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PETROGRAPHY OF SOME ERRATICS FROM CAPE ROYDS, ROSS ISLAND, ANTARCTICA

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ABSTRACT

A petrographical study is made of a suite of rocks collected by the British Antarctic Expedition, 1907–9, from Cape Royds, Ross Island, Antarctica. Of the 169 thin sections examined, 163 are of erratics. The igneous specimens constitute approximately 80 per cent of the collection, and may be described as typical East Antarctica rocks.

INTRODUCTION

Cape Royds, located in about latitude 77°33′ S and longitude 166°07′ E, is a promontory on the west side of Mount Erebus, Ross Island, Antarctica.

Results of other studies of Cape Royds erratics have been published. Benson's (1916) contribution relates to the dolerites collected chiefly from the moraines. Jensen (1916) records descriptions of anorthoclase trachyte, phonolitic trachytes, biotite-hornblende trachyte, acid and basic types of kenytes, shonkinitic kenyte porphyry, and porphyritic feldspar-olivine basalt. Smith (1954) refers briefly to the erratics of the Cape Royds district. Thomson (1916) in his microscopical studies of inclusions of the volcanic rocks of the Ross Archipelago mentions the occurrence of certain erratics, including a basic type of alkaline trachyte or orthophyre, sanidinite, and biotite microsanidinite. Walkom (1916), in discussing the petrography of pyroxene granulites, groups these rocks into acid, scapolite-bearing, and basic. Woolnough (1916) describes pegmatites, aplite, sodalite syenites, quartz diorite, granophyric granite porphyry, granophyre, feldspar porphyry, minettes, vogesite, porphyrite, sericitized diabase porphyry, sölvsbergites, sapphire-bearing trachyte, corundum-bearing trachyte, spherulitic trachyte, dense porphyritic basalt, actinolite gneiss, tremolite gneiss, actinolite schists, fine tremolite schist, spotted schist, phyllite, quartz schist, and micaceous sandstone.

CLASSIFICATION OF THE ROCKS

The specimens, represented by 169 thin sections, were collected by Sir Raymond E. Priestley, Geologist, British Antarctic Expedition, 1907–9. Aside from rocks 295A thru 295F and B–A thru B–R, whose numbers were either illegible or missing, the original numbering system is retained. Only six sections, 295, 295A–D and F, all kenytes, are of rocks collected *in situ*.

The collection contains 72 plutonites ranging in composition from

leuco-sodaclase adamellite to gabbro, leucoadamellites, adamellites and granodiorites predominating. There are 13 sections of hypabyssal rocks. Of the 54 extrusives, 29 are of basaltic compositions. Sedimentary rocks are represented by one breccia. Of the 28 rocks classified as metamorphic, 20 are gneisses, and of these 12 are granodioritic. One specimen of vein quartz is represented.

The rocks of this suite are: Pegmatite (211), leuco-sodaclase adamellite (195, 273), leucogranite (204, 242, 256, 300, 309, 324), garnetiferous leucogranite (308), leucogranodiorite (189, 244, 258, 287, 307), porphyritic leucogranodiorite (236), leucotonalite (B-K), leucoadamellite (196, 202, 207, 221, 230, 235, 237, 245, 260, 268, 299, 328), garnetiferous leucoadamellite (213), sodaclase granite (192), quartz granodiorite (251), adamellite (176, 180, 210, 223, 226, 227, 241, 246, 275, 304), porphyritic adamellite (272, 326, B-F), granodiorite (198, 208, 222, 229, 250, 257, 259, 269, 270, 293, 302, 305, 327, B-G), porphyritic granodiorite (191, 282), tonalite (173, 228, B-N, B-Q), diorite (281), syenogabbro (190), gabbro (200, 225, 240, 262) and melagabbro (279); graphic granite porphyry (261), leuco-sodaclase adamellite porphyry (298), micrographic granite porphyry (271), granophyric adamellite porphyry (186), granophyric granodiorite porphyry (B-I), granodiorite porphyry (234), diabase (206, 219, 332), kersantite porphyry (303) and camptonite (205, 252); granophyre (9, 11), biotite granophyre (B-L), granophyre porphyry (199), spherulitic granophyre porphyry (314, 323), altered vesicular extrusive (233), rhyolite porphyry (247), trachyte (226, 277), kenyte (212), kenyte, acid variety (238, 295, 295A-F), vitrophyric kenyte (183, 194, 243, B-B, B-O), plagioclase kenyte (286), basalt (174, 188, 217, 220, 239, 278, 329, 331), vesicular basalt porphyry (185, 224), olivine basalt (232, 254, B-P), olivine basalt porphyry (1, 184, 249, 274, B-C, B-J), vesicular olivine basalt porphyry (B-A), enstatite basalt (264), orthopyroxene basalt (283), vesicular analcime basalt (218), analcime basalt porphyry (182, 201, 263), basalt tuff (289) and amygdaloid (265); breccia (B-H); biotite-actinolite gneiss (187), leucogranodiorite gneiss (193, 316, 321, B-D), granodiorite gneiss (171, 172, 203, 214, 216, 248, 253, 280, 292, 294, 296, B-M), tonalite gneiss (215, 297) and diorite gneiss (197); biotite-quartz schist (179) and calcareous biotite-quartz schist (231, 284); quartzite (12, 175, 317, B-E); ferruginous slate (B-R); vein quartz (177).

The improved Wentworth recording micrometer was used in the quantitative determination of the constituents of 66 sections of igneous rocks (Table 1). An aggregate distance of 56,600 units was measured in traversing each section 16 times. These rocks have been named and classified in accordance with the system of Johannsen.

Characteristics of the Rocks

Zoned plagioclases are not frequently observed in rocks of East Antarctica, whereas they are commonly noted in acid and intermediate intrusives of West Antarctica. In the Cape Royds suite eight acid and intermediate igneous rocks exhibit distinct zoning of the plagioclases. Indistinct zoning of the plagioclases is observed in over 30% of all erratics examined. Over 50% of the erratics contain microperthite, which characterizes "Atlantic-type" rocks. Myrmekitic intergrowths are

TABLE 1. MINERALOGICAL COMPOSITION OF SOME ERRATICS FROM CAPE ROYDS, ROSS ISLAND, ANTARCTICA

Minerals	Specimens												
	251	307	210	195	223	308	244	192	202	230	304	272	207
Quartz	46.89	44.11	39.32	37.88	36.74	36.73	35.73	34.73	33.21	32.73	32.68	32.48	32.30
K-feldspar	12.04	9.56	26.56	25.27	23.67	43.14	15.13	37.39	30.89	37.90	35.46	24.75	38.41
Albite	—	—	—	34.06	—	—	—	21.44	—	—	—	—	—
Oligoclase	29.68	43.17	25.71	—	33.65	17.00	44.93	—	33.66	27.30	25.33	34.72	27.25
Labradorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	3.32	—	—	—	—	—	—	0.32	—	—	0.46	—	—
Chlorite	8.07	3.16	8.09	1.75	5.63	0.97	3.97	5.86	2.06	1.89	6.07	8.05	1.91
Biotite													
Augite	—	—	—	—	—	—	—	—	—	—	—	—	—
Muscovite	p	p	—	1.05	p	p	p	p	—	—	p	—	—
Apatite	p	p	p	p	p	p	p	p	p	p	p	p	p
Zircon	p	p	p	p	p	p	p	p	p	p	p	p	p
Fluorite	—	—	—	—	p	—	—	—	—	—	—	—	—
Garnet	—	—	—	—	—	2.17	—	—	—	—	—	—	—
Sphene	p	p	p	—	—	p	p	p	p	p	p	p	p
Pistacite	p	p	—	—	—	—	p	p	—	p	—	—	p
Zoisite	—	—	—	—	—	—	—	—	—	—	—	—	—
Allanite	p	—	—	—	p	—	p	p	p	p	p	p	p
Schorlite	—	—	—	—	p	—	—	p	—	—	—	—	—
Pyrite	p	p	p	—	—	—	—	—		—	p	—	—
Magnetite	p	p	p	p	p	p	p	p	0.18	0.17	p	p	p
Hematite	p	p	p	p	p	p	p	p			p	p	p
Leucoxene	—	—	p	p	—	—	—	—	p	p	—	—	—
Calcite	—	—	p	—	—	p	—	—	—	—	—	p	—
Kaolin	p	p	p	p	p	p	p	p	p	p	p	p	p
Sericite	p	p	p	—	p	p	p	p	p	p	p	p	p
Accessories	p	p	0.32	p	0.32	p	0.25	0.26	p	p	p	p	0.14
	100.00	100.00	100.00	100.01	100.01	100.01	100.01	100.00	100.00	99.99	100.00	100.00	100.01

p = present

251. Quartz granodiorite
307. Leucogranite
210. Adamellite
195. Leuco-sodaclase adamellite
223. Adamellite
308. Garnetiferous leucogranite
244. Leucogranodiorite
192. Sodaclase granite
202. Leucoadamellite
230. Leucoadamellite
304. Leucoadamellite
272. Porphyritic adamellite
207. Leucoadamellite

TABLE 1 (*Continued*)

Minerals	Specimens												
	287	293	B–K	237	242	324	245	221	180	236	298	226	189
Quartz	31.97	31.91	31.88	31.88	31.83	31.44	31.41	31.40	31.28	30.80	30.76	30.36	30.14
K-feldspar	21.62	13.20	1.81	38.32	33.33	41.30	31.83	36.72	31.69	18.16	31.04	30.57	9.96
Albite	—	—	—	—	—	—	—	—	—	—	—	—	—
Oligoclase	45.49	43.57	61.76	22.45	31.61	26.72	34.32	31.09	30.09	46.01	34.13	33.79	54.86
Labrodorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	—	4.00	—	—	—	—	—	—	—	p	—	—	—
Chlorite	0.65	6.66	4.54	1.15	2.51	0.63	2.22	0.78	6.58	5.03	4.06	5.28	4.88
Biotite													
Augite	—	—	—	—	—	—	—	—	—	—	—	—	—
Muscovite	p	p	—	5.92	—	p	—	p	p	—	p	—	—
Apatite	p	p	p	p	p	p	p	p	p	p	p	p	p
Zircon	p	p	p	p	p	p	p	p	p	p	p	p	p
Fluorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Garnet	—	—	—	—	—	—	—	—	—	—	—	—	—
Sphene	p	p	p	p	p	p	p	p	p	p	p	p	p
Pistacite	—	p	—	p	p	—	p	p	p	p	p	—	p
Zoisite	—	—	—	—	—	—	—	—	—	—	—	—	—
Allanite	—	p	—	—	p	—	p	—	p	—	p	p	—
Schorlite	—	—	—	—	—	—	—	—	—	—	—	—	—
Pyrite	—	—	—	0.27	—	—	—	p	0.15	p	—	—	—
Magnetite	p	p	p		0.61	p	p	p		p	p	p	p
Hematite	p	p	—			p	p	p		p	p	p	p
Leucoxene	—	—	—	—	—	—	—	—	p	p	p	p	—
Calcite	—	p	—	—	—	p	—	—	p	—	—	p	—
Kaolin	p	p	p	p	p	p	p	p	p	p	p	p	p
Sericite	p	p	p	p	p	p	p	p	p	p	p	p	p
Accessories	0.26	0.65	p	p	0.13	p	0.21	p	0.21	p	p	p	0.16
	99.99	99.99	99.99	99.99	100.02	99.99	99.99	99.99	100.00	100.00	99.99	100.00	100.00

p=present

287. Leucogranodiorite
293. Granodiorite
B–K. Leucotonalite
237. Leucoadamellite
242. Leucogranite
324. Leucogranite
245. Leucoadamellite
221. Leucoadamellite
180. Adamellite
236. Porphyritic leucogranodiorite
298. Leuco-sodaclase adamellite porphyry
226. Adamellite
189. Leucogranodiorite

TABLE 1 (*Continued*)

Minerals	Specimens												
	208	269	260	196	328	222	213	235	270	228	176	259	229
Quartz	29.86	29.53	29.40	29.01	29.01	28.61	28.57	28.31	28.27	28.25	27.64	27.51	27.13
K-feldspar	17.58	14.05	26.38	35.42	34.64	15.81	29.69	26.16	26.66	1.92	31.41	11.61	22.55
Albite	—	—	—	—	—	—	—	—	—	—	—	—	—
Oligoclase	44.81	50.62	39.70	32.13	33.85	48.21	40.83	41.60	39.67	59.54	34.48	54.70	43.98
Labradorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	0.66	—	—	—	—	—	—	—	—	—	p	—	—
Chlorite	7.00	5.55	4.53	2.98	2.49	7.37	0.30	3.92	5.40	9.24	6.37	6.18	6.17
Biotite													
Augite	—	—	—	—	—	—	—	—	—	—	—	—	—
Muscovite	—	—	—	—	—	—	—	p	p	p	p	p	p
Apatite	p	p	p	p	p	p	p	p	p	p	p	p	p
Zircon	p	p	p	p	p	p	p	p	p	p	p	p	p
Fluorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Garnet	—	—	—	—	—	—	p	—	—	—	—	—	—
Sphene	p	p	p	p	p	—	p	p	—	—	p	p	p
Pistacite	p	p	—	p	—	—	—	—	—	p	—	—	p
Zoisite	—	—	—	—	—	—	—	—	—	—	—	—	—
Allanite	p	—	p	p	p	—	—	p	p	p	p	—	p
Schorlite	—	p	—	—	p	—	—	—	—	—	—	—	—
Pyrite	—	—	—	—	—	—	—	—	—		—	—	—
Magnetite	p	p	p	0.32	p	p	p	p	p	0.27	p	p	p
Hematite	p	p	p		p	p	p	p	p		p	p	p
Leucoxene	—	p	p	—	p	p	—	p	—	—	—	p	—
Calcite	p	—	—	—	—	p	p	—	—	—	—	—	p
Kaolin	p	p	p	p	p	p	p	p	p	—	p	p	p
Sericite	p	p	p	p	p	p	p	p	p	p	p	p	p
Accessories	0.11	0.25	p	0.14	p	p	0.60	p	p	0.77	0.12	p	0.16
	100.02	100.00	100.01	100.00	99.99	100.00	99.99	99.99	100.00	99.99	100.02	100.00	99.99

p = present

208. Granodiorite
269. Granodiorite
260. Leucoadamellite
196. Leucoadamellite
328. Leucoadamellite
222. Granodiorite
213. Garnetiferous leucoadamellite
235. Leucoadamellite
270. Granodiorite
228. Tonalite
176. Adamellite
259. Granodiorite
229. Granodiorite

TABLE 1 (*Continued*)

Minerals	Specimens												
	299	327	256	258	B–G	273	B–F	326	186	275	282	227	268
Quartz	26.81	26.78	26.77	26.76	26.49	26.23	26.07	25.19	23.73	23.73	23.72	22.46	22.00
K-feldspar	40.81	20.91	27.22	22.07	34.52	37.75	31.13	35.03	29.88	28.50	9.92	42.07	47.10
Albite	—	—	—	—	—	—	—	—	—	—	—	—	—
Oligoclase	27.46	46.50	43.68	49.50	33.43	32.17	36.16	34.52	39.10	37.88	52.16	29.20	29.07
Labradorite	—	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende	p	—	—	—	—	3.85	1.76	p	7.18	9.50	4.39	—	1.83
Chlorite	4.44	5.81	2.34	1.65	5.56			4.69			9.25	6.27	
Biotite													
Augite	—	—	—	—	—	—	—	—	—	—	—	—	—
Muscovite	p	p	p	p	—	p	—	p	—	—	—	p	p
Apatite	p	p	p	p	p	p	p	p	p	p	p	p	p
Zircon	p	p	p	p	p	p	p	p	p	p	p	p	p
Fluorite	—	—	—	—	—	—	—	p	—	—	—	—	—
Garnet	—	—	—	—	—	—	—	—	—	—	—	—	—
Sphene	p	p	p	p	p	p	p	p	p	p	p	p	p
Pistacite	p	—	—	—	—	—	—	p	—	p	p	p	—
Zoisite	—	—	—	—	—	—	—	p	—	—	—	—	—
Allanite	p	—	p	—	p	p	p	p	p	p	p	p	p
Schorlite	—	—	—	—	—	—	—	—	—	—	—	p	—
Pyrite	—	—	—	—	—	—	p	—	p	—	—	—	—
Magnetite	p	p	p	p	p	p	p	p	p	p	p	p	p
Hematite	p	—	p	p	—	p	p	p	p	p	p	p	p
Leucoxene	—	—	—	p	p	—	p	—	—	—	—	p	p
Calcite	—	—	—	p	p	—	p	—	—	—	p	—	p
Kaolin	p	p	p	p	p	p	p	p	p	p	p	p	p
Sericite	p	p	p	p	p	p	p	p	p	p	p	p	p
Accessories	0.48	p	p	p	p	p	0.78	0.57	0.11	0.40	0.56	p	p
	100.00	100.00	100.01	99.98	100.00	100.00	100.00	100.00	100.00	100.01	100.00	100.00	100.00

p = present

299. Leucoadamellite
327. Granodiorite
256. Leucogranodiorite
258. Leucogranodiorite

B–G. Adamellite
273. Leuco-sodaclase adamellite
B–F. Porphyritic adamellite
326. Porphyritic adamellite

186. Granophyric adamellite porphyry
275. Adamellite
282. Porphyritic granodiorite
227. Adamellite
268. Leucoadamellite

TABLE 1 (*Continued*)

Minerals	Specimens													
	309	198	191	246	300	302	250	241	B–N	305	257	279	173	190
Quartz	21.67	21.41	20.18	18.97	18.46	16.65	13.31	14.82	12.83	11.23	7.55	6.68	3.32	1.42
K-feldspar	56.02	21.44	23.53	35.63	60.78	25.59	24.65	29.85	p	9.81	5.97	5.37	p	4.12
Albite	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oligoclase	19.32	51.54	47.51	37.59	16.91	46.10	42.02	45.63	51.85	46.25	68.70	35.32	55.29	61.77
Labradorite	—	—	—	—	—	—	—	—	—	—	—	—	—	
Hornblende	—	—	0.87	2.20	—	3.38	5.98	1.11	13.59	14.71	9.04	39.27	22.11	5.83
Chlorite	2.99	5.36	7.79	5.62	3.45	8.28	13.71	8.32	19.76	16.67	7.61	12.35	18.16	
Biotite									1.33	1.33	—	p	p	26.22
Augite	—	—	—	—	—	—	—	—	p	—	—	—	p	—
Muscovite	—	p	—	p	—	p	p	p	p	p	p	p	p	p
Apatite	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Zircon	p	p	p	p	p	p	p	p	—	—	—	—	—	—
Fluorite	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Garnet	—	—	—	—	—	—	—	—	—	—	1.14	p	p	—
Sphene	p	p	p	p	p	p	p	p	p	p	—	—	p	—
Pistacite	—	—	p	p	p	p	p	p	p	—	—	—	—	—
Zoisite	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Allanite	p	p	p	—	—	p	p	p	p	p	—	—	—	—
Schorlite	—	—	—	—	—	p	—	—	—	—	—	—	—	—
Pyrite	—	—	—	—	—	—	—	p	—	p	—	—	—	0.65
Magnetite	p	p	p	p	p	p	p	p	p	p	p	p	p	
Hematite	p	—	p	p	p	p	p	p	—	p	p	p	—	—
Leucoxene	—	—	—	—	—	p	—	—	—	—	—	—	—	—
Calcite	—	—	—	—	—	—	—	p	p	—	p	—	p	—
Kaolin	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Sericite	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Accessories	p	0.24	0.14	p	p	p	0.33	0.26	0.63	p	p	1.02	1.10	p
	100.00	99.99	100.02	100.01	100.00	100.00	100.00	99.99	99.99	100.00	100.01	100.01	99.98	100.01

p = present

309. Leucogranite
198. Granodiorite
191. Porphyritic granodiorite
246. Adamellite
300. Leucogranite
302. Granodiorite
250. Granodiorite
241. Adamellite
B–N. Tonalite
305. Tonalite
257. Granodiorite
279. Melagranodiorite
173. Tonalite
190. Syenogabbro

observed in slightly less than 50% of the Cape Royds specimens. Twinned hornblendes, so commonly noted in West Antarctica rocks, are uncommon in those of East Antarctica.

A review of the literature discloses that allanite is practically confined to rocks of East Antarctica. The only references to this mineral in West Antarctica are recorded by Pelikan (1909, p. 36) in a kersantite collected in Osterrieth Mountains, Anvers Island, Palmer Archipelago, and by Stewart (1945a, p. 147; 1947, p. 230) in intrusives of the Melchior Islands, Palmer Archipelago. Allanite and allanite (?) are observed in 8 of 125 thin sections.

Allanite in Antarctic rocks was first reported by Prior (1902, p. 323) in descriptions of a biotite granite boulder found on the plateau of Cape Adare, Victoria Land, and a boulder of biotite-hornblende granite from "Geikie Land" (Geikie Ridge), collected by the Southern Cross Antarctic Expedition, 1898–1900.

Prior (1907, p. 127), describing the rocks collected by the National Antarctic Expedition, 1901–4, refers to allanite in specimens from Cathedral Rocks, Victoria Land. Mawson (1916, p. 211), in his descriptions of rocks collected from the mainland of Victoria Land by the British Antarctic Expedition, 1907–9, states, "Allanite is by far the commonest of the accessory minerals appearing in nearly all the granites in our collections." On page 217, he refers to allanite in aplitic granite porphyry. Cotton (1916, p. 235–236) mentions allanite (?) in an augite porphyrite from Cape Ross, south of Depot Island, Victoria Land. Smith (1924, p. 183), in referring to hornblendic biotite granites of Granite Harbour and Ferrar Glacier areas, McMurdo Sound, Victoria Land, states, "Allanite (orthite) was found as an accessory in all typical specimens." In this same publication, page 185, he remarks that orthite as thin prisms (0.6 mm.×0.06 mm.) is a rare but constant accessory in aplite and pegmatite dikes of the McMurdo Sound region. He, also, reports allanite in quartz-orthoclase porphyries and mentions the mineral as a constant accessory in orthoclase porphyries. Biotite and hornblendic biotite granites contain allanite in the Terra Nova Bay region, Victoria Land.

Although Wade (1937) and Warner (1945) do not record allanite in their thin sections, Stewart (1945*b*) reports allanite in 9 of 30 slices of quartz-bearing intrusives from Marie Byrd Land, which rocks show affinities with both East and West Antarctica types.

Wade (1945) did not observe allanite in rocks of the Rockefeller Mountains, Edward VII Peninsula, nor did Stewart (1945*b*).

The occurrence of allanite is notable in the specimens collected by the Australasian Antarctic Expedition, 1911-14, from Adélie, George V, and eastern Queen Mary Coasts, as recorded in the writings of Glastonbury (1940*a*, *b*, *c*), Kleeman (1940), Nockolds (1940), Stillwell (1918, 1923), and Summers and Edwards (1940). Allanite is reported in granite, felsite, porphyry, granophyre, metamorphosed dolerite, gneiss, hybrid gneiss, schist, amphibolite and marble. On page 52, in describing the rocks of eastern Queen Mary Coast, Nockolds states, "A feature of this province, if province it can be called, is the universal presence of orthite in all acid rocks."

Although Woolnough (1916) does not mention the occurrence of allanite in Cape Royds erratics, a distinguishing feature of this suite from Cape Royds is the presence of allanite, being observed in 52 sections of acid igneous rocks and three of intermediate composition, as well as in eight gneisses and two schists. Allanite exhibiting neither twinning nor zoning is seen in 10 sections; zoned and twinned in 33 slides; zoned only in 19 thin sections, and twinned only in two slices.

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