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MINOR PHOSPHORITE IN THE DRUMMOND BASIN, QUEENSLAND.

by

H.F. Doutch

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CONTENTS

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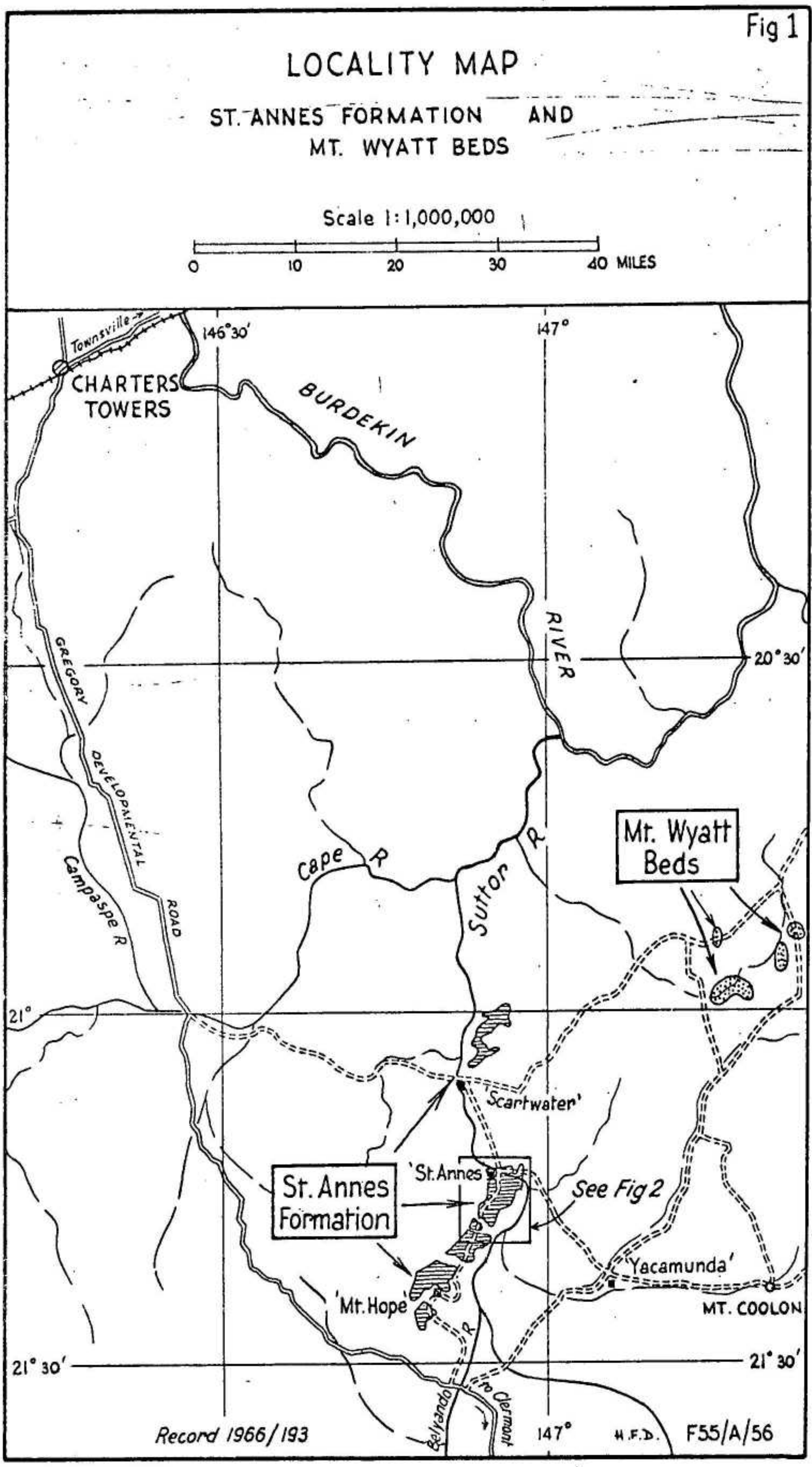
Fig 1
LOCALITY MAP
ST. ANNES FORMATION AND
MT. WYATT BEDS
Scale 1:1,000,000
0
10
20
30
40 MILES
146°30'
147°
Townsville
CHARTERS TOWERS
BURDEKIN
RIVER
20°30'
GREGORY
DEVELOPMENTAL
ROAD
Campaspe R
Cape R
Suttor R
Mt. Wyatt Beds
21°
'Scartwater'
'St. Annes'
St. Annes Formation
See Fig 2
'Yacamunda'
MT. COOLON
'Mt. Hope'
R
21°30'
21°30'
Belyando
to Clermont
147°
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SUMMARY

A small floater of black sedimentary phosphorite containing 15% P_2O_5 was found south of St. Annes Homestead, 90 miles south-south-east of Charters Towers, in an area where sediments of the ? Upper Devonian *St. Annes Formation are exposed. Close investigation revealed two calcareous feldspathic sandstone units containing significant amounts of phosphate (up to 4% P_2O_5). The phosphorite floater was probably shed from within one of these units.

The St. Annes Formation in this area is probably about 2,400 feet thick, and consists of a lower tuffaceous sandstone part, and an upper part of algal limestone and acid volcanics. The phosphatic sediments are transitional between the two parts and are indicative of marine deposition.

Although this investigation did not disclose any richly phosphatic beds, further prospecting of the region is warranted, as the greater part of the St. Annes Formation has not been examined in detail. As this is the first find of phosphorite in the Upper Devonian of Australia, re-examination of appropriate marine sequences elsewhere could be profitable.

* In this report all stratigraphic names with an asterisk are provisional and will be defined and formalized in a report on the geology of the Drummond Basin, now in preparation.

PLATE 1.

Fig. 1. Dry Creek bed in which the original phosphorite floater was found; looking upstream from locality 901D.

Fig. 2. Locality 901D.

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INTRODUCTION

In July 1966, *J.E. Thompson collected a small slab (3" x 3" x ¾") of black phosphorite from rubble in a small dry creek bed near St. Annes Homestead, an outstation of the Yacamunda property, and about 90 miles south-south-east of Charters Towers (Fig. 1). An approximate analysis for phosphate indicated about 15% P_2O_5 **in this specimen. The specimen is almost jet black and is made up of interfingering laminae of fine-grained calcareous sandstone and calcareous siltstone; short petrographic descriptions by ***P.J. Cook of two thin sections of the phosphorite are appended (Appendix 1).

The area can be reached from Charters Towers by driving along the Gregory Developmental Road for 120 miles, then driving north for about 25 miles along the track to St. Annes through the Mt. Hope property (see Fig. 1). A shorter route through Scartwater Homestead is practical when the two crossings of the Suttor River are dry. The actual specimen locality (Fig. 2) can be reached by walking east from the St. Annes-Mt. Hope track from a point about 2 miles south of the Suttor River crossing to the first fence and following it to the axis of the small syncline in which phosphatic units were mapped. The photographs on Plate 1 illustrate the dry creek bed from which the original specimen was taken.

The area was revisited by the writer for 3 days in August 1966. During this visit a small syncline was mapped in detail (Fig. 3), and nearly every bed between the track and fence was tested qualitatively in the field for phosphate with ammonium molybdate solution. As a result two phosphatic units were recognised, and twelve specimens forwarded to Canberra for testing (See Appendix 2).

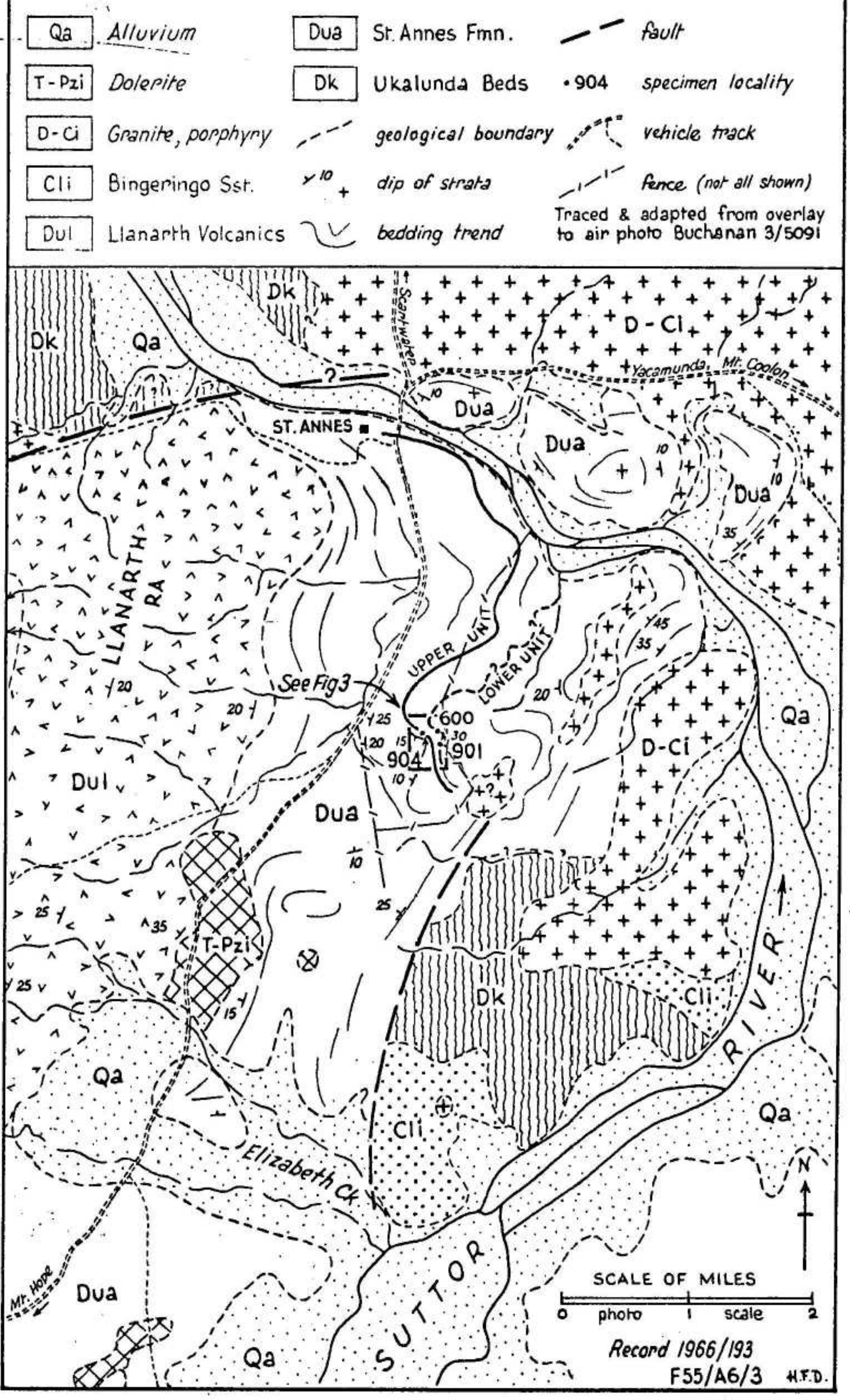
* Supervising Geologist, Bureau of Mineral Resources.

** All phosphate contents quoted in this report were determined by I. Boyd of the Phosphate Group, Bureau of Mineral Resources, using the Shapiro method (Shapiro, 1952).

*** Geologist, Bureau of Mineral Resources.

Fig 2

GEOLOGICAL MAP, ST. ANNES AREA
SHOWING PHOSPHATE BEARING BEDS



FINDINGS

The phosphorite floater locality is in an area in which sediments of the ? Upper Devonian *St. Annes Formation are exposed in the nose of a small south-westerly plunging syncline (Fig. 3). The two phosphatic units delineated by testing with ammonium molybdate solution crop out in continuous sequence on the northern limb of the syncline. Only the lower unit was seen on the south-eastern limb. The two units are separated by siliceous rocks which are probably altered acid volcanics.

The upper unit is approximately 35 feet thick, and consists of thin to medium bedded calcareous and/or feldspathic fine-grained sandstone and siltstone, variously brown, grey or green. A specimen (904U) from the bottom of the unit (Fig. 3) contained about 2% P_2O_5. The unit crops out for 3½ miles and becomes more calcareous towards the north; at the St. Annes crossing of the Suttor River (Fig. 2) it is represented almost entirely by black fine-grained limestone which gives a very weak positive reaction to the ammonium molybdate test.

The lower unit is approximately 80 feet thick and consists of thin to medium bedded dark grey calcareous feldspathic sandstone. Specimen 600P from the northern limb of the syncline contained about 1% P_2O_5, and 904D, from about the same stratigraphic position on the south-eastern limb, contained about 4% P_2O_5 (Fig. 3). The phosphorite specimen collected by J.E. Thompson was probably shed from within this unit. The lower unit crops out poorly, but probably persists to the north beneath the flood plain of the Suttor River.

North of the synclinal axis the units dip northwesterly from 10° to 15°. On the southeastern limb the lower unit at first dips 30° westerly, but as the strike changes to the south-east dips flatten to 10° to the south west. The units were not followed to the south; from a study of the air-photographs it appears that they are interrupted by a small intrusion and a fault. To the east, stratigraphically lower beds crop out poorly and were not examined closely. They are mainly tuffaceous sandstones.

STRATIGRAPHY

The two phosphatic sandstone units occur about 1000' below the top of the *St. Annes Formation, the basal formation in the Drummond Basin. This formation is probably of Upper Devonian age; Malone et al. (1964) report finding ? Protolepidodendron near the St. Annes crossing of the Suttor River and further plant fossil determinations are in progress.

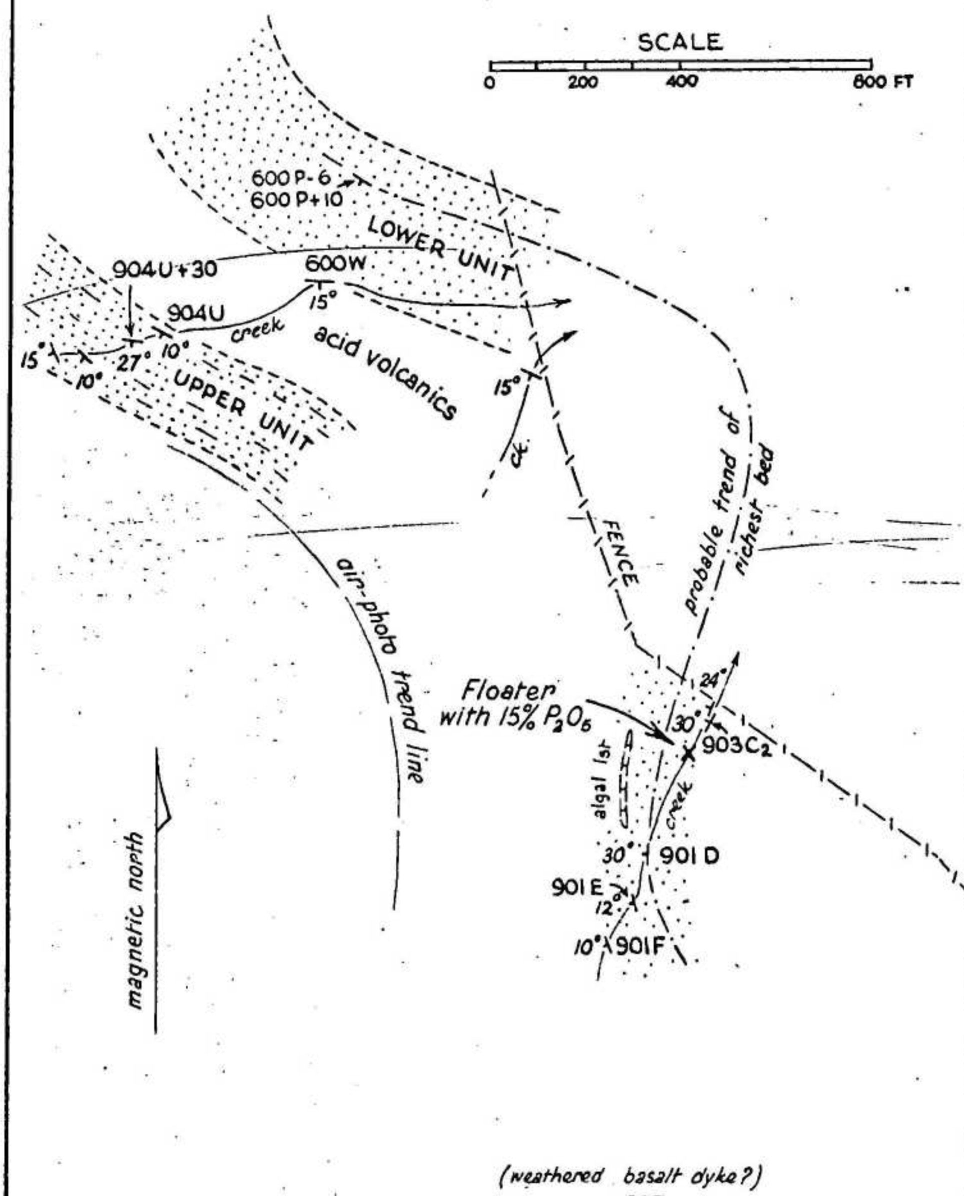
Below the phosphatic units the formation consists of 1400' + of tuffaceous sandstone and minor mudstone. Above the phosphatic units acid and intermediate volcanics in the south interfinger with algal limestones in the north. The contact of the *St. Annes Formation with underlying rocks is largely obscured by alluvium and has not been examined in detail. East of St. Annes Homestead, granite intrudes both the Middle Devonian Ukalunda Beds (Malone et al., 1966) and the *St. Annes Formation. North of Elizabeth Creek (Fig. 2) a fault separates the *St. Annes Formation from the Ukalunda Beds and outliers of the *Bingeringo Sandstone. To the west of these two localities the *St. Annes Formation is conformably overlain by the *Llanarth Volcanics, a sequence of acid tuffs and lavas (Fig. 2) probably equivalent to the Silver Hills Volcanics in the Emerald area (Veevers et al, 1964).

Outside the map area (Fig. 2) the *St. Annes Formation is poorly known. North-east of Scartwater Homestead (Fig. 1) a somewhat similar sequence of limestones, tuffs, and possibly flows have been assigned to the *St. Annes Formation. This sequence rests unconformably on the Ukalunda Beds. The *Llanarth Volcanics are missing, and the sequence is overlain by the next higher formation, the *Scartwater Formation, equivalent to the Telemon Formation in the Springsure and Emerald areas (SQD, 1952; Veevers et al, 1964). (No sequence equivalent to the *St. Annes Formation has been recognised in these southern areas).

Fig 3

PHOSPHORITE LOCALITY
ST. ANNES AREA

showing specimen localities
(901 D, etc.)



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Thirty miles east-north-east of Scartwater Homestead, the Mt. Wyatt Beds, siltstone, sandstone and conglomerate (Malone et al, 1966), are probably equivalent to the *St. Annes Formation. Between Mt. Wyatt and Scartwater Homestead, acid volcanics exposed intermittently may be equivalent to either formation; they have not been mapped and could be inter-bedded with phosphatic sediments.

South of the St. Annes phosphorite locality, towards Mt. Hope Homestead, alluvium conceals most of the *St. Annes Formation. Only a few isolated outcrops of acid volcanics have been examined.

DISCUSSION

The geological history of the *St. Annes Formation is broadly one of relatively prolonged sub-aqueous deposition of tuffaceous sandstone, followed by an interval involving phosphate accumulation. This quickly gave way to a period of algal limestone deposition and contemporaneous acid to intermediate volcanism, in part terrestrial. This succession may represent a progressive shallowing of the sea, and, possibly, increasing aridity.

Conditions conducive to phosphorite deposition occurred only while environmental and/or provenance conditions were changing. In this transitional interval detrital quartz and feldspar in appreciable amounts were entering the depositional environment, the ph of which apparently permitted the co-existence of primary calcite and phosphate (see Appendix 1). The sequence, as known, does not include black shale and chert, which are commonly associated with phosphorite deposition, as, for example, in the Phosphoria Formation (McKelvey and others, 1959). This suggests that the depositional environment was not wholly suitable for large scale deposition of phosphorite.

In Appendix 1 Cook suggests that the phosphorite specimen represents shallow marine deposition and may be associated with an unconformity. Field evidence so far neither supports nor denies these views. Nor has sufficient regional work been done to allow more than the broadest interpretation of tectonics and palaeogeography. Briefly, it seems likely that the Ukalunda Beds were being uplifted at this time and formed land east of the *St. Annes Formation and south of the Mt. Wyatt Beds, possibly in a palaeolatitude of 20°S or less (Irving, 1964).

A synthesis of these interpretations is that during the deposition of the *St. Annes Formation there was an interval in which a shelf or deeper marine environment existed in the St. Annes area, west of a land mass from which may have come the moderate supply of detritus. The palaeolatitude suited phosphate deposition (Sheldon 1964), but the ph of the environment was probably excessive. As this synthesis leans heavily on detailed work in only one small area, it should not discourage further prospecting.

This find is the first indication of phosphorite in the Upper Devonian of Australia. As most of Australia was probably in lower latitudes at that time (Irving 1964), and thus possibly favourably situated for phosphorite deposition (Sheldon 1964), a reexamination of appropriate marine sequences might be profitable. In particular the nearby Star and Yarrol Basins merit closer study.

CONCLUSION

Although no richly phosphatic beds were located in the St. Annes Area, and Malone's description (Malone et al, 1966) of the Mt. Wyatt Beds is not encouraging in terms of popular theories on phosphorite accumulation (e.g. Sheldon, 1964), further prospecting of the *St. Annes Formation is warranted because of the limited scope of this investigation. Prospecting should be supported by shallow core drilling to sample portions of the sequence not well exposed. Other nearby Upper Devonian marine sequences should be examined for the possibility of phosphorite deposition.

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APPENDIX I

REPORT ON TWO THIN SECTIONS OF A SPECIMEN OF PHOSPHORITE FROM THE DRUMMOND BASIN

by

P.J. Cook

66350022A.

The section is composed predominantly of a dark brown to pale brown isotropic matrix considered to be crypto-crystalline apatite; it is distinctly laminate in form, with the laminae ranging from 1 to 3 mms in thickness. The remainder of the slide is made up of calcite (10-20%), quartz (10-20% - mainly showing straight extinction but with a few composite grains) and feldspar (up to 5%). The quartz and feldspar are undoubtedly detrital; they range in grain size from fine sand to fine silt (3Ø to 6Ø) and are generally poorly rounded and sorted. A few fragmentary fossils (?sponge spicules) are present. The bonding of the calcite with phosphatic matrix is commonly rather indistinct and there are indications of replacement of the calcite by the apatite.

66350022B.

This specimen is similar to specimen 66350022A but there are no laminae visible in the crypto-crystalline apatite. Feldspar is also more abundant (up to 10%). Calcite quartz grains and fragments of fossils are again present.

This thin section was cut parallel to the phosphatic laminae.

Environmental conditions

The presence of abundant fresh feldspar suggests that conditions were either arid or deposition was rather rapid; the poor rounding would tend to support the later. However, the thin phosphatic laminae could only have accumulated under quiet conditions. For much of the time sediments were prevented from reaching the area either by a physical barrier or by sedimentation being sporadic due for instance to an infrequent rainfall.

The presence of micro-cross-laminae may be an indication of shallow water conditions.

Therefore it would appear that the depositional environment of these two specimens was shallow water marine, probably some distance from the shore, to escape the dilution effects of terrigenous sediments and probably within an arid climatic belt with only sporadic rainfall.

Although there are indications that some of the calcite is being replaced by apatite there is no evidence to suggest that all of the apatite has replaced calcite.

The only other phosphorite observed by the writer to have this laminate form is one which occurs on the unconformity surface at the base of the Areyonga Formation (Upper Proterozoic) of the Amadeus Basin. It is not inconceivable that the Drummond Basin phosphorite may also be found to occur on such an unconformity surface.

APPENDIX 2

RESULTS OF SHAPIRO TEST OF TWELVE SAMPLES FROM THE ST. ANNES FORMATION, DRUMMOND BASIN, QUEENSLAND

The results are listed in descending stratigraphic order. Thompson's floater probably came from locality 901D, which is the same horizon as locality 600P. Specimen 907 may be from a decomposed basalt dyke. See Figure 3.

Upper Unit

Sample No.	P_2O_5
904U + 30	n.d.
904U	2%

Lower Unit

Sample No.	P_2O_5
600W	n.d.
901F	< 1%
901E	n.d.
600 P + 10	1%
600 P - 6	n.d.
901D (upper)	n.d.
901D (upper) matrix	< 1%
901D (lower)	4%
903 C2	n.d.
907	1-2%