

ER Record I.D.# 54424

ERID NO: 54424 DATE RECEIVED: 6/10/96 PROCESSOR: DIC PG COUNT: 7

PRIVILEGED (Y/N): N RECORD CATEGORY: P RECORD PACKAGE NO.: N/A
FILE FOLDER: N/A

CORRECTION (Y/N): N CORRECTED NO.: N/A CORRECTED BY: N/A

AR (Y/N): Y AR DESCRIPTION (D/G): N/A

MISCELLANEOUS: GIDAY WOLDEGABRIEL



3085

7

5/12/94

PRELIMINARY REPORT
FY93

VOLCANIC STRATIGRAPHY OF THE PAJARITO PLATEAU

A. WILLIAM LAUGHLIN
GIDAY WOLDEGABRIEL
EES-1
LOS ALAMOS NATIONAL LABORATORY

DAVID DETHIER
WILLIAMS COLLEGE

October 29, 1993

Received by EFI-RPF
JUN 10 1996
Jic

OBJECTIVES

The primary objective of this work has been to establish, using chemical fingerprinting and high precision $^{40}\text{Ar}/^{39}\text{Ar}$ radiometric dating, a refined stratigraphy of the volcanic rocks of the Pajarito Plateau for the Los Alamos Environmental Restoration Program. A secondary objective was to begin training EES-1 staff in the geochemical, geochronological, and statistical techniques required to establish this stratigraphy.

SOURCE OF SAMPLES

During the second half of FY93, 56 samples of volcanic rocks were obtained from the Pajarito Plateau. These samples, which included 53 basalts and three rhyolites, were obtained from drill cores and cuttings and from surface sampling. Most of the surface samples were collected by David Dethler of Williams College as part of a geomorphological investigation of OU-1122. Subsurface samples were obtained from water wells OT-1 and OT-4 and from the Seismic Hazards Program drill hole SHB-1. Locations of these drill holes are shown in Figures 1 and 2. Descriptions of sample locations provided by Dethler are included in Appendix I. Dethler has not yet provided a map of sample locations.

ANALYTICAL METHODS

Microprobe sections were prepared for all samples collected this year; sections are not available for samples collected by Dethler in 1985 and 1986. These sections have been used to examine the petrology of samples and to select samples for radiometric dating. The EES-1 XRF laboratory was used to obtain major and trace element chemical data for all samples. These chemical data have been entered into the SYSTAT data base for statistical treatment.

Approximately 30 samples were selected for $^{40}\text{Ar}/^{39}\text{Ar}$ radiometric dating at the New Mexico Geochronology Research Laboratory (NMGRL). These samples have been prepared and 26 samples have been dated.

RESULTS

The results of XRF analyses are presented in Appendix II and the results of the statistical treatment of these data are presented in Appendix III. Results of the $^{40}\text{Ar}/^{39}\text{Ar}$ analyses are given in Appendix IV.

DISCUSSION

Geochemistry

The results of XRF major and trace element analysis of 53 basalt and basaltic andesite samples from the Pajarito Plateau show a wide range of chemical compositions, e.g., SiO_2 varies from 47.4 % to 65.80 %. This range, as expected, is very similar to that reported by Duncker et al. (1991) for basalts of the Cerros del Rio volcanic field. With the exception of K_2O (Figure 3), which has a bimodal distribution of concentrations, the major element oxides show unimodal distributions. In general, both the alkalic and tholeiitic basalts are much more evolved than basalts from other New Mexico volcanic fields.

As the first step in the statistical treatment of the geochemical data, a cluster analysis was performed on the 53 mafic rock samples. Because of the wide differences in concentrations of

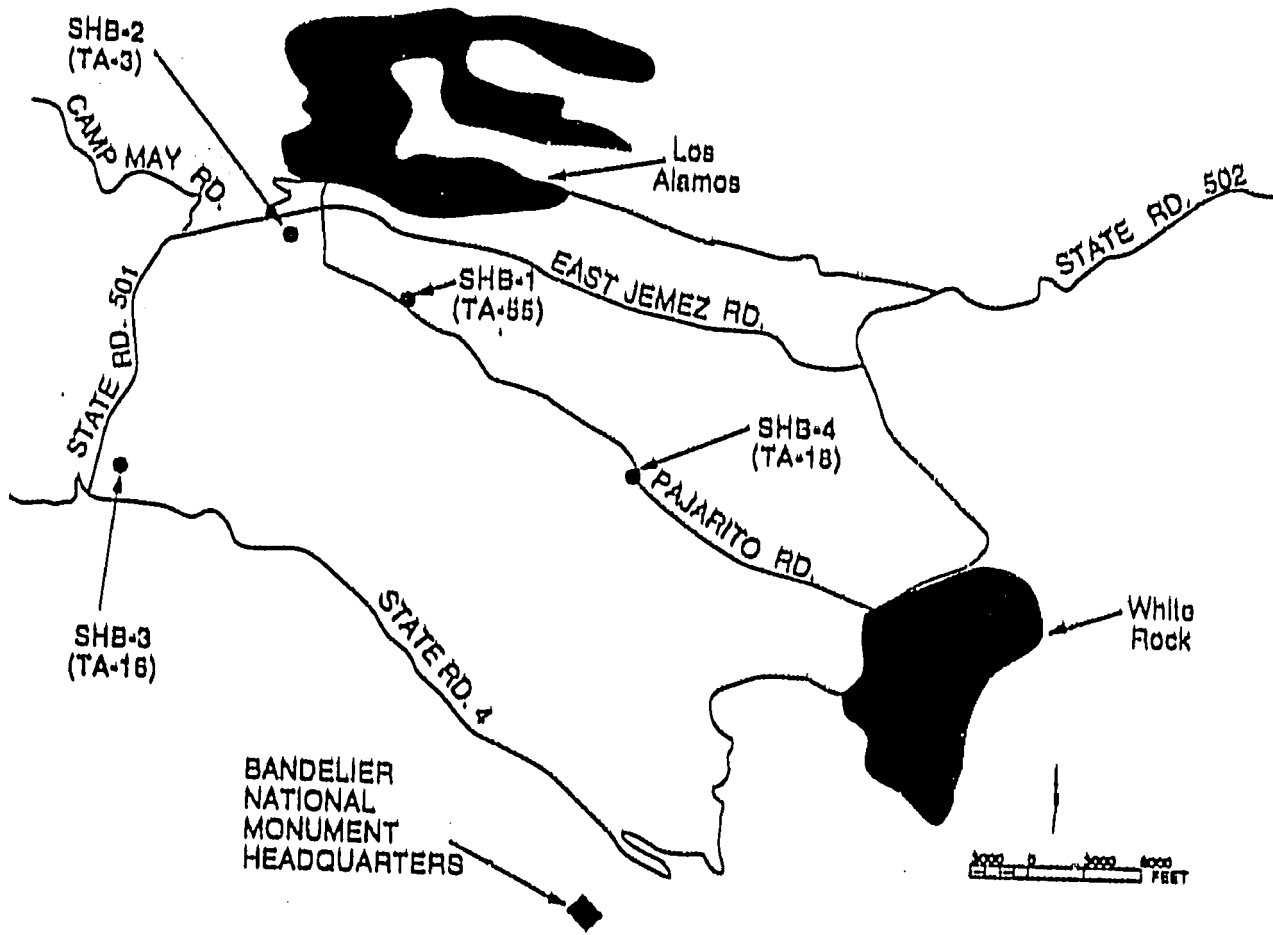


Figure 1: Map of Los Alamos National Laboratory area showing main roads, residential/commercial areas (shaded), and general locations of the Seismic Hazards Program core holes.

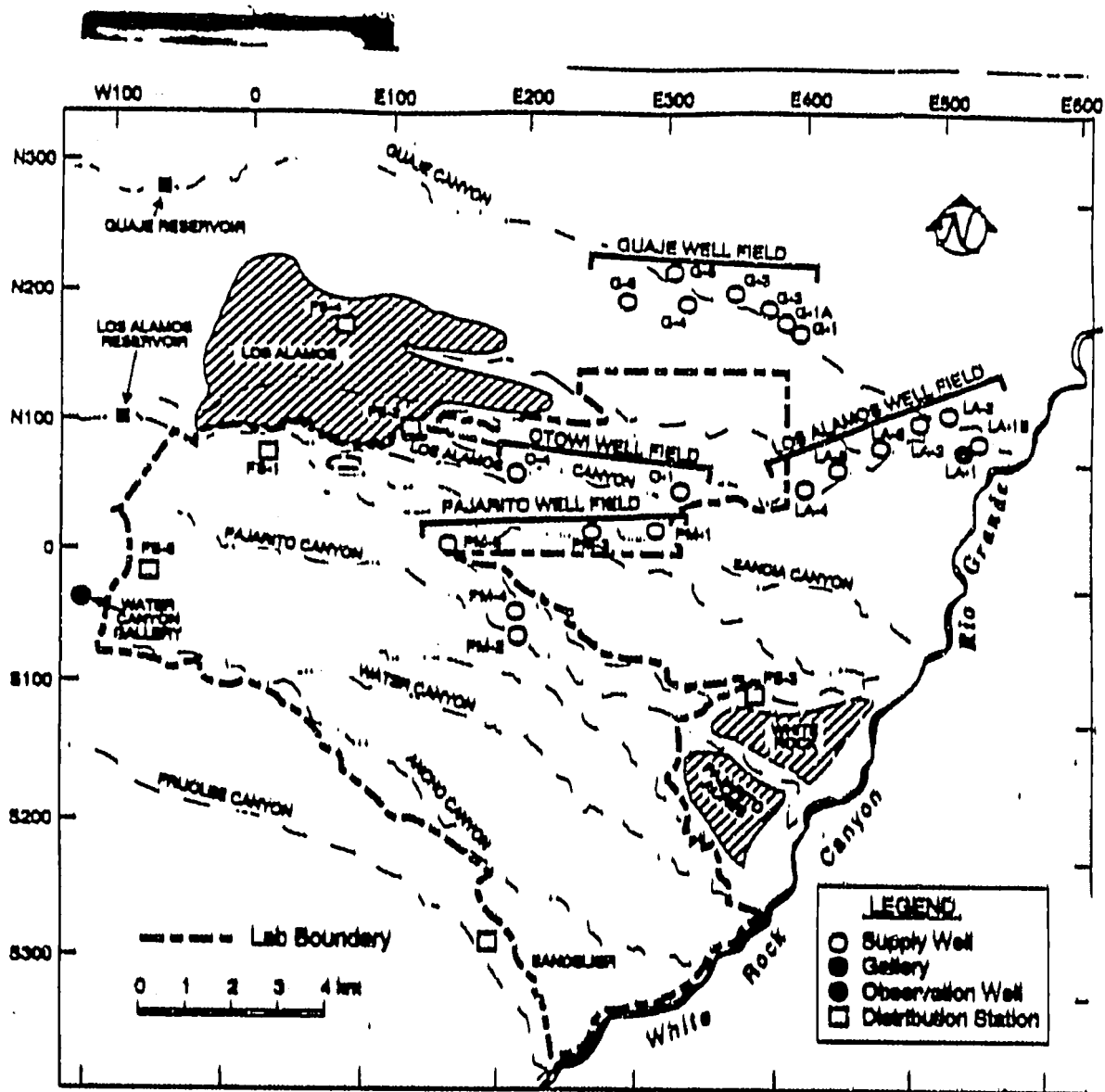


Fig. 1. Locations of reservoirs, well fields, water supply wells, and gallery water supply. Letter designations on the figure indicate wells in the Quaje (G), Pajarito (PM), Los Alamos (LA), and Otowi (O) well fields; some distribution stations are labeled (FS) to indicate fire station locations.

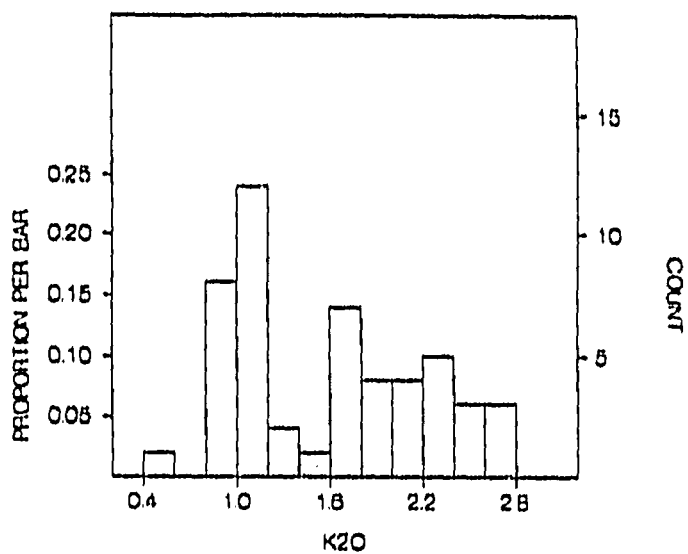


Figure 3. Histogram of K₂O contents of mafic rocks of the Pajarito Plateau.

major and trace elements, the Pearson clustering technique was employed as it is unaffected by scale. Five different basalt types (A-E) were identified by this clustering. Samples included in each of the five basalt types were compiled into five new data sets and the means for the concentrations of the major and trace elements in each type were calculated. These means are presented in Appendix III.

A Pearson correlation matrix was next run for all major and trace elements to determine the correlation coefficients for all possible pairs of major and trace elements. Variation diagrams were then plotted for all pairs where the correlation coefficients were $> +0.8$ or < -0.8 . These diagrams, which are reproduced in Appendix III, will be used eventually as an aid to correlation.

Geochronology

Twenty six samples of mafic rocks from the Pajarito Plateau were dated by the $^{40}\text{Ar}/^{39}\text{Ar}$ method at the NMORL. Results from two of these samples (OT4-1290 & OT1-450) are believed to be spurious because of mixed volcanic lithologies in the cuttings from drill holes. We believe that these intervals represent not single or multiple basalt flows but sedimentary sequences comprised of mixed volcaniclastic sediments.

ACCOMPLISHMENTS IN FY93

1. With ER Program, State of New Mexico, and NSF funding, the geochronology laboratory (NMORL) at New Mexico Institute of Mining and Technology was completed and the first dates released in April, 1993.
2. XRF whole rock chemical analyses were obtained on 53 basalt and three rhyolite samples from the Pajarito Plateau. This data base includes the results of the reanalysis of about 30 basalt samples collected by Dethler in 1985 and 1986 and analyzed at that time by EES-1. These 1985 and 1986 analyses were not considerable comparable to more recent analyses because of recent improved analytical techniques and the samples were reanalyzed.
3. Preliminary statistical treatment of this data base lead to recognition of five general basalt compositions. It is anticipated that when geographic and topographic information are incorporated, that it will be possible to recognize specific flows and source vents.
4. Radiometric dates have been obtained on 26 samples. The dates for mafic rocks range from 2.35 Ma to 11.98 Ma indicating the presence of Cerros del Rio, Paliza Canyon, and Lobato age basalts. Rhyolites were dated at 1.25 Ma and 0.525 Ma. Excess ^{40}Ar was present in sanidine from both rhyolites.
5. Laughlin and WoldeGabriel have received initial training in the use of the $^{40}\text{Ar}/^{39}\text{Ar}$ dating facility and, with only a few more days of training, will be capable of running the laboratory unassisted.
6. Laughlin has begun training WoldeGabriel and Carney in the use of SYSTAT.

ANTICIPATED WORK IN FY94

1. During FY94, surface and drillhole sampling of volcanic rocks from the Pajarito Plateau will continue.
2. All samples will be analyzed by the XRF technique and the results entered in the data base.
3. After petrographic examination, key samples will be selected for radiometric dating.
4. A detailed volcanic stratigraphy of the volcanic rocks of the Pajarito Plateau will be developed.
5. Laughlin will continue training of WoldeGabriel and Carney and will transfer the project to WoldeGabriel at the end of FY94.
6. A LAMS report will be prepared during the last quarter of FY94 summarizing all results. A paper will also be prepared for a refereed journal.

CORRECTION

END