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BY

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Chapter 1

by C.H.C. Shannon

Savage Resources Ltd.

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Plans 1 & 2: Main Creek Magnesite;
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1.0 INTRODUCTION

The detailed geological map information for the magnesite area was transferred to the new base plans, which are derived from the provisional editions of the new 1:25,000 topographical maps for Savage River and Meredith. The new maps are on a computerized base and also include some revision of correlations between the diamond drillholes.

The ochre project proceeded in fits and starts owing to problems at the Ballarat laboratory. An initial run of tests were done on material from the 1987 costean sampling programme; on fines extracted by cycloning only and recently work has been proceeding on a second series of tests in which appropriate fines are generated by directly grinding the sample in a ball mill. These have utilized another set of samples collected in late 1988 when the original costean sites were tidied up.

Costean

A revision of the laboratory work is in preparation as a separate report.

A one tonne sample of magnesite was collected for use in a plasma arc furnace for production of magnesium alloy. The sample has yet to be utilized owing to delays in setting up the plant.

magnesite

2.0 OCHRE PROGRAMME

2.1 Performance of the cycloned fines

Results were obtained using the Minolta chromameter. The ochre was examined as extracted from the ore by cycloning, with one run of tests done on the natural colours and a second run done with the calcined colours.

Each run compares the product for lightness, L (black to white), hue (expressed as colour angle) and chroma, C, (a measure of the intensity of the colour);

(a) as a dry powder 100% ochre

(b) mixed with an appropriate white powder (ground calcite) 10% ochre.

This gives 2 other ratios; C1/C2 and reflectance ratio which are measures of the pigment's capacity to survive dilution.

The pigments can in principle be improved markedly with further processing.

The measures of chroma value of the ground pigment, ($C1 > 40$) and the $C1/C2$ ratios ($> 60\%$) for the calcined series are annotated to mark the most promising materials. There is little overlap between the two criteria. The raw ochre series is not annotated (see tables 1-4).

The distribution of the samples show up some general rules which are rather hopeful:

- (a) all sites for which samples were tested have at least one sample that qualifies.
- (b) where there is a mixture of qualifying and sub-grade samples there are often well situated samples in the qualifying list.
- (c) the area with the greatest potential would appear to be the North, from the Top track (MC 28) onwards since every sample tested in this area qualified.
- (d) certain rather messy, sandy ochres considered almost not worth sampling proved alright.
- (e) dark purplish ochres were all goers where tested but the chocolate ochres from Bowry Creek were as a rule poor.

2.2 Comments on particular sites

2.2.1 Yellow paint drillhole (near MC 27)

Two pits dug in the vicinity of the original drill-hole produced a similar vivid yellow ochre once 2m of gravel cover was penetrated. The drillhole is indicative of an ochre depth of the order of 20m at this site. A cluster of other drillholes 150m NW also produced yellow ochre and there is a surface outcrop 100m N, in this case presumably the same bed. The hole 50m W however encountered peat and alluvium showing that there is a filled sinkhole at that point. The Gravelly track area 200m S is more seriously affected and about 80m of subcrop width where ochres would be expected proved to consist of gravel and breccia with only a little ochre. The ochre may be present at depth below the sinkhole fill but the waste occupies ground where ore would otherwise be accessible.

Around the yellow paint drillhole in the 4z/6 carbonate zone there would appear to be a volume of $200 \times 50 \times 20 = 200,000$ cubic metres of ochre in the area where some control exists. The site is mostly low lying and would be amenable to dredging.

The value of this area is further improved by the good performance of sample HT 5/1 in recent testing. This sample comes from an outcrop in the track 100m northwards from HT 2. It now appears more likely that the somewhat sandy ochres generally grind to produce good yellows. Such ochre probably underlies the residual sand exposed in the track 300m northwards and could link through to creek bed exposures of ochre 600m northwards from the HT 2 site.

2.2.2 Top Track area

Three varieties of ochre were encountered in the trenching operation along with some residual sand and sandy sinkhole fill. The most spectacular was the bright yellow talcose ochre in the TT 1 trench. The red brown talcose ochre at the west end of the trench (TT 1/1) is representative of a further measured section in the track itself.

The talcose character of ochres from the 7/8 carbonate bed may persist to the area of GT 1/1 500m N but there is no local strike control in the exposures. Depth may be considerable given the soft ground encountered in MC 28 at a point 40m below ground surface, where the hole entered the carbonate units. Given the ridgetop position a greater than usual depth of ochres is likely.

The second trench encountered a sinkhole fill, then brown mainly sandy ochre with some brown talcose ochre, from the vicinity of marker 4z.

Each of the three ochre varieties may have a volume of $10 \times 20 \times 100 = 20,000$ cubic metres per 100m of strike length northwards, but the controls are poorer than usual in this case. Note also that some of the samples taken were not tested.

2.2.3 Main Creek Drillholes area

Although there were 5 trenches put down in the area and there is shallow drillhole data of sorts for depth control the situation here is confused with a high proportion of non qualifying or untested samples. It is more easily interpreted by taking ochre types first.

(a) Costeans MT 1, 2, 3

Purple and purple brown ochre

This material was found but not tested on the Zig Zag trench MT 3. One sample MT 2/2 fails the test but is described as variable. All other "purples"

are described as locally uniform and are qualifiers. These occur in MT 1 (4m sect.) MT 2 (5m) and MT 4 (1m) from which it appears that the intervals of 5m and 3m in the trench MT 3 would match up also.

Thicknesses would be around 10m, strike length is limited so the resource is of the order of $15 \times 10 \times 50 = 7,500$ cubic metres in a comparatively awkward situation.

Yellow ochre

A body of rather sandy yellow ochre MT 1/3 not considered promising during sampling is alright in the tests. This seems to indicate that some bodies of material considered too sandy to have been of interest should have been sampled. But in this case there is very little volume of ochre present because of shallow bedrock. $4 \times 6 \times 50 = 1,200$ cubic metres. The duller yellow brown ochre bodies with talc blobs found marginal to greenschist beds, found in The Zig Zag trench MT 3, and tested by sample MT 2/1 only would seem to be poor throughout.

(b) Little creeks site

Trench MT 5 gave generally poor test results despite having very attractive natural orange colours and low impurity values indicated by analysis. The one qualifier has strike width of 5m. The other controls are poor but a notional $5 \times 10 \times 100 = 5,000$ cubic metres can be guessed at for each 100m of strike length. The test site is wet and would require dredging.

(c) Floating ochre site

The trench MT 4 combined with adjacent drillhole MC 19 gives relatively good depth control. Although the hole could not be cleared the discovery of floating ochre was made here and the drilling character indicated ochre, the ground being readily drilled with a drag bit at the end of the hole (18m). The floating ochre is brown and blocky structured and similar material was recovered from the costean. The wet slurry is yellow in contrast to the brown colour of the solid. Results were marginal but with the dump sample selected as the hardest material not qualifying. Perhaps it would respond well to finer milling prior to testing. The site is wet and would need a dredge for recovery. A possible resource of the order of $10 \times 20 \times 100 = 20,000$ cubic metres is indicated but with less confidence than usual. Ochre with similar fired colour (compare MT 4/1 with MT 1/3) occurs 100m away along strike.

The exotic colours (purples) may prove specially useful, otherwise the Main Creek drillholes area suffers from size of deposit limits.

2.2.4 Long Plains site

This site was selected because it is the most accessible blocky ochre source. The 2 costeans showed that the unit persisted over 20m and a much greater strike extension is likely, with a very consistent colour. A greater depth than usual is also likely, which compensates for the narrowness of the body. Although most of the samples were marginal non-qualifiers it is the deepest sample from furthest away from the scarp edge which performs best, i.e. the sample most likely to represent the extensions to the south. The poorer samples seem to reflect damage due to continued weathering. Being comparatively hard it may come up much better with fine grinding.

Should the deposit persist over 400m it may amount to $2*20*400=16,000$ cubic metres.

2.2.5 Bowry track site.

This area was initially rated highly since it showed a large amount of a uniform strong dark chocolate colour but the results are all over the place and generally poor, but with one sample the top performer on the C1/C2 criterion and otherwise the closest match to the control sample "Monier brown". In this case it seems that sloppiness is an advantage and the more consolidated state a defect that may respond to further milling. Unfortunately no low level sample was included in the testing. The successful sample BT 1/1 represents only a 2m stratigraphic section, but it is the portion furthest away from the fault which limits the possible strike length of the subcrops the more severely as they come closer to it. The depth of the body as a whole is of the order of 10m from surface indications but the deeper portions are at risk of matching the fail samples rather than the qualifiers. But provisionally BT 1/1 can be taken as representative of a body $2*10*100=2,000$ cubic metres with possible extensions to 300m.

The other chocolate ochres represent $20*10*100=20,000$ cubic metres with possible extension to 200m. These limits are imposed by the fault.

Note that the controls for the volume estimates throughout are for exploration planning and are nowhere near the standard of a formal ore reserve estimate.

2.3 Annotated field notes on ochre costean samples:

C denotes sample strong enough on chroma value to qualify;

S denotes sample with sufficient pigmenting strength to qualify;

* denotes sample which did not qualify on either criterion.

TABLE 1

Trench 1 Long Plains (see Fig. 1)

LP 1/1 * Brown ochre with minor quartz, (selective sample) 1.5m width, 1m below original surface.

LP 1/2 * Brown ochre with vein quartz (representative sample) 3m strike width from 1.5-2.5m down, excludes boudinaged lenses expressing 2 greenschist beds.

Trench 2 Long Plains, 15m S of No. 1

LP 2/1 * Brown ochre with black stain on joints, 1.5m + 0.3m boundary phase talcose greenschist, (within 1m of original surface). Note: The black stain proved to be confined to the upper 1m from surface.

LP 2/2 * (C marginal) Brown ochre and minor reddish calcined ochre, with minor greenschist and spongy quartz (only western 1m of section) c.3m strike width at 1m from surface.

LP 2/3 * (C marginal) c.f. 2/2. bucket sample from 1.5-2.0m down.

LP 2/4 * (S marginal) Channel sample c.f. 2/2 from 2-3m down 0.3m greenschist excluded.

LP 2/5 C Bucket sample from eastern 2m portion of ochre bed from 4m down.

Bowry Track (see Fig. 1)

BT 1/1 S (best) Chocolate ochre, approx 2m strat. sec. at 1.2m down. (1m green pyrophyllite? schist not sampled).

BT 1/2 * Chocolate ochre approx 2m strat. sect. at 1m down.

BT 1/3 * Chocolate ochre approx 2m strat. sect. at 0.8m down.

BT 1/4 * 6m strat. sect. 2m down.

BT 1/5 * Next 6m strat. sect. 2m down.

BT 1/6 2m strat. sect. 4m down, below 1/5.

BT 1/7? Bucket sample at 5m.

Dozer bog (see Fig. 2)

MT 1/2 S dark purple ochre, 2m section, 0.5m talc excluded, 1.5m down, w. end of trench.

MT 1/1 S Purple ochre next 2m section.

MT 1/3 C Yellow ochre, 4m section after 10m gap of sandy ochre not sampled.

MT 2/1 * Dull brown, variable ochre with talc, 2.5m down.

MT 2/2 * 3-4m section variable purple to very dark purple ochre at 3m down, selected for dark material.

MT 2/3 S 2m section uniform dark purple ochre at -2.5m down.

MT 2/4 S Purple ochre selected from uniform patches ove 3m.

Zig Zag Track (see Fig. 3)

MT 3/1 Mottled ochre, 4m sect. at 1m down (orange clay ochre matrix plus blobs of iridescent very dark purple ochre.

MT 3/2 4m sect. orange transported clay ochre at 1m down.

MT 3/3 3m mottled pink/brown ochre with talc at 1.5m down.

MT 3/4 7m orange to yellow brown transported ochre plus some in situ at 2m down.

MT 3/5 4m purple and some mottled ochre at 2m down.

MT 3/6 2m purple ochre at 4m down.

MT 3/8? Reddish purple ochre.

Floating ochre locality (see Fig. 3)

MT 4/1 * (S marginal) Yellow clay ochre.

MT 4/2 * (S marginal) Tough purple ochre from 1m block in yellow matrix.

- MT 4/3 C Yellow clay ochre at 3m down.
- MT 4/4 * (C marginal) Bucket sample (sloppy yellow? ochre) from 4.5m down.
- MT 4/5 * Brown "floating" ochre selected from excavator dump.

Little Creeks site (see Fig. 2)

- MT 5/1 S Brown/orange mottled ochre.
- MT 5/2 * Brown clay ochre.
- MT 5/3 * Yellow clay ochre at 3m down, bucket sample.
- MT 5/4 * Bright yellowish orange ochre at 2.5m down.
- MT 5/5 * Bright brownish orange ochre.

Top Track area.

- TT 1/1 S 1.5m sect. orange brown talcose ochre from 1.2m down.
- TT 1/2 3m section orange brown and khaki mixed ochre with minor talc (some black) from 1.2m down.
- TT 1/3 Yellow talc 3m section at 1.2m down.
- TT 1/4 C Yellow talc as above, next 3m.
- TT 1/5 Yellow talc as above, next 4m section.
- TT 1/6 C Cream talc, 1.2m section, after 4m greenschist bed.
- TT 1/7 C (Best) Brown ochre with white clay patches, possibly greenschist breccia.
- TT 2/1 C Sand and ochre 7m section, 2m down.
- TT 2/2 C (Marginal) Ochre with talc 1.5m section, 1.5m down.

Gravelly track area (see Fig. 5)

- GT 1/1 C Dark greyish yellow ochre, about 1.5m strat. sect. in an area of anomalous low dips interpreted as a large tilted block in a breccia pipe. Alluvial fill with organics occurs in the core of the pipe structure. Crystalline talc 1.5m occurs adjacent to the ochre as part of the same block.

Yellow Paint Drillhole area (see Fig. 6)

- HT 1/1 C Yellowish orange ochre, bucket sample from 3m down.
- HT 1/2 C Yellowish orange ochre from 4.5m down.
- HT 2/1 C Yellow ochre, bucket sample from 4.5m down.
- HT 2/2 C Yellow and some yellowish orange ochre. The yellow material is soft and also crumbles easily and becomes orange on exposure.
- HT 2/3 C Bottle sample; as above.

2.4 Notes on repeat samples collected December 1988

Samples were collected from new pits which were back-filled immediately, or from old surface dumps, which were in practice in rather good condition. Additional material of approximately 1 cubic metre is available for each.

New samples are included where the original is not accessible, or where an extension of ground with particular value is indicated. Samples that are near enough to true repeats are labelled "rpt".

The "MT5/5" sample is from a new excavation but affected by backfill from the original costean. MT5/5 is salvaged from the old dump but is likely to be the better sample.

TABLE 2

- TT1/1rpt Orange brown ochre from 2-3m down.
- TT1/2rpt Orange brown ochre with minor limonite from 3-4m down. (1 tonne sample pile collected 13-12-88).
- TT1/4rpt Yellow talcose ochre from old stockpile.
- TT1/8 Orange brown ochre, with sand and talc from track W of TT1/1, 5m section.
- HT 4/1 Yellow ochre from new stockpile collected 13-12-88, sample c.f. HT2/3.
- HT 4/2 As above
- HT5/1 Yellow ochre and sandy ochre from track exposure.

MT1/1rpt Dark purplish brown ochre from old dump.

MT2/3rpt As above.

MT4/6 Blocky yellow brown ochre which grids to bright yellow pug, from 3m below MT4/1. c.f. MT4/4 which could not be resampled.

MT5/4rpt Bright yellowish orange ochre from old stockpile.

MT5/5rpt Bright orange ochre from small stockpile with schist and talc contamination.

MT5/5rpt Bright orange ochre from old dump. A better sample than above.

BT1/1rpt Chocolate brown ochre.

BT1/6rpt Chocolate brown ochre with talc and green phyllite clasts.

LP2/4rpt Brown blocky ochre c.f. 2/5.

2.5 Ochre sample assays

TABLE 3

Sample Number	Fe2O3	SiO2	Al2O3	MgO	CaO	MnO	K2O	TiO2	LOI
88/0007	48.6	23.1	12.8	0.43	0.02	0.14	0.15	0.20	14.5
88/0008	70.6	6.0	4.3	1.88	<0.01	0.47	0.04	0.05	15.9

SOURCE: Analabs report 236.1.08 05069 dated 26-02-88.

Descriptions:

88/0007: Yellow ochre from HT2 costean/pit dump, near Sid's Bridge; location 46510018.

88/0008: Bright orange ochre from MT5 costean, c.f. Sample MT5/5 rpt; location 46879931.

3.0 CONCLUSIONS

The excavator costeans all yield at least some ochre that appears satisfactory even in a minimally processed form. It is to be hoped that many of the other samples will also come good with extended processing.

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But the costean program has limitations. It gave no control on the depth of the ochres, nor of the strike extent of ochre bodies of a particular colour. This lack means that volume assessment can be called mere guesswork.

There is some depth control from the previous air blast drilling plus 4 Wacker device samples. These give a measure of depth to bedrock but not actual ochre samples from below 5m. Indications are that depths of residuum of less than 10m are rare, 15-20m thickness (with non-ochre cover of c.3m included) is common and depths in excess of 30m do occur. The greater depths may be connected with pipe structures in with the overburden thickness including alluvium or breccia is also thickened. The pipe structures (fill of fossil sinkholes) are at least locally extensive and could prove a big problem. But under the pipe fill there may be greater thickness of ochre than normal.

The dry weight of the ochre is low, less than water at c.0.67 S.G. and the yields based on the dry weight were 20% to 70% in previous tests (the cycloned fines series). The best yellows tended to be from talc rich samples with low yields and the favoured calcined reds appear to have high yields but still it may take on average 5 cubic metres to gain 1 tonne of product on this basis. The initial results of a second series of tests, based on grinding of the entire sample have produced better pigmenting power with very little waste, so that yields of functional pigment of 1 tonne for each 2 cubic metres now seem likely.

4.0 PARAMETERS FOR A MINEABLE TARGET

An arbitrary model of 10,000 tonnes/year production *10 years can be used. This requires a volume of 200,000 cubic metres in the ground, of useable ochre. This volume can be visualized as a body 400X50X10 cu. m. or about 1/6 of the strike width by 1/5 of the strike length of the Main Creek body. The Bowry Creek body is about half the size of the former. If the ochre cover is 10m, 1/30 of the area of the Main Creek deposit is enough to make the target. Note that the ochre appears to be the normal weathering residue of the magnesite. Further weathering produces silica sand which probably has usable ochre at some level below it.

5.0 MAGNESITE

The only work done on the magnesite concerns the enquiry from Plasma Arc Ltd for a feed for magnesium metal production. A 1 tonne sample has been prepared but has not yet been called upon. The site selected 4680089950 is on the margins of the most extensively sampled area for which comparative data is included in the table.

TABLE 4 Magnesite rock assay values

Sample	MgO	CaO	Fe2O3	MnO	Al2O3	SiO2	CO2/LOI	Na	S
88/0001	45.6	2.95	0.90	0.11	0.15	-0.50	50.00	0.0150	
88/0002	46.6	1.17	0.75	0.08	<0.05	<0.05	51.40	0.0075	
88/0009	42.5	2.27	0.86	0.11	-	-	-	<0.0025	<0.005
A	43.0	2.32	0.88	-	<0.05	2.96	-		
B	44.9	2.95	1.22	-	<0.05	1.07	-		
3805	43.4	2.67	0.79	-	-	2.07	51.44		
3804	41.8	4.98	1.12	-	-	1.18	51.03		
3803	42.6	4.36	1.09	-	-	0.91	49.83		

5.1 Comments

The samples 88/0001 and 88/0002 are point samples with the outer weathering rind was trimmed off.

Sample 88/0009 is a 10kg sample from the same site as 88/0001; a further 1 tonne of magnesite has been collected from this outcrop.

A and B are calculated from the drillhole MC 2 assay results.

3805, 3804 and 3803 are systematic large samples from the main Creek outcrop in sequence eastwards and carry on the stratigraphic section to the east.

An average of these samples, excluding the two point samples gives a reasonable approximation to the overall grade of the deposit over 150m of strike width in the best exposed section, (but includes c.20m of greenschist, etc. i.e. 130m thickness of magnesite rock containing 85%+ of the magnesite mineral.

Source for 88/0009: Analabs report 236.1.08.05773 dated 23-11-88.

6.0 FUTURE WORK

6.1 The determination of ore volume for the ochres

A broad approach could be managed by drilling out the existing track network. On present indications the quantity present is far in excess of the likely demand but most localities tested show colour variation on

the scale of a few metres, and if proof of patches of consistent colour is critical a very closely spaced drilling pattern will be needed, even 1m *10m grids. But there are two areas, the LP, BT and HT test sites appear at this stage to have generally consistent colour for which the raw pigment colour is a good yellow (or dark brown: BT) and the calcined colour a good red. In both areas a wider line and hole spacing is likely to be satisfactory; say 5mX80m. The TT site shows greater variability.

The HT and TT sites (Sids Bridge, Yellow Paint Drillhole) requires road upgrading for all weather access.

6.2 Ground constraints on drilling rigs

Air blast drilling is no good. It has been tried on two occasions and becomes hopeless once the hole makes water, and when a compressor had to be towed, the crawler mounted rig still needed help from a bulldozer to get up an easy slope. The ground becomes very slippery when even slightly wet and tracked vehicles have been unable to operate effectively in wet conditions.

An auger type rig is a possibility, but a conventional truck mounted rig is too cumbersome to cope with the existing tracks. A power auger mounted on a trailer, normally hauled by a light truck could cope with sites along the roads to depths of 20m. If on skids and towed by a traxcavator, etc. it could probably handle all but a few rough dozer cut access lines. Samples taken by auger tend to be contaminated, and the rig is easily stopped by alluvial cobbles such as cover much of the HT site. The trailer would need to be hauled in by bulldozer. Stacpooles have available a trailer mounted Gemco 210 D capable of being towed by a Toyota and with skids for rough going and dozer haulage.

6.3 Costs (from Stacpooles)

Location: \$1,000.00

Hourly rate \$110

Accommodation for operator and offsider to be provided.

6.4 Capacity

The depth capacity in ochre is likely to be 20-30m, and it may achieve 6 holes in a 10 hour day assuming 2 out of 3 do not have to be deep.

6.5 The driven core rig

Mr. Nick Poltock has a light rig which collects its sample as a wet sludge from inside driven casing, internal diameter 48mm. The sample would be clean relative to the Gemco auger sample. It can operate from a cut line and has been used to penetrate alluvial cover up to 15m depth. In ochre its depth limit may be 20m or so. It may achieve 4 holes a day.

6.6 Costs

Basic rig: Daily rate \$350 plus board to be provided for operator and offsider.

Big hammer: Further \$75 per day.

The Gemco holes would appear to average \$200 per hole but would be deeper than the Poltock machine which would appear to do the holes for \$100 per hole.

7.0 FUTURE WORK PROGRAMME

The outline of a work project intended for last summer has been notified previously (letter to the department 9-10-87). A basic framework of dozer/traxcavator accesswork needed for the follow up of all the present discoveries was proposed. The present preference is to concentrate on the LP and HT sites so as to prove up a notional commercial volume of consistent ore as quickly as possible. The laboratory has expressed preference for the Gemco rig style of sampling. So close spaced rough tracks are proposed as notified to the department 8-5-89 to give access to a skid mounted Gemco assisted with a traxcavator to penetrate veneers of quartz cobbles. Holes 5m apart on lines separated by 40 metres, adjusted to approximate the contour are proposed.

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88-2775

APPENDIX 1

Laboratory Tables

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SAVAGE O OCHRES

SAMPLE	CYCLONED			RAW			C1/C2	Reflect Ratio
	L	Angle	Chroma	10% dilution L	Angle	Chroma		
MT 2/2	43.65	63.30	17.19	73.22	71.00	9.33	44.6%	38.8%
MT 2/4	44.56	55.90	18.29	74.49	67.90	10.86	51.4%	36.9%
MT 2/3	46.20	65.70	18.54	75.20	74.80	11.40	54.1%	36.7%
HT 2/1	60.07	80.00	44.82	91.63	91.50	11.53	20.4%	1.2%
MT 5/3	54.24	71.50	34.67	85.45	80.50	12.56	30.2%	17.3%
MT 5/2	56.09	73.20	34.14	84.74	81.30	12.71	31.2%	20.2%
TT 1/6	78.12	83.70	37.61	91.64	91.40	13.22	29.5%	2.6%
LP 2/1	50.84	75.20	32.12	84.19	84.50	13.40	35.7%	19.0%
GT 1/1	57.71	79.00	32.09	85.19	86.00	13.98	37.7%	19.9%
MT 5/5	48.07	69.00	35.85	75.85	70.70	14.17	34.0%	36.8%
MT 5/1	50.25	73.10	31.31	79.68	79.40	14.45	40.4%	29.5%
HT 2/2	57.66	78.20	44.35	89.83	89.80	14.75	28.4%	6.3%
MT 1/1	45.83	60.00	25.49	74.49	70.50	14.80	52.5%	37.9%
TT 1/7	71.05	80.40	41.92	89.70	88.10	15.03	30.9%	11.0%
MT 2/1	52.54	70.90	35.87	79.00	73.30	15.30	37.4%	32.9%
LP 2/2	56.62	75.20	40.73	85.33	83.60	16.29	35.2%	18.9%
TT 1/4	69.28	81.30	41.12	88.72	88.50	18.11	39.6%	14.4%
HT 2/3	59.56	78.90	44.86	89.03	90.00	18.57	37.2%	9.2%
MT 5/4	58.45	73.50	38.52	79.12	77.20	19.64	46.8%	38.4%
LP 2/3	57.46	74.70	42.54	81.37	81.00	21.84	47.6%	30.8%
LP 2/4	56.18	73.80	43.93	78.66	78.70	23.27	49.5%	37.2%
TT 1/1	64.10	77.30	40.32	80.22	81.30	23.73	55.5%	42.2%
LP 2/5	58.65	75.10	47.91	79.96	79.50	25.27	49.6%	36.1%
Mon YEL	69.21	81.10	52.46	79.76	83.70	38.03	70.8%	53.7%
BT 1/1							100.0%	100.0%
BT 1/2							100.0%	100.0%
BT 1/3							100.0%	100.0%
BT 1/4							100.0%	100.0%
BT 1/5							100.0%	100.0%
BT 1/6							100.0%	100.0%
BT 1/7							100.0%	100.0%
							100.0%	100.0%

SAVAGE O OCHRES

SAMPLE	L	Angle	CYCLONED Chroma	10% dilution		Chroma	C1/C2	Reflect Ratio
				L	Angle			
HT 2/1	60.07	80.00	44.82	91.40	91.50	11.53	20.4%	1.2%
HT 2/2	57.66	78.20	44.35	89.83	89.80	14.75	28.4%	6.3%
TT 1/6	78.12	83.70	37.61	91.64	91.40	13.22	29.5%	2.6%
MT 5/3	54.24	71.50	34.67	85.45	80.50	12.56	30.2%	17.3%
TT 1/7	71.05	80.40	41.92	89.70	86.10	15.03	30.9%	11.0%
MT 5/2	56.09	73.20	34.14	84.74	81.30	12.71	31.2%	20.2%
MT 5/5	48.07	69.00	35.85	75.85	70.70	14.17	34.0%	36.8%
LP 2/2	56.62	75.20	40.73	65.33	83.60	16.29	35.2%	18.9%
LP 2/1	50.84	75.20	32.12	84.19	84.50	13.40	35.7%	19.0%
HT 2/3	59.56	78.90	44.86	89.03	90.00	16.57	37.2%	9.2%
MT 2/1	52.54	70.90	35.87	79.00	73.30	15.30	37.4%	32.9%
GT 1/1	57.71	79.00	32.09	85.19	86.00	13.98	37.7%	19.9%
TT 1/4	69.28	81.30	41.12	88.72	88.50	18.11	39.6%	14.4%
MT 5/1	50.25	73.10	31.31	79.68	79.40	14.45	40.4%	29.5%
MT 2/2	43.65	63.30	17.19	73.22	71.00	9.33	44.6%	38.8%
MT 5/4	58.45	73.50	38.52	79.12	77.20	19.64	46.6%	38.4%
LP 2/3	57.46	74.70	42.54	81.37	81.00	21.84	47.6%	30.8%
LP 2/4	56.18	73.80	43.93	78.66	78.70	23.27	49.5%	37.2%
LP 2/5	58.65	75.10	47.91	79.96	79.50	25.27	49.6%	36.1%
MT 2/4	44.56	55.90	18.29	74.49	67.90	10.86	51.4%	36.9%
MT 1/1	45.83	60.00	35.49	74.49	70.50	14.80	52.5%	37.9%
MT 2/3	46.20	65.70	18.54	75.20	74.80	11.40	54.1%	36.7%
TT 1/1	64.10	77.30	40.32	80.22	81.30	23.73	53.5%	42.2%
Mon YEL	69.21	81.10	52.44	79.76	83.70	38.03	70.8%	53.7%
BT 1/1							100.0%	100.0%
BT 1/2							100.0%	100.0%
BT 1/3							100.0%	100.0%
BT 1/4							100.0%	100.0%
BT 1/5							100.0%	100.0%
BT 1/6							100.0%	100.0%
BT 1/7							100.0%	100.0%
							100.0%	100.0%

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APPENDIX 2

Location sketches

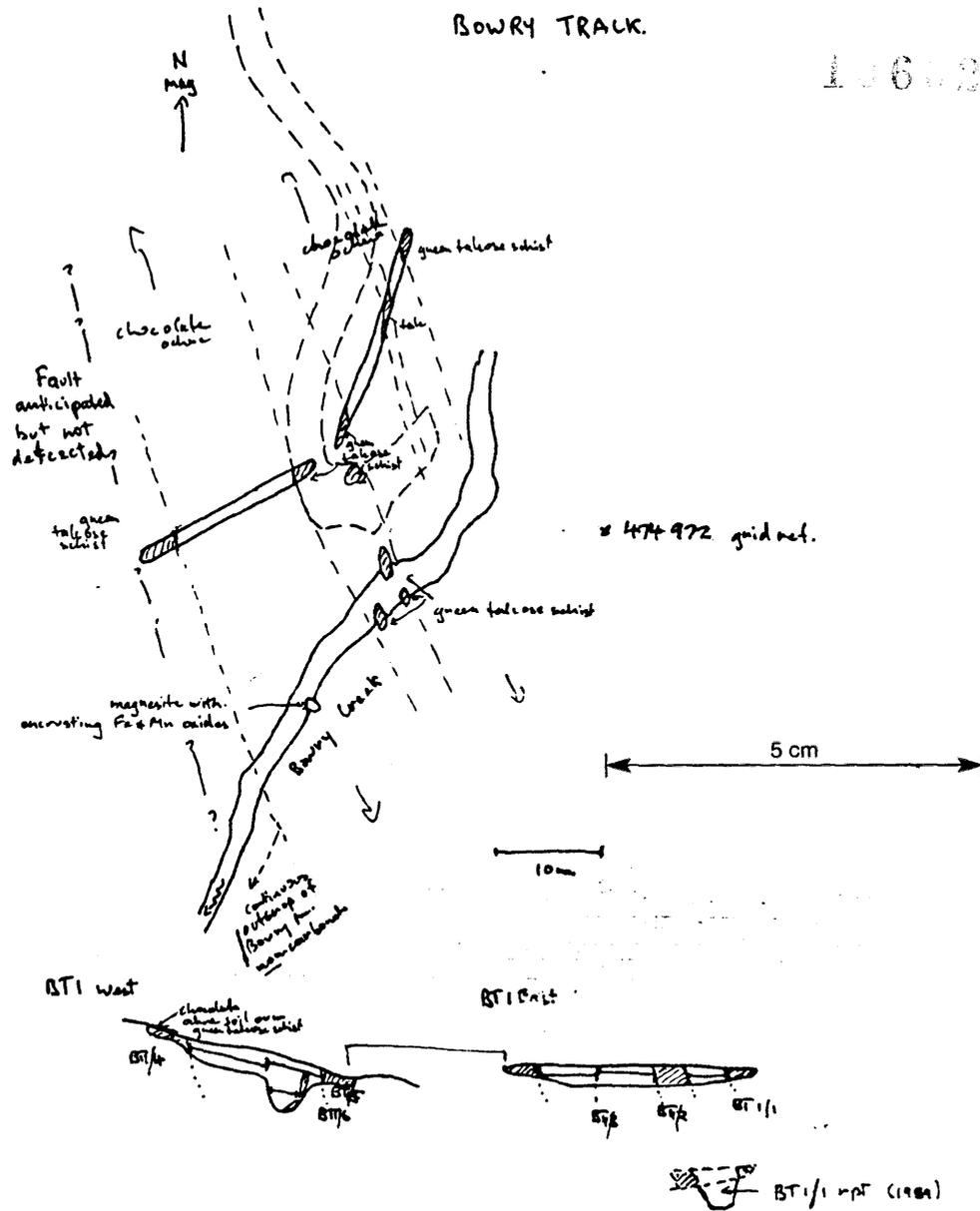
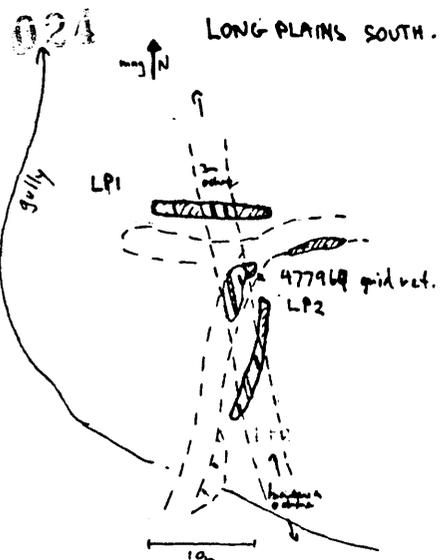
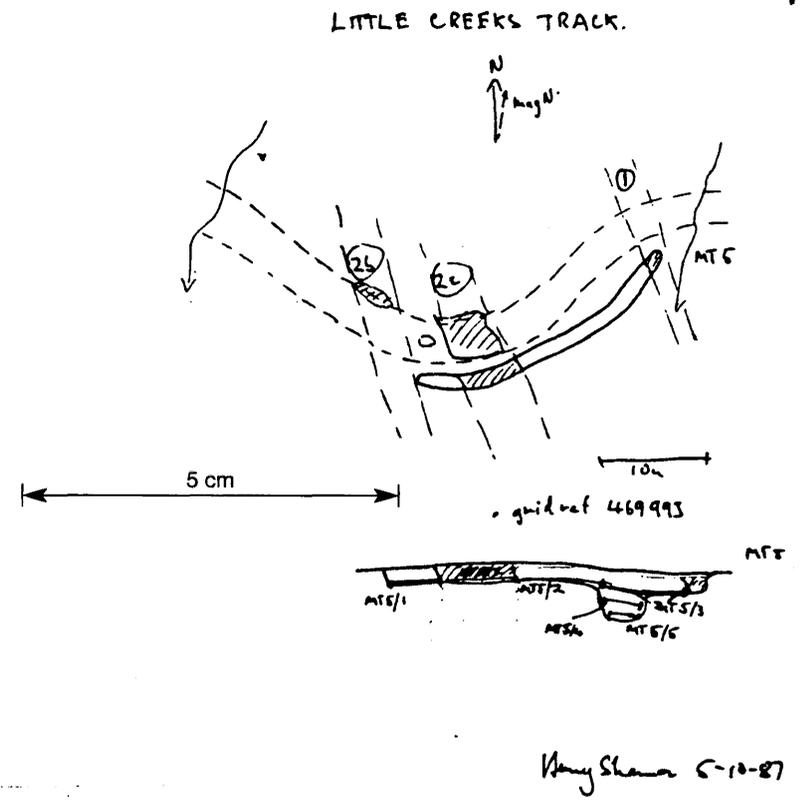
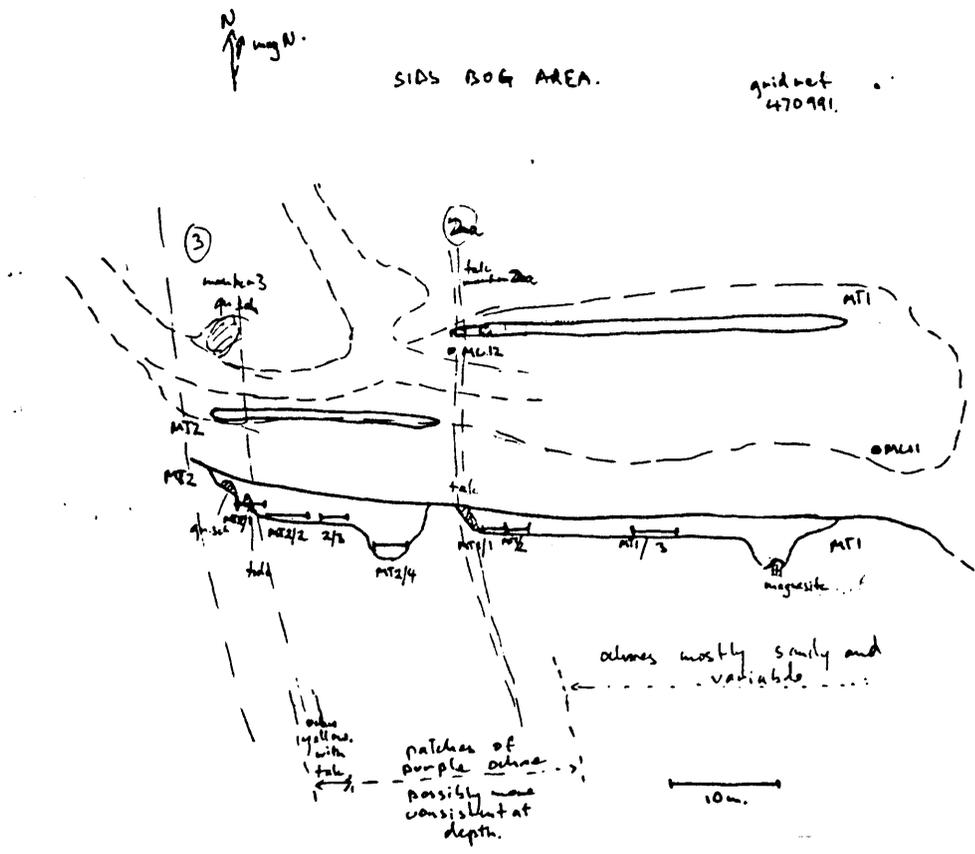


Fig 1

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Fig 2

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TOP TRACK WEST - TALC AREA.

TOP TRACK SAND CUTTING SITE

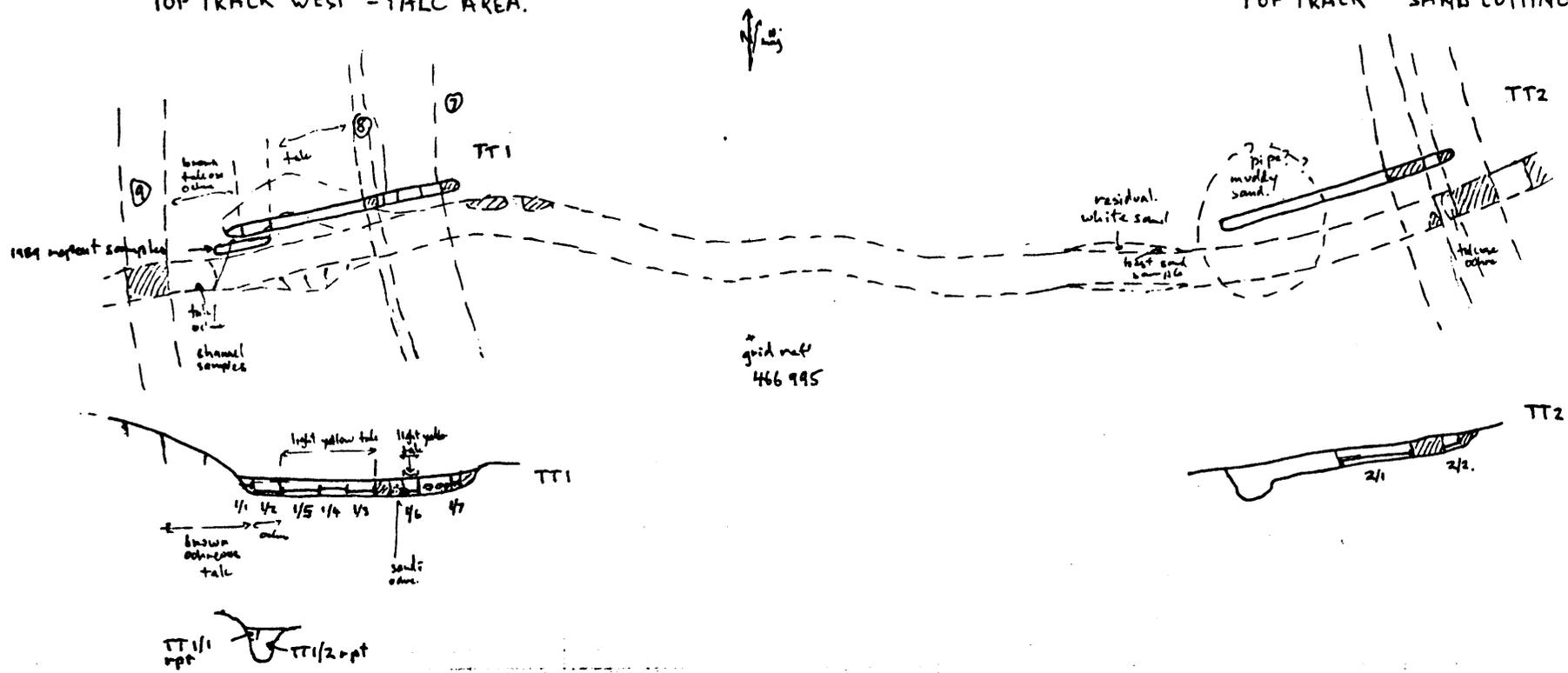
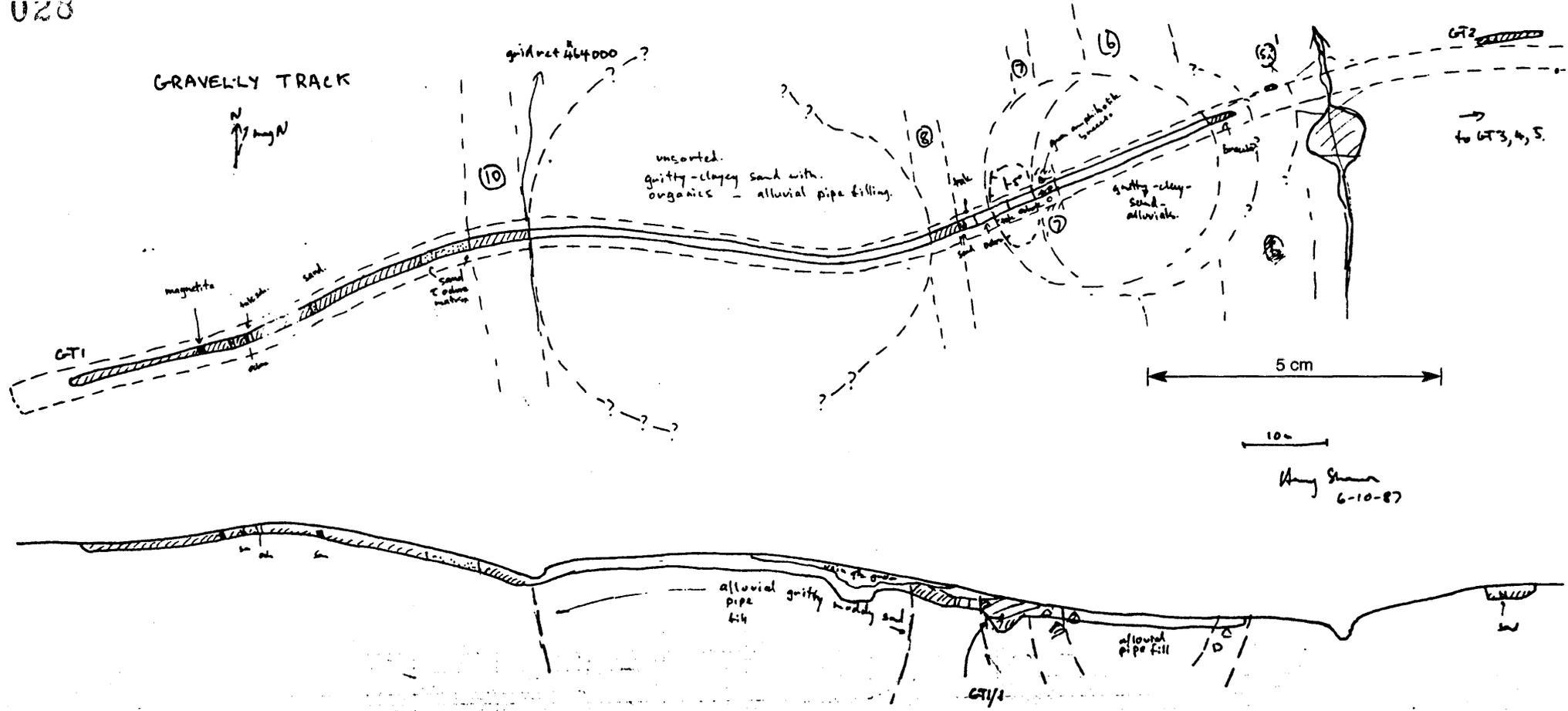


Fig 4

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note - GT 3, 4, 5 short
test holes
encountering greenclists
only.

Fig. 5a

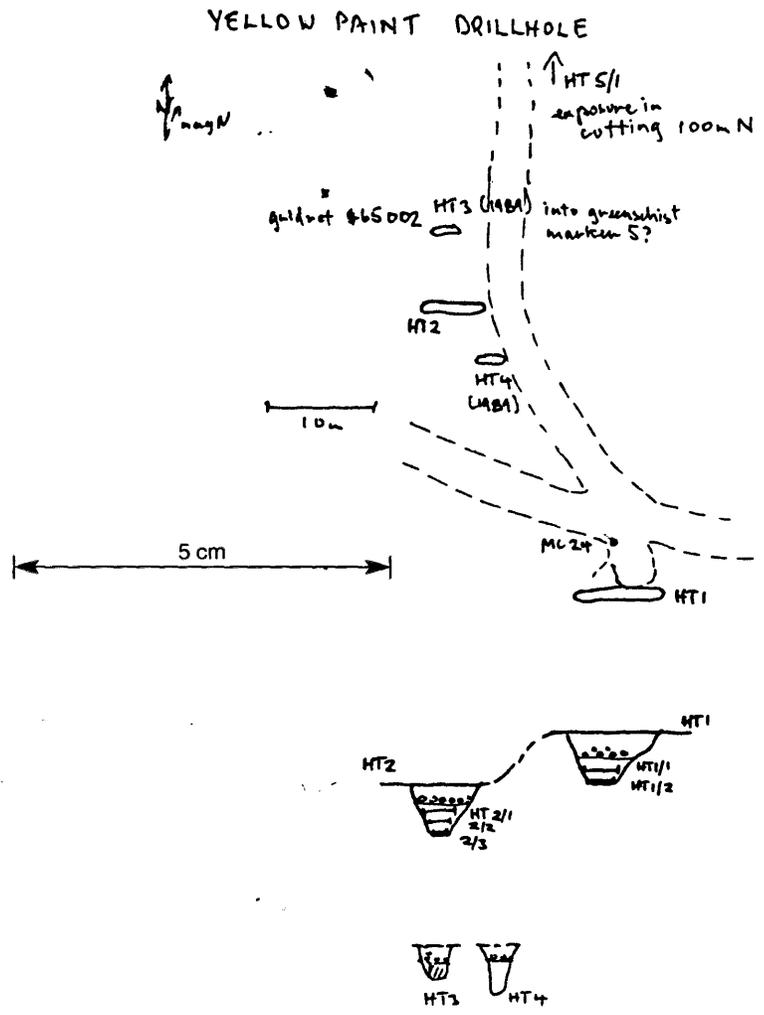


Fig 6

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Chapter 2

by John A Hosking

Marafield Pty Ltd

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1.0 INTRODUCTION

As has been indicated in chapter 1, the preliminary sampling carried out in 1987, was used to identify promising areas of ochre and to examine the effects of cycloning the feed material. Each sample was cycloned and both the raw and treated material subjected to calcination at an arbitrarily selected temperature of 400 C .

The colour parameters of the resultant powders were measured, as were those of a 10% dilution with calcite.

These techniques were not strictly reproducible but served to identify promising areas.

The second stage sampling was carried out to achieve some precise aims with regard to processing routes, grinding and calcination optimisation, and to investigate our ability to produce pigments to a predetermined set of parameters.

2.0 TESTING PROCEDURES

2.1 Sample Preparation

Raw ochre sample was weighed and dried in a convection oven. This took 36 to 48 hours to achieve zero moisture, which was later shown to be important.

The dried sample was split, one half retained and the other ball milled. The milled product was again split and half of it calcined.

2.2 Preliminary testing

Before commencing routine work, it was necessary to establish the ball milling time and the calcination temperature to be used.

Initially grinding was carried out using a 300 mm diameter unlined steel ball mill, which we constructed for the purpose. However the first trial resulted in the ochre charge plastering the inside of the mill with little or no grinding. To overcome this the mill was fully lined with 3mm linatex sheeting. This cured the initial problem but resulted in excessive coating of the balls. Although the moisture of the charge was measured at only 1%, this appeared to be the cause of the problem and on re-drying the problem disappeared. The sample in question had been left in the cold oven over the weekend and the uptake of

atmospheric moisture over this time was sufficient to impede grinding. All further samples were kept in the hot oven until loaded into the mill.

A sample of ochre was milled for 1Hr, 2Hrs, 4Hrs, 8Hrs, 16Hrs, and 32Hrs and samples checked for colour parameters and diluted colour parameters. The chroma level increased with increased grinding time but as the increase was only marginal above 8Hrs, we accepted this as the practical optimum for the system and standardised at this level.

Calcination is used to convert the hydrated yellow ochres to red colours and to establish the calcination temperature, a sample was calcined at 250 C, 300 C, 350 C, and 400 C. The chroma levels and colour angle were then measured. Colour angle decreased (moved towards red) as the temperature was increased to 350 C and then stabilised. The chroma level decreased significantly when 300 C was exceeded, we standardised on 300 C. However some fine tuning around this temperature may be beneficial.

2.3 Routine Testing

Based on the above information, we established the following routine testing procedure.

- a) Weigh out two samples of 3.5 Kilos each
- b) Dry these at 120 C for at least 36 hours or until 0% moisture.
- c) Charge the mill with 65 Kg graded balls and one sample (circa 2.5 Kilos).
- d) Mill for 8Hrs.
- e) Split the milled sample and charge the cold calciner.

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- f) Raise the calciner to 300 C and cut off gas (2Hrs).
- g) Allow to cool naturally and remove.

3.0 PIGMENT PREPARATION

3.1 Sizing

As the batch milling process did not allow classification to be used, some standard system was required to remove any tramp oversize prior to testing pigmenting properties. At a later stage, air classification will be used to generate ultrafine fractions which will conform closely to commercial sizing. However at this stage it was felt that simply screening at 100 um would allow rapid and reproducible comparisons of the ochre range.

3.2 Paint Formulations

Previous testing of ochres had relied on powder colour measurements and one dilution at 10%. This system had its disadvantages in that the samples themselves were hard to store or transport and were of little use for marketing studies.

For this study we decided to use a paint medium as the vehicle for pigment evaluation and to examine a far wider range of dilutions.

The paint selected for this study was a low sheen acrylic formulation with titanium dioxide as the sole pigment. The general formulation is as follows:-

Filler (Calcite)	136 grams / litre
Extender (Kaolin)	44 grams / litre
Pigment (TiO ₂)	323 grams / litre

We decided to progressively substitute ochre pigment for titanium dioxide up to 160 grams / litre.

3.3 Sample Paint Preparation

A master batch of paint was produced for each sample as follows:-

- a) Weigh up
2.2 grams kaolin
6.8 grams calcite
26.85 grams ochre
- b) Disperse this batch in 43 mls. of acrylic resin base with 1 ml Dispex, using high speed laboratory mixer for 5 min..
- c) Add 50 mls. of Low sheen white acrylic paint and re - mix
- d) Remove 50 ml aliquot and store (160 grams / litre)
- e) Add 50mls white paint and re - mix etc.
- f) Continue with dilutions until final sample at 10 grams / litre is taken.

This results in 5 samples at pigment loadings of 10,20,40,80, & 160 grams per litre.

3.4 Sample disc Preparation

The sample paints were diluted with 5mls of water and well stirred. A 10 ml aliquot was then transferred to an inking tray and a 60 ml sponge roller evenly charged with the paint. The paint was then laid on a bond paper which was

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backed with double sided tape.

Sets of disks were cut from the dried paper using a wad punch and were then mounted on the prepared forms.

4.0 COLOUR MEASUREMENT AND DATA ANALYSIS

4.1 Colour Measurement Technique

The instrument used for colour measurement was a Minolta Chromameter. This is self contained unit with a measuring head using a xenon source and the ability to report the data on a number of scales or even on the Munsell colour chart. Prior to a measurement run the unit is standardised against a colour tile and then each disc is measured in turn using the triple measurement and averaging function of the unit.

4.2 Colour Field Choice

As stated above, the unit can report on a number of scales. For good colour measurement the choice lies between the Lab system and the LCH system. The former measures brightness (L) and red and yellow co-ordinates and is probably the more useful for production control. The second system uses radial co-ordinates to describe colour, reducing it to a colour strength and a hue angle which are directly comparable between samples and were selected for this evaluation stage.

4.3 Plotting Results

The data was transferred to a P.C. using a Supercalc 3.0 spreadsheet programme which enables the automatic production of graphs of the data. As the work proceeds, regression programmes will be introduced to reduce dilution

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relationships to mathematical formulae for use in designing blending programmes for colour matching.

The output of this programme is appended as tables for each of the six samples examined to date and graphs of the performance of both natural and calcined pigments.

5.0 COMMENTARY ON RESULTS AND FURTHER WORK REQUIRED

The visual examination of the sample discs is carried out in the light of the fact that, in commercial paint production, what are referred to as "mid" colours are produced using a coloured pigment loading of 60 grams / litre.

Against this subjective standard all six samples perform extremely well. Another subjective comment may be made about the colour range which covers reds, pinks yellows, creams, and lilac and dove greys. A more objective view may be expressed in terms of colour angle which ranges from 40.7 to 89.5 covering 14% of the total colour spectrum.

Although the pigmenting power varies considerably even the worst result shows a chroma retention of 0.4 when diluted 16 times while the best gives a result of 0.6 at the same dilution! There is no doubt that these results will be further improved by finer grinding.

Of the current sampling programme we still have some nine samples to examine and it is likely that these will further extend the range.

Once this work is completed we intend to carry out the following supplementary programme on the same samples.

1.0 Establish parameters for three pigments at the yellow

end, red end, and middle of the existing range.

2.0 Endeavour to manufacture these by blending.

3.0 Using these three blended feeds examine the effects of:

- a) Small changes in calcination temperatures
- b) Very high grinding energy inputs.

Following these studies, further large samples will be required for the production of market samples for pilot trials.

A parallel study will examine the effectiveness of the pigment as a cement colourant.

CA4

TASMANIAN OCHRE PROJECT

SAMPLE NO :- HT 5/1

MILLED:- 8 HRS
CALCINED: 300 C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1	1
PIGMENT LOADING grams/litre	1	1	1	1	1	1	1	1	1
	10	20	40	80	160				
CALCINED	1	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1	1

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TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1

MILLED:-

8 HRS

TOTAL PIGMENT LOADING

CALCINED:

300 C

323 g/l

MINUS 100um FRACTION

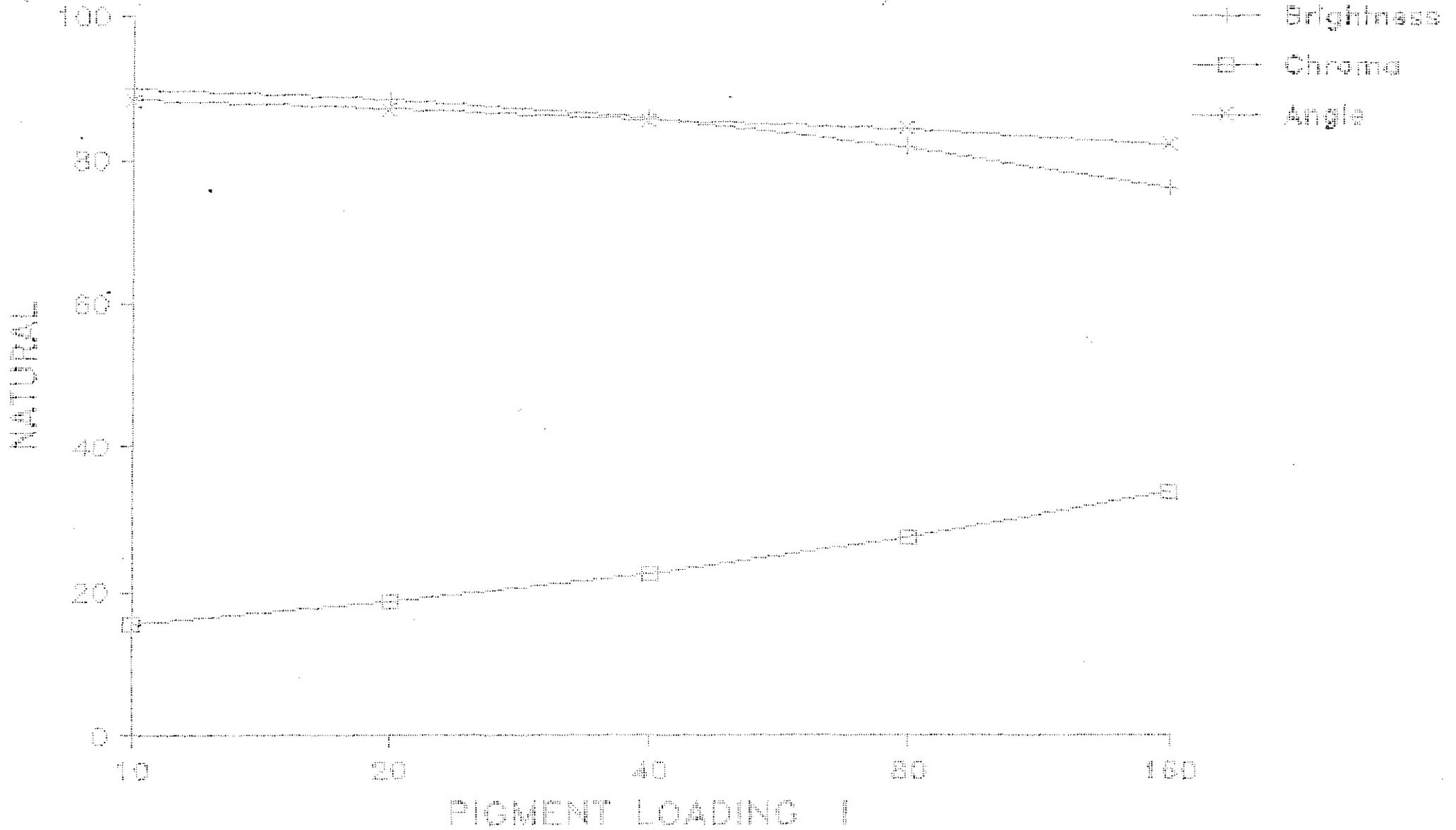
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NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	90.1	1	88.3	1	85.7	1	81.9	1	76
Chroma	1	15.5	1	18.6	1	22.5	1	27.4	1	33.9
Angle	1	88.3	1	87	1	85.5	1	84.3	1	82.2
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	82.2	1	79.2	1	75.4	1	70.1	1	61.6
Chroma	1	14.1	1	16	1	18	1	20.4	1	24
Angle	1	53.1	1	51.9	1	51.4	1	50.4	1	49

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046

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1

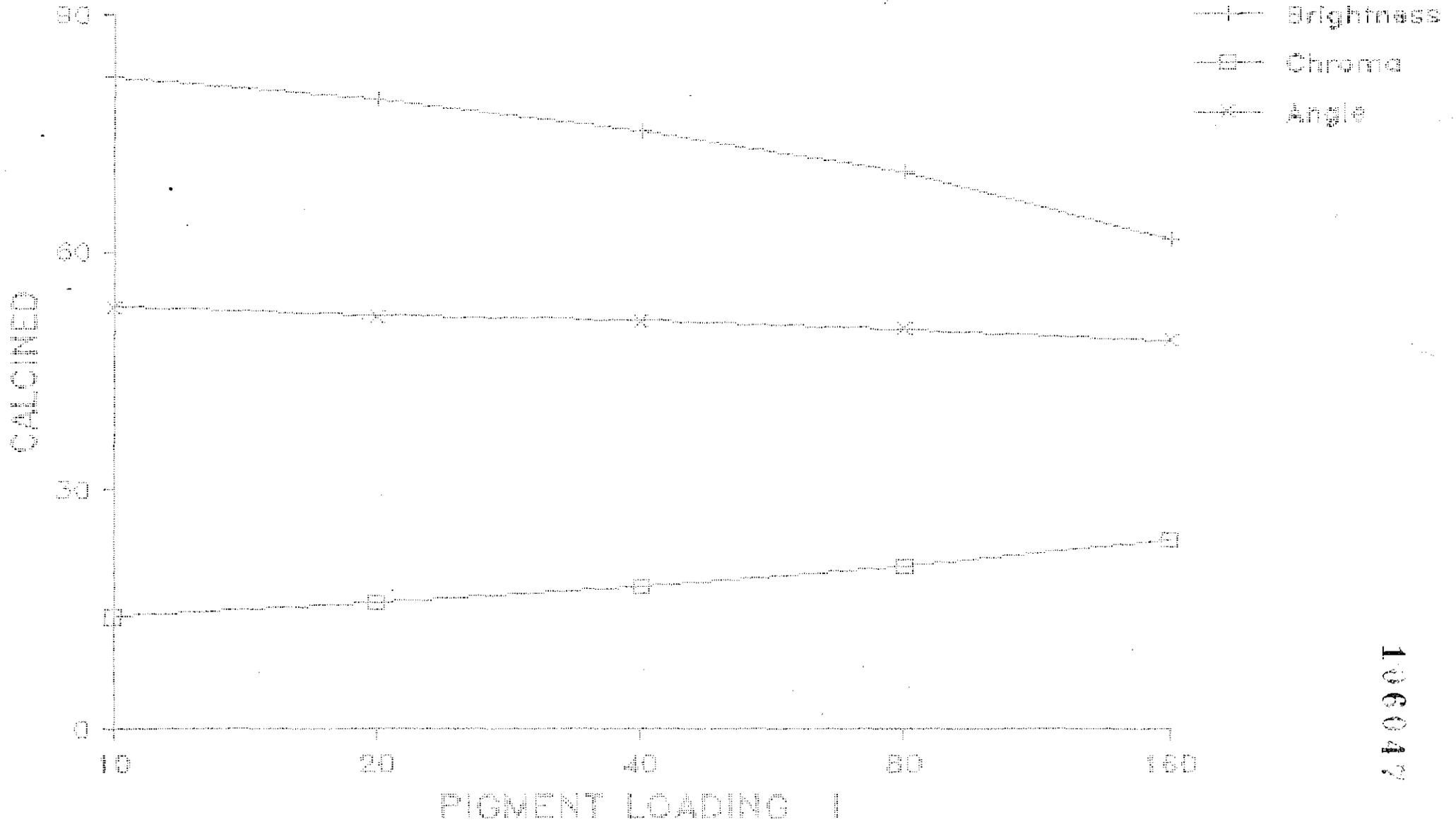


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047

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1



106047

048

TASMANIAN OCHRE PROJECT

SAMPLE NO :- HT 5/5

MILLED:- 8 HRS
CALCINED: 300 C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1
PIGMENT LOADING grams/litre	1	1	1	1	1	1	1	1
	10	20	40	80	160			
CALCINED	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1

106048

TASMANIAN OCHRE PROJECT

SAMPLE NO: - HT5/5

MILLED: - 8 HRS
CALCINED: 300 CTOTAL PIGMENT LOADING
323 g/l

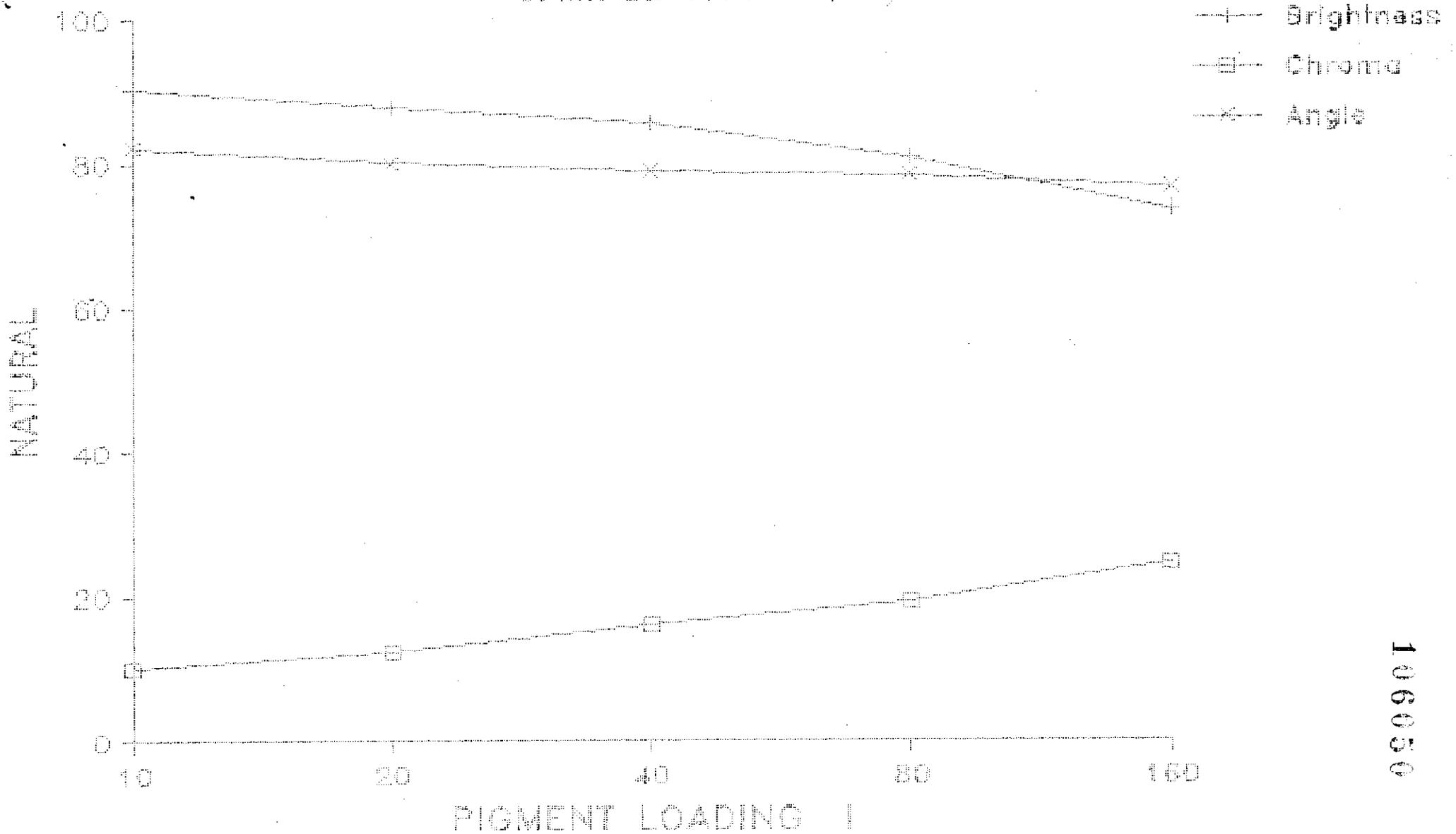
MINUS 100µm FRACTION

SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	90.2	1	87.6	1	85.4	1	80.9	1	73.7	1
Chroma	1	10.2	1	12.5	1	16	1	19.2	1	24.6	1
Angle	1	82.1	1	80.1	1	78.9	1	78.4	1	76.7	1
PIGMENT LOADING grams/litre	1		1		1		1		1		1
	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	82.4	1	78.5	1	73.9	1	68.7	1	57.7	1
Chroma	1	9.9	1	11.1	1	13.4	1	14.2	1	17.3	1
Angle	1	44.3	1	44.6	1	43.8	1	43.9	1	42.4	1

050

TASMANIAN OCCHRE PROJECT

SAMPLE NO:- HT5/5

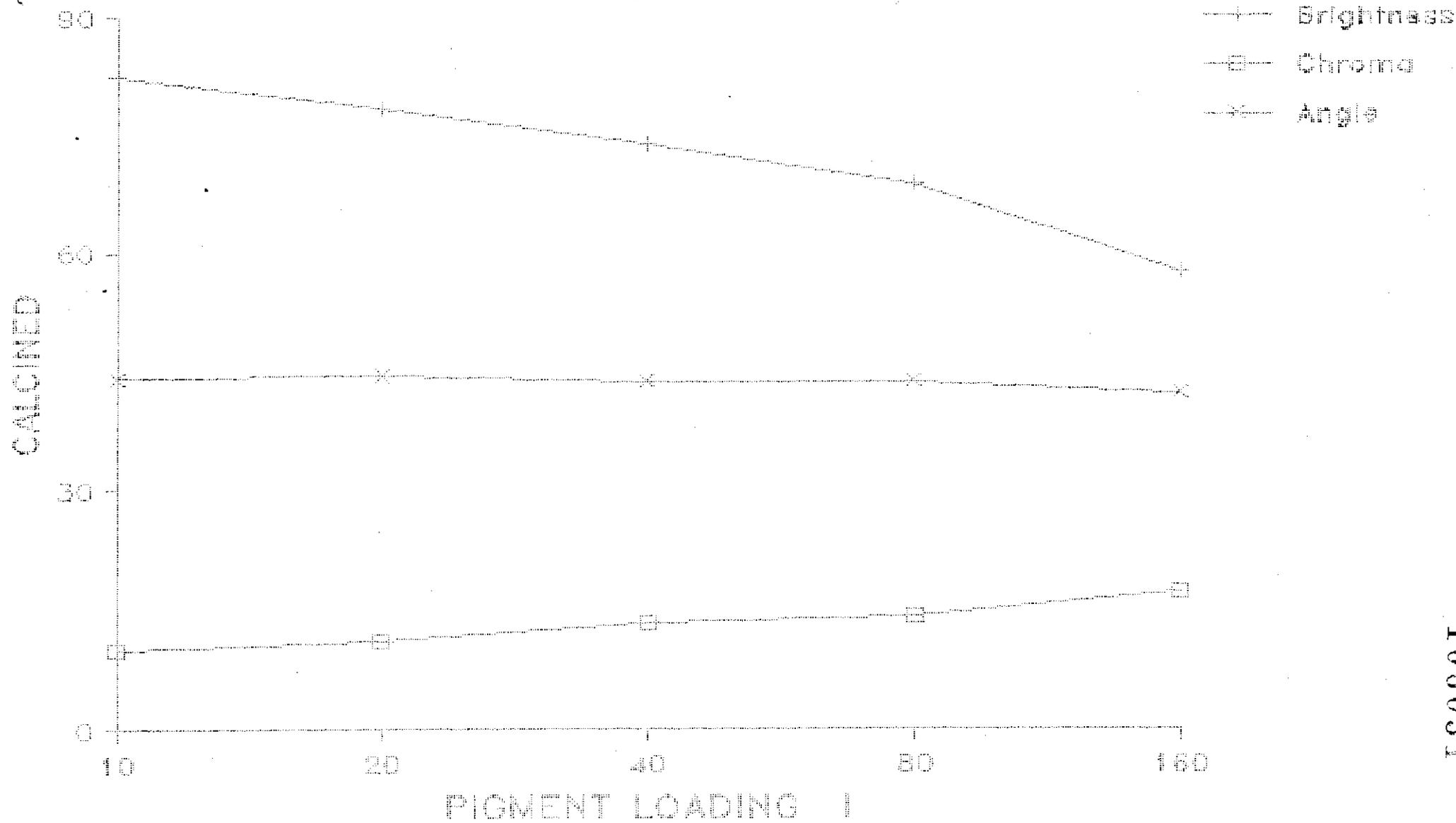


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TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/5



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052

TASMANIAN OCHRE PROJECT

SAMPLE NO :- MT 1/1

MILLED:- 8 HRS
CALCINED: 300 C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	1	1	1	1	1	1	1	1	
Chroma	1	1	1	1	1	1	1	1	1	
Angle	1	1	1	1	1	1	1	1	1	
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	
Brightness	1	1	1	1	1	1	1	1	1	
Chroma	1	1	1	1	1	1	1	1	1	
Angle	1	1	1	1	1	1	1	1	1	

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106053

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT111

MILLED:-

8 HRS

TOTAL PIGMENT LOADING

CALCINED:

300 C

323 g/l

MINUS 100um FRACTION

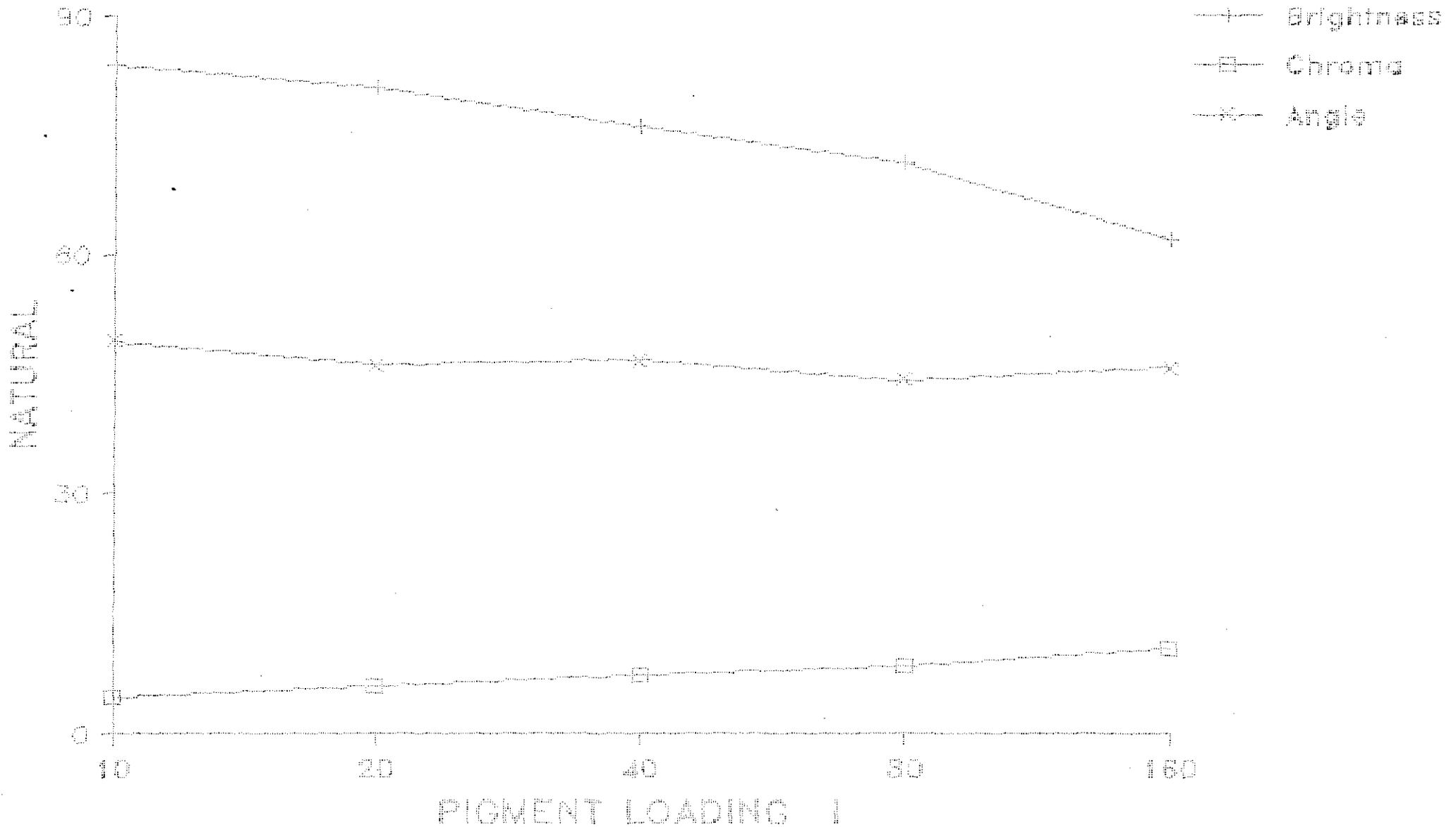
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NATURAL	1		1		1		1		1		1
Brightness	1	83.9	1	80.9	1	76.1	1	71.5	1	62	1
Chroma	1	4.6	1	6	1	7.3	1	8.5	1	10.8	1
Angle	1	49.2	1	46.2	1	46.8	1	44.4	1	46	1
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	82.5	1	78.9	1	74	1	67.8	1	57.3	1
Chroma	1	5.9	1	7.1	1	7.9	1	9	1	11.2	1
Angle	1	40.7	1	40.1	1	39	1	39.3	1	40.2	1

054

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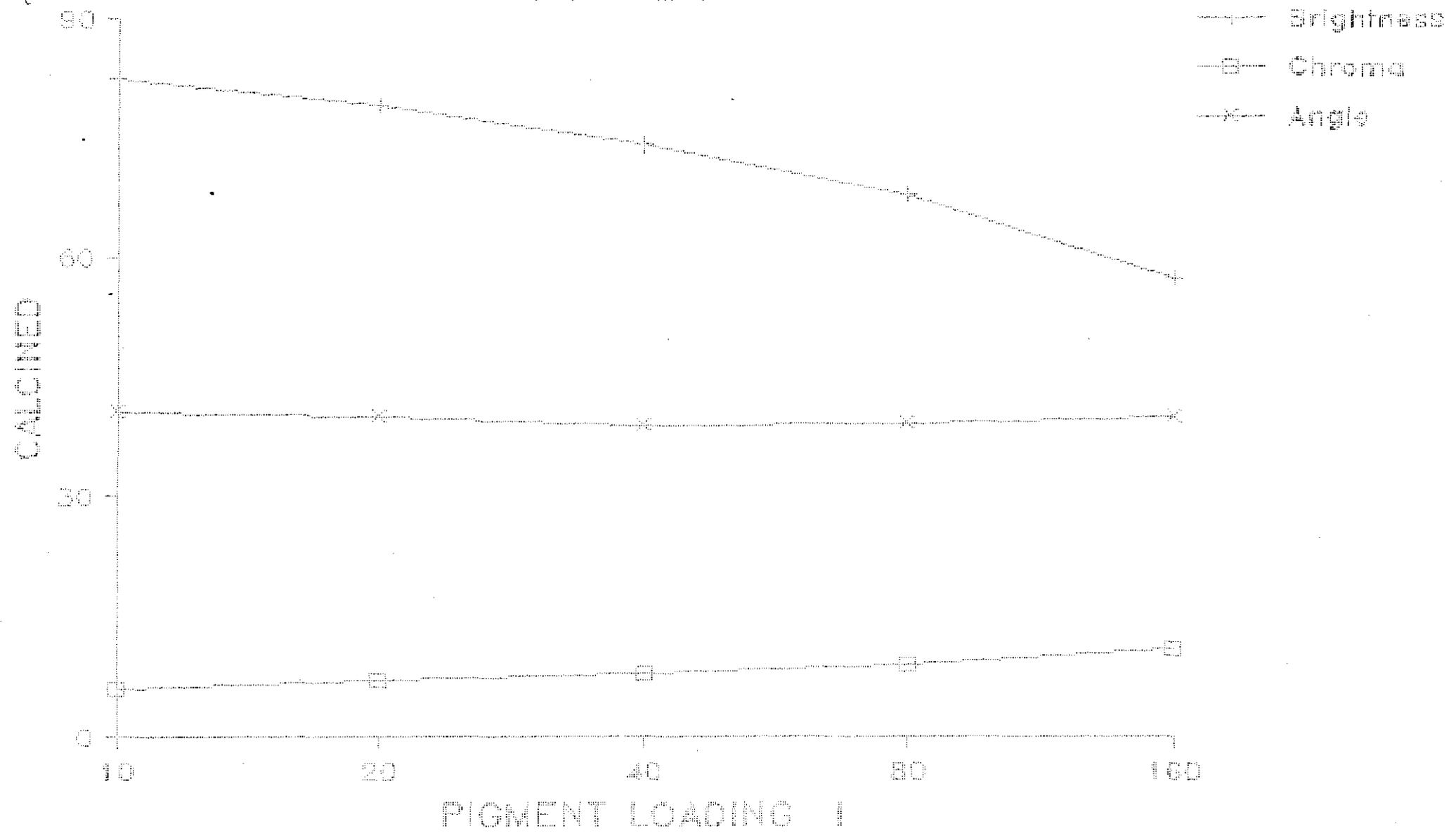
TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT111



TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT111



057

106057

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT2/3

MILLED:-
CALCINED:8 HRS
300 CTOTAL PIGMENT LOADING
323 g/l

MINUS 100um FRACTION

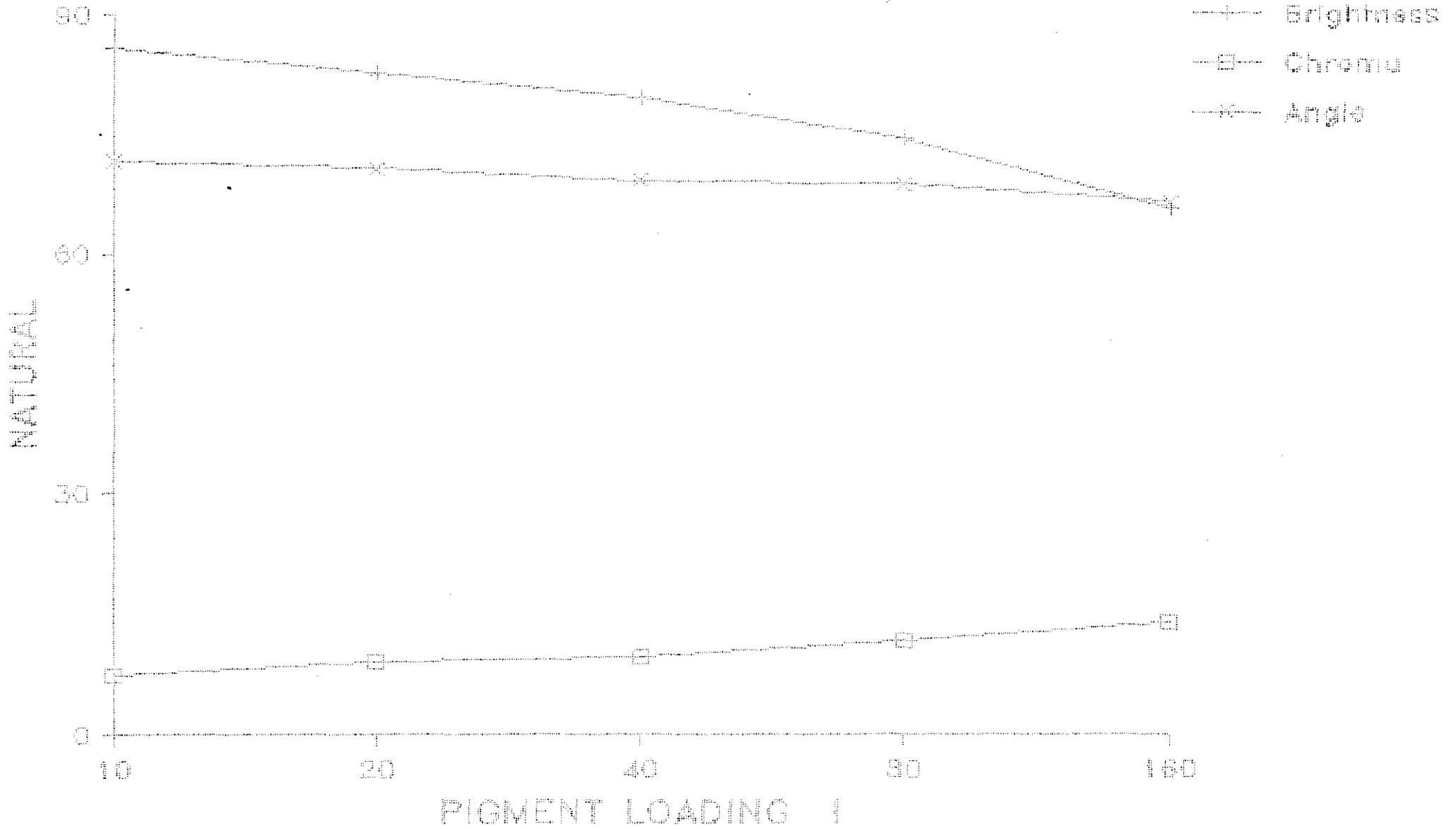
SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	85.9	1	82.7	1	79.4	1	74.3	1	65.7	1
Chroma	1	7.3	1	9.2	1	9.8	1	11.6	1	14	1
Angle	1	71.6	1	70.7	1	69.1	1	68.7	1	66.4	1
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	84.1	1	80.7	1	75.8	1	69.6	1	59.7	1
Chroma	1	7.4	1	9.2	1	10.1	1	11.9	1	13.3	1
Angle	1	50.1	1	48.8	1	48	1	47.4	1	44.9	1

058

106058

TASMANIAN OCHRE PROJECT

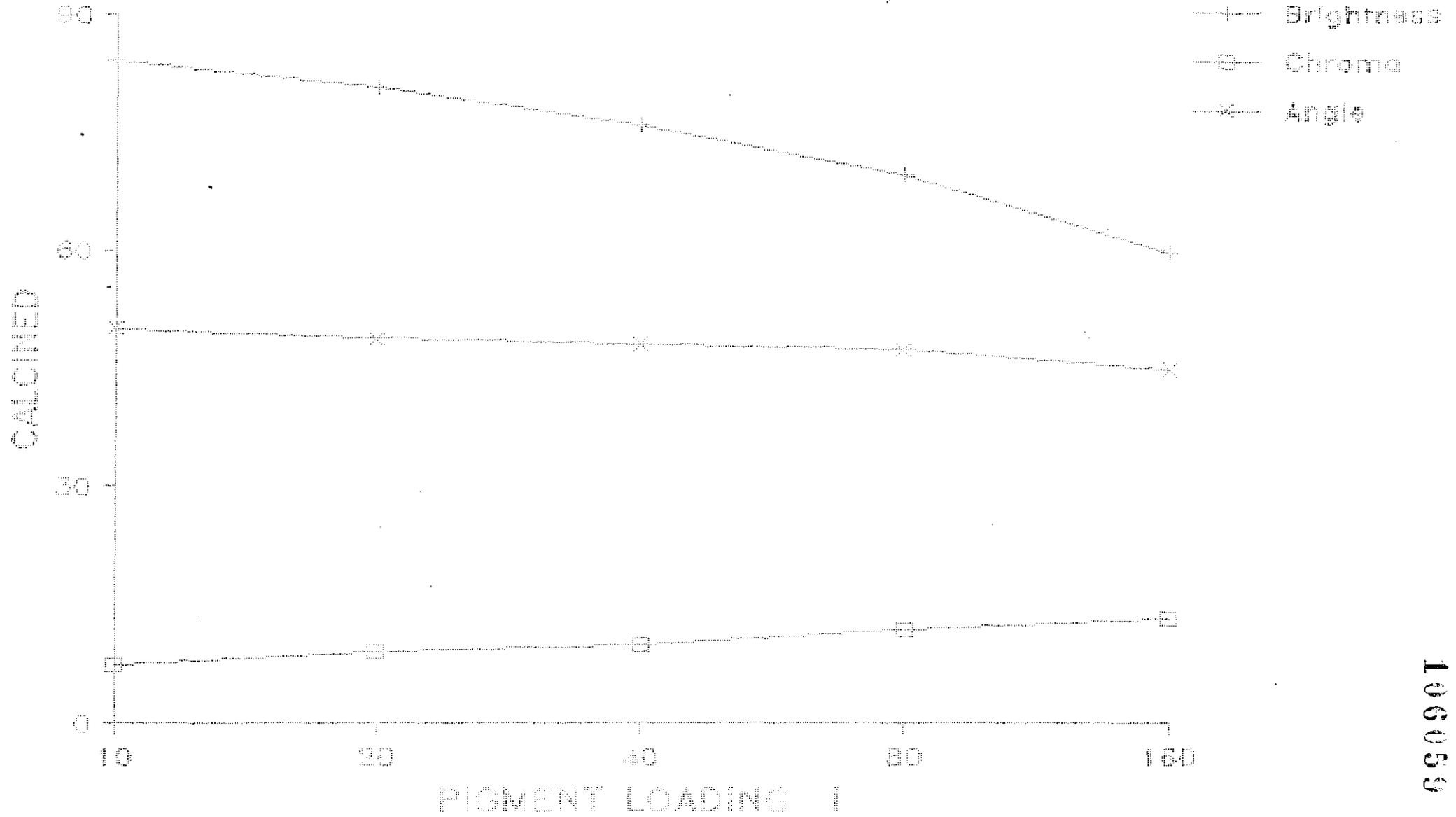
SAMPLE NO:- MT2/3



059

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT2/3



106059

061

106061

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT4/6

MILLED:-

8 HRS

TOTAL PIGMENT LOADING

CALCINED:

300 C

323 g/l

MINUS 100um FRACTION

SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	90.5	1	88.8	1	86.4	1	82.7	1	75.5	1
Chroma	1	12	1	15	1	17.4	1	21.7	1	27	1
Angle	1	89.3	1	87.5	1	86.1	1	83.9	1	81.9	1
PIGMENT LOADING grams/litre	1		1		1		1		1		1
	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	85.7	1	82.4	1	78.4	1	73.1	1	63.8	1
Chroma	1	9.9	1	12.4	1	13.7	1	16.3	1	18.7	1
Angle	1	55.2	1	53.4	1	51.4	1	49.5	1	47.3	1

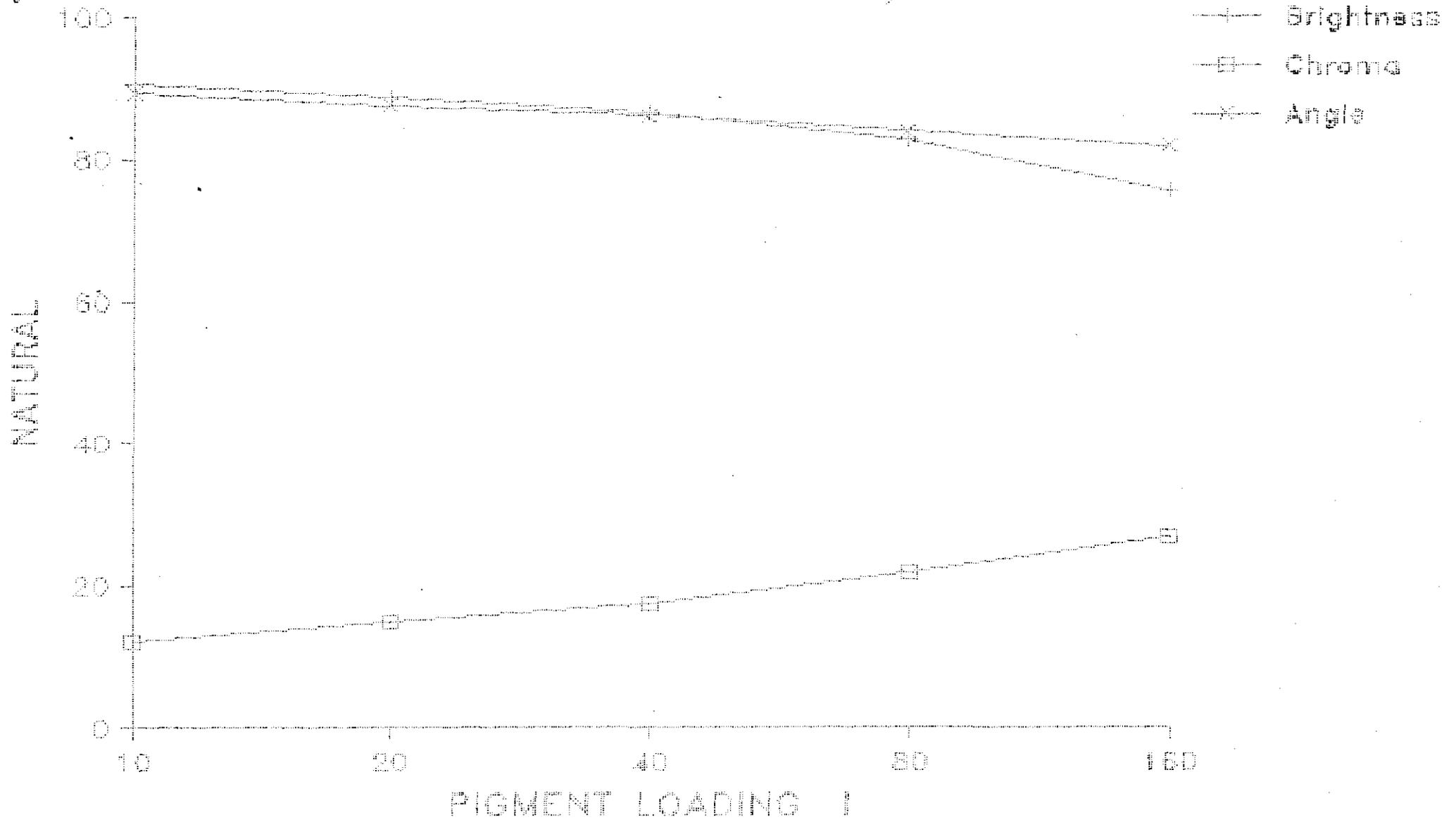
NATURAL

062

106062

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT4/6

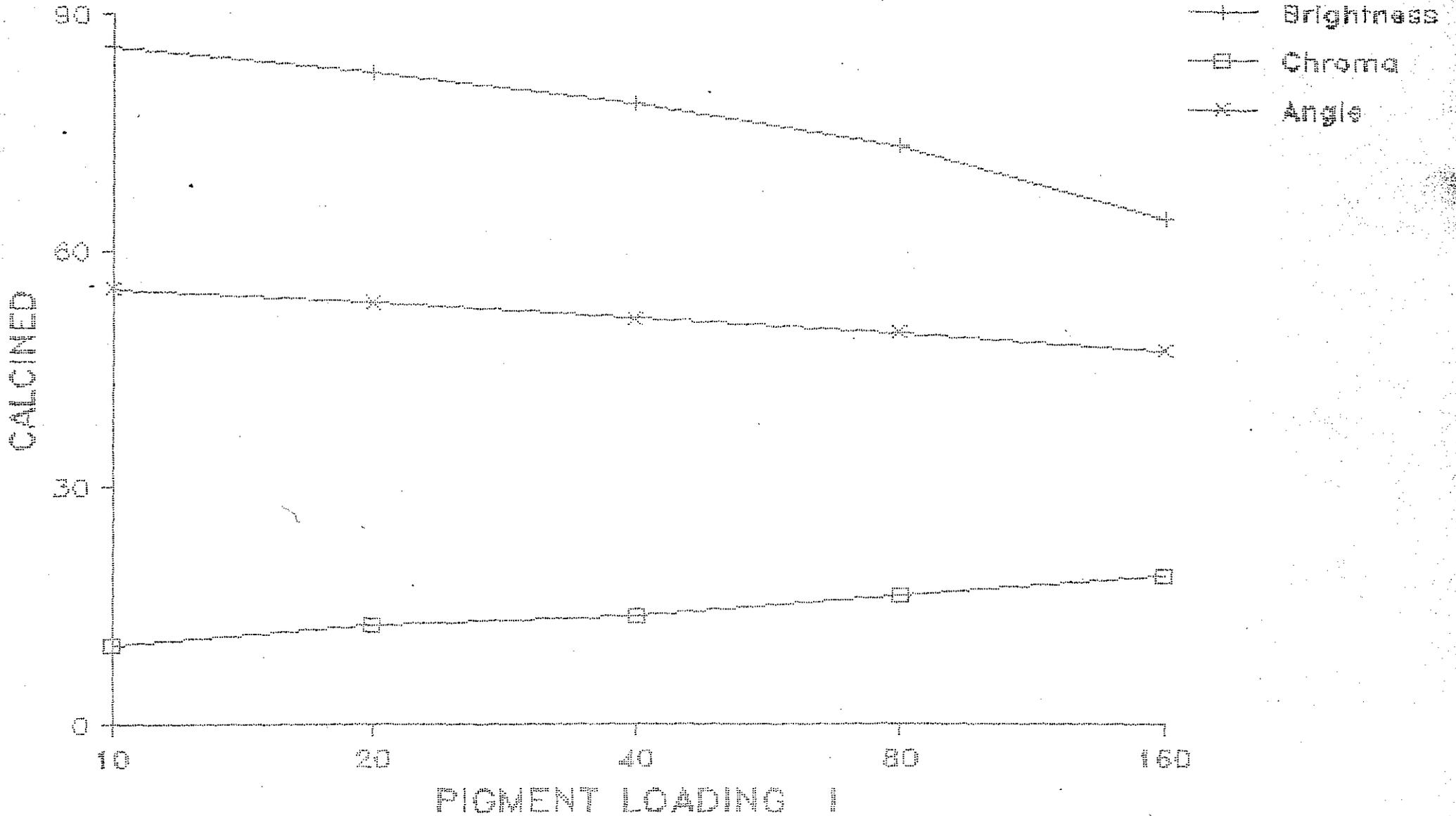


063

106063

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT4/6



065

106065

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/1

MILLED:-

8 HRS

TOTAL PIGMENT LOADING

CALCINED:

300 C

323 g/l

MINUS 100um FRACTION

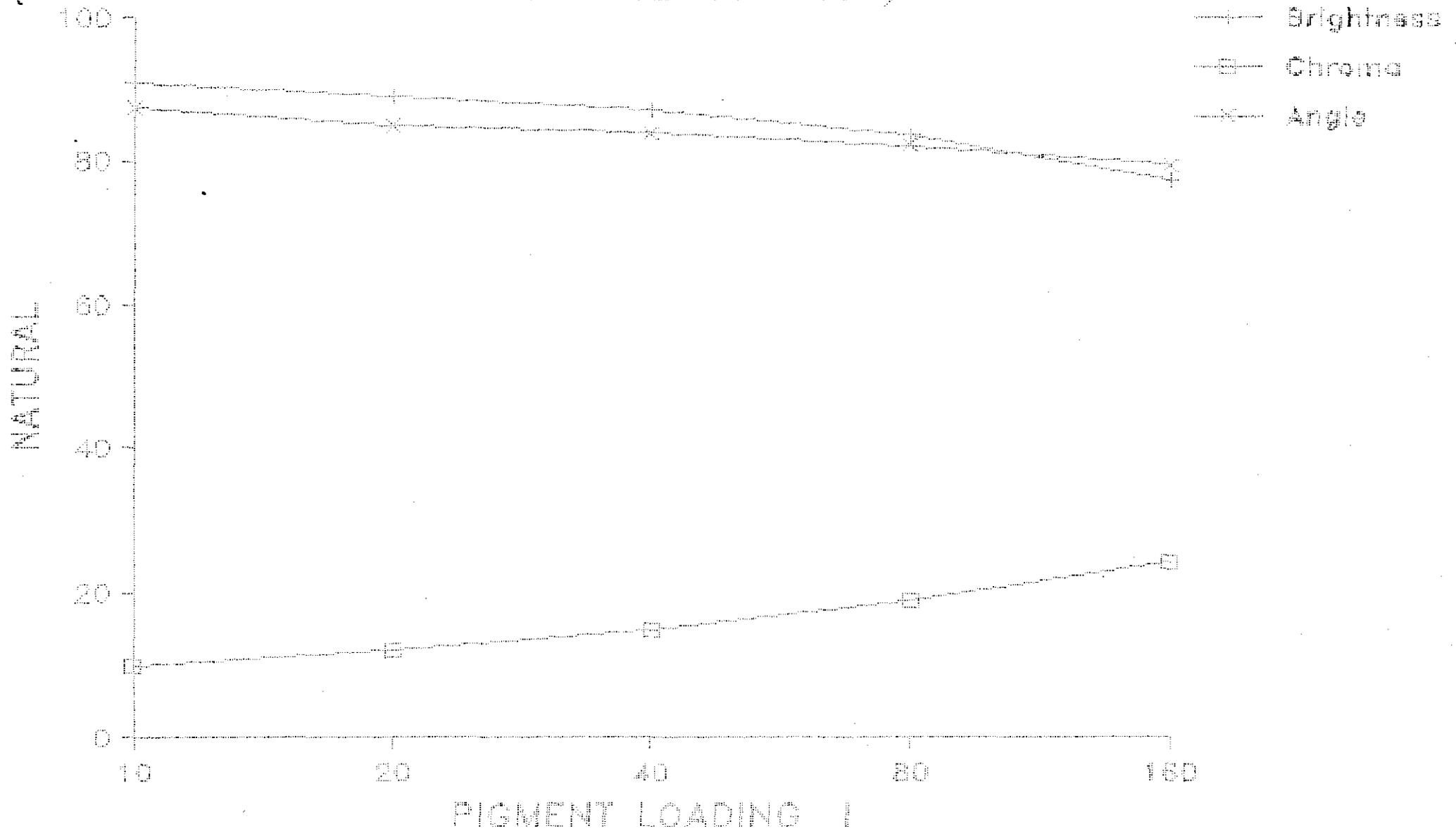
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	91	1	89.1	1	87.2	1	83.7	1	77.3
Chroma	1	9.7	1	12	1	14.9	1	18.9	1	24.4
Angle	1	87.4	1	84.9	1	83.9	1	82.2	1	79.4
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	86.1	1	83.2	1	79.6	1	74.2	1	65.2
Chroma	1	10	1	11.9	1	15.2	1	17.4	1	21.1
Angle	1	56.2	1	54.9	1	53.5	1	52.8	1	52.6

066

106066

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/1

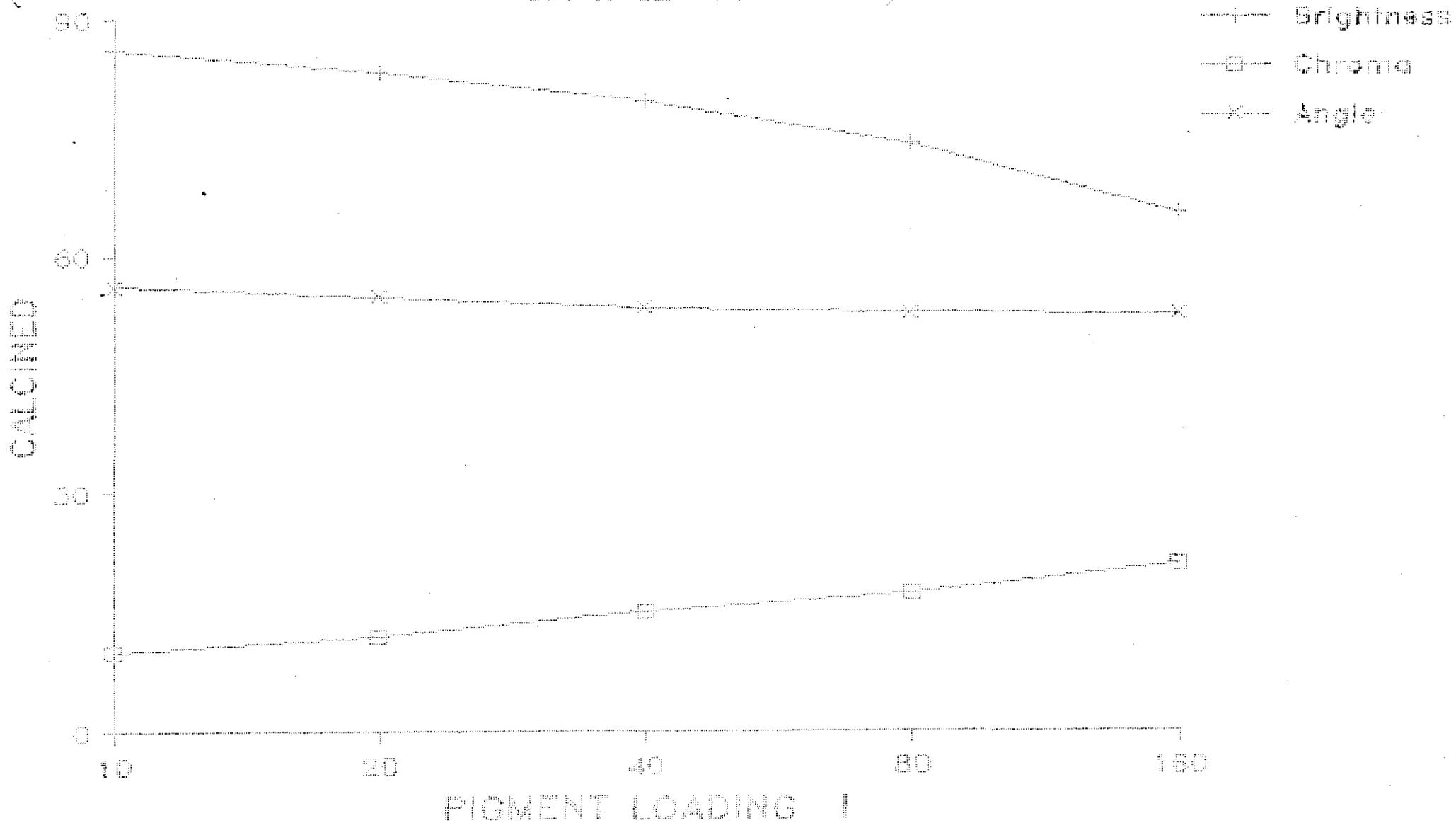


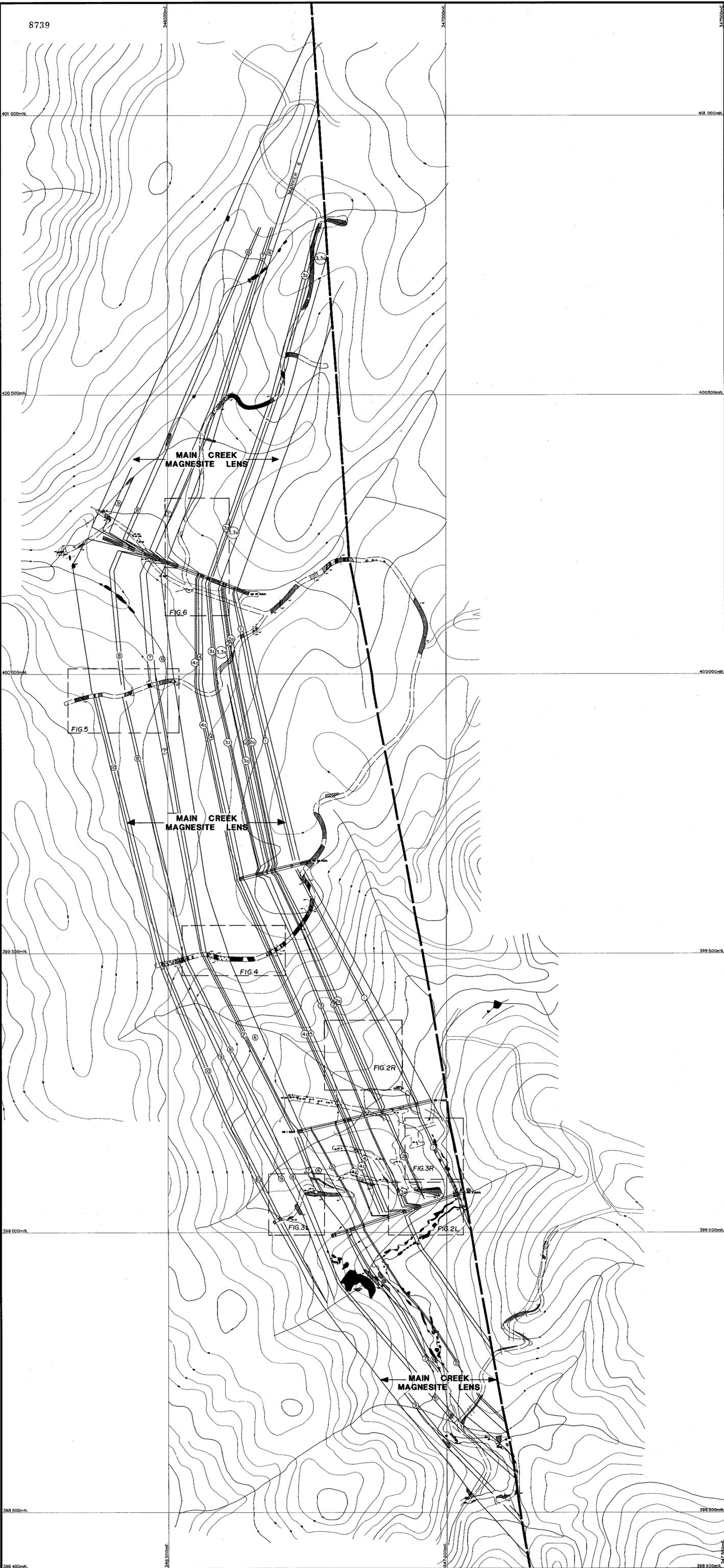
067

106067

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/1

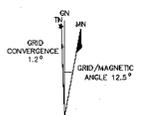
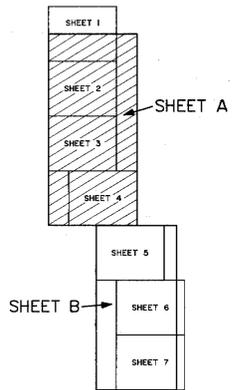




LEGEND

- CARBONATES
- SILICA ROCK
- TALC
- POROUS OCHRE, AFTER CARBONATE
- RESIDUAL SAND, AFTER CARBONATE
- SAND OR POROUS OCHRE / LIMONITE PISOLITES
- GREENSCHIST BRECCIA USUALLY OVER CARBONATE
- GREENSCHIST UNDIFFERENTIATED
- GREENSCHIST WITH DISSEMINATED MAGNETITE
- MAGNETITE ROCK
- GREY SANDSTONE
- BRECCIA PIPE
- INCLUDED BLOCK
- MUDDY GRITS WITH ORGANICS

SHEET LOCATION

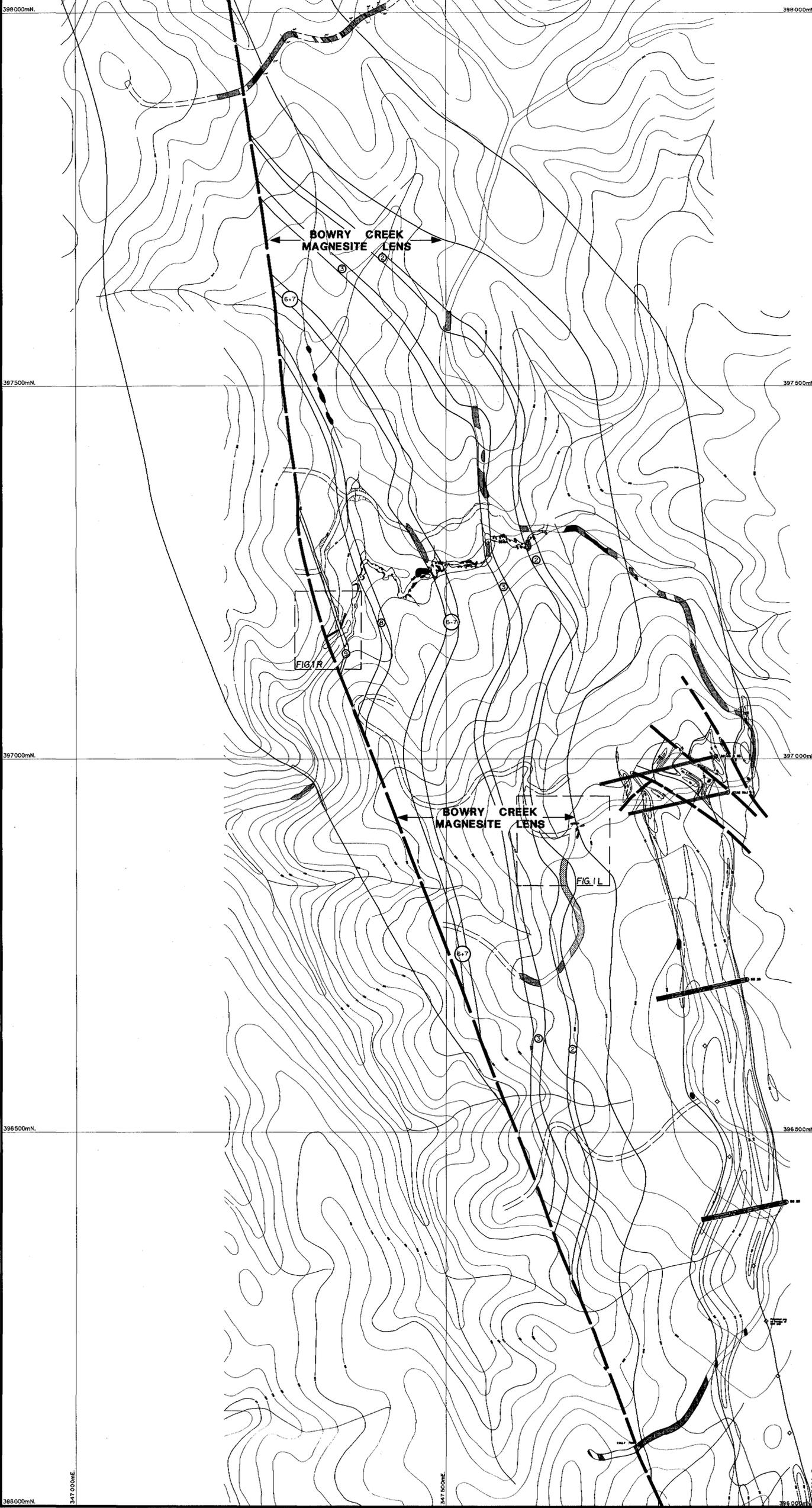


106068 89-2963

SAVAGE RESOURCES LIMITED		DRAWN BY: H.S.
SAVAGE RIVER E.L. 4 / 81		DRAFTSMAN: T.O.D.S.
MAIN CREEK MAGNESITE		DATE: May '89
SHEET A		REVISIONS:
DRILLING, GEOLOGY		FILE No.:
OUTCROP & INTERPRETATION		FIG. 1

SCALE 1:2500

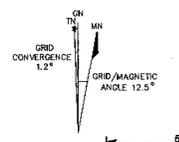
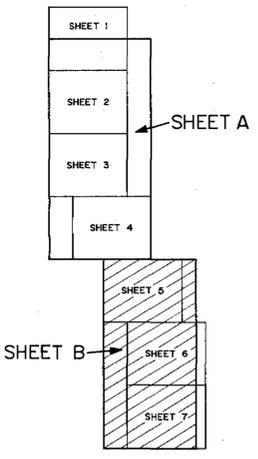
S740



LEGEND

- CARBONATES
 - SILICA ROCK
 - TALC
 - POROUS OCHRE, AFTER CARBONATE
 - RESIDUAL SAND, AFTER CARBONATE
 - SAND OR POROUS OCHRE / LIMONITE PISOLITES
 - GREENSCHIST BRECCIA USUALLY OVER CARBONATE
 - GREENSCHIST UNDIFFERENTIATED
 - GREENSCHIST WITH DISSEMINATED MAGNETITE
 - MAGNETITE ROCK
 - GREY SANDSTONE
- 20 20,000 m CONTOUR

SHEET LOCATION



106069 89-2963

SAVAGE RESOURCES LIMITED	
SAVAGE RIVER E.L. 4 / 81	DRAWN BY : H.S.
MAIN CREEK MAGNESITE	DRAFTSMAN: T.G.D.S.
SHEET B	DATE : May '89
	REVISIONS :
	FILE No.
DRILLING, GEOLOGY OUTCROP & INTERPRETATION	
SCALE 1 : 2500	FIG. 2