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## FISSION-TRACK AGES FOR TEPHRA LAYERS IN UPPER CENOZOIC ROCKS, ESPAÑOLA BASIN, NEW MEXICO

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Zircon phenocrysts from six tephra layers in upper Cenozoic sedimentary rocks of the Española Basin of north-central New Mexico were dated by the fission-track method. At the southern end of the basin, the sedimentary rocks are included in the Miocene to Pliocene Tesuque and upper Pliocene or lower Pleistocene Ancha Formations of the Santa Fe Group as defined by Spiegel and Baldwin (1963). Galusha and Blick (1971) considered the Ancha Formation to be Pleistocene and did not include it in their Santa Fe Group because of the angular unconformity between it and the Tesuque Formation. In the north-central and western parts of the Española Basin, Galusha and Blick (1971) divided the Santa Fe Group into the Miocene Tesuque and Pliocene Chamita Formations. The Puye Formation unconformably overlies the Chamita along the western margin of the basin. On a high plateau in the northeast part of the basin, Miller and others (1963) mapped an ~100 m-thick gravel unit as overlying the Tesuque Formation. It was given a Pleistocene age and the name Ancha, which implied correlation with the Ancha Formation to the south. Remapping of this plateau (Manley, 1976a) has shown that: 1) the gravels are pediment and terrace deposits, which are thinner (< 5 m) and more discontinuous than was previously assumed (Miller and others, 1963), and 2) they are of late Pliocene to Pleistocene age. Unconformably below these gravels are rocks now known to be part of the Tesuque Formation, which include most of the Ancha Formation of Miller and others (1963).

The two oldest samples (nos. 1 and 2) are from the Tesuque Formation on the north and south margins of the plateau in the northeast part of the Española Basin. Ages of  $12.7 \pm 1.8$  m.y. (sample no. 1) and  $10.8 \pm 1.6$  m.y. (sample no. 2) from pumice beneath the Pliocene to Pleistocene pediment gravels indicate that these rocks of the Tesuque are Miocene and probably equivalent to the upper part of the Skull Ridge Member and lower part of the Pojoaque Member of the Tesuque Formation of Galusha and Blick (1971).

Sample nos. 3 and 4 are from the type locality of the Chamita Formation, which is directly south of Black Mesa between the confluence of the Rio Chama and the Rio Grande. Unconformably overlying the Chamita Formation, and capping Black Mesa, is a 2.8 m.y. basalt flow (Manley, 1976b) from the Servilleta Formation. The Chamita Formation contains two tuffaceous zones separated by 150 m of section (MacFadden and Manley, 1976). Vertebrate fossils from the upper tuffaceous zone were assigned to the Hemphillian land mammal age of Wood and others (1941) by Galusha and Blick (1971). Sample no. 3, from

near the middle of the lower tuffaceous zone, is dated at  $5.2 \pm 1.0$  m.y.; sample no. 4, from the uppermost lapillistone of the upper tuffaceous zone, is dated at  $5.6 \pm 0.9$  m.y.

The Puye Formation is considered by both Smith (1938) and Denny (1940) to be primarily of Pleistocene age. Griggs (1964) suggested a late Pliocene(?) age. It is unconformably overlain by the Bandelier Tuff to the north and a basalt flow from the Cerros del Rio volcanic field to the south. This flow has been dated at  $2.4 \pm 0.3$  m.y. by Miles Silberman of the U.S. Geological Survey (R. L. Smith, written communication, 1977). The lower member of the Bandelier Tuff has an age of 1.4 m.y. (Doell and others, 1968). Zircons from a pumice bed in the Puye Formation (sample no. 5), which directly overlies the basal 4.6 m of gravels of the ancestral Rio Grande, have an age of  $2.9 \pm 0.5$  m.y. This age, therefore, provides a slightly older age for Rio Grande deposits than was previously reported (Manley, 1976b).

The type Ancha Formation at the southern end of the Española Basin is overlain by a basalt flow that has a K-Ar age of 2.0 m.y. (Manley, 1976c). Sample no. 6, from near the top of the Ancha at its type locality, has an age of  $2.7 \pm 0.4$  m.y. This age establishes the Ancha Formation as late Pliocene and contemporaneous with the Puye and Servilleta Formations.

### SAMPLE DESCRIPTIONS

1. 75T1 Fission track  
Ash, Tesuque Formation (near  $36^{\circ}02'21''$ N.,  $105^{\circ}53'17''$ W.; Chimayo quadrangle, Rio Arriba Co., NM).  
Analytical data: ratio spontaneous to induced tracks  $ps/\pi = 0.19$  (234 spontaneous tracks; 1,260 induced tracks), neutron flux  $\phi = 1.09 \times 10^{15}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon)  $12.7 \pm 1.8$  m.y.
2. 72027 Fission track  
Pumice, Tesuque Formation (near  $36^{\circ}07'18''$ N.,  $105^{\circ}50'08''$ W.; Truchas quadrangle, Rio Arriba Co., NM).  
Analytical data: ratio spontaneous to induced tracks  $ps/\pi = 0.153$  (207 spontaneous tracks; 1,356 induced tracks), neutron flux  $\phi = 1.15 \times 10^{15}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon)  $10.8 \pm 1.6$  m.y.
3. 75C2 Fission track  
Pumice, Chamita Formation of Galusha and Blick (1971) (near  $36^{\circ}04'20''$ N.,  $106^{\circ}05'08''$ W.; San Juan Pueblo quadrangle, Rio Arriba Co., NM). Analytical

3. (continued)  
data: ratio spontaneous to induced tracks ps/pi = 0.153 (144 spontaneous tracks; 944 induced tracks), neutron flux  $\phi = 5.58 \times 10^{14}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon) 5.2±1.0 m.y.
4. 75C1 Fission track  
 Pumice, Chamita Formation of Galusha and Blick (1971) (near 36°05'57"N., 106°04'50"W.; San Juan Pueblo quadrangle, Rio Arriba Co., NM). Analytical data: ratio spontaneous to induced tracks ps/pi = 0.16 (182 spontaneous tracks; 1,114 induced tracks), neutron flux  $\phi = 5.58 \times 10^{14}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon) 5.6±0.9 m.y.
5. 72P2 Fission track  
 Pumice, Puye Formation (near 35°57'36"N., 106°09'02"W.; Puye quadrangle, Rio Arriba Co., NM). Analytical data: ratio spontaneous to induced tracks ps/pi = 0.086 (144 spontaneous tracks; 1,680 induced tracks), neutron flux  $\phi = 5.58 \times 10^{14}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon) 2.9±0.5 m.y.
6. 73A2 Fission track  
 Pumice, Ancha Formation (near 35°45'10"N., 106°06'26"W.; Horcado Ranch quadrangle, Santa Fe Co., NM). Analytical data: ratio spontaneous to induced tracks ps/pi = 0.047 (131 spontaneous tracks; 2,782 induced tracks), neutron flux  $\phi = 9.27 \times 10^{14}$  n/cm<sup>2</sup>; collected by: Kim Manley; dated by: Kim Manley and C. W. Naeser. (zircon) 2.7±0.4 m.y.

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