Regional Mapping Section

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
REGIONAL SURVEYS SECTION

REPORT ON PYRITE - PYRRHOTITE DEPOSIT OF NAIRNE

by

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Asst. Sen. Geologist

17th April, 1963

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REPORT ON PYRITE - PYRRHOTITE DEPOSIT OF NAIRNE (1)

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(1) Published with the consent of The Hon. the Minister Of Mines for South Australia.

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CONTENTS PAGE

ILLUSTRATIONS

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INTRODUCTION

The Nairne Pyrite Deposit occurs at Brukunga, three and a half miles east of Nairne, and 29 miles from Adelaide on the eastern flank of the Mt. Lofty Ranges. The deposit is being worked for iron sulphides.

Operations commenced in 1955 as a joint venture by a group of companies who formed Nairne Pyrites Limited under the sponsorship of the South Australian Government. The quarrying, crushing and concentration operations are carried out at Brukunga and the concentrate forwarded to Birkenhead, near Port Adelaide, for processing to sulphuric acid.

The operations at Brukunga are supervised by Broken Hill Proprietary Co. Ltd. as managing agents for Nairne Pyrites Limited.

REGIONAL GEOLOGY

The deposit, a stratiform group of pyritic beds, occurs at the base of the Nairne Pyrite Member (Thomson, in press) which is the lower member of the Brukunga Formation in the Kanmantoo Group. Pyrite beds have been mapped over a strike length of 65 miles. Individual beds are lenticular, but some persist for as much as 20 miles. The intervening rock between the pyrite lenses is predominantly greywacke, often slightly pyritic near the base of the member.

The pyrite beds are shown on the Echunga 1 mile Geological Sheet (Sprigg and Wilson 1954) within the undifferentiated Kanmantoo Group. The pyrite deposit, opened subsequent to publication of this map lies on and immediately to

the north of Shephards Hill, two and a half miles northeast of Nairne.

The regional structure controlling the outcrop of the Nairne Pyrite Member is a major syncline with its axis approximately north-south lying some five miles to the east.of Brukunga. The syncline plunges to the south at an average of 30°. Several major (350° approx.) shears have been mapped and one passes within a mile of the workings. This shear displaces the Nairne Pyrite Member, north block to the east, much of the movement being taken up by distortion of the beds rather than by faulting. Little evidence of the proximity of this shear is seen within the workings. The dip of the beds is 70° E in the quarry.

The Nairne Pyrite Member has been sampled as part of the regional geochemical investigations of the South Australian Mines Department and the samples checked spectrographically for the following metals:-

Cu, Pb, Zn, Ag, V, Co, Ni, Cr. The pyrite lenses within the member are significantly higher in Cu, Pb and Zn than the adjacent greywackes and of the order of 20 times the content of the members below the Nairne Pyrite Member.

NATURE OF THE PYRITE BEDS

The Nairne Pyrite beds are generally accepted as sedimentary sulphide deposits. Skinner (1958) discusses the origin at length and summarizes the following points in favour of a sedimentary origin:-

1. The wide extent of the Nairne Pyritic Formation and the constancy of composition along its length.
2. The complete conformity of the sulphide bearing rocks with all sedimentary features, including minor cross bedding and lensing of sediments.
3. The close relationship between grain size of the silicate minerals and the grain size of the sulphides especially in graded beds.

4. The strict conformity between variations in sulphide content and composition, with the bedding.
5. Existence of planes of tiny pyrrhotite crystals parallel to the bedding, within massive pyrite layers, showing variations in the initial sedimentary sulphide composition.
6. Compatible relations between pyrite and pyrrhotite and between sulphides and silicate minerals, indicating they were all involved in the metamorphism.

Skinner further observes that there is no apparent relation between the distribution of disseminated sulphides and the folding of the Kanmantoo Group. Recent mapping, by the writer, of pyritic beds higher in the Brukunga Formation confirms Skinner's observations.

Within the regional syncline all the beds in the Brukunga Formation have a well developed foliation inclined steeply to the east indicating the attitude of the synclinal axis. In the workings this foliation is parallel to the bedding, and dips 70° to the east. The rock is not fissile on the foliation except in the weathered state. The fresh rock tends to be massive, does not break evenly and considerable secondary breakage is required. Fractures, joints, tension gashes occur, some are infilled with secondary sulphides, more massive pyrite with rare galena, chalcopyrite, sphalerite, arsenopyrite, and rutile. These infillings are thought to have developed from the adjacent pyrite beds during metamorphism.

A section across the quarry face was sampled in ten feet lengths and the samples examined spectrographically as part of the regional geochemical sampling programme. The average results for the ore and waste beds are summarized in Table 1.

TABLE I

Unit Sample	No. of samples	Pb	Zn	Ag	Cu	V	Cr
Wall Rock (Hanging Wall)	3	15	160	1	50	60	600
Orebed 1.	14	540	4250	2	550	300	500
Waste bed A.	5	40	530	1	620	230	260
Orebed 2.	8	700	6200	4	700	260	1100
Waste bed B.	7	120	2600	2	760	320	760
Orebed 3. (Hanging wall only)	10	600	3600	3	450	120	400
Wall Rock Footwall	4	60	100	1	15	100	300

Metal values are quoted in parts per million.

The values of all metals tested except chromium are higher in the Nairne Pyrite Beds than in adjacent rocks. Also the values for lead zinc and silver are appreciably higher in the orebeds than in the waste beds.

The sulphide rich beds readily weather in near surface zones with the development of weathered haloes on joints and fissures. The weathered zone extends to a depth of 60 feet. In outcrop the pyrite beds are recognized by a ferruginous gossan at or near the Tertiary peneplain level. In the more recently eroded areas the beds are conspicuous due to the formation of kaolin and yellow ochreous clay, enabling ready identification on aerial photographs.

MINERALOGY

Investigations by La Ganza (1959) show five varieties of FeS_2 to be present.

1. Primary Pyrite, disseminated grains up two millimetres in diameter. This type forms 90% of sulphide present.
2. Vein Pyrite, coarser grained, occurs in joints

and fractures and occasionally has associated pyrrhotite, galena, and chalcopyrite.

3. Concentric FeS_2, occurs as a replacement of pyrrhotite, the FeS_2, consists of concentric shells of extremely fine grained material. ~~This type is more common in the northern part of quarry and when abundant results in poor flotation recoveries.~~ deleted at request of J. Hammer

4. Zoned Pyrite, inclusions and cores of concentric FeS_2 suggests that, in some cases at least, the zoned pyrite has formed from the concentric material.

5. FeS_2 from circulating ground water, in the weathered zone there has been some solution and re-deposition of FeS_2.

Variations in the ratios of the types of FeS_2 in the feed are frequent and cause fluctuations in the efficiency of the concentration.

THE QUARRY

After geological and metallurgical investigations carried out by the Zinc Corporation and subsequently by the ~~Geological Survey Branch and the Research and Development Branch of the~~ Department of Mines, the present company commenced operations at Brukunga. In selecting the present quarry site overburden ratio was most important. The sulphur content and thickness of ore beds do not vary significantly along the strike near the quarry. At Shephards Hill the lower pyrite beds lay on the easterly slope of a high ridge formed by a quartzitic lens at the top of the Inman Hill Formation (Inman Arkose). The lower beds have also been protected from Recent erosion by a resistant ferruginous capping developed in Tertiary times. Erosion of the beds immediately to the east has given ready access to the pyritic beds.

Within the quarry area three beds are considered as ore beds with lower grade waste beds between. The ore beds are designated as 1, 2 and 3 on the section and waste beds A and B.

The overall thickness of the deposit is approximately 300 feet, but at the lowest quarry level it is only intended to remove ore beds 1 and 2 and waste bed A.

The sulphur content is shown on the drill hole inter-sections. Production and quarry assays have shown these grades to be reliable. The grade of the crusher feed has been selected at 10.5% sulphur. This is obtained by quarrying ore beds 1 and 2 and ~~blending~~ portion of waste bed A. Waste bed B is not treated and ore bed 3 only used in the feed where it is exposed to form the face batter.

The jointing and fracturing is subdued, it does not assist in quarrying, nor are the secondary sulphides occurring in the fractures significant in the ore feed. As the near surface weathered material requires a modified treatment process it is either stripped or blended to give a uniform feed.

Table 2 shows the tonnages of pyritic material quarried and concentrate produced over the past 5 years.

TABLE II

Year	Tonnage Feed	Sulphur Tonnage ~~Concentrate~~
1958	319,033	26,482
1959	260,514	25,327
1960	259,524	23,467
1961	268,545	26,673
1962	292,890	26,777

With the completion of the crushing ~~and flotation~~ plant extensions ~~circuits~~ it is anticipated the tonnage treated will ~~increase to 29,000 tons of concentrate this year.~~ yield 33000 tons of sulphur in concentrate this year

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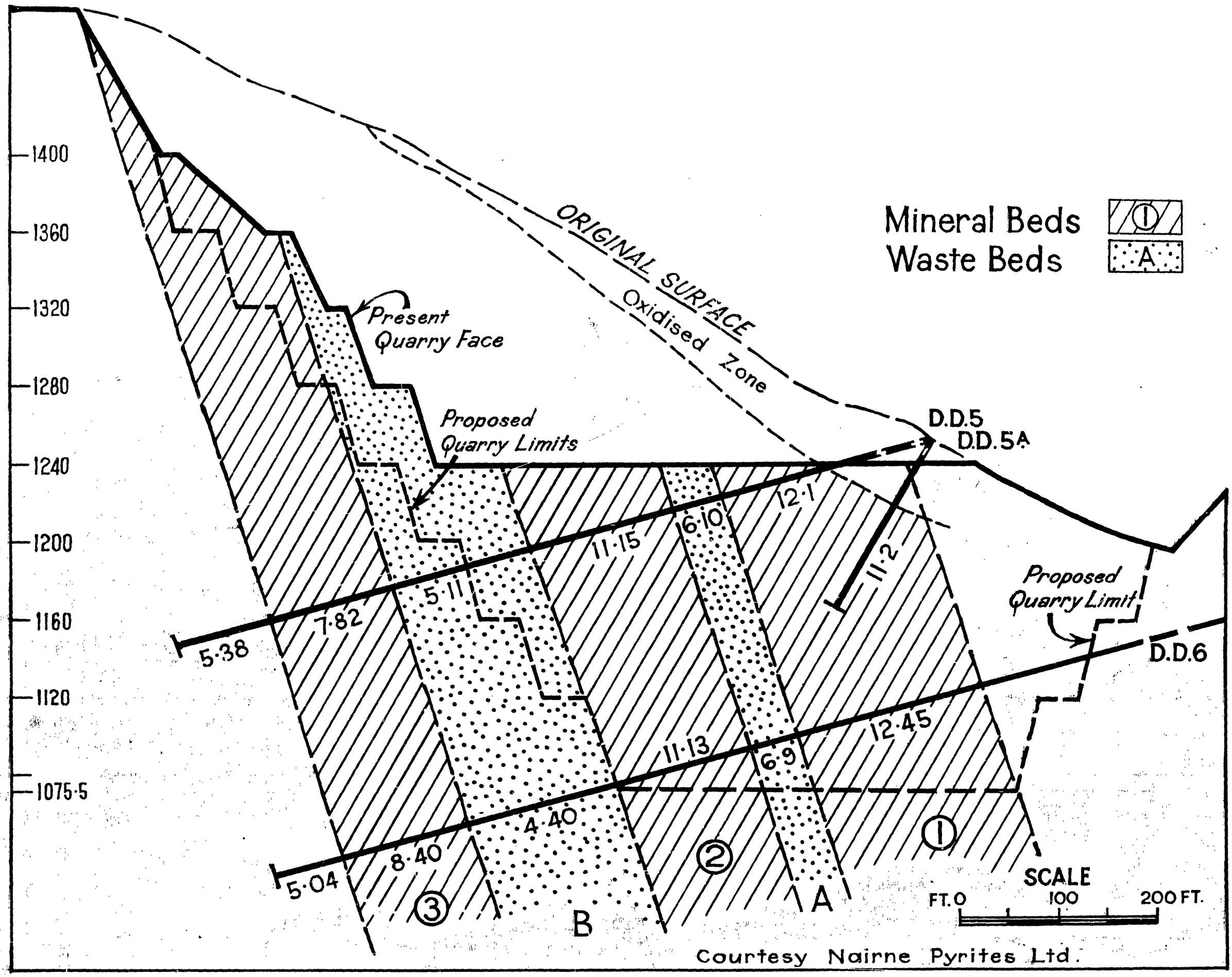

Courtesy Nairne Pyrites Ltd.

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