1-1-1963

Westerly Granite and related Rocks of the Westerly-Bradford Area

Feininger, Tomas

FIELD TRIP G

WESTERLY GRANITE AND RELATED ROCKS OF THE WESTERLY-BRADFORD AREA

(Publication authorized by the Director, U.S. Geological Survey)

Leader: Tomas Feininger, Brown University and U.S. Geological Survey

Introduction

Westerly Granite has been quarried in the Westerly area since 1846, and at one time was the principal industry of Westerly and nearby Niantic (now Bradford), Rhode Island. The Westerly Granite is a superior statuary granite and although the area's quarry industry is now a faded relic of its former greatness, just enough demand remains to keep a quarry or two operating.

Westerly Granite is fine grained, equigranular, and light gray. It is generally almost massive, although faint primary foliation is commonly visible with a hand lens. Locally this foliation is strong near contacts with other rocks. Surface and near-surface rock is pink, and locally known as "swamp granite". The uniformity of the Westerly Granite from exposure to exposure and from body to body is exceptional for a felsic intrusive rock. This property was paramount in leading to the selection of the Westerly Granite as the reference standard G-1 (Fairbairn and others, 1951; Stevens and others, 1960). Only in very small bodies (generally less than ten feet across) is the Westerly inhomogeneous. In these it tends to be somewhat streaky, and commonly is porphyritic with phenocrysts of microcline and acicular biotite.

Westerly Granite is actually a quartz monzonite or granodiorite, bearing subequal amounts of potassium feldspar (microcline) and plagioclase (oligoclase). A mode is given below.

Geologic evidence suggests the Westerly is late or post-Pennsylvanian. Lead-alpha ages on separated zircon and monazite range from 220 to 243 m.y. (Quinn and others, 1957). More recent radiometric dating has given K-Ar ages of $240^{+}_{-}12$ m.y. and Rb-Sr ages of $260^{+}_{-}13$ m.y. (Hurley and others, 1960).

A granitic rock associated with and only very slightly older than the Westerly is the Narragansett Pier Granite. This pink, medium-grained granite is massive to moderately foliated, and generally equigranular. It resembles the typical "Granite" shown in Geology 1 classes around the world. The Narragansett Pier Granite is chemically and mineralogically almost identical with the Westerly (see mode given below), and is also a quartz monzonite or granodiorite. The Westerly and Narragansett Pier are probably two phases of a single magma-forming event. Lead-alpha ages on zircon separated from Narragansett Pier Granite range from 208 to 274 m.y. (Quinn and others, 1957).

Westerly Granite is principally found as a dike rock. With few exceptions the dikes strike east and dip gently to moderately southward. About 30 dikes are exposed in the Westerly area, and probably as many are exposed farther west in Connecticut.

The persistent structural setting of the Westerly Granite suggests that a regional stress pattern prevailed during intrusion. An east-trending, north-dipping low-angle thrust fault is known to traverse southeastern Connecticut (Lundgren, 1963; Snyder, 1961). Stresses that produced this fault could have produced east-west southward-dipping tensional fractures in the Westerly-Bradford area. This correlation of geologic structures of southeastern

Connecticut-southwestern Rhode Island is tentative.

Modes:

	1	2
Quartz	27.5%	27.0%
Microcline	35.4	36.0
Plagioclase	31.4	33.0
Muscovite	1.3	1.0
Biotite	3.2	2.5
Opaque	0.8	0.5
Other	0.4	trace

1. Westerly Granite, Chayes in Fairbairn and others, 1951, p. 61, based on average of 16 thin sections, 1500 counts each.

2. Narragansett Pier Granite, Feininger, mode made in 1960, based on average of six thin sections, 2000 counts each.

References: Selected papers on the Westerly Granite.

Fairbairn, H. W., and others, 1951, A cooperative investigation of precision and accuracy in chemical, spectrochemical and modal analysis of silicate rocks: U.S. Geol. Survey Bull. 980, 71 p.

Hall, B. A., and Eckelmann, F. D., 1961, Significance of variations in abundance of zircon and statistical parameters of zircon populations in a granodiorite dike, Bradford, Rhode Island: Am. Jour. Sci., v. 259, no. 8, p. 622-634.

Hurley, P. M., Fairbairn, H. W., Pinson, W. H., and Faure, G. 1960, Potassium-argon and rubidium-strontium minimum ages for the Pennsylvanian section in the Narragansett Basin: Geochim. et Cosmochim. Acta, v. 18, p. 247-258.

Macomber, S. W., 1958, The story of Westerly Granite: Westerly Historical Soc., 38 p.

Quinn, A. W., 1943, Settling of heavy minerals in a granodiorite dike at Bradford, Rhode Island: Am. Mineralogist, v. 28, p. 272-282.

Quinn, A. W., and others, 1957, Lead alpha ages of Rhode Island granitic rocks compared to their geologic ages: Am. Jour. Sci., v. 255, p. 547-560.

Stevens, R. E., and others, 1960 Second report on a cooperative investigation of the composition of two silicate rocks: U.S. Geol. Survey Bull. 1113, 126 p.

Other references:

Lundgren, Lawrence, Jr., 1963, The bedrock geology of the Deep River quadrangle: Connecticut Geol. and Nat. Hist. Survey, Quad. Rept. 13, 40 p.

Snyder, G. L., 1961, Bedrock geology of the Norwich quadrangle, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-144.

Itinerary:

The trip will be by private cars and will assemble at 9:30 AM Sunday on the R. I. Rte. 3 overpass of R. I. Rte. 95. This is about midway between Hopkinton and Ashaway, R. I. The starting point is about 40 miles from Providence, a little more than an hour's drive. The entire trip will be within the Ashaway and Carolina 7½ minute topographic quadrangles. All the stops, especially the first, third, and last, are dangerous. Please use caution when scrambling over dumps or climbing in quarries. Permission to visit the first quarry was obtained only upon the promise that all participants would sign a paper releasing the Westerly Granite Co. of Bradford, R.I. from responsibility for injuries sustained on their property.

I would like to thank Mr. Angelo M. Gencarelli, owner of the quarries at Stops 2, 3, and 4, and Mr. L. Bottinelli, and Mr. E. Monti, owners of the Crumb Quarry. Without their cooperation this trip would not have been possible.

Approx. Mileage	
00.0	R. I. Rte. 3 overpass of R. I. Rte. 95. Proceed south on Rte. 3.
01.8	Turn LEFT on Rte. 216 (Ashaway village).
04.2	Stop sign, turn RIGHT.
04.5	Cross Pawcatuck River.
04.6	Bear LEFT (Bradford Village on right).
04.9	Cross main line NYNH&HRR.
05.1	Turn LEFT (follow Rte. 216).
05.8	Turn RIGHT (at sign "BEDROCK"), follow paved road.
06.4	Wide gravelled area, park for

STOP 1:

The Crumb Quarry. Typical development of the Westerly Granite is well shown in this large east-west, south-dipping dike. The bottom contact is excellently exposed, and shows the accumulation of heavy minerals in the Westerly. This is the site of the studies by Quinn (1943) and Hall and Eckelmann (1961). Other features to be discussed include jointing, primary flow structures, inclusions, and the pegmatitic nature of the contact. The host rock is the Hope Valley Alaskite Gneiss.

Turn around and go in the reverse direction on the same road.

06.9	Turn LEFT (Rte. 216).
07.7	Stop sign, turn LEFT (toward Westerly).
09.3	Bear RIGHT (follow the main road).
12.3	Extremely sharp (150°) RIGHT turn onto Old Hopkinton Road.
12.4	Cross main line NYNH&HRR.
12.6	Turn LEFT onto gravel road (opposite dilapidated house in trees on right), park.

STOP 2:

Abandoned quarry. Here a different dike of Westerly Granite has intruded Narragansett Pier Granite. Exposures on the far wall are unusually clean and clearly show apophyses of the Westerly in the Narragansett Pier, partially

stoped blocks of Narragansett Pier in the Westerly, and two generations of pegmatite. The upper contact of the dike is exposed, and here dips about 40°. Note that it is locally irregular, showing that dike dip readings obtained from a single small exposure can be misleading. Note the quarried blocks lying about. Many interesting relationships can be seen in these.

Return to cars, continue to paved road.

Turn LEFT, continuing as before on Old Hopkinton Road.

13.1 Turn LEFT onto wide gravel road.
13.5 Park cars at wide gravelled area (probably to be shared with several "Euclid" trucks). Continue on foot about 500 ft. to a large operating quarry on the right.

STOP 3:

The Gencarelli Quarry. This quarry was reactivated on a large scale about three years ago, and is producing huge groin blocks for breakwaters. The Westerly dike, the same one as at the previous stop, is here 67 feet thick. Exposures are very good; however the topography of the quarry changes so rapidly with quarrying that any description made now (July, 1963) would be meaningless by October. Some features will be noted in any event, especially: 1) the top contact, here dipping 15° to 20°, and quite regular; 2) strongly developed, locally closely spaced, north-south vertical joint systems, and associated rock alteration; and 3) structures in the host Narragansett Pier Granite.

Walk back toward the cars. Approximately where the cars are parked, turn RIGHT and climb the rubble embankment on the east, walk about 300 feet farther east to

STOP 4:

Water-filled abandoned quarry. The quality of the Westerly here is poor, and the quarry probably never was successful. The quarry exposes an unusual feature, the upward termination of a dike. This is the same dike as at the two previous stops, here again in Narragansett Pier Granite which contains at least one large inclusion of gneiss. The contact between Westerly and Narragansett Pier is highly amoeboid, quite unlike that seen at the other stops. The contact will be examined, and its petrologic and structural significance will be discussed.

Return to cars

END OF TRIP

To return to starting point:

Reverse direction on wide gravel road.

13.8 LEFT fork.
14.0 Turn LEFT on paved road (Old Hopkinton Road).
14.2 Turn LEFT, stop sign immediately ahead. Cement road is R.I. Rte. 3. Left is southward toward Westerly, RIGHT is northward toward Ashaway, and
18.4 Starting point.

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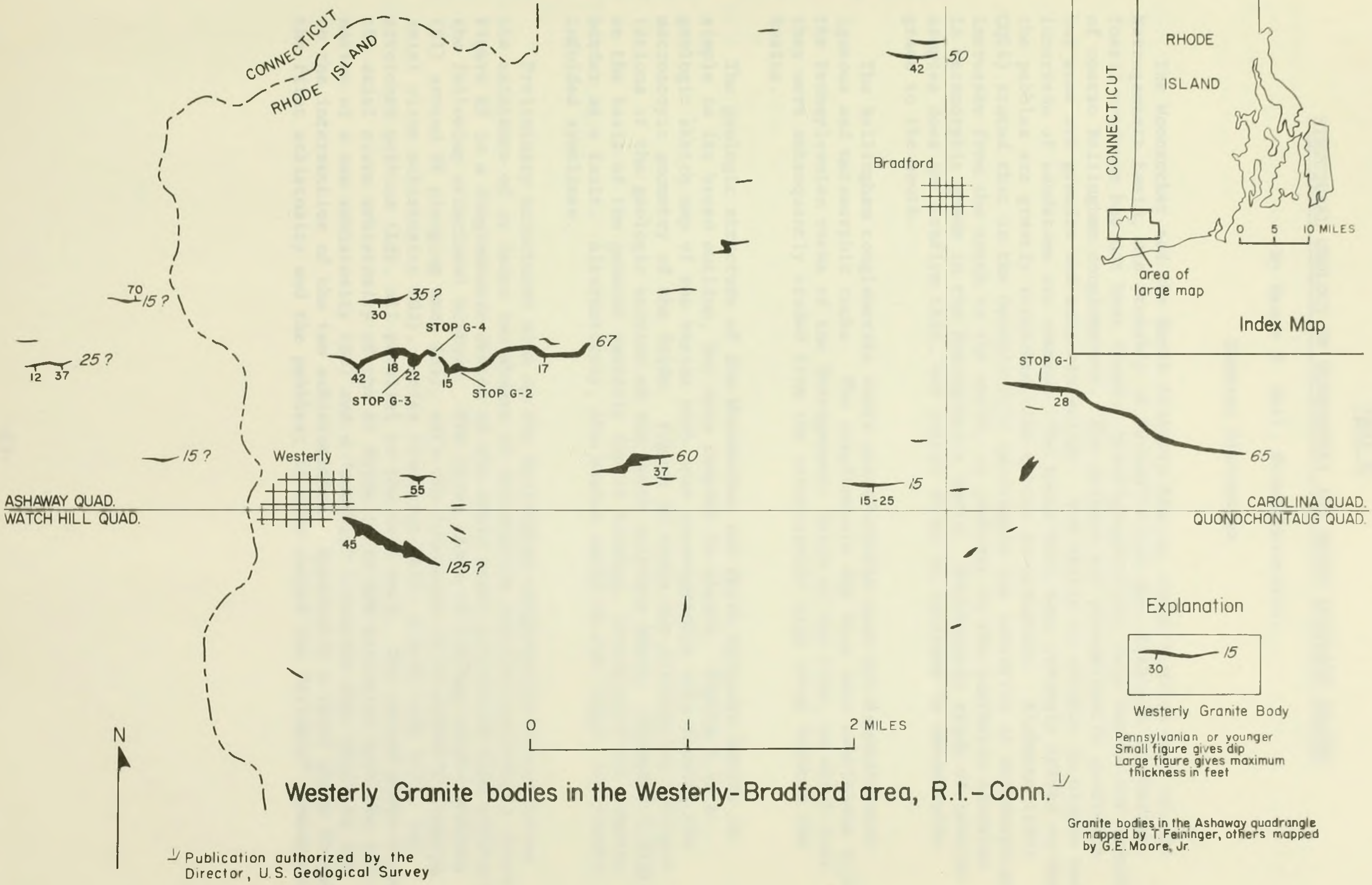
Prepared in cooperation with State of Rhode Island, Development Council



Explanation

Westerly Granite Body

Pennsylvanian or younger
Small figure gives dip
Large figure gives maximum thickness in feet

Westerly Granite bodies in the Westerly-Bradford area, R.I.-Conn.[1/]

Granite bodies in the Ashaway quadrangle mapped by T. Feininger, others mapped by G.E. Moore, Jr.

[1/] Publication authorized by the Director, U.S. Geological Survey

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FIGURE G-1