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FISSION TRACK DATING OF RAPAKIVI GRANITE IN THE RAINBOW GARDENS AND IN THE SOUTH VIRGIN MOUNTAINS, CLARK COUNTY, NEVADA

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INTRODUCTION

Longwell (1974) described blocks of rapakivi granite and gneiss interbedded with sedimentary rocks of the Tertiary Thumb Formation in Rainbow Gardens, 30 km to the east of Las Vegas. Bohannon (1979) proposed an informal stratigraphy for Tertiary rocks in the Rainbow Gardens area and demonstrated that the blocks are contained in the upper subunit of the lower clastic unit. Longwell (1974) proposed that these blocks were landslide masses that originated in the Gold Butte Pluton in the South Virgin Mountains where similar rocks are exposed. Subsequent strike-slip faulting along the right-lateral Las Vegas Shear Zone displaced the Frenchman Mountain—Rainbow Gardens area containing the slide blocks into the present location. Anderson (1973), and Bohannon (1979a) modified Longwell's interpretation by suggesting instead that the Frenchman Mountain—Rainbow Gardens block was emplaced by left-lateral motion along the Lake Mead Fault System. Additional work on the slide masses and adjacent areas includes that of Brenner-Tourtelot (1979), and Bell and Smith (1980). Whitesell and Wilbanks (1977) in a study of crystal growth parameters of accessory zircon suggested that the rapakivi granites in the slide masses in the Rainbow Gardens correlate with those in the Gold Butte Pluton.

Volborth (1962) mapped the granites of the Gold Butte Pluton and reported Rb-Sr dates determined by Wasserburg and Lanphere (1965) on rapakivi granite and pegmatite ranging from 1061 to 1707 m.y. Volborth (1973) reported a single fission track date on biotite of 84.7 ± 0.2 m.y. on the rapakivi granite at the Gold Butte townsite. Silver and others (1977), by using the U-Pb technique, indicated that the rapakivi granites in Clark County formed about 1410 m.y. ago as part of a large-scale anorogenic plutonic episode that resulted in a series of alkali intrusions stretching from Nevada to Newfoundland, and possibly into eastern Europe (Emslie, 1978). Bohannon (1979b) provided zircon fission track dates which cluster at 15 m.y. from air-fall tuff interbedded with the lower clastic unit. Since the rapakivi granite masses lie within the lower clastic unit, these dates provide a good estimate of the age of gravity sliding.

We provide the first dates on the rapakivi granite in the landslide masses of the Rainbow Gardens. These dates may be helpful in testing the equivalency of the Rainbow Gardens and Gold Butte rapakivi granites, and in dating Laramide and Tertiary events.

Analytical Techniques and Decay Constants

Fission track dating was done at the University of Nevada—Las Vegas according to the techniques of Naeser (1978). Samples were irradiated in the U.S. Geological Survey's nuclear reactor in Denver, Colorado. Tracks were counted on a Zeiss Universal Microscope using a 100 power oil immersion objective. The decay constant for spontaneous fission of ^{238}U used in this paper is 6.85×10^{-17} YR^{-1} (Fleischer and Price, 1964). The neutron dose was determined by counting the induced fission tracks in a piece of standard glass after irradiation. The dates are summarized on Table 1.

Discussion

The zircon date of 84.9 m.y. from the Gold Butte Pluton probably reflects the time of uplift during the Laramide or Sevier Orogenies. The 27.2 m.y. date on apatite from the Gold Butte Pluton is difficult to interpret. It may represent complete or partial annealing of tracks in apatite caused by a heating event related to volcanism, or it may reflect regional arching or uplift.

The zircon date of 45.7 m.y. in the Rainbow Gardens granite may be related to the time of uplift of the source area (possibly the South Virgin Mountains). If this interpretation is correct the source area may have experienced variable degrees of uplift over a period of 40 m.y., or possibly two distinct pulses of uplift. The second model is supported by the work of Young (1979) who suggested two peaks of deformation along the southwestern margin of the Colorado Plateau. The first pulse reached a peak between 72 and 65 m.y. ago (Laramide), and the second during the late Paleocene or early Eocene. The early Tertiary event was also discussed by Drewes (1978). The 10.9 m.y. old date on apatite may reflect the intense volcanic episode that occurred in southern Nevada between 6 and 20 m.y. ago (Anderson and others, 1973). Heating during this event may have caused track annealing in apatite. Apatite will lose 100 percent of its tracks if heated to 200°C for 1000 years. Several dacite flows and intrusions occur within 5 km of the dated slide mass and may be responsible for resetting the apatite date. In the Rainbow Gardens area major strike-slip faulting along the Lake Mead Fault Zone, volcanism and basin sedimentation occurred contemporaneously in the late to middle Miocene (Bohannon, 1979b; Smith, 1981).

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Table 1. Sample descriptions.

Sample No.	Rock type/Location	Mineral	Number of grains	t_s	t_i	t_ϕ	ϕ X10^{15} n/cm^2	Correlation (r)	T X10^6 yr	P_a	σ X10^6 yr
F4	Biotite-perthite bearing rapakivi granite (from a slide block in Rainbow Gardens; 36°11′15″N, 114°55′W; Clark Co., NV).										
		Apatite	2	46	125	317	.979	1.0	10.93	8.07	0.88
		Zircon	3	997	647	317	.979	.807	45.68	6.08	2.78
G3-1	Biotite-perthite bearing rapakivi granite (from Gold Butte townsite; 36°17′N, 114°12′W; Clark Co., NV).										
		Apatite	6	109	119	317	.979	.968	27.19	6.11	1.66
		Zircon	4	457	200	395	1.22	.99	84.92	5.63	4.78

t_s - number of natural tracks counted.

t_i - number of induced tracks counted.

t_ϕ - number o' tracks counted in detector.

ϕ - neutron f'ux.

T - age in years.

P_a - percent error in age.

σ - standard error.