COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

OCCURRENCE OF PHOSPHATE IN UPPER PROTEROZOIC ROCKS AT RUM JUNGLE, NORTHERN TERRITORY

by

B.P. Walpole

RECORDS 1961/149

CONTENTS

List of Plates.

Plate No.	Title	Scale
1	Locality Map	1" to 1 mile
2	Area 1. Easticks Anomaly	1" to 100 feet
3	Area 4	1" to 100 feet
4	Area 2. Geolsec Anomaly	1" to 100 feet

OCCURRENCE OF PHOSPHATE IN UPPER PROTEROZOIC ROCKS AT RUM JUNGLE, NORTHERN TERRITORY

by

B.P. Walpole

SUMMARY

A rock type, referred to by the field term of "lilac formation", which occurs within the Upper Proterozoic Buldiva Sandstone at Castlemaine Hill, Rum Jungle, was found by laboratory investigations to be high-grade phosphate rock. The phosphate-bearing mineral is apatite. Samples collected as a result of this discovery confirmed the presence of phosphate in a number of scattered outcrops along the eastern flank of Castlemaine Hill. The size and grade of the deposits is unknown.

INTRODUCTION

A programme of geochemical sampling of auger cuttings from radiometric anomalies at Rum Jungle, combined with radiometric and electromagnetic investigations, resulted in the discovery of two new radiometric anomalies (Geolsec & Easticks) near Flynns prospect on the eastern flank of Castlemaine Hill. Both these anomalies were caused by weak radioactivity in a rock referred to by B.P. Ruxton (party leader) as "lilac formation". This rock type was also found by Ruxton at two other localities in this area - Flynns and Castlemaine anomalies - and considered by him to be the basal unit in the Upper Proterozoic sequence in this area. Some auger boring was carried out on Geolsec anomaly but was discontinued when the rock type was recognised as similar to weakly radioactive material which had been tested without success for uranium at Sleisbeck and at Saddle Ridge in the South Alligator area; but samples were forwarded to the Geological Laboratory in Canberra for spectrographic study - two to determine the cause of the radioactivity and a third sample as a routine check against geochemical analyses carried out at Rum Jungle. Spectrographic analyses of all samples revealed the presence of phosphate and a chemical analysis on the third sample showed 39.5% P_2O_5, 3.6% Fe_2O_3, 50.4% CaO, less than 0.5% SiO_2, and no sulphate. Alumina was very low. X-ray and petrographic examination (see appendix B) identified the presence of abundant apatite in the rock.

RECONNAISSANCE SAMPLING

Reconnaissance sampling of the four known localities where "lilac rock" cropped out at Castlemaine Hill was subsequently carried out, and the 64 samples* collected run on the spectrograph with the results shown in the accompanying tables and plans. Seventeen of these samples were selected and chemically assayed as a further check. These assays were for phosphate only.

* NOTE: These samples were collected by C.E.Prichard and B.P.Ruxton, who also prepared the plans accompanying this report.

GEOLOGICAL SETTING

The localities of the four known outcrops of phosphate rock sampled are shown on Plate I. In each case they are the lowest outcropping unit in the Upper Proterozoic Buldiva Sandstone sequence, and occur near the base of a gentle slope running east off Castlemaine Hill to Rum Jungle Creek. It is not known if the outcrops are connected beneath the soil cover; but there is a chance that they are. The dip of the Upper Proterozoic rocks in this area ranges from 5° to 30°, and probably averages about 10° - 15°, to the west. Assuming the dip is 10°, section C D (Plate 4) suggests that the phosphatic formation in this locality is at least 100 feet thick. Section A B suggests more than one bed is present.

OTHER POSSIBLE OCCURRENCES

A few of the samples analysed were of a rock type previously named "Hematite Quartzite Breccia" or "hematite-rich calcarenite breccia". Probably most of this particular rock type at Rum Jungle is arenaceous but it should be sampled as a check. Localities where it occurs and where phosphate rock may occur are :

i) the embayment area at Rum Jungle

ii) higher in the Castlemaine Hill sequence

iii) the south-eastern and western flanks of the Waterhouse Granite

iv) B.M.R. No. 1 Saddle Ridge, Scinto & Coronation Hill, South Alligator area.

v) Sleisbeck.

A rock from the Lower Proterozoic sequence at Rum Jungle (Golden Dyke Formation), was described by W.B. Dallwitz for E.K. Carter of the 1951 Rum Jungle field party and was found to contain an estimated 10% of apatite. The Lower Proterozoic rocks in this area therefore also warrant attention.

Apatite has also been recorded in the ore of the Palette mine in the South Alligator Valley, and, probably of less interest, from the Edith River uranium prospect.

CONCLUSIONS & RECOMMENDATIONS

Phosphate rock occurs at (probably) the base of the Upper Proterozoic Buldiva Sandstone at Castlemaine Hill at Rum Jungle. The exposures are limited to four separate localities extending over a distance of about two miles. Most of the samples collected to date are medium to high-grade.

Information available on these occurrences is limited by the poor outcrop in the area of interest and, in keeping with other members of the Buldiva Sandstone, the deposits could be small lenticular bodies. The possibility exists, however, that they are connected and auger traverses should be bored to check this possibility.

Six traverses of six holes each to bedrock are recommended between localities 1 & 2 (Plate 1) and 8 traverses between localities 3 & 4, as an initial test. Section C-D (Plate 4) suggests that the spacing between holes should not be greater than 100 feet.

The other possible occurrences listed should be checked.

While phosphatic rocks have been previously identified in the Precambrian, it is believed that the Castlemaine occurrence is the first recorded example of ore-grade phosphate of this age.

Members of field parties, particularly those operating in lime-rich areas such as the McArthur River and Bulman should be made aware of the difficulty in recognizing such rocks.

APPENDIX A

DETERMINATION OF PHOSPHATE IN OUTCROP SAMPLES AND AUGER CUTTINGS FROM THE CASTLEMAINE HILL - FLYNN'S AREA, RUM JUNGLE, NORTHERN TERRITORY

by

A.D. Haldane and S. Baker

Spectrographic examination was carried out by A.D. Haldane to estimate the phosphorus content and sort out non-phosphatic samples. Selected samples were then chemically analysed by S. Baker, using the magnesium ammonium phosphate method.

(1) OUTCROP SAMPLES

Area 1 - (Eastick's)

Field No.	$\%P_2O_5$ Spec.	$\%P_2O_5$ Chem.	Field No.	$\%P_2O_5$ Spec.	$\%P_2O_5$ Chem.
8.5E/1846N	20+		9E/1860N	20+	
8.5E/1870N	20+	29	9E/1900N	20+	
9E/1836N	20+		12E/1900N	20+	33

Area 2 - (Geolsec)

Field No.	$\%P_2O_5$ Spec.	$\%P_2O_5$ Chem.	Field No.	$\%P_2O_5$ Spec.	$\%P_2O_5$ Chem.
25E/1210N	20+		25E/1482N	10-20	
25E/1231N	<5		25E/1500N(A)	10-20	
25E/1258N	20+		25E/1500N(B)	20+	40
25E/1278N	20+		26E/1200N	<5	
25E/1300N	20+	29	26E/1250N	10-20	
25E/1324N	<5		26E/1270N	20+	42
25E/1350N	<5		26E/1300N	20+	
25E/1410N	20+		26E/1330N	20+	
25E/1431N	10-20	38	26E/1382N	20+	
25E/1455N	20+		26E/1427N	20+	

Area 3

40.3E/254N	20+	35			

Area 4

118E/1550N/A	20+	33	124E/1106N	20+	
B	<5		124E/1147N	20+	
C	20+		124E/1244N	20+	
D	20+	26	124E/1282N	20+	38
			124E/1300N	20+	

2) Auger Cuttings.

Area 2 - Geolsec Anomaly (radiometric)

% P_2O_5

24E/1750N

Depth	Spec.	Chem.
31'-35'	<5	
56'-60'	10	12
76'-80'	10	

24E/16N

Depth	Spec.
12'-16'	<5
18'-22'	<5
24'-28'	<5
30'-34'	<5
36'-40'	<5
42'-46'	<5
48'-52'	<5
54'-58'	<5
64'-66'	<5

26E/15N

Depth	Spec.	Chem.
2'-4'	10-20	
6'-10'	10-20	
12'-16'	10-20	16
18'-22'	10-20	
24'-28'	10-20	
30'-34'	10-20	26
35'-37'	10-20	

26E/14¼N

Depth	Spec.	Chem.
6'-10'	20+	
12'-16'	20+	30
18'-22'	20+	
24'-28'	20+	
30'-34'	20+	35
36'-40'	20+	
42'-46'	20+	
48'-52'	20+	27
58'	20+	

(3) Partial analysis of sample F/25E/15N(B)

Calcium oxide (CaO)	50.4%
Phosphorus pentoxide (P_2O_5)	39.5%
Ferric Oxide (Fe_2O_3)	3.6%
Silica (SiO_2)	0.5%
Alumina	not analysed (low)

Spectrographic estimates were made visually and were intended only as a guide. They should not be taken as exact determinations.

The average phosphate value for the outcrop samples is 34% and 24% for the auger cuttings.

APPENDIX B

HEMATITE-BEARING APATITE ROCK FROM THE "GEOLSEC" RADIOMETRIC ANOMALY, RUM JUNGLE AREA, NORTHERN TERRITORY

by

W.M.B. Robert., S. Baker and W.B. Dallwitz

Introduction

Two samples (Nos. 195932 and 195933) of slightly radioactive material from the "Geolsec" radiometric anomaly, Rum Jungle area, were submitted by the Rum Jungle Geochemical Party at the request of the A/Asst. Chief Geologist, for mineralogical and petrographic examination. Sample No. 195932 was of drill cuttings and sample No. 195933 consisted of small rock fragments taken from an outcrop.

Petrographic, X-Ray and Chemical Results

Specimen No. 195933 is a massive, fine-grained, purplish brown rock with pockets and encrustations of a white to pale brown mineral. The brown colouration is due to inclusions of fine-grained iron oxide. Encrustations of this mineral may take the form of groups of small rosettes made up of fine acicular crystals; these crystals were identified as apatite by X-Ray powder photography.

A thin section (No. 7670) of Specimen 195933 (Registered Rock No. R 9415) was found to consist almost entirely of apatite (90 to 95%) and hematite (5 to 10%). Very small amounts of hydrated iron oxide had been formed from the hematite in places. The apatite is mostly granular (grainsize 0.015 mm to 0.25 mm), but some of it has a fibrous-radiating, colloform structure. The grainsize of the hematite ranges from dust-sized particles up to about 0.15 mm. Some of the fibrous-radiating apatite is densely packed with dusty hematite. None of the apatite is free from hematite.

A small fragment of the specimen from which the section was cut was found to contain 36.8% P_2O_5.

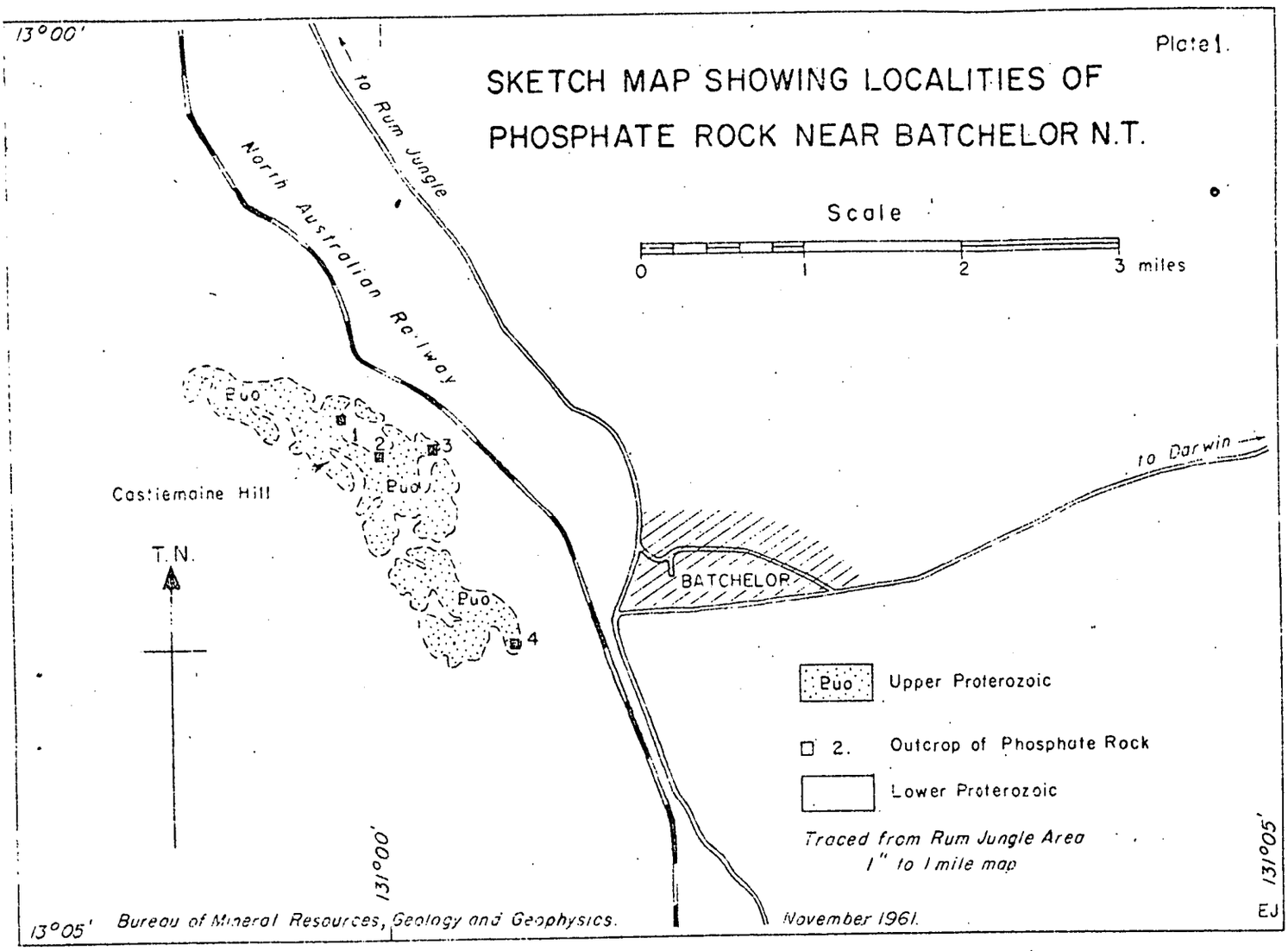
Parts of samples No. 195932 and No. 195933 were examined on the X-Ray spectrograph, and the radioactivity (0.044%e U_3O_8 for sample No. 195932) was found to be due almost entirely to uranium. Minor traces of thorium are present in about the quantity usually found with uranium in nature.

Attempts to isolate a separate uranium mineral from Sample No. 195933 were unsuccessful. A pinkish fibrous-radiating mineral, which was separated from the crushed rock, was identified by X-Ray diffraction as a mineral of the apatite group. An X-Ray powder photograph of crushed material representing the whole rock showed that it was made up almost entirely of the same mineral.

A sample (Field No. F25E/15N/0) taken from the same general area had previously been chemically analysed by S. Baker and was found to contain 39.5% P_2O_5, 50.4% CaO, 3.6% Fe_2O_3 less than 0.5% SiO_2 and no sulphate. Microscopic examination of this material showed that it consists of apatite and minor amounts of hematite, and an X-Ray diffraction analysis confirmed that the principal constituent is a mineral of the apatite group.

Plate 1.

SKETCH MAP SHOWING LOCALITIES OF PHOSPHATE ROCK NEAR BATCHELOR N.T.



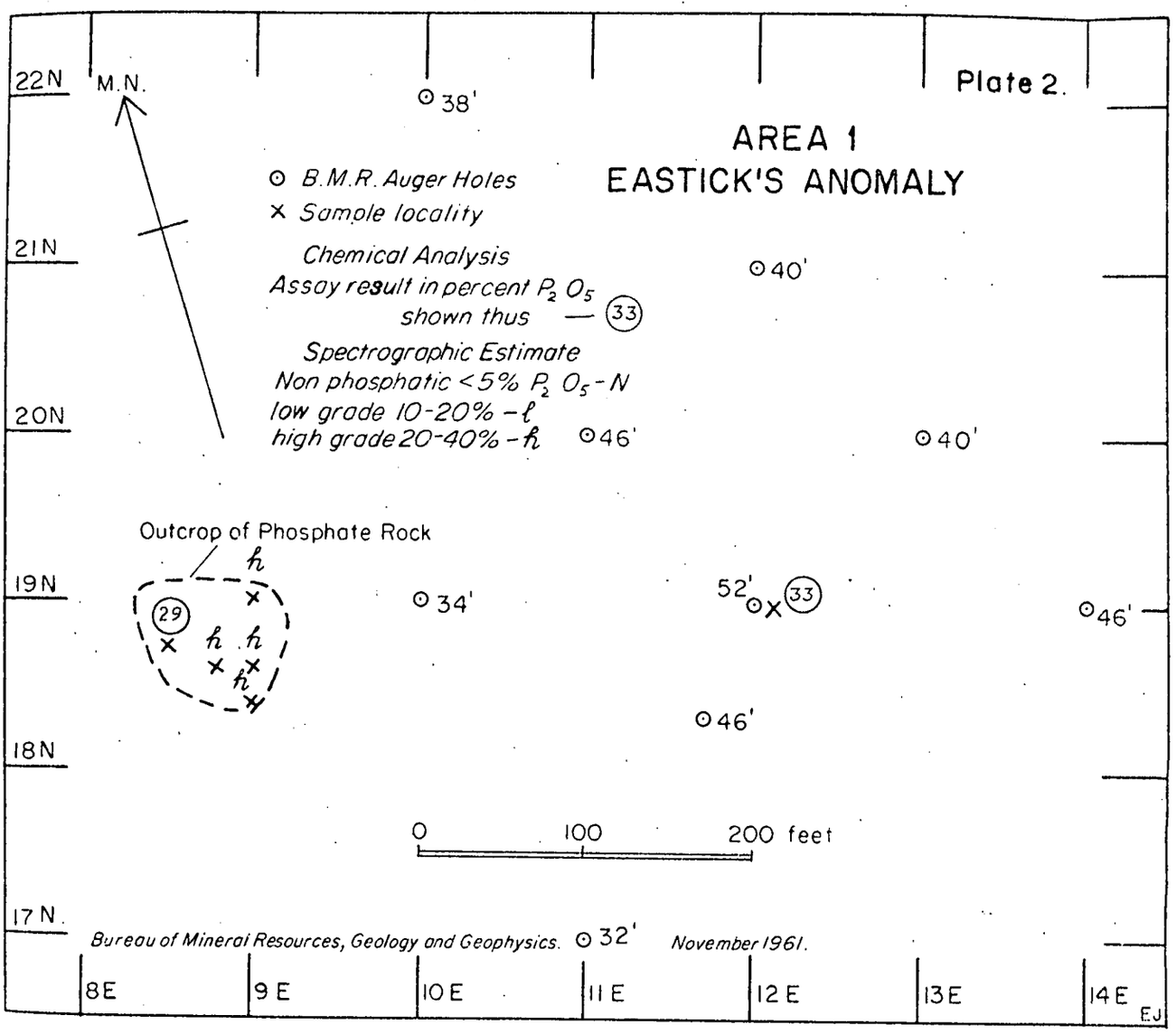
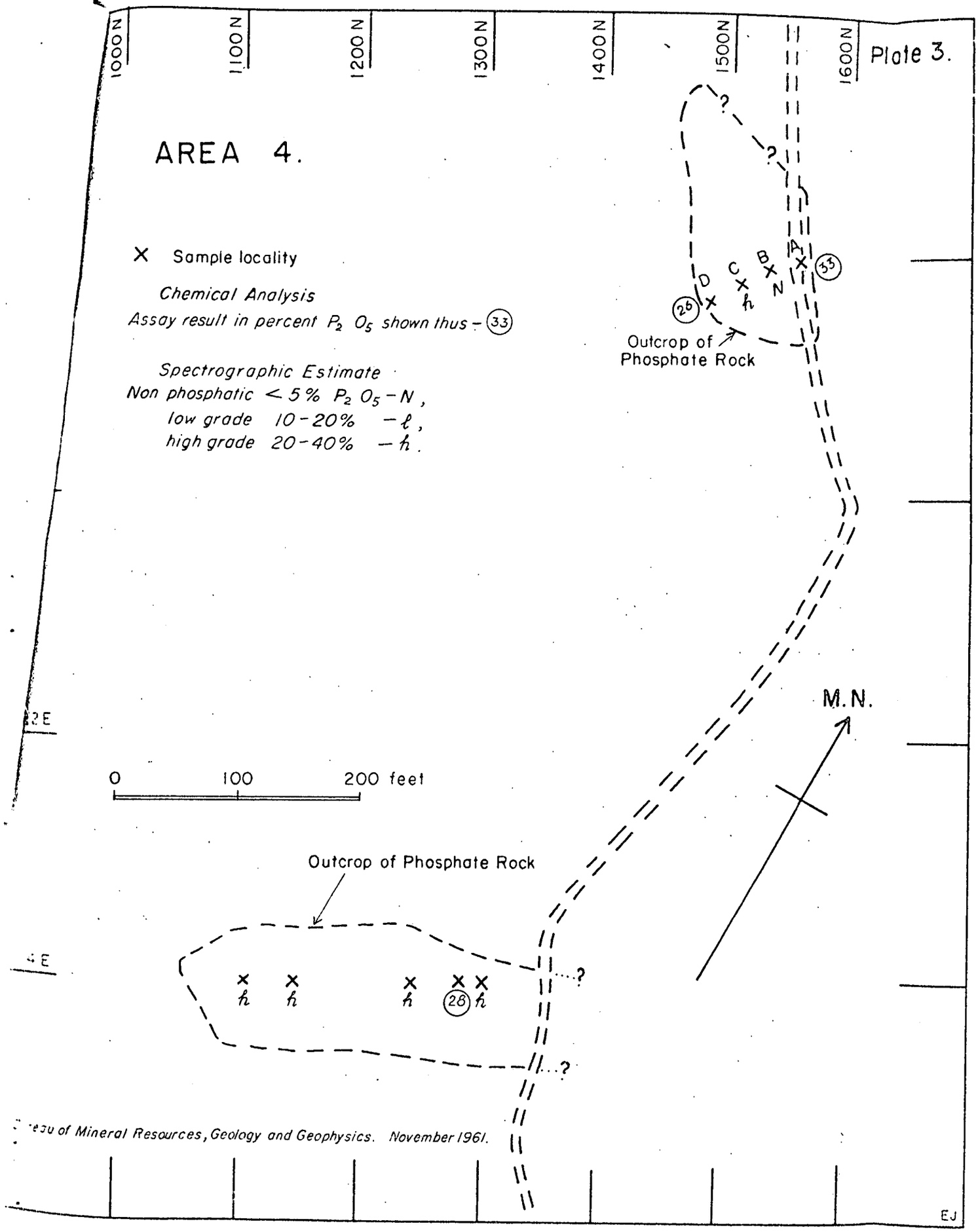


Plate 2.
AREA 1
EASTICK'S ANOMALY
22N
21N
20N
19N
18N
17N.
M.N.
B.M.R. Auger Holes
Sample locality
Chemical Analysis
Assay result in percent P_2O_5 shown thus — (33)
Spectrographic Estimate
Non phosphatic < 5% P_2O_5 - N
low grade 10-20% - l
high grade 20-40% - h
Outcrop of Phosphate Rock
38'
40'
46'
40'
34'
52'
(33)
46'
46'
32'
0 100 200 feet
Bureau of Mineral Resources, Geology and Geophysics.
November 1961.
8E
9 E
10 E
11 E
12 E
13E
14 E
EJ

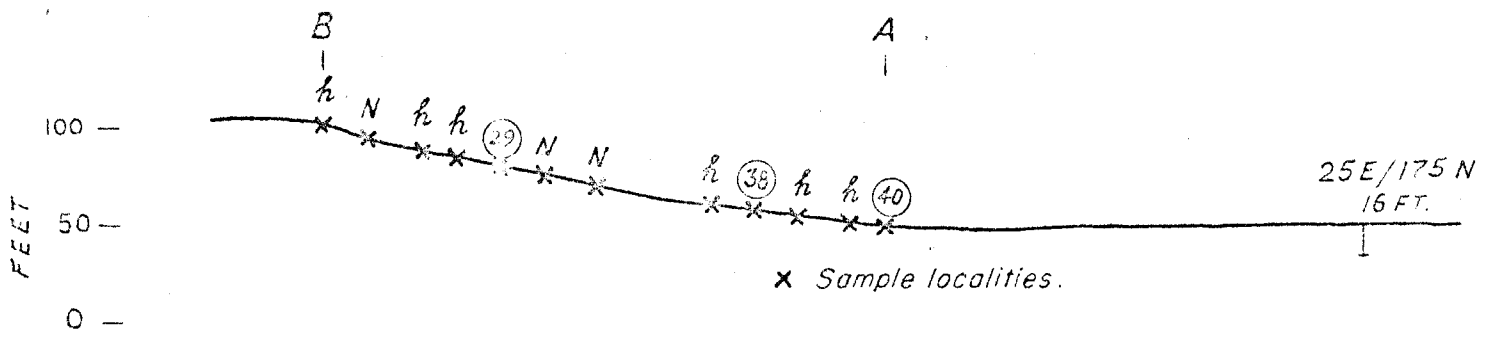
Plate 3.



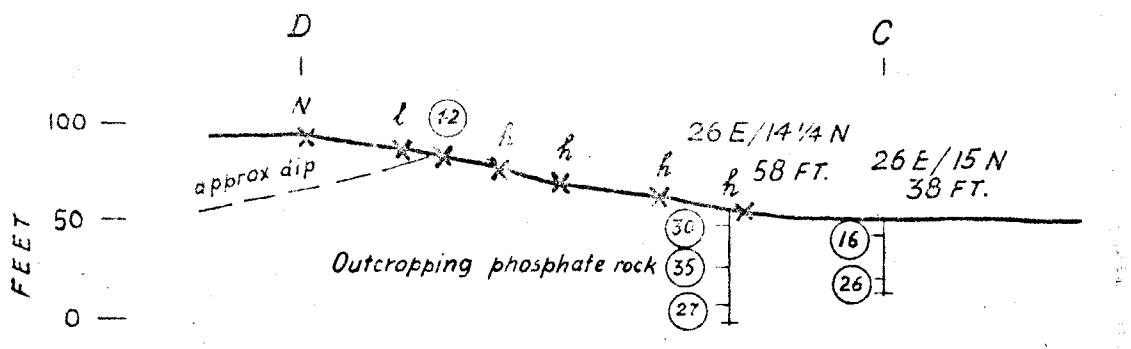
...eau of Mineral Resources, Geology and Geophysics. November 1961.

AREA 2 "GEOLSEC ANOMALY"

SECTION ALONG 25E



SECTION ALONG 26E



Chemical Analysis
Assay result in percent P_2O_5 shown thus — (33)

Spectrographic Estimate
Non phosphatic < 5% P_2O_5 — N,
low grade 10-20% — l,
high grade 20-40% — h.