

LEHMANN EXPLORATION MANAGEMENT, INC.

GEOLOGISTS

POLARIS JOINT VENTURE  
CHRONOLOGY OF PROJECT ACTIVITIES

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I. 1979

A. Geophysics

1. INPUT survey of 2 flight blocks begun in December. Contract called for 10,000 line-miles of survey.
  - a. Flight-block boundaries were determined by E. H. Eisenbrey of Ernest K. Lehmann & Associates, Inc., (ELA) and N. Patterson of Patterson, Grant and Watson (PGW). Flight blocks were selected on the basis of geological and geophysical characteristics and location of Northern Minnesota Mineral Pool (NMMP) lands (see E. Lehmann memo, July 6, 1986, appended).
  - b. Questor was selected to run the survey when Geoterrex was unable to fly the survey at the specified time.
  - c. N. Patterson (PGW) was retained to set the technical specifications of the survey and assist in overview of the field operations.
  - d. Three test lines were run in the Hubbard block where the glacial sediments were known to be over 200 feet thick. Patterson reviewed the test lines and recommended flying the entire Hubbard block (see minutes of the PJV Policy Committee Meeting, January 17-18, 1980).

B. Geochemistry

To determine the suitability of geochemical exploration techniques for the area near Ely. C.F. Gleason, consulting geochemist from Ottawa, Canada, made a field visit to the Ely area in September 1979, accompanied by J. Prockneau (Billiton), T. W. Bastien (ELA), and T. Wells (ELA). Gleason recommended a systematic sampling of the soils and tills combined with a geochemical study of the rocks as part of a base-metals exploration program.

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## C. Geology

1. E. H. Eisenbrey (ELA) was in charge of the technical direction of the geological, geochemical, and geophysical programs and reported to T. Bastien (ELA), the overall project manager.
2. T. Wells (ELA) began a review of the DNR files of exploration data in the Minerals Division office at Hibbing, Minnesota.
3. S. Kruse (ELA) reviewed the data on Cretaceous rocks in northern Minnesota with respect to their possible location in the PJV flight blocks.

## D. Land

Approximately 500,000 gross acres of mineral rights in the PJV area of interest were in the NMMP.

## II. 1980

## A. Geophysics

1. INPUT survey completed in February with a total of 9,250 line-miles flown, covering 2,337 square miles in the Sturgeon and Hubbard blocks.
2. Quality of the data was checked while the survey was in progress by D. Watson (Questor), R. Watson (PGW), and T. Bastien, E. Eisenbrey, and T. Wells (ELA). No problems were noted. R. Watson (PGW) suggested the use of helicopter-EM follow-up as an alternative to the usual ground follow-up procedures (see also Lehmann memo of July 6, 1986).
3. Final review of the data was done by E. Eisenbrey and T. Bastien (ELA) in Toronto with representatives of Questor, PGW, and Aerodat (the HEM contractor). Problems with the surficial conductivity in the Hubbard block were noted. PGW was given permission to calculate depth to bedrock from the magnetic data and Questor was authorized to run two test lines over the Hubbard block utilizing computer processing to normalize all channels to the first channel and screen out surficial conductors.

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4. Copies of the field-plotted INPUT anomalies (red-ball maps) were received from Questor in March.
  - a. T. Cockshutt and T. Wells (ELA) categorized anomalies by proximity to NMMP land.
  - b. Field-checking anomalies was delayed until after the spring snowmelt.
  - c. The preliminary maps of Sturgeon block indicate that 53 anomalies are on private land where there is some NMMP land position.
5. In May, Questor was authorized to normalize all of the INPUT data from the Hubbard block, based on R. Watson's (PGW) conclusion that it was successful in eliminating surficial conductors.
  - a. Aerodat was approved for the HEM ground follow-up (see minutes of the PJV Policy Committee Meeting, May 1-2, 1980).
    - 1) Advantages: speed, no land acquisition required, data quality similar to a ground survey.
    - 2) Disadvantages: limited depth penetration (to be used in areas with less than 200 feet of overburden) and problems in determining the dip of a conductor.
  - b. Field-checking the INPUT anomalies was delayed until the final selections were received from Questor. It was felt that the accuracy of the location from the preliminary maps (to within 500 feet) did not warrant checking the preliminary INPUT selections.
6. A technical session of the joint-venture partners was held in June to make selection of INPUT zones from the preliminary maps; the final report from Questor was not yet available. T. Cockshutt and R. Allen (ELA) began field-checking the anomalies selected at the meeting.
7. The final report on the INPUT survey was received from Questor in July; they outlined 148 conductive zones in the Sturgeon block. Because Questor did

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not rate the anomalies in a systematic fashion, PGW was authorized to review and rank the INPUT anomalies chosen by Questor. PGW also outlined preliminary boundaries for the blocks to be considered for HEM surveys.

8. In August the joint-venture partners met and discussed PGW's blocks for HEM surveys. Questor completed the normalization of the Hubbard INPUT data.
9. PGW completed their assessment of the INPUT zones selected by Questor in the Sturgeon block; PGW selected 71 conductive zones as having possible economic interest. Of the 71 zones selected by PGW, 12 were INPUT anomalies that Questor did not pick. The HEM survey began in September and reconnaissance lines of MaxMin II were used to evaluate some of the INPUT anomalies selected by PGW. R. Allen and M. Stanbrough (ELA) collected the data and PGW did the interpretation. Table 1 lists the areas where ground geophysical follow-up was run.
10. The HEM survey was completed in November and PGW was chosen to interpret the data collected by Aerodat during the survey. A total of 2,436 line-miles were flown in 55 blocks; there are 8 blocks in the Hubbard area, 45 blocks in the Sturgeon area, and 2 blocks in the Ely area. It was decided that brushed-out lines should be used for the ground geophysical follow-up instead of the rough lines used previously.
11. At the October joint-venture meeting, a consensus was reached that the normalization of the INPUT data in the Hubbard block had failed to screen the overburden responses from possible bedrock conductors. In December PGW was authorized to calculate 100 depths-to-bedrock for the Hubbard block in order to identify areas of shallow overburden where the INPUT survey could have seen to bedrock.

#### B. Geochemistry

1. The specifications for the Ely soil-geochemistry survey were set at the joint-venture meeting during May. Samples were to be collected on a

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reconnaissance grid with  $\frac{1}{2}$ -mile line spacing and a sample interval of 400 feet along the line. Northeast Geochemical Company in Maine was selected to do the base-metal analyses and Bondar-Clegg was chosen for precious-metal analyses.

2. The program began in June with T. Wells (ELA) running the field surveys out of a base in Clear Lake (south of Ely); he was assisted by a three-person field crew (S. Mills, D. Raymond, C. Lehmann). Orientation surveys were run at three localities: (1) The Raspberry gold prospect; (2) the Skeleton Lake copper-bearing massive-sulfide showing; and (3) the contact between the Giants Range Batholith and the Ely greenstones. The results of these surveys showed anomalous concentrations of copper, silver, and mercury in the soils at Skeleton Lake and anomalous gold (up to 2.5 ppm) at the Raspberry site. During the reconnaissance survey a total of 86 samples were collected from the three sites.
3. Sampling in the Ely area was completed in November; 4950 samples were collected and analyzed for copper, lead, zinc, silver, and gold. Of these, 3450 were collected in the reconnaissance grid covering 135 square miles and 1500 were collected to follow up on anomalous samples found in the reconnaissance survey. Outcrop and float locations were noted but no mapping was completed. A final report on the 1980 survey was completed in July of 1981 (B. Gavin and E. Eisenbrey) in which anomalous areas were defined (see table 2). Additional exploration was recommended in 16 of the 23 areas.
4. In August a reconnaissance soil-geochemistry survey was run in the East Sturgeon flight block by R. Langevin (ELA). The sampling was done parallel to Minnesota Highway 65 which runs roughly north-south through the flight block. Approximately 300 sites were sampled over a 17-mile distance. Both humus and B-horizon soil samples were collected for analysis; the humus samples were analyzed for copper, arsenic, and mercury and the B horizon (including swamp-muck and bottom samples) was analyzed for copper, lead, zinc, nickel, silver, and gold. It does not

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appear that the results of the survey were presented in any report or memorandum. The sample locations and analytical results are on file in the Hibbing field office and some of the high values reported are 202 ppm copper, 162 ppm zinc, and 300 ppb gold; the high gold values are from swamp-muck samples.

## C. Geology

Data on prior exploration within the PJV area of interest that were on file at the Minnesota DNR Minerals Division were examined and copies were made for use by the venture. Personnel working on the compilation include T. Wells, T. Cockshutt, R. Allen, E. Eisenbrey, and R. Langevin, all of ELA. Areas for which drill core, outcrops, and other sources of data were examined in detail included the Deer Lake Complex, the Dragonfly anomaly, and the Skeleton Lake anomaly. Information obtained from the DNR files is included in the anomaly portfolios.

## D. Land

1. Approximately 678,000 gross acres of mineral rights in the PJV area of interest were held under license by the NMMP.
2. Negotiations began with U.S. Steel, Boise Cascade, and Burlington Northern for leases on their lands. U.S. Steel was negative but Burlington Northern and Boise Cascade negotiations continued.
3. Title work began on identified INPUT targets. K. Campbell (ELA) was responsible for most of the title work. By the end of the year the land situation had been determined for 22 anomalies and acquisition had started on 5 (Wamp Lake, Skeleton Lake, Sherry Lake, Gale Brook, and Kabekona).

## III. 1981

## A. Geophysics

1. PGW completed their depth-to-bedrock determinations for the Hubbard Block and reviewed the INPUT data to locate any anomalies that might have been overlooked by Questor. Alcohol Creek and Buffalo

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Swamp were the anomalies in Hubbard for which additional follow-up work was recommended.

2. Processing of the HEM data collected by Aerodat was not completed until April and PGW completed their interpretation and recommendations in July. All the data for the HEM blocks were compiled in portfolio form.
3. Approximately 62 anomalies were geophysically surveyed on the ground; of these, 32 were in the East Sturgeon area, 26 in West Sturgeon, and 5 in the Hubbard block. Table 1 summarizes the work completed. Data collection of MaxMin HLEM and total-field magnetics continued to be done by ELA (M. Stanbrough), with PGW interpreting the results, during the first half of the year. Interpretation of the survey results in the second half of the year was done by K. Bagdadi (ELA).

B. Drilling

1. The drilling program began in June and was completed in December; ten holes were drilled on six targets for a total of 6,146 feet of drilling. Table 3 lists the drilling completed. In the West Sturgeon area F. Campbell (ELA) was responsible for the drilling program, and T. Cockshutt and R. Allen (ELA) were in charge of the drilling in the East Sturgeon area. Of the six targets drilled, four proved to be pyrite-pyrrhotite bodies containing minor amounts of base metals (Titan, Vanessa, Dragonfly, and Cricket) and at two targets no conductors were identified (Janus and Cormorant).
2. A total of 140 samples representing 713 feet of split drillcore were shipped to the Rocky Mountain Geochemical Company for analysis. The highest analytic values were from the Inez HEM block where, at the Titan anomaly, a 10-foot section of core ran 0.30% zinc and 0.11% lead and at the Vanessa anomaly a 13.5-foot section of core ran 0.165% copper. Values for gold and silver were at or slightly above detection limits.
3. Major-oxide and trace-element analyses were done of 24 samples collected from the core drilled in 1981; the analytical work was completed by

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Barringer Magenta Ltd. Samples were collected of the major lithologies seen in the core and altered and mineralized core was also sampled. F. Campbell carried out this sampling program, which was designed by E. Eisenbrey, to characterize the trace-element distribution in the rocks seen in drillcore.

## C. Geochemistry

1. In the Ely area soil surveys were run over the anomalous zone identified in the 1980 survey and over the HEM targets identified in the two Ely-area HEM blocks. The work was carried out by B. Gavin (ELA) assisted by 2 samplers. Approximately 1000 soil samples were analyzed for major oxides and trace elements. The results of the work showed ten HEM conductors associated with geochemically anomalous soils, and six of the areas identified in the 1980 survey were also anomalous in the follow-up work (see table 2).
2. A study of the Deer Lake Complex covering the West End, Zeissers Island, and East End HEM blocks was completed in 1981 by J. Beck (see ELA report dated February 1981). Included in this study: (1) relogging of 13 drillholes; (2) outcrop mapping and whole-rock geochemistry (20 samples); and (3) soil sampling over 16 HEM zones. A total of 589 B-horizon and swamp-muck samples were collected and show low background values (7 ppm copper, 34 ppm zinc, and 14 ppm nickel). One anomaly (Miro) showed good correlation between the geophysical conductor and the anomalous soil geochemistry; it was tested by drilling in 1982, which located a pyrite-pyrrhotite conductor. There are six other HEM zones that have weak geochemical anomalies associated with them; none were tested. The remaining 9 HEM zones showed no anomalous soil geochemistry. The geologic environment at the Deer Lake Complex is a series of differentiated (peridotite to gabbro) mafic sills intruded into tholeiitic basalts with interflow argillites.
3. Additional soil surveys were run in the East Sturgeon block, in the Sherry Lake and Wamp Lake HEM blocks. A total of 300 B-horizon and swamp-muck samples were collected and analyzed for base metals; they were not analyzed for gold. No



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anomalous values were reported from these surveys. R. Allen (ELA) was in charge of this program. There does not appear to be any formal report on this work.

## D. Geology

1. Mapping was completed in the Ely area and in the Deer Lake Complex in conjunction with the geochemical studies (see ELA reports by B. Gavin, November 1981, on the Ely Area and by J. Beck, February 1982, on the Deer Lake Complex).
2. Reconnaissance outcrop mapping was started in the East Sturgeon area by R. Allen and T. Schloesser. There does not appear to be any formal report on this work.
3. At the end of 1981 E. Eisenbrey compiled a geologic interpretation of the PJV area of interest; his study was made part of the PJV work plan and budget for 1982. He describes the Ely and Hubbard areas and breaks the Sturgeon block into 9 geologic terranes.
4. Another major section of the work plan and budget for 1982 is a set of tables that lists and prioritizes all of the geophysical and geochemical targets identified during the first two years of the project. In that report there are listed 31 anomalies as drill targets; 115 anomalies warranting additional ground work to determine drill status; and 60 anomalies that were not considered for any additional work. The only areas considered in that study were those from HEM blocks and the anomalies from ground geophysical and geochemical surveys completed in 1981.

## E. Land

1. 40,900 net acres of NMMP land were retained.
2. Title research was completed for 1020 forty-acre parcels over 167 anomalies in Beltrami, Itasca, Hubbard, Koochiching, and St. Louis Counties.
3. Agreements with 24 private landowners, covering 2460 acres at 9 anomalies, were signed in 1981.

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4. Surface leases were signed by Itasca and Beltrami Counties (320 acres).
5. A negotiated lease with the State of Minnesota for 200 acres was signed in 1981.
6. Negotiations for a sub joint venture with Boise Cascade in the Deer Lake Complex was well underway. A similar agreement was being considered with Burlington Northern.

## IV. 1982

## A. Geophysics

1. Twenty-two anomalies were surveyed with MaxMin HLEM and magnetics (see table 1). The data were collected by M. Stanbrough and J. Hanson and the interpretation completed by K. Bagdadi. Approximately 46 line-miles were run.
2. In the Hubbard block the Beefeater anomaly (Questor INPUT zones 59B and 60C) and the Buffalo Swamp anomaly (Questor INPUT 52-A) were covered by time-domain EM surveys. Both were surveyed by Geoterrex using the EM-37 system, and the Beefeater anomaly was also surveyed by the Crone pulse-EM system. The interpretation of these surveys was that the INPUT zones reflected overburden conductivity. Those surveys essentially eliminated the Hubbard block from further consideration.

## B. Drilling

1. During 1982, 10 holes were completed on 6 conductive zones for a total of 5,131 feet of drilling (see table 3). One of the targets tested in 1982, Vanessa, had also been tested in 1981. Of the 6 conductive zones tested, three were interpreted to be pyrite-pyrrhotite bodies (Iapetus, Vanessa, and one at Miro) with minor concentrations of base metals and three as argillites (Haden Creek, Liam, and one at Miro). F. Campbell was in charge of the field operation of the drilling program, supervised by E. Eisenbrey.

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2. A total of 85 samples representing 466 feet of split core were shipped for analysis to the Rocky Mountain Geochemical Company or to Bondar-Clegg. The highest values were from the Vanessa anomaly in the Inez HEM block where 5 feet of core ran 0.50% copper, 0.15% lead, 0.32% zinc, and 0.47 ounces per ton silver. At the Miro anomaly the pyrrhotite/pyrite-bearing argillite typically contains up to 300 ppm copper and 950 ppm zinc. Analyses from other samples commonly showed background levels.
3. Major-oxide and trace-element analyses, by Barringer, were completed on 28 samples of core from the 1982 drilling program. Sampling procedures followed those used in the 1981 program, i.e., altered and mineralized lithologies were analyzed.

## C. Geochemistry

1. No work was completed in the Ely area because of the problems of acquiring land outside of the state lease sale, which was held late in the year.
2. One target in the Deer Lake Complex (Miro) showing anomalous soil geochemistry associated with an HLEM conductor was drilled. The conductor was determined to be a pyrrhotite/pyrite-bearing argillite having slightly anomalous copper and zinc values.

## D. Geology

Reconnaissance outcrop mapping was done by F. Campbell in the Deer Lake North HEM block. The environment was determined to be dominantly basalt flows and the anomalies in this area were consequently given lower priorities because most of the drilling completed by the project had tested mafic environments.

## E. Land

1. The 1982 state lease sale was held late in the year. Of the 108 bids submitted by LEM for the joint venture, 82 were awarded. This amounted to approximately 40,900 gross acres of state land.

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2. Negotiations continued with Boise Cascade and Burlington Northern. Both companies had successfully bid at the state lease sale; either Boise Cascade or Burlington Northern was the high bidder for each of the 26 bids lost by LEM.
3. Agreements were signed with 20 private landowner for approximately 3700 gross acres of land. One surface lease was signed with Itasca County for 240 acres.

## V. 1983

## A. Geophysics

Geophysical ground surveys (MaxMin HLEM and magnetics) were completed at 15 anomalies, a total of 45 line-miles surveyed. Data were collected by J. Hanson and K. Bagdadi interpreted the results. A list of targets surveyed in 1983 is given in table 1.

## B. Drilling

1. With the award of 82 state leases in the 1982 sale, there was a backlog of drill targets. The drill program ran nearly continuously through the year, excepting only a break during the spring thaw. The first quarter drilling was staffed by F. Campbell, R. Langevin, and K. Campbell, and when drilling resumed J. Beck was responsible for the field program; E. Eisenbrey continued to supervise the drilling program. Twenty-two holes were drilled, totaling 12,809 feet and testing 15 conductors. Table 3 summarizes the drill results. Of the 15 conductors tested: 6 were pyrite-pyrrhotite (Skeleton Lake [3], Callisto, Ganymede, and Kaiso), 4 were graphitic (Conan, Liam, Hera, and Soca), 3 were pyritic cherts interbedded with graphitic-pyritic argillite (Gale Brook, Hera, and Snake Trail), and at 2 no conductors were identified (Vanessa and Plotinus). The hole at Vanessa was to test the downdip extension of the pyrite-pyrrhotite body previously identified, and at Plotinus the conductor may have been associated with a basalt that had been intensely altered to epidote, calcite, and magnetite.

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2. Approximately 355 samples representing 2130 feet of split core were analyzed by Bondar Clegg for base and precious metals. Some of the highest analyses were: Skeleton Lake, 8 feet, 1.5% copper and 300 ppb gold; Liam, 6 feet, 245 ppb gold; Callisto, 10 feet, 400 ppb gold; and Kaiso, 5 feet, 0.27% zinc, 695 ppm lead, and 3.0 ppm silver. Other samples from these areas also showed values above background.
3. Major-oxide and trace-element analyses were run on 78 samples of core from the holes completed in 1983. The analyses were done by Acme Analytical Laboratories Ltd. The results of these analyses are shown in the PJV Annual Report for 1983; the majority of the rocks are chemically classified as tholeiitic basalts.

## C. Geochemistry

1. The South Block target in the Ely area defined by soil geochemistry was followed up with mapping and rock and soil geochemistry. The land over this target was acquired in the 1982 state lease sale. B. Gavin and D. Hall worked on the program and reported the results of the study in January 1984. A total of 311 soil samples was collected and analyzed along with the pulps of 252 samples collected in the 1980 survey. A suite of 20 rock samples were analyzed for major-oxide and trace element content. This study identified anomalous gold-barium-zinc in soils associated with anomalous gold in rock (up to 230 ppb) in an area mapped as a transition zone from the volcaniclastic member of the Lake Vermilion formation to its graywacke member. The operator recommended additional work in this area.
2. Another target from the 1980 soil geochemical program, Nickolson Lake, was followed up by mapping and rock-chip sampling. J. Beck did this work and the results showed the gold-copper-zinc geochemical anomalies in soils to be spatially associated with a quartz-feldspar porphyry dike cutting the basalt flows. No anomalous mineralization was found in the rock samples and it was recommended that an IP survey be run over the soil anomaly to locate possible disseminated

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sulfides associated with the porphyry covered by the glacial till.

## D. Geology

Mapping and rock-chip sampling was carried out in the South Block and Nickolson Lake areas near Ely, as described above.

## E. Land

1. At the 1983 state lease sale the venture acquired 11 additional leases totaling 4,438 gross acres. Most of these leases were on the South Block and Nickolson Lake anomalies.
2. Agreements were signed with 8 private owners covering 560 acres at 3 targets.
3. Land was dropped at 6 targets during 1983. The total dropped was 800 acres covering agreements with 8 private owners and 2 county leases.
4. At the end of 1983 the venture continued to hold 40,900 acres of land through NMMP.

## VI. 1984

## A. Geophysics

1. Geophysical ground surveys were run at 9 targets, and a total of 75 line-miles of survey were completed. In addition to the MaxMin HLEM and magnetics, a time-domain EM-37 survey was run by Geotrex at the Gull Lake anomaly, which was determined to be an overburden conductor. At the Nickolson Lake anomaly, one line of IP was run over the soil geochemical anomaly and no significant sulfide mineralization was identified in the area of the geochemically anomalous soils. During the year J. Hanson was in charge of the data collection and M. Gerety interpreted the results.
2. Jens Hansen of Geotest Corporation re-evaluated the Sturgeon block INPUT data in an effort to locate targets that were missed by Questor and PGW. Of particular interest were the locations of volcanogenic base-metal massive sulfides in the

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central Sturgeon area. Hansen selected 74 INPUT zones, and of these, 9 were chosen for ground follow-up. The details of Hansen's study are in his report of November 1984. Field examination of the 74 zones selected by Hansen was completed by J. Beck (ELA) and S. More (Billiton). The results of the field-checking are in the PJV Monthly Report of the Operator for October 1984; of the 74 zones checked: 29 were cultural responses; 16 were follow-up targets; 11 were very low priority follow-up targets; 10 were bedrock targets previously tested or held by other companies; and 8 were overburden responses.

## B. Drilling

1. In 1984 8 holes were drilled on 7 targets for a total of 4311 feet of drilling. The drilling program was designed by E. Eisenbrey with J. Beck in charge of the field operations. At two of the targets (Kathryn and Guava) pyrite/pyrrhotite-bearing conductive units were identified; at three targets (South Detling, Anake, and Loki), graphitic argillites caused the HLEM response; one target (Plotinus) was associated with intense carbonate-epidote alteration of basalts flows; and at the remaining target (Gale Brook) the conductor was identified as pyritic cherts and graphitic argillite.
2. A total of 109 samples of split core representing 646 feet of drilling was analyzed by Bondar Clegg for base and precious metals. The only anomalous mineralization was from the Gale Brook anomaly where drillhole GBD-1 intersected a 10-foot section which assayed 1400 ppb gold.

## C. Geochemistry

Additional mapping and rock-chip sampling by D. Hall in the South Block area did not confirm the anomalous gold detected in soils and rocks in the previous surveys. A total of 119 rock-chip samples was analyzed for gold by Bondar Clegg and for trace elements by Acme. The details of this study are found in ELA report number 8414. As a result of this study, the land in the South Block was farmed out to Kerr-McGee. The land at the

Nickolson Lake anomaly was also farmed out to Kerr-McGee.

D. Geology

1. Syver More (Billiton) completed a compilation of data in the Sturgeon block in an attempt to locate areas permissive to base-metal mineralization that may have been overlooked by the venture. His efforts are found in a preliminary map and report dated June 1984 and a final map completed in November 1984. Emphasis was placed on identifying the geology of the central Sturgeon block where little geologic data existed.
2. E. Eisenbrey summarized the results of the drilling program in the Sturgeon block (see PJV annual report for 1984). He notes the absence of felsic volcanics, lack of explosive fragmental volcanic material, and the lack of significant base-metal mineralization in the drilling completed in Sturgeon block. The conclusion reached was that the origin of the rocks tested by drilling is in a deep expanding basin filled by basalts and low-energy sediments, with little explosive volcanic activity.

E. Land

1. During 1984, 42 state leases totalling 18,627 acres were terminated.
2. Agreements with 27 private landowners and with Itasca County, a total of 2,798 acres, were terminated in 1984.
3. A total of 5,235 acres of private land were acquired in 1984; most of the acquired acres were at the Hay O'Brien (3,180 acres) and central Sturgeon (1,560 acres) targets.
4. During 1984 the NMMP license agreements expired and the mineral owners were approached about an extension that would allow LEM to continue to explore their land.



## VII. 1985

## A. Geophysics

As part of a farm-out agreement that would allow the Hanvey European Group to explore for diamonds in the PJV area of interest, a geophysicist (Chris Jewell) reviewed the INPUT and magnetic data from the Hubbard and Sturgeon blocks. The results were favorable and follow-up work was recommended at several targets in the east Sturgeon block.

## B. Geochemistry

Working for the Hanvey European Group, a heavy mineral survey was run by Rod Baker through the east Sturgeon and Ely areas. He identified minerals indicative of kimberlite in some of his samples near INPUT zones selected by C. Jewell. These zones were recommended for acquisition to the Hanvey European Group.

## C. Geology

Core from the drilling completed in 1983 at the Skeleton Lake anomaly was resampled by J. Beck to check for gold mineralization that may have been overlooked during the initial sampling. A total of 75 samples of split core representing 395 feet were analyzed for gold and trace elements by Acme. The additional sampling supported the anomalous values found in the initial sampling; in drillhole PSL-4, a 10-foot section ran 0.45% copper and 20 ppb gold and in PSL-8 a number of 5-foot samples show from 25 ppb to 225 ppb gold. The results of this resampling are in the PJV Monthly Report of the Operator for September 1985.

## D. Land

1. In 1985, 32 state leases totaling 17,000 acres were terminated.
2. Agreements with three private owners covering a total of 4,260 acres were also dropped in 1985.
3. A state lease sale was held in 1985 and the venture acquired 12 leases totaling 4,987 acres;

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much of this land covers targets in the central and east Sturgeon block.

4. Option agreements were signed by two private owners at the Dunbar anomaly in the central Sturgeon area; 230 acres were acquired.

## VIII. 1986 (through the end of June)

## A. Geophysics

Ground surveys were completed at 6 central Sturgeon targets; 36 line-miles were surveyed. J. Hanson was responsible for the data collection and interpretation. Of the 6 targets, 2 are probable bedrock responses and 4 are overburden conductors.

## B. Geochemistry

A reconnaissance biogeochemical survey in the east Sturgeon area was completed by F. Busche (Shell Mining-Billiton). Samples were collected of the new-growth needles of balsam firs at 52 sites in the Gale Brook and Wamp Lake areas. The needles were found to contain significantly anomalous gold (up to 30 ppb).

## C. Geology

Core from drillholes at the Dragonfly and Cricket anomalies were re-logged and sampled to test for gold mineralization. A total of 35 samples representing 166 feet of split core were analyzed for gold and trace elements by Acme. The reported values are within background levels.

## D. Land

Agreements with two private landowners for 280 acres at the Dunbar anomaly were signed.