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AMDEX MINING LIMITED

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TRIAKO MINES N.L., BUKA MINERALS N.L.,
GIPPSLAND MINERALS N.L., KIBUKA MINES PTY. LTD.
169 Miller Street, North Sydney, Australia 2060

TECHNICAL REPORT

SCOTIA LEAD, TASMANIA

SIX MONTHLY REPORT FOR PERIOD
26 JULY 1978 to 25 JANUARY 1979

OPEN FILE

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Investigations Conducted by: Kibuka Mines Pty. Limited

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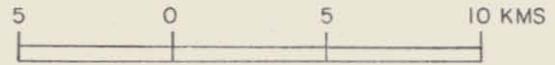
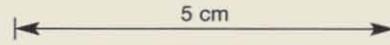
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MAP SHOWING LOCATION OF PERCUSSION DRILL HOLES

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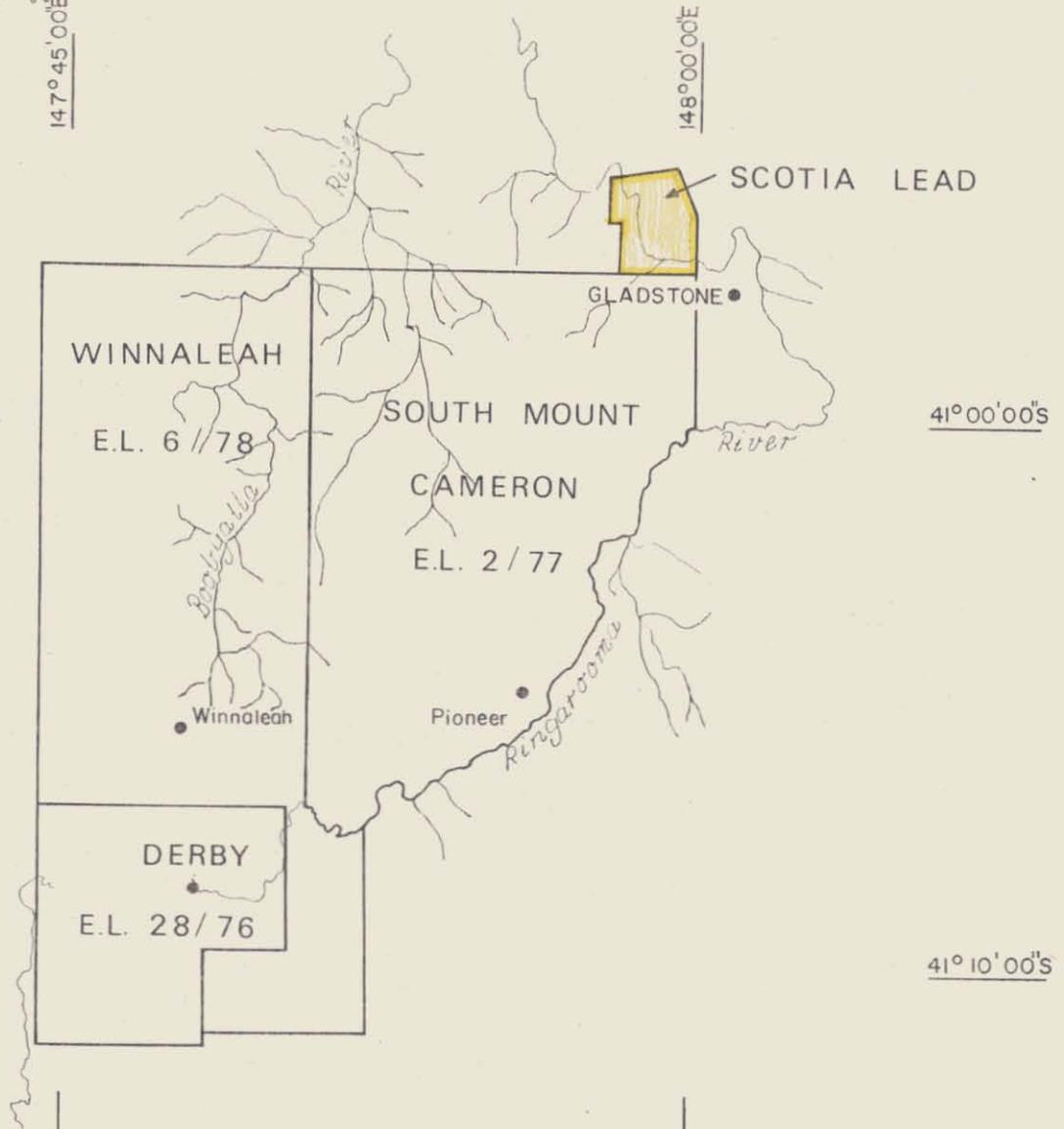
King Island



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147° 45' 00" E

148° 00' 00" E



AMDEX MINING LIMITED
 NORTH - EASTERN TASMANIA LOCATION MAP
 SHOWING CURRENT E.L.'S

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1. INTRODUCTION

This report summarises the results of investigations into Scotia Lead for the six monthly period ended 25th January 1979. Permission to explore the Scotia Lead was granted to Kibuka Mines Pty. Ltd. as from 23rd July 1976. Various preliminary feasibility studies were superficially considered in the early stages of tenure by Kibuka Mines, however no moves to develop or further test the area were attempted. The area has had a long history of intense exploration by the Tasmanian Mines Department. Various companies have considered it for further check boring or feasibility study however no development ensued and all these companies terminated their involvement in North-East Tasmania. The previous approaches by these companies are briefly summarised.

Our experience with North-East Tasmania has led us to consider the information and problems of Scotia more cautiously. The problems are discussed and the results of our limited percussion drilling are presented. Future exploration and the priorities of such are briefly discussed.

2. EXPLORATION

2.1 Previous Exploration

In the Great Northern Plains area, many old mine workings exist for which limited information is available. These were productive from the 1880's to the early 1900's, and include the Scotia, Lochaber, Mallinson and Doone workings. These have been summarised in Warin and Appleby, 1964. An extensive boring campaign involving 855 holes was completed by the Tasmania Department of Mines from 1935 to 1944. Of those holes drilled, 185 contained tin giving an average grade of 0.34 lbs/cu. yard (Blake, 1955). Blake defined mine block areas over the Scotia area but did not discuss the reliability of the basic drilling information or what methods were employed in the sampling and calculation of grade values.

Tin grades over various intervals from many of the Mines Department holes were tabulated by Mearing (1941 ?). Mines Department holes drilled subsequently to Mearing's information had been compiled by J.C. Standard (1973 a) wherein many of the Mines Department assay sheets were photocopied. Commonly, only the final tin-bearing sections were analysed. The limited information presented suggests that the tin content from the Mines Department holes is calculated from the theoretical volume of the length of drill pipe and that no provision or measurement was made for flow-in of semi-fluid material. This phenomenon of flow-in of material is commonplace in the Scotia area, particularly in the lower tin-bearing section of strata. There may be additional information held by the Tasmanian Mines Department that may resolve these dilemmas, however check drilling by various companies has cast some doubt on the credibility of the grades reported.

Rattigan (1958 a) working for Rio Tinto of Australia conducted a check boring program in the Scotia area along a line of government holes.

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The overall grades measured in their nine hole program was dramatically less than the Mines Department values, (0.07 lbs SnO₂ per cubic yard compared with 0.22 lbs SnO₂ per cubic yard) and Rattigan makes some strongly worded accusations of the Mines Department results. He maintained that the Mines Department drilling was not supervised and was compiled by individuals not familiar with the program, and many years after the drilling. Rattigan, however, did not present his own calculations and methods of grade determination for the Rio Tinto holes although he had vaguely outlined a procedure in Rattigan (1958 b).

Utah were next in the general area. However, at this time, the limits of the Scotia Lead were held by Storeys Creek Tin Mining Company. Utah did not consider Scotia grades to be viable by their standards and explored for undiscovered shallow deposits in the area (Warin and Appleby, 1964; Appleby and McEwan, 1966). Warin and Appleby suggested the possibility that a small area of the Lochaber Mine was worked only to false bottom, however this suggestion does not appear to have been followed-up. Utah (Appleby and McEwan, 1966) outlined by auger drilling, a shallow tributary lead to Scotia which they considered too small to warrant sample drilling.

Storeys Creek Mining Company's test work (1964 to 1966) also aimed at checking the results of the Government boring. The Government boring was confined to the central "economic" zone of the Lead. The values from their logs appear on average less than the nearby Government bores however, their log calculations seem superficial particularly their treatment of core volumes and Sn analyses. In most cases the Sn analyses were only estimated. They conclude:

- a) The accuracy of their boring is in doubt;
- b) The Government results should be used for final evaluation; and
- c) That sufficient holes should be bored to establish the reliability of the Government results.

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B.M.I. conducted exploration and evaluation over the Scotia area for several years, Standard (1971, 1972, 1973 b). The approach this Company pursued was solely in terms of Scotia Lead being a viable mining proposition and various mine blocks, plans and cross-sections were presented. Standard (1971) states that the results of B.M.I. check drilling substantiates Mines Department holes. However, very little evidence is presented to substantiate this. Criticism can be directed at B.M.I.'s work for the following reasons:

- a) No drill logs are presented in any of Standard's Scotia report;
- b) There is no documentation of the method of grade calculations used for the values shown on Standard's Scotia cross-section;
- c) Very few check bores were drilled over very limited spacing and few of these are in close proximity to Mines Department holes;
- d) No attempt was made to compare a wide spread of drill hole averages in the check drilling.

Initial observations indicate that B.M.I.'s grades are more erratic and slightly less than the Mines Department holes, ~~but~~ without knowing the precise methods of calculation in each case the comparison is dubious.

Criticism has been directed at much of Standard's work in the North-East of Tasmania and at the general standard of B.M.I.'s sample treatment Thomas (1974).

Gibson (1976) analysed the possibility of economically mining tin from the Scotia Lead for Kibuka Mines. The past work and data was discussed very briefly and accepted as being reliable. Gibson's approach was then similar to B.M.I.'s, in analysing Scotia as a viable entity and calculating overburden and ore reserves according to envisaged dredge paths and batter angles.

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In summary, there is insufficient documentation of the basic data, the check boring and the calculations for confident appraisal of this deposit.

2.2 Current Exploration

Three percussion holes were drilled in the northern part of the Scotia Lead by Kibuka Mines during the six monthly period ended 25th January 1979. In addition, the regional geology, past work and methods of grade calculations were reviewed as part of an overall program for appraisal of North-East Tasmania.

The logs of these three holes are presented in Appendix 1 and their locations are shown on the accompanying plan. The grade values are calculated using the formula:

$$\frac{\text{Weight (concentrate grams)} \times \text{Assay (concentrate \%)} \times 0.000851}{\text{Corrected Volume}}$$

The concentrated weight and the Sn assay were measured by Fox Laboratories, Sydney. "0.000851" is a constant derived as follows:

$$\frac{27 \text{ (cu. feet to cu. yards)}}{453 \text{ (converting grams to lbs)} \times 70 \text{ (converting Sn to 70\% SnO}_2\text{)}}$$

The corrected volume used needs further comment. It is common practice in alluvial tin drilling to refer the tin content to a percentage of the theoretical volume. This percentage is known as the "Radford Factor". In many tin fields, an 88% Radford Factor is used. In North-East Tasmania coarse tin-bearing wash occurs at the base of the hole and this greatly inhibits the recoverability of tin so a slightly more optimistic

Radford Factor of 80% is used. In most cases the recovered volume is significantly less than the theoretical volume and in these cases the 80% Radford Factored theoretical volume is used. In cases where a run-in of material has occurred and excess material is recovered, the tin grade is proportioned to the volume in excess of the Radford Factor volume, as shown on the logs. A 20% reduction in the corrected over volume takes into account the expansion of the uncompacted gravel in the sample.

The grade figures stated on the logs are quoted to three decimal figures, however by the nature of the sampling, this accuracy of calculation could not mirror the true nature of the ground. True grade values in the ground are supposedly approximated by applying the Radford Factor which by general mining experience is the best approximation of the mining entity. Provided the basic data is presented subsequent adjustment of the Radford Factor can be applied after the initial phase of mining.

2.3 Future Work

The potential for conducting future work depends on the reliability of past information. A feasibility study cannot be confidently conducted without assurance of the validity of previous grade values. A crucial factor to previous grade values is the flow-in of excess material, commonplace in the Scotia ground. Retrieval of drilling information or previous records will be attempted, however, from an initial appraisal of most of this information is lacking.

Substantial check drilling will have to be undertaken eventually in order to verify previous boring by the Mines Department. Check drilling should duplicate at least two lines of drill holes across the Lead and a series of holes should be drilled along the axis of the Lead. In this way, an average value for tin-bearing holes can be made and any necessary

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adjustments to the Mines Department hole values made. About 30 percussion drill holes may be required to check drill previous boring, if insufficient basic information can be retrieved from the previous drilling. In view of the large number of check bores required and the marginal nature of the ground, this drilling cannot be considered until other studies are further developed.

One area that warrants investigation is a small side lead outlined from auger drilling conducted by Utah (Appleby and McEwan, 1966). At least 10 percussion sample holes are required to test this area. It is expected that this drilling will be undertaken during the next six monthly period.

During the past few months we have been investigating alternative drilling methods to the cable tool percussion technique. The Company owns two cable tool percussion rigs and these have been working continuously now for almost twelve months. The cable tool drilling method is slow and we have some reservations about the accuracy of sampling with this rig. We have reviewed many alternative methods of drilling, with drilling contractors, manufacturers of drilling equipment and other mining companies who have been involved in drilling alluvial. Three techniques are possible alternatives to the cable tool method. They are: rotary drilling with compressed air and a carefully monitored mud mixture, the Odex drilling system manufactured by Atlas Copco and large diameter reverse circulation drilling. The reverse circulation system seems to have most promise but coarse pebbles could present a problem. Appendix 2 contains copies of correspondence and literature resulting from these investigations.

We consider that the cable tool percussion drilling method is too slow to be cost effectively applied at Scotia. We are hopeful of carrying out a test drilling program in the Pioneer area with a suitable reverse circulation rig in the near future and if this drilling system proves to be practicable we would be looking towards using it in due course for further drilling at Scotia Lead.

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3. GEOLOGY

The Scotia area consists of unconsolidated Tertiary alluvial sediments overlying a Mathinna sediment, usually slate bottom. Small quantities of tin occur in the basal wash zones of the Tertiary section. The bulk of the Tertiary section consists of moist sand and gravel with abundant clay. Coarse conglomerate or "wash" with smaller pebble conglomerate or "birds-eye wash" commonly occurs towards the base of the section. Occasional beds of peat are encountered towards the base of the section. The sediments are moist, unconsolidated and often with bands of clay material, and are conducive to semi-fluid flow. These factors add to mining problems.

The sediments are considered to be deposited in estuarine conditions under a tidal influence. Thick clay beds, deposited from suspension are considered to be untypical of fluvial conditions. Mature pebble beds of "birds-eye wash" are also considered to be of a size range not typical of fluvial sediments. Additional evidence for the estuarine interpretation has been presented in reports from adjacent areas and will not be repeated here.

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4. CONCLUSIONS AND RECOMMENDATIONS

- 4.1 Although extensive drilling has been conducted into the Scotia Lead there is insufficient basic data available from this drilling with which to confidently evaluate the mining potential of this ground.

- 4.2 An additional search for data from past drilling will be undertaken however, extensive check drilling will have to be undertaken eventually in order to verify or disprove grades in the Scotia area.

- 4.3 A small shallow (25 metres deep) side lead outlined by auger drilling conducted by Utah should be tested by percussion sample drilling. Approximately 10 holes should be drilled in this target in the next drilling program.

Leon R McDonald

L. McDonald.

23rd February 1979

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APPENDIX 1

Drill Logs of Percussion
Holes S 1, 2 and 3

AMDEX MINING LIMITED - PERCUSSION DRILL LOG

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AREA : Scotia HOLE NO. : S 1 COLLAR COORDINATES : SURFACE R.L. : BASEMENT R.L. :

Date: 30-6-78 Driller: A. Watson Assistant: D. Nicholls Sample Washer: S. Moore Geologist: N.G.P. Cutting shoe diameter : 6.31"
 18-7-78 Casing diameter : 6"

Section Feet		Sample No.	Recovered Volume (ft ³)	Theoretical Volume (ft ³)	Corrected Volume (ft ³) 80% Rec.	Weight Concentration (gms)	Concentration Assay (Sn)	Value over Interval		Description of Sample
From	To							Sn ₂ lbs/cu yd	SnO ₂ kg/m ³	
0	5	C1401	.70	1.086	.87	8.322	0.40	0.003	0.002	Fine sand, mon & iron frags
5	10	C1402	.60		.87	30.305	0.32	0.009	0.005	Fine & coarse sand, mon & iron frag.
10	15	C1403	.80		.87	19.120	1.34	0.025	0.015	Fine & coarse sand, trace of fine tin, mon & iron.
15	20	C1404	.70		.87	16.346	0.99	0.016	0.010	As Above.
20	25	C1405	.60		.87	20.311	0.67	0.013	0.008	As Above.
25	30	C1406	.45		.87	13.496	0.63	0.008	0.005	As Above with clay.
30	35	C1407	.40		.87	20.343	0.66	0.013	0.008	Fine & coarse sand, trace of fine tin, monazite.
35	40	C1408	.85		.87	18.509	0.74	0.013	0.008	As Above.
40	45	C1409	.90		.87	13.086	0.98	0.012	0.007	As Above.
45	50	C1410	.80		.87	20.321	0.32	0.006	0.004	Fine & coarse sand, clay, trace of fine tin, mon, py, iron.
50	55	C1411	.90		.87	10.666	0.90	0.009	0.005	Fine & coarse sand, clay, py, trace of fine tin, mon, py, iron.
55	60	C1412	.85		.87	13.598	0.61	0.008	0.005	Coarse & fine sand, clay, py, monazite, & iron frags.
60	65	C1413	.60		.87	18.089	0.27	0.005	0.003	Fine sand & clay, py, mon & iron frag.
65	70	C1414	.60		.87	10.034	0.92	0.009	0.005	Fine sand, coarse gravel, py, monazite & iron frags.
70	75	C1415	.10		.87	39.354	0.20	0.008	0.005	Coarse & fine sand, clay, py, mon, iron frags.

Drillers reported basement at 148 ft.
 Interval of tin bearing wash 135-140 ft. @ .354 lbs /cu yd 0.213 kg /m³ =
 @ 0.046 lbs Sn /cu yd = 0.028 kg / m³ (cassiterite 70% Sn).

AMDEX MINING LIMITED - PERCUSSION DRILL LOG

180017019

AREA : **Scotia** HOLE NO. : **S 1** COLLAR COORDINATES : SURFACE R.L. : BASEMENT R.L. :

Date **30-6-78** Driller: **A. Watson** Assistant: **D. Nichols** Sample Washer: **S. Moore** Geologist: Cutting shoe diameter : **6.31"**
18-7-78 Casing diameter : **6"**

Section Feet		Sample No.	Recovered Volume (Ft ³)	Theoretical Volume (Ft ³)	Corrected Volume (Ft ³)	Weight Concentration (gms)	Concentration Assay (Sn)	Value over Interval		Description of Sample
From	To							80% Bad F.	Sn ₂ lbs/cuyd	
75	80	C1416	.75	1.086	.87	15.717	0.24	0.004	0.002	Coarse & fine sand, clay, pyrite, monazite & iron frag
80	85	C1417	.60		.87	8.878	0.49	0.004	0.002	As Above.
85	90	C1418	.90		.87	16.000	2.55	0.040	0.024	Coarse & fine sand, py, mon & iron frag.
90	95	C1419	1.65		1.32	16.5708	3.10	0.033	0.020	Coarse & fine sand, small wash, py, mon, & iron frag.
95	100	C1420	.90		.87	16.026	3.50	0.055	0.033	Coarse sand, & small wash, py, mon & iron frag.
100	105	C1421	.75		.87	19.785	2.43	0.047	0.028	Coarse sand, wash & clay, trace of fine tin, mon & py.
105	110	C1422	.50		.87	16.918	1.14	0.019	0.011	Fine sand, trace of fine tin mon & py.
110	115	C1423	.80		.87	8.368	4.42	0.036	0.022	Coarse sand, wash, trace of fine tin, py - mon.
115	120	C1424	1.15		.92	10.723	9.48	0.094	0.057	Coarse sand, wash, tr of f. ti py, mon & iron frag.
120	125	C1425	1.00		.87	41.038	1.10	0.044	0.027	Coarse sand & wash, py, mon & iron frags.
125	130	C1426	.65		.87	23.348	3.53	0.081	0.049	As Above.
130	135	C1427	1.2		.96	11.378	13.1	0.132	0.079	Coarse & fine sand, small wash, clay, py, mon, & iron frag
135	140	C1428	1.75		1.40	43.081	13.5	0.354	0.213	Coarse sand, wash, peat, mon, p & iron frag.
140	145	C1429	1.00	✓	.87	11.652	12.9	0.147	0.088	Coarse sand & wash, mon, py & iron frag.
145	150	C1430	1.20	0.652	.96	30.360	8.1	(0.2183)	0.131	Coarse sand, wash & slate bottom, py, mon, & iron frag.

Drillers reported basement at **148** ft.

Interval of tin bearing wash **0.028 kg/m³** ft.

Small amount from surface to **148** **0.046** lb Sn₂ /cu yd (Cassiterite 70% Sn)

AMDEX MINING LIMITED - PERCUSSION DRILL LOG

AREA: **Scotia** HOLE NO.: **s 2** COLLAR COORDINATES: SURFACE R.L.: BASEMENT R.L.:

Date: **11-8-78** Driller: **A. Watson** Assistant: **D. Nichols** Sample Washer: **S. Moore** Geologist: **N.G.P.** Cutting shoe diameter: **6.31"**
18-8-78 Casing diameter: **6"**

Section Feet		Sample No.	Recovered Volume (ft ³)	Theoretical Volume (ft ³)	Corrected Volume (ft ³) 80% Fed	Weight Concentration (gms)	Concentration Assay (Sn)	Value over Interval		Description of Sample
From	To							Sn ₂ lbs/cuyd		
0	5	C1431	.60	1.086	0.87	3.976	1.80	0.007	0.004	Fine & coarse sand, monazite.
5	10	C1432	.85		.87	7.467	3.38	0.025	0.015	Coarse & fine sand, small wash, mon iron frags.
10	15	C1433	.85		.87	8.621	3.57	0.030	0.018	As Above.
15	20	C1434	.80		.87	14.900	0.71	0.010	0.006	As Above no iron.
20	25	C1435	.65		.87	8.735	0.92	0.008	0.005	As Above.
25	30	C1436	.60		.87	7.321	0.82	0.006	0.003	Clay mon & iron frags.
30	35	C1437	.40		.87	7.065	0.84	0.006	0.003	Coarse & fine sand, clay small wash, monazite.
35	40	C1438	.90		.87	8.674	4.43	0.038	0.022	Coarse & fine sand, small wash, mon, pyrite, iron fr
40	45	C1439	.80		.87	13.284	1.71	0.022	0.013	As Above with clay.
45	50	C1440	.85		.87	60.200	0.08	0.005	0.003	Coarse & fine sand, clay pyrite, monazite.
50	55	C1441	.80		.87	37.700	0.007	0.003	0.002	As above with iron frags
55	60	C1442	.40		.87	69.500	BLD	0.001	0.000	As Above.
60	65	C1443	1.85		1.48	182.800	BLD	0.001	0.000	Coarse & fine sand, small wash, pyrite.
65	70	C1444	1.20		0.96	67.900	0.11	0.007	0.004	As Above.
70	75	C1445	1.00		.87	38.2166	2.85	0.107	0.063	Coarse & fine sand, pyrit

Drillers reported basement at 146 ft.

Interval of tin bearing wash ft.

Overall value from surface to 147 ft. **0.091** lb Sn₂ / yard **0.054** kg/m³ (cassiterite 70% Sn)

AMDEX MINING LIMITED - PERCUSSION DRILL LOG

180019
610

AREA : **scotia** HOLE NO. : **s 2** COLLAR COORDINATES : SURFACE R.L. : BASEMENT R.L. :

Date: **11-8-78** Driller: Assistant: Sample Washer: Geologist: Cutting shoe diameter : **0.21"**
18-8-78 **A. Watson** **D. Nichols** **S. Moore** **N.G.P.** Casing diameter : **6"**

Section Feet		Sample No.	Recovered Volume (ft ³)	Theoretical Volume (ft ³)	Corrected Volume (ft ³)	Weight Concentration (gms)	Concentration Assay (Sn)	Value over Interval		Description of Sample
From	To						Sn ₂	lbs/cuyd	SnO ₂ kg/m ³	
75	80	C1446	1.25	1.086	1.00	41.513	0.18	0.006	0.004	Coarse & fine sand, py.
80	85	C1447	1.15		0.92	14.681	2.90	0.039	0.023	As Above with monazite.
85	90	C1448	.90		.87	30.449	0.47	0.014	0.008	As Above.
90	95	C1449	1.40		1.12	13.3365	13.80	0.140	0.083	Coarse & fine sand, small wash, monz, ilm, py.
95	100	C1450	1.50		1.20	24.934	20.63	0.365	0.216	Coarse & fine sand, small wash trace of fine tin, mon, py, ilm.
100	105	C1451	1.40		1.12	24.120	18.90	0.346	0.205	As Above, no tin mentioned
105	110	C1452	1.60		1.28	24.301	7.33	0.118	0.070	Coarse & fine sand, peat small wash, py, mon, il, iron frags.
110	115	C1453	.60		.87	19.097	0.94	0.018	0.010	Coarse & fine sand, small wash, py, mona.
115	120	C1454	1.70		1.36	24.320	3.46	0.053	0.031	As Above with ilmenite.
120	125	C1455	1.25		1.00	21.146	17.43	0.314	0.186	As Above.
125	130	C1456	1.10		0.88	12.679	18.14	0.222	0.132	As Above.
130	135	C1457	1.30		1.04	14.331	7.59	0.089	0.053	As Above with iron frags
135	140	C1458	1.75		1.40	22.616	19.50	0.268	0.159	Coarse & fine sand, peat big wash, mon, ilm, py, iron
140	145	C1459	1.35		1.08	18.2585	23.90	0.344	0.204	As Above no peat.
145	147	C1460	1.00	0.434	0.8	19.493	15.50	0.321	0.191	Fine sand wash, slate, mon py, ilm iron.

Drillers reported basement at 146 ft.

Interval of tin bearing wash ft.

Overall value from surface to 147 ft

0.091

lb SnO₂ / yard 0.054 (assumed 70% Sn)

AMDEX MINING LIMITED - PERCUSSION DRILL LOG

AREA: **Scotia** HOLE NO.: **S-3** COLLAR COORDINATES: SURFACE R.L.: BASEMENT R.L.:

Date: **25-8-78** Driller: **A. Watson** Assistant: **D. Nichols** Sample Washer: **S. Moore** Geologist: **N.G.P.** Cutting shoe diameter: **6.31"**
29-8-78

Section Feet		Sample No.	Recovered Volume (ft ³)	Theoretical Volume (ft ³)	Corrected Volume (ft ³)	Weight Concentrate (gms)	Concentrate Assay (Sn)	Value over Interval		Description of Sample
From	To							SnO ₂ lbs/cuyd		
0	5	C1461	0.35	1.086	0.87	9.2248	1.10	0.010	0.006	Fine sand iron stone clay mon, ilmenite, iron.
5	10	C1462	0.40		0.87	5.8921	0.42	0.002	0.001	Fine & Coarse sand, clay mon, ilm, iron.
10	15	C1463	0.50		0.87	6.7644	0.64	0.004	0.003	As Above.
15	20	C1464	0.50		0.87	4.3097	1.54	0.006	0.004	As Above.
20	25	C1465	0.25		0.87	10.6865	0.25	0.003	0.002	As Above.
25	30	C1466	0.30		0.87	12.5323	0.15	0.002	0.001	As Above.
30	35	C1467	0.80		0.87	5.7600	0.98	0.005	0.003	As Above.
35	40	C1468	0.55		0.87	11.0532	0.71	0.008	0.005	Coarse & fine sand, clay, peat, py, mon, iron.
40	45	C1469	0.95		0.87	29.6778	0.38	0.011	0.007	As Above.
45	50	C1470	1.20		0.96	35.2509	0.21	0.007	0.004	Coarse & fine sand clay, py.
50	55	C1471	0.95		0.87	56.6756	BLD	0.000	0.000	As Above with mon & iron.
55	60	C1472	0.65		0.87	50.4632	BLD	0.000	0.000	As Above.
60	65	C1473	0.80		0.87	41.1151	0.10	0.004	0.002	Coarse & fine sand, py, mon, iron.
65	70	C1474	1.00		0.87	51.5903	0.43	0.022	0.013	Coarse & fine sand, pyr.
70	75	C1475	1.15		0.92	33.8906	0.15	0.005	0.003	Coarse & fine sand, clay, peat, py.

Drillers reported basement at _____ ft.

Interval of tin bearing wash _____ ft.

Overall value from surface to **100** ft **0.010** lb SnO₂ / yard **0.006** (cassiterite 70% Sn)

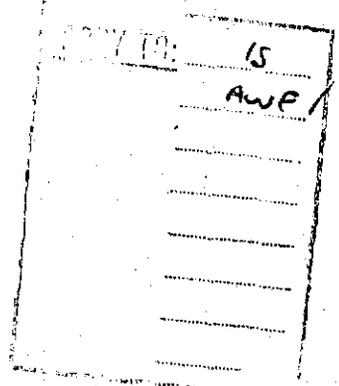
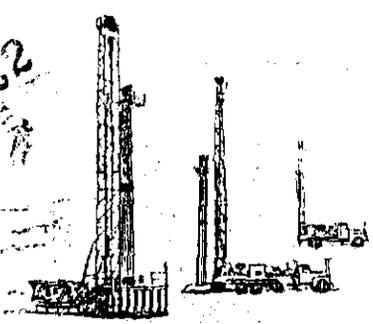
APPENDIX 2

Copies of Correspondence and Literature
on Alternative Methods of Drilling to the
Cable Tool Percussion Technique

180023

W. L. SIDES & SON PTY. LTD.
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES:
SIDESON, CLAYTON, VICTORIA



022

VJS/PM

30th. January, 1979

Amdex Mining Ltd.,
P.O. Box 147,
NORTH SYDNEY 2060.

Attention Mr. Adrian Fleming
Senior Geologist

Dear Sirs,

Re: Test Drilling - N.E. Tasmania

Thank you for your letter of 8th. January 1979 and we also refer to our telephone conversation with you recently regarding the proposal for test drilling in N.E. Tasmania.

We are making up large diameter dual pipe as suggested in our letter of 30th. October 1978 except that the outer pipe will now be 6.5/8" diameter and the inner pipe will be slightly over 4" inside diameter permitting rocks or solids to 4" diameter to pass up the inner pipe to the surface.

This big dual pipe will be used on a job we have for another client and will be more expensive than when using our regular dual pipe, but, as against that, it will produce bigger volume samples.

Nevertheless, as we said in our last letter of 12th. December 1978, we believe, on your leases, our regular dual pipe will work and will work well, based on our previous experience.

This dual pipe has 4.1/2" o.d. and the inner tube is 2.1/4" diameter which will permit solids of 2" diameter to be brought to the surface. As previously agreed, if we come up against the odd boulder we would use rock roller bits to drill our way through.

We would be agreeable to work on an hourly basis until you can see what sort of results you are getting. I said today that we would not necessarily fix a minimum time but we would reckon it would be difficult for you to judge results on anything less than a weeks drilling.

Our normal working day is 12 hours but this can be reduced to 10 hours if it suits you better. We would want to work 6 days per week.

We expect to be able to work at a speed per hour which will make it profitable for you to continue but after we have drilled two or three bores we can summarise the time taken and maybe set a footage rate if this is what you want in the event you decide to carry on with a test drilling programme.

.../2

023
Amdex Mining Ltd.,
Re: Test Drilling - N.E. Tasmania

180024

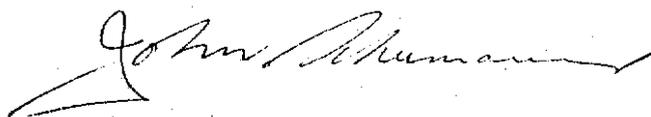
On the attached sheet we have summarised the new proposal, bringing in the hourly rates.

We have had another look at the likely costs for getting equipment and crew established in site at Gladstone and have made some revisions as shown on attached sheet.

While you advised you would probably not be ready to start drilling until April we are in a position to start in February or March - subject of course to the number of other orders we receive between now and when you give us instructions to proceed. We remind you also that April may be getting a bit too close to the wet season.

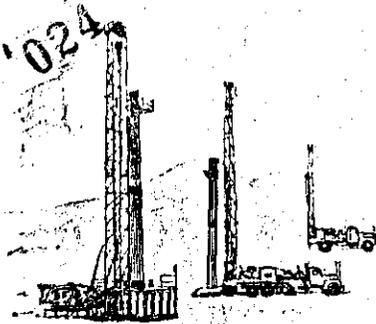
We will be very pleased to do this work for you. The dual pipe system of sampling has proved to be good and we feel that you will be happy with the results.

Yours faithfully,
W.L. SIDES & SON PTY. LTD.



JOHN SCHUMANN
GENERAL MANAGER

Encl:



180025

TELEPHONES:
5608650-5608433
560 8733

W. L. SIDES & SON PTY. LTD.
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES:
SIDESON, CLAYTON, VICTORIA

VJS/PM

30th. January, 1979

Ardex Mining Ltd.,
P.O. Box 147,
NORTH SYDNEY 2060.

QUOTATION FOR DUAL PIPE TEST DRILLING IN N.E. TASMANIA

Equipment

It is proposed to use a "Foxmobile" or "Failing" Rotary Rig.

Along with the rig we will supply a Bedford 4 x 4 service truck to transport the dual pipe and other equipment and also cart water for drilling.

200 ft. of 4.1/2" x 2.1/8" dual pipe

All necessary subs. handling gear and a supply of rig and motor spares

A Toyota or other utility for transporting the crew

Crew

We will provide a crew of three (3)

The Quotation is as follows:-

1. Establishment
Taking shipping freight into account -
Melbourne to Devonport, plus transport
from Devonport to Gladstone and air fares
for crew, establishment cost is estimated at \$2,879.00

Copies of shipping accounts and other expenses would be presented to you for verification after arrival of equipment on site - see attached sheet for details of estimate

2. Dual Pipe Drilling - on hourly basis
Having regard for working a minimum of 10 hours per day all operations from when we arrive on the drilling site will be regarded as operating time including:-

- (a) Setting up to drill
- (b) Providing water storage and water for drilling
- (c) Drilling, including running in and out of the hole to change bits or seals
- (d) Installing surface casing if necessary
- (e) Moving rig and equipment from one site to another

Operating Time is chargeable at \$78.50/hour

180026

025 Amdex Mining Ltd.,
Quotation for Dual Pipe Test Drilling in N.E. Tasmania

3. Standby Time
This will cover:-

- (a) Time lost for rig and crew if held up because of access to site, including bogging time
- (b) Time lost waiting on instructions from Amdex Geologist
- (c) Time lost if unable to work because of weather conditions
- (d) Contractor accepts responsibility for major mechanical breakdowns but normal servicing of rig and equipment is to be included in standby time

Standby Time is chargeable at

\$65.00/hour

4. Treatment of Samples

As it is intended to do only a small amount of drilling in the first instance, samples could be collected in a trough, but if an extensive programme is undertaken consideration should be given to using one or two sluice boxes for treatment of the sample material and trapping of the tin.

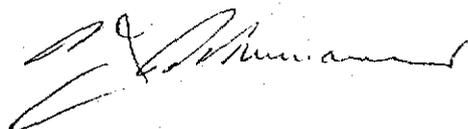
5. Accommodation

We are reckoning on our crew being able to stop at hotels within short distances of where we will be working, but according to location there could be instances where we have to do considerable travelling between rig and the hotel which involves cost for time and travel. While we will absorb the travelling cost, we would require you to pay actual hotel accommodation charges.

6. Disestablishment

This is estimated to be the same as for establishment - approximately \$2,879.00 with documents to be submitted for verification.

Yours faithfully,
W.L. SIDES & SON PTY. LTD.



V. J. SCHUMANN
GENERAL MANAGER

026

180027

JS/PM
30th. January, 1979

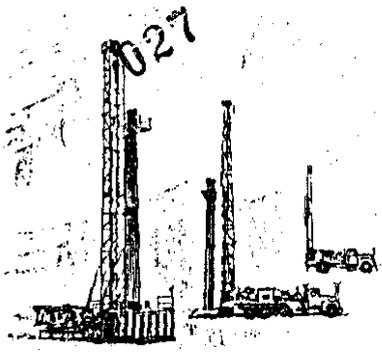
Information for:-

AMDEX MINING LTD.,
P.O. BOX 147,
NORTH SYDNEY 2060.

Estimate of cost for establishing Drilling Equipment & Crew at Gladstone, Tas.

- | | | | |
|----|--|---------------|----------------------------------|
| 1. | Preparing equipment and taking to wharf
(actual cost will be more but we will charge a nominal amount) | | \$250.00 |
| 2. | Australian National Line has quoted the following freight for shipment from Melbourne to Devonport | | |
| | Drilling Rig | \$1,121.86 | |
| | Bedford Truck | 642.07 | |
| | Toyota | <u>193.15</u> | \$1,957.08 |
| 3. | Air Fares for three (3) men - Melbourne to Devonport @ \$44.10 each plus taxis = \$25 | 157.30 | |
| | Wages for 3 men, including overheads such as workers compensation, pay roll tax etc., from Clayton to Devonport and waiting in Devonport for delivery of rig and equipment ex ship - say 7.00am - 11.00am i.e. 4 hours | <u>122.12</u> | \$279.42 |
| | | | <i>\$31/hour : \$10/hour/man</i> |
| 4. | Transporting equipment from Devonport to Gladstone - approx. 135 km - estimate 5 hours at work time rate of \$78.50 per hour | | <u>\$392.50</u> |
| | <u>Estimated Total Cost including Transport to Gladstone</u> | | <u>\$2,879.00</u> |

AK



TELEPHONE
560 8651-560 8633
560 8723

180028

W. L. SIDES & SON PTY. LTD.

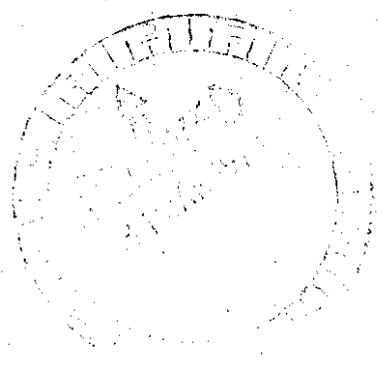
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES :
SIDESON, CLAYTON, VICTORIA

VJS/PM

25th. January, 1979

Amdex Mining Ltd.,
P.O. Box 147,
NORTH SYDNEY 2060.



DATE	15
AWF	/

Attention Mr. Adrian Fleming
Senior Geologist

Dear Sir,

Re: Test Drilling - Kings Plains, Queensland

We refer to our telephone conversation with you yesterday in which you advised that you are partners with the French company named Serum in the proposed mining project at Kings Plains.

We would be very interested in any proposal you may have for doing further test drilling in this area because we have carried out a considerable amount of work in the area as the following history will disclose.

In 1966 and again in 1967 we drilled for Eastern Prospectors

We commenced drilling in June 1966 with a "Failing" 750 rotary drill rig (R26) drilling 4.3/4" diameter holes and all cuttings were put through a desander alongside the rig. This rig drilled through to November 1966, then shut down for the "wet".

A second "Failing" 750 rotary rig was brought on to the Kings Plains area in May 1967. This was Rig R21, and it was also equipped with its own desander.

Both of these rigs worked through from May 1967 to December 1967. We drilled a lot of holes with these two "Failing" 750 rotary rigs. The holes ranged in depth from 50 ft. to 175 ft. Many holes exceeded 100 ft.

In July 1967 we brought in a percussion cable tool rig which was used to drill 6" diameter holes. The 6" casing was driven ahead of the bit so as to trap the strata and the samples were then extracted from within the casing by means of an earth socket or drive pump.

With this rig we drilled a lot of shallow holes in the depth range of 12 ft. to 20 ft. but we also drilled deeper holes in the range of 60 ft. to 140 ft. depending on locality within the Kings Plains area.

As you will see the cable tool rig was working in the area at the same time as the "Failing" rotary rigs.

He mentioned in phone conversation 24.1.79 .../2 that early ... rotary and percussion drilling for oil, minerals, water foundations important role in above program

180029

Amdex Mining Ltd.,

Re: Test Drilling - Kings Plains, QueenslandIn 1971 we again drilled at Kings Plains this time for Endeavour Oil Company

We drilled for 3 months from June to September 1971 and this was large diameter drilling using a "Calweld" Model 200B rotary rig.

Holes were drilled to various depths with a maximum of 145 ft.

We had some 20" diameter steel casing specially made and screwed in 10 ft. lengths for easy handling. On the bottom of the casing we used a Calyx bit and the rig rotated the casing into the ground to trap a big volume of strata. Then, with an 18" diameter Calweld type bucket we extracted the samples from within the 20" casing.

So you will see we used three different methods of sampling:-

- (a) Small hole rotary
- (b) Percussion cable tool drilling using 6" casing
- (c) Large hole rotary - using 20" casing

You advised that some cable tool drilling carried out recently confirmed the results obtained by us with the small hole rotary drilling.

We believe that the regular rotary system of test drilling - which we are constantly doing in various parts of Australia - is very good but we think that the dual pipe system is even more reliable in obtaining samples free from contamination.

Since we drilled at Kings Plains we introduced dual pipe testing into our various systems and would certainly have used this method if we had it then.

Everything the bit drills comes up the inner tube of the dual pipe and anything of interest can be analysed at the surface with accurate knowledge of depth from where the strata comes.

If you decide we can be of service to you with some further test drilling we would appreciate information regarding the programme you have in mind - perhaps the number of holes you would drill or the duration of the testing and we will quote you for a dual pipe testing programme which we feel sure will give you maximum results.

We are enclosing one of our brochures also an article regarding dual pipe drilling carried out by us in the Oaklands Basin for the N.S.W. Department of Mines.

You may like to hand these to the Manager of Serum for his information.

Kind regards,

Yours sincerely,
W.L. SIDES & SON PTY. LTD.



JOHN SCHUMANN
GENERAL MANAGER

Encl:

029



AMDEX MINING LIMITED

169 MILLER STREET NORTH SYDNEY N.S.W. AUSTRALIA
TELEPHONE: 922 6299 TELEX: AA22316 CABLES: SHULMINE
P.O. BOX 147 NORTH SYDNEY N.S.W. AUSTRALIA 2060

8th January, 1979

W.L. Sides & Son Pty. Ltd.,
P.O. Box 228,
CLAYTON. Vic. 3168

Attention: Mr. V.J. Schumann and
Mr. J. McLean

Dear Sirs,

Re: Drilling - North-East Tasmania

In reply to your letter of 12th December, 1978 and further to my telephone conversation of 4th January, 1979 with John McLean.

I believe your standard reverse circulation drilling equipment should work in North-East Tasmania. If the reverse circulation drilling system does work successfully, I can envisage our utilising it very extensively. Layers of coarse wash, which tend to occur in the lower part of the section can, presumably, be readily penetrated using a rock roller bit. Most of the alluvial material is less than 2½" diameter so should not be difficult to drill. We cannot be certain, however, that the system will work until we try it.

I would like to see your equipment working at our Pioneer Mine this summer, but our present budget does not permit us to enter into a contract for 305 metres at \$32.82 per metre plus other costs when we are uncertain of whether the equipment will work. The two cable tool percussion rigs that we own and operate currently drill for \$17.00 per metre all up on site cost.

Would you consider an alternative costing for a test drilling program which could conceivably start shortly. An arrangement whereby your costs are covered and we are not committed to a specific meterage contract would, I

feel, be more satisfactory. John McLean suggested several possibilities:

- an hourly or daily rate
- a meterage rate which both parties would review, once the program was successfully underway, and which could be reduced to a rate based on your costs plus 10%.

I would be grateful if you could give this proposal you earnest consideration and communicate with me again in the near future.

Yours sincerely,

R. McNeil

for

Adrian Fleming.

Senior Geologist
AMDEX MINING LIMITED.

/rm

C.C.: S. Everett,
Pioneer Mine,
PIONEER. Tas.

031

180032

Sides NE Tas drilling

driller + 2 assistants

Drill 4x4 truck Toyota
drilling \$32.80/m, min 304m

mob. & demob \$4800

moving time \$65.00/hr

Water carting \$15.00/hr

Standby \$65.00/hr

accommodation at cost

Total say \$20,000

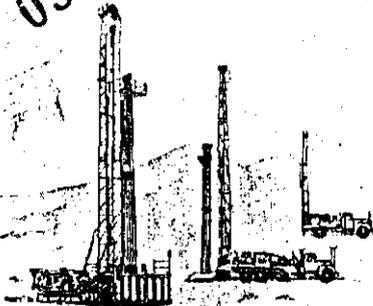
Trial run

after 2 mos ? time
reduce ~~cost~~ price

Both parties
review after one month
and reduce rate to
cost + 10%

hourly or daily rate

032



TELEPHONES:
560865-5608433
5608713

180033

W. L. SIDES & SON PTY. LTD.
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES:
SIDESON, CLAYTON, VICTORIA

VJS/PM

12th. December, 1978

Amdex Mining Ltd.,
P.O. Box 147,
NORTH SYDNEY,
NEW SOUTH WALES 2060.

Attention Mr. Adrian Fleming
Senior Geologist

COPY TO:	IS
	AWF

Dear Sir,

Subject: Proposed Test Drilling - North East Tasmania

Thank you for your letter of 21st. November 1978 which arrived in this office on 23rd. November 1978.

I have been away on leave and your letter was held for my return to the office.

It was interesting to note that in all the areas you have drilled to date you have not encountered basalt boulders, but a significant proportion of coarser gravels consists of quartz pebbles.

It would appear that the regular size dual pipe may well suit your test drilling programme.

This dual pipe consists of a 4.1/2" outside diameter pipe with an inner pipe which will provide 2.1/4" diameter samples.

As you have suggested - if we do come up against a boulder we could use rock roller bits to drill our way through.

We do not believe we could drill any faster with our regular size dual pipe than we would with the larger dual pipe we had proposed to make up but, while we cannot guarantee any set rate of drilling, we would be aiming at a progress rate of 10 ft. per hour which I feel sure will be a good deal faster than could be achieved with a percussion cable tool rig.

As there will be cost savings to us by using our regular dual pipe we find we would be able to reduce the price to you from \$12 per ft. to \$10. per ft.

The cost of rock roller bits will be included in this price per ft. - on the understanding that there will not be excessive use.

.../2

033
Amdex Mining Ltd.,

Subject: Proposed Test Drilling - North East Tasmania

If there is an area where we encounter a lot of rock drilling which involves extensive use of rock roller bits we would expect compensation for bit use.

We suggest that 1,000 ft. of drilling should be the minimum but if you are well satisfied with this method of test drilling we have no doubt you will want to put down some more bores.

It is proposed to use the Failing CFD1 rotary rig as set out in our letter of 30th. October 1978 and our Quotation remains the same in respect of the items quoted, excepting that the dual pipe drilling charge is reduced from \$12.00 per ft. to \$10.00 per ft.

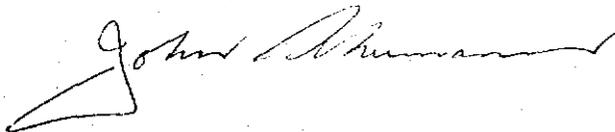
I feel sure that taking speed of operation into account plus the good recovery which can be expected from the dual pipe operation, you will find this an economical and efficient method of test drilling.

Your instructions to proceed will receive our best attention.

In view of Christmas being so close at hand, we suggest a start as soon as possible in January, but will await your advice.

Kindest regards and best wishes for Christmas and the New Year.

Yours sincerely,
W.L. SIDES & SON PTY. LTD.



JOHN SCHUMANN
GENERAL MANAGER

034

180035

414014

21st November, 1978

Mr. V.J. Schumann,
W.L. Sides & Son Pty. Ltd.,
P.O. Box 228,
CLAYTON. Vic. 3168

Dear Sir,

With respect to your letter of 30th October, 1978 concerning test drilling on our properties in North-East Tasmania. I have discussed your proposals with our Pioneer Mine Manager, Mr. Steven Everett. At the present time we are not in a position to consider embarking upon a program of 3,000 feet of drilling. We are, however, interested in the utilisation of reverse circulation drilling equipment in the North-East of Tasmania, as I feel the method may be quicker and more efficient than the two Cable Tool Percussion rigs that we are presently using.

Our discussions to date, and your quotation, includes the cost of fabricating dual pipe with an internal diameter of five inches. I am wondering if you would be good enough to quote on drilling in this area using the reverse circulation equipment that is currently in use by your Company in Victoria. I would think that if we can avoid fabrication of new larger diameter dual pipe, that the cost per foot of drilling would perhaps be less. My reason for suggesting large diameter dual pipe is to overcome problems that I expect may occur in coarse alluvial wash that exists in certain horizons of the Tertiary gravels within our area. It may be possible, however, to use the existing reverse circulation equipment that you have and using a roller bit. You mention the possibility of basalt boulders, that this may cause some problems. In all the areas that we have drilled to date we have not encountered basalt boulders, although a significant proportion of the coarser gravels consists of quartz pebbles.

Thank you once again for your consideration, and I look forward to hearing from you in due course.

Yours faithfully,

Adrian Fleming.
Senior Geologist
AMDEX MINING LIMITED.

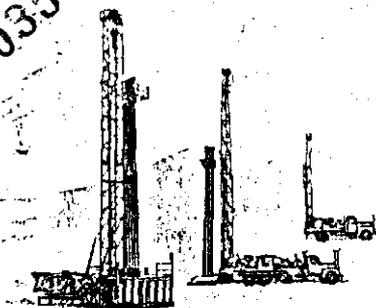
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414014

180036

W. L. SIDES & SON PTY. LTD.
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES:
SIDESON, CLAYTON, VICTORIA



VJS/PM

30th. October, 1978

Amdex Mining Limited,
119 York Street,
SYDNEY 2000.

Attention Mr. Adrian Fleming

Dear Sirs,

Re: Proposed Test Drilling - North East Tasmania

We refer to our several conversations with you and also Mr. Leon McDonald regarding the above Project.

As we told you we are prepared to make up some large diameter dual pipe and while size is not definite we are considering using tube of 7.5/8" outside diameter as the outer tube with 5 inch diameter for the inner tube. This will give a volume of 5 inch diameter samples of the softer alluvial materials and also permit gravel or stones up to 5 inch diameter to be discharged through the inner tube.

With dual pipe drilling almost 100% of the material drilled is recovered through the inner tube for discharge at the surface. You have our brochure which describes dual pipe drilling.

We could use a varied number of our rotary rigs to operate this big dual pipe, but at this stage we propose to use a "Failing" Model CFD1 truck mounted rotary rig which will have ample capacity for the job.

Along with the rig we will need to supply a Bedford 4 x 4 truck as a service vehicle to transport the dual pipe and other drilling equipment and also cart water for drilling.

We may equip the rig with hydraulic jacks to jack up the dual pipe if and when necessary or alternatively we will provide a trailer mounted set of jacks.

A Toyota or other utility will be used by the crew for moving from base to the rig.

We plan on providing a driller with two (2) assistants and a supervisor to get the job started.

.../2

036
Amdex Mining Limited

Re: Proposed Test Drilling - North East Tasmania

180037

We would want you to pick out accessible areas in which we could transport and operate our drilling equipment and this of course is very necessary as we could not use this type of drilling rig in the swampy places.

You have said that you anticipate maximum depth of the bores will be 175 ft. and we would make provision for sufficient dual pipe to do this.

Regarding basalt or basalt boulders which could be encountered there is of course a certain amount of risk that we will strike a big boulder or thick layer of basalt and it is not possible to give a guarantee that we will drill through such an obstruction, but using rock roller bits gives us a very good chance of doing so.

As mentioned before rocks up to 5 inch diameter would come up the inner pipe. Also it is likely that somewhat larger rocks would be pushed aside by the drill bit.

We are hopeful that you would consider a programme of 3,000 ft. of test drilling and that would make it worthwhile for us to make up the big dual pipe and other special equipment needed for this operation.

Our Quotation is as set down hereunder:-

1. Establishment

Taking shipping freight into account -
 Melbourne to Bell Bay, plus transport
 from Bell Bay to Gladstone, the
 establishment cost is estimated at - \$2,400.00

Copies of shipping accounts and other
 expenses would be presented to you for
 verification after arrival of equipemnt
 on site.

2. For all Dual Pipe Drilling based on
 estimated 3,000 ft. of drilling,
 we propose to charge -

\$12.00/ft.

3. Moving Time from one bore site to
 another - some of the holes may
 only be a short distance apart, but
 others will involve a move from one
 area to another and we will need
 reimbursement. It is proposed to
 charge you for all site moves, i.e.
 moves between each bore including
 rigging down and rigging up - on
 an hourly basis of -

\$65.00/hr.

4. Treatment of Samples

We suggest that in view of the big
 volume of material which will be
 coming through from the dual pipe
 it would be advisable to arrange
 for a couple of sluice boxes (maybe
 for alternate use) for treatment of
 the sample material and trapping of
 the tin.

037
Amdex Mining Limited

Re: Proposed Test Drilling - North East Tasmania

5. Accommodation

We are reckoning on our crew being able to stop at hotels within short distance of where we will be working, but according to location there could be instances where we have to do considerable travelling between rig and the hotel which involves considerable cost for time and travel. While we will absorb the travelling cost we think it reasonable to ask you to pay actual hotel accommodation charges.

6. Carting Water for Drilling

There will be no charge for carting water if we can get water within 2 miles of the drill site, but otherwise hire for the water tanker will be at a rate of - \$15.00/hr.

It is anticipated that we may be able to get water from swamps or other surface supplies and we will provide a pump and hoses to discharge the water into the tanker.

7. Standby Time

If our rig and crew are held up because of access to drill sites, or waiting for instructions from your Geologist or Superintendent, such standby time is chargeable at - \$65.00/hr.

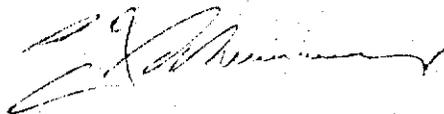
8. Disestablishment

This is estimated to be the same as for establishment - approximately \$2,400 with documents to be submitted for verification.

We trust we have set this proposal out to your satisfaction but will be happy to give you further information if requested to do so.

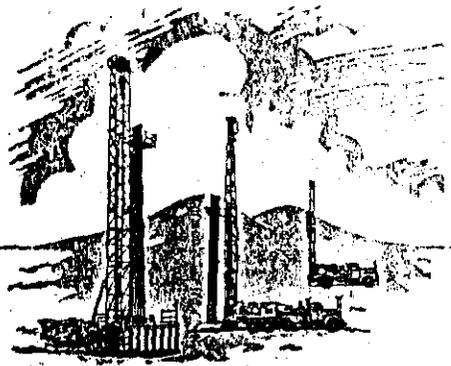
We feel you will get very satisfactory results if you decide on the dual pipe testing and are looking forward to receiving your instructions to prepare the equipment.

Yours faithfully,
W.L. SIDES & SON PTY. LTD.



V.J. SCHUMANN
GENERAL MANAGER

038



180039

TELEPHONES
5608655-5608433
560 8733

W. L. SIDES & SON PTY. LTD.
DRILLING CONTRACTORS

REG. OFFICE: 168-188 WELLINGTON RD., CLAYTON, VICTORIA, 3168
P.O. BOX 228, CLAYTON, 3168
TELEGRAMS AND CABLES :
SIDESON, CLAYTON, VICTORIA

11th. September, 1978

Amdex Mining,
P.O. Box Q162,
SYDNEY,
NEW SOUTH WALES 2001.

Attention Mr. Adrian Fleming

COPY TO:	IS
	AWF (attached)
	SE

Dear Adrian,

Thank you for your telephone call today regarding your proposed drilling in the Pioneer area of Tasmania.

As you know we are quite familiar with the area having drilled there for various clients over the years.

I am enclosing an article from the N.S.W. Geological Survey on dual pipe reverse circulation drilling.

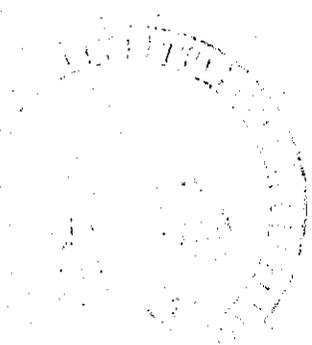
It may be necessary to use larger diameter dual pipe than what is discussed in this article, however the principal is exactly the same.

We would be very happy to talk to you when next you are coming through Melbourne. If you care to give me a call, I can meet you at the airport and bring you to our depot.

Regards,

Yours sincerely,
W.L. SIDES & SON PTY. LTD.

JOHN A. McLEAN
SALES MANAGER

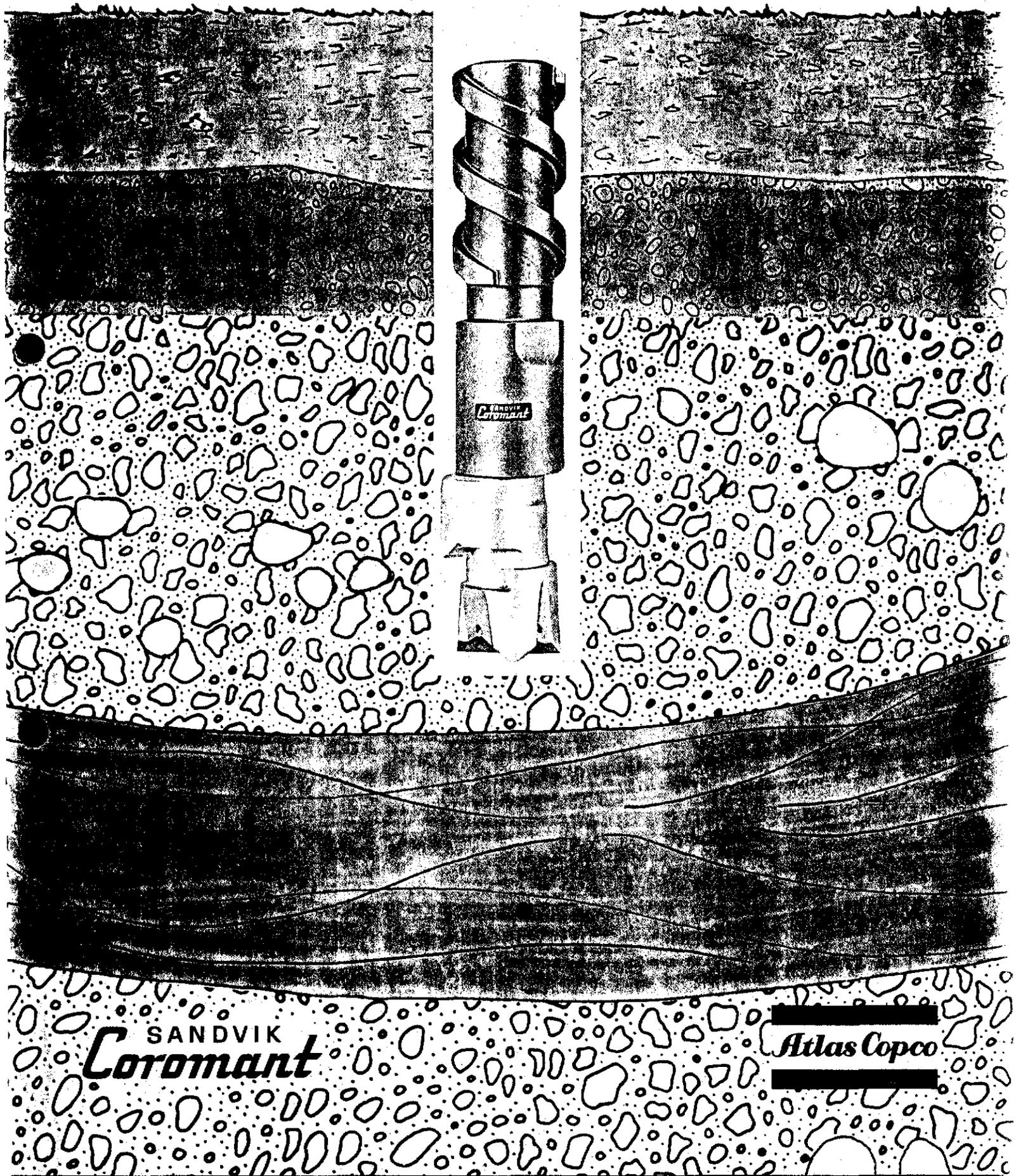


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ODEX

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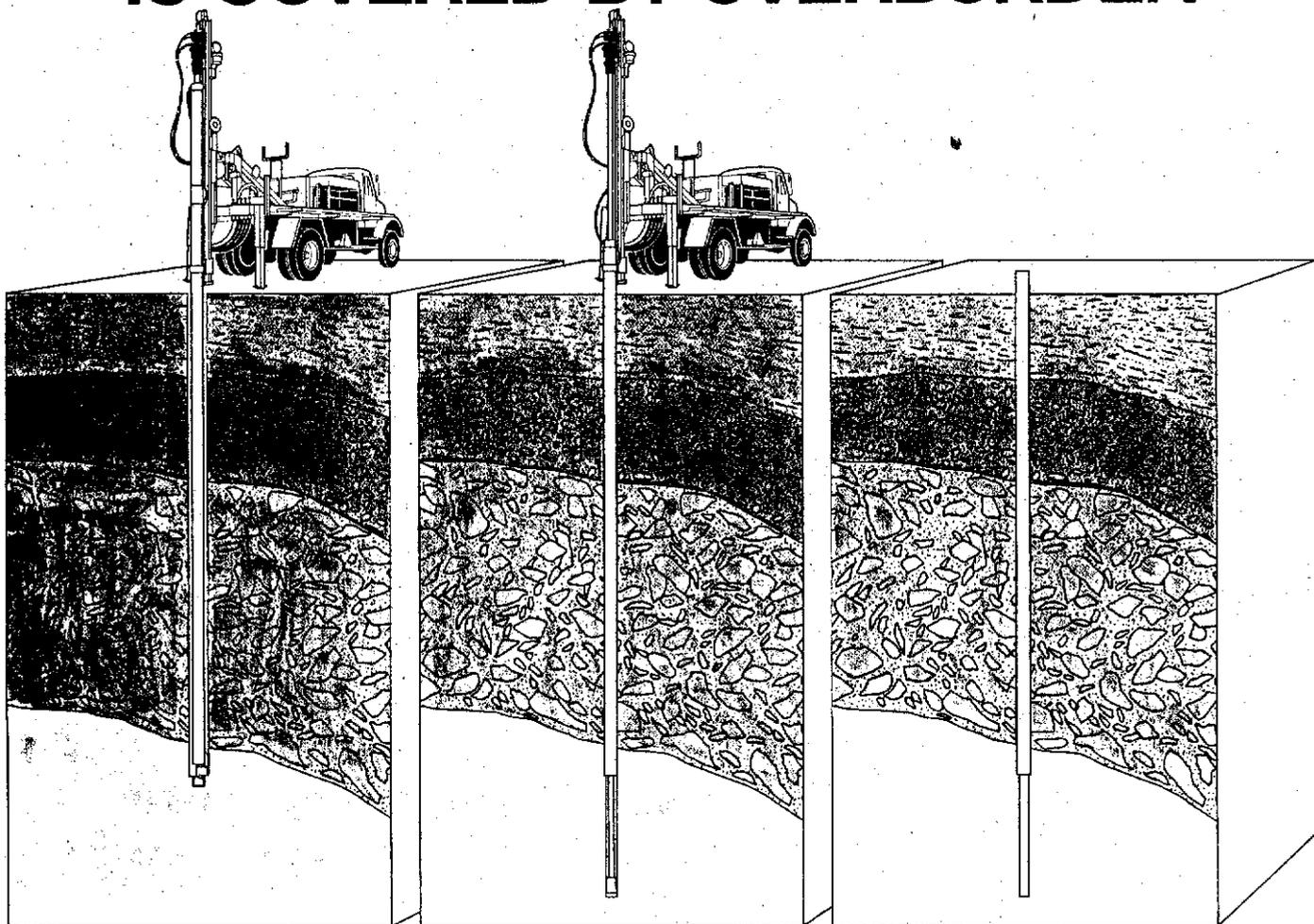
The method that makes it technically
and economically feasible to drill deep holes through overburden.
Developed by Atlas Copco and Sandvik



SANDVIK
Coromant

Atlas Copco

95% OF THE EARTH'S LAND SURFACE IS COVERED BY OVERBURDEN



The ODEX principle: overburden drilling to solid rock. The casing tubes follow without rotation.

Rock drilling continues with conventional equipment.

The tubes are left in place to stabilize the hole walls.

Drilling through overburden is often necessary, despite the fact that it is perhaps the most difficult type of drilling there is.

One of the problems is that you have to pass through several different types of formation in drilling a single hole. Another problem is that the hole walls are often unstable. In certain cases this makes drilling by ordinary methods impossible.

In ODEX you have the method and equipment to tackle deep, lined holes under the most difficult conditions. Now it is possible to complete overburden drilling operations which were previously accompanied by great problems — where expensive methods such as diamond drilling, driving down tubes combined with blasting or stripping the overburden down to bedrock were the only alternatives.

ODEX is designed for difficult overburden drilling

ODEX is a new method for overburden drilling which has been developed by Atlas Copco and Sandvik in collaboration. The method is based on a drill bit with an eccentric reamer, which drills a hole larger than the outer diameter of the casing tubes.

You can drill deeper

In drilling with casing tubes which rotate, the friction between the tubes and the hole walls sets a limit to the depth which you can reach. Normally about 25 m (80 ft) is the maximum depth with a 127 mm (5") drill bit.

ODEX can drill lined holes as deep as is required, 50, 75, 100 m (165, 245, 330 ft) or more depending on local conditions.

Cheaper casing tubes can be used

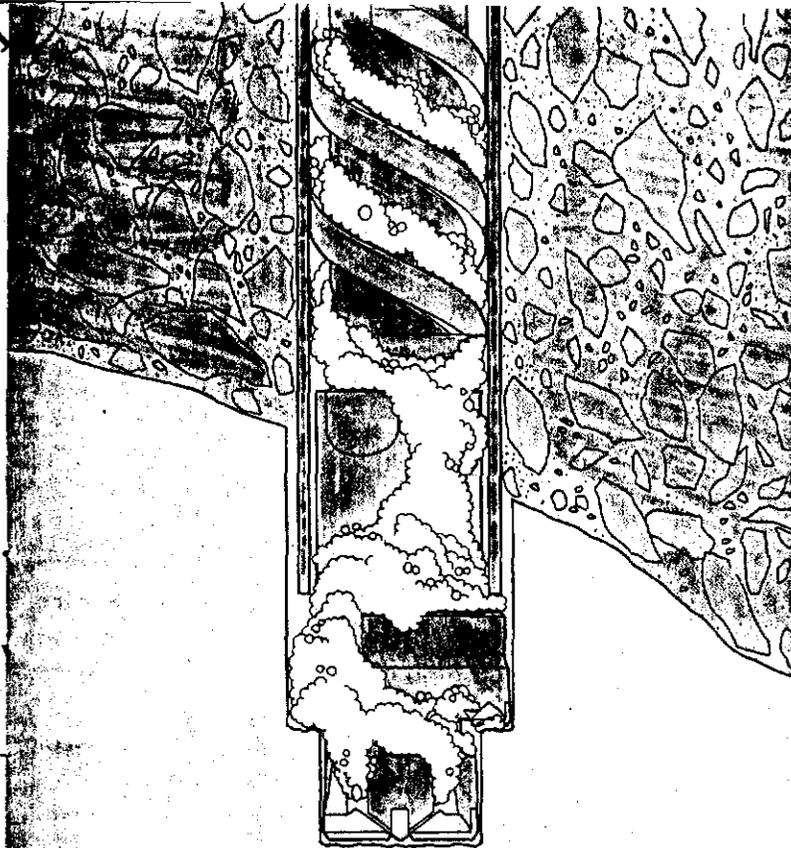
When the casing tubes are to be left in place, non-machined steel tubes can be used, welded together. The only requirement for the casing tubes is that they are of the correct size and of a grade suitable for welding. The dimensions of the drilling equipment are matched to international tube standards in order to facilitate acquisition.

Some typical applications for the ODEX method

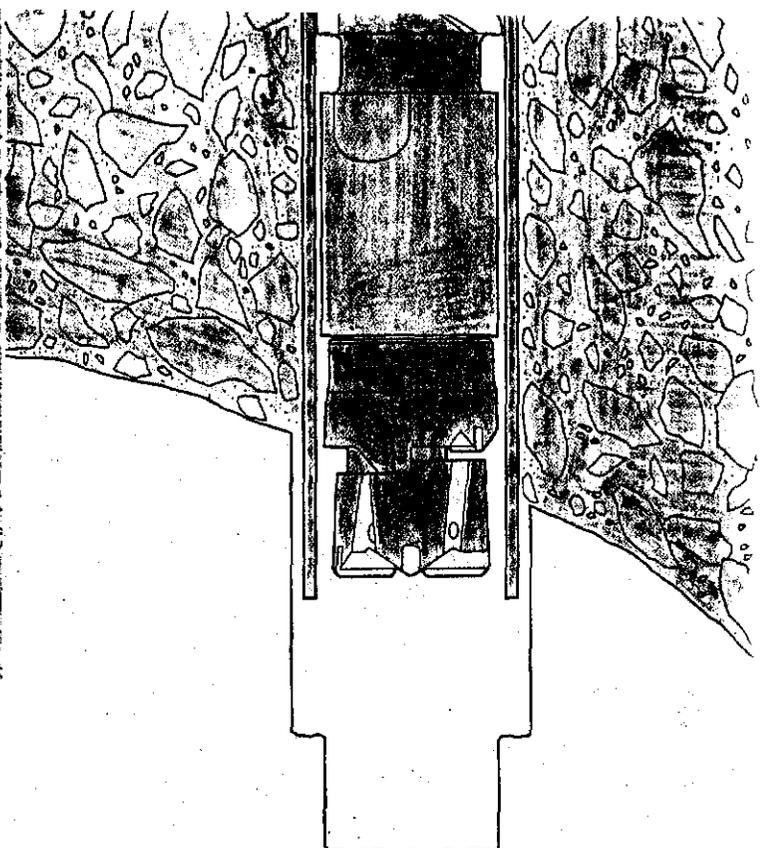
Drilling holes in civil engineering operations, for example
 anchoring
 grouting
 pipe and cable-laying through highway and railway embankments
 drilling blast holes without soil removal
 water wells

Prospecting, for example
 holes which will be continued with diamond drilling
 cuttings sampling
 soil sampling
 investigation of the thickness of the overburden
 investigation of the ground water table

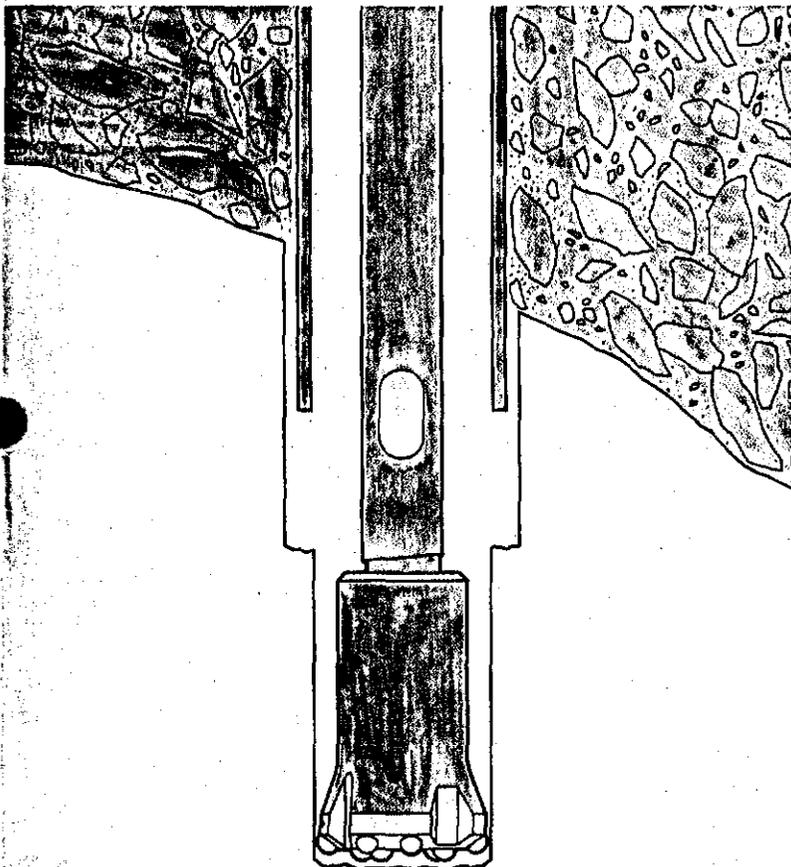
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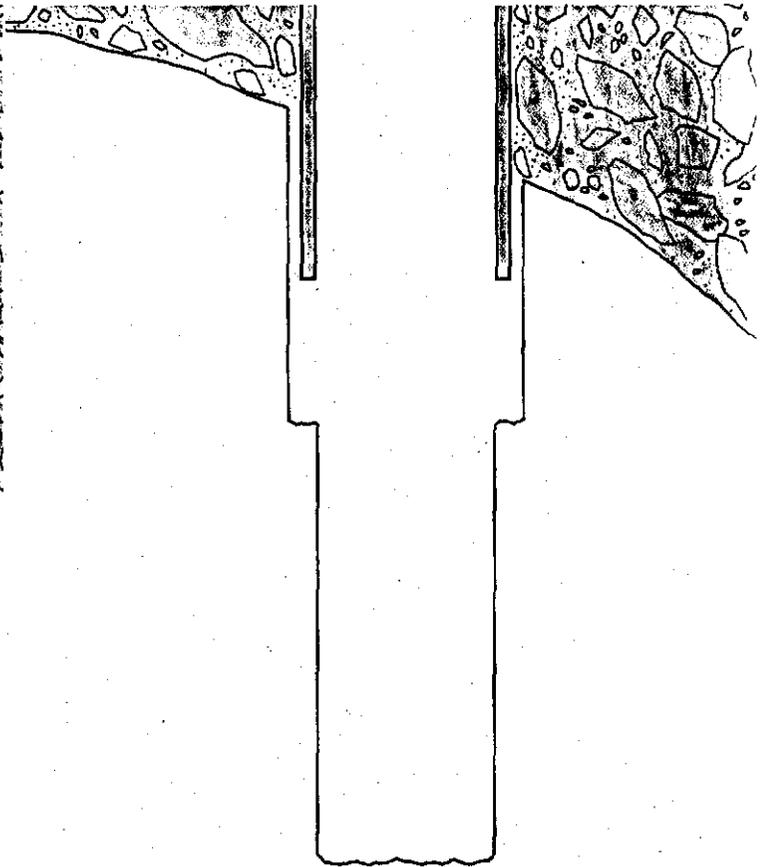
1. ODEX equipment at work. The pilot bit drills at the bottom of the hole. When rotation begins, the reamer swings out automatically and reams up the hole so that the casing tubes can slide down. The cuttings are transported upwards by means of foam flushing inside the casing tubes.



2. When drilling is completed, the drill bit is rotated in the other direction, so that the reamer is felled in. With the reamer in this position the drilling equipment can easily be withdrawn through the casing tubes.



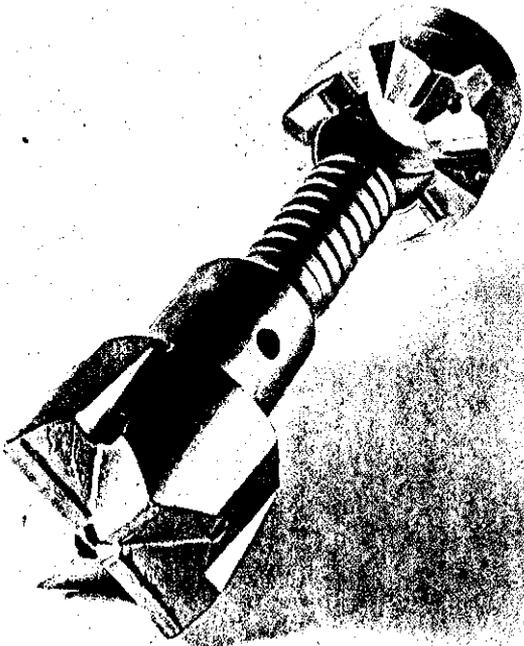
3. If the ODEX hole has been drilled into solid rock, drilling can continue there with standard equipment through the casing tubes.



4. The casing tubes are left in place in the hole to stabilize the walls.

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INGENIOUS ODEX



Pilot bit with eccentric reamer for ODEX 76.

The ODEX bit is truly ingenious.

This simple but reliable design has the answer to most overburden drilling problems.

With ODEX drilling you can, for example, put down water wells where they will give the most water, not just where they are easiest to drill.

ODEX equipment can drill in anything. From the most non-consolidated soil stratum to homogeneous rock. Stones and boulders are easily passed.

Rugged, reliable design

The ODEX bit consists of three parts: pilot bit, reamer and guide.

The pilot bit is machined in a single piece and carries four cemented carbide cutting inserts.

The reamer has two cemented carbide inserts. The eccentrically placed hole permits the reamer to be felled out or in depending on the direction in which the equipment is rotated. Stop lugs hold the reamer in the correct position.

The flushing channels in the column between the reamer and pilot bit assure that the flushing agent keeps this area clean and that felling out and in occur smoothly. This and the rugged design eliminate the risk of the reamer getting stuck in the felled out position.

Guide to screen cuttings

Flushing and cuttings removal are critical points in overburden drilling. The cuttings must be finely ground for the flushing agent to be able to lift them to the surface.

For this reason the guide on ODEX bits is designed to screen the cuttings in the column in the casing tube. Only the smallest cuttings particles are allowed to pass. The remainder is forced back to be recrushed or is pressed out into the hole walls.

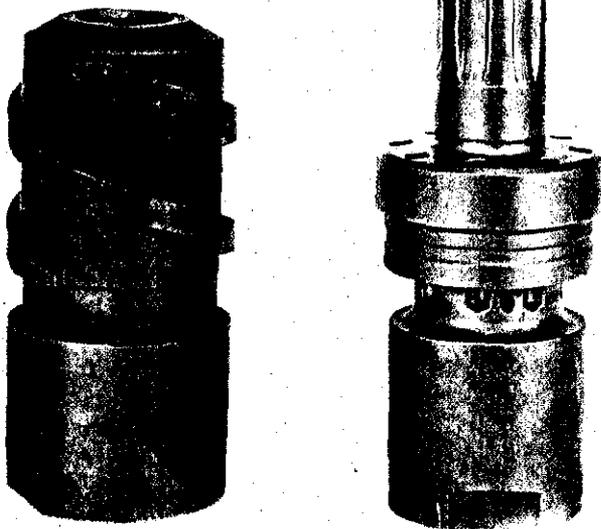
Effective ODEX drilling requires effective flushing

That's why we recommend foam flushing, which has proven the most effective means to remove cuttings.

The foam disintegrates the cuttings and lifts them. It lubricates and seals the hole walls. It makes it possible to drill deeper than with just air or water flushing and it reduces the risk of getting stuck. It also reduces wear on the equipment.

The casing tubes slide more easily down into the hole. The flushing effect is not lost when the drilling equipment passes through cavities or fissured rock.

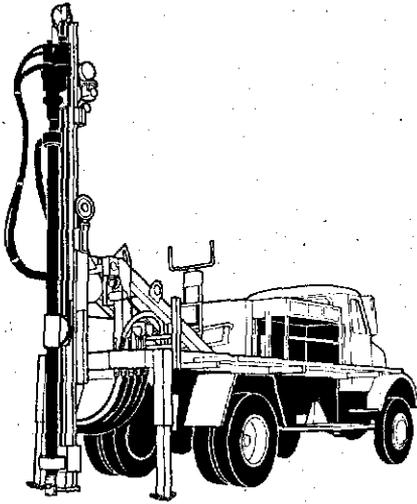
Foam makes the supply of flushing water last longer too. Consumption is only 3-5 l/min (0.7-1.1 Imp.gal/min), as compared to the normal ca 30 l/min (6.6 Imp.gal/min). This is an advantage you'll appreciate when the water has to be transported from a great distance.



Guides for eccentric bits, the one on the left for ODEX 127 with top hammer, that on the right for ODEX 115 with down-the-hole drill.

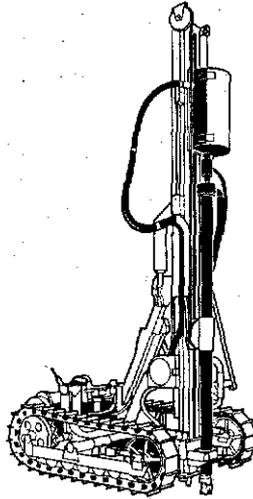
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CAN BE USED ON ATLAS COPCO STANDARD RIGS



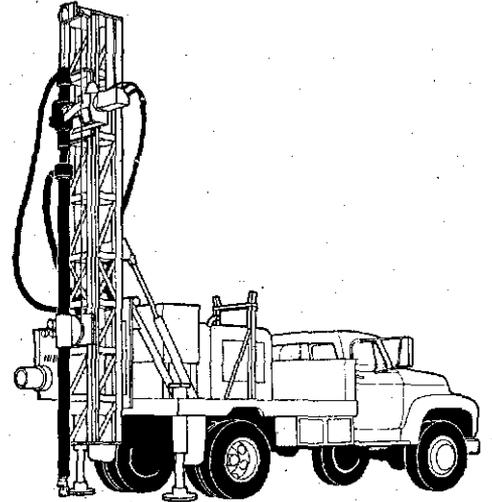
Aquadrill 461

Water well drilling rig equipped with down-the-hole drill COP 4 and rotation unit BBR 6-01. A simple, easily serviced rig suitable for the ODEX method. Easy to mount on a lorry or similar vehicle.



ROC 601-00

Versatile cross-country bench drilling unit with rock drill BBE 57-01. BBE 57-01 has separate rotation with high torque. For especially demanding drilling there is a rock drill with double rotation motor, BBE 53.



Mobile Drill B80

Lorry mounted drill rig with hydraulic rotation and feeding. Suitable for both Auger drilling and ODEX drilling.

A simple conversion makes ROC 601 a dual purpose rig

Atlas Copco ROC 601-00 crawler drills which are not already equipped for ODEX drilling can easily be completed. Handling the casing tubes and the foam flushing require a certain amount of complementary equipment. The set includes:

1. Winch with wire rope, controls and attachment device
2. Pulley
3. Yoke
4. Specially constructed drill steel support
5. Foam generator with transfer pump

The difference between rock drilling and ODEX drilling lies in tube handling and foam flushing

The yoke makes it easier to handle the casing tubes. During drilling it serves, with the drill steel support, as a guide for the casing tubes. The yoke is also used as an aid in taking up the tubes. The winch is used for manoeuvring the yoke along the feed beam. The wire rope between the yoke and the winch runs over the pulley.

Foam flushing requires a container (e.g. an oil drum) for the water and a one litre measure for adding the foaming concentrate. The mixture ratio is 0.5-4 parts Atlas Copco DFA 51 concentrate to 100 parts water.

The Atlas Copco foaming concentrate is a biologically degradable non-pollutant and is not dangerous to work with.

Tubes left in the hole are welded together

If the casing tubes are to be left in the hole when drilling is completed, it is suitable to weld them together. Then inexpensive non-machined steel tubes can be employed. The casing tubes are cut in lengths which match those of the extension rods.

For jointing we recommend equipment consisting of a bevelling machine, brackets and welding gear with suitable electrodes.

Tubes which are screwed together so that they can be withdrawn afterwards must be of relatively good quality so that the threads will last and the tubes themselves will stand up to the stresses of being driven up.

To facilitate the withdrawal of the casing tubes there is a special tube-lifting device.

For grouting work there is a combined tube lifter/grouting device which lifts the tubes at an even rate as grouting progresses.

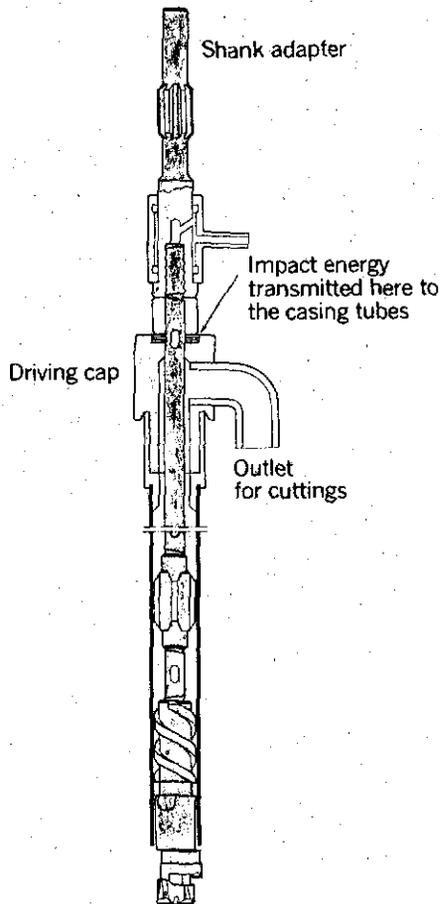
AVAILABLE FOR BOTH TOP HAMMER AND DOWN-THE-HOLE DRILLS

TOP HAMMER PRINCIPLE

The ODEX equipment for top hammers works in the traditional way with impact and rotation transmitted by means of extension rods.

To get the casing tubes to follow in the hole a portion of the impact energy is transferred from the rock drill by way of the shank adapter to a driving cap above the casing tube. The tube is then driven down without being rotated.

Connected to the driving cap is a rubber hose to lead off the foam and cuttings which come up out of the tubes.



ODEX 76 for top hammers

This equipment drills a 96 mm (3 25/32") hole with rotation to the left leaving room for casing tubes with an external diameter of 84 mm (3 5/16") and a goods thickness of 3.5 mm (9/64"). Drilling can then continue in rock with button bits or bits with conventional inserts with a maximum diameter of 76 mm (3").

ODEX 127 for top hammers

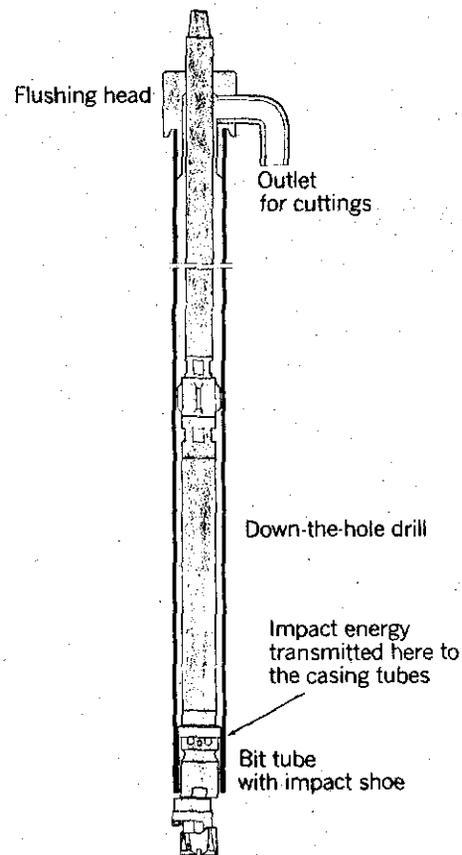
The equipment drills a 162 mm (6 3/8") hole with rotation to the left leaving room for casing tubes with a maximum external diameter of 142 mm (5 9/16"). The goods thickness should be 5-6 mm (13/64 - 15/64") to avoid deformations. Drilling can continue in rock with button bits or bits with conventional cutting inserts with a maximum diameter of 127 mm (5").

DOWN-THE-HOLE PRINCIPLE

No impact energy is lost in the drill tubes which only transmit rotation to the drill bit.

Since the hammer works at the bottom of the hole, the impact energy to the casing tubes must be transferred there too. A special bit tube is employed in down-the-hole drilling with the ODEX method. The bit tube has a driving shoe where the guide of the ODEX bit engages.

The driving cap of the top hammer version is here replaced by a flushing head which leads off foam and cuttings.



ODEX 115 for Atlas Copco down-the-hole drill COP 4

The equipment drills a 152 mm (6") hole with rotation to the right making room for casing tubes with a maximum external diameter of 142 mm (5 9/16") and a goods thickness of 5-6 mm (13/64 - 15/64"). Drilling can then continue in rock with a standard drill bit with a maximum diameter of 115 mm (4 1/2").

ODEX 165 for Atlas Copco down-the-hole drill COP 6

The equipment drills a 212 mm (8 1/2") hole with rotation to the right making room for casing tubes with a maximum external diameter of 196 mm (7 11/16") and a goods thickness of 5-7 mm (13/64 - 1/4"). Drilling can then continue in rock with a standard drill bit with a maximum diameter of 165 mm (6 1/2").

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ODEX bit

Pilot bit, diameter, mm (in)
Reamer, diameter, mm (in)
Standard bit for continuing drilling in rock, max. diameter, mm (in)

Extension rods

R 38, 1 1/2" rope thread,
L = 3050 mm (10')
L = 2435 mm (8')
L = 1220 mm (4')

Drill tubes

API 2 3/8" REG
Outer dia = 76 mm (3") or 89 mm (3 1/2")
L = 3000 mm (9'10")
L = 1500 mm (4'11")

API 3 1/2" REG

Outer dia = 114 mm (4 1/2")
L = 3000 mm (9'10")
L = 1500 mm (4'11")
L¹ = 6250 mm (20'6")
L² = 7600 mm (25')

Casing tubes

Right hand threaded
Dia = 84/77 mm (3 5/16"/3 1/32")
L = 3050 mm (10'), 2435 mm (8'),
1220 mm (4')

Dia = 140/128 mm (5 1/2"/5 1/16")
L = 3050 mm (10'), 2435 mm (8'),
1220 mm (4')

Left hand threaded

Dia = 140/128 mm (5 1/2"/5 1/16")
L = 3000 mm (9'10"), 1500 mm (4'11")

Non-machined steel tubes

with good weldability
Outer dia = 138-142 mm (5 3/8"-5 1/2")
Inner dia = 128-130 mm (5"-5 1/8")
L = 3050 mm (10'), 2435 mm (8'),
1220 mm (4')
L = 3000 mm (9'10"), 1500 mm (4'11")

Outer dia = 192-196 mm (7 1/2"-7 11/16")
Inner dia = 180-183 mm (7 5/64"-7 1/8")
L = 3000 mm (9'10"), 1500 mm (4'11")
L¹ = 6250 mm (20'6")
L² = 7600 mm (25')

Atlas Copco standard rigs

ROC 601-00 with chain feed type
BMM 36K 258 (8' equipment)
BMM 36K 268 (10' equipment)

Aquadrill 461

Mobile Drill B 31L
Mobile Drill B 80
ROC 604-01
Rotamec 1302
Rotamec 1802

Foam flushing

Foam concentrate DFA 51 and possibly
foam stabilizer C mixed with water
Foam liquid consumption 3-5 l/min
(0.7-1.1 Imp.gal/min) of which
0.5-4% DFA 51

ODEX 76

70 (2 3/4)
96 (3 25/32)

76 (3)

ODEX 115

110 (4 5/16)
152 (6)

115 (4 1/2)

ODEX 127

110 (4 5/16)
162 (6 3/8)

127 (5)

ODEX 165

152 (6)
212 (8 1/2)

165 (6 1/2)

Extension rods

L = 3050 mm (10')
L = 2435 mm (8')
L = 1220 mm (4')

	Weights kg	Weights lb
L = 3050 mm (10')	24.1	53.1
L = 2435 mm (8')	19.2	42.3
L = 1220 mm (4')	9.6	21.1

Drill tubes for down-the-hole drill COP 4

API 2 3/8" REG
Outer dia = 76 mm (3")
L = 3000 mm (9'10")
L = 1500 mm (4'11")

L = 3000 mm (9'10")	23.0	50.7
L = 1500 mm (4'11")	14.0	30.8

Drill tubes for down-the-hole drill COP 6

API 3 1/2" REG
L = 3000 mm (9'10")
L = 1500 mm (4'11")
L¹ = 6250 mm (20'6")
L² = 7600 mm (25')

L = 3000 mm (9'10")	62.0	136.4
L = 1500 mm (4'11")	36.0	79.2
L ¹ = 6250 mm (20'6")	158.0	348.0
L ² = 7600 mm (25')	189.0	416.0

Casing tubes, threaded

84/77 mm (3 1/32"/3 5/16")
L = 3050 mm (10')
L = 2435 mm (8')
L = 1220 mm (4')

L = 3050 mm (10')	21.3	46.9
L = 2435 mm (8')	17.0	37.4
L = 1220 mm (4')	8.5	18.7

140/128 mm (5 1/2"/5 1/16")

L = 3050 mm (10')
L = 3000 mm (9'10")
L = 2435 mm (8')
L = 1500 mm (4'11")
L = 1220 mm (4')

L = 3050 mm (10')	56.4	124.0
L = 3000 mm (9'10")	55.5	122.0
L = 2435 mm (8')	45.0	99.0
L = 1500 mm (4'11")	27.8	61.2
L = 1220 mm (4')	22.6	49.7

Non-machined steel tubes

Inner dia = 128 mm (5 1/16")
Outer dia = 139.7 mm (5 1/2")
L = 3050 mm (10')
L = 3000 mm (9'10")
L = 2435 mm (8')
L = 1500 mm (4'11")
L = 1220 mm (4')

L = 3050 mm (10')	66.4	124.2
L = 3000 mm (9'10")	55.5	122.2
L = 2435 mm (8')	45.0	99.1
L = 1500 mm (4'11")	27.8	61.1
L = 1220 mm (4')	22.6	49.7

Inner dia = 182.5 mm (7 3/16")

Outer dia = 193.7 mm (7 5/8")
L = 3000 mm (9'10")
L = 1500 mm (4'11")
L¹ = 6250 mm (20'6")
L² = 7600 mm (25')

L = 3000 mm (9'10")	75.0	165.5
L = 1500 mm (4'11")	37.5	82.7
L ¹ = 6250 mm (20'6")	156.3	344.6
L ² = 7600 mm (25')	190.0	419.1

1) For Rotamec 1302 only

2) For Rotamec 1802 only

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Standard
Option
Option
Standard

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Option
Option

ODEX dimension	Drill rig	Rock drill	Rotation unit	Feed	Suitable compressor	
ODEX 76	ROC 601-00	BBE 57-01	—	BMM 36K 258	XA 350	
	ROC 601-00	BBE 57-01	—	BMM 36K 268	XA 350	
ODEX 115	Aquadrill 461	COP 4	BBR 6-01	BMM 36K 855	XR 350	
	ROC 604-01	COP 4	BBR 6-01	BMM 36K 855	XR 350, XRH 350	
	Mobile Drill B 31L	COP 4	Hydraulic	—	XR 350, XRH 350	
	Mobile Drill B 80	COP 4	Hydraulic	—	XR 350, XRH 350	
ODEX 127	ROC 601-00	BBE 57-01 alt. BBE 53	—	BMM 36K 258	XA 350	
	ROC 601-00	BBE 57-01 alt. BBE 53	—	BMM 36K 268	XA 350	
ODEX 165	Mobile Drill B 80	COP 6	Hydraulic	—	XR 350, XRH 350	
	Rotamec 1302	COP 6	Hydraulic	—	XRH 350 (included in the rig)	
	Rotamec 1802	COP 6	Hydraulic	—	PN 1200 (included in the rig)	
	BBE 57-01	BBE 53	COP 4	COP 6		
Air consumption during drilling at a working pressure* of						
	l/s	m ³ /min	cfm	l/s	m ³ /min	cfm
6 bar, 87 psig	270	16	564	300	18	634
12 bar, 175 psig	—	—	—	—	—	—
18 bar, 260 psig	—	—	—	—	—	—
Weight (without shank adapter or bit)	kg	lb	kg	lb	kg	lb
	170	375	250	550	36	79
					86	190

* Overpressure 1 bar = 100 kPa = 1.02 kg/cm² = 14.5 psig

SANDVIK COROMANT ECCENTRIC DRILLING METHODO.D.E.X.

R. SANDEN - TECHNICAL REPRESENTATIVE SANDVIK COROMANT
AUSTRALASIA

The problem of drilling through glacial type of overburden found for example in Scandinavia forced Sandvik Coromant and Atlas Copco to develop a drilling method which includes the usage of casing tubes. The main problem when drilling through the glacial type of overburden is that the hole walls collapse and therefore a casing tube has to be used. Another problem is the boulders nearly always found in this type of ground.

In 1955 the biggest civil construction company in Sweden, Skanska Cement Gjuteriet AB, experienced drilling problems during excavating of a channel. Sandvik Coromant then developed the O.D. drilling method (O.D. = overburden drilling method) and Atlas Copco developed a pneumatic rock drill with enough torque to enable the O.D. method to work satisfactorily. The only economical way of excavating the above mentioned channel was to try to drill through the overburden with a casing tube method and blast the underlying bedrock without first removing the overburden. This was made possible with the O.D. method. (Fig.1)

The O.D. method consists of a shank adaptor, an inner string of drill rods, couplings, and a tungsten carbide bit. The casing tubes are connected to the shank adaptor and in the first casing tube there is a tungsten carbide tipped ring bit. Both the inner string of drill rods and the casing tubes are subsequently connected to the rock drill and therefore the shock wave and the rotation from the rock drill are transmitted through the casing tubes and the drill string to respective drill bits at the bottom of the hole. With the O.D. method it is possible to drill casing tubes and

inner drill steels simultaneously, it is also possible to pilot drill with only the inner drill steels or to drill only with the casing tubes. When drilling through boulders it is very useful to be able to pilot drill with only the inner drill string. It is also very useful and practical to be able to pilot drill when drilling in bedrock. Undisturbed soil samples can be taken through the casing tubes by using a soil sampler that is put through the casing tubes down into the ground in front of the casing tubes. Separate flushing or reversed circulation can also be used by a separate flushing head assembly. For grouting operations or when drilling mud has to be used, we therefore do not have to pump this material through the rock drill. By using this separate flushing assembly, high pressure of the flushing aide can be used without causing problems with the rock drill itself. The O.D. method is a very reliable drilling method available in three sizes, 55 mm, 72mm and 109mm. These measurements correspond with the internal measurements of the coupling sleeves of the casing tubes for 72mm and 109mm sizes, and the internal measurements of the casing tubes for the 55mm size. The O.D. method is only available for top hammer drills.

The Sandvik Coromant O.D. method is today used for a lot of different tasks, the most important applications are the following:

- Blasting bedrock without removing the overburden.
- Blasting of trenches
- Underwater blasting
- Grouting
- Tieback anchoring
- Securing sheet pilings
- Soil sampling
- Water boring
- Diamond drilling through overburden (where a casing tube has to be used)

In Australia O.D. 72 is today used in the Newcastle Harbour Deepening Project. It has recently been used for the same applications in Wollongong, Bunbury and Port Hedland. For grouting purposes OD.72 was used recently at Sean Weir Dam, outside Newcastle.

In order to be able to rotate the casing tubes Atlas Copco developed the following rock drills BBE57-00, BBE57-01 and BBE53. These rock drills develop following torque 340NM, 785NM and 1180NM. We recommend the use of BBE53 when O.D. 109 is used.

The Sandvik Coromant O.D. drilling method is a very reliable drilling method using high quality casing tubes. The problem is however, that in order to make drilling operations economical, the casing tubes have to be withdrawn when the drill hole has been completed. For a lot of applications, such as diamond drilling through overburden when a casing tube was needed, tie back anchoring, waterwell drilling, there was a need to use a cheaper casing tube that could be left in the hole when drilling has been completed. There was therefore a need for a casing method where we did not have to use a tungsten carbide tipped ring bit and where a cheaper casing tube could be used. In order to meet the problem with a less quality of the casing tubes we had to develop a method where we did not have to rotate and transmit the shockwave from the rock drill through these casing tubes. The answer to this problem was the ODEX system. ODEX-system is a simple answer to the abovementioned problems and involves an eccentric reamer bit that drills a hole slightly larger than the dimension of the casing tube following. The ODEX-method has been on the market since early 1970. (see Fig.2).

The ODEX-system is available for both top hammers and down-the-hole hammers.

The ODEX-system for top hammers works in the traditional way with impact and rotation transmitted by means of extension rods (Fig.3). To get the casing tubes to follow in the hole, a portion of the impact energy is transferred from the rock drill by way of the shank adaptor to a driving cap above the casing tube. The tube is then driven down without being rotated. Connected to the driving cap is a rubber hose to lead off the cuttings which come up out of the tube.

The ODEX-system for down-the-hole hammers works in a slightly different way due to the design of the down-the-hole hammer concept. (Fig.4).

Since the hammer works at the bottom of the hole, the impact energy to the casing tube must be transferred there too. A special bit tube is employed in down-the-hole drilling with ODEX. The bit tube has a driving shoe or a shoulder where the guide of the ODEX bit engages. The driving cap of the top hammer version is therefore replaced with a flushing discharge head which leads off the cuttings.

The working principal is the same for both top hammers and down-the-hole hammers. The reamer assembly consists of three parts, guide, reamer and pilot bit. (Fig.5) The reamer bit is equipped with two only tungsten carbide inserts. The pilot bit has four only tungsten carbide inserts.

When drilling, the eccentric reamer bit is drilling a hole slightly larger than the casing tube. After the desired depth has been reached or if for some other reason the drilling with the eccentric bit should be interrupted, the eccentric reamer bit is swung inwards by changing the direction of rotation. The reaming assembly can then be pulled up through the casing tubes. The casing tubes can then be used for what purpose they are intended for. If for any reason drilling with the casing tubes should be continued, the reaming assembly can again be put down through the casing tubes and the

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drilling with the ODEX method can continue.

During the early development we experienced that the critical point when drilling through overburden was removal of the cuttings. The cuttings must in a lot of cases be finely ground to be able to be lifted up through the casing tubes. For this reason the guide on ODEX bits is designed to screen the cuttings in the column in the casing tube. Only the smallest cuttings particles are allowed to pass. It has been proven that the most effective way of removing cuttings is to use foam flushing. The foam separates the cuttings and lifts them. It lubricates and seals the hole walls. It makes it possible to drill deeper than with just air or water flushing and it reduces the risk of getting stuck. It also reduces the wear on the equipment. The casing tubes also slide more easily down into the hole. Foam makes the supply of flushing water last longer too, consumption is only 3-5 l/min. compared to about 30 l/min. when only water is used. (Operational instructions and description for foam DFA51 with stabilizer C can be obtained from the nearest Atlas Copco Sales Office. MCT printed matter No. 20200). Another very important thing regarding the ODEX method is that the casing tubes used to have the dimensions recommended in our leaflets. If the wrong size of tubes are used, problems will occur regarding flushing and cuttings removal, as too coarse cuttings perhaps are let inside the casing tubes or perhaps if the inside diameter of the tubes is too small, no cuttings are let in between the guide and the inside of the casing tube.

ODEX-methods for top hammer drills are used with left hand rotation.

ODEX-methods for down-the-holes hammers are used with right hand rotation.

During drilling, the eccentric reamer bit is locked in position against a shoulder on the pilot bit. In order to withdraw the guide assembly through the casing tubes,

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a few backward revolutions are applied and the eccentric reamer falls inside the casing tube and can be withdrawn through these.

ODEX for top hammer drills are available in two sizes 76mm and 127mm. These dimensions indicate the largest bit size that can be used inside the casing tubes.

ODEX 76 (see Fig. 5)

This ODEX size is mainly used for the following purposes:

Tie back anchoring

Grouting

Diamond drilling through overburden (where casing tubes are needed)

Drilling of cable holes through road embankments.

Investigation of water tables.

Soil sampling

And so on.

The eccentric reamer bit is drilling a hole 96mm in diameter, the pilot bit, a 70mm hole, and the casing tube has an outside diameter of 88.9mm. The casing tubes are threaded - female and male threads. The inner drill string is of standard (1½") 38mm rope-threaded rods. We recommend that a few wing couplings are used, especially on the first connection behind the guide of the reaming assembly. Between the flushing head and the driving cap we are using a shock absorber assembly, with cup springs. The reason for this is to save the thread of the casing tube and the end of the casing tube. A special tube lifter can be put on the casing tube, this makes the withdrawal of the tubes easy (if you are withdrawing these tubes). It is also possible to keep the eccentric reamer bit in its locked drilling position and use this bit as a shoulder and lift the package by using the inner drill string. This tube lifter also makes it possible to use a yoke, which can be connected to a winch on the drilling. For grouting purposes we supply a special grouting device. This grouting device is also used for pumping cement when

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ODEX 76 is used for anchoring purposes. When drilling through boulders or bedrock, a bit size of 64-76mm is recommended.

ODEX 127 (See Fig.7)

The eccentric bit is drilling a hole 162mm in diameter, the pilot bit a 110mm hole. The casing tube should have an outside diameter of 138 (min) - 142 (max) mm. This size is mainly used in Northern Europe for water well drilling purposes. As standard, we supply casing tubes that have to be welded together. For water well purposes the casing tubes are left in the ground and a threaded casing tube is generally more expensive than tubes welded together, that is why we supply welded tubes. As, for this dimension, we also are using (1½") 38mm inner drill steel, it is very important that wing couplings are used in order to guide these 38mm steels inside these larger tubes. The casing tubes used are normal grade (SIS 1300) that are easy to weld. Welding instructions and auxiliary tools can be obtained from the nearest Atlas Copco sales office. As the space between inner drill steels and casing tubes is larger for ODEX 127 compared to ODEX 76, it is strongly recommended that foam flushing is used. We have less velocity inside these larger casing tubes and foam is in most cases, needed in order to bring the cuttings up through the tubes. We recommend a bit size of 110-127mm to be used when drilling through boulders or bedrock with ODEX 127.

ODEX for down-the-hole hammers are available in two sizes - 115mm and 165mm. The dimensions indicate the largest bit size that can be used inside the respective casing tubes.

ODEX 115 (See Fig.8)

This method is developed to suit Atlas Copco COP-4 down-the-hole hammer. The eccentric reamer drills a hole 152mm in diameter and the pilot bit a 110 mm hole. The casing tubes should have an outside diameter of 138 (min) - 142 (max) mm. Threaded casing tubes or welded casing tubes are provided.

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The bit tube (with the shoe) has an inside diameter of 116 mm and an outside diameter of 142mm. The bit tube is always welded together to the casing tube. In order to stabilize the drill pipes inside the casing tubes, wing couplings are recommended to be used.

ODEX 165 (See.Fig.9)

This method is developed to suit Atlas Copco COP-6 down-the-hole hammer. The eccentric reamer drills a hole 212mm in diameter and the pilot bit a 152mm hole. The casing tubes should have an outside diameter of 192 (min) - 196 (max) mm. Recommended casing tube size, outside diameter 192 (min) - 196 (max)mm with an inside diameter of 180 (min) - 183 (max) mm. These tubes are mainly welded together and there is a standard SIS 1300 (193.7 x 5.6) tube on the market which we recommended to be used. The bit tube is always welded together with the casing tube. We also recommend a few wing couplings to be used on the down-the-hole drill pipe for stabilizing purposes.

The electric reaming idea has been used for drilling in Scandinavia since early 1960, but the ODEX concept is, to my knowledge, the only method that is working satisfactorily. During the early development of ODEX we used too thin walled casing tubes. We thought that we could use thin walled diamond drilling casing tubes, but experience showed that we had to use slightly heavier tubes. Compared to the old OD method when drilling with ODEX, the driller has to be a little more careful. The OD casing tubes are so heavy that nobody can destroy them, but with ODEX casing tubes (especially ODEX 76), more careful feeding must be applied. The Coromant eccentric method has two very important features compared to earlier used eccentric methods. The first is that ODEX has a bigger pilot bit, the second is that we have succeeded in fitting two only tungsten carbide inserts in the eccentric reamer. As we are using a bigger pilot bit, we therefore drill a bigger area with a full face bit, which means that a smaller area has to be drilled with the

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eccentric reamer. The ODEX reamer bit with two only inserts, drill the remaining hole area very easily. These two points have proven to be very favourable, especially when drilling through boulders or hard foundation. When drilling through fairly soft formations, you must make sure that you are able to clean the casing tube from cuttings and do not let the casing tubes get clogged. The best way is to drill about one metre and then lift the rods and let the cuttings flush through the tubes. When drilling deeper holes, especially through clay and similar material, foam flushing should be used. In this type of material, foam is lubricating the outside of the casing tubes and makes it easy for the tubes to follow the reaming assembly down into the hole.

Another very important thing is the usage of casing tubes of our recommended sizes. I have seen customers run into problems because they use casing tubes that are out of round, have the wrong dimensions, or do not do the welding operations to our recommendations.

Looking at wear on ODEX equipment, it is mainly the eccentric reamer inserts and the steel around these inserts that get worn. It is possible to build up the steel portion again by applying a weld. But you have to remember that the tungsten carbide inserts have a co-efficient of expansion only half that of steel. Furthermore, tungsten carbide does not have the ability to conduct heat. These points mean that heat expansion has to be absorbed by the brazing joint around the insert and remember, that heat applied to the insert, very easily causes cracks in the insert itself. In order to get the full life out of the eccentric reamer bit, and the pilot bit, you have to dress these inserts according to our recommendations.

The ODEX method is used a lot today in Europe and North America where a casing tube has to be used. The smaller ODEX (76mm) is mainly used for tie back anchoring and grouting, but also for diamond drilling application where a casing tube through the overburden layer is needed. For soil sampling purposes the ODEX method has proven to be in some cases the

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only drilling method that can be used. The ODEX 165 is mainly used for waterwell drilling purposes. ODEX has been used very little here in Australia. In Sweden we have a few companies drilling only with ODEX and about 100,000m. per year is drilled with ODEX there. We can supply case stories from Canada, England, Scandinavia and USA. This information can be obtained from the nearest Atlas Copco sales office.

In October 1978 I visited P.T. International Nickel, Soroako, Sulawesi, Indonesia where ODEX 115 has been used since 1977. I would like to brief you regarding these companies' experiences with ODEX 115.

Soroako is located in the centre of Sulawesi (Celebes) about 400m above sea level. The lateritic nickel deposit is covered with an average of 10m. of fine grained limonite with approximately 35% water content. The ore consists of serpentized peridotite, very broken material mainly boulders up to 2-3m. in diameter. In order to find out the thickness of the ore and the ore content, they needed a casing drilling method. The mine tried all types of drilling, from diamond drilling to down-the-hole hammer drilling, and rotary drilling with reverse circulation, but with no success regarding soil sampling. The problem was mainly the water content in the limonite which caused clogging in the drill tubes. Auger drilling was impossible because of the boulders.

Before we started using ODEX 115 we made a slight design change to the guide device. We realised that in order to bring this type of soil up through the casing tubes we had to open up the spacing between the guide device and the bit tube. This was done at our Sandvik factory in Sydney according to Fig.10.

The ODEX 115 is today used on a Schramm C64 rig and a COP-4 down-the-hole hammer. The COP-4 at the start was working at an air pressure of 8.5 bar. Casing tubes used have an

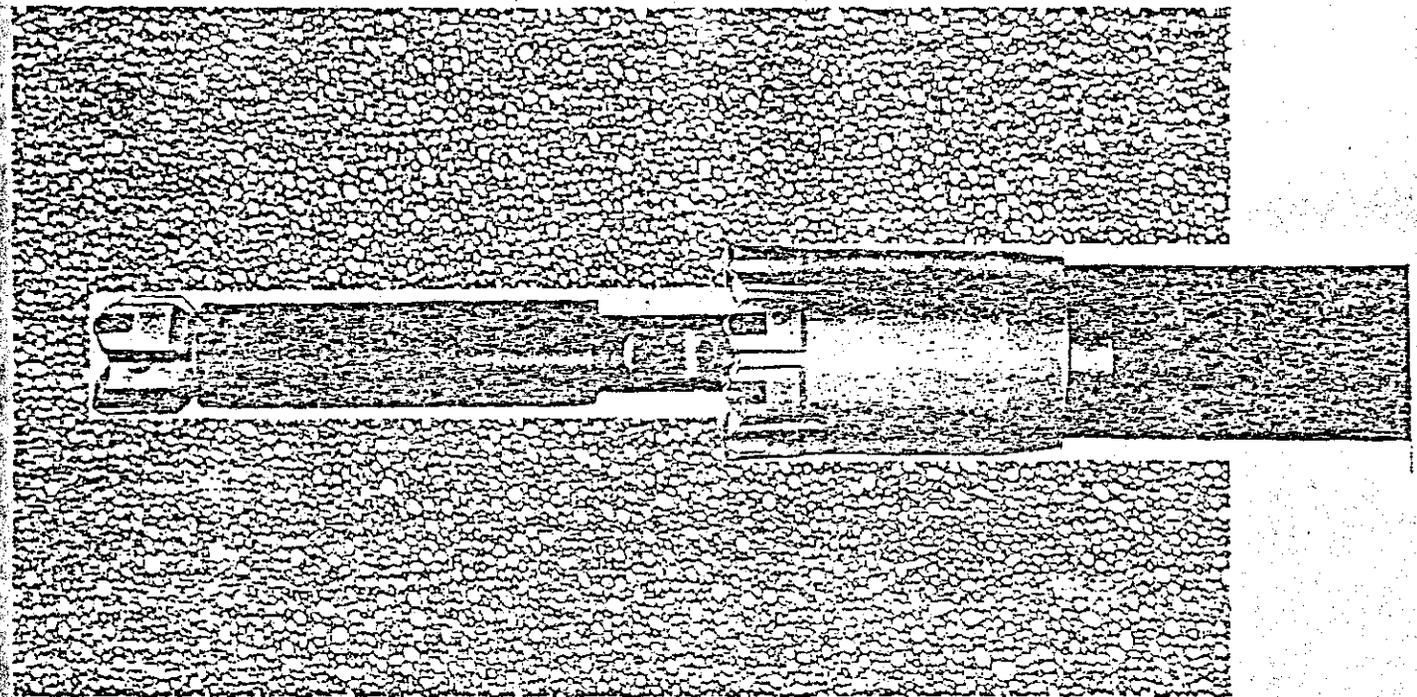
056

outside dimension of 142 mm and inside dimension of 130mm. These casing tubes are threaded. Drill tubes used for the COP-4 hammer are 89mm in diameter. Due to clogging problems, the design of the flushing head had to be slightly changed. Instead of a discharge hose being fitted at a right angle to the flushing head, it was fitted at a 45° angle and the size of the discharge hose was changed from Ø 64mm to Ø 102mm. Even with these changes, drilling has to be interrupted every 0.20m in order to let all cuttings go through the casing tubes. Even with these interruptions 1m. could be drilled as an average in 20 mins. We have now changed the air pressure of the COP-4 hammer to 12 bar, which means an increase of the flushing air by 60%. This increase in flushing air makes it possible to drill without stopping to clean cuttings from the casing tubes. Only air flushing is used. We have also further opened up the flushing grooves in the guide device and put two extra flushing holes in these grooves.

Today, this customer has drilled about 1500m. in their Konde South ore body, and the sampling has been close to 100% and samples have been collected from each meter drilled. All samples are checked by volume and weight. The deepest hole drilled today is 33m. and average 25m. holes are drilled.

We have been drilling 100m. holes with ODEX 76 in Sweden. Technically it should be possible to drill deeper holes with the down-the-hole hammers, as no energy is lost in a drill string, because the hammer is all the time working immediately over the bit.

Regarding future development for ODEX we are today trying to protect the eccentric reamer bit from steel wear by using tungsten carbide buttons. Regarding casing tubes, it may be possible to use a plastic type material in the future. For waterwell drilling purposes, it would perhaps be possible to manufacture casing tubes with screens already built into these tubes.



1

2

3

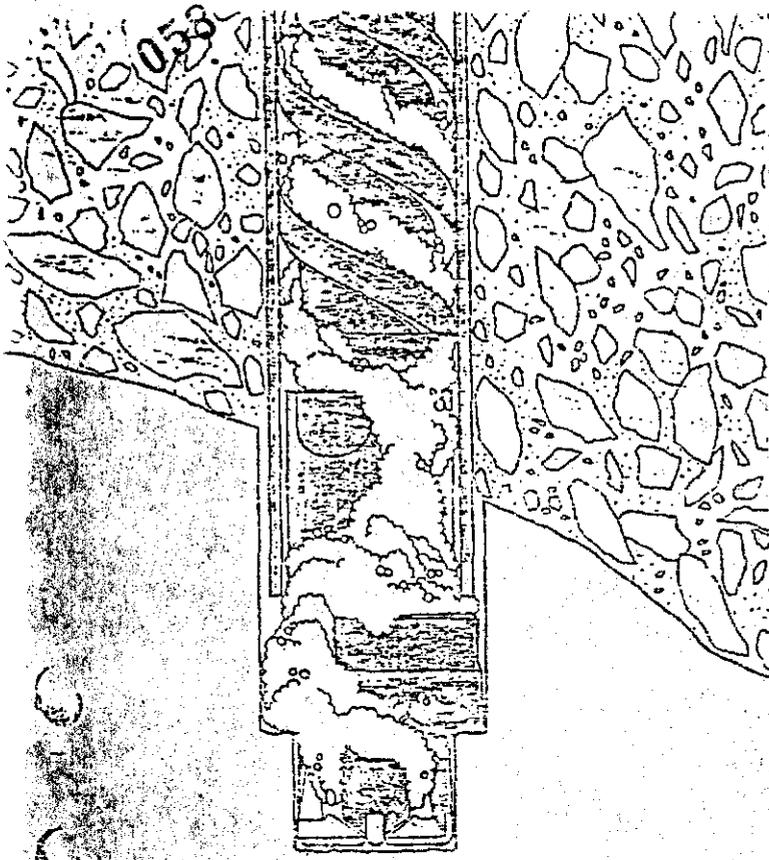
4

The drill pipes and the extension steels inside are drilled simultaneously through overburden including boulders. After reaching bedrock both the ring bit and the cross bit are collared into the rock.

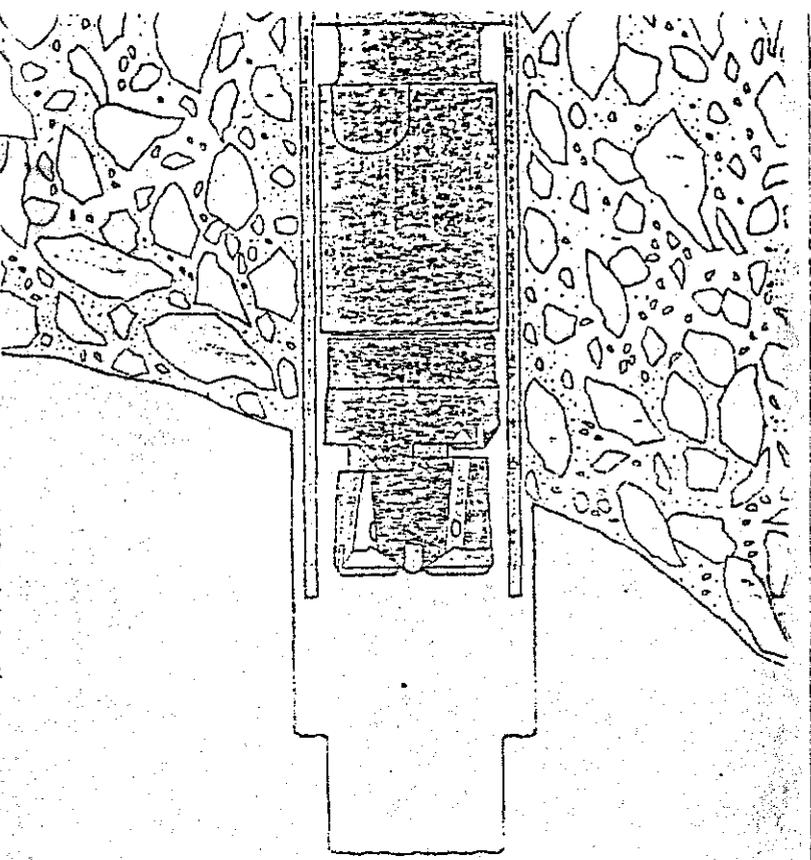
The string of pipes is disengaged from further drilling by disconnecting the top drill pipe from the shank adapter. An extra rod is added and drilling continued with the extension steels alone.

When the hole has been drilled to a predetermined depth the extension steels are withdrawn leaving the drill pipe as a lining in the overburden section of the hole. A plastic tube for charging is now inserted and the drill pipes are withdrawn.

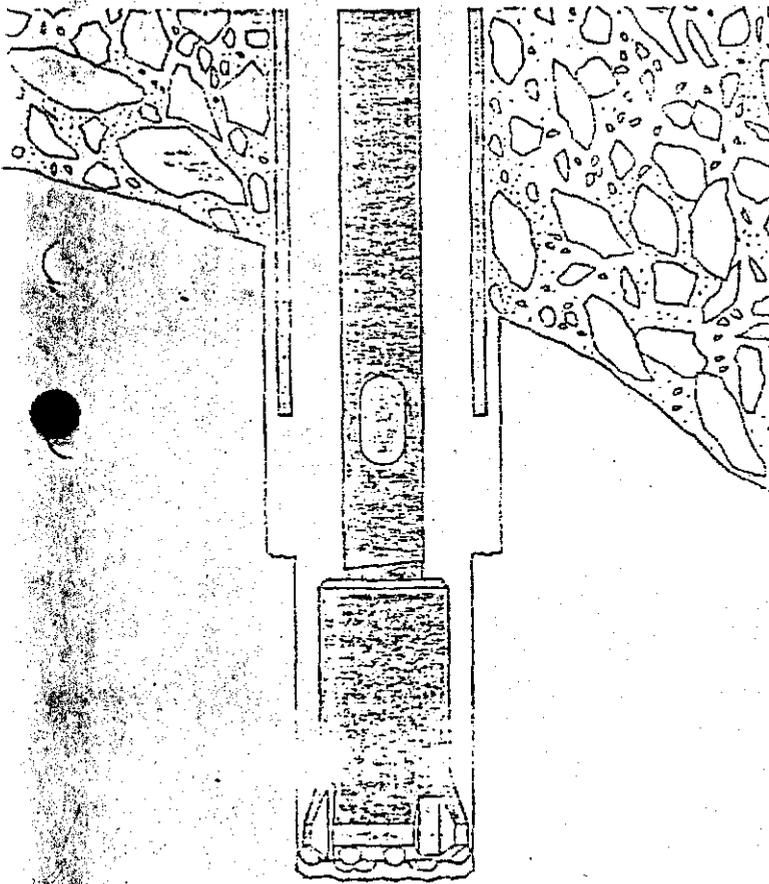
Charging can now easily be carried out by introducing detonator and explosives through the plastic tube. Other equipment, for grouting etc., can also be inserted this way.



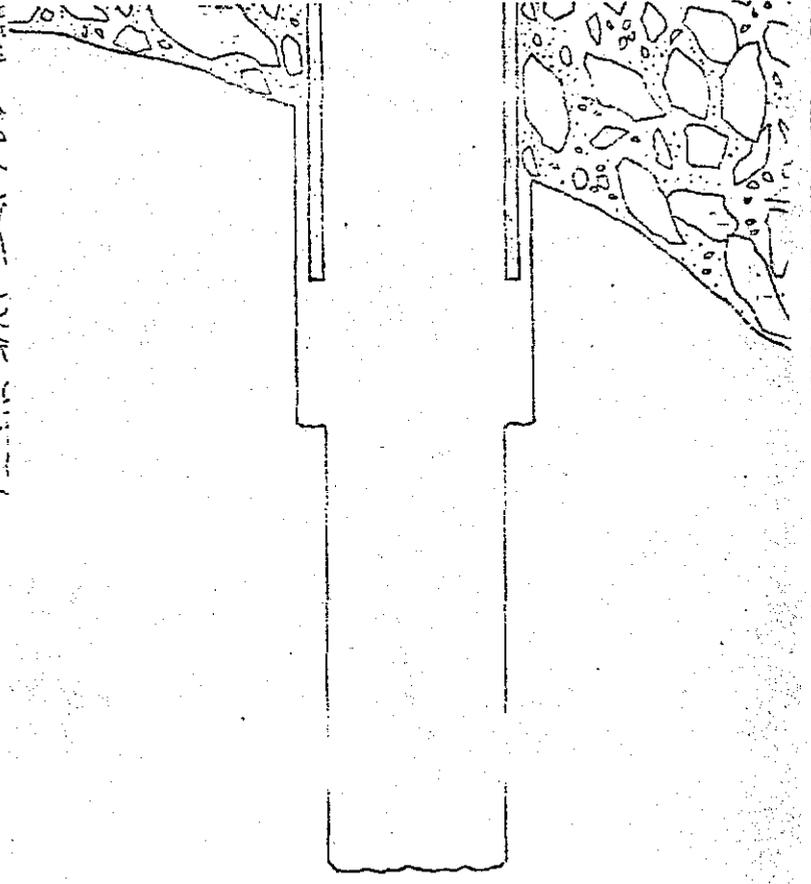
1. ODEX equipment at work. The pilot bit drills at the bottom of the hole. When rotation begins, the reamer swings out automatically and reams up the hole so that the casing tubes can slide down. The cuttings are transported upwards by means of foam flushing inside the casing tubes.



2. When drilling is completed, the drill bit is rotated in the other direction, so that the reamer is pulled in. With the reamer in this position the drilling equipment can easily be withdrawn through the casing tubes.

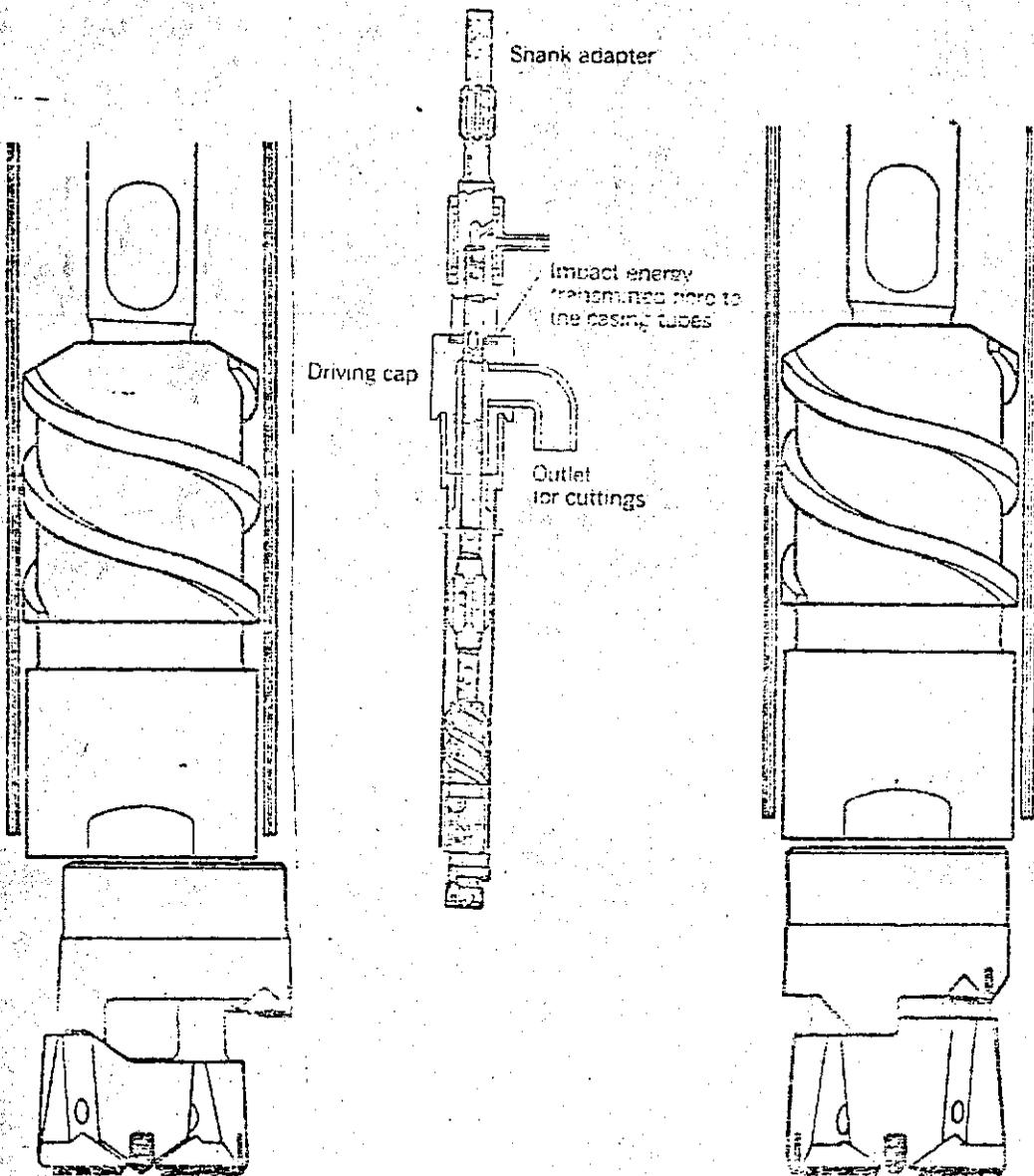


3. If the ODEX hole has been drilled into solid rock, drilling can continue there with standard equipment through the casing tubes.



4. The casing tubes are left in place in the hole to stabilize the walls.

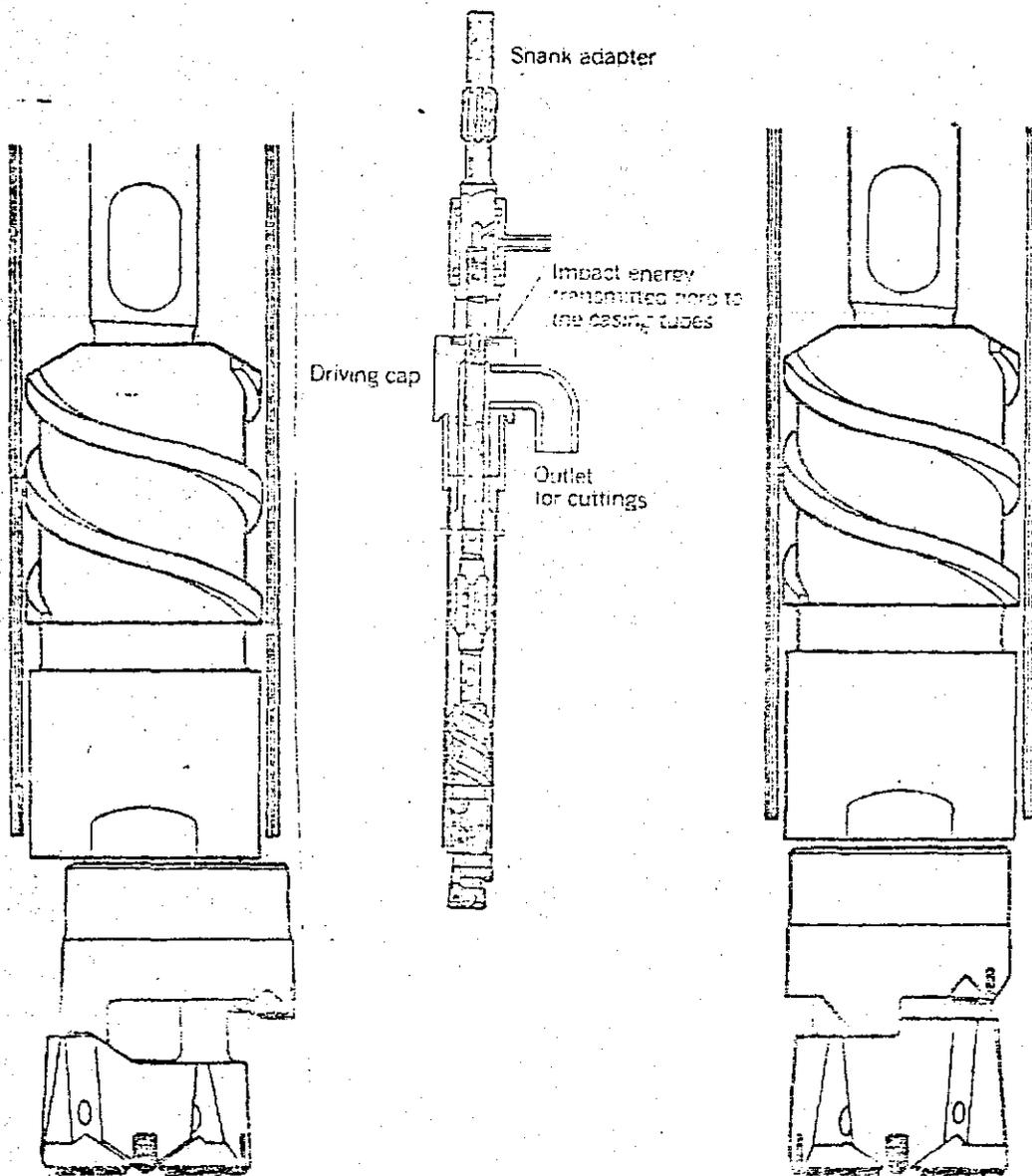
ODEX for Top Hammer



Drilling Position

Retrac Position

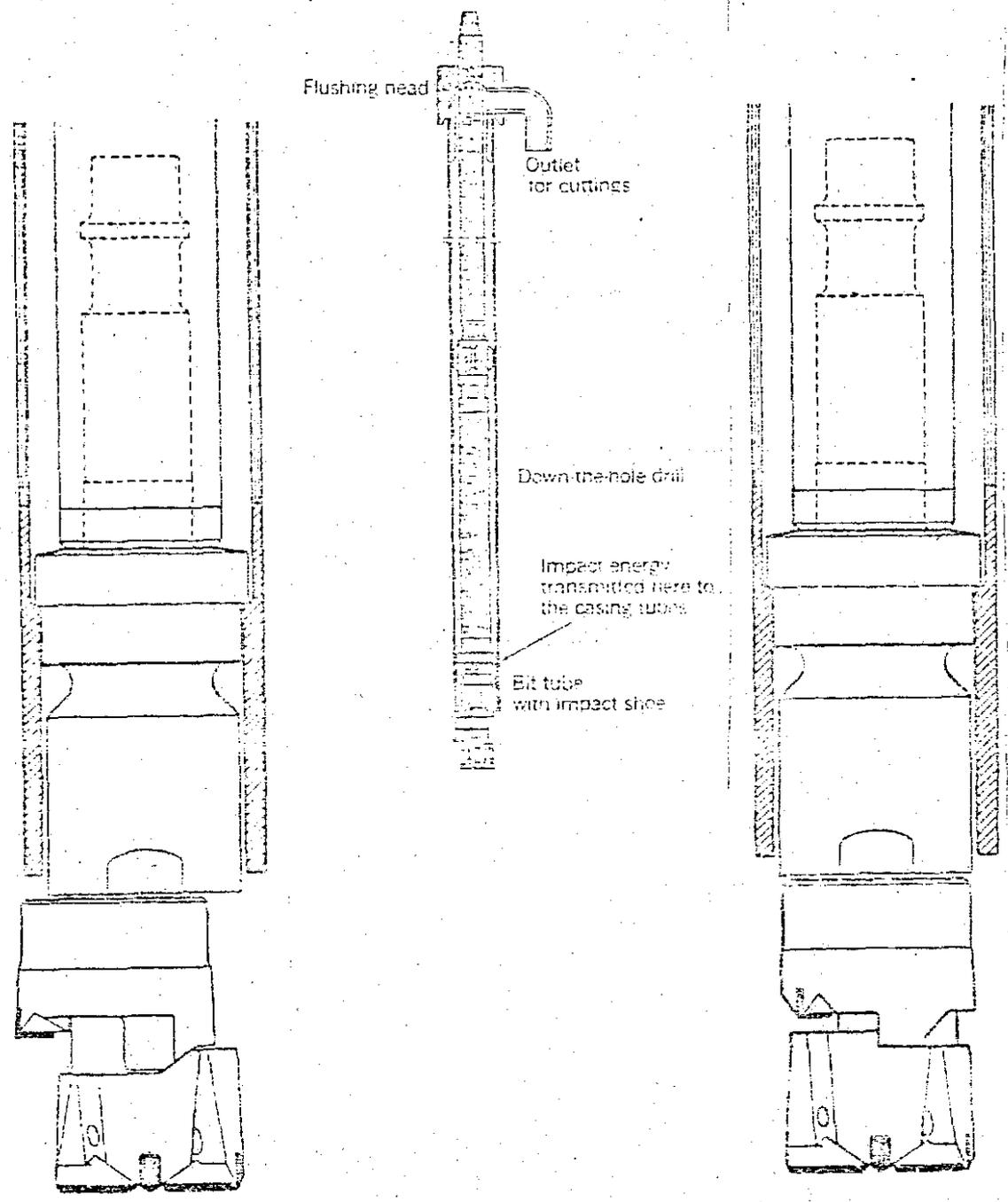
ODEX for Top Hammer



Drilling Position

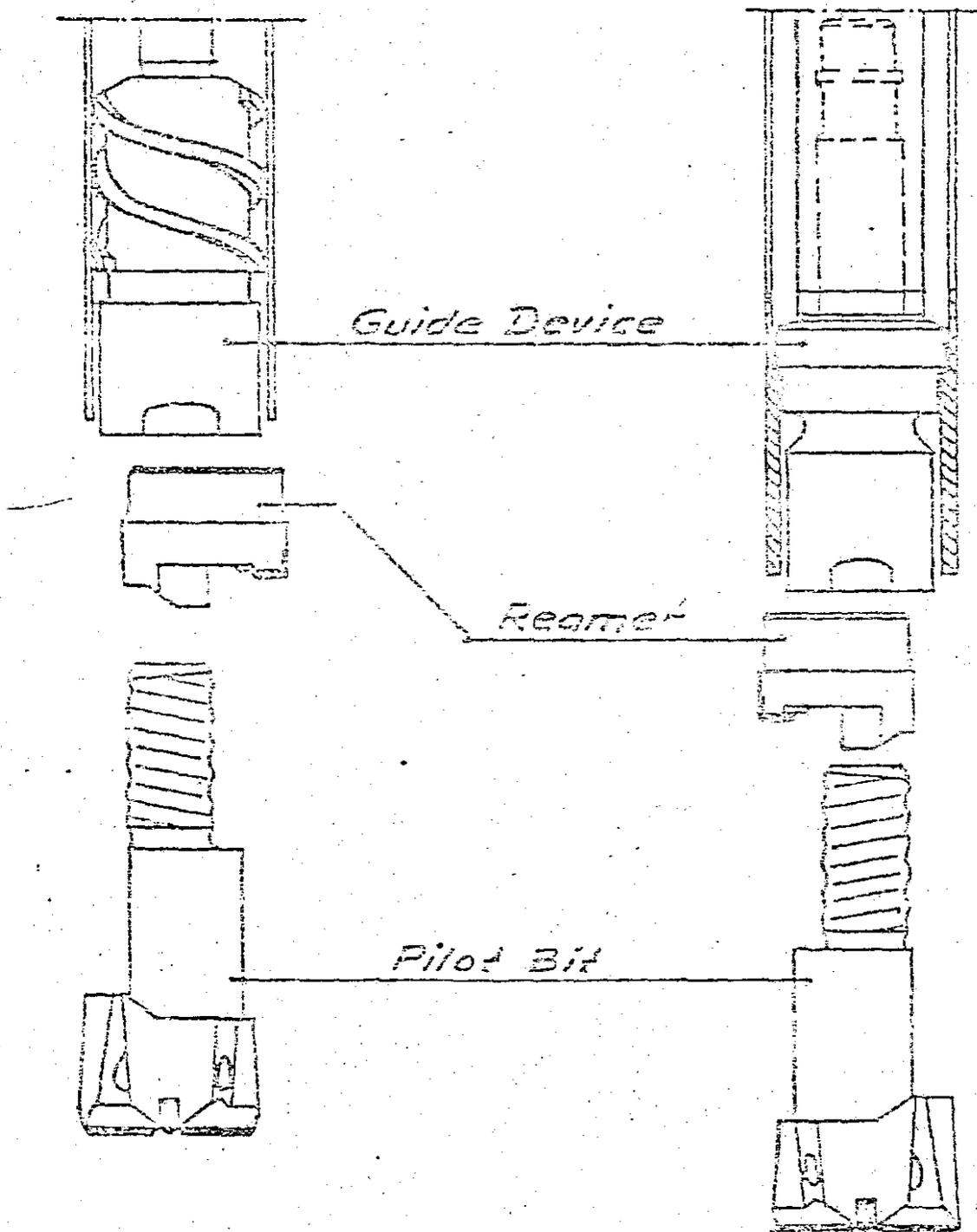
Retrac Position

ODEX for Down-the-Hole Hammer



Drilling Position

Retrac Position



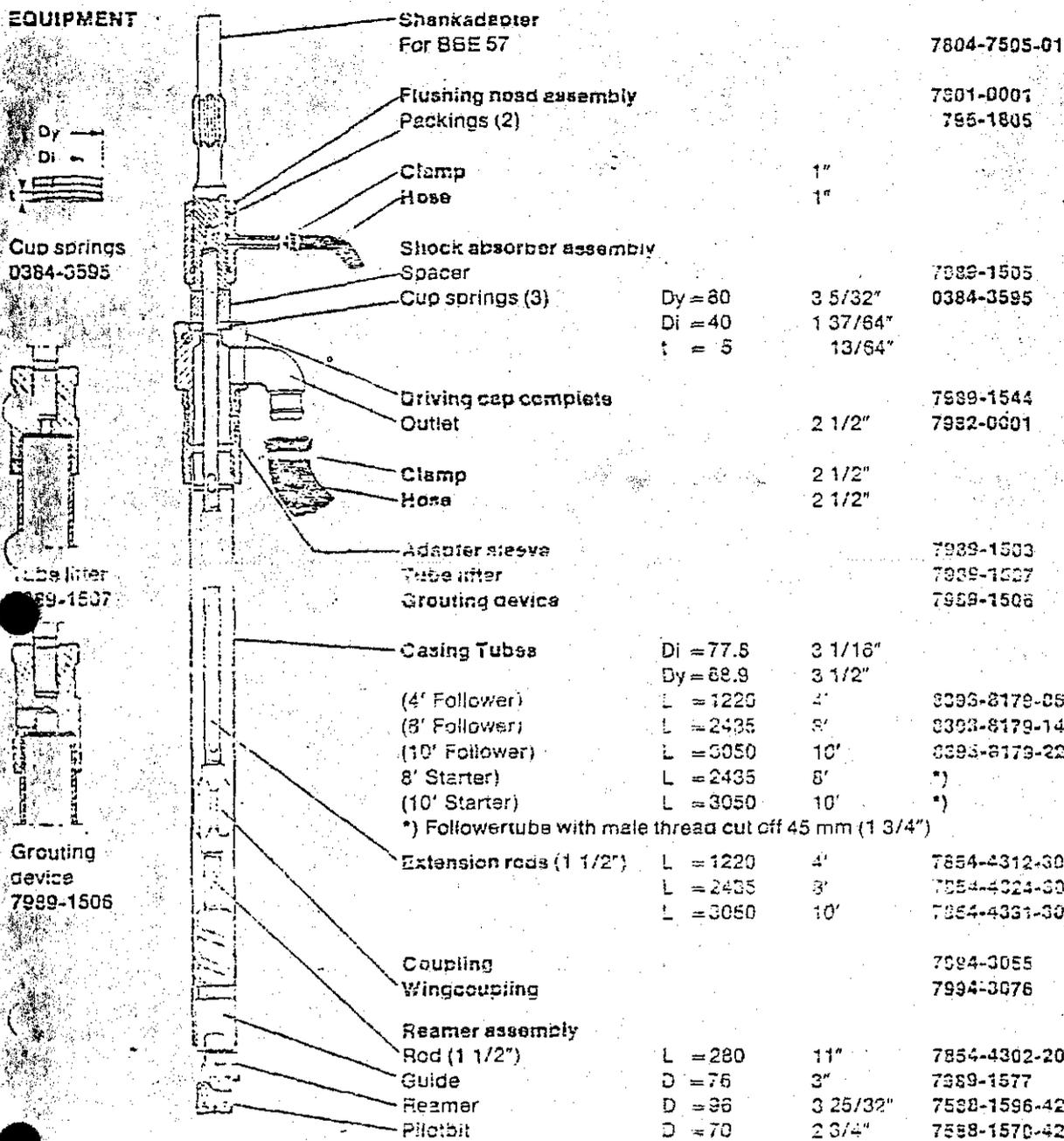
ODEX 76
Eccenter Equipment
for Overburden Drilling

063

180064

Dimensions
mm Inch Part No Notes

EQUIPMENT

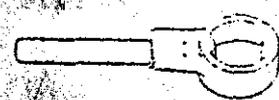


Grouting device
7989-1506



Bits	D	Inch	Part No
X-type	D = 64	2 1/2"	7734-4864
	D = 70	2 3/4"	7734-4870
	D = 76	3"	7734-4876
Buttons	D = 64	2 1/2"	7734-6664
	D = 70	2 3/4"	7734-6670
	D = 76	3"	7734-6676

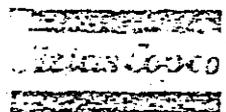
TOOLS



Wrenches for Rods (1 1/2") Short	795-1402
Rods (1 1/2") Long	795-1412
Adaptersleeve and tube lifter	795-1430
Guide	795-1495
Bits (X-type)	725-1415



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ODEX 127 New Eccenter Equipment for Overburcendrilling

180065
Notes

Dimensions
mm (inch)

Part No

EQUIPMENT
064

Shankadapter For BBE 57			7804-7505-01
Flushing head assembly			7801-0001
Packings (2)			795-1806
Clamp	25	(1")	
Hose	25	(1")	
Shock absorber package			
Spacer			7968-1305
Cup springs (3)	Dy = 60 Di = 40 t = 5	(3 5/32") (1 37/64") (13/64")	0384-3535
Driving cap			
Complete			7969-1370
Outlet	64	(2 1/2")	7962-0001
Clamp	64	(2 1/2")	
Hose	64	(2 1/2")	
Casing Tubes 127 mm (5") (SIS 1300) (139.7 x 5.4)	Di = 123 min Di = 130 max Dy = 133 min Dy = 142 max L = 3050	(5") (5 1/8") (5 3/8") (5 1/2") (10")	
Extension rod 38 mm (1 1/2") (10' Follower) (8' Starter)	L = 3050 L = 2435	(10") (8")	7854-4331-30 7954-4324-30
Coupling 38 mm (1 1/2") Wing coupling 38 mm (1 1/2")	D = 106	(4 5/32")	7994-3066
Guide coupl. 51/38 mm (2" / 1 1/2")	D = 127	(5")	7994-727
Rod 51 mm (2")	L = 770	(2' 6 5/16")	7855-3308-30
Bitadapter	D = 35	(2 3/32")	7834-6701
Reamer assembly			
Guide	D = 127	(5")	7823-1323
Reamer	D = 162	(6 3/8")	7828-1332-42
Pilotbit	D = 110	(4 5/16")	7828-1310-42

ADDITIONAL



Bits

X-Type

D = 127

(5")

7550-6227-42



Buttons

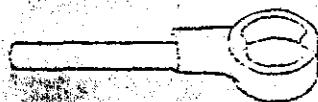
D = 110

(4 5/16")

7734-6610-40

Fig. 3

TOOLS



Wrenches for

Rods 38 mm (1 1/2") Short

795-1432

Rods 38 mm (1 1/2") Long

795-1419

Rod 51 mm (2")

795-1420

Wing coupling

795-1405

Guide

795-1404

Bits

795-1415

Fig. 4

SANDVIK

SANDVIK CROMANT — A QUALITY PRODUCT FROM SANDVIK
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Atlas Copco

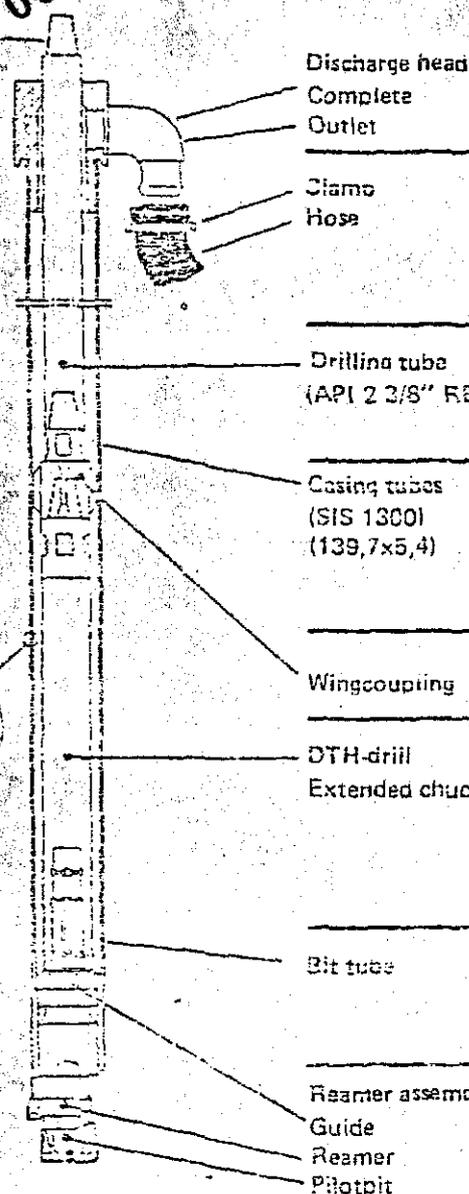
ODEX 115
New Eccenter Equipment
for Overburdendrilling
with COP 4

Dimensions
 mm inch Part No Notes

EQUIPMENT
 Fig. 2

API 2 3/8" REG

065



Discharge head
 Complete 7989-1630
 Outlet 7932-0001

Clamp 2 1/2"
 Hose 2 1/2"

Drilling tube
 (API 2 3/8" REG) Di=68 2 11/16"
 Dy=76 3"
 L=3000 9'10"

Casing tubes
 (SIS 1300) Di=120 min 5"
 (139,7x5,4) Di=130 max 5 1/8"
 Dy=138 min 5 3/8"
 Dy=142 max 5 1/2"
 L =3000 9'10"

Wingcoupling Dy=127 5" 7989-1627

DTH-drill
 Extended chuck COP 4
 3161 0992

Bit tube Di=116 4 9/16"
 Dy=142 5 1/2"
 L=670 26 3/8"

Reamer assembly
 Guide D=126 4 31/32" 7989-1615
 Reamer D=152 6" 7588-1652
 Pilotbit D=110 4 5/16" 7582-1610

ADDITIONAL



DTH-bits
 X-Type D=115 4 1/2" 7745-4115

Buttons D=115 4 1/2" 7745-2615

Fig. 3

TOOLS

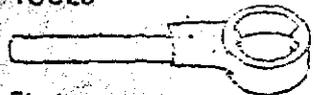
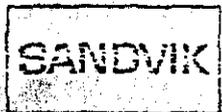
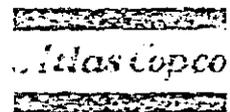


Fig. 4

Wrenches for
 Tube and coupling 795-1495
 Guide 795-1430
 Pilotbit 795-1415
 DTH-bit 795-1499



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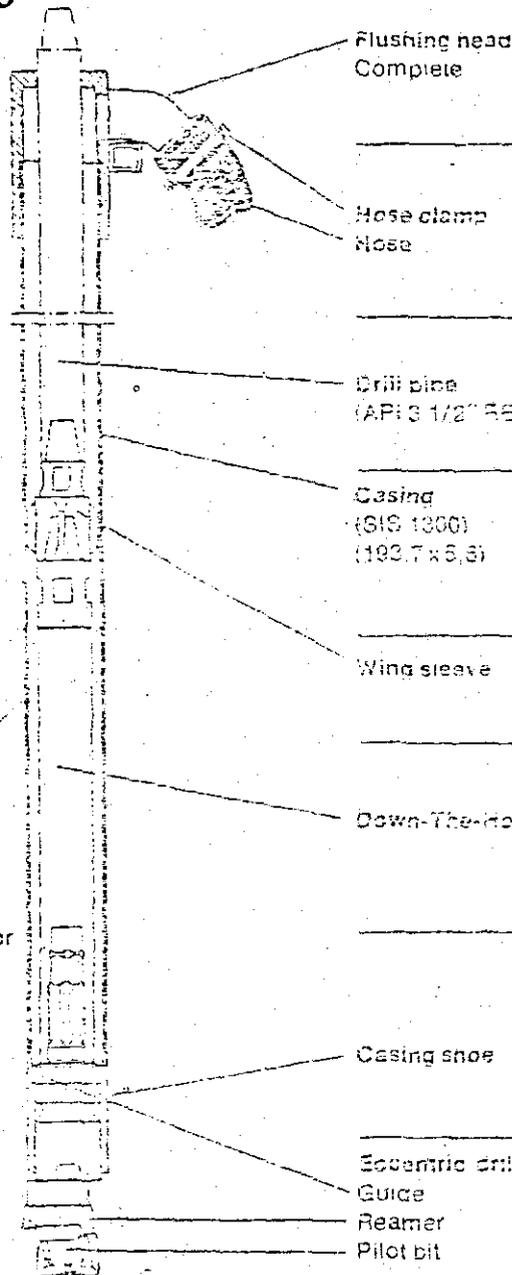
ODEX 165
Eccentric equipment
for Overburden Drilling with COP 6

180067

Dimensions,
mm (inch) Part No. Remarks

EQUIPMENT
Fig. 2
API 3 1/2" REG

066



Flushing head Complete 7988-1725

Hose clamp D = 102 (4")
Nose D = 102 (4")

Drill pipe (API 3 1/2" REG) Dv = 115 (4 1/2") 7950-6591
L = 3050 (10')

Casing (SIS 1300) (103.7 x 5.3) Di = 180 min (7 3/32")
Di = 183 max (7 13/64")
Dv = 192 (7 9/16")
Dy = 155 max (7 20/32")
L = 3050 (10')

Wind sleeve Dv = 177 (6 31/32") 7969-1777

Down-The-Hole drill COP 6



Fig. 2 a
Edge preparation for welding

Casing shoe Di = 168 (6 5/8") 7989-1703
Dv = 194 (7 41/64")
L = 280 (11 1/32")

Eccentric drill-head
Guide D = 167 (6 37/64") 7989-1767
Reamer D = 212 (8 11/32") 7598-1712-42
Pilot bit D = 152 (6") 7588-1752-42

ACCESSORIES



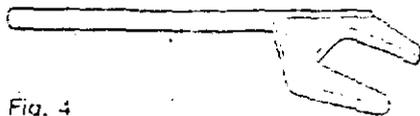
Down-the-hole bits

X-bit D = 165 (6 1/2") 7745-8165-11

Button bit D = 165 (6 1/2") 7745-7665-40

Fig. 3

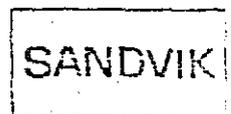
TOOL



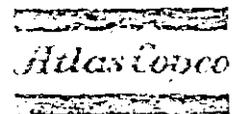
Spanner for

Guide 795-1445

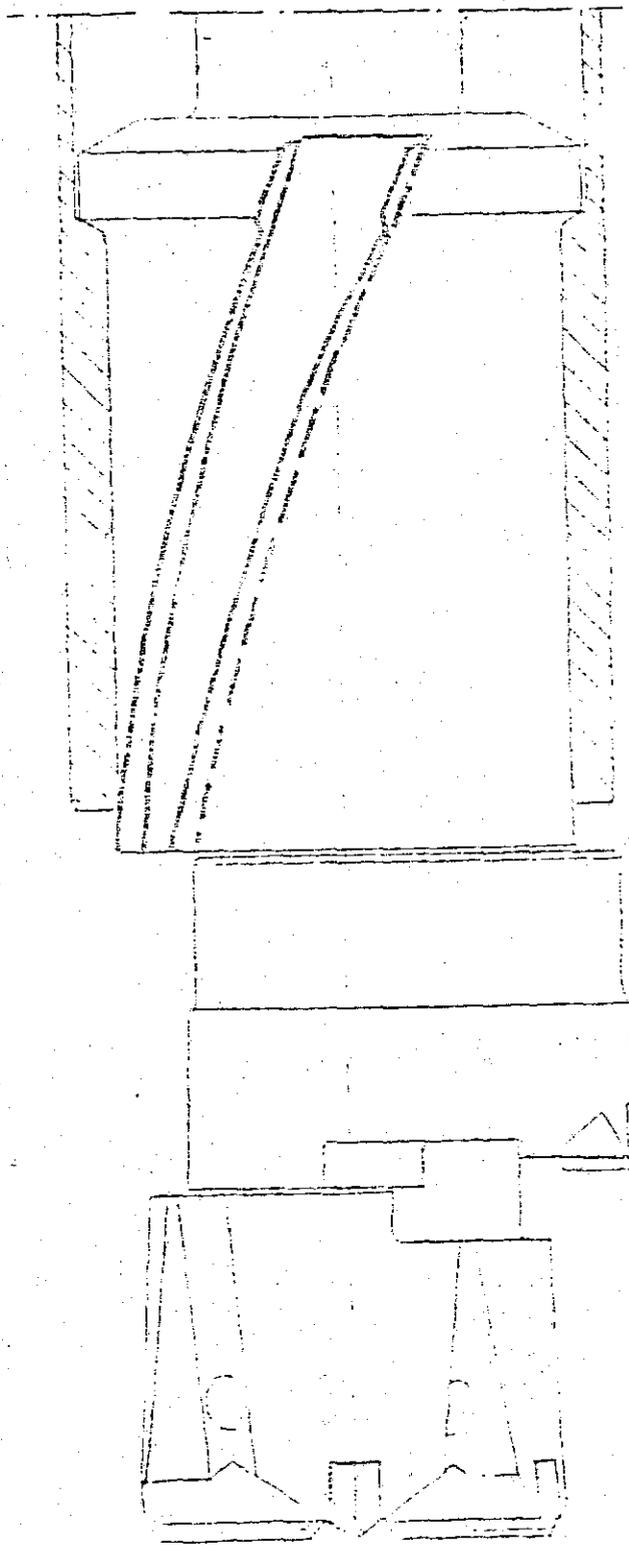
Fig. 4



SANDVIK COROMANT — A QUALITY PRODUCT FROM SANDVIK
SOLD AND SERVICED BY THE WORLD-WIDE ATLAS COPCO ORGANIZATION.



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VISIT REPORT NO. 37

CUSTOMER: P. T. International Nickel Indonesia

LOCATION: Soroako, Sulawesi (Celebes). Indonesia

CUSTOMER CONTACTS:	N.A. McPhedran	Inco - Singapore
	A. Wahju	P.R. Officer. Inco - Jakarta
	J.C. Makatita	" " " "
	R. Muso	Mine Manager, Soroako
	B. Niemi	Chief Mine Engineer, Soroako
	B. Macintosh	Mine Planning Eng. "
	O. Samosie	Mine Planning Eng. "
	C. Davis	" " " "
	G. Suparman	Chief Mine Geologist "
	A. Jakubek	Mine Eng. (Inco-Canada) "

VISITOR: R. Sanden Sandvik Australia Pty. Ltd.

PURPOSE OF VISIT: Check up of ODZX-115

SUPPLEMENTARY INFORMATION:

Soroako is located in the centre of Sulawesi (Celebes) about 400m above sea level. The ore is a laterite nickel deposit, covered with an average overburden of 9m. Production started about 1.5 years ago and today's production rate is about 30 million pounds per year. There is a capacity of about 100 million pounds per year built into the plant.

The mine has following drilling rigs:

2 only Schramm C-64, 5 only Halco 625, 2 only crawlers (for secondary blasting). One only Schramm C-64 is used for ODEX-drilling. All other rigs are used for blasting drilling. This drilling is today done by using Halco DC-500 ITD-hammers drilling 5" (130m/m) holes.

For bench drilling a 4 x 5 m pattern is used, bench height is 6m. 20-25m per shift is the capacity today. Bit life is unknown. (Air pressure used 125psi).

Secondary blasting is done by using IR-spiral rods (38m/m) and 70-76m/m crossbits.

Mr. Jakubek is today building a Mobile 40L unit on a cat. D4D. The intention of this unit is to try to use a smaller more mobile unit for ODEX-drilling. It is expected that drilling with this unit will commence week 846.

The exploration drilling is extremely difficult and the mine has tried a lot of different methods in order to get soil samples. All types of reverse circulation methods and diamond drilling have been used, but with no success. The over burden consists

069

of 4-10m layer of fine grained limonite with approximately 35% water content. The ore consists of serpenized peridotite, very broken material with boulders. (Max ore layer drilled is 26m). The mine has more or less finished the exploration drilling of Konde South, about 1500m of ODEX-drilling has been drilled. Average drilling depth about 25m, the deepest hole drilled was 33m. The mine has soil samples from each metre drilled. For each metre drilled the sample is measured by volume and weight. Some holes have been checked and full sample recovery have been obtained. By using other reverse circulation methods the sample recovery has been nil or very small and due to the moisture content the samples have clogged the casing tube. Diamond drilling has been unsuccessful due to boulders. The mine can today use auger drilling til they hit the first boulder, then they switch to ODEX. After drilling through the overburden and the ore 3m is drilled into the bedrock.

Since March 1978 all drilling is done by Indonesian drillers. No resharpening of bits have been done. The mine has now tools for the grinding operation and the life of the equipment will increase. Today 200-250m is obtained on the pilot bit and 125m of the reamer bit. The reason for failures is overdrilling. The mine will get higher life figures when they start resharpening of the bits. Threaded casing tubes are used by recommendation from A.C. Canada. The measurements of the casing tubes are O.D. 5 9/16" and I.D. 5" (5 1/6"), the measurements of the ITH-pipes are 3 1/2". Experience from their operations indicate that they will continue using these dimensions.

180071

Phone: Bus. 275 3115

A.H. 372 1263

Telegraphic Address: "KITCHCON" SALISBURY

Kitching

11 LILLIAN AVENUE
SALISBURY, BRISBANE 4107
P.O. Box 211, Rocklea, 4106

**DRILLING CONSULTANTS
& SUPPLIES PTY. LTD.**

8th February, 1979

The Chief Geologist,
Serem (Aust.) Pty. Ltd.,
G.P.O. Box 443,
SYDNEY. 2001

Attention. Mr. D. J. Casey

Dear Sir,

I have today received your letter, regarding your forthcoming drilling programmes in the Kings Plains and Lee Creek areas.

Firstly, I would like to briefly explain to you our method of successfully sampling your type of deposits. As you are aware, it has always been a problem to take accurate samples in such unconsolidated material. Although a hole can be successfully kept open by rotary mud drilling, it does not necessarily follow that the true sample reaches the surface. In fact, in nearly all cases, the sample is continually polluted by the continual unconsolidated stratum in the upper parts of the hole.

Not only is the sample a false one, but the method is messy and extremely slow and expensive and compared to the modern jet stream method - quite inefficient. The inception of our jet stream method commenced exactly ten years ago, and it was not until approx. two years ago, that we made major breakthroughs in equipment design, and above all, drilling technique.

With our small Toyota mounted units, we have successfully sampled areas to fifty metres in coarse alluvial areas, recovering aggregate up to 1½" in diameter. The method is such, that samples from the area being drilled are almost instantaneously deposited in a bucket or plastic bag, through a catcher which is situated beside the drill and easily handled by samplers. The method is so fast and efficient, that it takes at least two good samplers to change bags or buckets every metre.

If a large boulder is encountered which halts the bits' penetration, the bag or bucket is removed until the bit pushes past the obstacle and then replaced again. This keeps the sample uniform and then all metre samples are approximately the same size. We have in the past, encountered very large and substantial boulder areas, which are usually cemented together with clays and solid sediments. These types of stratum are usually difficult to penetrate.

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However, we have largely overcome this type of situation by setting up the unit at a 45° angle, and this allows us to either skid off the top of the large boulder or drill under it. It has proven a highly successful method in large aggregate areas. There has been a tendency over the years for Geologists in alluvial areas to want all of the stratum being drilled to determine, in the future, the type of dredge which may be used for recovery, if the deposit proves viable.

I would venture to suggest here that such drills do not exist to take large boulders, as well as all of the finer aggregate. The Caldwell is the only one and it is limited to depth and type of deposit being drilled, and again, it is extremely large, slow and expensive.

We have proven over many years and metres of drilling that the experienced operator and Geologist "on the job" can successfully determine the size of larger aggregate being drilled. This know-how coupled with local knowledge of the topography, gives one all the information which is needed to determine the future working of the deposit. Finally, we have also proven that the smaller the drill stem size, the more efficient the method is. After all, if the largest payable aggregate which comes up the tube is 1½", then all other larger aggregates will be nothing short of a "bonus issue".

Our drill stem cuts a maximum hole of 2½" and being flush jointed, rarely gives trouble of being "hung in the hole". In easy going - such as beach sands and fine alluvials, it is not uncommon to reach 300 metres per day in holes up to about 30 metres in depth. We consider a bad day to be 150 metres.

I consider our technique and equipment is second to none in Australia, and we would only be too pleased to demonstrate it to you should you so desire. I am sure that "seeing is believing". For conclusive proof of our performance in the field, regarding the larger size alluvials I would suggest that you speak at length to Mr. A. J. O'Toole, a consulting Geologist for whom we have done considerable work. Also with Mr. W. Maehl, North Queensland Manager for Geopeko Ltd., for whom we carried out work on and adjacent to the Bloomfield River, Nth. Q'ld.

Their addresses are.-

Mr. A. J. O'Toole, 8 Hendon Road, Wilston Heights, BRISBANE.	Phone	3563606	Private
		2611044	Business.

Mr. W. Maehl, P.O. Box 501, HERMIT PARK TOWNSVILLE	Phone	(077) 793858	Business.
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180073

Phone: Bus. 275 3115

A.H. 372 1263

Telegraphic Address: "KITCHCON" SALISBURY



Kitching

DRILLING CONSULTANTS & SUPPLIES PTY. LTD.

17th November, 1978

11 LILLIAN AVENUE
SALISBURY, BRISBANE 4107
P.O. Box 211, Rocklea, 4106

The Manager,
Amdex Mining Pty. Ltd.,
P.O. Box 147
NORTH SYDNEY. 2060

Attention. Mr. A. Fleming

Dear Sir,

Relative to our telephone conversation of October 15th., concerning the reverse circulation equipment originally manufactured by us for Australia Cities Services several years ago. I understand that the small rig and equipment was sold by Cities Services to Swiss Aluminium who in turn sold it to Aquitaine, who in turn have turned it over to your Company to use.

Firstly, let me make it clear that we do not manufacture this equipment for sale to anybody who wants to buy it, mainly because.-

- a. It costs too much
- b. It is specialist's equipment developed by us over a period of years at great expense and hardship, and it is only recently that we have been starting to capitalise on the commercial use of this technique. The only way in which we have been able to gain financially, is to privately negotiate with Companies who wish to capitalise on our equipment and technique.

Let me also explain at this juncture that even though our equipment has been copied by others, they have never been able to efficiently use it and gain the ultimate results we do ourselves. Simply because it is a specialist operation. The attitude that "Any good driller will do" just does not apply, because one has to completely understand the system before he can work it.

As mentioned to you by telephone, of all the personnel I have tried to teach to operate the equipment and grasp the technique, I have not even averaged 1% only because, they simply haven't got what it takes.

..2 contd.

Having been the only commercial drilling consultant in Australia for many years, I have found that this also applies to other phases of the drilling industry, and it is simply a fact that very few top drilling men exist, mainly because they have never had any knowledgeable tutors in their youth.

I have taken the time to try to explain our situation, because it is not only our wish to "keep our hands on this equipment" for as long as possible, but also, to ensure that our equipment and technique does not obtain adverse publicity caused by those who think they are astute enough to handle it.

So therefore Mr. Fleming, I would urge you, contrary to what you may hear of how easy the equipment is to copy and operate, to completely ignore such advice, 'because it is just not on!'

I give you this advice to save you needless expense in manufacture and operation. It is my opinion that the personnel in our organisation are the only ones in the country who are fully competent to operate this equipment, which I have developed, and it is with this in mind that I will make the following proposals.

At your invitation, I would visit you and the site where the machinery is stored and determine what condition it is in, and in fact, decide whether it can be up-graded and renovated to comply with our present standards of operation. Such a visit would be to your expense and would include a daily charge for this service.

If it was decided between us that the equipment had to be upgraded to our specifications, then it would be desirable from our point of view to enter into an agreement with your company to operate this equipment on a profitable basis for our own organisation.

Such an agreement would entail payment of a daily rate for one or two of our operators, plus an amount per metre over a period of approx. six months. Such agreements in the past have been entirely acceptable to other clients and particularly, to those who have tried to operate the equipment themselves, and failed dismally.

Another point of contention regarding the supply of our equipment and technique is that we are currently undergoing negotiations with another firm who wish to purchase our Company, together with our drilling machines, mainly for our expertise in the reverse circulation field. It is my opinion and that of some others in the exploration industry that alluvials, particularly gold, and tin are now the direction in which mining companies should go because of the facts that, not only are these metals going to hold their world market, and in fact improve, but also because alluvials are much easier and cheaper to mine and process.

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Andex Mining Pty. Ltd.,

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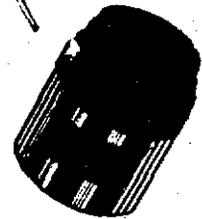
180075
17th November, 1978

It is my hope that you understand our situation and also that we may meet and discuss the possibility of some future joint venture.

Yours faithfully,



John Kitching,
Managing Director.



Kitching

180076

Phone: Bus. 275 3115

A.H. 372 1263

Telegraphic Address: "KITCHCON" SALISBURY

11 LILLIAN AVENUE
SALISBURY, BRISBANE 4107
P.O. Box 211, Rocklea, 4106

**DRILLING CONSULTANTS
& SUPPLIES PTY. LTD.**

The Chief Geologist,
Serem Aust. Pty. Ltd.,
G.P.O. Box 443,
SYDNEY. 2001.

Dear Sir,

I write to you with regard to any future drilling and sampling programmes which you may carry out in the future, either over water or on land.

For the past eight years we have been developing a reverse circulation technique, which we have now perfected to a degree where we can sample any type of strata, except excessively hard rock. We can penetrate the Brisbane clays and alluvials at the rate of approx. 120 feet per hour, and fine sands whether dry or wet, in approx. 180 feet per hour. All samples are instantly deposited into plastic bag or bucket in true uncontaminated form. Using the same drilling bits, we can also core medium to hard sandstones in the same operation. The small cores, approx. $\frac{3}{4}$ " diameter, being deposited in the bag or on the ground in the same manner.

The drills are mounted on Toyota Land Cruisers and can be put on barges to drill over water, in depths of up to 70 feet, and then a further 100 feet into the sea bed. We have at times drilled in excess of 1000 feet per day. By way of our success in this drilling technique, you may check with some of our past clients, as follows. -

Coffey & Partners, Southport
Coffey & Partners, Brisbane
Mineral Deposits, Southport

Australia Cities Services, Sydney
Dillingham Mining
Robertson Research, Sydney
Pioneer Concrete, Brisbane
Geopeko Ltd., Mount Morgan
Geopeko Ltd., Townsville
Geopeko Ltd., Sydney
G.E.S. Pty. Ltd., Brisbane
Unimet Ltd., Sydney
Kallangur Sand & Gravel Brisbane

Mr. Simon Lo
Mr. S. McPherson
Mr. L. Johnson, Geologist
Mr. P. Grenning, Manager
Mr. J. Cucvara, Manager
Mr. W. Everson, Manager
Mr. N. Grollman
Mr. D. Gordon
Mr. R. Kitching
Mr. W. Maehl
Mr. K. Wright
Mr. H. Jensen Manager
Mr. D. Shatwell
Mr. A. O'Toole, Geologist
..2 contd.

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..2 contd.

- Oct. 78.

Our largest job to date was approx. 25,000 feet of drilling for Australia Cities Service over water and on mud flats on the King River delta in Tasmania. Our most recent job, which is still being carried out over water and on land, is at the Bloomfield River, south of Cooktown for Geopeko Ltd. We have also carried out work for this Company on their uranium deposits in Arnhem land.

To show you the authenticity of our drilling technique, we would like to give you a demonstration at your convenience, in the hope that we may be of future assistance to your Company. We believe that our drilling technique, particularly in unconsolidated formations and over water is a major breakthrough in the industry.

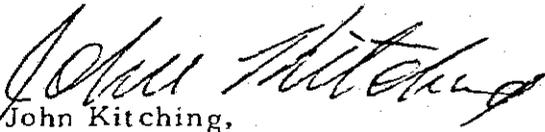
We would also like to mention that we work closely in conjunction with Mr. A. J. O'Toole of Geological Research Services, who specialises in offering Geological Services to the exploration and Civil Engineering industries.

Mr. O'Toole has a vast experience in the Mining and Metallurgy field, covering a span of twenty years, since graduating from the University of New South Wales, where he gained his Bachelor of Science degree, majoring in Economic Geology.

His experience during this time has covered Exploration - Research - Metallurgy - Metallics - non-metallics - sand and gravel and heavy minerals.

We look forward to being of assistance to you in the future, and ask that you call us, should you have any interest in our services.

Yours faithfully,



John Kitching,
Managing Director.

Memorandum

From	Department	P.G. HASKINS	Ref	Date	16.02.79
To	AMDEX - A. FLEMING.				
	Copy to B.L. KULBICKI.				
	Your Reference				
	Attachments				
	<u>Subject</u> <u>Rionex A.C. Drilling.</u>				
	<p>Following our discussions it seems quite clear that we are not ready to purchase a second hand rig at this stage - especially one of Mr. Barding's museum pieces. By the way the Rionex P160 rig as advertised went for \$27,000.00, which is well above the limit set by G. Kulbicki.</p> <p>The remaining alternatives, as discussed with Steve Everett, A: - trying to improve bit design on the Kitching rig & importing our AC axilles from Kunenauwa or B: - using a test by W.L. Sides & Don Pk remain unchanged.</p> <p>I have been unable to contact Dave Jones at Van Moppes as he is absent. Notwithstanding this I have looked at our costs & the lag points in putting our man in & getting the Jarrow going. I don't think the economics are really favorable. It would appear much more attractive to put Sides in, knowing the cost beforehand, with a big rig in sound condition. Should Sides' operation prove effective in the sampling then we ^{will} know the cost of the exercise per metre & be able to use this as a yardstick. The final decision on continuing contract, second hand medium rig or revamping the Jarrow can then be made quite fairly.</p> <p>P.D.</p>				

The first authority will have to come of course through the proper channels. At present I can only recommend that we utilize Steyer, which I will be doing by not to C. Kubicki on his return.

TO	FROM	DATE	REMARKS

180079

078

079

180080



5 COLONSAY ST.,
MIDDLE PARK, QLD. 4074
BRISBANE
AUSTRALIA
TELEPHONE
OFFICE: 277 5378
A/H.: 376 2821
TELEX: AA 40626

Mr. Peter HASKINS to P.H. please
16th February 1978
Aquitaine Australia Minerals Pty Ltd
P. O Box 725
NORTH SYDNEY . N.S.W. 2060

Dear Peter.

I am enclosing a copy of the paper
in R.C. presented by P. WICKLUND
from AMAX at the Adelaide drilling
Symposium

Please give my regards to all the
one I know at Aquitaine.

Yours Sincerely,

[Signature]
D. BOSQUET

19 FEB 1979	
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ROTARY REVERSE CIRCULATION DRILLING IN FIJI

By A. P. WICKLUND - MANAGER OF DRILLING OPERATIONS

AMAX EXPLORATION, INC. - DENVER, COLORADO

During the past year, Amax in conjunction with three other mining companies have carried out a reverse circulation drill program using double wall pipe on two copper properties inter-connected and known as Waisoi East and Waisoi West located some 19 miles northwest of Suva, the capital city of the Fiji Islands and near the village of Namosi.

Prior to 1977, eighty one diamond drill holes were drilled into these properties utilizing helicopters as the primary means of transportation. Drill holes in the quartz monzonite rocks were spaced about 450 ft apart in Waisoi West, where core recovery averaged about 90 percent, and 650 ft apart in Waisoi East, where core recovery was between 70 to 80 percent. High water flows were common in many holes and encountered at various depths. The areas of poor core were usually in highly altered and fractured zones of mineralized rock. Because of the lack of complete core information, it was believed by our Geologists that the results of the assays for copper were lower than what was expected and they wanted to know what could possibly be done to obtain drilling results in excess of 95 percent.

Having drilled various size core holes, BQ, NQ, and HQ on the previous programs and used various types of core barrels, diamond bit designs and mud programs, we looked to alternative methods of drilling. The ideal drilling method selected must be capable of recovering all the sample. It was hoped that the copper grade could be increased by 10 percent over the original calculated values.

In checking the drill results of a project Amax had in 1968 using reverse circulation drilling for sulphur, we determined that our chip sample recovery was 100 percent. We started putting together a drill program utilizing a contractor with reverse circulating rotary equipment and at the same time we checked on various kinds of tracked carriers for mounting the drill equipment. We also had to determine, prior to moving this equipment to Fiji 6000 miles away from the west coast of the U.S.A., if it was feasible and practical to use this kind of heavy equipment on the project site in Fiji.

Physical problems which must be completely understood and dealt with were:

- 1: An all weather road 11 miles long has to be designed and built into the area to service the drill program and camps. All access roads from the camps to the drill sites had to be built to support the rotary equipment. Elevations varied from 800 to 1300 ft in the area where work was to be done.
2. Average rainfall on the property is 240 inches per year which at times causes flooding of the river which flows by the base camp and over a considerable part of the Waisoi East drill target area.
3. The area is in a rain forest with trees growing over 100 ft high, vines hanging to the ground with heavy undergrowth. Humidity is always high (imagine yourself working in a greenhouse), and proper maintenance of the equipment would be required.

- 2 -

4. Weather conditions have oxidized the sulphides near surface changing the volcanic rocks to lateritic clays that when exposed by a bulldozer turn to muds which near the river beds or in areas of poor drainage, makes it near impossible to walk.

5. The mountains which are completely vegetated rise sharply making access difficult. When making a road 14 ft wide, required for the equipment, you would expose a lateritic face on the side of the mountain up to 60 ft high with grades of the road of up to 20 percent and sometimes steeper.

6. Rock studies from drill cores showed that the hardest rocks on the property to be drilled had a compressive strength of 28,000 P.S.I., and in many areas were highly abrasive, altered, and fractured. Weathering of the rocks was common down to 100 ft and in some cases 320 ft. It was desirous not to use drill mud if possible, although we were prepared with foams, muds and various additives in the event they were required.

7. In addition to the Geologic problems, artesian flows could be expected in some holes and elsewhere in the valleys the water table was just under the grass roots. In the mountains, water could be up to 300 gallons per minute. Add the drill cuttings to the volume of water and it became a matter of concern in splitting and collection.

8. A camp with additional housing would have to be provided for the drill crews and their families. The main base camp would have to be expanded, shops built and the size of storage facilities increased.

PREPARATION OF EQUIPMENT

The drill equipment must be capable of drilling and setting a 6" casing through the overburden. It further must be able to drill using the reverse circulation method to 1,200 ft with 4-1/2" drill, pipe which weighs 20 lb. per foot cutting a 5-1/4", 5-1/8", 5" and 4-7/8" hole. The drill should provide variable rotational speeds preferable with a top head drive and have a minimum pull down pressure of 30,000 pounds. This amount of pull down coupled with the weight of the drill pipe and drill collars would be more than adequate to tricone through the hardest known rocks on the property. In addition to tricone bits of various tooth design we also arranged for button bits, down hole hammers, and a PQ core barrel in the event we wanted a spot core.

The drill must have high pressure air 250 P.S.I. and a separate booster compressor which could boost the air to 1,000 P.S.I. to combat the excessive water flows that could be encountered.

TWO TYPES OF SAMPLING EQUIPMENT

One type of sampler which was built consisted of a deaerating cyclone to separate the air from the rock cuttings and water. The air/water/cuttings mixture enters the cyclone tangentially at the upper rim and hits against replaceable wear plates so as not to eat out the sides of the cyclone. The air is dissipated through the top of the cyclone and the water/cuttings mixture drops down and through a bottom outlet with four equal spaced collecting troughs, each designed to cut 1/32 of the complete circle. With all collection troughs exposed to the stream flow, the splitter takes an 1/8 sample with 7/8 of the sample being discarded.

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- 3 -

The second type of sampler made was a filtering system which collected the samples in two stainless steel circular tanks with a filter paper which could contain 5 micron size particles, resting on a 6 mesh backing screen and polyethylene grid. Sealing of the filter paper in the pan was achieved by an aluminum ring 12" deep with rubber tubing on the base. The ring was approximately 4 ft in diameter. The vacuum pump provided a vacuum of 26 inches of mercury which pulled the water through the filter paper, leaving the sample on the paper. The sample and paper would be sent to the drying ovens.

The drying ovens were also custom built and developed temperatures between 150° and 200° centigrade.

CONTRACTOR AND DRILL EQUIPMENT

Amex negotiated a contract with Drilling Services, Inc. for 49000 ft provide one drill foreman, 3 drillers, and 1 mechanic and a portadrill model 100L drill. The drill alone weighed approximately 20 tones and had one leveling jack on the front of the drill and two on the rear. This drill met all the requirements in a drilling machine we wanted such as:

The rotary top head drive was powered by a hydrastatic transmission system. A hydrostatic motor provided infinitely variable speeds from 0 - 145 RPM with a torque of 4800 foot pounds. The top drive head could be hydraulically pivoted out of the mast when pulling drill pipe.

The power unit on this machine was an 8V-71 GMC diesel, the same as that which powered the FN 360 carrier. A complete 8V-71-GMC spare engine block was sent as back up for the FN 360 carrier and/or the drill. Water injection was supplied by a triplex positive displacement pump 0-20 gallons per minute. The mast with a four part line had the rate capacity of 60,000 pounds.

Pull down-holdback-feedoff which normally is infinitely adjustable using 5" hydraulic cylinders to 30,000 pounds were replaced with 6" diameter hydraulic cylinders. A clark air booster was supplied by the contractor which develop 1000 PSI air capability. A 5x6 gardner denver pump was furnished to be used if required. In addition the contractor furnished supply pumps, a 15 KW generator, electric welder, and numerous spare parts for all his equipment.

The drill was sent to Calgary, Alberta for mounting on the FN 360 carrier. We foam filled the 8 weight supporting tires (each tire weighted in excess of 500 pounds). Each track on the carrier is 5 ft wide and 27 ft long. Ground pressure for the drill and carrier when mounted would be four pounds per square inch on a unit which would weigh in excess of 40 tons. We put in a heavy duty transmission and also changed the final drive of the soft tracks to a 4:1 reduction. With the above changes we could float on mud or drive the equipment up a 45 degree slope, and never have to worry about a flat tire due to excessive weight on four of the eight tires when going up or down steep grades. The axles on the FN 360 carrier had steel walking beams with urethane bearings to keep surface contact of the tracks to a maximum when crawling steep grades or going over obstacles. In addition to the tracked drill carrier, two model FN 240 soft tracked carriers were obtained: one to be used as a pipe carrier which held 1000 ft of pipe and the other equipped hydraulic with a crane capable of extending the boom crane to 28 ft and pick up a 2000 pound load and rotate through 360 degrees for accurately placing the sampling and other equipment as required. This crane was extremely useful in pulling up timbers out of the mud on completion of holes and in moving from one location to another. Two county model 4-wheel drive tractors were used as personnel carriers and to carry drill cuttings up to the drying ovens.

LING METHOD

A 5-1/8" hole using reverse circulation was drilled from surface until confirmed by a geologist that fresh volcanic rocks had been encountered. The hole was then reamed out to 8-1/2" in diameter and a 6 inch casing was set down above the fresh volcanic rocks.

Since each hole was planned to a certain depth, say 1000 ft we would drill approximately to 330 ft, rotating at approximately 22 RPM using a 5-1/8" Tri-cone bit, the second 330 ft with a 5" Tri-cone rock bit and the last 340 ft with a 5-1/8" Tri-cone rock bit. Rock bits were run for a period not to exceed 22 hours during that time footage drilled on one bit varied from 200 ft to 400 ft depending primarily on rock types drilled and bit types used. During each of the above drilled intervals, we would place a wear sleeve just above the bit which was 1/8" diameter smaller than the hole size. The wear sleeves proved crucial in preventing foreign material from falling down the annulus between the drill pipe and the wall of the hole and it became standard practice to replace the wear sleeves as soon as they were worn down 1/16" in diameter. Two drill collars (3/4" in diameter x 20 ft long) were run above the wear sleeve to give additional hole weight to the bit. The remainder of the drill string consisted of 2-1/2" double wall pipe. The inner pipe had a diameter of 2-1/4 inches. The primary compressor would force air down the annulus of the two pipes. Water was injected with a bean triplex pump into the air system at the start of a hole to prevent the O rings in the inner couplings from drying out which effect a seal on each 20 ft length of pipe. When groundwater was encountered the water injection pump would be shut down as the groundwater performs the same function as the injected water.

In order to assist in lifting the large volumes of water which would be lifted by the drill string each time a drill pipe was added, small holes were drilled (1/8" diameter) at a 45 degree angle upwards from the outside of a special inner pipe coupling so that as air was being forced down the annulus of the two pipes, some of the air would pass through the smaller holes and return to the surface. These couplings were spaced every 200 ft. During this process groundwater is lifted up the center pipe which helped unload part of the water in the drill string so that the compressor did not have to overwork by building up pressure to unload the water in the entire drill string all at one time on deep holes. When the holes reached depths of 500 ft, the Clark booster compressor would be activated which had the capacity of 1000 PSI. The maximum pressure used in an 1000 ft hole was 750 PSI. At the tricone rock bit the air groundwater rock chips are combined with the exception of what air crossed over through the special inner couplings. Most of the air went down to the bit and was deflected up the inner drill pipe. When the air overcame the hydrostatic pressure in the hole and the drill string, it combined with the water/cuttings to make a slurry which moved at 1000 to 5000 ft per minute up the center pipe. The speed of the slurry increased as it advanced up the pipe due to expansion of the air as it got closer to the surface. The groundwater which flowed toward the hole via fractures went down the annulus between the pipe and wall rock and up the inner pipe. This flow of water assisted in bringing all the drilled cuttings to the surface.

After the slurry of water and chips went through a specially designed screen it would pass into a 4" rubber hose-go through a pipe 6 inches in diameter into the deaerating cyclone. Even with this deceleration, the slurry still hit the cyclone at about 1500 ft per minute.

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The sample after going through the deaerating cyclone would drop through to the splitter which was rotated at a constant speed of approximately 45 RPM by an air motor. Although we had the capability of 1/8", 1/16" and 1/32" splits, all of our sampling was with the 1/8" split. Periodically we would catch the 7/8 split which was normally discarded and run an assay check against the 1/8 split for that same zone.

The sample in situ drilling with a 5 inch diameter bit assuming a specific gravity of 2.56 should weight 160 pounds per cubic foot. So the theoretical sample weight was 215 pounds for a 10 ft drilled interval. Since we obtained samples every 10 ft in addition to the chips, we also obtained on the average about 3000 gallons of water. The split of the rock weighed 27 pounds and was accompanied usually with 530 gallons of water.

We originally started out collecting the samples in rubbish bins but too many were required, so galvanized tanks were made up 7' 8-1/2" long - 4 ft wide - and 2' 7" high able to hold 580 U.S. gallons. Four tanks were made up and by adding a length of 3" rubber pipe to the bottom of the splitter we were able to reach all of the tanks. In most cases a 10 ft sample run (which took one half hour to drill) could be caught in one tank. The tanks were equipped with decanting plastic hoses so that after a flocculating agent was added to the drill cuttings water mixture and allowed to stand for 15 minutes to 30 minutes, all the material in solution would settle and clear water decanted off. Crews would then clean out the tanks with plastic dust pans and finally a rubbish bin was placed under a drain in the bottom of the tank and with a hole of clean water spraying a fine mist we would catch all the cuttings which were in a slurry of 15 to 20 gallons of water.

These samples were then taken up to the area of the drying ovens and put into the filter pans where the vacuum pump pulled the excess moisture through the filter paper leaving the residue of drill cuttings on the paper. The filter paper and cuttings which contained 12 percent moisture were placed in stainless steel pans and into the ovens. Drying the sample usually took from 8 to 12 hours. After drying the sample was weighed and sent to the laboratory for analysis. A geolograph was operated to determine penetration rates and depths of hole as well as time consumed in the various drilling operations.

CONTAMINATION

Because of the weights of the sample varied at times for each interval drilled and visual contamination could be seen on occasions, it was believed that the contamination was on the order of 1 to 5 percent. The contamination was thought to be caused by chips spalling off the sides of the hole and being sucked up in the inner string. By utilizing larger diameter wear sleeves (in some cases tolerances were up to 1/32") we could contain the contamination to less than 1 percent. To check where the contamination was coming from various tests were run:

- 1) Blow tests whereby the drill pipe was raised off the bottom of the hole and with the compressor running but with no pipe rotation, we collected the sample and ran it through the splitter.
- 2) Blow tests with the pipe rotating at the same speed used in drilling and with the compressor operating, all the sample was again run through the splitter.

In both cases, fine particles were being picked up but had little or no copper values.

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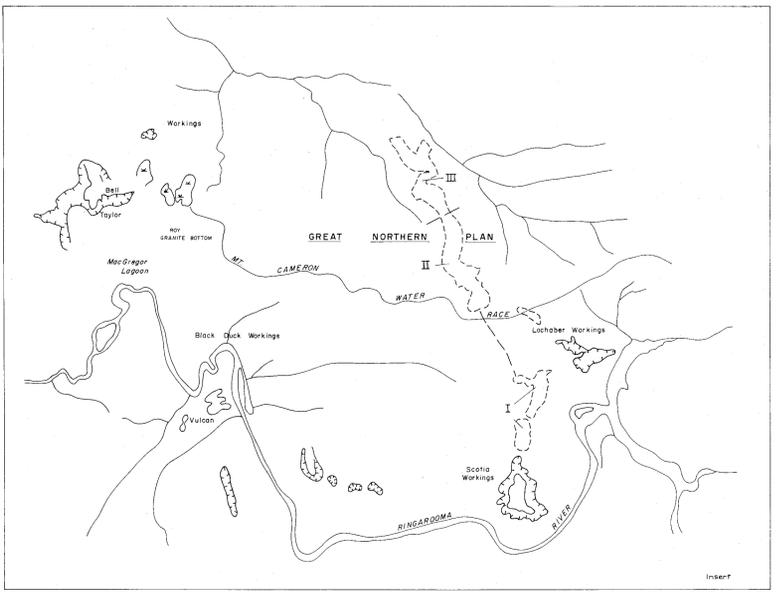
A caliper tool was brought into gauge the hole after each size bit had been run from the bottom of a particular bit size to surface. After this was done for the three size bits used in drilling a hole, an overlay of all three graphs obtained from the printed logs alerted us as to what zones were breaking down and to what extent. We could also tell from assays obtained from a particular section as to whether there were any copper values in the zones which were eroding.

CONCLUSIONS

The entire drill program turned out to be a success because of team effort by contractor and Amax personnel. Work started June 5th 1977 and was completed February 15th 1978. It was projected to get 180 ft per day and production was 212 ft per day with our best day of 500 ft in a 24 hour period which included moving and setting up. Costs were anticipated at \$20.57 where in actual cost were \$21.00 per ft. Not once were the crews stuck to the extent that drill pipe was lost down any hole.

Because on previous drill programs the diamond drills would non-core with roller bits to competent rock reverse circulation proved that the mineralized zone in Waisoi East and 15 to 20 ft closer to the surface.

The results obtained have justified the start up of phase II which will be a 53,460 ft drilling program using once again diamond drills, taking large diameter cores for metallurgical testing as well as engineering and hydrological studies with fill in drilling between previously drilled holes with a minor amount of exploration holes.



- Mines Department Hole
- ⊙ B.M. Hole
- S1 Storey's Creek Hole
- S3 Kibuka Hole

AMDEX MINING LIMITED
 SCOTIA LEAD
 ORE RESERVE PLAN 180087

Scale: 1" = 300' Ft. Date: December, 1976
 Data by: Amdex - C. Gibson
 Traced by: K. Stewart

