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RECORDS:

1967/9

UPPER JURASSIC BENTONITE FROM YUELBA CREEK, ROMA DISTRICT.

by

P.G. Duff and E.N.Milligan

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1. INTRODUCTION

During the Bureau of Mineral Resources regional mapping survey of Roma 1:250,000 Sheet area, clays with an appearance strongly suggestive of bentonite were found cropping out in the east bank of Yuleba Creek, 20 miles north of Yuleba. A sample (approximately 8 oz. in weight) was tested by the Petroleum Technology Laboratory. The results were sufficiently encouraging to warrant further collecting and four (5 lb.) samples were tested. Although one of these samples was a recollection of the original sample, all the new samples were of an inferior grade. A limited number of cored scout holes were later drilled to obtain fresh material from the same horizons as the more promising outcrop sample.

11. GEOLOGY (E.N.M.)

STRATIGRAPHY

The 'clays' tested come from the Orallo Formation which is of Upper Jurassic age (Day, 1964, p.5.). The top of the formation is characterised by a unit of mudstones and claystones commonly associated with carbonaceous laminae and lignite beds. This unit has a known extent from Bungeworgorai Creek in the west of the Roma Sheet area to the eastern margin of the Roma Sheet area (see Figure 1). Variation in thickness and detailed lithology of this upper unit is virtually unknown as good outcrop is exposed only under well developed outcrops of the overlying Mooga Sandstone Member of the Blythesdale Formation. However, small outcrops of claystone and 'clay' have been recognised in the unit throughout its mapped extent.

LOCATION OF SAMPLES

Two samples were collected from 'claystone' interbeds in the coarse grained sandstone of the middle unit of the Orallo Formation (531, from 500 yards upstream from the original sample locality/and 474, from near the eastern margin of the Roma Sheet area - see Figure 1 and inset).

TABLE 1.

Summaries of Lithologic Logs and Correlations.

OUTCROP SAMPLE 441 Base Mooga	B.M.R. ROMA SCOUT 5 base Mooga	B.M.R. ROMA SCOUT 2,3 & 4. Alluvial & ? colluvial clay*, mud and sand	OUTCROP SAMPLE 40. base Mooga
3" mudstone, sandy, shaly. 3' mudstone, carbonaceous; and lignite.	3'3" (mudstone, red-brown and grey-brown, grading down to lignite.		ca 10' mudstone, bluish grey, grading to dark grey and lignitic.
3' + 'bentonite'*	6'10" (2'5" 'bentonite' (1'6" claystone, bentonitic (2'11" mudstone & 'bentonite', interlaminated. * (37'- 39')		2' + 'bentonite' and claystone *
	2'5" mudstone, grey to brown * (41'6" - 42'2" & 42'8"-43'3")		
	7'3" claystone, ?bentonitic * (46'1" - 46'9")		
	4'2" claystone, grey		
	1'6" mudstone, dark grey		
	6'4" claystone, green grey, lignitic at base *(58'3" - 58'11").	3' mudstone, very fine grained with carbonaceous lenses*	ca 10' mudstone, bluish grey, grading to dark grey and lignitic
	3'6" claystone, green grey * (63'4" - 64'0").	2'3" 'bentonite' and clay*	2'+'bentonite' and claystone.
	4'7" mudstone, brown and grey-brown, interlaminated and cross laminated.	7'0" mudstone, brown and grey brown, interlaminated and cross laminated *	
	sandstone	sandstone	

Alternative correlation

* Sample interval A.P.I. Tested.

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The remainder were collected from the upper unit of the Orallo Formation and their relative stratigraphic position is indicated in Table 1.

Scout holes Nos. 2, 3 and 4 were drilled to intersect the section at sample locality 40. These sections could not be positively correlated as the Mooga Sandstone Member is eroded in the scout hole sections and photo-interpretation shows a weak lineament between the scout holes and the outcrop, suggesting a possible fault. The scout hole 2,3 and 4 sections can however, be more confidently correlated with the scout hole 5 section and thus with outcrop sample 441 (and the original sample 441a).

Scout hole No. 5 was drilled 500 yards north-north-east of sample locality 441, in order to penetrate that section at depth. The section was encountered at a level approximately 25 feet above the outcrop sample. A fault with downthrow to the south is considered responsible for this difference in elevation.

GEOLOGICAL SIGNIFICANCE OF THE SAMPLES

Outcrop samples 474 and 531 were selected at random to test the lateral and vertical extent of apparent 'swelling clays' in the Orallo Formation and therefore have no comparative significance in relation to the other samples.

Outcrop samples 441a and 40 (and scout hole No. 3 sample 21'10"-22'8" which is believed to be a clay band which is either alluvial or injected into the alluvium) are of higher quality (with respect to A.P.I. standards) than outcrop sample 441 and 'bed-rock' samples from the scout holes. Sample 441a and 40 were collected from the outcrop surface which had been covered for some time by the water in the creek. Sample 441 was collected by 'trenching' into fresh material.

It is possible, then, that water action has selectively concentrated higher quality bentonite on the surface of the outcrop due to the varying swelling properties of interlaminated 'clays'. This possibility is supported by the fact that the interval represented by sample 441 in scout hole No. 5 was logged as interlaminated bentonite and mudstone. The sample tested from scout hole No.5 would have contained a mixture of these two types.

The samples tested from the scout holes were selected by general 'bentonitic' appearance. At the well site, clays approaching the appearance of the outcrop material were recognised as occurring only in thin bands interbedded and interlaminated in 'claystone' and 'mudstone'. The 'claystones' were generally firm in texture but varied appearance, some being more suggestive of bentonite than others.

The tests showed that irrespective of appearance, the cored material showed a generally uniform reaction throughout the sequence. The lowest value for plastic viscosity, however, was from a section logged at the well site as 'mudstone'.

111. LABORATORY TESTING

Samples of bentonitic material selected from the cores taken were evaluated using A.P.I. (American Petroleum Institute) standard equipment and prescribed procedure.

Air-dried samples were used throughout the testing and the mixing procedure was as follows :-

The (air-dried) sample was added to the required amount of distilled water and the resultant mixture was then high-speed mixed for 30 minutes. The slurry so formed was then allowed to stand for 24 hours before being given a further 30 minutes high-speed mix just prior to testing.

Test results show that the weathered outcrop samples exhibited the best characteristics, and that treatment with up to 6% by wt. of soda ash did not appreciably affect the Plastic Viscosity (P.V.) of these slurries. These results are presented in detail in Tables 2 to 6. The explanation of these tables is given below :

TABLE 2 shows test results for the original Orallo Formation outcrop sample (441a) compared with test results for Black Alley shale bentonite from near Early Storms homestead and for B.A.S. from Mantuan Downs.

TABLE 3 shows the full test results obtained from the untreated, air-dried, Orallo outcrop samples subsequently collected and numbered 40, 44a, 474, and 531. At a bentonite concentration of 6% by wt. only one sample, No. 40, surpasses the test results of the original outcrop sample submitted.

TABLE 4 results indicate that all of the outcrop samples are susceptible to alkaline treatment and it is possible that concentrations of sodium carbonate, in excess of 6% by wt., may further improve the thixotropic properties of these samples.

TABLE 5 concerns only the pieces selected from cores taken in the drilling programme. Results are disappointing as none of these samples exhibited properties as good as the original outcrop sample or the outcrop sample No. 40.

TABLE 6 contains test results on the core samples after treatment with 5% by wt. of soda ash.

With this treatment an Apparent Viscosity (A.V.) rise is obtained in all cases but this is seen to be due to a rise in the Yield component and not to any appreciable rise in Plastic Viscosity (P.V.).

A rise in P.V. is essential if the bentonite is to conform to the A.P.I. specification for drilling mud fluids. The A.P.I. specification requires that a 6% by wt. bentonite slurry will have a minimum P.V. of 8 cp.

It will be noticed that the increase of viscosity in the samples from Holes Nos. 3 and 4 has brought about an increase in the filtrate values, this is explained as follows :-

In the untreated slurries, exhibiting zero gel strength, there is no force present to prevent the settling of the finely divided, non-bentonitic material which may be present in the sample. This material falls on the filtering membrane in the filter press and, under a pressure of 100 p.si., compacts to form a barrier against the egress of water from the sample. However, when a similar slurry is treated to give considerable gel strength the finely divided material is held in suspension by the gel of the slurry and is prevented from compacting on the filter membrane in the press.

This effect can also be seen to some extent in the test results in Table 4.

IV. ECONOMIC CONSIDERATIONS

1. Quality :

These test results compare favourably with those obtained from testing of the Black Alley Shale material at Mantuan Downs, Queensland (Thompson and Duff, 1965), and even surpass the latter material in respect of the wall-building characteristics. However, the Orallo Formation bentonitic material, discussed here, still does not meet the A.P.I. specifications for bentonites for use in drilling muds but could possibly be used, after alkaline treatment, for iron ore pelletising.

The quality of the deposit is fairly uniform throughout 34 feet of section in scout hole No. 5.

2. Preserved thickness :

There is a marked contrast in preserved thickness between scout hole No. 5 and the remaining scout holes. There is not sufficient evidence available to determine whether this thinning is due primarily to erosion or depositional thinning. In any case the area in the vicinity of scout holes 2,3 and 4 must be considered non-prospective.

3. Overburden :

Where the best thickness of the deposit has been investigated (scout hole No. 5) there is 37feet of overburden, including approximately 20 feet of alluvium, 13 feet of hard Mooga Sandstone Member and 4 feet of Orallo Formation. The overburden is expected to increase in thickness east and south of scout hole No. 5.

4. Dip :

The regional dip of the strata is expected to be in the order of 1 to 2 degrees south.

The deposit cannot be considered to be economic in the area sampled. More drilling is required to test the area north and north-east of scout hole No. 5 where the Mooga Sandstone Member has been eroded and where the topography and soil suggests that the top 'claystone/mudstone' unit of the Orallo Formation is still preserved.

V. REFERENCES

DAY, R.W., 1964, - Stratigraphy of the Roma- Wallumbilla area. Geol. Surv. Qld. Publ., 318.

THOMPSON, J.E., and Duff, P.G., 1965 - Bentonite in the Upper Permian Black Alley Shale, Bowen Basin, Queensland. Bur. Min. Resour. Aust. Rec. 1965/171.

TABLE 2.

A.P.I. TEST.	Natural clay only			Treated with Soda Ash		
	Orallo Outcrop First collected (Sample 441a)	Black Alley shale from near Farly Storms	Black Alley Shale from near Mantuan Downs.	Orallo etc. plus 2% soda.	Black Alley Shale from near Early Storms plus 1% soda	Black Alley Shale from near Mantuan Downs plus2% soda
APPARENT VISCOSITY (cp.)	3.8	3.3	2.5	5.3	8	3.5
PLASTIC VISCOSITY (cp.)	3	3	1	3	5	2.5
YIELD (lbs/100 sq.ft.)	1.5	0.5	3	4.5	6	2
INITIAL GEL (lbs/100 sq.ft.)	0	0	1	1	1	1
TEN MINUTE GEL (lbs/100 sq.ft.)	3	0	3	15	23	8
FILTRATE (c.c.)	10	16	36	10	12	20
pH by (Lovibond Comparator.)	9	9	8	9.5	9.5	9

All slurries 6% by weight of Bentonite in distilled water

TABLE 3.

	Original Orallo Outcrop Sample 441a		Outcrop Sample No. 40				Outcrop Sample No. 441					Outcrop Sample No. 474					Outcrop Sample No. 531				
PER CENT BY WT. BENTONITE IN WATER	6	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8	4	5	6	7	8
A.V. (cp.)	3.8	2	3.3	5	7	11	1.8	2.3	2.5	3.5	5	1.8	2.5	3.3	4.3	5.5	1.8	2	2.5	3.5	4.3
P.V. (cp.)	3	1.5	3	4	6	9	1	1.5	2	3	4	1	1.5	2.5	3.5	4	1	1.5	1.5	2.5	3.5
YIELD (lbs/100 sq.ft.)	1.5	1	0.5	2	2	4	1.5	1.5	1	1	2	1.5	2	1.5	1.5	3	1.5	1	2	2	1.5
INITIAL GEL (lbs/100 sq.ft)	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TENMINUTE GEL (lbs/100 sq.ft)	3	1	0	1	1	1	0	3	5	4	9	1	1	1	1	1	0	1	1	1	1
FILTRATE. (C.C.)	10	22	16	14	12	10	23	20	16	16	14	21	18	15	13	11	18	17	15	13	12
pH. by (Lovibond comparator.)	9	9	8.5	9	8.5	8.5	8.5	7	8	8	8	7	7	7	7	7	8.5	8	8	8	8
SAND (% by vol.)	-			0.1					0.1					0.3					0.6		

TABLE 4.

A.P.I. TEST	Original Orallo Outcrop Sample No. 441a.		Orallo Outcrop Sample No. 40			Orallo Outcrop Sample No. 441			Orallo Outcrop Sample No. 474			Orallo Outcrop Sample No. 531		
	Natural clay	+2% soda	Natural clay	+2% soda	+6% soda	Natural clay	+2% soda	+6% soda	Natural clay	+2% soda	+6% soda	Natural clay	+2% soda	+6% soda
A.V. (cp.)	3.8	5.3	5	5.8	12	2.5	3.8	6	3.3	10	21.5	2.5	5	11.8
P.V. (cp.)	3	3	4	4	4	2	3	3.5	2.5	5	3	1.5	3	3.5
YIELD (lbs/100 sq.ft)	1.5	4.5	2	3.5	16	1	1.5	5	1.5	10	37	2	4	6.5
INITIAL GEL (lbs/100 sq.ft.)	0	1	0	1	15	0	1	3	0	10	too high	0	1	15
TEN MINUTE GEL (lbs/100 sq.ft)	3	15	1	12	33	5	7	14	1	26	too high	1	21	37
FILTRATE(c.c.)	10	10	13.5	12.5	18.5	16	16	17	15	14	13.5	15	14.5	14.5
pH by (Lovibond comparator)	9	9.5	9	10	11	8	10	11	7	10	11	8	10	11

All slurries 6% by wt. of bentonite in distilled water.

TABLE 5.

ROMA (B.M.R.) SCOUT HOLES

A.P.I. TEST.	No. 2.		No. 3.					No. 4				No. 5.					
	23'1" 23'7"	35'6" 36'2"	21'10" 22'8"	24'9" 25'4"	25'4" 26'0"	31'10" 31'5"	32'0" 32'8"	23'7" 24'2"	27'6" 28'4"	28'10" 29'6"	33'1" 33'7"	37'0" 37'7"	41'6" 42'2"	42'8" 43'3"	46'1" 46'9"	58'3" 58'11"	63'4" 64'0"
BENZIDINE TEST. DRY SAMPLE	Mid blue	Dark blue	Mid blue	Mid blue	Dark blue	Dark blue	Dark blue	Dark blue	Dark blue	Dull bluish grey	Dull dark blue	Dark blue	Mid blue	Mid blue	Mid blue	Mid blue	Dark blue
MOISTURE CONTENT.(% by wt.)	21	20	25	22	28	16	20	25	14	20	23	24	37	31	24	20	22
A.V. (cp.)	2.5	1.3	3.5	2	2.5	1.5	1.8	1.8	1.3	1.3	1.3	1.3	1	1.3	1.3	1.3	1.8
P.V. (cp.)	2	1	3	1.5	2	1	1.5	1	1	1	1	1	0.5	1	1	1	1
YIELD. (lbs/100 sq.ft.)	1	0.5	1	1	1	1	0.5	1.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1.5
INITIAL GEL.(lbs/100 sq.ft.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEN MINUTE GEL (lbs/100sq.ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FILTRATE (c.c.)	19	37	15	22	19	25	29	36	38	60	45	29	42	39	39	29	30
pH. by (Lovibond Comparator.)	8.5	8.5	8.5	8.5	8	8.5	8.5	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5

All slurries 6% by wt. of bentonite in distilled water.

TABLE 6

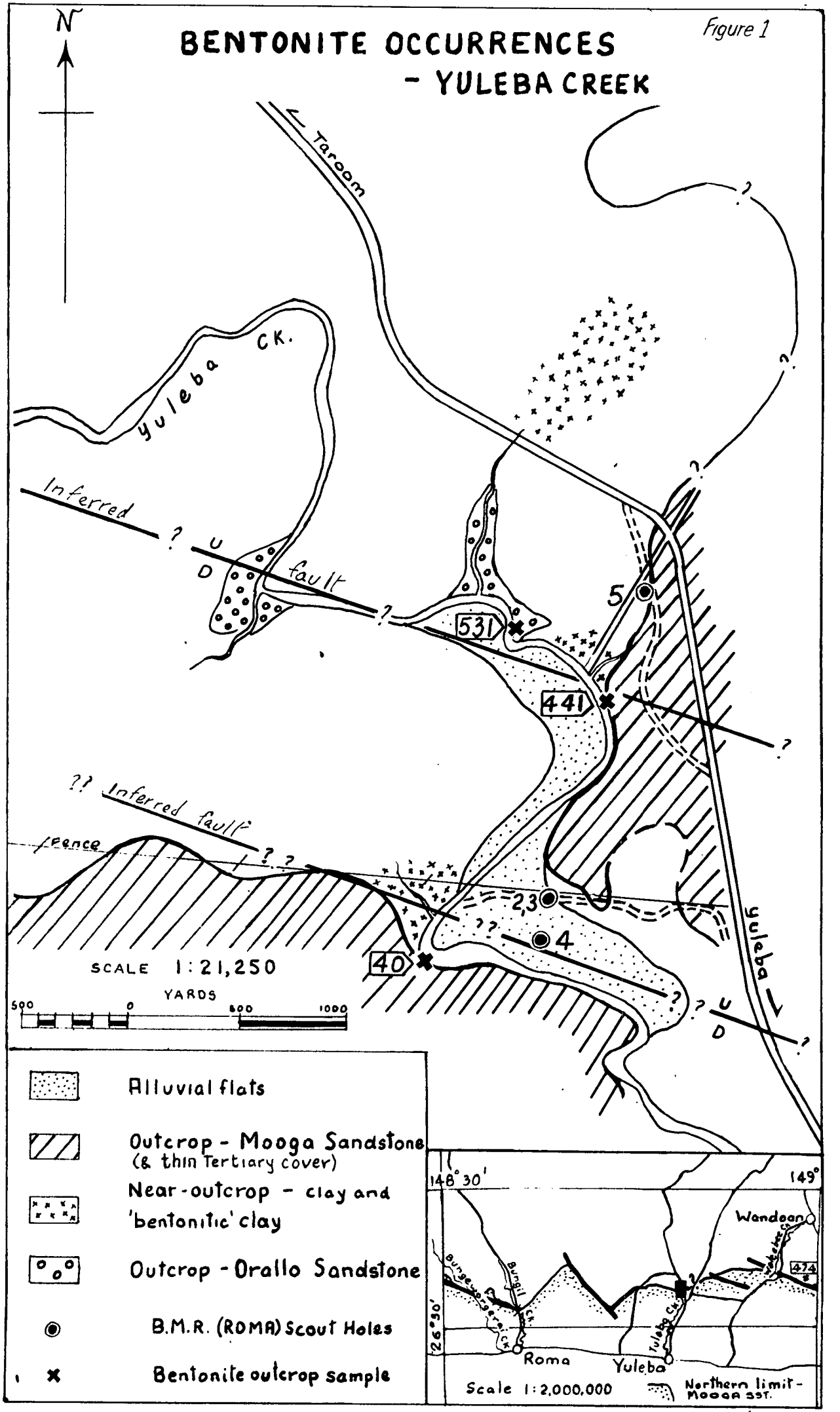
ROMA (B.M.R.) SCOUT HOLES

A.P.I. TEST.	No. 2. (23'1"- 23'7")		No. 3. (21'10"-22'8")		No. 4. (23'7" - 24'2")		No. 5. (63'4"- 64'0")	
	Untreated	Treated with 5% soda	Untreated	Treated with 5% soda	Untreated	Treated with 5% soda	Untreated	Treated with 5% soda
A.V. (cp.)	2.5	9	3.5	8	1.8	7.5	1.8	5
P.V. (cp.)	2	3	3	3	1	3	1	2.5
YIELD (lbs./100 sq.ft.)	1	12	1	10	1.5	9	1.5	5
INITIAL GEL. (lbs /100 sq.ft.)	0	10	0	8	0	6	0	3
TEN MINUTE GEL (lbs/100sq.ft.)	0	18	0	13	0	14	0	5
FILTRATE (c.c.)	19	19	15	19	36	16	20	27
pH. by (Lovibond comparator)	8.5	10.5	8.5	10.5	8	10.5	8.5	10.5

All slurries 6% by wt. of bentonite in distilled water.

Figure 1

BENTONITE OCCURRENCES - YULEBA CREEK



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