Changes in Stratigraphic Nomenclature by the U.S. Geological Survey, 1969

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CONTRIBUTIONS TO STRATIGRAPHY

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AGE AND STRATIGRAPHIC RELATIONS OF AMCHITKA, BANJO POINT, AND CHITKA POINT FORMATIONS, AMCHITKA ISLAND, ALEUTIAN ISLANDS, ALASKA

By W. J. CARR, W. D. QUINLIVAN, and L. M. GARD, JR.

Detailed reconnaissance mapping in 1966 and 1967 of Amchitka and Rat Islands in the western Aleutian Islands (fig. 1) supplemented an original study by Powers, Coats, and Nelson (1960) and has resulted in some modifications of the ages and stratigraphy of the rocks. Two formations, the Banjo Point and overlying Chitka Point, are here slightly redefined; the Amchitka Formation is areally restricted and subdivided into two informal units. Several potassium-argon dates are now available for the Chitka Point, one for the East Cape intrusive complex and three for younger intrusive rocks. Age of a fossil pollen collection from the Chitka Point Formation agrees well with the radiometric dates. New fossil collections from the Banjo Point Formation provide a better basis for dating.

AMCHITKA FORMATION

As defined by Powers, Coats, and Nelson (1960), the Amchitka Formation includes rocks of diverse type and age. Rocks of the northwest part of Amchitka formerly mapped as Amchitka Formation are petrographically like and stratigraphically continuous with the Chitka Point Formation. The Amchitka Formation of eastern Amchitka is retained, with some changes in contacts with other formations (fig. 1), but it is divided into two informal units: (1) older breccias, overlain by (2) the pillow lavas and breccias of Kirilof Point. Both units are present in drill holes in the central part of Amchitka.

The older breccias, which constitute the lower part of the Amchitka Formation, are the oldest rocks exposed on Amchitka Island; the base is not exposed. The older breccias are restricted in outcrop to the eastern part of Amchitka Island, mainly between Constantine Harbor and the dioritic intrusive rocks of East Cape. The unit consists of fine- to coarse-grained sedimentary breccias and minor interbedded sandstone, siltstone, and claystone composed of volcanic debris. The rocks are generally propylitically altered. The degree of alteration increases erratically eastward toward the intrusive complex, and strongly metamorphosed older breccias occur within and adjacent to the intrusive masses. Numerous dikes, including many of hornblende

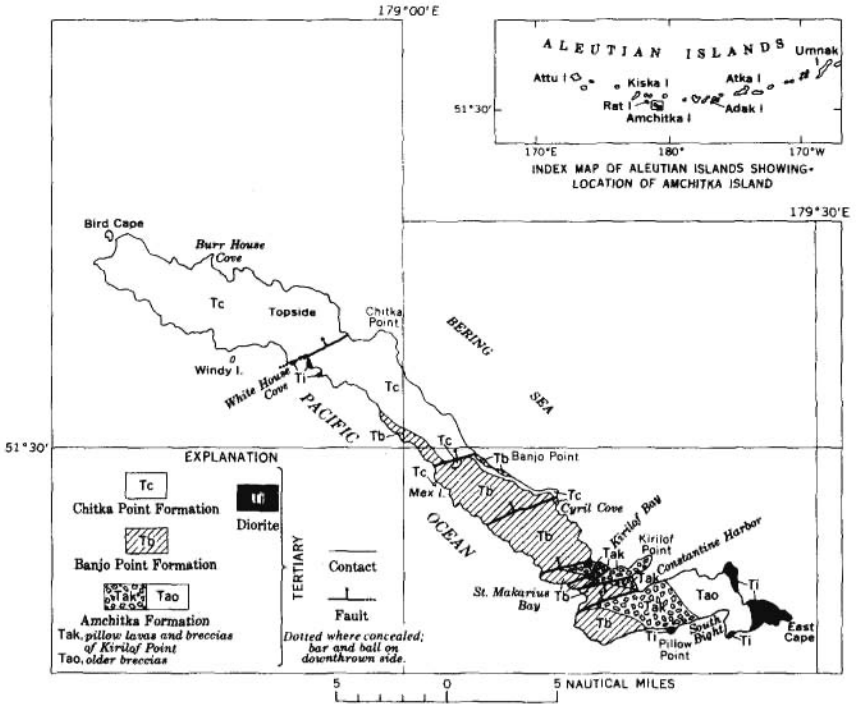

FIGURE 1.—Geologic sketch map of Amchitka Island.

andesite, cut the breccias on the eastern part of Amchitka Island. A maximum thickness of about 4,000 feet of the older breccias may be exposed; however, because of numerous dikes and sills that intrude the section and the possibility of fault repetition, this estimate is probably too high.

The Kirilof Point unit consists of glassy generally monolithologic breccia and tuff breccia, subordinate pillow lava flows, and very minor bedded volcanic sedimentary rocks, most of which were probably deposited in a submarine environment. The lower contact of the unit is exposed 1.6 miles east of Pillow Point at the base of a locally glassy lava and breccia sequence and at the top of a thin layer of sedimentary rocks. The lateral continuity of this contact and its stratigraphic and petrographic significance have not yet been determined. Compositionally some of the rocks of the Kirilof Point unit are less mafic than others known on Amchitka Island; Powers, Coats, and Nelson (1960) published an analysis of hydrated glassy breccia from Kirilof Point which indicates that the rock is a latite. Most other Kirilof Point rocks

analyzed in the current study are a little less silicic. The Kirilof Point unit is about 3,500 feet thick in the vicinity of Pillow Point and ranges from about 1,450 to 3,650 feet thick in drill holes in central Amchitka.

BANJO POINT AND CHITKA POINT FORMATIONS

The Banjo Point Formation consists mainly of breccias, sedimentary rocks, and minor pillow lavas of basaltic composition and submarine deposition. Hornblende-andesite and basalt sills and dikes intrude the formation in places. The Banjo Point is more nearly conformable with the underlying Amchitka Formation than reported by Powers, Coats, and Nelson (1960) but is overlain with considerable angular discordance by the Chitka Point Formation. The Banjo Point remains virtually as defined by Powers, Coats, and Nelson (1960) except for a few changes in its boundaries with the Chitka Point Formation. Outcrops near White House Cove and Burr House Cove, too small to be shown in figure 1, are probably Banjo Point Formation. Largely because of the major erosional unconformity between the two formations, no complete section of Banjo Point is exposed. The formation is a maximum of about 3,600 feet thick in a drill hole west of Kirilof Bay.

Rocks called Chitka Point Formation are here restricted to subaerial hornblende and pyroxene-andesite lava flows, breccias, tuffs, and conglomerate in the northwestern two-thirds of Amchitka (fig. 1). Excluded from the Chitka Point, as mapped by Powers, Coats, and Nelson (1960), are basaltic breccias, now included in the Banjo Point Formation and extending southeastward along the Pacific Coast from about lat 51°32′ N. The contact previously shown (Powers and others, 1960) between Chitka Point and Banjo Point Formations on the Pacific Coast is no longer considered a formational boundary. Included in the Chitka Point Formation by the present authors are all rocks previously mapped by Powers, Coats, and Nelson (1960) as Amchitka Formation on the northwest part of the island, and some small areas previously mapped by them as Banjo Point Formation along the Bering Sea Coast between about 51°30′ N. and Cyril Cove. All these rocks are hornblende or pyroxene-bearing andesites typical of the Chitka Point and are stratigraphically continuous with it. The Chitka Point ranges in thickness from a featheredge near the middle of Amchitka to a minimum of 4,000 feet in a drill hole 2 miles south of Chitka Point; about 1,100 feet are exposed in the vicinity of Topside.

Thus we restrict the Banjo Point to basaltic rocks of generally submarine deposition and the Chitka Point to andesitic rocks of mostly subaerial deposition, each unit representing a distinct episode of eruptive activity separated by uplift and erosion.

AGE

On the basis of Foraminifera and mollusks, Powers, Coats, and Nelson (1960, p. 538) assigned an Oligocene or Miocene age to the Banjo Point Formation. All their fossil material appears to be from beds assigned to the Banjo Point in the current study. Recently MacNeil (1967, p. 37) assigned an age of Oligocene(?) to the Banjo Point on the basis of a further evaluation of fossils in it and in similar beds on nearby Rat Island. Microfossils (table 1) collected by the authors and R. H. Morris from the Banjo Point and Amchitka Formations supplement the original collections which were made by Powers, Coats, and Nelson (1960) and which were studied by Todd (1953) and MacNeil (1967). Studies of the Foraminifera by R. L. Pierce permit refinement of the original ages for these formations. The Banjo Point Formation and similar beds on Rat Island (Gunners Cove Formation) are designated as late Eocene or Oligocene on the basis of mollusks and numerous microfossils from several localities (table 1). Age of the Amchitka Formation is less certain; it underlies the Banjo Point with general conformity, and the one fossil collection from it (table 1) contains only two genera not found in the Banjo Point; the species are not identified.

There is nothing to indicate a significant age difference between the Banjo Point and the upper part of the Amchitka Formation—the breccias and pillow lavas of Kirilof Point—but because of the meager fauna and fact that the lower contact of the formation is not exposed, the authors prefer to assign an age of early Tertiary to the Amchitka Formation.

A coal sample from the Chitka Point Formation yielded numerous pollen and spores which were studied by Estella Leopold

TABLE 1.—*Distribution of Foraminifera in the Amchitka, Gunners Cove, and Banjo Point Formations, Amchitka and Rat Islands, Alaska*

	Amchitka Formation	Gunners Cove Formation	Banjo Point Formation			
	69LG10[1]	WJC70A67[2] (M337)	69LG6[3]	69LG7[4]	69LC8[5]	69LG9[6]
Cassidulina globosa Hantken	X			X		X
sp. cf. *C. galvinensis* Cushman and Frizzell		X	X			
Globigerina sp.	X					X
sp. cf. *G. eocaena* Gümbel						X
(?) *Globorotalia* sp. aff. *G. pseudobulloides* Plummer	X					
Bolivina sp.	X					
Oridorsalis umbonatus (Ruess)	X		X			

TABLE 1.—*Distribution of Foraminifera in the Amchitka, Gunners Cove, and Banjo Point Formations, Amchitka and Rat Islands, Alaska*—Continued

	Amchitka Formation	Gunners Cove Formation	Banjo Point Formation			
	69LG10[1]	WJC70A67[2] (M337)	69LG6[3]	69LG7[4]	69LC8[5]	69LG9[6]
Gyroidina sp. c. *G. Soldanii octocamerata* Cushman and G. D. Hanna	X		X	X		X
Cibicides sp. cf. *C. sandiegensis* Cushman and M. A. Hanna		X	X	X		
sp. cf. *C. hodgei* Cushman and Schenck			X			X
hodgei Cushman and Schenck					X	
sp. cf. *C. haydoni* (Cushman and Schenck)						X
sp.			X		X	
Nonion sp. aff. *N. planatus* Cushman and Thomas		X	X			
Plectofrondicularia vaughani Cushman			X			
sp. cf. *P. packardi multilineata* Cushman and Simonson			X			X
packardi packardi Cushman and Schenck						X
sp.						X
Guttulina sp. cf. *G. problema* d'Orbigny			X			
problema d'Orbigny						X
Planularia sp. aff. *P. markleyana* Church			X			
Uvigerina elongata Cole			X	X		X
Nodosaria sp. cf. *N. pyrula* d'Orbigny			X			
holserica Schwager						X
sp. (?)					X	
Dentalina consobrina d'Orbigny						X
(?) *amchitkaensis* Todd						X
sp.			X			
Sigmorphina sp. cf. *S. schencki* Cushman and Ozawa			X			
Melonis cf. *M. umbilicatulus* (Montagu)						X
(?) *Melonis* sp.				X	X	
Alabamina sp. cf. *A. kernensis* Smith				X		
kernensis Smith						X
Bulimina schencki Beck						X
Glandulina laevigata ovata (Cushman and Applin)						X
Angulogerina hannai Beck						X
Globorotaloides sp. cf. *G. suteri* Bolli						X
Radiolaria	X					

[1] Locality 69LG10: Amchitka Formation, pillow lavas and breccias of Kirilof Point, Kirilof Bay, Amchitka Island; lat 51°24′45″ N., long 179°14′30″ E.

[2] Locality WJC70A67 (near M337 original collection made by H. A. Powers): Gunners Cove Formation, southeast side of Gunners Cove, Rat Island; lat 51° 48′40″ N., long 178°19′ E.

[3] Locality 69LG6: Banjo Point Formation, south side St. Makarius Bay, Amchitka Island; lat 51°22′40″, long 179°13′10″ E.

[4] Locality 69LG7: Banjo Point Formation, 1.6 miles northwest of Mex Island, south coast of Amchitka Island; lat 51°29′38″ N., long 179°01′25″ E.

[5] Locality 69LG8: Banjo Joint Formation, Banjo Point, north coast of Amchitka Island; lat 51°28′36″ N., long 179°08′15″ E.

[6] Locality 69LG9: Banjo Point Formation, Clam Point (same stratigraphic horizon that contained *Chlamys* aff. *C. washburnei* Arnold (Powers, and others, 1960, p. 537), south coast of Amchitka Island; lat 51°24′32″ N., long 179°09′44″ E.

TABLE 2.—*Pollen and spores from Amchitka Island, Alaska*

[Identified by Estella Leopold. Sample 68 M–1 from a thin coal seam in volcanic breccia of the Chitka Point Formation, lat 51°32′ N., long 178°58′ E., Pacific coast of Amchitka]

	Number	*Percent*
Taxodiaceae-Cupressaceae-Taxaceae	21	17.2
Sequoia type	1	.8
Pinus	8	6.5
Alnus p6	2	1.6
p5	27	22.2
p4	13	10.5
Picea	2	1.6
Betula	3	2.5
Corylus type	1	.8
Juglans	2	1.6
Pterocarya	2	1.6
Ulmus?	1	.8
Ostrya-Carpinus	3	2.5
Populus type	4	3.3
Corylus type	1	.8
Ericales, cf. *Rhododendron*	3	2.5
Dicot pollen, mangled, broken	13	10.5
Polypodiaceae	1	.8
Monocots undet.	12	10.0
Undet. fern spores	2	1.6
Total	122	.....

NOTE.—Seen but not in count:
Tsuga heterophylla
Quercus
cf. *Fagus*

(table 2). She reported that "the sample count contains 6.5 percent of deciduous broadleaved trees now exotic to Alaska, and about a fifth of the generic list includes forms foreign to the region*** the age is Miocene, probably middle to late."

Seven potassium-argon dates on rocks from Amchitka Island are listed in table 3. Radiogenic dating is hampered by scarcity of fresh holocrystalline material for whole-rock analysis and of rocks containing minerals with sufficient potassium for dating of mineral separates.

Three dates were obtained on lava flows of the Chitka Point Formation at different localities in central and northwestern Amchitka. All represent flows in the upper part of the Chitka Point. The youngest date obtained, 12.4±1.1 m.y. (million years), may be slightly too young because of the presence of a very small amount of noncrystalline material in the groundmass. Of the three dates, the one considered most reliable (14.1±1.1 m.y.) because of the freshness and relatively coarse texture of the rock was obtained on an andesite flow in a quarry near the middle of Amchitka. On the basis of these dates and the pollen collection (table 2), we assign an age of Miocene to the Chitka Point, previously dated (Powers and others, 1960) as Tertiary or Quaternary.

A date of 15.8±0.7 m.y. was obtained on a biotite-bearing phase of the East Cape pluton. This complex of dioritic rocks intrudes rocks as young as the upper unit of the Amchitka Formation, and

fossils indicate that the Banjo Point Formation is also older than the East Cape plutonic complex.

TABLE 3.—*Potassium-argon dates on rocks from Amchitka Island, Alaska*

Sample	Rock type, location	Material analyzed	Stratigraphic relations	Age × 10^6 years [1]
WJC-87A-66	Hornblende andesite dike between Pillow Point and South Bight; lat 51°21′55″N., long 179°20′40″E.	Hornblende	Intrudes Amchitka Formation.	2.7±3.0
69 Amc-12	Basaltic andesite dike, west side of Kirilof Bay; lat 51°26′N., long 179°14′E.	Whole rock	Intrudes Banjo Point Formation.	8.9±0.6
WJC-1-67	Basalt dike(?), point on north side of St. Makarius Bay; lat 51°23′30″N., long 179°12′50″E.	do	do	10.2±1.1
69 Amc-15	Pyroxene andesite lava flow on ridge 2 miles north of Windy Island; lat 51°36′N., long 178°48′E.	do	Upper part of Chitka Point Formation.	12.4±1.1
69 Amc-17	Hornblende andesite lava flow, Mex Island; lat 51°28′30″N., long 179°02′30″E.	do	do	13.2±1.2
69 Amc-2	Hornblende andesite lava flow quarry, central Amchitka; lat 51°31′N., long 179°02′E.	do	Upper part of Chitka Point Formation.	14.1±1.1
69-Amc-11	Biotite-hornblende granodiorite; lat 51°23′N., long 179°25′E.	Biotite	Intrusive dioritic complex of East Cape. Parts of complex intrude upper and lower units of Amchitka Formation.	15.8±0.7

[1] All dates determined by Geochron Laboratories, Inc. Mineral separations by D. R. Miller.

Emplacement of the East Cape pluton appears to be concurrent with a mid-Miocene change from predominantly submarine volcanic deposition to uplift, followed by mostly subaerial andesitic volcanism along the insular ridge. The possibility of a major mid-Tertiary uplift of the Aleutian Arc was pointed out several years ago by Gates, Fraser and Snyder (1954).

Dates (table 3) of 8.9±0.6 and 10.2±1.1 m.y. were obtained on intrusive rocks that appear to belong to a Pliocene episode of basaltic activity that followed eruption of the Chitka Point. Both samples are from northeast-trending bodies that are probably dikes in the Banjo Point Formation.

A date obtained on hornblende from a dike that is part of a swarm that postdates the East Cape plutonic complex is probably not very reliable because of the small amount of hornblende in the sample. However, intrusive rocks of intermediate composition apparently were emplaced relatively late in the island's history.

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