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Nuclear Waste Management Technology Development Activities

January—December 1978

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Edited and Compiled by

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APPENDIX 62

for samples from beneath and away from the pit. Further, the results were indistinguishable, at the 99% confidence level, from uranium concentrations measured in outcrops of the respective units.

Radiochemical analyses of core samples from beneath the disposal pit did not detect any radionuclides whose presence in the core can be attributed to migration from the pit.

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E. Geologic Studies at LASL Waste Disposal Sites

[M. A. Rogers, B. W. Burton, and V. L. Christie]

All waste disposal pits and shafts at Los Alamos are excavated in the Bandelier Tuff, a series of volcanic ashflows and ashfalls with a total maximum thickness of 305 m. Geologic descriptions of the structure and stratigraphy of the tuff are considered essential to a thorough understanding of possible migration pathways from buried waste.

The Bandelier Tuff contains numerous joints or fractures which are a potentially important migration pathway. A joint study of the Bandelier Tuff was done to provide information for assessment of disposal area integrity.

The Bandelier Tuff was deposited by several volcanic eruptions. As each flow cooled, fractures developed. These cooling joints are present only in the tuff and do not extend to depth through other rock units. Structural joints, the result of physical stress upon the rock, do extend to depth. The present joint study has identified those fractures that are the result of regional structural trends as compared to those that are the result of cooling.

All joints have a bearing (strike) and an inclination (dip). Only strike measur[illegible] made in the study because experience has shown the dip of the joints to be vertic[illegible] vertical. Locations were chosen to give a good geographic coverage of the Pajarito Plateau. A computer-based software package was used to plot rose diagrams (see Fig. 1) of the strike data for each location in the study and for a composite of the data. Chi square (X^2) statistical tests were done on the rose diagrams to test for random distribution. The cooling joints should be randomly oriented while the structural joints should have a preferred orientation. Therefore, in order to separate cooling joints from structural joints, the X^2 test must indicate that the distribution of joints on a rose diagram is not the result of random distribution.

Using the combined methods of analysis, structural joints were identified which show alignment with tectonic trends in the area. Data from the study show that in many instances preferred joint orientations from individual locations can be seen to have strongly influenced orientation of various canyons of the Pajarito Plateau drainage system. In particular, the Rio Grande, as it flows through White Rock Canyon, seems to be defined by trends identified in the study.

There are several distinct sets of mapping units for the Bandelier Tuff reported in the literature. Physical properties, chemical properties, and interpretation of the dispositional history of the tuff have been used as bases for these units. No one set can be practically applied to

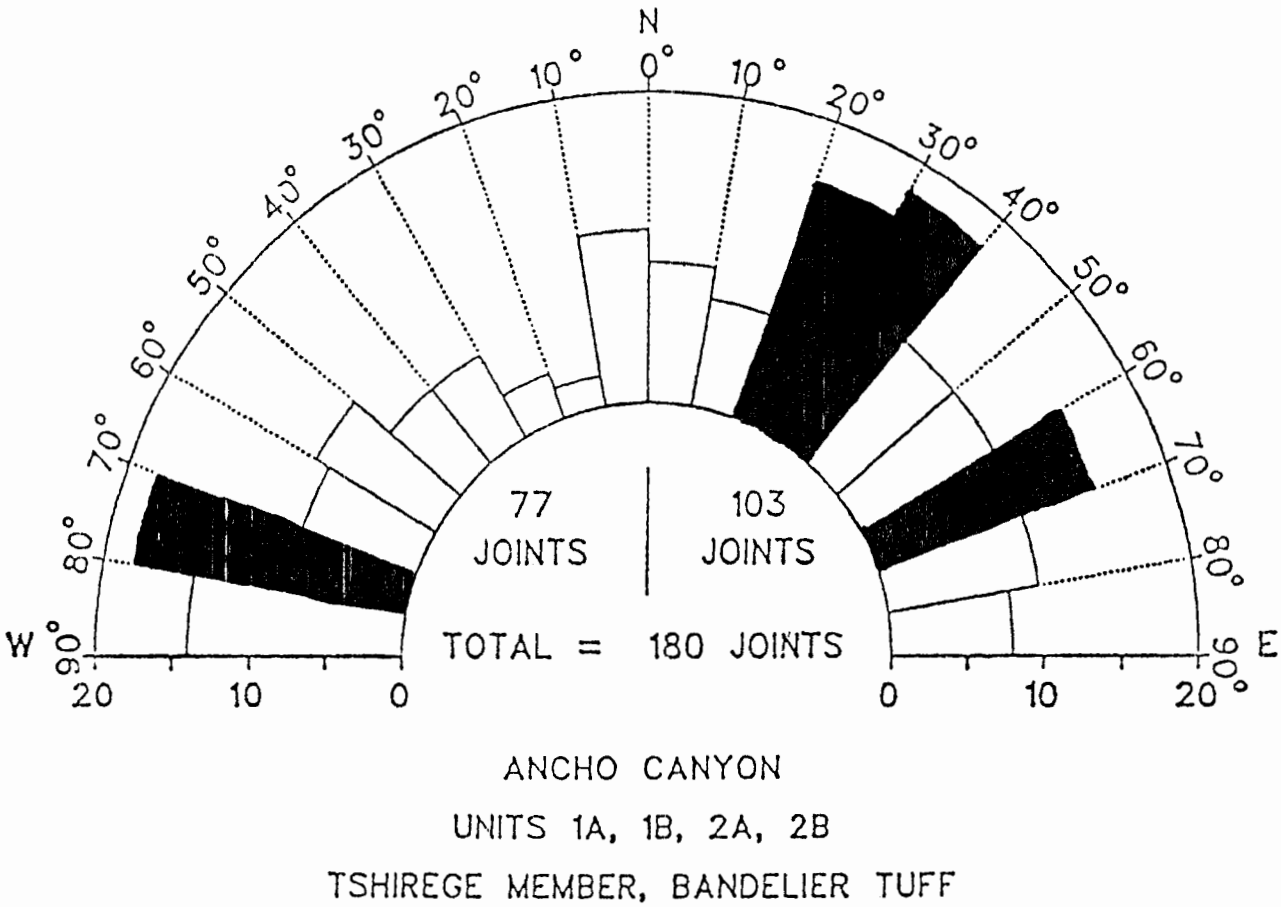

Fig. 1.
Intervals shown in black represent directions of structural jointing. There is 99% confidence that these intervals are not the result of random distribution of joints.

the mapping of the Pajarito Plateau in the LASL environs. However, one set was chosen as a working outline for a new stratigraphy mapping project for waste management purposes. The new stratigraphy (map units) will be related to those currently in the literature to reduce confusion.

The new map units must solve three problems: (1) apply to all of the tuff cropping out on the plateau; (2) accurately correlate the tuff at the surface with the tuff encountered by excavation and drilling; and (3) accurately correlate tuff exposed at the distal end of the plateau with tuff exposed at the proximal end.

One of the problems under investigation in the third category is structural-stratigraphic concerning the amount of displacement on the Pajarito Fault (Fig. 2).[1] Current estimates of displacement are based on present topographic relief in the fault zone. Greater accuracy could be achieved (as well as additional information on erosion rates for the tuff) if the rock on one side of the fault could be correlated with the rock on the other side. Toward this objective, a preliminary investigation of the variation of the axial angle of sanidine feldspar crystals in the tuff was done. With decreasing age a systematic increase was shown in the axial angle. To examine whether this increase had important implications, the Na-K-Ca ratio of the feldspars was determined by microprobe analysis. It appears that the increase in axial angle is not due to changes in chemical composition. The increase in axial angle is sufficiently small that, within the margin of error, it cannot be used by itself as a correlation tool.

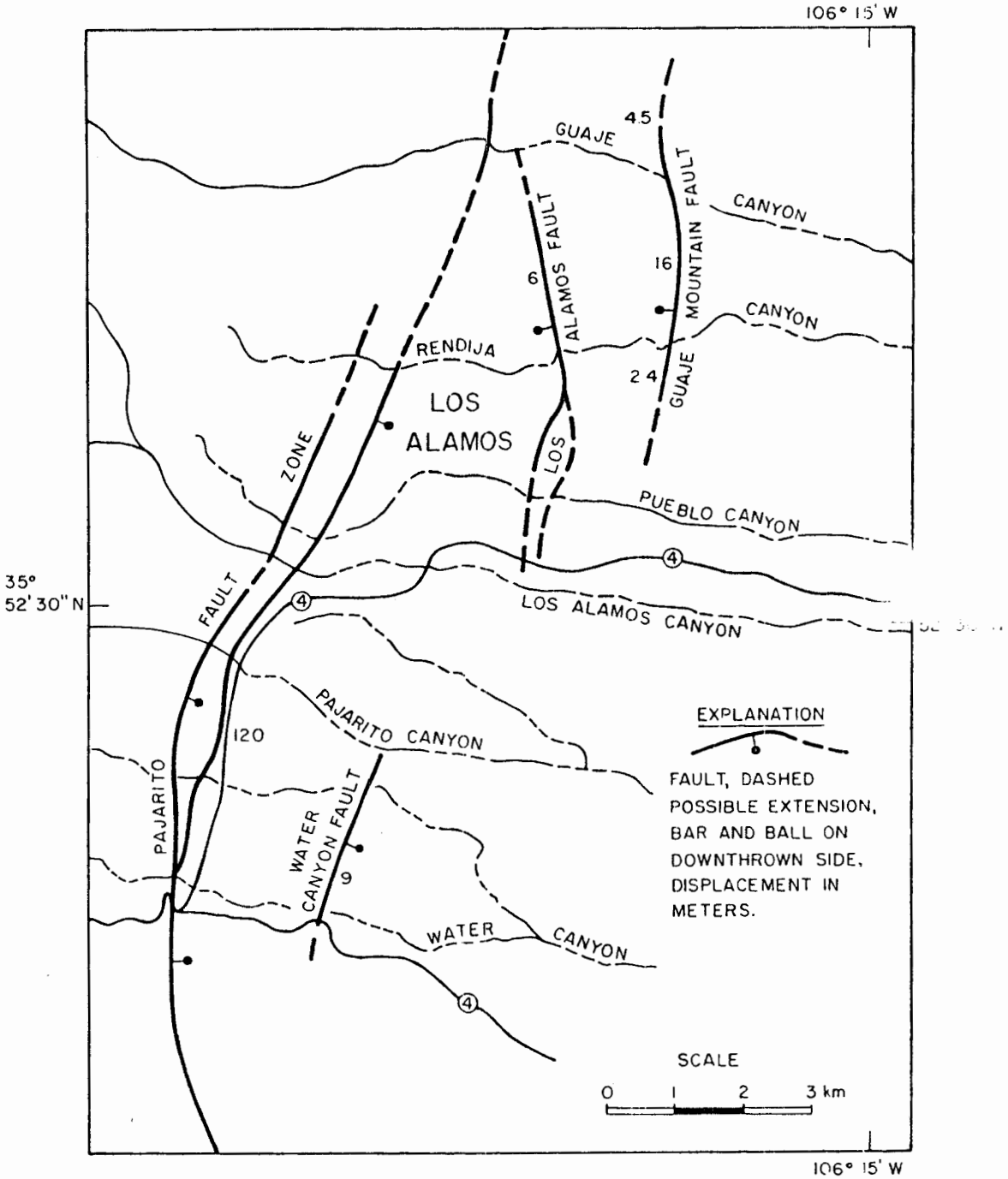

Fig. 2.
Faults in the Los Alamos area.

The Na-K-Ca ratio of the feldspars has been used by other workers,[2] in part as a correlation tool. Further work is in progress.

Another approach to solve problems (2) and (3) in establishing the new map units, is a trace element study. Twenty-seven samples were collected and analyzed for zinc, tungsten, uranium, thorium, rubidium, cesium, cobalt, and tantalum. The initial results shown in Table I suggest that this may be a workable method for differentiating the units. An additional 92 samples are undergoing analyses.

TABLE I

TRACE ELEMENT DISTRIBUTION IN THE BANDELIER TUFF (In PPM)[a]

Unit	Zn	W	U	Th	Cs	Rb	Co	Ta
'shirege Member								
5	32-47	1.1	2.4-3.6	13.1-16.7	1.7-1.9	90.3-98.2	1.1-2.0	2.4-3.1
4	27	0.8	2.1-4.3	13.5	1.2	59.6	1.6	2.7
3b	47-61	1.5-2.2	3.8-4.0	12.2-14.6	2.0	100.0-115.9	0.5-1.5	3.0-3.4
3a	43-54	1.2-3.2	2.9-5.7	12.3-14.0	2.6-2.7	102.6-126.1	0.6-1.2	2.8-3.2
2b	68-80	0.9-2.4	3.9-6.3	17.2-17.8	2.7-3.6	153.8-183.3	0.7-1.1	4.0-4.1
2a	86-91	2.0-3.9	4.9-8.2	22.2-25.2	5.1-6.5	216.1-259.9	0.6-1.1	6.1-6.7
1b	82-93	4.8-5.6	7.2-8.2	22.2-23.6	4.3-5.6	176.9-206.3	0.5-0.7	6.3-6.9
1a	85-114	2.6-4.5	7.4-11.7	22.7-26.2	7.6-9.1	229.3-278.2	0.5-0.8	6.3-7.4
Tsankawi Pumice Bed	---	---	8.3-8.8	---	---	---	---	---
towi Member								
Otowi	---	---	6.3-6.9	---	---	---	---	---
Guaje Pumice Bed	---	---	14.6	---	---	---	---	---

[a] Analytical precision is ±10 per cent.

Table I shows the concentration range for each element studied in each of the current working subunits of the Bandelier Tuff. Only uranium values are available for the Tsankawi Pumice Bed of the Tshirege Member and the Otowi Member. All elements except cobalt show an irregular decrease in concentration from the base to the top of the Tshirege Member. Cobalt concentrations increase slightly upward. Preliminary statistical analysis of the concentration distributions of 8 elements in 27 samples suggests a division of the Tshirege Member into two groups: units 1 and 2 in the lower division and units 3, 4, and 5 in the upper division. Further refinement should be possible as more data become available.

Further work on the mapping project 1978 included the completion of the base topographic maps. The most recently published geologic map (1970),[3] which includes the Pajarito Plateau, is on a scale of 1-in. = 2 miles (2.54 cm = 3.2 km), with a topographic contour interval of 100 ft (30 m). This map does not offer the detail necessary in establishing monitoring schemes for each disposal area. The geologic map preparation uses new base maps which have a scale of 1-in. = 400 ft (2.54 cm = 122 m) with a contour interval of 10 ft (3 m). The compilation of the base maps involved transfer of cultural information onto a set of mylar topographic maps of LASL.

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