

A PSEUDO-RING DIKE, MT. DESERT ISLAND, MAINE

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Mount Desert Island, Maine, the largest bedrock island on our Atlantic coast, is underlain by a central mass of granite (probably late Devonian) which is surrounded by a nearly continuous fringe of older rock (Fig. 1). The older rock consists mostly of contact-metamorphosed quartzite and siliceous sediments of Silurian (?) age, much altered gabbros of possibly Upper Devonian age, and some schist, gneiss, and quartzite of the Bartlett Island formation (possibly Lower Cambrian).

The granite core of the island is now known to consist of two distinct rock units. The larger and older is a coarse-grained hornblende granite. The younger is a medium-to fine-grained biotite granite which forms a discrete body cutting out much of the northwestern portion of the hornblende granite. A number of smaller masses of hornblende granite occur in the older fringe rock of the island and some of the neighboring islands to the west (Fig. 1). These are believed to be ring dikes and, although somewhat variable in width, they can be traced for several miles. Where the ring dikes terminate, shatter zones appear to continue for several miles through the older rock.

It has already been shown (Chapman, C. A., 1953) that the two large granite masses of the island have been emplaced by cauldron subsi-

dence. The best evidence for such subsidence is as follows: 1) smooth rounded contacts resemble those in most other areas of cauldron subsidence; 2) centripetal pattern of dips of the planar structures in the older fringe rocks; 3) contact shatter-zone around the granite; 4) abundant steep tangential pegmatite veins in the surrounding breccia zone; and 5) numerous tangential granite satellites or ring dikes in the fringe rock.

In the northeastern part of the hornblende granite area (Fig. 1), extending northward along the western slopes of McFarland and Youngs mountains (Fig. 2), is a crescent-shaped mass of granite "porphyry". The mass is about 1.5 miles long in a north-south direction and 0.2 miles wide. The crescent is concave to the west with a radius of curvature of approximately 1.5 miles. This crescent subtends an angle of about 130 degrees, and either cusp terminates the form rather bluntly.

In the field, contacts between the "porphyry" and enclosing hornblende granite are not sharp. On the other hand they are not of a simple gradational character, with typical "porphyry" gradually passing over into hornblende granite. Instead, these two geologic units are separated by a highly irregular and ill-defined boundary zone in which both rock types appear mixed to a greater or less degree. Patches of

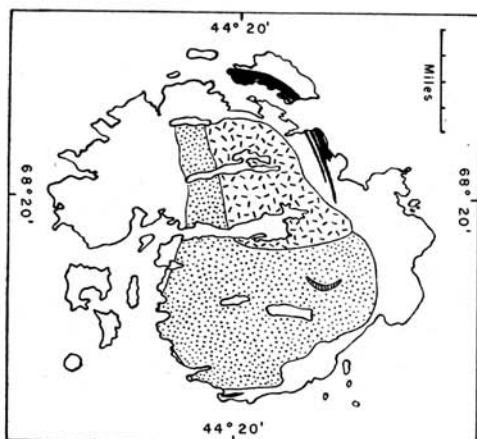


FIG. 1.—Simplified geologic map of Mt. Desert Island, Maine. Biotite granite, dashed; hornblende granite, stippled; country rock, blank; granite "porphyry", lined; ring dikes, black. The four elongate blank areas within the granite area are freshwater lakes.

hornblende granite up to a few hundred feet across occur locally as much as a few hundred feet in from this boundary zone. These large inclusion-like masses of hornblende granite are as vaguely separated from the surrounding "porphyry" as is the "porphyry" from its enclosing hornblende granite.

The hornblende granite is a pink, coarse-grained rock of very uniform character. It is allotriomorphic granular and composed predominantly of microperthite as grains 3 to 8 mm. across and commonly showing a poorly developed zoning. Quartz as slightly smaller grains is commonly intergrown with perthite to form implication texture. Patches several millimeters across of fine-grained feldspar and deep green to yellow-brown hornblende are commonly observed. Hornblende also occurs outside these patches as large

euhedral to irregular grains. A little biotite, magnetite, apatite, and well-formed zircon crystals constitute the accessories.

The "porphyry" is a pink rock with abundant quartz and feldspar crystals about 5 mm. across in a fine-grained matrix. In many specimens patches of "porphyry" are intimately associated with patches of hornblende granite, and contacts between rock types are vaguely defined. Thin sections show rather wide ranges in texture. At one extreme, numerous "phenocrysts" of quartz and microperthite appear embedded in a fine-grained mixture of microperthite, quartz, and mafics. At the other extreme, the rock resembles the hornblende granite with but a small amount of fine-grained intergranular material.

In the typical "porphyry", large grains of quartz (about 5 mm. across) are abundant. These show clear centers, but peripheral zones (1 mm. wide) are filled with diversely oriented, tiny grains of perthite (Fig. 3). Superficially the clear cores appear as phenocrysts in a fine matrix of quartz and feldspar; but, under crossed nicols and more strikingly so with the gypsum plate inserted, the quartz of the apparent matrix is in optical continuity with the clear cores. The line of demarcation between core and feldspar-rich fringe is generally sharp, and round to subpolygonal. Where quartz grains are smaller, quartz cores are correspondingly smaller. In the smallest quartz grains no core is observed and the entire crystal is crowded with tiny feldspar grains. Apparently, therefore, cores occur only in those quartz grains whose diameter exceeds about 2 mm.

Large feldspar grains uncommonly appear as isolated crystals except in those specimens with abundant matrix. Most commonly they occur in aggregates with more or less quartz and hornblende. These aggregates appear as patches of the hornblende granite and are penetrated and transected by numerous irregular veins of medium- to fine-grained quartz which poikilitically encloses abundant tiny feldspar grains. Where veins are extensively developed, large feldspar crystals are isolated in a finer matrix and resemble phenocrysts.

The crescentic shape and "porphyritic" texture of McFarland Mountain body suggest the mass is a ring dike emplaced in the slightly older hornblende granite. This idea is further substantiated by the facts, already stated, that there are several ring dikes on and adjacent to Mount Desert Island, and that the hornblende granite and biotite granite themselves have been emplaced by cauldron subsidence. The crescent shape of this "porphyry" mass resembles that of several ring dikes in New Hampshire (Billings, 1955).

Most field and microscopic evidence, however, is strong against interpreting the "porphyry" mass as a ring dike. The lack of a sharp contact with chill effects, of well-defined inclusions, and of apophyses strongly opposes the magmatic interpretation. Microscopically the rock is not a true porphyry. The "phenocrysts" of quartz and feldspar represent relict crystals or crystal aggregates from the coarse-grained hornblende granite between which reconstitution of material has occurred. Most of the textures and structures of the hornblende granite

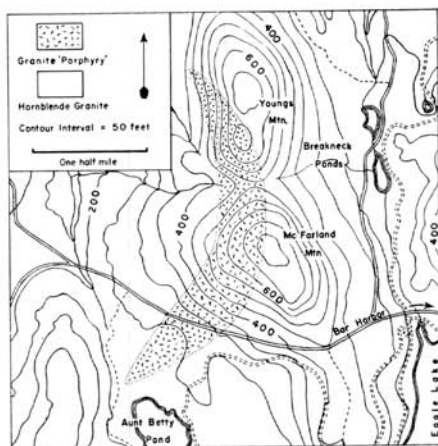


FIG. 2.—McFarland Mountain pseudo-ring dike.

are partially preserved in the "porphyry", and all stages in the apparent disintegration of the hornblende granite may be observed.

The "porphyry" is believed to be derived from the hornblende granite by intergranular recrystallization. This process of recrystallization appears to have been confined to a shatter-zone or zone of ring-fracturing associated with local subsidence in the hornblende granite. This belief is supported by the fact that several arcuate shatter-zones associated with ring dikes are found in the older fringe rock on the western side of the island. The association of ring dike with shatter-zone has been well demonstrated in the Mount Washington, New Hampshire Quadrangle (Chapman, R. W., 1942), where a shatter-zone (0.2-mile wide) trends in arcuate fashion for about five miles. At one end it passes into a ring dike which extends beyond for a distance of about two miles. The absence of an associated ring dike in the McFarland Mountain

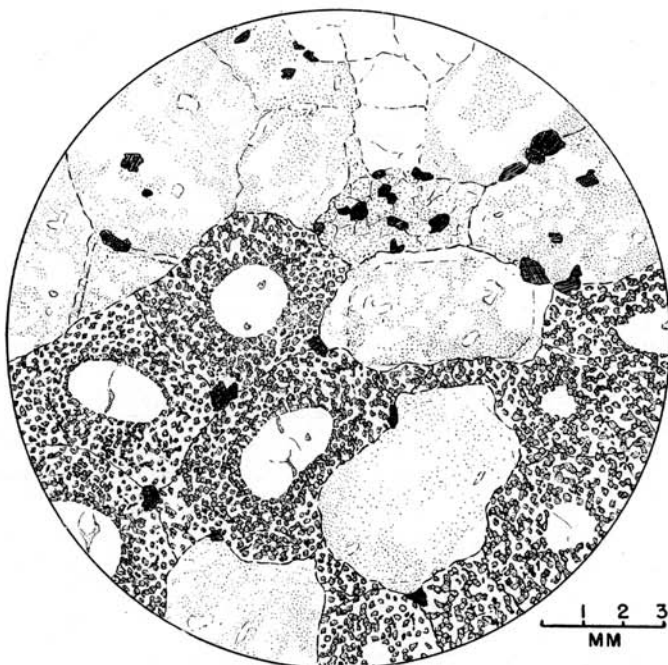


FIG. 3.—Granite "porphyry". Quartz, clear; microperthite, stippled; hornblende and magnetite, dark.

area may be the result of inadequate dilation of the shatter-zone and/or the nonavailability of magma.

There is good reason to believe, therefore, that a ring-fracture zone, approximately three miles in diameter, formed in the hornblende granite. It seems likely that, at our present level of observation, at least, the zone of dislocation did not form a complete ring, but shattering was most pronounced and extensive along the eastern portion of the subsiding granite block. Such a mechanism not only explains the crescent shape of the body with its convex side to the east, but provides the necessary physical conditions for intergranular recrystallization. "Porphyry" for-

mation may have been enhanced by fluids which had their origin in depth and moved along fractures of the shatter zone. The porphyry body, therefore, is not a true-ring dike and may be called a pseudo-ring dike. It was dependent for its formation, however, upon the mechanics of ring fracturing and cauldron subsidence.

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