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1.

INTRODUCTION

This report is not intended as a full scale report on the geology of the Alice Springs water area, but is restricted to a discussion of information relevant to the immediate requirement for selection of further production holes in the Barcaldine Sandstone. This information has been obtained largely from Stage I and Stage II of the Water Investigation Bore: Barcaldine drilling programme, but also from previous programmes such as the Australian Investment drilling.

Geology (see Plate 1)

Each unit, including sandstones, shales and conglomerates, resting in age from Upper Palaeozoic to Upper Palaeozoic in the area. The regional dip is to the south. It is steep in the northern part and decreases southwards to leave about 2%. The rocks from the southern flank of a large syncline which plunges to the west. There is some evidence for folding and faulting superimposed on this main structure. The most important unit in this sequence, in the present context, are the Barcaldine Sandstones, the unconformably overlain by the: Junction Formation which is the youngest unit, and the Alice Springs Limestone which is the second oldest unit (Upper Palaeozoic). The Barcaldine Sandstones is discussed separately below. The Junction Formation has a dirty poorly sorted brown sandy fine grained sandstone (Richmond not known) at the base, overlain by a sequence of coarse conglomerate and fine poorly sorted brown sandstones. The Alice Springs Limestone is a grey carbonate with grey shales near the base. Kyrite is present, particularly in the shales.

The Palaeozoic and Palaeozoic rocks have been eroded to form a deep, well trending valley. This trough has been filled with more than 5,000 ft of Tertiary sediments, which are locally fine to medium grained sandy clays, generally pale grey and red-brown, often as yellow laterite. Important sediments occur within the sequence, but they are difficult to trace from here. Sediments are generally medium to very coarse grained sands. The Tertiary sediments directly overlain all the Palaeozoic and Palaeozoic rocks with an angular unconformity. They have very fine to flat dips.

Sandstone Occurrence

This unit is a fine grained well sorted coarse to white sandstone, often having a white silty matrix. It is commonly cross bedded and the size range from a few inches to hundreds of feet in thickness. It was deposited in a terrestrial and/or continental environment.
Information obtained during Stage I of the Hermosa Drilling program indicated the presence of a body of white sandstone within the formation, lying below a green to brown sandstone. Areas of major faulting, associated with micro-porosity in joints, are often encountered while drilling in this white sandstone.

Only the upper surface of the white sandstone body is known in any detail; very little is known about its base. Contours have been drawn on the upper surface, after eliminating the regional dip by rotating the body 20° about an axis along the line 50 N (North is 50° East magnetic). These are shown in Fig. 1, which represents the plan view of the surface (cf. Fig. 2). The picture is of an east-north-east trending ridge, flanked on the south-east side by a valley. There is also a small escarpment on a valley on the north-western flank. Total relief on the surface is over 200 feet. It probably represents the top of a large sandstone, and large scale areas holding probably occur within the white sandstone body. Faulting plane joints along the escarpment opened during drilling may cause the micro-porosity associated with the body.

Fig. 2 shows contours drawn on the same surface, but without rotating the body to a horizontal plane. The picture is therefore distorted by the regional dip of 20° to the north. The trend of the ridge is still east-north-east.

There is a reasonable coincidence between the location and direction of this ridge, and the location and trend of a major distortion of contours on the planimetric surface in the area (Fig. 3). It is considered that there is a direct connection between the distortion of the planimetric surface and porosity associated with the white sandstone.

The definition of one such body in an area where a considerable amount of drilling has been done suggests that similar bodies may occur at other places within the formation. Little evidence is available at present to estimate what sort of spacing and arrangement occurs, but it appears that in the area the production bore areas they are close together and in some instances, they would occur in widely separated groups. Their location, or even their presence, cannot be predicted yet in areas of an outcrop.

Summary

A most interesting picture of salinity distribution is emerging in this area. Groundwater in the New Old Sandstone, and in some of the Sandstone in the Outer Still-Area, is a mixture of two end members. At one end is recharge water having a low salinity (e.g., connate water, saline 36/44-75) with low sub-
FIG 4  Groundwater salinity, Meramee Sandstone production bore area
FIG 5  Groundwater salinities, Marrania Sandstone, east of production area
FIG 6  Groundwater salinities, Tertiary aquifers, south of Amoonguna
FIG 7  Groundwater salinities, Tertiary and Bitter Springs Limestone aquifers,
Amoongura Settlement area
...er, low sulphate and high bicarbonate. At the other end is water from the Bitter Springs Limestone, which has high calcium, high sulphate and low bicarbonate. There is a continuous change of water type from the recharge water at 51/14-76 (where river sand in the San Creek rests directly on Bacton limestone), to pure Bitter Springs water at Aconguma 13. Stages in the gradation are shown in Figs. 6-7.

Fig. 4 shows water types from bore in the Bacton limestone in the vicinity of the production bore. There is a slight increase in total salinity with increasing distance from the recharge area. The type remains very similar, except for the low chloride values, the reasons for which are not yet understood. Bore 26 and B14-5 fall exactly into the pattern of 53 but have been omitted from Fig. 4 to avoid crowding.

Fig. 5 shows water types from bore in the Bacton limestone in the area to the west and south-west of the production area. It is difficult to conform closely to the pattern of 53, but have been omitted for clarity of the diagram. This diagram clearly shows that water containing Na SO 4 has been added to the water from the recharge area. The boundary between the pure recharge water and the mixed recharge / Ca SO 4 water occurs between 51.2247.5 (adjacent to 74) to the west, and 57 and 54.249 to the east.

Unfortunately no reliable water analysis from 53 is available.

Fig. 6 shows water types from aquifers in the Tertiary sediments south of Aconguma settlement. These do not differ very greatly from the mixed waters in the Bacton limestone. Basic distinctions are a slightly increased calcium level, and a considerable increase in chloride. Waters represented in this diagram are probably a mixture of Tertiary water and Bitter Springs water.

Fig. 7 shows water types from Tertiary aquifers in the vicinity of the Aconguma Settlement, and from one aquifer within Bitter Springs Limestone to the north of the settlement (Aconguma 13, dotted line at Fig. 7). These are all clearly high in SO 4 waters. It is also apparent that water quality in the Tertiary sediments at Aconguma is strongly influenced by inflow of water from the Bitter Springs Limestone.

1. Water of excellent quality (less than 400 parts per million - ppm) occurs in the Bacton sandstone west of a point somewhere between 51.2247.5 and 54.249. East of this point, the water is of poorer quality (greater than 700 ppm) due to mixing with Ca SO 4 water, which originates in the Bitter Springs Limestone.

2. Close water should be kept on the salinity of existing...
production occurs. It is possible that the same of mixed water will migrate westward as a result of large scale pumping.

3. The quality of the mixed water is satisfactory for domestic consumption (2,2. 2. 750-900 ppm)

4. Future production holes should be sited west of P4 and preferable west of P2.

5. Holes having high specific yields can be constructed within white sandstone bodies through to be excavation within the Hercynite Sandstone. There trend east-north-east in the production bore area, and the shallowest known body occurs under P7, P8 and P9.

Additional Information

1. One further production hole could be sited west-south-west of P2 to take advantage of the shallow white sandstone. Grid point 35345 is suggested as a convenient location for this. The expected sequence at this site is as follows:
   6-70' Quartzary sand
   50-150' Karaijarra Sandstone
   150-200' Hercynite Sandstone (grey to brown)
   200-220' Hercynite Sandstone (white)

   The site is slightly down dip from, and approximately midway between, P1 and P2. The stratigraphic interval 650-700' in P2 should be penetrated between 650-900', using a bit of 80'. It is not considered that a depth greater than 1,000 feet will be necessary.

2. Grid point 43,5230 (1,500 feet north-east of P3) is suggested as a suitable site for an additional production hole. This site is within an area of distortion of the palaeocurrent surface similar to that described above. (See Fig. 1). There is slight evidence that it is above a shallow white sandstone body (indicated by contours in Fig. 1). It is therefore possible that this site is in a situation analogous to that of P2. The depth of this hole is adjacent to the recharge area, and water of excellent quality should be available over long periods. The hole should penetrate Hercynite Sandstone directly beneath about 20 feet of Quartzary sand. A total depth of 1,000 feet should be sufficient to provide an adequate supply. Stratigraphically the location is slightly up dip from P3. At this location is outside the limits of the investigation drilling, it may be advisable to drill one or two test holes before commencing a production hole.