560-6-5-1

REPORT PREPARED FOR:

ACCURATE EXPLORATION LTD., CALGARY, ALBERTA, CANADA

SPARKER SURVEY
FORT NORMAN,
MACKENZIE RIVER AREA
N.W.T.

JULY, 1959

REPORT PREPARED BY:

MARINE GEOPHYSICAL SERVICES INTERNATIONAL INC.

DATE: 31 OCTOBER, 1959

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2. NAVIGATION BASE, MAP SCALE 1 INCH = 1 MILE, SURVEY (FIX) LOCATIONS GIVEN BY TIME OF DAY.

INTRODUCTION

THE SPARKER SURVEY NEAR FORT NORMAN ALONG THE MACKENZIE RIVER, FOR WHICH THE INTERPRETATION IS GIVEN HEREIN WAS CONDUCTED JOINTLY BY MARINE GEOPHYSICAL SERVICES INTERNATIONAL INC., HOUSTON, TEXAS, U.S.A. AND ACCURATE EXPLORATION LTD., CALGARY, ALBERTA, CANADA, FOR THE ACCOUNT OF ACCURATE EXPLORATION LTD.

THIS SURVEY WAS CONDUCTED DURING THE MONTHS OF JUNE-SEPTEMBER, 1959, ALONG THE MACKENZIE RIVER AND ITS TRIBUTARIES. THE INTERPRETATION GIVEN IN THIS REPORT COVERS ONLY THAT PORTION OF THE SURVEY FROM LAT. 64° 28', LONG. 124° 47' TO LAT. 64° 55', LONG. 125° 49' ALONG THE MACKENZIE RIVER.

THE SPARKER EQUIPMENT WAS OPERATED BY MR. J. J. SIMMONS OF MARINE GEOPHYSICAL SERVICES INTERNATIONAL INC. THE NAVIGATION, BOAT OPERATION, LOGISTICS, AND OVERALL SUPERVISION OF THE OPERATION WERE HANDLED BY ACCURATE EXPLORATION LTD. THE NAVIGATION CONTROL WAS DETERMINED FROM TIME PHOTOGRAPHS OF A RADAR SCREEN ON THE SURVEY BOAT AND FROM SEXTANT ANGLES TAKEN FROM THE SURVEY BOAT. THE NAVIGATION BASE MAP WAS PREPARED BY ACCURATE EXPLORATION LTD.

SURVEY [illegible]

THE SURVEY COVERED BY THIS REPORT CONSISTED OF A SINGLE TRAVERSE ALONG THE MACKENZIE RIVER. THE NAVIGATION FIXES (LOCATION POINTS) WERE TAKEN AT IRREGULAR INTERVALS ALONG THE TRAVERSE. THESE POINTS, ALONG WITH THE INTERPOLATED LOCATION POINTS, ARE DESIGNATED BY THE TIME OF DAY OF THE SURVEY BOAT'S LOCATION ALONG THE TRAVERSE, E.G., 1820, AUG. 5, 1959. TIMES ARE GIVEN ON

THE BASIS OF A TWENTY-FOUR HOUR CLOCK. LOCATIONS ALONG THE SURVEY TRACT, WHICH ARE DISCUSSED IN THIS REPORT, ARE REFERRED TO BY THE TIME OF DAY FROM THE SURVEY.

THE SPARKER ELECTRODE AND HYDROPHONE WERE TOWED 250 FT. ASTERN OF THE SURVEY BOAT. THE NAVIGATION BASE MAP SUPPLIED BY ACCURATE EXPLORATION LTD. WAS MADE WITH RESPECT TO THE SURVEY BOAT. CONSEQUENTLY, THE SPARKER DATA SHOULD BE PLOTTED 250 FT. ASTERN OF THE LOCATIONS SHOWN ON THE NAVIGATION MAP. HOWEVER, ON THE MAP SCALE USED, 1 INCH = 1 MILE, THIS MAKES AN IMPERCEPTIBLE DIFFERENCE.

THE SURVEY WAS MADE BY THE SURVEY BOAT PROGRESSING DOWN THE RIVER. THE SPARKER ELECTRODE AND HYDROPHONE WERE STREAMED BEHIND THE SURVEY BOAT, AND A CONTINUOUS SEISMIC (SPARKER) PROFILE WAS OBTAINED AS THE BOAT PROGRESSED DOWN THE RIVER.

AT THE TIME A NAVIGATION FIX WAS TAKEN, THE SPARKER OPERATOR ACTUATED A SWITCH WHICH MADE A MARK ON THE SPARKER RECORD. THIS PRESERVED DIRECTLY ON THE SPARKER RECORD THE NAVIGATION LOCATIONS.

THE SURVEY BOAT SPEED VARIED FROM 5 TO 10 MILES PER HOUR, DEPENDING UPON THE VELOCITY OF THE RIVER CURRENT. THE HIGH RIVER CURRENT VELOCITY DID PRODUCE A HIGHER NOISE LEVEL THAN IS EXPERIENCED IN NORMAL SPARKER PROGRAMS.

PRINCIPLES OF OPERATION

THE EQUIPMENT USED WAS THE SPARKER; A CONTINUOUS SEISMIC PROFILER DEVELOPED AT THE WOODS HOLE OCEANOGRAPHIC INSTITUTION. IN THIS SYSTEM, A HIGH VOLTAGE CIRCUIT IS CLOSED AT REGULAR INTERVALS, CAUSING AN ELECTRICAL DISCHARGE TO OCCUR BETWEEN TWO ELECTRODES IN THE WATER.

EACH DISCHARGE (SPARK) CAUSES A LOCAL ELECTROLYTIC BREAKDOWN IN THE WATER, WHICH IS ACCOMPANIED BY ELASTIC VIBRATIONS OF AUDIO FREQUENCY. THE PULSE OF SOUND ENERGY SO FORMED, TRAVELS DOWN THROUGH THE WATER AND IS PARTIALLY REFLECTED FROM THE BOTTOM AND FROM VARIOUS STRATA BENEATH THE BOTTOM. THE REFLECTED PULSES ARE DETECTED BY A HYDROPHONE; THE SIGNALS ARE THEN AMPLIFIED, FILTERED, AND RECORDED. THE OPERATOR USES AN ELECTRONIC FILTER TO SELECT THE BAND OF SOUND FREQUENCIES WHICH GIVE THE BEST POSSIBLE RECORD OF THE REFLECTIONS FROM THE GEOLOGIC STRATA BENEATH THE BOTTOM.

THE RECORD IS COMPOSED OF A SERIES OF VERTICAL SCANS BY THE RECORDER. EACH SCAN BEGINS WITH A SPARK PULSE IN THE WATER AND RECORDS THE SERIES OF ECHOES FROM THE SPARK. SINCE THE SCANS ARE PLACED SIDE BY SIDE ON THE MOVING PAPER BY THE RECORDER, A CONTINUOUS GEOLOGIC CROSS SECTION IS FORMED.

FOR A MORE COMPLETE DESCRIPTION OF THE OPERATION OF THE SPARKER PLUS SOME SURVEY RESULTS THAT HAVE BEEN OBTAINED IN VARIOUS AREAS, REFERENCE MAY BE MADE TO THE FOLLOWING: MARCH 13, 1959 ISSUE OF Petroleum Week; APRIL, 1959 ISSUE OF World Oil; JULY, 1959 ISSUE OF Offshore; AND THE AUGUST 14, 1959 ISSUE OF Oil Week.

INTERPRETATION

THE RESULTS OF THE INTERPRETATION ARE GIVEN ON THE ENCLOSED MAP.

IN GENERAL, THE OVERALL RECORD QUALITY FROM THIS SURVEY WAS SOMEWHAT BELOW PAR. THIS WAS DUE CHIEFLY TO THE HIGH NOISE LEVEL CAUSED BY THE HIGH BOAT SPEED DOWN THE RIVER. HOWEVER, IN CERTAIN SMALL AREAS ALONG THE SURVEY TRACT, THE RECORD QUALITY WAS EXCELLENT. IN THESE SPECIFIC AREAS, A VERY STRONG REFLECTION COULD EASILY BE

FOLLOWED ALONG THE RECORD UNTIL ITS DIP TOOK IT OUT OF THE RANGE OF THE INSTRUMENT. ALONG THESE SEGMENTS A GREAT AMOUNT OF DETAIL COULD BE OBSERVED, INCLUDING THE LOCATION OF SMALL FAULTS AND OTHER RATHER DISCRETE STRUCTURAL FEATURES. THESE AREAS OCCURRED AT THE FOLLOWING PLACES ALONG THE SURVEY TRACT: 1941-2008, AUGUST 4TH; 0933-0943, AUGUST 5TH; 1040-1050, AUGUST 5TH; 1106-1115, AUGUST 5TH; 2105-2129, AUGUST 6TH; 2215-2232, AUGUST 6TH; AND 0952-1017, AUGUST 7TH. AN ELECTROSTATIC REPRODUCTION OF THE SPARKER RECORD BETWEEN 0952 AND 1017, AUGUST 7TH, IS ENCLOSED WITH THIS REPORT.

IT HAS BEEN CONJECTURED THAT THE SPASMODIC APPEARANCE OF THIS STRONG REFLECTION RESULTS FROM THE UNDULATIONS OF A PARTICULAR FORMATIONAL CONTACT, PROBABLY LOCATED IN THE UNDIFFERENTIATED TERTIARY (PERHAPS THE BASE OF TERTIARY). THIS CONTACT IS OF SUCH A NATURE AS TO BE AN EXCELLENT REFLECTOR OF SEISMIC ENERGY. IT MIGRATES IN AND OUT OF THE RANGE OF THE INSTRUMENT (APPROXIMATELY 0 TO 1140 BENEATH THE RIVER SURFACE). THIS CONJECTURE IS SOMEWHAT SUBSTANTIATED BY THE REPEATABLE CHARACTERISTICS OF THE STRONG REFLECTION WHEREVER IT APPEARS THROUGHOUT THE SURVEY.

THE REFLECTIONS FROM THE UNDERLYING GEOLOGIC STRATA COULD BE FOLLOWED AND MAPPED ALONG THE ENTIRE TRAVERSE. THE INTERPRETATION PROCEDURE WAS TO MARK THE DEEP REFLECTIONS ON THE SPARKER RECORDS. A FICTITIOUS HORIZON WAS THEN DETERMINED FOR THE ENTIRE TRAVERSE FROM THE OBSERVED REFLECTIONS. THE MAP ENCLOSED IS A MAP OF THE DEPTH OF THIS FICTITIOUS HORIZON BENEATH THE SURVEY BOAT'S TRAVERSE.

ALL DEPTHS ON THIS MAP ARE WITH RESPECT TO RIVER SURFACE LEVEL. THESE DEPTHS ARE COMPUTED FROM AN ASSUMED AVERAGE SEISMIC VELOCITY OF 9120 FT/SEC. FOR THE UNDERLYING SHALE-CALCAREOUS SHALE SECTION.

BETWEEN 2008, AUGUST 4TH AND 0933, AUGUST 5TH, NO NAVIGATIONAL AND/OR SPARKER DATA WAS OBTAINED. THE TWO SEPARATED AREAS WERE TIED TOGETHER BY ASSUMING AN ABSENCE OF DIP ACROSS THIS GAP.

SURVEY RESULTS

THIS SURVEY CONSISTED OF ONE SPARKER PROFILE, APPROXIMATELY 50 MILES IN LENGTH. NO TIE LINES COULD BE INCORPORATED IN THIS RIVER SURVEY AND LITTLE SURFACE GEOLOGY OF THIS PARTICULAR AREA WAS KNOWN.

IT SHOULD BE UNDERSTOOD THAT A SURVEY OF THIS NATURE CAN NOT BE RELIED UPON TO GIVE CORRECT VALUES FOR HORIZON DEPTHS OVER AN EXTENDED TRAVERSE. IT WOULD BE INCORRECT TO CONSIDER THAT THERE WAS EXACTLY 3175 FT. OF REGIONAL NORTHWEST DIP BETWEEN THE BEGINNING (-765') AND THE END (-3940') OF THE SURVEY. THE SOURCE OF POSSIBLE ERROR TO SUCH A CORRELATION IS THE UNKNOWN DISPLACEMENT ACROSS SOME OF THE FAULTS.

HOWEVER, IT SHOULD ALSO BE UNDERSTOOD THAT THE DATA PRESENTED HERE IS QUITE RELIABLE IN ANY SPECIFIC AREA. A SURVEY OF THIS TYPE IS EXCELLENT FOR LOCATING VARIOUS STRUCTURAL FEATURES SUCH AS FAULTS, FOLDS, ETC.

THE GENERAL CONFIGURATION OF THE SUBSURFACE GEOLOGY IS SHOWN BY THE TABULATED DEPTHS OF THE FICTITIOUS HORIZON ON THE ENCLOSED MAP. AS STATED PREVIOUSLY, THESE NUMBERS REPRESENT THE DEPTHS IN FEET OF THE FICTITIOUS HORIZON BELOW OUR DATUM (RIVER SURFACE). ALSO SHOWN ON THIS MAP ARE THE MAJOR FOLD AXES; ANTICLINAL AXES SHOWN IN RED AND SYNCLINAL AXES SHOWN IN PURPLE. ALSO SHOWN ARE THE FAULTS (GREEN) OBSERVED ON THE RECORDS.

IN GENERAL, THE FICTITIOUS HORIZON RISES TO THE SOUTHEAST.

THE TRAVERSE CUTS ACROSS A SERIES OF ANTICLINAL AXES AT 1815, AUGUST 6TH; 1912, AUGUST 6TH; 2215, AUGUST 6TH; AND 1010, AUGUST 7TH. THE CORRESPONDING SYNCLINAL AXES ARE AT 1835, AUGUST 6TH; 2155, AUGUST 6TH; AND 0959, AUGUST 7TH.

THE SYNCLINE LOCATED AT 1835, AUGUST 6TH, IS THE MOST PROMINENT SYNCLINE ALONG THE TRAVERSE. ANOTHER SYNCLINE IS AT 2155, AUGUST 6TH. THIS SYNCLINE IS COINCIDENT WITH ONE SHOWN BY SURFACE GEOLOGY. THE SYNCLINE ENCOUNTERED AT 0959 IS ALSO COINCIDENT WITN ONE FOUND BY SURFACE GEOLOGICAL METHODS.

FIVE FAULTS ARE SHOWN AND ARE LOCATED AT 1946, AUGUST 4TH; 0938, AUGUST 5TH; 1045, AUGUST 5TH; 2048-2052, AUGUST 6TH; AND 2124-2128, AUGUST 6TH.

THE FAULT SHOWN AT 1946, AUGUST 4TH, IS AT THE BEGINNING OF THE SURVEY AND IS IN AN AREA OF GOOD RECORD QUALITY. THIS FAULT SHOWS AN APPROXIMATE DISPLACEMENT OF 630 FT. AND IS DOWNTHROWN TO THE SOUTHEAST.

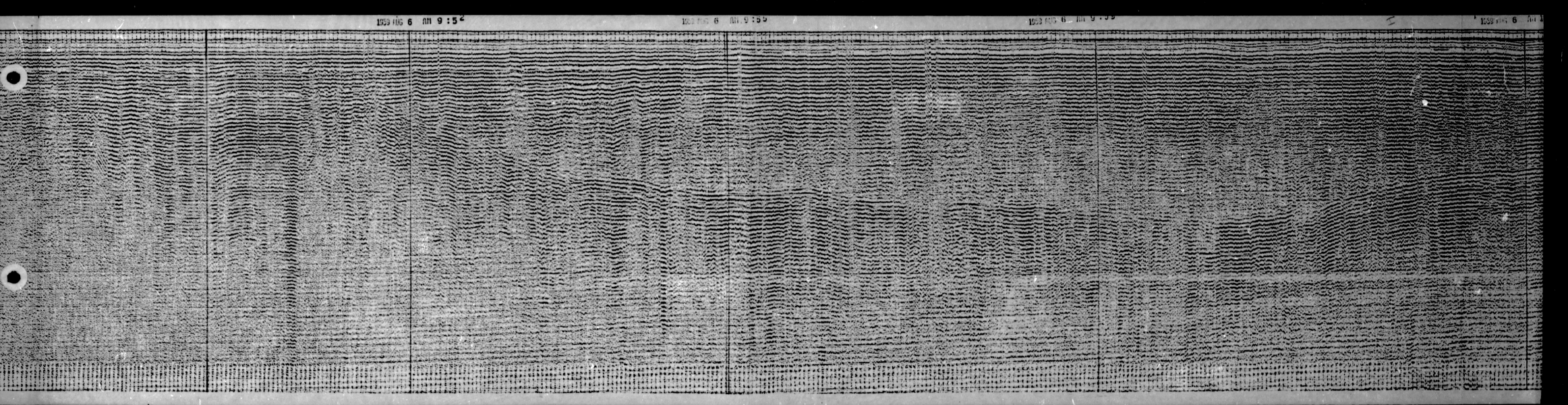
ANOTHER FAULT IS ENCOUNTERED AT 0938 AUGUST 5TH. THIS FAULT IS ALSO IN A GOOD RECORD AREA AND A DISPLACEMENT OF 100 FEET CAN BE OBSERVED. THIS FAULT IS DOWNTHROWN TO THE NORTH.

ONE OF THE MOST PREDOMINANT FEATURES IN THE SURVEY IS THE LARGE FAULT SHOWN AT 1045, AUGUST 5TH. THIS FEATURE IS QUITE EVIDENT ON THE RECORD. AN OBSERVED THROW OF AT LEAST 900 FT. TO THE NORTH MAY BE NOTED ON THE RECORD; THE VERTICAL DISPLACEMENT OF THIS FEATURE MAY BE IN EXCESS OF THIS VALUE. THE FICTITIOUS HORIZON IS SHOWN WITH A DISPLACEMENT OF 900 FT. ACROSS THIS FAULT.

A FAULT ZONE IS NOTED BETWEEN 2048 AND 2052, AUGUST 6TH. NEITHER THE VERTICAL DISPLACEMENT NOR THE DIRECTION OF THROW COULD BE OBSERVED. NONE HAS BEEN INCLUDED FOR THE FICTITIOUS HORIZON ACROSS THIS ZONE. THIS FAULT IS COINCIDENT WITH A FAULT SHOWN BY SURFACE GEOLOGY.

THE LAST FAULT SHOWN ON THE ENCLOSED MAP IS SITUATED BETWEEN 2124 AND 2128, AUGUST 6TH. THIS FAULT IS IN AN AREA OF EXCELLENT RECORD QUALITY AND CAN BE EASILY OBSERVED ON THE SPARKER RECORD. THE FAULT IS DOWNTHROWN TO THE EAST WITH AN APPROXIMATE VERTICAL DISPLACEMENT OF 560 FT.

THE FICTITIOUS HORIZON IS ADJUSTED ACROSS ALL FAULTS TO SHOW THE CALCULATED OR ASSUMED VERTICAL DISPLACEMENT OF THE GIVEN FAULT. THE ONE EXCEPTION TO THIS IS THE FAULT ENCOUNTERED BETWEEN 2048 AND 2052, AUGUST 6TH. SINCE NO VERTICAL DISPLACEMENT COULD BE OBSERVED IN THIS ZONE, NO ADJUSTMENT OF THE FICTITIOUS HORIZON WAS MADE.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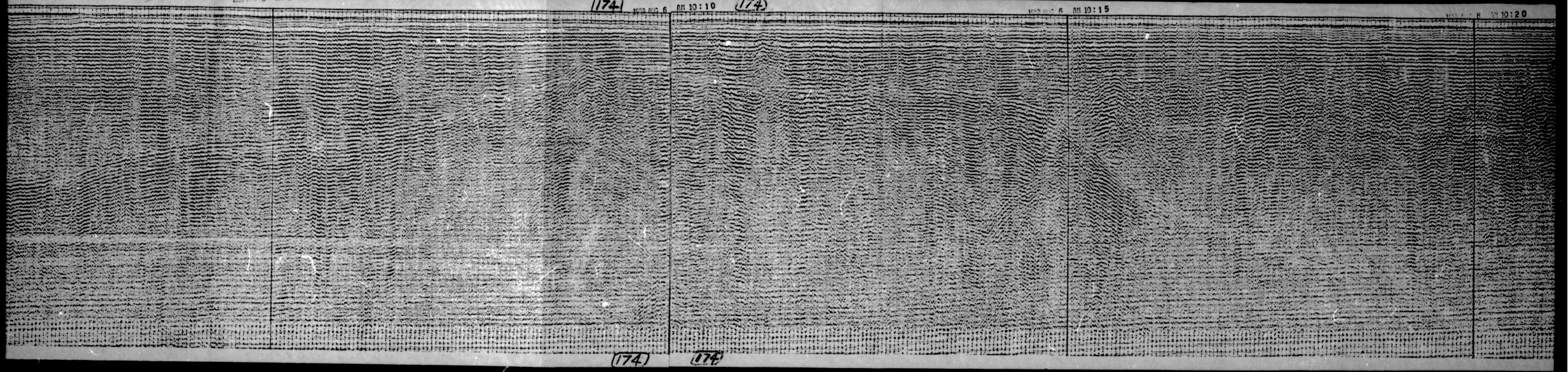
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