL Nielson	T	Ascension Island	AI-86-102	87041	0.66	0.02
3	DL Nielson	R	Ascension Island	AI-86-103	87042	0.92	0.03
4	DL Nielson	R-F	Ascension Island	AI-86-103	87042	1.15	0.04
5	DL Nielson	O	Ascension Island	AI-86-104	87043	0.99	0.02
6	DL Nielson	R	Ascension Island	AI-86-105	87044	0.06	0.01
7	DL Nielson	R	Ascension Island	AI-86-107	87045	0.82	0.02
8	DL Nielson	T-F	Ascension Island	AI-88-16	88046	0.65	0.02
9	G Priest	BA	Oregon Cascade	CTGH-1-1756	87016	2.92	0.08
10	G Priest	B	Oregon Cascade	ET-104	87021	2.35	0.14
11	G Priest	BA	Oregon Cascade	HC-180	87022	4.96	0.37
12	G Priest	B	Oregon Cascade	BHS-20	87198	0.86	0.06
13	G Priest	B	Oregon Cascade	BHS-21	87199	1.47	0.06
14	G Priest	B	Oregon Cascade	BHS-22	87200	0.65	0.05
15	G Priest	B	Oregon Cascade	PP-2	87218	0.94	0.05
16	G Priest	BA	Oregon Cascade	CTGH-1-3195	88017	5.15	0.25
17	G Priest	BA	Oregon Cascade	CTGH-1-4633	88018	4.64	0.12
18	G Priest	B	Oregon Cascade	35-015	88019	0.63	0.09
19	G Priest	BA	Oregon Cascade	CTGH-1-3152	88040	4.95	0.23
20	G Priest	BA	Oregon Cascade	CTGH-1-4740	88041	4.65	0.12
21	G Priest	B	Oregon Cascade	88-2-1819	89063	0.15	0.05
22	G Priest	B	Oregon Cascade	88-4-810	89064	0.07	0.03
23	G Priest	B	Oregon Cascade	88-3-1240	89065	1.35	0.07
24	G Priest	B	Oregon Cascade	88-3-1741	89066	1.49	0.06
25	J Moore	D	Los Azufres	#1	87238	1.09	0.03
26	J Moore	A	Los Azufres	#2	87239	5.92	0.14
27	J Moore	R	Los Azufres	#3	87240	0.90	0.03
28	J Moore	D	Los Azufres	#4	87241	0.45	0.03
29	J Moore	A	Los Azufres	#5	87242	1.36	0.06
30	J Moore	R	Los Azufres	#6	87243	0.13	0.01
31	M Korosec	B	Washington Cascade	MK-87-9-70	88163	0.13	0.01
32	M Korosec	BA	Washington Cascade	MK-87-9-75	88164	0.31	0.05
33	M Korosec	B	Washington Cascade	MK-88-8-8	88165	0.22	0.12
34	M Korosec	B	Washington Cascade	MK-88-8-9	88166	0.31	0.08
35	M Korosec	B	Washington Cascade	MK-88-8-10	88167	0.49	0.08
36	M Korosec	BA	Washington Cascade	MK-88-8-11	88168	0.28	0.02
37	M Korosec	B	Washington Cascade	MK-88-8-14	88169	1.67	0.23
38	M Korosec	A	Washington Cascade	MK-88-8-18	88170	0.20	0.04
39	M Korosec	A	Washington Cascade	MK-88-8-20	88171	0.29	0.03
40	M Korosec	B	Washington Cascade	MK-88-8-24	88172	0.39	0.04
41	M Reed	B	Cerro Prieto	CP-1	86252	0.10	0.06
42	M Reed	B	Cerro Prieto	CP-2	86253	0.12	0.07

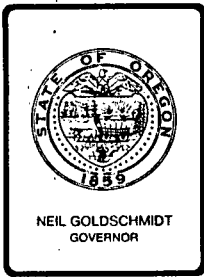
Sample type dated - groundmass feldspar concentrate or feldspar
separate

Rock type

A = Andesite	B = Basalt
D = Dacite	BA = Basaltic andesite
O = Obsidian	R = Rhyolite
T = Trachyte	R-F = Feldspar
	T-F = Feldspar

Affiliation of Researchers

J Moore	UURI - Utah
DL Nielson	UURI - Utah
G Priest	Oregon Dept. of Geology and Mineral Industries
M Korosec	Washington State Dept. of Natural Resources
M Reed	DOE- Geothermal Technology Division



Department of Geology and Mineral Industries
ADMINISTRATIVE OFFICE

910 STATE OFFICE BLDG., 1400 SW 5th AVE., PORTLAND, OR 97201-5528 PHONE (503) 229-5580

rec: 5/03/89
WPR

April 28, 1989

Dr. Paul Damon
Laboratory of Isotope Geochemistry
Geology Building
University of Arizona
Tucson, AZ 85721

Dear Paul:

Four basalt samples are being sent to you for isotopic age determination. These samples are from drill core in the High Cascades of Oregon. The ages will help to tell us the minimum offset on a major arc-parallel graben in the central part of the range. This information will in turn aid us in our understanding of the geologic framework of potential hydrothermal systems in the Cascades.

My understanding from Howard Ross at UURI is that the cost of analysis will be covered under your contract with USDOE.

The following samples were sent:

82-2-1819 (Devils Lake drill hole at a depth of 1819 ft.)
82-4-810 (Trout Creek Butte drill hole at a depth of 810 ft.)
82-2-1240 (Abbott Butte drill hole at a depth of 1240 ft.)
82-3-1741 (Abbott Butte drill hole at a depth of 1741 ft.)

These ages will be very valuable for correlation purposes as we go forward this summer with our own scientific drilling program in the High Cascades. I eagerly await the results.

Sincerely,

George R. Priest
Regional Geologist

CC Howard Ross
David Sherrrod
Scott Hughes
Britton Hill
Ed Taylor
Platt Bradbury

Rev 6/17/89

THE UNIVERSITY OF ARIZONA
Tucson

INVOICE

52232

Date 17-Apr-89Invoice No. 1146

Dr. Ken Taylor
Project Manager
Advanced Technologies Division
DOE - Idaho Operations Office
Idaho Falls, Idaho 83402

PE Damon/M Shafiqullah
Geosciences, Bldg # 77
University of Arizona
Tucson, AZ. 85721

Please make check payable to
THE UNIVERSITY OF ARIZONA and mail to Department of:

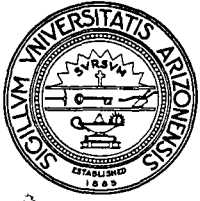
Analysis of 6 K-Ar samples at \$750 per sample

				<u>Age Date</u>
1.	MK 87 9 75	UAKA-	88 164	(0.314 +/- 0.054)
2.	MK 88 8 11	UAKA-	88 168	(0.277 +/- 0.020)
3.	MK 88 8 14	UAKA-	88 169	(1.67 +/- 0.23)
4.	MK 88 8 18	UAKA-	88 170	(0.203 +/- 0.036)
5.	MK 88 8 20	UAKA-	88 171	(0.292 +/- 0.033)
6.	MK 88 8 24	UAKA-	88 172	(0.394 +/- 0.039)

Amount billed \$ 4500

Please return one copy of invoice with your check.

	AK	Apr. 17, '89	Dec. 23, '88	
	MK 87-9-70	163 0.125 +/- 0.014 my	0.510 +/- 0.040	
Thomas Lake	MK 88-8-8	165 0.217 +/- 0.122 my	1.74 +/- 0.09	K re anal.
Burnt Peak	MK 88-8-9	166 0.309 +/- 0.075 my	1.74 +/- 0.13	K not re anal.
	MK 88-8-10	167 0.492 +/- 0.084 my	1.58 +/- 0.13	
		Revised	In Error	



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TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

*Rec.
6/1/89*

Dr. Paul Hammond
Department of Geology
State University
Portland, Oregon 97207

May 31, 1989

Dear Dr. Hammond

It was a great pleasure to talk to you over the telephone last Tuesday and discuss the dates on samples sent by Dr. Korosec. It was a good feeling to hear that you liked the numbers and that they fit the geologic setting of the area you have been mapping for a long time and are familiar with the sample locations. Some of the samples analyzed for this project were close to our analytical limits and we had to reanalyze them. However, Mike was not happy with some of the values and I mentioned that we will be happy to analyze one sample collected from one of the flows with very low K-content at no cost to DOE if it has about 0.5 percent K or more. Please keep an eye for such a sample.

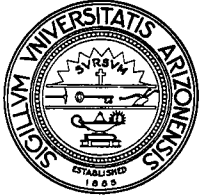
Please give me a call if I can be of any assistance.

Sincerely

M. Shafiqullah
M. Shafiqullah

Copy to

HP Ross
M. Korosec



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TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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February 1, 1988

Dr. Howard P. Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Ross:

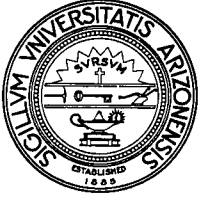
Enclosed are the data for George Priest's Cascade Mountains geothermal project and copies of letters to Dr. Ronald King and Kenneth Taylor.

Sincerely,

Paul E. Damon
Professor

hn
Enclosures

Rec 2/4/88



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TUCSON, ARIZONA 85721

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September 15, 1987

Dr. Howard P. Ross
University of Utah Research Institute
391 Chipeta Way
Salt Lake City, Utah 84108-1295

Dear Dr. Ross:

Enclosed are the results for the six samples from Ascension Island that you submitted and two samples from George Priest. The data were sent to George Priest earlier this summer.

You will note that the K-Ar age of the estimated youngest rock from Ascension Island is apparently younger than expected - 60,000 \pm 10,000 years. This could be a geothermal target.

As I mentioned in the enclosed letter to Dr. Ronald King, we have completed only 10 of 40 samples under Modification No. M001 to contract DE-F607-S861D12622. We will give high priority to any samples that DOF submits under this contract.

Sincerely,

Paul E. Damon
Professor

PD:kw

CC: M. Shafiqullah



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Rec 2/4/88

February 1, 1988

Mr. Kenneth Taylor
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

Dear Mr. Taylor:

With reference to instrument No. DE-FG07-861D12622, we have only received 20 samples out of 40 required for completion of our grant. Hence, we request an extension to 1/31/88 in order to complete the grant. Howard Ross telephoned today and informed us that we will receive 20 or more samples after grants are awarded and, so, there should be no difficulty in completing the grant in the next 12 months. We have completed 14 K-Ar analyses and billed for them. We are working on an additional 6.

Please take the necessary steps to make modification M002 to instrument NO. DE-FG07-861D12622.

Thank you.

Sincerely,


Paul E. Damon
Professor

hn
xc: Ronald King
Howard Ross
M. Shafiqullah



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TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

January 29, 1987

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Dear Dr. King:

We have received only 2 of 40 samples to be dated under Instrument No. DE-FG07-861D12622. We will report the results next week. In addition, six samples from Ascension are en route to us.

We have not received enough samples to complete our project during the 2/1/86 to 1/31/87 budget period. Therefore, I request an extension of the budget period but with no additional expense other than the original \$30,000.

Sincerely,

Paul E. Damon
Professor

jo
cc: ✓ Howard P. Ross

Rec. 9/12/86



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TUCSON, ARIZONA 85721

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TEL. (602) 621-6024

September 8, 1986

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Dear Dr. King:

We have received no samples to date. However, according to Howard P. Ross, we should receive a total of 18 samples in September from Ascension Island, Oregon and Cerro Prieta, Mexico. I pointed out to Howard Ross that our sample backlog is low and, so, we can move the incoming samples fast.

Sincerely,

Paul E. Damon
Professor

hn

xc: Howard P. Ross

Rec 9/12/86

U.S. DEPARTMENT OF ENERGY FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

1. Program/Project Identification No. DE-FG07	2. Program/Project Title R-Aa Dating of young volcanic rocks	3. Reporting Period 6/1/86 through 8/31/86
4. Name and Address Dr. Paul E. Damon, Dept. of Geosciences - Gould-Simpson Bldg 114, Univ. of Arizona, Tucson, 85721		5. Program/Project Start Date 2/1/86
		6. Completion Date 1/31/87

7. FY 86-87	8. Months or Quarters	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan
9. Cost Status	a. Dollars Expressed in	b. Dollar Scale											
10. Cost Chart													
Fund Source		Quarter				Cum. to Date	Tot. Plan						
		1st	2nd	3rd	4th								
P		7.5	7.5	7.5	7.5	15.0	30.0						
A		0	0			0							
P													
A													
P													
A													
P													
A													
Total P													
Total A													
Variance													
Total Planned Costs for Program/Project	Planned	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0
	Actual	0	0	0	0	0	0	0	0	0	0	0	0
	Variance	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0

11. Major Milestone Status	Units Planned	4	8	12	16	20	24	28
	Units Complete	0	0	0	0	0	0	0
no rocks dated	P							
	C							
	P							
	C							
	P							
	C							
	P							
	C							
	P							
	C							
	P							
	C							
	P							
	C							
	P							
	C							

12. Remarks **Sample collection has been slow. We expect to receive 18 samples in September according to Howard Ross [(800) 524-3444]**

13. Signature of Recipient and Date	14. Signature of DOE Reviewing Representative and Date
-------------------------------------	--



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Dr. Michael Korosec
State Geologist
Geology and Earth Resources Div.
Mail Stop: PY-12
Olympia, WA 98504

April 17, 1989

Dear Mike

In accordance to our telephone conversation, enclosed please find data on the remaining six samples you submitted for K-Ar dating. Each sample was ground to -100+150 mesh and potassium-rich feldspar groundmass concentrate was separated as far as practical with the removal of pyroxene and olivine by exploiting both magnetic properties and density. Phenocryst feldspars were removed as non-magnetic fraction.

As I mentioned over the telephone this morning, we had too many unusual problems recently. The Research Assistant who started working with us last summer was accident prone and modified both tracer concentration and composition without our knowledge. She is no longer us us. We are recalculating all analyses since last July, and have reanalyzed quite a few samples. Data on your four samples sent in December, on recalculation, came out quite a bit different. It is unfortunate that it had to happen this way. Looking at the hind side, we are glad that we could correct the data before it is in print.

We note that all your samples are geologically young. Even though the percent atmospheric argon appears high, the total atmospheric argon content is low in all but two cases (UAKA 88-164 and 88-169). Measurement of radiogenic argon content in some of your samples with low potassium (<0.3 %) required meticulous attention to details. We tried our best and reanalyzed some samples. We will be happy to analyze one recollected sample at no additional cost to DOE.

The analytical results were checked by Paul Damon before release. It was a pleasure to work on this project and we look forward to continued cooperative research. With season's greeting and best wishes.

Respectfully

M. Shafiqullah

M. Shafiqullah
Research Scientist

Copy to:
Howard P Ross
Ken Taylor

Rec
6/7/89



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*Rec
6/7/89*

Dr. Ken Taylor
Project Manager
Advanced Technologies Division
DOE Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

April 17, 1989

Dear Dr. Taylor

Enclosed please find the K-Ar data along with the bill for the samples submitted by Dr. Mike Korosec of Washington State Department of Natural Resources. This completes his samples. We will work on the four samples from Dr Priest when received on a high priority basis. That should complete our current contract with you.

It appears that we have not yet received the \$3000 payment for the last bill sent on Dec 23, 1988. When a check comes directly to the University it is considered a donation from an anonymous source and our Lab account is not credited. Since this happened to us before we request that the payments come to our Department for deposit to the proper account. Could you please check if the check has already been mailed?.

Respectfully

M. Shafiqullah

M. Shafiqullah

Copy to

H. Ross

Rec
01/04/89
KPK

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: December 23, 1988

Project:DOE- Washington State
Mike Korosec

Sample Number
UAKA 88166~~7~~ Originator's - MK-88-8-9

Sample Information
Basalt of Burnt Peak
Groundmass feldspar concentrate

Location Information
Crazy Hills, Skamania CO., Washington
Burnt Peak Quad.
Lat. 46 03.42' N
Long. 121 54.15 W

* Incorrect Dates
due to technical error

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date +/- Err
0.204	0.198	0.565	0.599	80.0	81.3	1.74 +/- 0.13
0.199		0.631		80.0		
0.190		0.619		81.8		
0.200		0.584		84.3		
		0.597		80.3		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: December 23, 1988

Project:DOE- Washington State
Mike Korosec

Sample Number
UAKA 88 167~~4~~ Originator's - MK-88-8-10

Sample Information
Groundmass feldspar concentrate
Basalt of Trout Lake Creek

Location Information
Indian Heaven, Skamania CO., Washington
Sleeping Beauty Quad.
Lat. 46 05.09' N
Long. 121 43.55' W

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date +/- Err
0.251	0.241	0.651	0.659	85.1	85.0	1.58 +/- 0.13
0.245		0.660		84.5		
0.231		0.667		85.5		
0.238						

*

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: December 23, 1988

Project:DOE- Washington State
 Mike Korosec

Sample Number
 UAKA 88 163 * Originator's - MK 87-9-70

Sample Information
 Groundmass feldspar concentrate
 Andesite of Forlorn Lake

Location Information
 Indian Heaven. Skamania CO., Washington
 Gifford Peak Quad.
 Lat. 45.56.92' N
 Long. 121 45.54' W

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date +/- Err
0.785	0.798	0.691	0.706	85.5	85.3	0.510 +/- 0.040 *
0.805		0.730		84.3		
0.803		0.702		85.5		
		0.700		85.9		

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: December 23, 1988

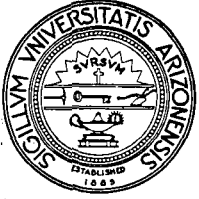
Project:DOE- Washington State
 Mike Korosec

Sample Number
 UAKA 88 165 * Originator's - MK-88-8-8

Sample Information
 Groundmass feldspar concentrate
 Basalt of Thomas Lake

Location Information
 Crazy Hills, Skamania Co., Washington
 Burnt Peak Quad.
 Lat. 46 05.03' N
 Long. 121.54.85' W

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date +/- Err
0.189	0.195	0.587	0.586	64.4	65.1	1.74 +/- 0.09 *
0.199		0.590		60.4		
0.194		0.574		66.2		
0.196		0.591		69.5		



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TEL. (602) 621-6024

Dr. Michael Korosec
Geologist
Geology and Earth Resources Div.
Mail Stop: PY-12
Olympia, WA 98504

Dec 29, 1988

Dear Mike

In accordance to our telephone conversation, I am enclosing analytical data on four samples you submitted for K-Ar dating. It is nice to know that you are happy with the dates.

Each sample was ground to -100+150 mesh and potassium-rich feldspar groundmass concentrate was separated by exploiting both magnetic properties and density. Phenocryst feldspars were removed as non-magnetic fraction. Data on your other samples will be sent in January, 1989.

The analytical results were checked by Paul Damon before release. It was a pleasure to work on this project and we look forward to continued cooperative research. With season's greeting and best wishes for a new productive year.

Respectfully

M. Shafiqullah
Research Scientist

Copy to:
Howard P Ross
Ken Taylor

THE UNIVERSITY OF ARIZONA
Tucson

INVOICE

51872

Date 29-Dec-88

Invoice No. 1146

Dr. Ken Taylor
Project Manager
Advanced Technologies Division
U.S. Department of Energy
Idaho Operations Office
785 DOE place
Idaho Falls, Idaho 83402

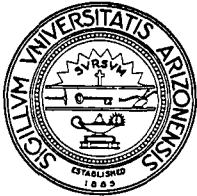
PE Damon/M Shafiqullah
Geosciences
G-S Building #77
University of Arizona
Tucson, AZ 85721

Please make check payable to
THE UNIVERSITY OF ARIZONA and mail to Department of:

Analysis of 4 K-Ar samples at \$750 per sample			
1.	MK 87 9 70	UAKA-	88 163
2.	MK 88 8 08	UAKA-	88 165
3.	MK 88 8 09	UAKA-	88 166
4.	MK 88 8 10	UAKA-	88 167

Total \$ 3000

Please return one copy of invoice with your check.



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DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

18-Apr-88

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls Idaho 83402

Dear Dr. King

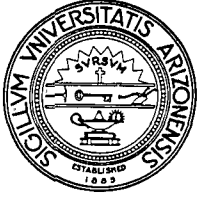
Enclosed are the analytical results on the samples submitted by Dr. Priest for K-Ar analysis and the invoice. Each sample was ground, sieved to -100+150 mesh and the potassium-rich mineral or composite fraction was separated by exploiting shape, magnetic properties and/or density. Special comment on individual samples is on the report sheet.

The analytical results were checked by Paul Damon before release. Please remit the invoiced amount. It was a pleasure to work on this project, we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Howard Ross
George Priest



THE UNIVERSITY OF ARIZONA

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19-Apr-88

*Rec 4/22/88
APP*

Dr. George R Priest
Regional Geologist
Department of Geology and
Mineral Industries
Portland, Oregon 97201

Dear George

When we discussed the K-Ar dates on your three rush samples last month, you had problems with our 4.64 ± 0.12 m.y date on UAKA 88-18 (sample from 4633' depth). Your correlations suggested that it should fall between 10 and 14 m.y. Hence, we decided to date the sample from a depth of 4740.5 ft at no cost to DOE. The 4.65 ± 0.12 m.y. calculated date on this sample is identical to the previous date.

Yesterday I talked to Dr. David Sherron at the USGS, Menlo Park, who has been working with you on this project. His geochemical work suggests that a large number of flows make up the volcanic sequence and that the flows between 3000 and 4800 ft depth are geochemically similar. His geochemical work substantiates our dating. At the face value, 5.15 ± 0.25 and 4.95 ± 0.23 m.y dates for UAKA 88 017 and 88 040 respectively are older than 4.64 ± 0.12 m.y date on UAKA 88 018. However, the former two samples contain lower potassium contents in the groundmass feldspar concentrates, presumably during hydrothermal alteration. Dave mentioned that the whole sequence has undergone low temperature alteration to variable degrees and we believe that potassium was preferentially lost from part of the sequence to yield the date pattern. All the four dates are within two sigma statistical limits. He will incorporate all these along with our sample preparation technique in his report.

It was a pleasure to work on this interesting project with you and we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to:

Paul E Damon
Howard Ross

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: March 7, 1988

Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 87 016 Originator's -CTGH-1 1756'

Sample Information
Groundmass feldspar concentrate
Basaltic andesite from 4633' depth

Location Information
Northern Oregon Cascade

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.167	1.155	5.788	5.845	29.6	29.5	2.92 +/- 0.08
1.145		5.840		29.8		
1.154		5.860		29.4		
		5.893		29.0		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: April 18, 1988

Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 88 019 Originator's -35-015

Sample Information
Feldspar concentrate, basalt
Young silicic volcanic field in High Cascades, Oregon
East of Bend and also east of Three Sisters Volcanoes

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.974	0.9843	1.206	1.078	92.7	93.4	0.63 +/- 0.09
0.993		0.978		94.0		
0.986		1.049		93.6		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: March 7, 1988

Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 88 017 Originator's -CTGH-1 3195'

Sample Information
Groundmass feldspar concentrate
Altered basaltic andesite from 3195' depth

Location Information
Northern Oregon Cascade

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.658	0.665	6.011	5.949	83.4	83.5	5.15 +/- 0.25
0.663		5.918		83.6		
0.674		5.917		83.6		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: April 18, 1988

Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 88 040 Originator's -CTGH-1 3152

Sample Information
Groundmass feldspar concentrate
Altered basaltic andesite from 3152' depth

Location Information
Northern Oregon Cascade

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.504	0.510	4.310	4.388	79.7	80.6	4.95 +/- 0.23
0.518		4.405		80.9		
0.509		4.699		79.6		
0.511		4.138		82.0		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: March 7, 1988

Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 88 018 Originator's -CTGH-1 4633'

Sample Information
Groundmass feldspar concentrate
Basaltic andesite from 4633' depth

Location Information
Northern Oregon Cascade

Repeat Sample

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.061	1.075	8.492	8.664	58.3	57.4	4.64 +/- 0.12
1.057		8.728		57.2		
1.108		8.786		56.9		
		8.650		57.3		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: April 18, 1988

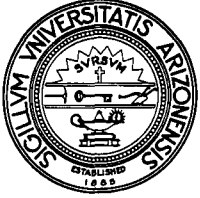
Project: DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 88 041 Originator's -CTGH-1 4740.5

Sample Information
Groundmass feldspar concentrate
Basaltic andesite from 4740.5' depth

Location Information
Northern Oregon Cascade

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.144	1.144	9.252	9.232	60.9	60.9	4.65 +/- 0.12
1.137		9.250		60.9		
1.152		9.254		60.7		
1.141		9.171		61.1		



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May 4, 1988

Dr. Howard P. Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Ross

Enclosed please find the data for Ascension Island geothermal area sample sent by Dennis L Nielson along with copies of letters to Drs. Ronald King and Dennis Nielson.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Dennis L Nielson
Ronand King

Rec
5/6/88
HAR

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: May 4, 1988

Project: DOE - UURI
 Ascension Island
 DL Nielson

Sample Number
 UAKA 88 046 Originator's - AI-88-16

Sample Information
 Sanidine phenocrysts, trachyte
 Ascension Island

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
4.375	4.343	4.892	4.899	50.0	51.4	0.650 +/- 0.017
4.387		4.993		51.1		
4.268		4.861		52.1		
		4.850		52.2		



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04-May-88

Dr. Ronald King
US Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho, 83402

Dear Dr King

Enclosed are the analytical results on the samples submitted by Dr. D.L. Nielson for K-Ar analysis and the invoice. The sample was ground, ultrasonified and sieved to -100+150 mesh and sanidine was separated by exploiting shape, magnetic properties and density.

The analytical results were checked by Paul Damon before release. Please remit the invoiced amount. It was a pleasure to work on this project, we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to

Paul E Damon
Dennis L Nielson



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

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TEL. (602) 621-6024

May 4, 1988

Dr. Dennis L Nielson
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Nielson

Enclosed please find K-Ar data on your Ascension Island sample. Sanidine separation was quite a challenge considering the condition of the sample. If you have any question about our analytical procedure or the data please give us a call. It was a pleasure to work on this project and we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to

Paul E Damon
Howard Ross
Ronand King



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Rec
4/4/88
HPR.

March 29, 1988

Dr. Howard P. Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Ross

Enclosed are the data for Joe Moore's Los Azufres geothermal area samples from Michoacan, Mexico along with copies of letters to Dr. Ronald King and Joe Moore.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Joe Moore
Ronand King



THE UNIVERSITY OF ARIZONA

TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

March 29, 1988

Dr. Joe Moore
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Moore

Enclosed please find K-AR data on your Los Azufres samples from Michoacan, Mexico. Sorry for the delay in sending you the data. If you have any question about our analytical procedure or data please give us a call. It was pleasure to work on this project and we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Howard Ross
Ronand King

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: February 23, 1988

Project: DOE - UURI
Los Azufres, Mexico
Joe Moore

Sample Number
UAKA 87 238 Originator's - #1 dacite

Sample Information
Feldspar concentrate
Dacite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
3.781	3.792	7.148	7.149	49.4	49.9	1.087 +/- 0.025
3.830		7.150		50.0		
3.766		7.160		50.0		
		7.137		50.0		

Sample Number
UAKA 87 239 Originator's - #2 Andesite

Sample Information
Groundmass feldspar concentrate
Andesite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.481	1.507	15.594	15.488	21.8	21.9	5.92 +/- 0.14
1.537		15.539		21.6		
1.504		15.330		22.2		

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: February 23, 1988

Project: DOE - UURI
 Los Azufres, Mexico
 Joe Moore

Sample Number
 UAKA 87 240 Originator's - #3 Rhyolite

Sample Information
 Feldspar concentrate
 Rhyolite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
4.088	4.055	6.441	6.344	73.4	74.4	0.902 +/- 0.030
4.017		6.383		74.7		
4.060		6.332		74.3		
		6.221		75.3		

Sample Number
 UAKA 87 241 Originator's - # 4 Dacite

Sample Information
 Groundmass feldspar concentrate
 Dacite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.134	1.161	0.830	0.914	81.7	80.8	0.454 +/- 0.034
1.168		0.867		82.3		
1.181		0.975		79.9		
		0.907		80.4		
		0.938		80.1		
		0.965		80.6		

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: February 23, 1988

Project: DOE - UURI
 Los Azufres, Mexico
 Joe Moore

Sample Number
 UAKA 87 242 Originator's - # 5 Andesite

Sample Information
 Groundmass feldspar concentrate
 Andesite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.189	1.195	2.791	2.827	84.4	84.4	1.364 +/- 0.061
1.198		2.858		84.3		
1.194		2.846		84.2		
1.198		2.811		84.5		

Sample Number
 UAKA 87 243 Originator's - # 6 Rhyolite

Sample Information
 Sanidine
 Rhyolite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
7.359	7.353	1.533	1.672	83.1	81.2	0.131 +/- 0.012
7.311		1.645		81.1		
7.389		1.839		79.4		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: January 11, 1988

Project: Oregon - Geothermal
George Priest

Rec 2/4/88
HPR

Sample Number

UAKA 87-198 Originator's - BHS-20

Location Information

Breitenbush-Austin area of Cascade Mountains

Sample Information

Groundmass feldspar concentrate, basalt

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.678	0.674	0.980	1.002	75.6	75.7	0.857 +/- 0.060
0.674		1.041		75.0		
0.670		0.985		76.5		

Sample Number

UAKA 87-199 Originator's - BHS-21

Location Information

Breitenbush-Austin area of Cascade Mountains

Sample Information

Groundmass feldspar concentrate, basalt

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.738	0.731	1.993	1.858	69.3	71.6	1.47 +/- 0.06
0.727		1.887		71.3		
0.724		1.729		73.5		
0.731		1.823		72.1		
0.733						

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: January 11, 1988

Project: Oregon - Geothermal
 George Priest

Sample Number
 UAKA 87-200 Originator's - BHS-22

Location Information
 Breitenbush-Austin area of Cascade Mountains

Sample Information
 Groundmass feldspar concentrate, basalt

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.583	0.573	0.665	0.649	81.3	82.8	0.652 +/- 0.045
0.565		0.648		83.6		
0.572		0.611		84.0		
		0.670		82.3		

Sample Number
 UAKA 87-218 Originator's - PP-2

Sample Information
 Groundmass feldspar concentrate, basalt

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
0.578	0.572	0.941	0.934	84.8	85.9	0.941 +/- 0.050
0.569		0.936		86.3		
0.570		0.918		86.5		
		0.940		86.1		



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TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
BUILDING #77
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TEL. (602) 621-6024

March 26, 1987

Dr. Marshall Reed
Geothermal and Hydropower Tech. Divisions
U.S. Department of Energy, C.E. 324
Washington, D.C. 20585

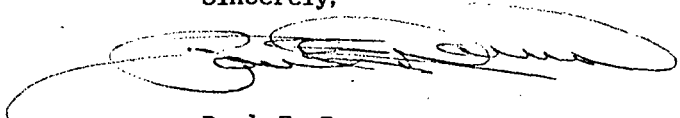
Dear Dr. Reed:

We have completed the K-Ar analyses for your samples CP1 & CP2. The data sheet is enclosed. The dates are, as follows:

CP1:	102,000 \pm 56,000 years	4 analyses	15
CP2:	121,000 \pm 71,000 years	5 analyses	10

I will send an invoice to Ronald King and copies of the data to Joseph Smith and Howard Ross.

Sincerely,



Paul E. Damon
Professor

hn
Enclosure

xc: Dr. Joseph Moore
Dr. Howard R. Ross

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

January 27, 1987

Dr. Paul E. Damon
Department of Geosciences
Gould-Simpson Building
The University of Arizona
Tucson, Arizona 85721

Dear Dr. Damon:

We are transmitting under separate cover six rock samples for age dating under your DOE grant. The samples were obtained by Dennis Nielson of UURI as part of his geothermal studies of Ascension Island, South Atlantic Ocean. We anticipate that all samples are less than 1 Ma.

Enclosed for your information is a copy of an informal memo from Dennis to me with estimated age information and a table of previous age dates obtained from Ascension Island. We appreciate your support in completing these age dates.

Sincerely,



Howard P. Ross
Section Head/Geophysics

To: H. P. Ross

1-26-87

From: D. L. Nielson *Dan*

Re: Samples for age dating

The following samples from Ascension Island, South Atlantic Ocean, have been collected for age dating.

AI-86-100 Basaltic dike. This dike cuts rhyolite dome which is represented by sample AI-86-107.

AI-86-102 Trachyte flow. Estimated age 0.6 Ma.

AI-86-103 Rhyolite dike. Estimated age 0.5 Ma.

AI-86-104 Obsidean. Sample is from same unit represented by sample AS-2 in the attached table.

AI-86-105 Porphyritic rhyolite. Estimated age 0.3 Ma.

AI-86-107 Rhyolite dome. Estimated age 0.5 Ma.

Table 3-11 K-Ar data for samples from Ascension Island

Sample No.	Material Dated	Weight (gms.)	%K	Moles/gm		Age (m.y.) $\pm 1\sigma$
				Ar ⁴⁰ _{Rad} ($\times 10^{-11}$)	%Ar ⁴⁰ _{atm}	
AS-2	Whole Rock	1.01716	3.84	0.627	93	0.94 \pm 0.19
AI-82-13	Anorthoclase	0.70031	5.40	No detectable radiogenic argon		
AI-82-15	Whole Rock	1.05185	3.51	0.370	97	0.61 \pm 0.28
AI-82-26	Whole Rock	2.03944	1.08	0.025	99.96	0.01 + 0.35 -0.01
AI-82-29	Whole Rock	0.70857	4.25	0.546	94	0.74 \pm 0.17

Constants Used:

$$\lambda_{\beta} = 4.962 \times 10^{-10}/\text{yr.}$$

$$\lambda_{\epsilon} = 0.581 \times 10^{-10}/\text{yr.}$$

$$k^{40}/k_{\text{Tot.}} = 1.167 \times 10^{-4} \text{ Mole/Mole}$$

S. H. Evans, Jr., analyst

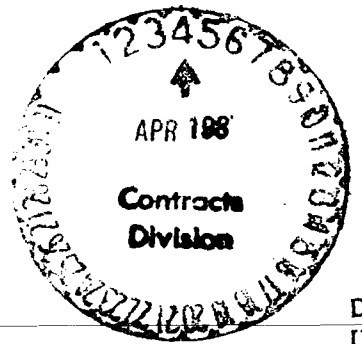
Jeff

ID 12622

353770

Prestwich

H. Ross
4/22/88



THE UNIVERSITY OF ARIZONA
Tucson

Prompt Payment Act

INVOICE Yes
No

46777

Due Date _____ 23-Feb-88

Date _____ 1113

Invoice No. _____

Dr. ~~Ronald King~~
US Department of Energy
Idaho Operations Office
Idaho Falls, Idaho, 83402

PE Damon/ M Shafiqullah
Department of Geosciences
G-S Building #77
University of Arizona
Tucson, Az. 85721

Please make check payable to
THE UNIVERSITY OF ARIZONA and mail to Department of:

~~Analysis of 5 K-Ar samples at \$750 per sample~~
Analysis of 1 K-Ar samples at \$500 per sample

Total Invoiced \$ _____
Less Amount Withheld \$ _____
Total Approved _____
Payment \$ _____

- | | | | |
|----|---------|-------|--------|
| 1. | UURI-#1 | UAKA- | 87 238 |
| 2. | UURI-#2 | UAKA- | 87 239 |
| 3. | UURI-#3 | UAKA- | 87 240 |
| 4. | UURI-#4 | UAKA- | 87 241 |
| 5. | UURI-#5 | UAKA- | 87 242 |
| 6. | UURI-#6 | UAKA- | 87 243 |

CMD Authorized Signature _____ Date _____

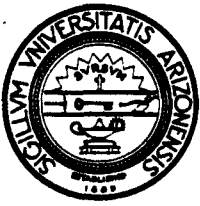
Work covered by this invoice was performed satisfactorily to the best of my knowledge.

Approved by: [Signature]
Technical Monitor

Total \$4250

Date 4/8/88

Please return one copy of invoice with your check.



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

March 29, 1988

Dr. Joe Moore
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Moore

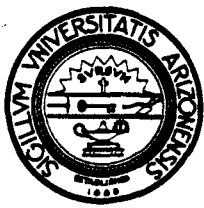
Enclosed please find K-AR data on your Los Azufres samples from Michoacan, Mexico. Sorry for the delay in sending you the data. If you have any question about our analytical procedure or data please give us a call. It was pleasure to work on this project and we look forward to continued cooperative research.

Respectfully,

A handwritten signature in cursive script that reads 'M. Shafiqullah'.

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Howard Ross
Ronand King



THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

March 29, 1988

Dr. Howard P. Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt LAke City, Utah 84108

Dear Dr. Ross

Enclosed are the data for Joe Moore's Los Azufres geothermal area samples from Michoacan, Mexico along with copies of letters to Dr. Ronald King and Joe Moore.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Joe Moore
Ronand King

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: February 23, 1988

Project: DOE - UURI
 Los Azufres, Mexico
 Joe Moore

Sample Number
 UAKA 87 240 Originator's - #3 Rhyolite

Sample Information
 Feldspar concentrate
 Rhyolite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
4.088	4.055	6.441	6.344	73.4	74.4	0.902 +/- 0.030
4.017		6.383		74.7		
4.060		6.332		74.3		
		6.221		75.3		

Sample Number
 UAKA 87 241 Originator's - # 4 Dacite

Sample Information
 Groundmass feldspar concentrate
 Dacite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.134	1.161	0.830	0.914	81.7	80.8	0.454 +/- 0.034
1.168		0.867		82.3		
1.181		0.975		79.9		
		0.907		80.4		
		0.938		80.1		
		0.965		80.6		

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: February 23, 1988

Project: DOE - UURI
 Los Azufres, Mexico
 Joe Moore

Sample Number
 UAKA 87 238 Originator's - #1 dacite

Sample Information
 Feldspar concentrate
 Dacite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
3.781	3.792	7.148	7.149	49.4	49.9	1.087 +/- 0.025
3.830		7.150		50.0		
3.766		7.160		50.0		
		7.137		50.0		

Sample Number
 UAKA 87 239 Originator's - #2 Andesite

Sample Information
 Groundmass feldspar concentrate
 Andesite, Michoacan

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.481	1.507	15.594	15.488	21.8	21.9	5.92 +/- 0.14
1.537		15.539		21.6		
1.504		15.330		22.2		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: February 23, 1988

Project: DOE - UURI
Los Azufres, Mexico
Joe Moore

Sample Number

UAKA 87 242 Originator's - # 5 Andesite

Sample Information

Groundmass feldspar concentrate
Andesite, Michoacan

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
1.189	1.195	2.791	2.827	84.4	84.4	1.364 +/- 0.061
1.198		2.858		84.3		
1.194		2.846		84.2		
1.198		2.811		84.5		

Sample Number

UAKA 87 243 Originator's - # 6 Rhyolite

Sample Information

Sanidine
Rhyolite, Michoacan

Analytical Data

% Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date +/- Err
Data	Mean	Data	Mean	Data	Mean	
7.359	7.353	1.533	1.672	83.1	81.2	0.131 +/- 0.012
7.311		1.645		81.1		
7.389		1.839		79.4		



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TEL. (602) 621-6024

29-Mar-88

Dr. Ronald King
US Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho, 83402

Dear Dr King

I am writing on behalf of Paul E Damon who is out of State. I was sick with pneumonia for the last 2-3 months and Paul was travelling quite a bit. Hence the delay in sending you the data.

Enclosed are the analytical results on the samples submitted by Dr. Joe Moore for K-Ar analysis and the invoice. Each sample was ground, sieved to -100+150 mesh and the potassium-rich mineral or composite fraction was separated by exploiting shape, magnetic properties and/or density.

The analytical results were checked by Paul Damon before release. Please remit the invoiced amount. It was a pleasure to work on this project, we look forward to continued cooperative research.

Respectfully,

M. Shafiqullah
Research Scientist

Copy to
Paul E Damon
Joe Moore



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TUCSON, ARIZONA 85721

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September 16, 1987

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 D.O.E. Place
Idaho Falls, Idaho 83402

Dear Dr. King:

Enclosed are separate billings for six samples from the Ascension Islands submitted by Howard P. Ross and two samples from Oregon submitted George Priest. George Priest has already received the data sheets for his samples and we are sending data sheets for the six Ascension Island samples forthwith to Howard Ross.

We have now completed 10 of the 40 samples contracted for under Modification No. M001 to contract No. De-FG07 - S861D12622. We will give high priority to any samples submitted by DOE to fulfill the contract.

Sincerely,

A handwritten signature in black ink, appearing to read 'Paul E. Damon', written over a horizontal line.

Paul E. Damon
Professor

PD:kw

cc: Howard P. Ross
M. Shafiqullah

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: August 13, 1987

Project: DOE-Ascension Island
HP Ross
DL Nielson

Sample Number

UAKA 87-40

Originator's -AI-86-100

Sample Information

Groundmass feldspar concentrate, Basaltic andesite
Dike cuts rhyolite, rhyolite dome, UAKA 87-045

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
2.219	2.250	3.090	3.108	68.0	68.6	0.80 ± 0.03
2.259		2.990		70.0		
2.274		3.191		68.1		
2.246		3.162		68.4		

Sample Number

UAKA 87-41

Originator's -AI-86-102

Sample Information

Groundmass feldspar concentrate, Trachyte

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
3.513	3.464	3.986	3.946	60.0	60.9	0.66 ± 0.02
3.441		3.925		61.1		
3.439		3.927		61.0		
		3.945		61.7		

University of Arizona
 Isotope Geochemistry Laboratory
 Date of Report: August 13, 1987

Project: DOE-Ascension Island
 HP Ross
 DL Nielson

Sample Number
 UAKA 87-42 Originator's -AI-86-103

Sample Information
 Rhyolite - groundmass feldspar concentrate

Location Information
 Ascension Island, South Atlantic Ocean

Analytical Data for Feldspar phenocrysts

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
2.795	2.752	5.471	5.474	78.2	78.3	1.15 ± 0.04
2.854		5.509		78.2		
2.744		5.489		78.3		
2.613		5.428		78.5		

Analytical Data for Groundmass feldspar concentrate

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
2.664	2.6437	4.221	4.206	64.7	64.8	0.92 ± 0.03
2.629		4.246		64.5		
2.670		4.188		64.9		
2.612		4.169		65.1		

Sample Number
 UAKA 87-43 Originator's -AI-86-104

Sample Information
 Glass, Obsidian

Location Information
 Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
3.968	3.915	6.732	6.746	24.6	23.9	0.99 ± 0.02
3.919		6.746		24.2		
3.860		6.733		23.6		
3.823		6.772		23.3		
4.004						

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: August 13, 1987

Project: DOE-Ascension Island
HP Ross
DL Nielson

Sample Number

UAKA 87-44

Originator's -AI-86-105

Sample Information

Rhyolite porphyry

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
4.958	4.976	0.458	0.516	95.6	95.1	0.06 ± 0.01
5.031		0.579		94.5		
5.033		0.511		95.1		
4.894		0.515		95.1		
4.965						

Sample Number

UAKA 86-45

Originator's -AI-86-107

Sample Information

Rhyolite, groundmass concentrate

Location Information

Ascension Island, South Atlantic Ocean

Analytical Data

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported
Data	Mean	Data	Mean	Data	Mean	Date + Err
3.877	3.891	5.669	5.548	50.7	51.8	0.82 ± 0.02
3.886		5.520		52.0		
3.877		5.516		51.9		
3.925		5.486		52.6		

University of Arizona
Isotope Geochemistry Laboratory
Date of Report: May 30, 1987

Project:DOE-OREGON
George Priest
Ronald King

Sample Number
UAKA 87-21 Originator's - ET-104

Sample Information
Basalt - groundmass feldspar concentrate
Glassy pillow lava
USDOE-funded geologic map project,
McKenzie Bridge Quad., Oregon

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
0.350	0.355	1.462	1.446	86.9	86.9	2.35 ± 0.14
0.360		1.344		86.9		
0.354		1.510		86.9		
		1.468		86.9		

Sample Number
UAKA 87-22 Originator's - HC-180

Sample Information
Basaltic andesite - groundmass feldspar concentrate
USDOE-funded geologic map project,
McKenzie Bridge Quad., Oregon

Potassium		Radiogenic Ar pm/g		% Atm. Ar		Reported Date + Err
Data	Mean	Data	Mean	Data	Mean	
0.785	0.762	6.707	6.563	83.9	83.6	4.96 ± 0.37
0.754		6.575		82.4		
0.743		6.406		84.5		
0.764						



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DEPARTMENT OF GEOSCIENCES
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March 26, 1987

Dr. Ronald King
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Fall, Idaho 83402

Dear Dr. King:

I have received notice of Modification No. M001 to Contract No. DE-FG07-S861D12622 and the project is now active. We have completed work on two Cerro Prieto samples for Marshall Reed and commenced work on six Ascension Island samples for D.L. Nielson. In addition we are working on several Oregon samples for George Priest.

The invoice for the two completed samples is enclosed. The data have been sent to Marshall Reed.

Sincerely,

Paul E. Damon
Professor

hn
Enclosure
xc: Howard P. Ross

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

February 2, 1987

TELEX: 2291 INE ED

Ing. Franklin Carrasco
Director Ejectivo
Institutio Nacional De Energia
Quito, Ecuador

In response to your TELEX of 01/28/87, it is possible to receive free age dates for a maximum of six samples of young (less than 5 ma old) volcanic rocks through US DOE geothermal program. Each labeled sample should be 10-12 kg of fresh unweathered rock. The lab will separate plagioclase out of groundmass here.

Ship samples directly to: Dr. Paul Damon, Department of Geosciences, Gould-Simpson Building, Tucson, Arizona 85721 USA. Include list of samples with estimated ages and note that age dating was authorized by Dr. Howard Ross, UURI.

Please ship samples before 4/01/87 and send TELEX to me when samples are shipped.

Sincerely,

Dr. Howard Ross
University of Utah Research Institute

GRAPHNET 3789459 UNIV UTAH SLC

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

March 11, 1986

MEMORANDUM

TO: Howard Ross
FROM: Duncan Foley
SUBJECT: Collection of Samples for K-Ar Dating

Several preliminary questions need to be answered before geologic samples are collected for dating by K-Ar methods. The goal of the dating program must be identified, and the samples must be selected appropriately to meet that goal. A program to establish geologic ages of rock units will require different samples than a program to establish ages of alteration episodes or thermal events.

For young volcanic rocks, Paul Damon at the University of Arizona suggests the following procedures. Only fresh material should be collected. Remove all weathering and, if possible, collect massive rather than fractured portions of units. For basalt, this means that the middle of flows, rather than rubbly flow tops or bottoms, will give the best results. Damon separates plagioclase out of the groundmass for dating basalts. In rhyolitic units, he prefers to use potassium feldspar with good crystal face reflections, especially sanidine. These procedures are undertaken to minimize contamination by atmospheric argon, as such contamination could totally obscure the small amount of radiogenic argon generated in short geologic times. Other K-bearing minerals can be dated, but they may not give reliable results for young units. Damon has found, for instance, that biotite, which is often used in K-Ar dating programs, may contain significant amounts of excess argon.

The amount of sample collected will, of course, be dependent upon the amounts of K-bearing minerals in the various rocks. No general rule applies, but 10 to 30 lbs (5-15 kg) may be needed. It is always best to err on the side of too much sample.

An additional requirement is to estimate the age of the sample. This will allow Damon to estimate the amount of sample that will be loaded in the mass spectrometer.

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

December 9, 1985

MEMORANDUM

TO: Marshall Reed
Peggy Brookshier

FROM: Duncan Foley

SUBJECT: University of Arizona Dating

The time is fast approaching for us to make some fundamental philosophical decisions about the handling of the Arizona dating program. We need to identify the 40 best samples for dating, and make sure that we are fair to all researchers who might be interested in using this service. We will need to establish procedures to decide who gets what dated, which I hope we can keep at an informal level.

We can inform people of this service either through phone calls or letters. The following people and programs might be contacted:

- State Coupled Program teams
- Cascade researchers
- Magma researchers
- Ascension program
- Cooperative work with Mexico
- Industry (for samples that are otherwise unavailable which would add to DOE programs, e.g. Union or others in Long Valley, etc.)

If researchers are interested in having sample(s) dated, we should request brief statements of the importance of each sample to their program, the anticipated age of the sample (hopefully younger than 500,000 years), and a sample description including, if possible, mineralogical and chemical analyses, and how many minerals in each sample they would like dated. We should also request other appropriate data to evaluate the datability of the samples, to be able to develop priorities.

If fewer than 40 samples are identified, we will be able to date them all. If more than 40 are suggested, we may wish to prioritize them and date the top 25 or 30, and save the rest of the dates for the field season next year. I have listed potential samples below. Many more probably exist.

I will call you for feedback on these thoughts.



DF/jp

Potential Samples for University of Arizona K-Ar Dating

State Coupled Program

Oregon (George has 5 or more samples)
Others (Alaska, Hawaii, New Mexico, Utah, etc.?)

Cascade Program

Possible samples from areas near drill sites, or other areas (Medicine Lake)

Magma

Long Valley, Coso, Black Butte, others

Ascension

Dennis Nielson has several samples to be dated

Mexico

Cerro Prieto, Los Azufres

Industry

Long Valley, Newberry, Medicine Lake



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DEPARTMENT OF GEOSCIENCES
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TEL. (602) 621-6024

January 29, 1987

Dr. Howard P. Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Dr. Ross:

I have enclosed ten specimen information sheets for the samples that you are sending and for the two sent by Marshal Reid (CP1, CP2). We need to know an estimated age to adjust our isotopic spike and sample weight for optimum measurement conditions.

Also enclosed is a Xerox copy of my letter to Ronald King requesting extension of the financial assistance award for an additional year at no extra cost.

Sincerely,

Paul E. Damon
Professor

jo
Enclosures

UNIVERSITY OF ARIZONA DEPARTMENT OF GEOSCIENCES
LABORATORY OF ISOTOPE GEOCHEMISTRY
SPECIMEN INFORMATION PAGE 1 (8/76)

U A -
1 File number

2 Date received

Work Verified

14 Latitude

Longitude

Om
Circ. error

17 Topographic Map Name/Size

Scale Fraction

Alt. m

16 Country

T R
18 Land survey position

S
Section

State or Province

Outcrop

b	a
c	d

Letter grid

County or Sub-province

Mine



District

Drill hole

Quarters

19 Location name

0-Official
L-Local Use
P-Proposed
U-Unofficial

20 Rock formation name

27 Rock type

WR or Mineral Separated

Kg Rock

Mineral

Thin Sect.

13 Cost Share

(11) Hold Date

7 Project name

8 Principal investigator

9 Collaborator

10 Address

12 Collector(s)

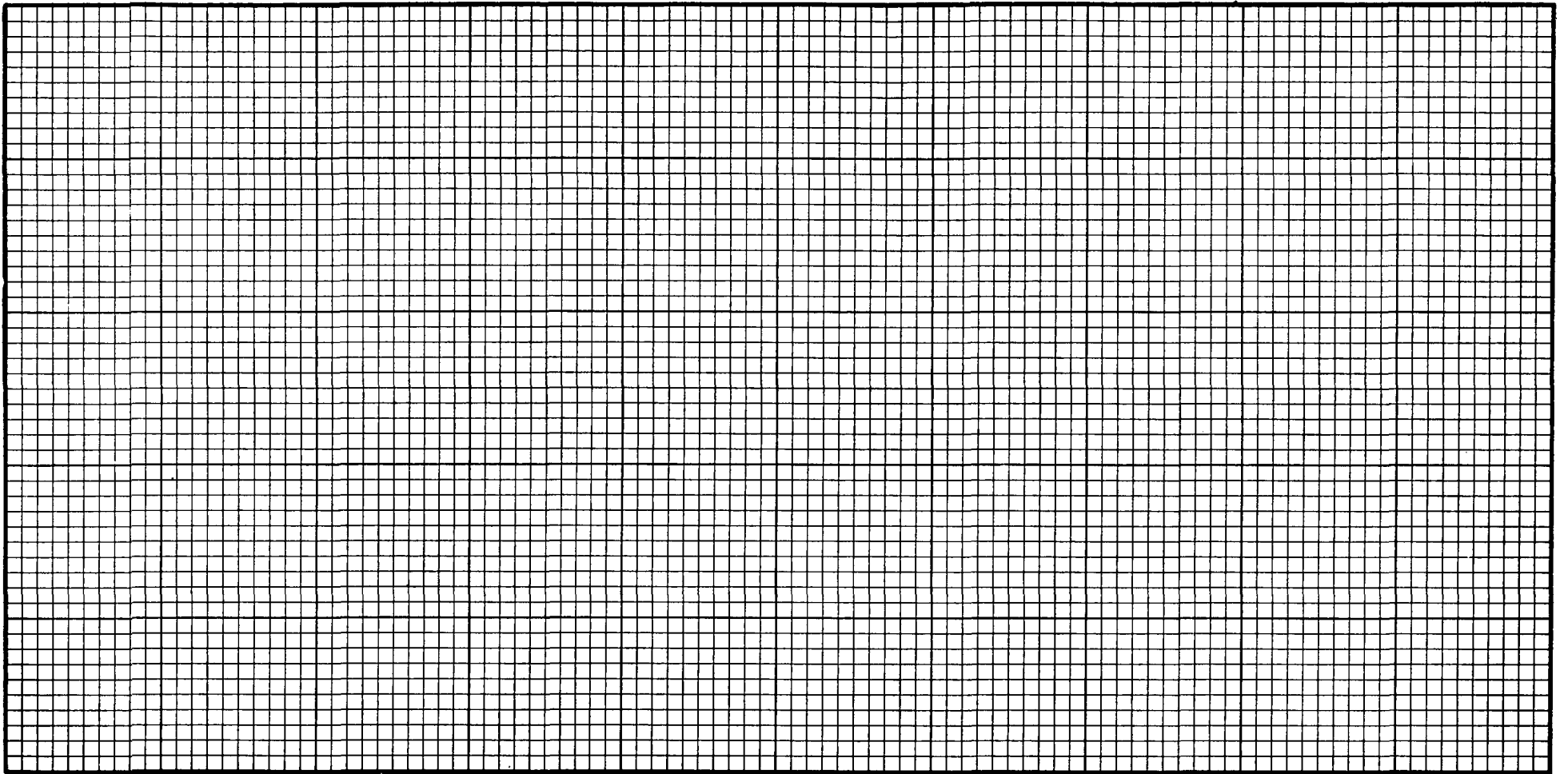
4 Alternate identification this specimen

Geologic significance of this date

23

Estimated Age m.y.

Comments not to be coded



Sketch

Site Geology and
Description of Locality

2 Date received

Work Verified

14 Latitude

Longitude

Om
 Circ. error

17 Topographic Map Name/Size

Scale Fraction

Alt. m

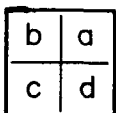
16 Country

T R
 18 Land survey position

S
 Section

State or Province

Outcrop



Letter grid

County or Sub-province

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Thin Sect.

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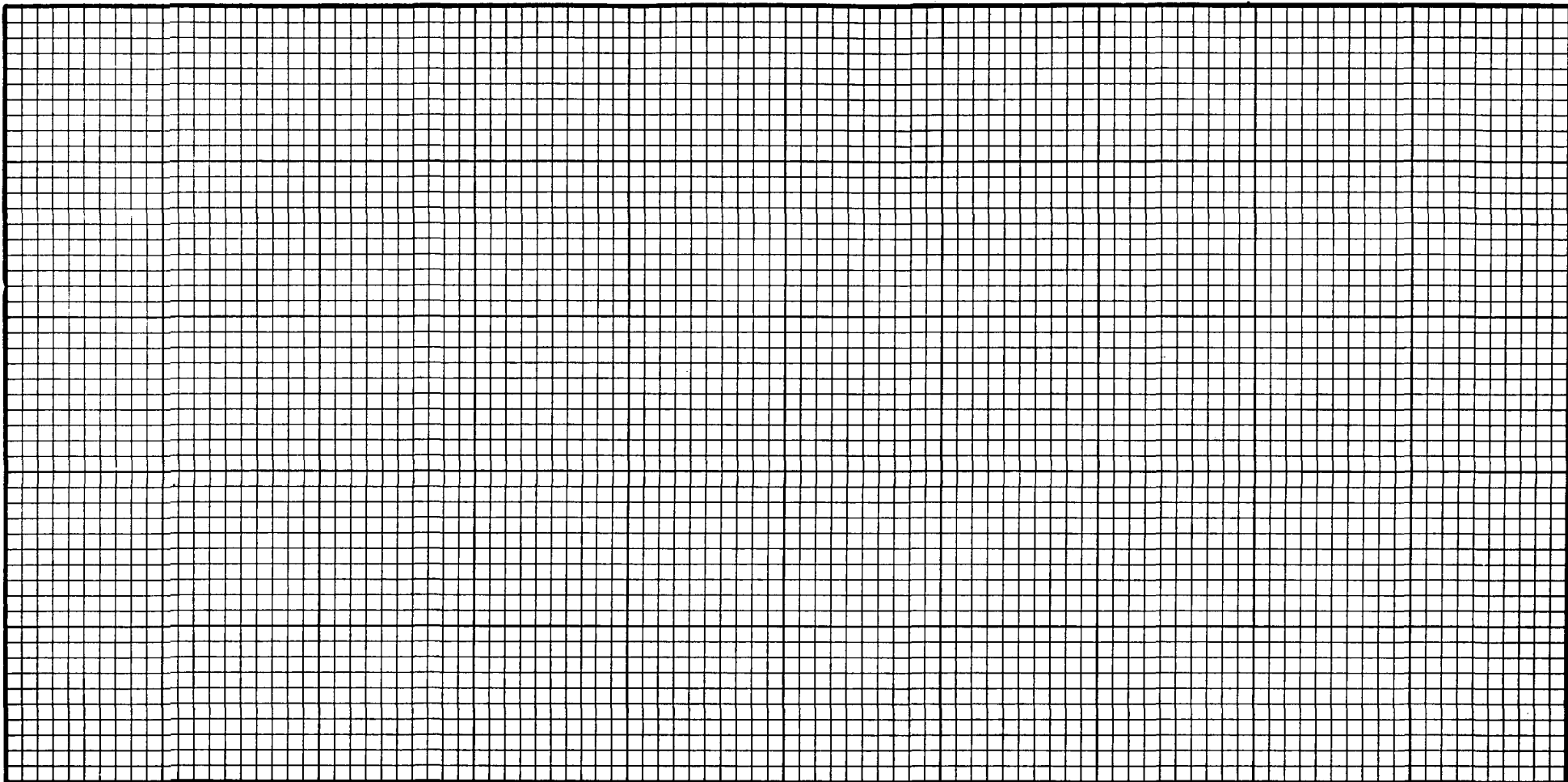
4 Alternate identification this specimen

Geologic significance of this date

23

Estimated Age m.y.

Comments not to be coded



Sketch

Site Geology and
Description of Locality

UNIVERSITY OF ARIZONA DEPARTMENT OF GEOSCIENCES
 LABORATORY OF ISOTOPE GEOCHEMISTRY
 SPECIMEN INFORMATION PAGE 1 (8/76)

U.A. -
 1 File number

2 Date received / /
 Work Verified / /

14 Latitude Longitude Om
 Circ. error

17 Topographic Map Name/Size Scale Fraction Alt. m

16 Country **T** **R** **S**
 State or Province Outcrop Section
 County or Sub-province Mine Letter grid
 District Drill hole

b	a
c	d

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 Quarters

19 Location name 0-Official
 20 Rock formation name L-Local Use
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 U-Unofficial

27 Rock type WR or Mineral Separated / /
 Kg Rock Mineral Thin Sect. 13 Cost Share (11) Hold Date

7 Project name

8 Principal investigator

9 Collaborator

10 Address

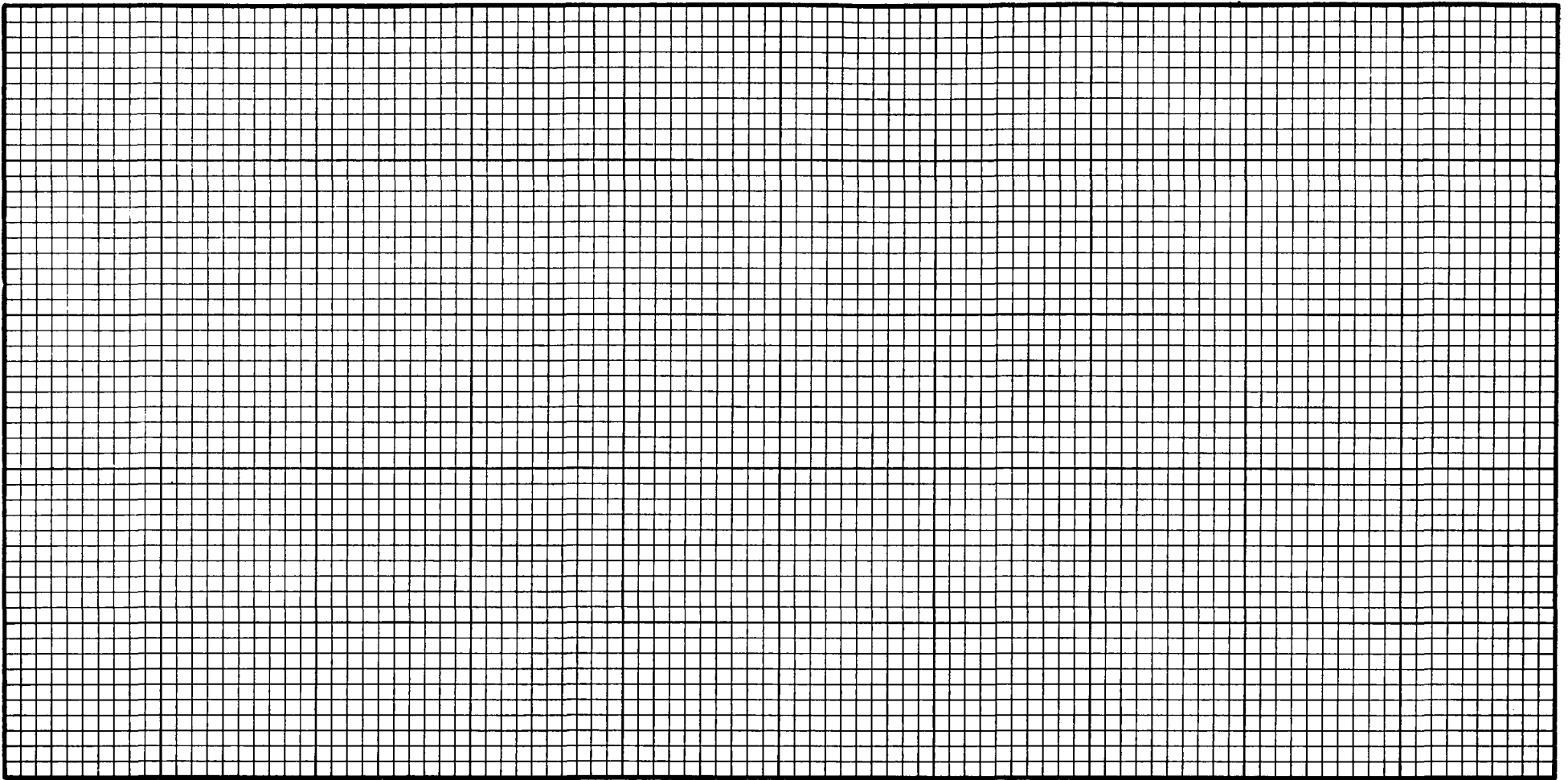
12 Collector(s)

4 Alternate identification this specimen

Geologic significance of this date
 23

Estimated Age m.y.

Comments not to be coded



Sketch

Site Geology and
Description of Locality

2 Date received _____

Work Verified _____

14 Latitude _____

Longitude _____

Circ. error _____ Om

17 Topographic Map Name/Size _____

Scale Fraction _____

Alt. _____ m

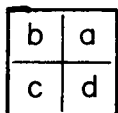
16 Country _____

18 Land survey position **T** **R** _____

Section **S** _____

State or Province _____

Outcrop



Letter grid

County or Sub-province _____

Mine



District _____

Drill hole

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27 Rock type _____

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Kg Rock

Mineral

Thin Sect.

13 Cost Share

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9 Collaborator _____

10 Address _____

12 Collector(s) _____

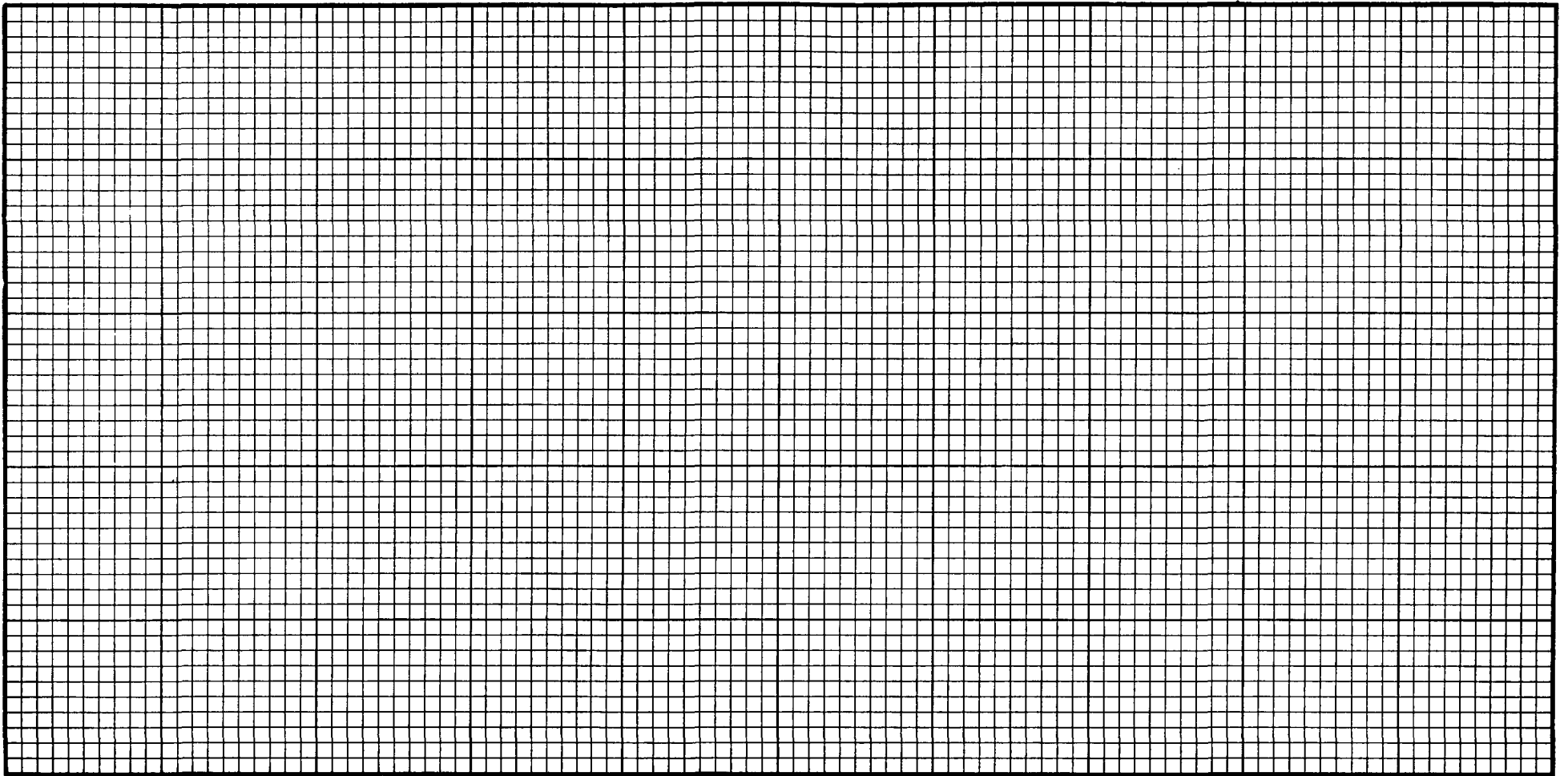
4 Alternate identification this specimen _____

Geologic significance of this date

23

Estimated Age _____ m.y.

Comments not to be coded



Sketch

Site Geology and
Description of Locality

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14 Latitude

Longitude

Circ. error

17 Topographic Map Name/Size

Scale Fraction

Alt. m

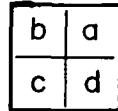
16 Country

18 Land survey position

Section

State or Province

Outcrop



County or Sub-province

Mine

Letter grid

District

Drill hole

↓
Quarters

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L-Local Use
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Kg Rock

Mineral

Thin Sect.

13 Cost Share

(11) Hold Date

7 Project name

8 Principal investigator

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10 Address

12 Collector(s)

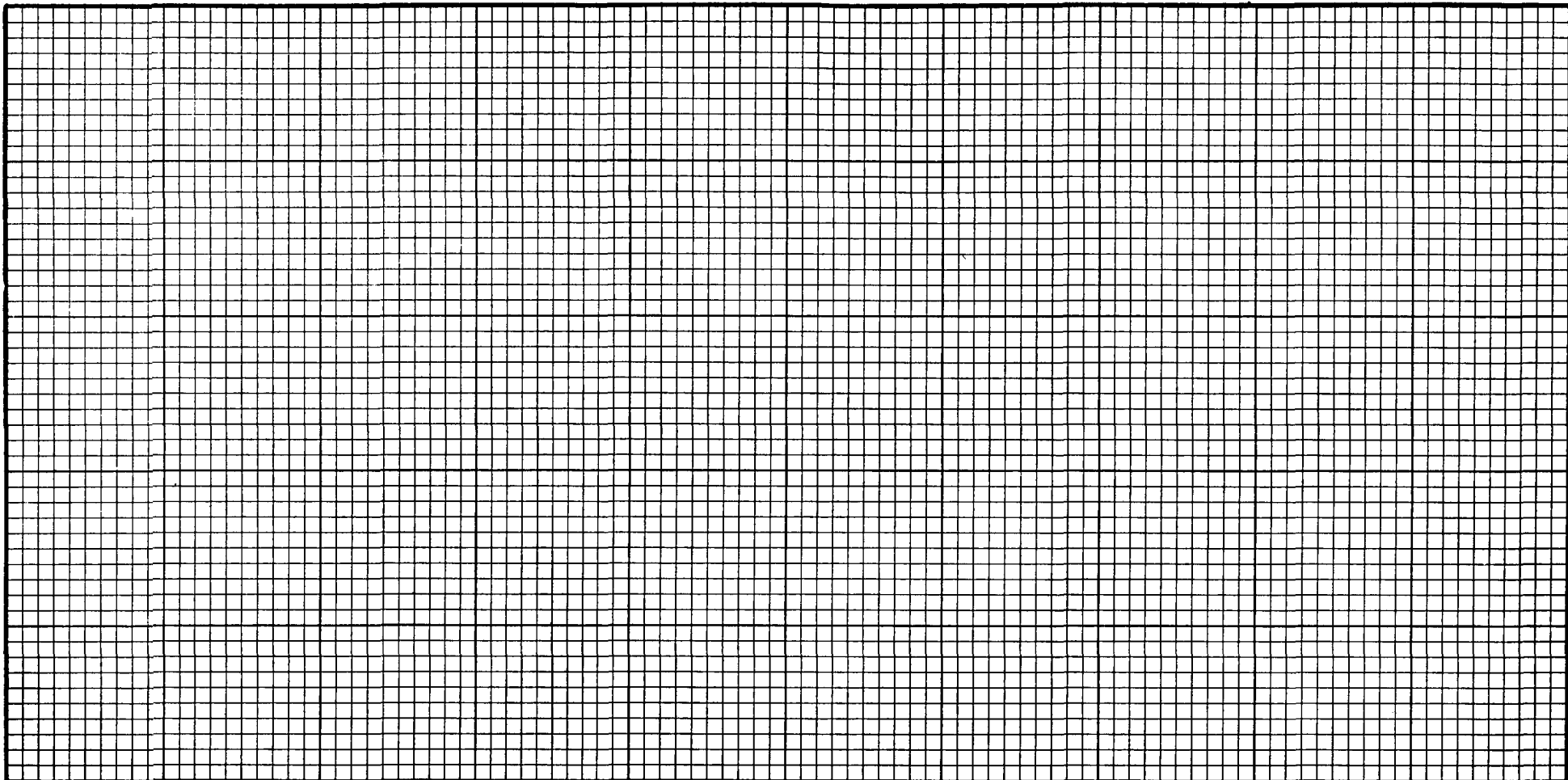
4 Alternate identification this specimen

Geologic significance of this date

23

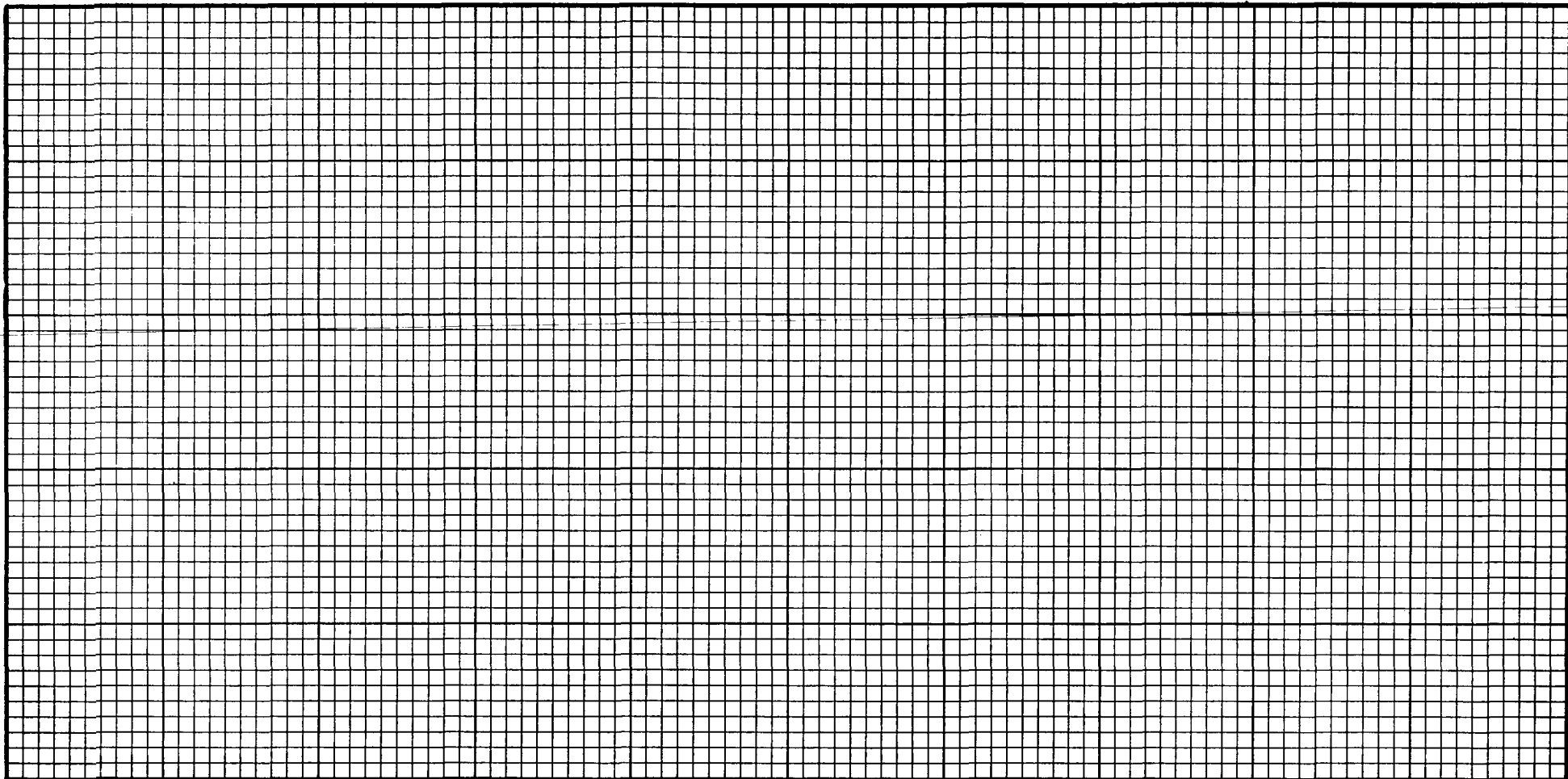
Estimated Age m.y.

Comments not to be coded



Sketch

Site Geology and
Description of Locality



Sketch

Site Geology and
Description of Locality

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

March 11, 1986

MEMORANDUM

TO: Howard Ross
FROM: Duncan Foley
SUBJECT: Collection of Samples for K-Ar Dating

Several preliminary questions need to be answered before geologic samples are collected for dating by K-Ar methods. The goal of the dating program must be identified, and the samples must be selected appropriately to meet that goal. A program to establish geologic ages of rock units will require different samples than a program to establish ages of alteration episodes or thermal events.

For young volcanic rocks, Paul Damon at the University of Arizona suggests the following procedures. Only fresh material should be collected. Remove all weathering and, if possible, collect massive rather than fractured portions of units. For basalt, this means that the middle of flows, rather than rubbly flow tops or bottoms, will give the best results. Damon separates plagioclase out of the groundmass for dating basalts. In rhyolitic units, he prefers to use potassium feldspar with good crystal face reflections, especially sanidine. These procedures are undertaken to minimize contamination by atmospheric argon, as such contamination could totally obscure the small amount of radiogenic argon generated in short geologic times. Other K-bearing minerals can be dated, but they may not give reliable results for young units. Damon has found, for instance, that biotite, which is often used in K-Ar dating programs, may contain significant amounts of excess argon.

The amount of sample collected will, of course, be dependent upon the amounts of K-bearing minerals in the various rocks. No general rule applies, but 10 to 30 lbs (5-15 kg) may be needed. It is always best to err on the side of too much sample.

An additional requirement is to estimate the age of the sample. This will allow Damon to estimate the amount of sample that will be loaded in the mass spectrometer.