Project #: G-35-655  
Center #: R6373-0A0  

Contract#: DACW19-87-M-0209  
Prime #:  

Subprojects ?: N  
Main project #:  

Project unit: GEO SCI  
Project director(s): WAMPLER J M  

Sponsor/division names: ARMY / CORPS OF ENGINEERS  
Sponsor/division codes: 102 / 010  

Award period: 870709 to 870818 (performance) 871130 (reports)  

Sponsor amount  
Contract value 3,000  
Funded 3,000  

Cost sharing amount  

Does subcontracting plan apply ?: N  

Title: POTASSIUM-ARGON DATING OF CLAY AND ROCK SAMPLES FROM THE PORTUGUESE.....  

OCA contact: William F. Brown  
Sponsor technical contact  
MR. RAY WILLINGHAM 
(404)429-5271  
US ARMY ENGR DIV LAB, SO. ATLANTIC_  
611 SO. COBB DRIVE_  
MARIETTA, GA 30060-3112_  

Sponsor issuing office  
MS. DORTHEA DAVIS  
(404)331-6939  
US ARMY ENGR DIV (CESADCT)  
435 TITLE BLDG, 30 PRYOR ST., SW_  
ATLANTA, GA 30335-6801_  

Security class (U,C,S,TS): U  
Defense priority rating: NONE  
Equipment title vests with Sponsor X  
NONE PROPOSED OR ANTICIPATED  

ONR resident rep. is ACO (Y/N): N  
N/A supplemental sheet  
GIT  

Administrative comments - 
INITIATION OF PROJECT G-35-655. FIRM FIXED PRICE. NCE TO 11/30/87 REQUESTED.
SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 3/16/88

Project No. G-35-655

School/Lab  Cae. Sci.

Includes Subproject No.(s)  N/A

Project Director(s)  J. M. Wampler  GTRC/61X

Sponsor  Army Corp of Engineers

Title  Potassium-Argon Dating of Clay and Rock Samples from the Portogues and Cerrillo Dam Sites

Effective Completion Date:  8/18/87 (Performance)  11/30/87 (Reports)

Grant/Contract Closeout Actions Remaining:

☐ None
☐ Final Invoice or Copy of Last Invoice Serving as Final
☒ Release and Assignment
☒ Final Report of Inventions and/or Subcontract:
  Patent and Subcontract Questionnaire
    sent to Project Director  ☒

☐ Govt. Property Inventory & Related Certificate
☐ Classified Material Certificate
☐ Other

Continues Project No.  ___________________________________ Continued by Project No.  ___________________________________

COPIES TO:

Project Director
Research Administrative Network
Research Property Management
Accounting
Procurement/GTRI Supply Services
Research Security Services
Reports Coordinator (OCA)
Program Administration Division
Contract Support Division

Facilities Management - ERB
Library
GTRC
Project File
Other

______________________________________________________

______________________________________________________
FINAL REPORT

Potassium-Argon Dating of Clay and Rock Samples from the Portugues and Cerrillo Dam Sites

for:

U. S. Army Engineer Division Lab
South Atlantic Division
611 South Cobb Drive
Marietta, Georgia 30060-3112

by:

J. M. Wampler
School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, Georgia 30332

Project No. G-35-655
Georgia Tech Research Corporation

February 1988
Table of Contents


2. Table: Potassium-argon analytical data for clay-size (< 2 micrometers) material separated from fault-gauge samples and for one specimen of igneous rock.


4. Table: Potassium-argon analytical data for very fine clay (< 0.2 micrometers) separated from fault-gauge samples from the Portugues dam site.
Mr. Ray Willingham
U. S. Army Engineer Division Lab.
South Atlantic Division
611 South Cobb Drive
Marietta, GA 30060-3112

Dear Ray:

Enclosed is a table of potassium-argon analytical data we have obtained from five samples of very fine clay (particle size less than 0.2 micrometers) separated from soil samples from the Portugues dam site. If you remember my preliminary report by telephone, you will find that these age values are slightly larger than those I reported verbally. The difference is a consequence of a necessary correction for a background signal in the mass spectrometer, which had not been included when the preliminary age values were calculated.

The results of these analyses on the very fine clay fractions are little different from the earlier-reported results on clay-sized (less than two micrometers) samples separated from the same soil samples. The reason we have analysed the very fine clay fractions is the presumption that the effects of disturbances such as faulting would most likely be manifest in the finest material. But in these cases, the finest material has about the same potassium-argon age as the coarser clay. In two cases (259/255 and 259/257) the apparent age of the very fine clay is lower than that obtained for the coarser clay by an amount that is several times the estimated analytical error. Perhaps these differences have some geological significance.

My interpretation of the results of the earlier work, which I reported to you in July, was that the potassium-argon ages provided good evidence that the clay that we analysed had formed during the Eocene Epoch and has not been significantly altered since. The results reported herein suggest that the very fine clay also has not been significantly altered since the Eocene, except in two cases where there is a possibility that a later disturbance has caused a little change in the fine clay. But it is clear that if there has been a disturbance much later than Eocene time, its effect on the potassium-argon relationship in even the finest clay has been minimal.

Sincerely,

J. M. Wampler
Associate Director
Potassium-argon analytical data for very fine clay (<0.2 micrometers) separated from fault-gouge samples from the Portugues dam site

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Mass (g)</th>
<th>Potassium (%)</th>
<th>Radiogenic Argon (%)</th>
<th>Apparent Age (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>259/249</td>
<td>0.0347</td>
<td>1.30 ± 0.01</td>
<td>7.6</td>
<td>39.3 ± 10.7</td>
</tr>
<tr>
<td>259/251</td>
<td>0.0270</td>
<td>0.80 ± 0.01</td>
<td>18.3</td>
<td>46.8 ± 4.9</td>
</tr>
<tr>
<td>259/252</td>
<td>0.0644</td>
<td>3.10 ± 0.03</td>
<td>61.3</td>
<td>45.3 ± 1.1</td>
</tr>
<tr>
<td>259/255</td>
<td>0.0994</td>
<td>4.81 ± 0.05</td>
<td>84.1</td>
<td>40.7 ± 0.8</td>
</tr>
<tr>
<td>259/257</td>
<td>0.0368</td>
<td>3.76 ± 0.04</td>
<td>45.6</td>
<td>36.7 ± 1.3</td>
</tr>
</tbody>
</table>

1. The percentage of radiogenic argon is relative to the total amount of argon released during heating of the sample. Some of the non-radiogenic argon comes from the apparatus rather than from the sample, so this quantity is not necessarily reproducible in repeated analyses of a particular material.

2. Apparent ages were calculated using the values for the decay constants and isotopic abundance of potassium-40 adopted by the IUGS Subcommission on Geochronology in 1976.
Mr. Ray Willingham  
U. S. Army Engineer Division Lab.  
South Atlantic Division  
611 South Cobb Drive  
Marietta, GA 30060-3112

Dear Ray:

Enclosed is a table of potassium—argon analytical data we have obtained from nine samples of clay (particle size less than two micrometers) from the Portugues dam site and from one sample of clay and one sample of igneous rock from the Cerrillos dam site. The igneous rock is the one that you have identified as a dike rock, and in this case the material analysed was a sample of the whole rock.

The apparent ages obtained for these samples range from 39 million years to 46.5 million years and provide good evidence that the clay and rock analysed were formed in the Eocene Epoch and have not been significantly altered since. We analysed the clay samples by x-ray diffraction and found them to have varying proportions of illite, illite/smectite, smectite and kaolinite. The consistency in the apparent ages for the clays is rather remarkable in comparison to what is generally found for clay samples of continental origin, which often are mixtures of clays having a wide range in age. When such mixtures are analysed, the apparent ages obtained are usually quite variable, because the apparent age of a mixture will depend strongly on the proportions of the different components. The apparent ages obtained in this work cluster around 40 million years. I would guess that most of the material that you gave us was formed by geological processes about 40 million years ago, but that in some samples there is an admixture of somewhat older material.

There were problems during analysis of some of these samples, which may not be fully expressed in the estimated errors shown in the table. The clays separated from the soil in jars 259/254 and 259/255 were both rich in illite and are quite similar in potassium content, which is to be expected since these jars were filled from the same fault-gouge material. Yet the apparent ages for these two clays are near the bottom and at the top of the range of values we obtained. Clay-sized material was separated from the material in each jar independently, so the two materials analysed were not necessarily identical, yet I am suspicious of the relatively large difference in the results for these two. For this reason, I expect to re-analyse a few of these samples. We also plan to subdivide some of the clay samples into more narrow size fractions to see if, for example, we can partially separate the discrete illite from other potassium-bearing material that may be present. We would then be able to see whether there is a variation in apparent age that depends on size or composition.
Mr. Ray Willingham
28 July 1987

Please let me know if you or your colleagues have any particular requests for additional analyses of these samples. For example, would you want us to attempt a mineral separation on the dike rock to see if different minerals give the same apparent age as the whole rock? I regret that it has taken us so long to get this work done, but I hope you will find these results to be quite useful.

Sincerely,

J. M. Wampler
Associate Director
Potassium-argon analytical data for clay-size (<2 micrometers) material separated from fault-gouge samples and for one specimen of igneous rock

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Mass (g)</th>
<th>Potassium (%)</th>
<th>Radiogenic Argon (%)</th>
<th>Apparent Age (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portugues Dam Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>259/249</td>
<td>0.1530</td>
<td>1.91 ± 0.02</td>
<td>19.2 ± 0.02</td>
<td>45.3 ± 4.5</td>
</tr>
<tr>
<td>259/250</td>
<td>0.1175</td>
<td>2.11 ± 0.02</td>
<td>65.4 ± 0.04</td>
<td>41.6 ± 1.0</td>
</tr>
<tr>
<td>259/251</td>
<td>0.0241</td>
<td>2.25 ± 0.02</td>
<td>15.8 ± 0.03</td>
<td>43.6 ± 5.4</td>
</tr>
<tr>
<td>259/252</td>
<td>0.1644</td>
<td>3.45 ± 0.03</td>
<td>60.4 ± 0.05</td>
<td>42.0 ± 1.1</td>
</tr>
<tr>
<td>259/253</td>
<td>0.1828</td>
<td>4.97 ± 0.05</td>
<td>82.5 ± 0.04</td>
<td>44.6 ± 0.8</td>
</tr>
<tr>
<td>259/254</td>
<td>0.2012</td>
<td>5.62 ± 0.06</td>
<td>94.5 ± 0.05</td>
<td>39.9 ± 0.7</td>
</tr>
<tr>
<td>259/255</td>
<td>0.2012</td>
<td>5.88 ± 0.06</td>
<td>95.0 ± 0.06</td>
<td>46.5 ± 1.2</td>
</tr>
<tr>
<td>259/256</td>
<td>0.1369</td>
<td>3.66 ± 0.04</td>
<td>71.5 ± 0.04</td>
<td>39.0 ± 0.8</td>
</tr>
<tr>
<td>259/257</td>
<td>[0.1391]</td>
<td>3.26 ± 0.03</td>
<td>59.3 ± 0.02</td>
<td>40.6 ± 1.0</td>
</tr>
<tr>
<td>Cerrillos Dam Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>258/638-B</td>
<td>0.1595</td>
<td>0.68 ± 0.01</td>
<td>61.1 ± 0.01</td>
<td>39.9 ± 1.0</td>
</tr>
<tr>
<td>258/639</td>
<td>0.1162</td>
<td>2.29 ± 0.02</td>
<td>69.1 ± 0.03</td>
<td>45.8 ± 1.0</td>
</tr>
</tbody>
</table>

1. The mass listed is that of the sample analysed for argon. In some cases, the potassium analysis was done on a separate, equivalent sample of the material.

2. The percentage of radiogenic argon is relative to the total amount of argon released during heating of the sample. Some of the non-radiogenic argon comes from the apparatus rather than from the sample, so this quantity is not necessarily reproducible in repeated analyses of a particular material.

3. Apparent ages were calculated using the values for the decay constants and isotopic abundance of potassium-40 adopted by the IUGS Subcommission on Geochronology in 1976.

4. A mistake was made in weighing the sample used for argon analysis, so the quantities in brackets were determined indirectly from potassium measurements of the unweighed sample (after the argon analysis) and of an equivalent sample of the same material, correctly weighed. The uncertainty in the mass of the sample used for argon analysis does not affect the apparent age.

5. The sample identified as 238/638-B is a small portion of a large specimen of igneous rock. The small portion was crushed to provide the material sampled for the "whole-rock" analysis.