

GRAPHIC LITHOLOGIC AND ALTERATION LOGS FROM DIAMOND DRILL
HOLES ON AND NEAR THE RED LAKE INDIAN RESERVATION LANDS IN
THE INTERNATIONAL FALLS, ROSEAU, AND BIMIDJI 1°X2°
QUADRANGLES, NORTHERN MINNESOTA

by

T.L. Klein

Open-file Report
94-447

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1994

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GRAPHIC LITHOLOGIC AND ALTERATION LOGS FROM DIAMOND DRILL HOLES ON AND NEAR RED LAKE INDIAN RESERVATION LANDS IN THE INTERNATIONAL FALLS, ROSEAU, AND BIMIDJI 1°X2° QUADRANGLES, NORTHERN MINNESOTA

Introduction

This report presents lithologic and alteration logs from exploration drill holes in the western part of the International Falls, the Roseau, and the northwestern part of the Bimidji 1° x 2° quadrangles in northern Minnesota. It contains sixty-six logs from drill holes nearest Red Lake Indian Reservation lands and more than 200 additional drill logs from adjacent areas were used to establish the regional geologic framework and evaluate the mineral resource potential of the Reservation lands. Many of the holes were examined and (or) relogged at the core library of the Minnesota Department of Natural Resources (MNDNR), Hibbing, Minnesota by T.L. Klein and W.C. Day of the U.S. Geological Survey between the years 1983-1992 (see, Klein and Day, 1989, and Klein, 1991). The remainder were summarized from exploration drill logs. These logs, from mineral exploration drilling projects, represent data that was released for public use through mid-1992. Table 1 contains digitized drill-hole locations with the latitudes and longitudes in decimal degrees.

The logs were produced using LOGGER (RockWare, Inc., Wheatridge, Colorado). Most logs are at a scale of 1 inch = 50 ft. However, several other smaller scales were used to minimize log length when the total depth exceeded approximately 800 ft. Common symbols for rock units and alteration assemblages were used throughout. The total depth (feet) drilled below the surface is noted near the bottom of the drill log (e.g. -690 TD).

Geochemical analyses and assays for samples from these drill holes are summarized by Klein and others (1987), Klein and others (1988), Klein (1994), and Klein and others (1994).

References

- Klein, T.L., 1991, Lithologic descriptions of bedrock core from the Roseau 1° x 2° quadrangle, northern Minnesota: U.S. Geological Survey Open-File Report 91-35, 10 p.
- Klein, T.L., and Day, W.C., 1989, Tabular summary of geologic characteristics from diamond drill holes in the western International Falls and the Roseau 1° x 2° Quadrangles, Northern Minnesota: U.S. Geological Survey Open-File Report 89-346; 98 p.
- Klein, T.L., 1994, Tabulated geochemistry and assays of bedrock samples from mineral exploration drilling on or near Red Lake Indian Reservation lands, northern Minnesota: U.S. Geological Survey Open-File Report 94-xxxx.
- Klein, T.L., Brown, F., Jackson, J.C., Taggart, J.E., Ardith, J., Bartel, J., Stewart, K., Palmer, C., Wandless, G., Crock, J., Wilson, S., Brown, Z., Skeen, C., Crandell, W., Moore, R., Rait, N., Smith, H., Bauer, R., Steineck, R., and Day, W., 1987, Geochemical data from the International Falls and Roseau, Minnesota CUSMAP projects: U.S. Geological Survey Open-File Report 87-366, 98 p.

- Klein, T.L., Jackson J.C., Taggart, J.E., Bartel, J., Palmer, C., Wandless, G., Skeen, C., Crandell, W.B., Moore, R., Rait, N., Siems, D., Kavulak, M., and Day, W.D., 1988, Supplemental geochemical data from the Roseau, Minnesota, CUSMAP Project: U.S. Geological Survey Open-File Report 88-575, 12 p.
- Klein, T.L., Siems, D.F., Fey, D.L., Motooka, J.M., Love, A.H., Doughten, M.W., Gillison, J.R., and Baedecker, P.A., 1994, Geochemical analyses of bedrock samples from drill holes on and near Red Lake Indian Reservation Lands, northern Minnesota: U.S. Geological Survey Open-File Report 94-429, 9 p.

Fig. 1
DRILL HOLE 40918

OPERATOR
COMPLETED
LOCATION

Inco
MAY 12, 1971
NW NE Sect. 8, T.157 W, R.93 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
0				OVERBURDEN, glacial drift
-25				
-50				
-75				
-100				
-125				
-150				
-175				
-200				
-225				
-250				GRAYWACKE, immature, tuffaceous, variably saprolitic.
-275				
-300				
-325				GRAYWACKE, siliceous, fine-grained, tuffaceous
-350				
-375				MAFIC TUFF, interlaminated with minor chert, carbonate and metagraywacke.
-400				
-425				
-450				
-475				BASALT, amphibolitic, locally garnetiferous, and locally silica and carbonate-altered
-500				
-525				
-550				
-575				
-600				

Fig. 2 DRILL HOLE 40919

OPERATOR: Inco.
COMPLETED: MAY 12, 1971.
LOCATION: NW NE Sect. 8, T.157 N, R.33 N

ALTERATIONS
6

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

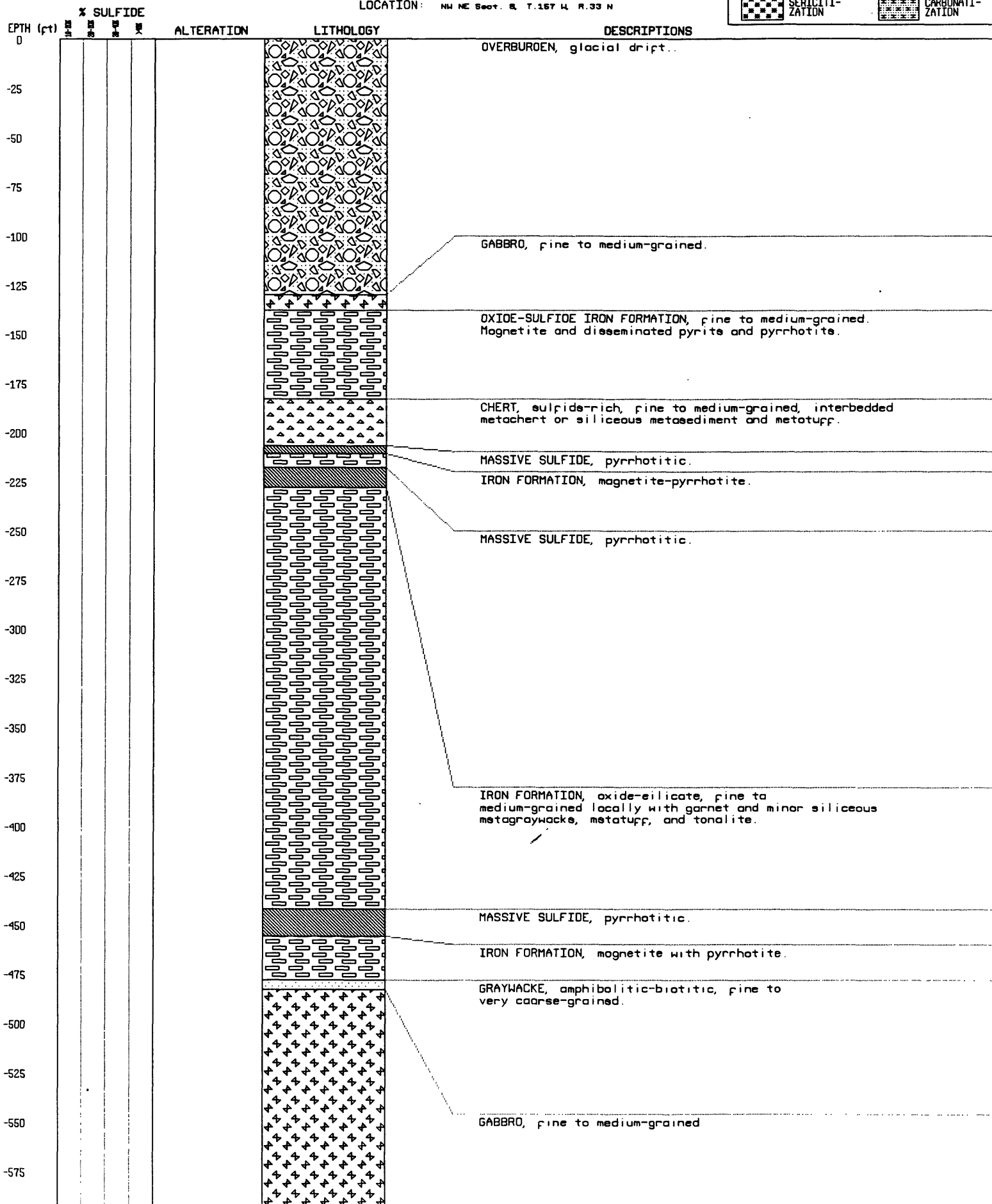


Fig. 3 DRILL HOLE 40920

OPERATOR: Inco
COMPLETED: MAY 12, 1971
LOCATION: NW NE Sect 8, T 157 W, R. 33 N

7
ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
0				OVERBURDEN, glacial drift.
-25				
-50				
-75				
-100				
-125				
-150				
-175				
-200				
-225				
-250				
-275				BASALT, amphibolitic, fine-grained, variably sheared, saprolitic to variably altered
-300				
-325				
-350				
-375				
-400				
-425				BASALT, amphibolitic, fine-grained, with calcite veinlets and disseminated sulfides
-450				
-475				
-500				







Fig. 4

DRILL HOLE A-6-1

OPERATOR AMOCO MINERALS COMPANY

LOCATION SEC 29, T 158 N, R 29 N

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

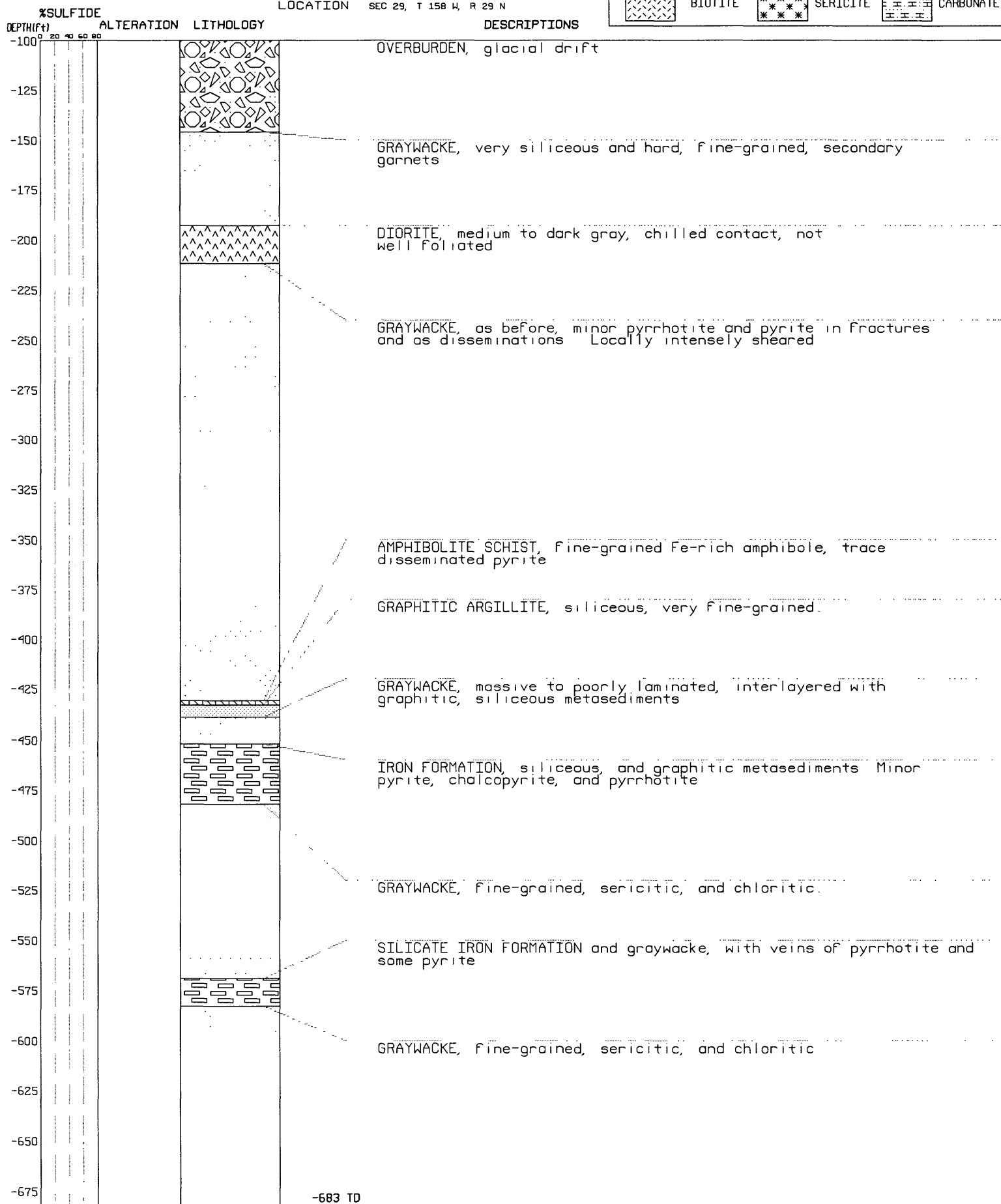


Fig. 5

DRILL HOLE A-6-2

OPERATOR
COMPLETED
LOCATION

AMOCO MINERALS COMPANY
FEBRUARY 12, 1975
SEC 18, R 158 W, T 29 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
-100				OVERBURDEN, glacial drift.
-125				
-150				
-175				
-200				
-225				GRAYWACKE, heavily chloritized, highly weathered, dark green
-250				
-275				INTERMEDIATE VOLCANICLASTIC ROCK, light to dark gray, very siliceous, hard, massive, with quartz, biotite and some feldspars. Minor pyrite.
-300				
-325				
-350				
-375				
-400				GRAYWACKE, siliceous, chloritic, banded, dark gray-green to light gray bands. Some garnets, trace sulfides in veins and disseminated.
-425				
-450				
-475				
-500				
-525				
-550				
-575				
-600				
-625				
-650				

Fig. 6 DRILL HOLE A-8-1

OPERATOR AMOCO MINERALS COMPANY
COMPLETED FEBRUARY 12, 1975
LOCATION SH SW Sect 7, T 15B, R 2B

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

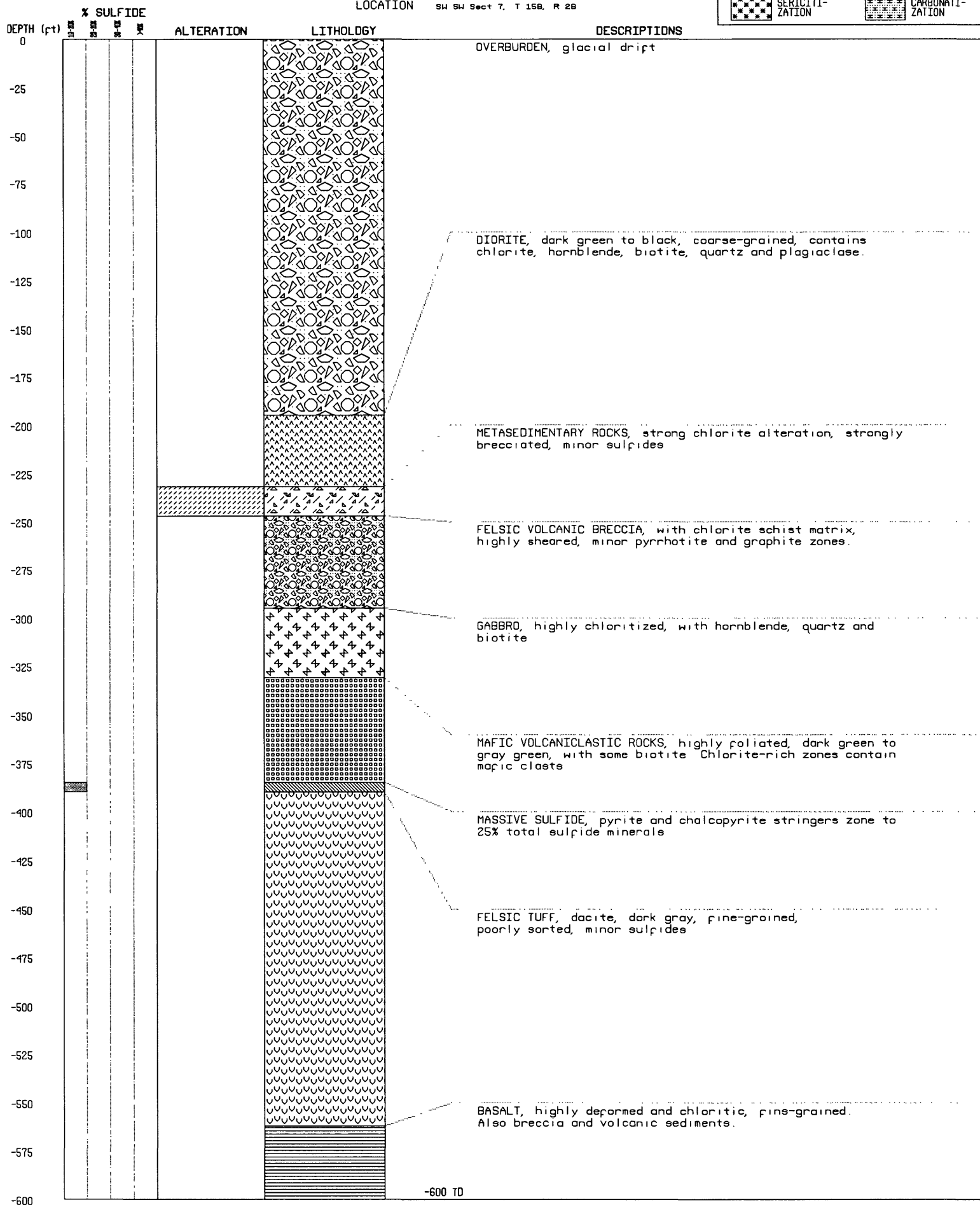
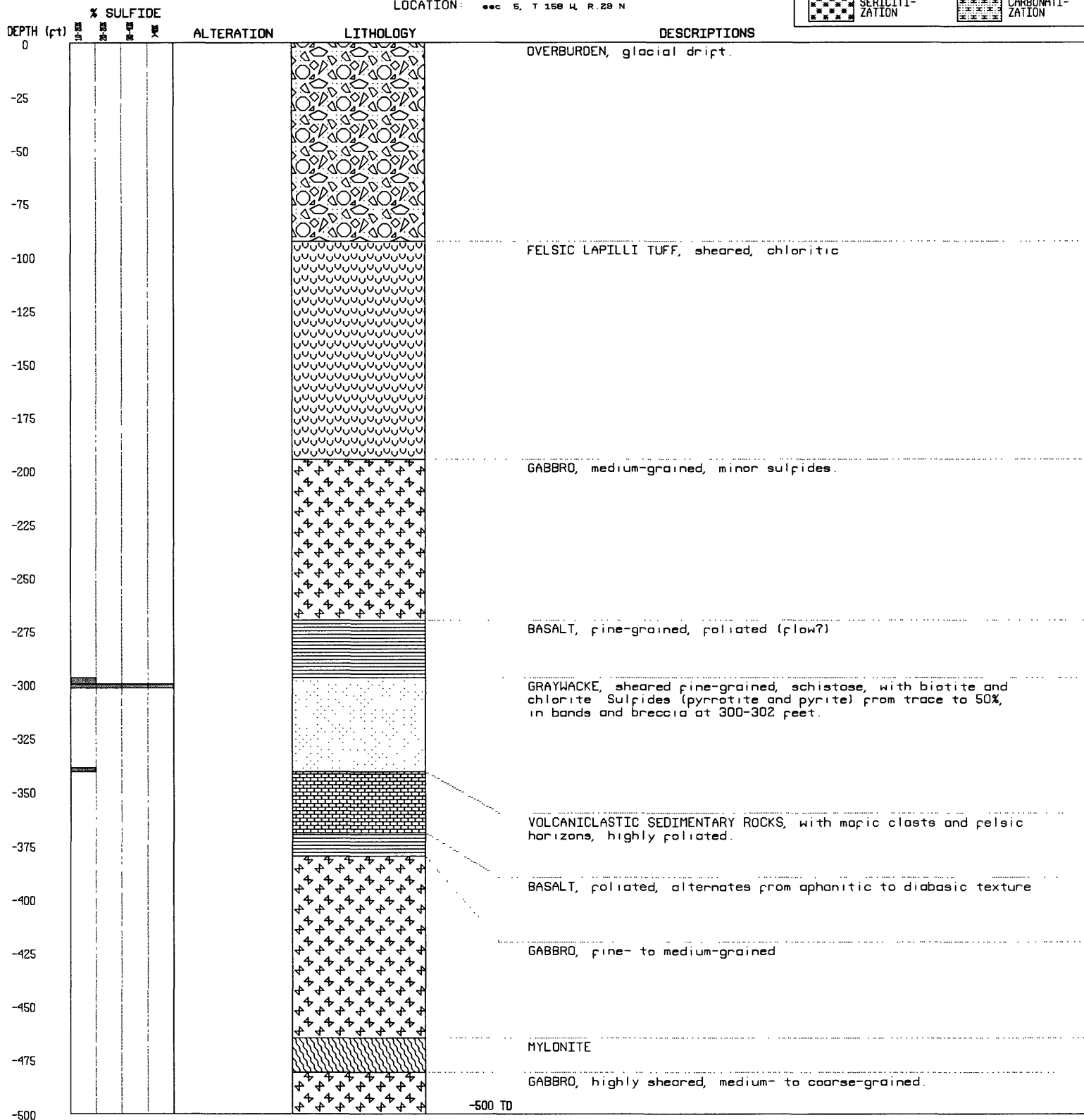


Fig. 7
DRILL HOLE A-9-1

OPERATOR: AMOCO MINERALS COMPANY
COMPLETED: FEBRUARY 28, 1975.
LOCATION: sec 5, T 158 N, R. 29 N





ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



DRILL HOLE A-9-2

OPERATOR: AMOCO MINERALS COMPANY
COMPLETED: JUNE 26, 1977
LOCATION: NW NW SECT 8, T 158 R. 28

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

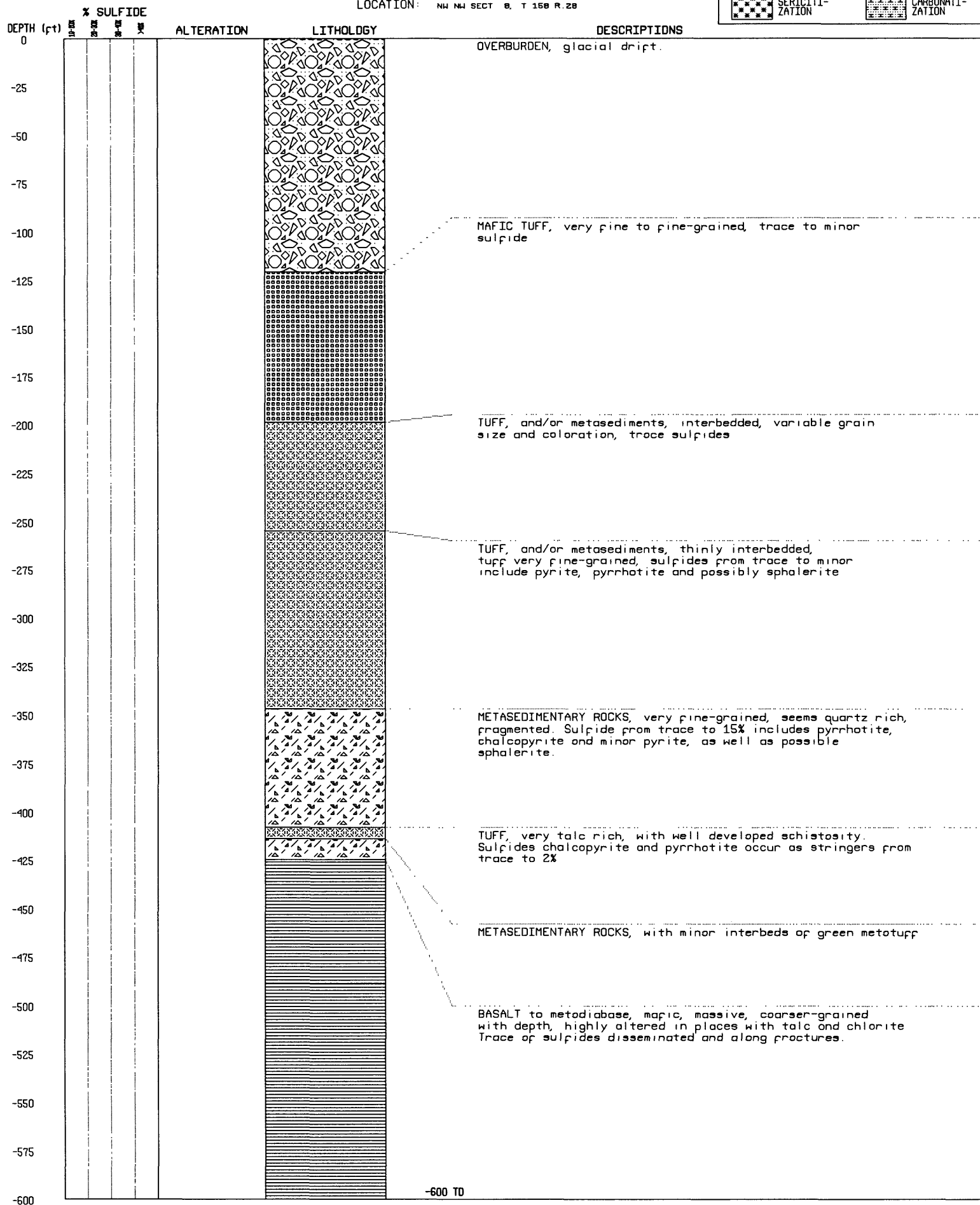


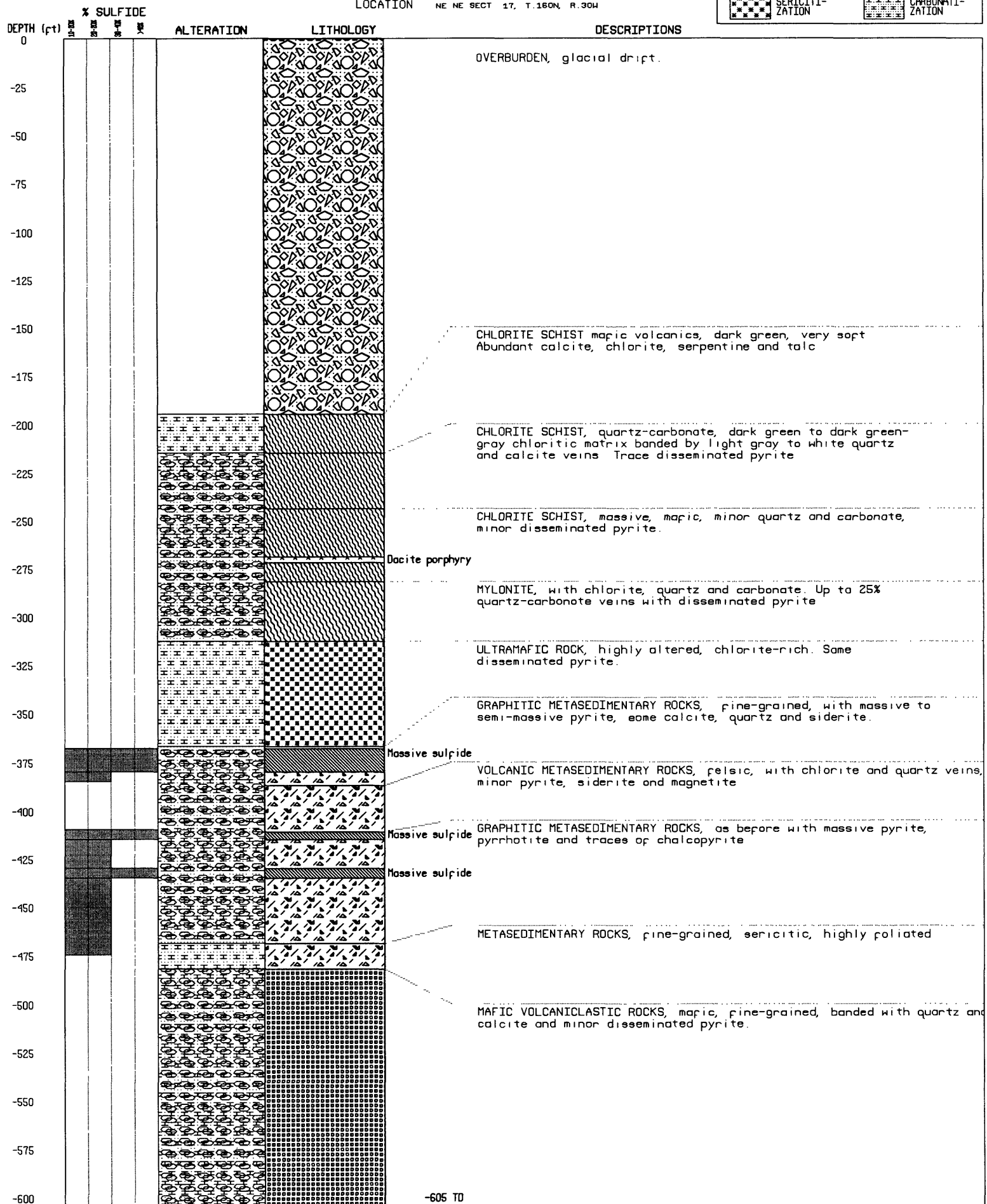
Fig. 9
DRILL HOLE B-3-2

OPERATOR
COMPLETED
LOCATION

AMOCO MINERALS COMPANY
MARCH 4, 1974
NE NE SECT 17, T.160N, R.30W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

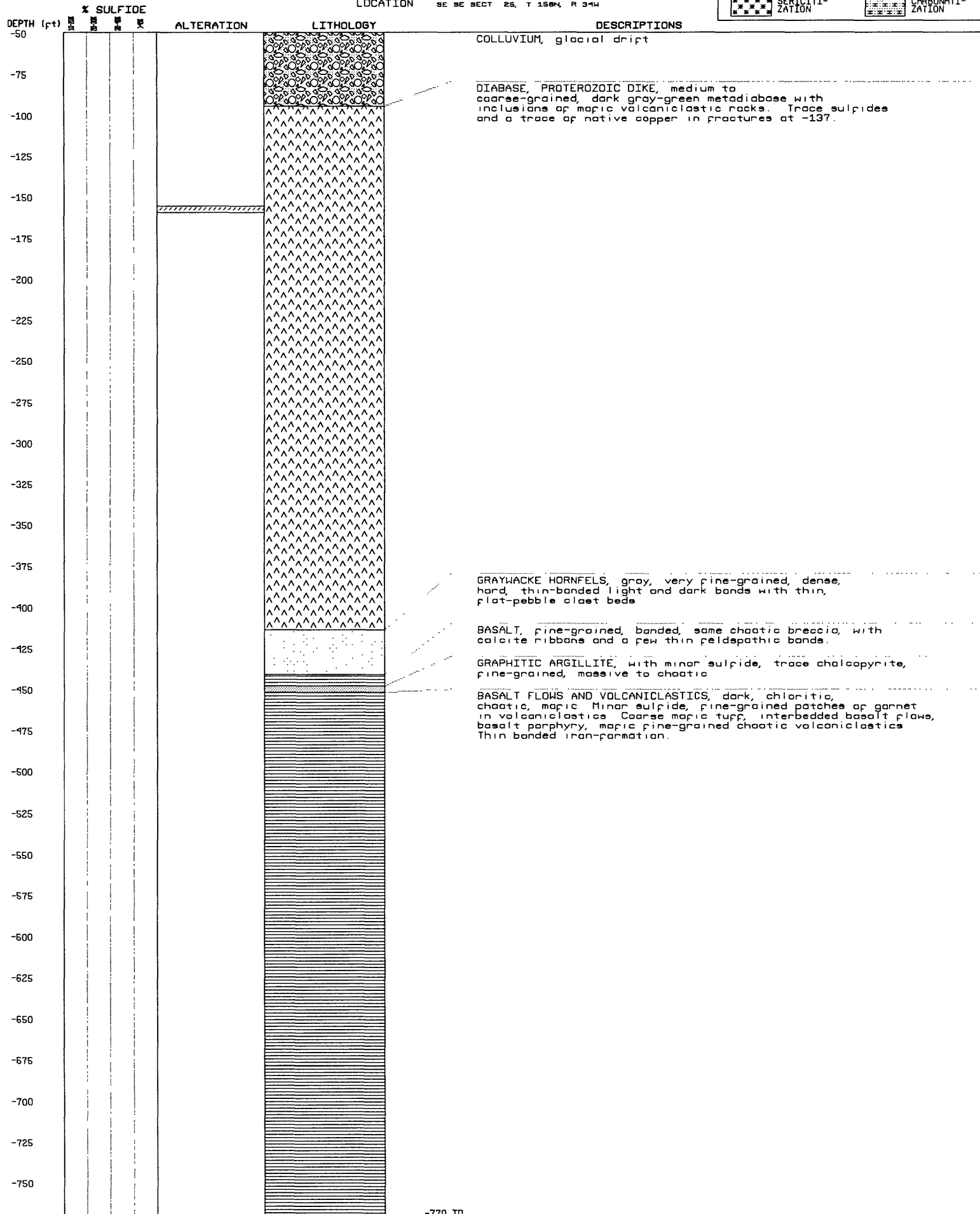


	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 10 DRILL HOLE B-5-1

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
APRIL 6, 1971
SE 36 SECT 25, T 150N, R 34W



	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 11

DRILL HOLE B-21-1

OPERATOR:
COMPLETED
LOCATION:

HUMBLE OIL AND REFINING CO.
JANUARY 8, 1971
NE NE SECT. 3, T. 158N, R. 33W

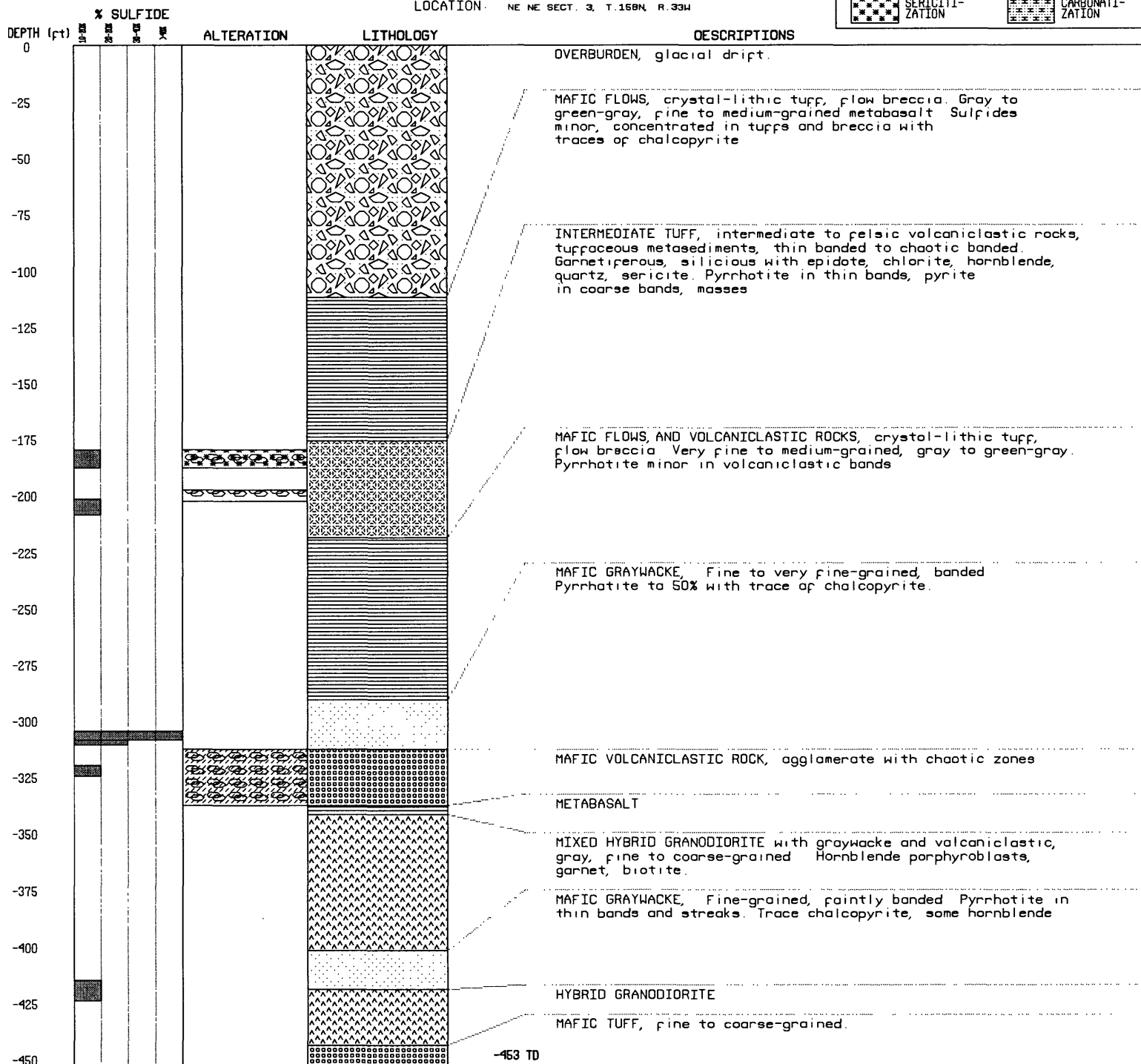


Fig. 12

DRILL HOLE B-21-2

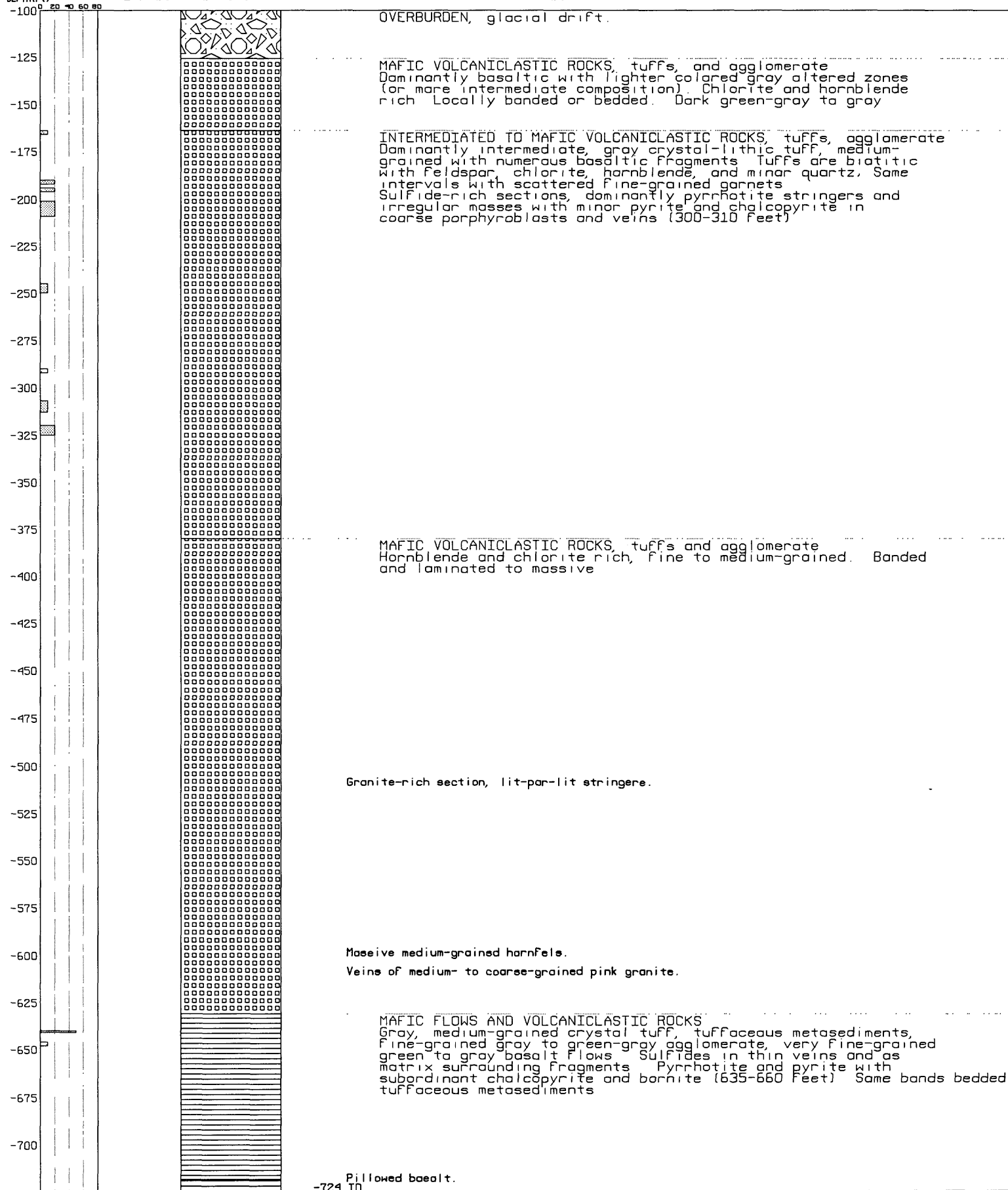
OPERATOR HUMBLE OIL AND REFINING CO
 LOCATION NE NW SECT 3, T 158N, R. 33W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

%SULFIDE
 DEPTH(FT) ALTERATION LITHOLOGY

DESCRIPTIONS



	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 13

DRILL HOLE B-21-3

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
FEBRUARY 26, 1971
NW NW SECT 2, T. 158N, R. 34W

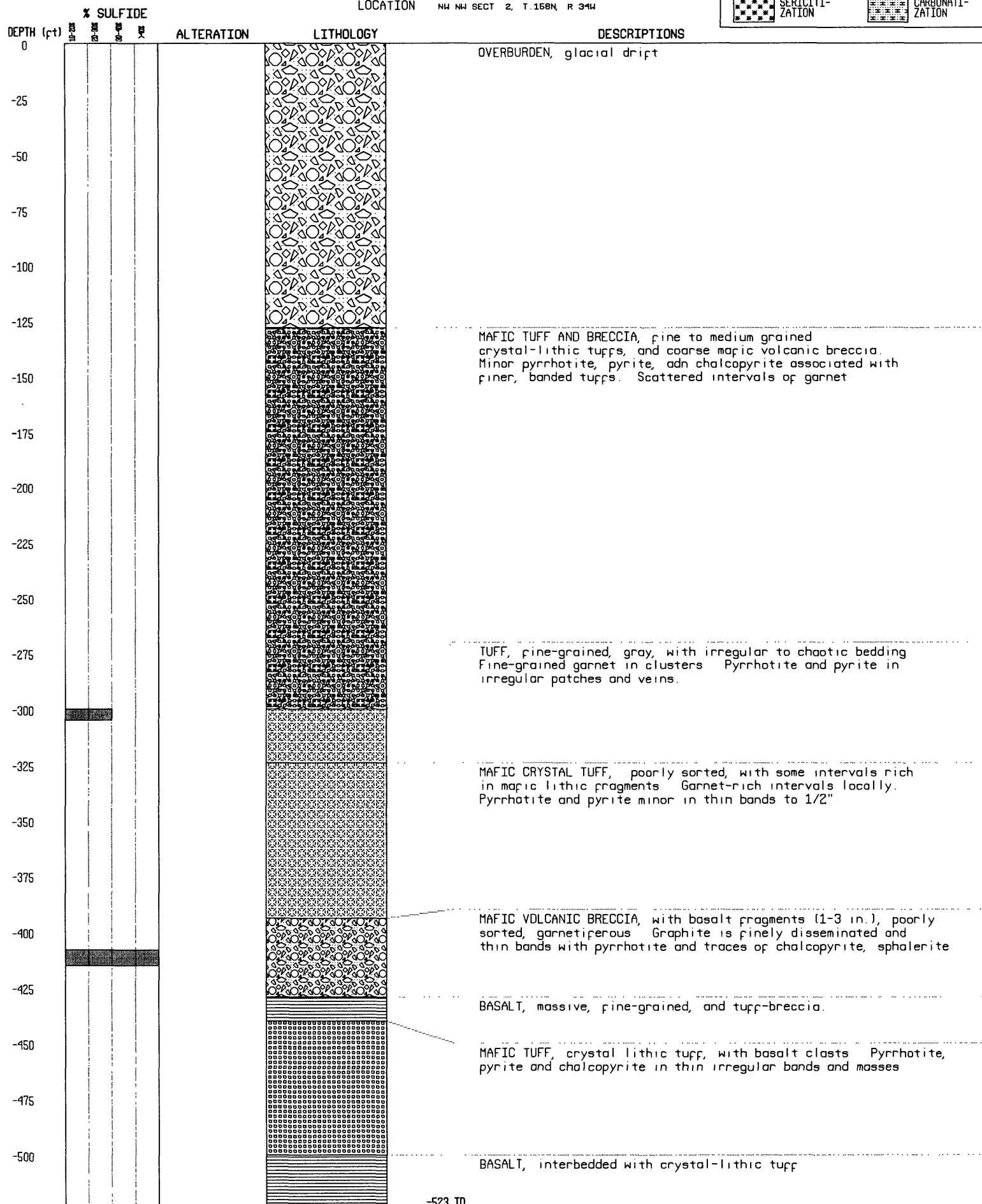


Fig. 14
DRILL HOLE B-24-1

OPERATOR: HUMBLE OIL AND REFINING CO.
COMPLETED: JANUARY 15, 1971
LOCATION: NE NE SECT. 30, T. 158N, R. 33W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

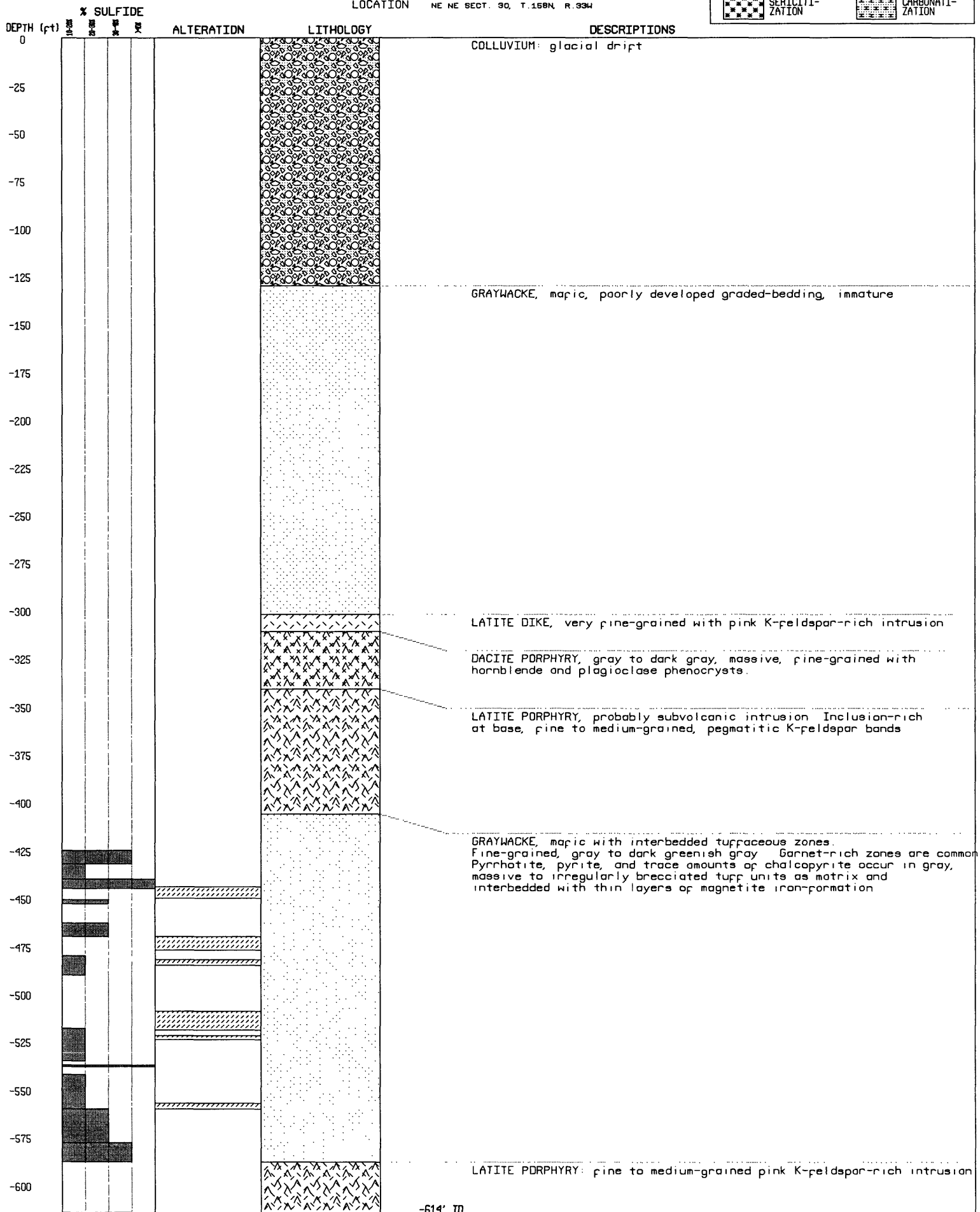


Fig. 15
DRILL HOLE B-24-2

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
FEBRUARY 2, 1971
NE NE SECT 30, T 158N, R. 33W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

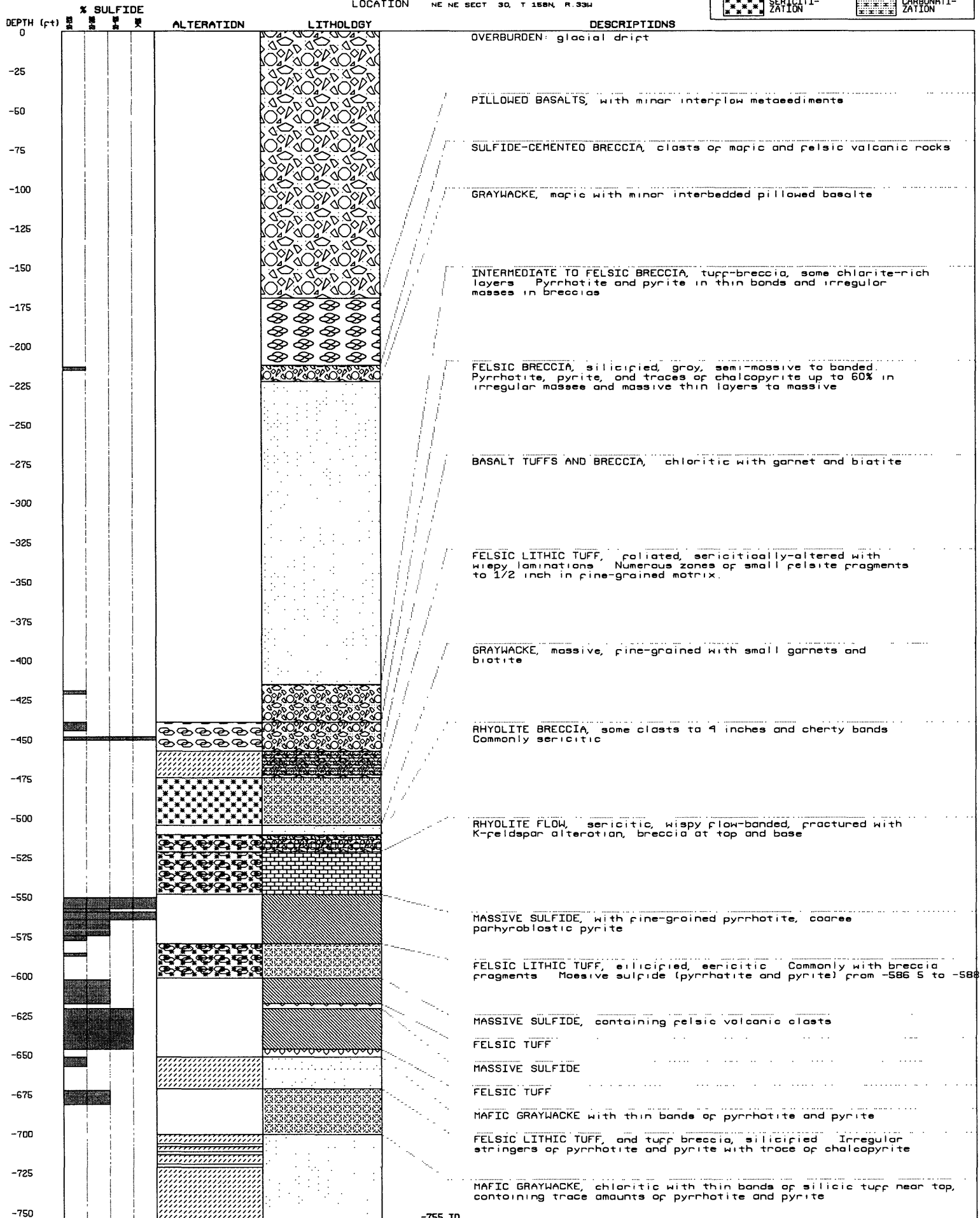
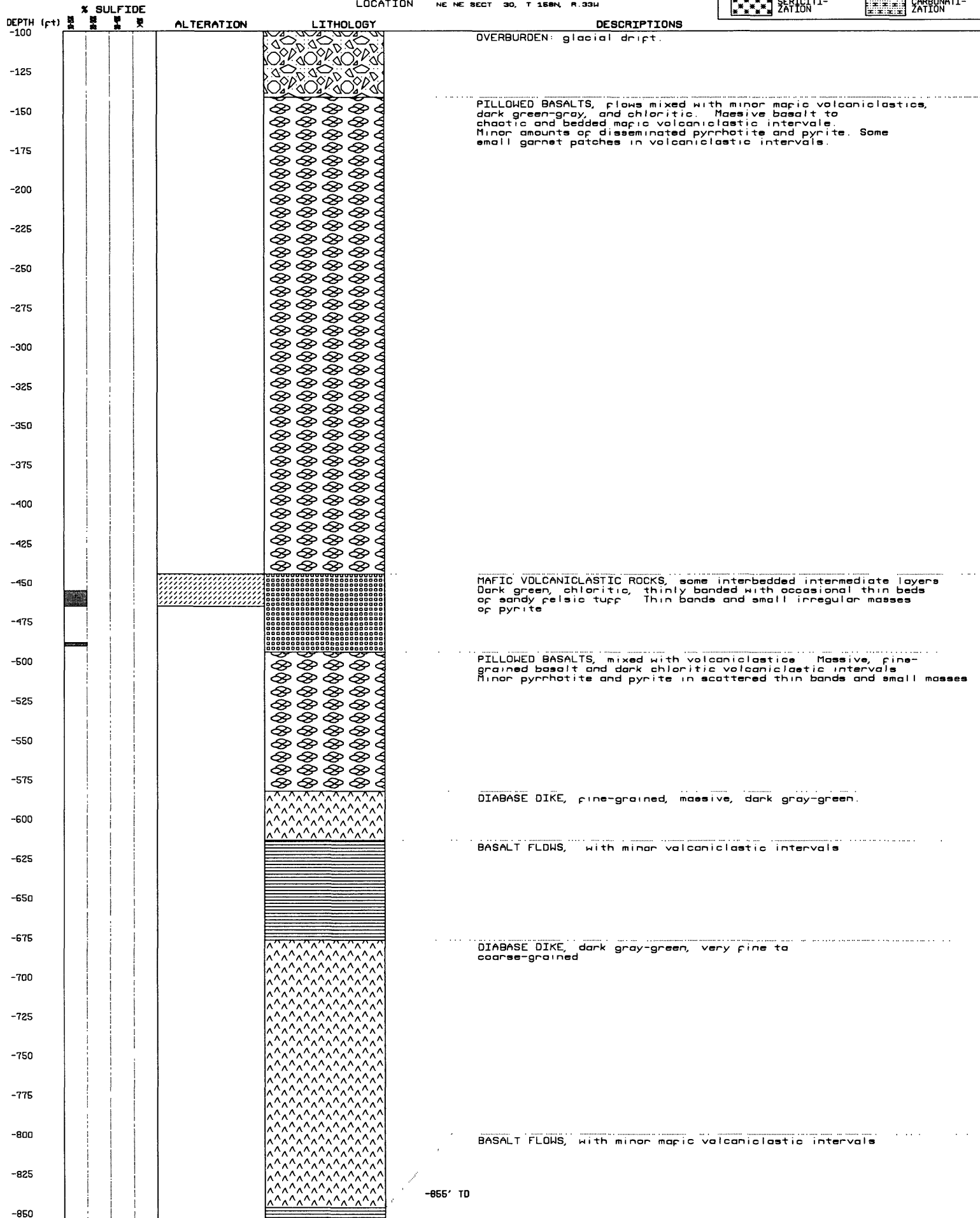


Fig. 16
DRILL HOLE B-24-3

OPERATOR: HUMBLE OIL AND REFINING CO.
 COMPLETED: MARCH 24, 1971
 LOCATION: NE NE SECT 30, T 168N, R. 33W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



-855' TO

Fig. 17
 DRILL HOLE B-24-4

OPERATOR
 COMPLETED
 LOCATION

EXXON
 AUGUST 8, 1975
 SE 9E SECT 18, T.169N, R.33W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
-75				OVERBURDEN: glacial drift.
-100				
-125				MAFIC METASEDIMENTS, with interbedded magnetite bands. Garnets are present locally. Up to 10% pyrrhotite and pyrite
-150				
-175				
-200				
-225				
-250				
-275				
-300				
-325				
-350				
-375				
-400				
-425				
-450				
-475				
-500				
-525				
-550				GRAYWACKE, fine-grained.
-575				
-600				
-625				
-650				
-675				MAFIC METASEDIMENTS and interbedded tuffe. Fine-grained, pyrrhotite, pyrite and traces of chalcopyrite up to 40%. The lowermost 150 feet of this unit may be sheared
-700				
-725				
-750				
-775				
-800				

DRILL HOLE B-31-1

HUMBLE OIL AND REFINING CO
APRIL 5, 1971
SE NW SECT 6. T 157N. R 34W

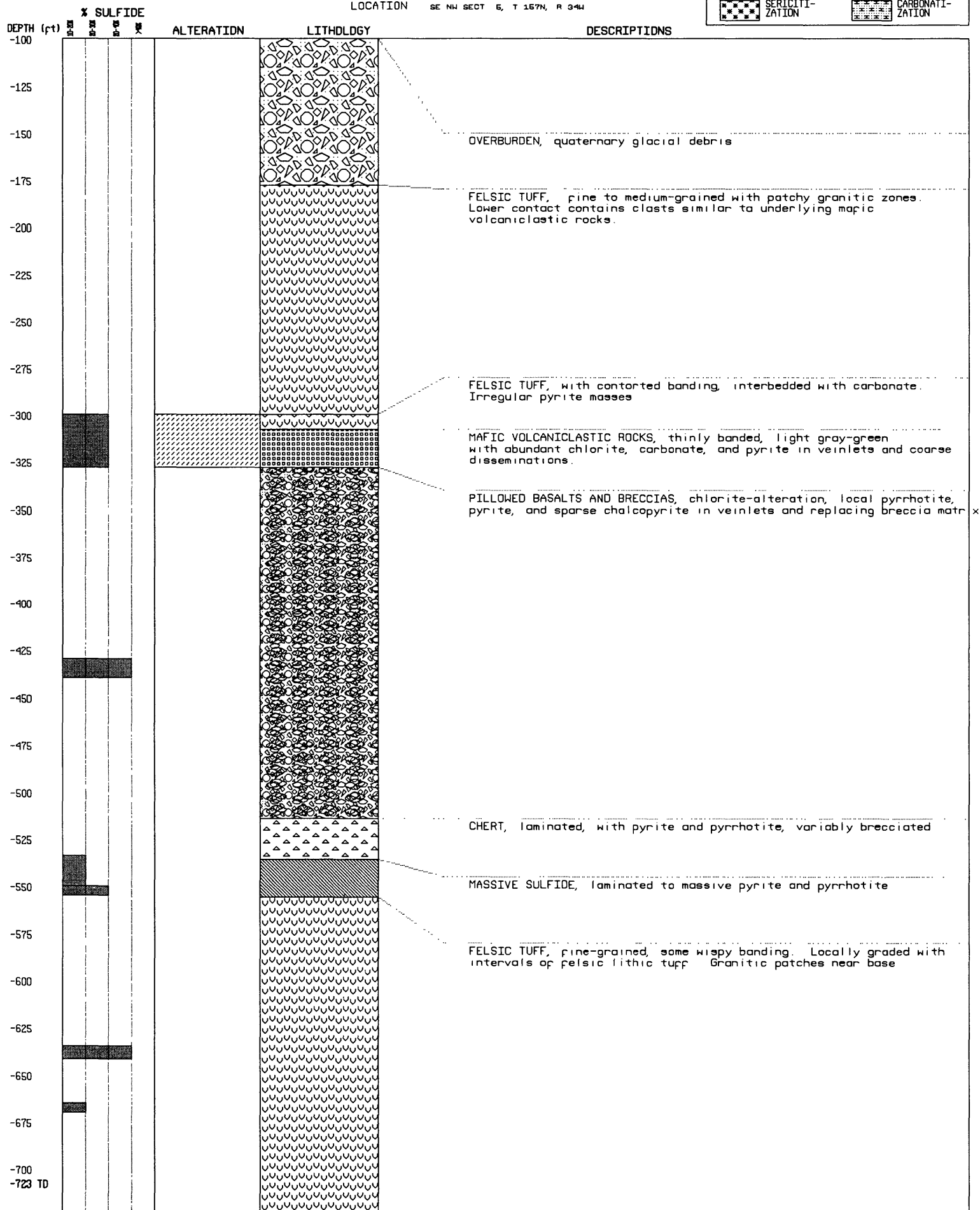
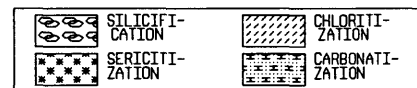


Fig. 19
DRILL HOLE B-31-2

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
MARCH 20, 1972
NE NW SECT 6, T 167N, R 34W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
-250				OVERBURDEN, glacial drift
-275				MIGMATITE, tuffaceous metasedimentary rocks, intruded by numerous coarse-grained K-feldspar-rich dikes and stringers
-300				
-325				
-350				
-375				BASALT, massive, fine-grained
-400				FELSIC TUFF, fine-grained, brown, poorly banded
-425				MASSIVE SULFIDE, laminated with fine-grained mafic volcaniclastic rocks
-450				MAFIC VOLCANICLASTIC ROCKS, fine- to medium-grained, dark green, thin interlayers of basalt and tuffaceous rocks, some slump? breccias. Garnets are widespread and locally abundant
-475				
-500				
-525				
-550				
-575				
-600				
-625				
-650				
-675				
-700				
-725				
-750				
-775				
-800				
-825				
-850				
-875				
-900				
-925				FELSIC TUFF, crystal-lithic tuff, gray-green, fine-grained
-950				MAFIC VOLCANICLASTIC ROCKS, as above
-975				

Fig. 20

DRILL HOLE B-31-3

OPERATOR HUMBLE OIL AND REFINING CO

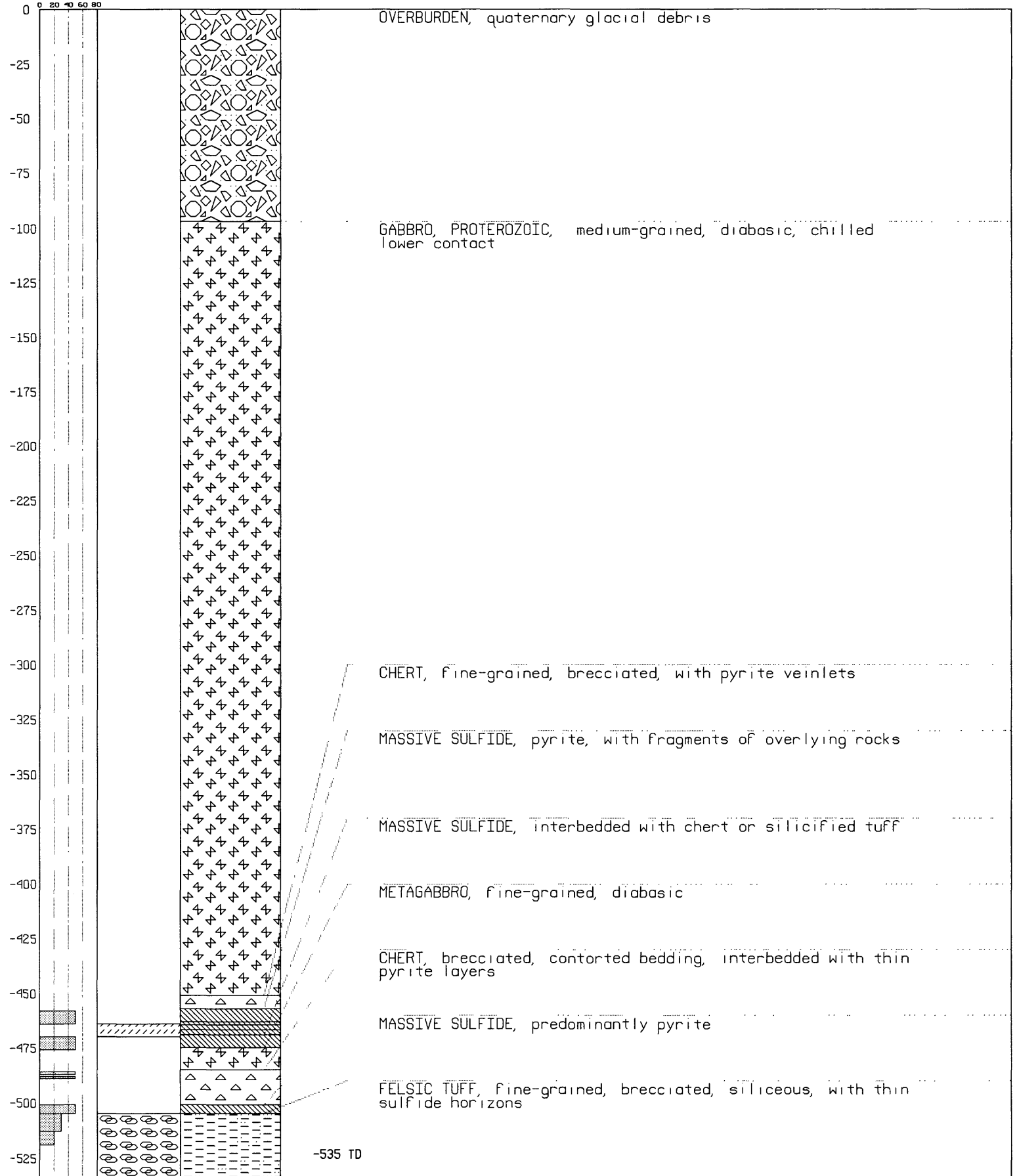
LOCATION SW NE SECT 5, T 157N, R 34W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

%SULFIDE
DEPTH(ft) ALTERATION LITHOLOGY

DESCRIPTIONS

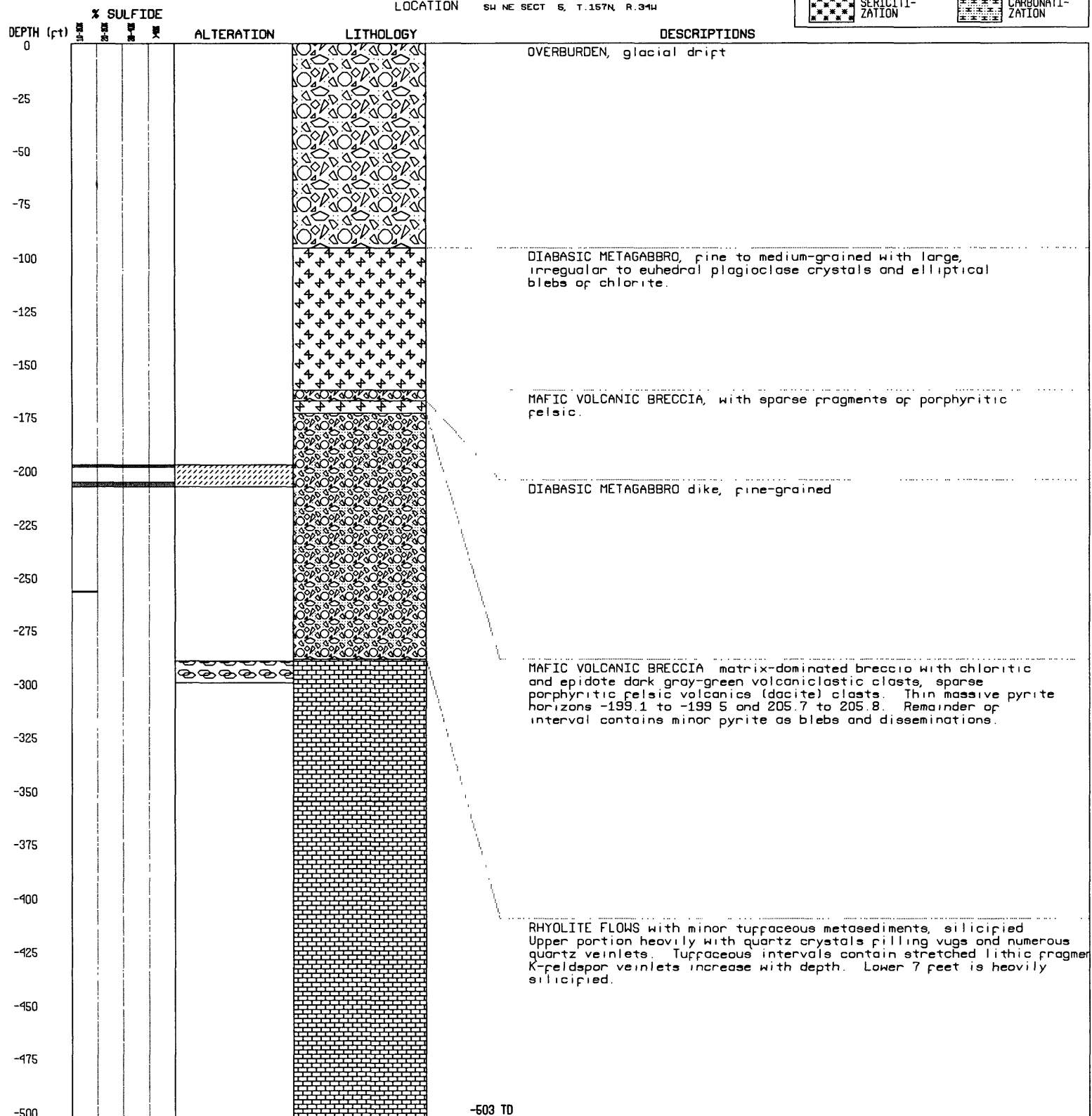


	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 21 DRILL HOLE B-31-4

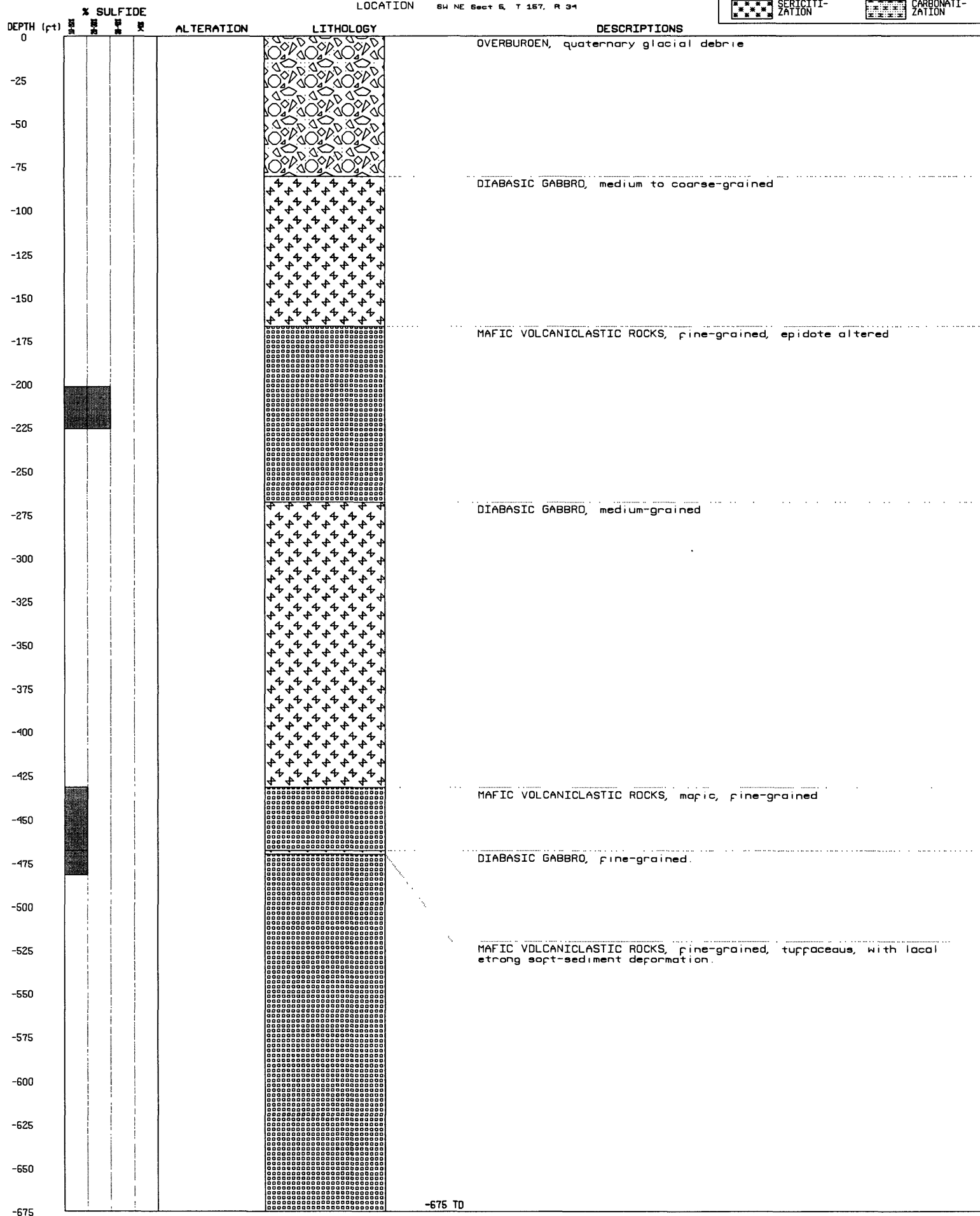
OPERATOR
COMPLETED
LOCATION

EXXON COMPANY
JANUARY 12, 1973
SW NE SECT 6, T.157N, R.34W



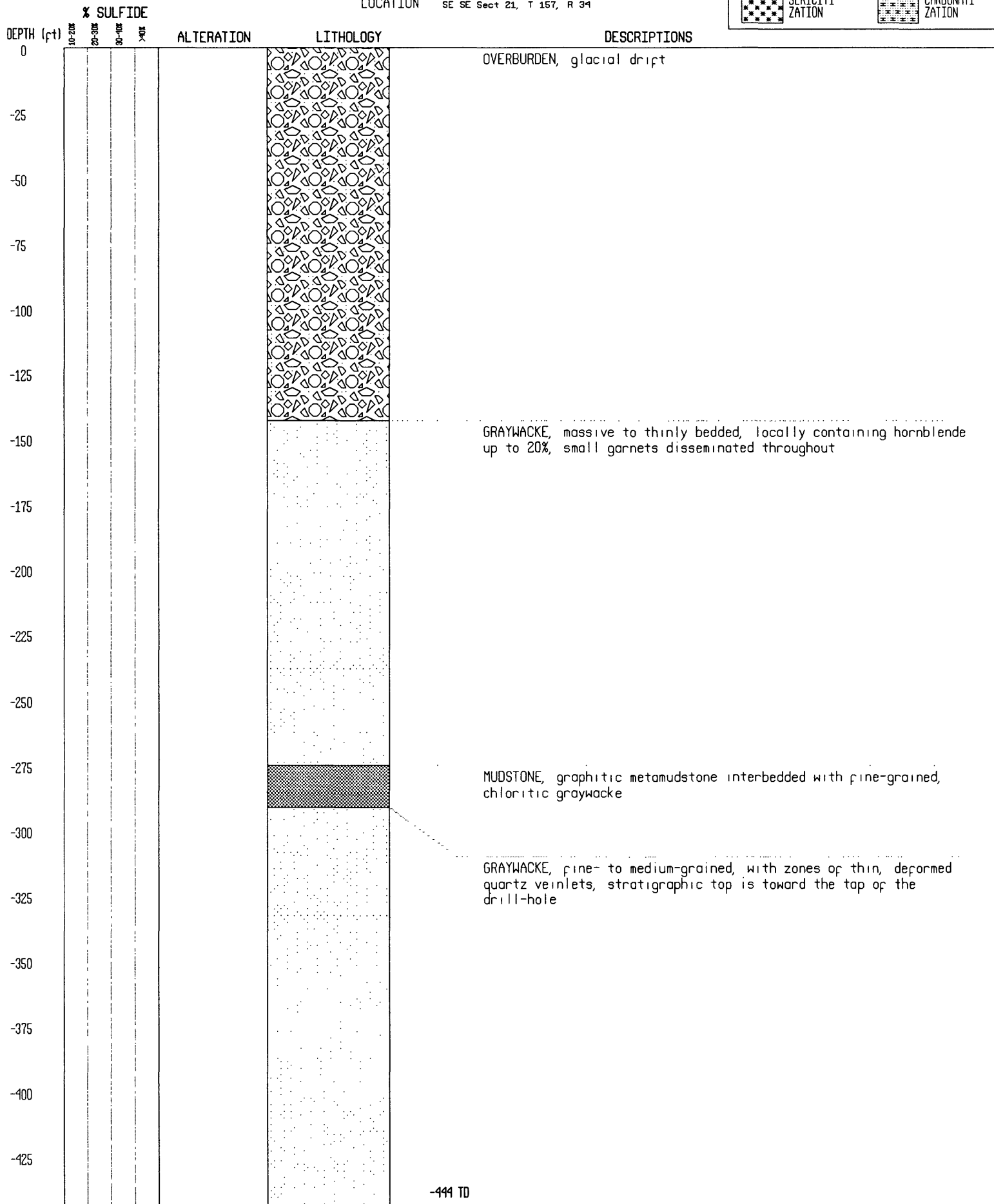
ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 22
DRILL HOLE B-31-5OPERATOR
COMPLETED
LOCATIONEXXON
FEBRUARY 5, 1979.
64 NE Sect 5, T 157, R 34

DRILL HOLE B35-1

EXXON
February 24, 1971
SE SE Sect 21, T 157, R 34



ALTERATIONS





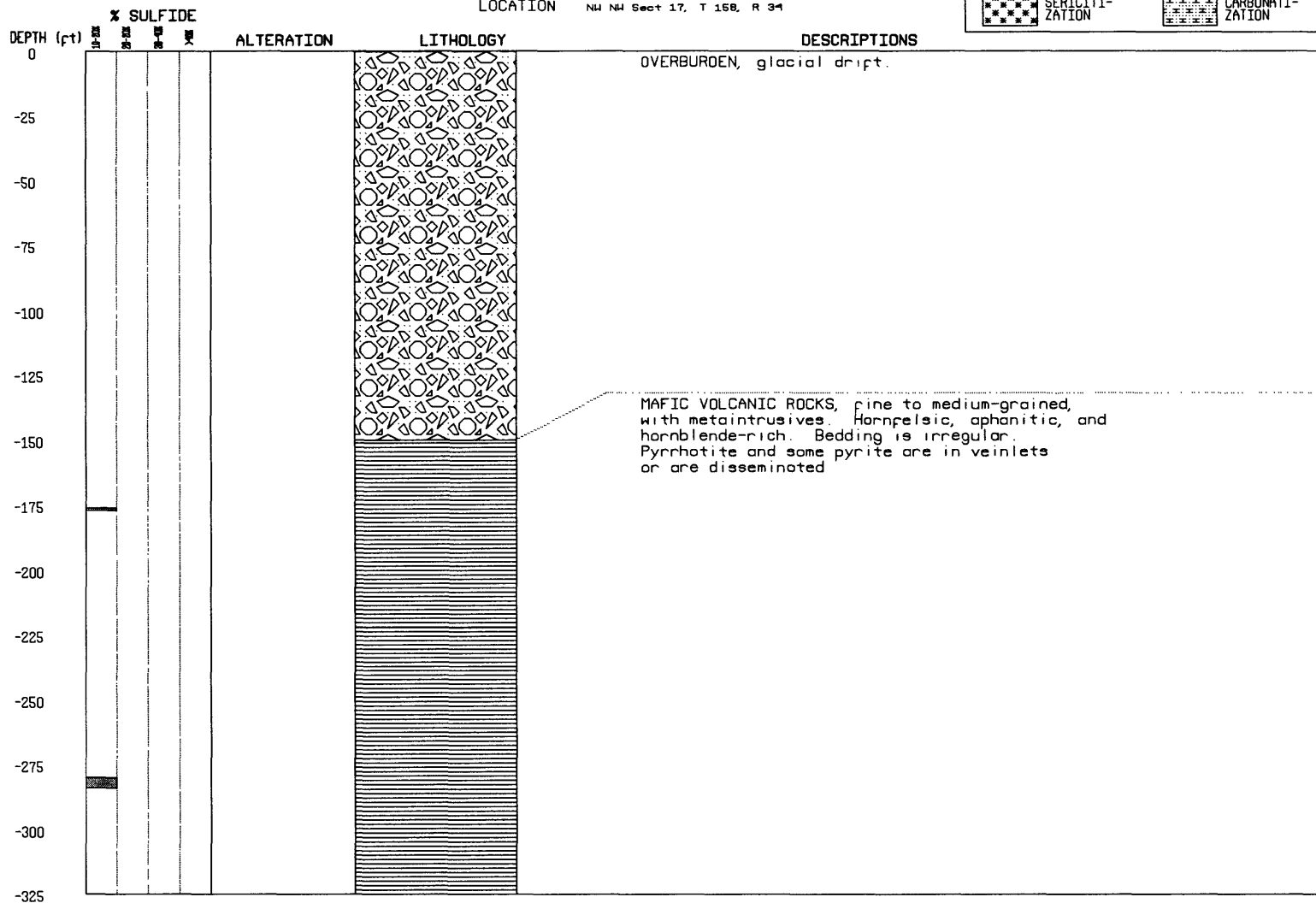
	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 24
DRILL HOLE B54-1

OPERATOR: EXXON
COMPLETED:
LOCATION: NW NW Sect 17, T 158, R 34



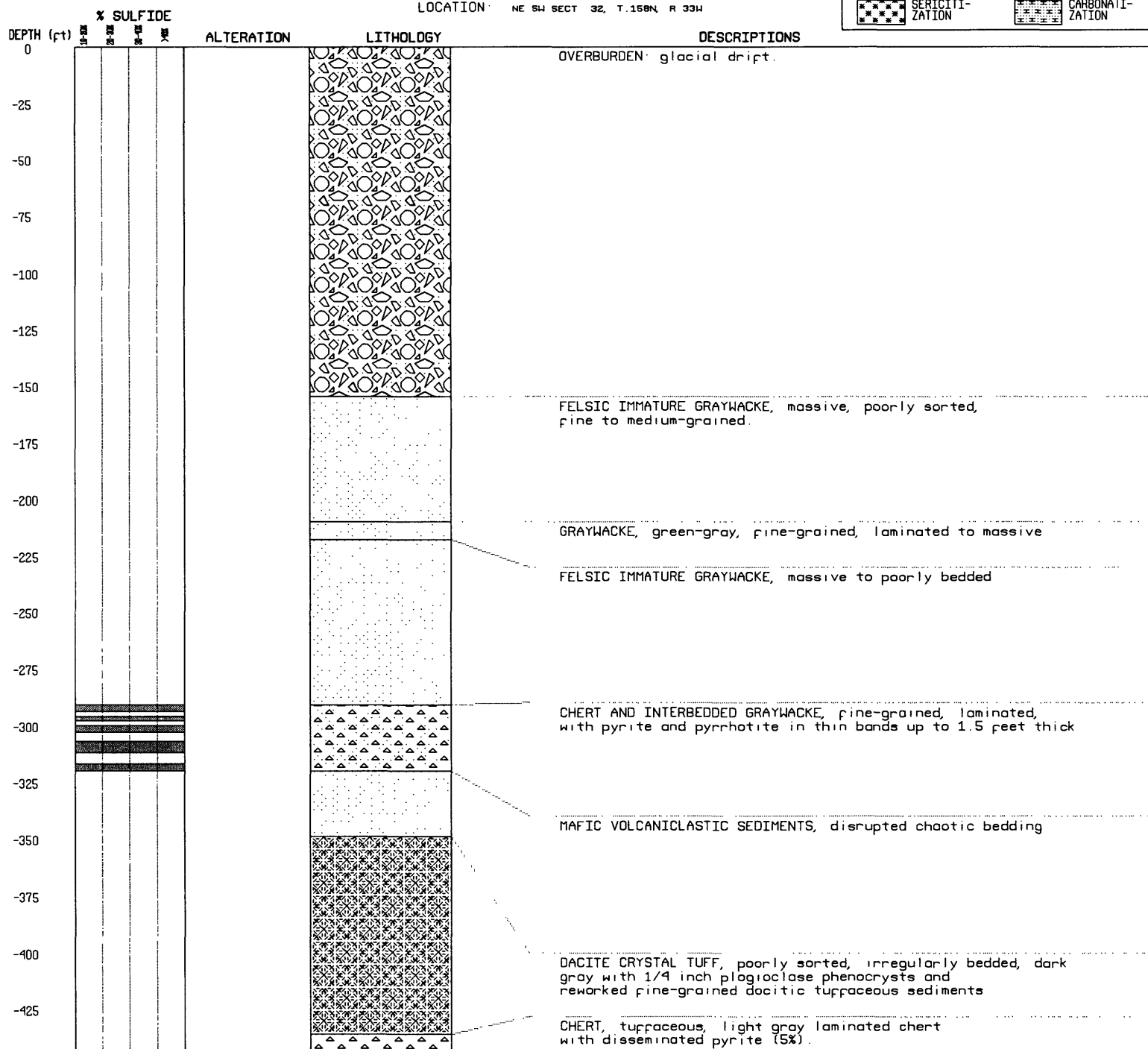
ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 25

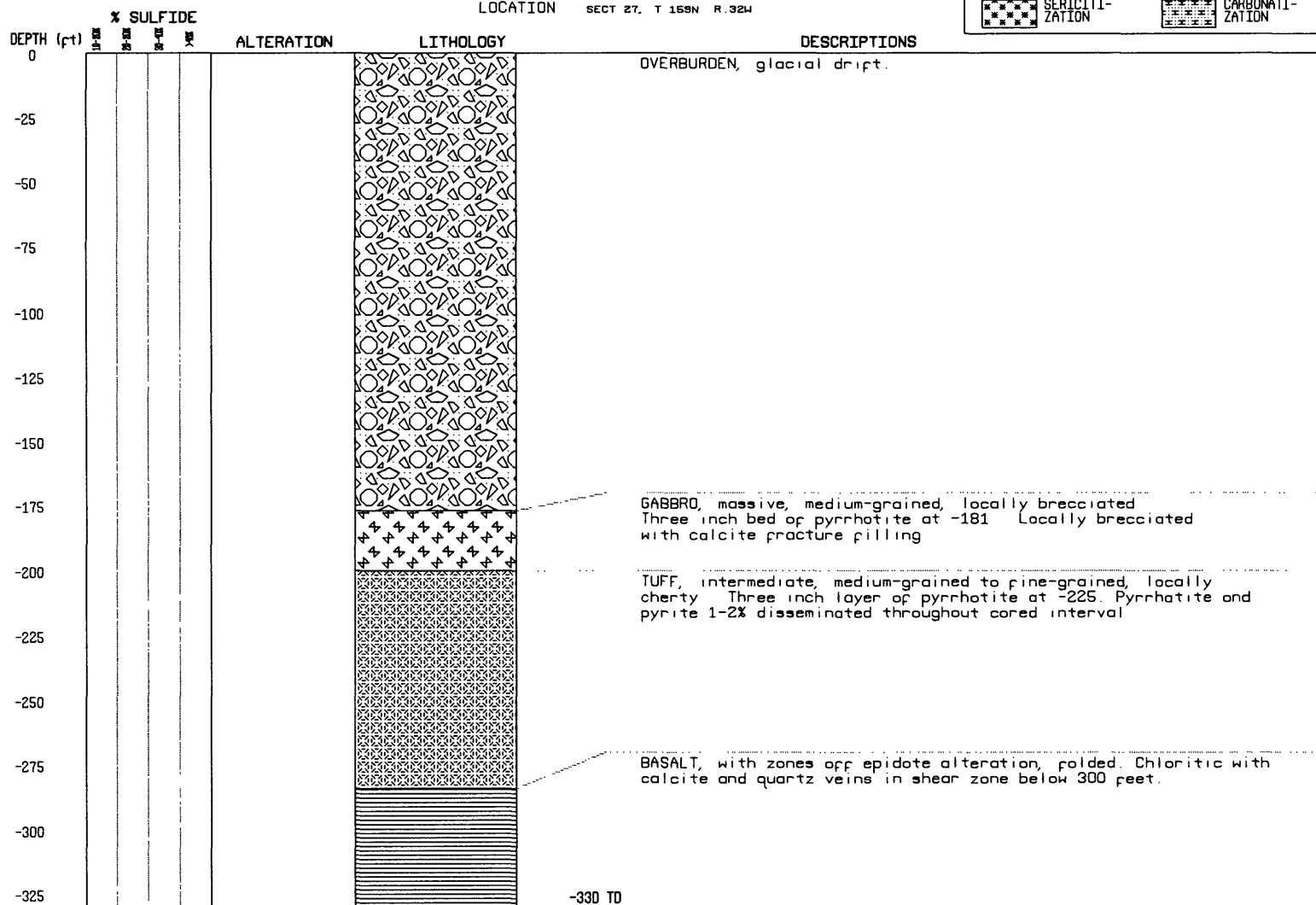
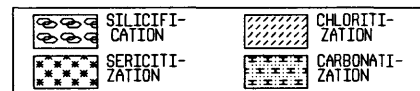
DRILL HOLE B-58-1

OPERATOR HUMBLE OIL AND REFINING CO.
 COMPLETED FEBRUARY 16, 1971
 LOCATION NE SW SECT 32, T.158N, R 33W



DRILL HOLE B-B-2

OPERATOR W S MOORE
COMPLETED NOVEMBER 2, 1970.
LOCATION SECT 27, T 159N R.32W



DRILL HOLE BD-1

OPERATOR RIDGE MINING
COMPLETED: JULY 2, 1971.
LOCATION SW SE SECT 12, T 159N R 32W

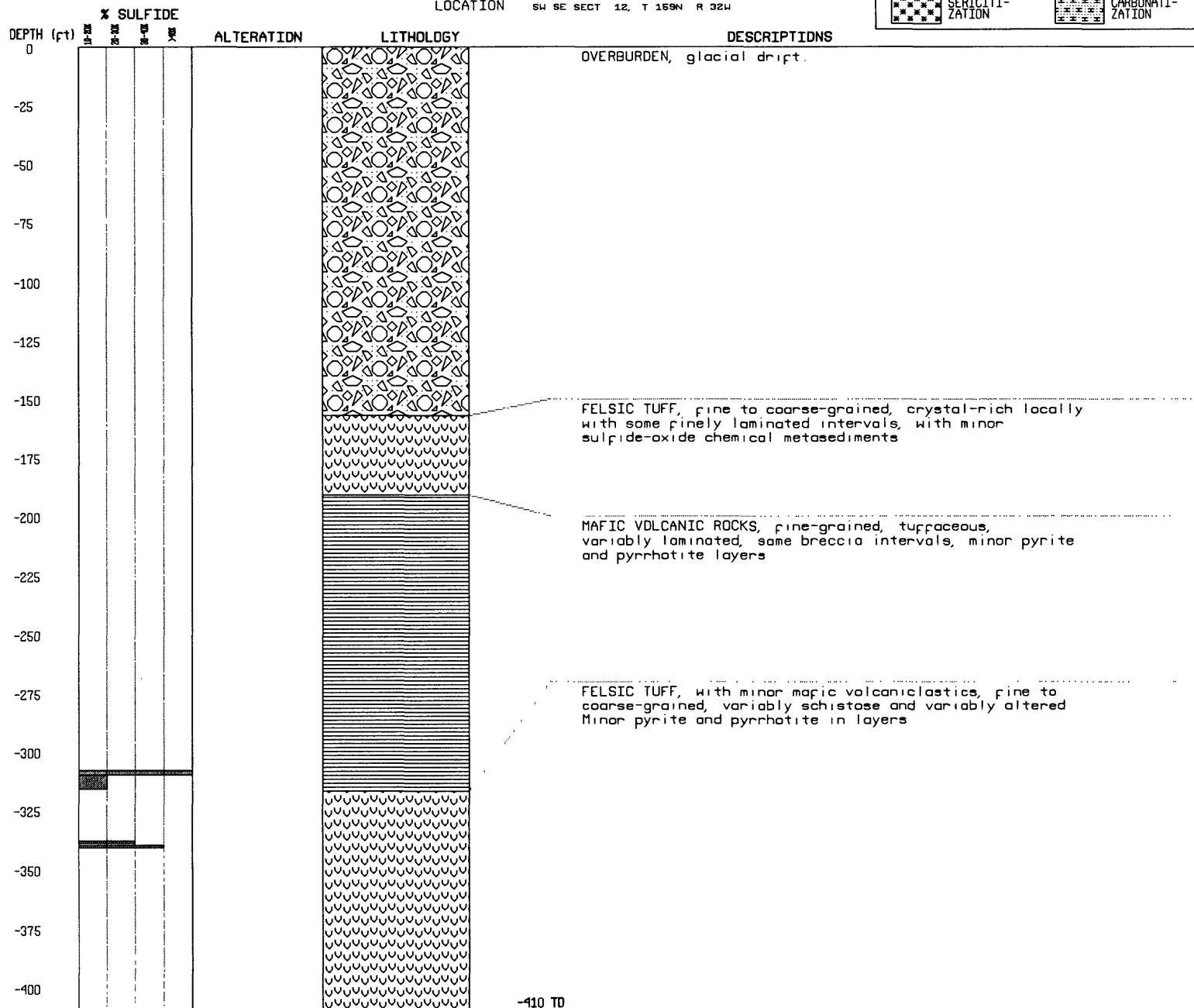
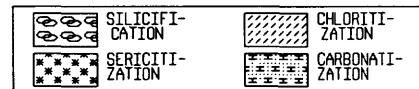


Fig. 28

DRILL HOLE BD-2

OPERATOR Ridge Mining.
 COMPLETED July 15, 1971
 LOCATION SE SW SECT 15, T 15N R 32W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

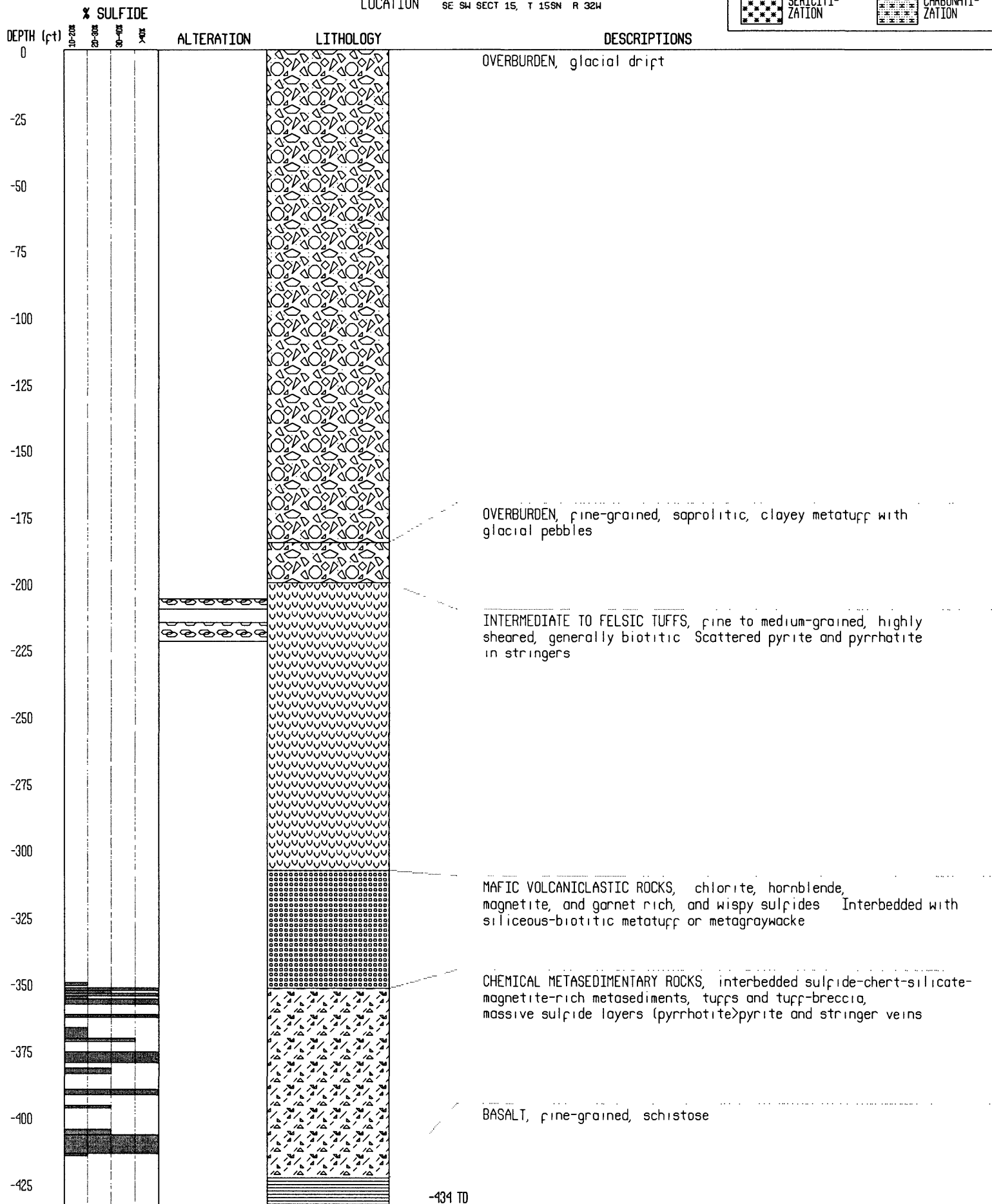




Fig. 29

DRILL HOLE BD-3

OPERATOR TEXASGULF MINERALS COMPANY

LOCATION SEC 14, R 159 W, T 32 N

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

%SULFIDE
DEPTH(ft) ALTERATION LITHOLOGY DESCRIPTIONS

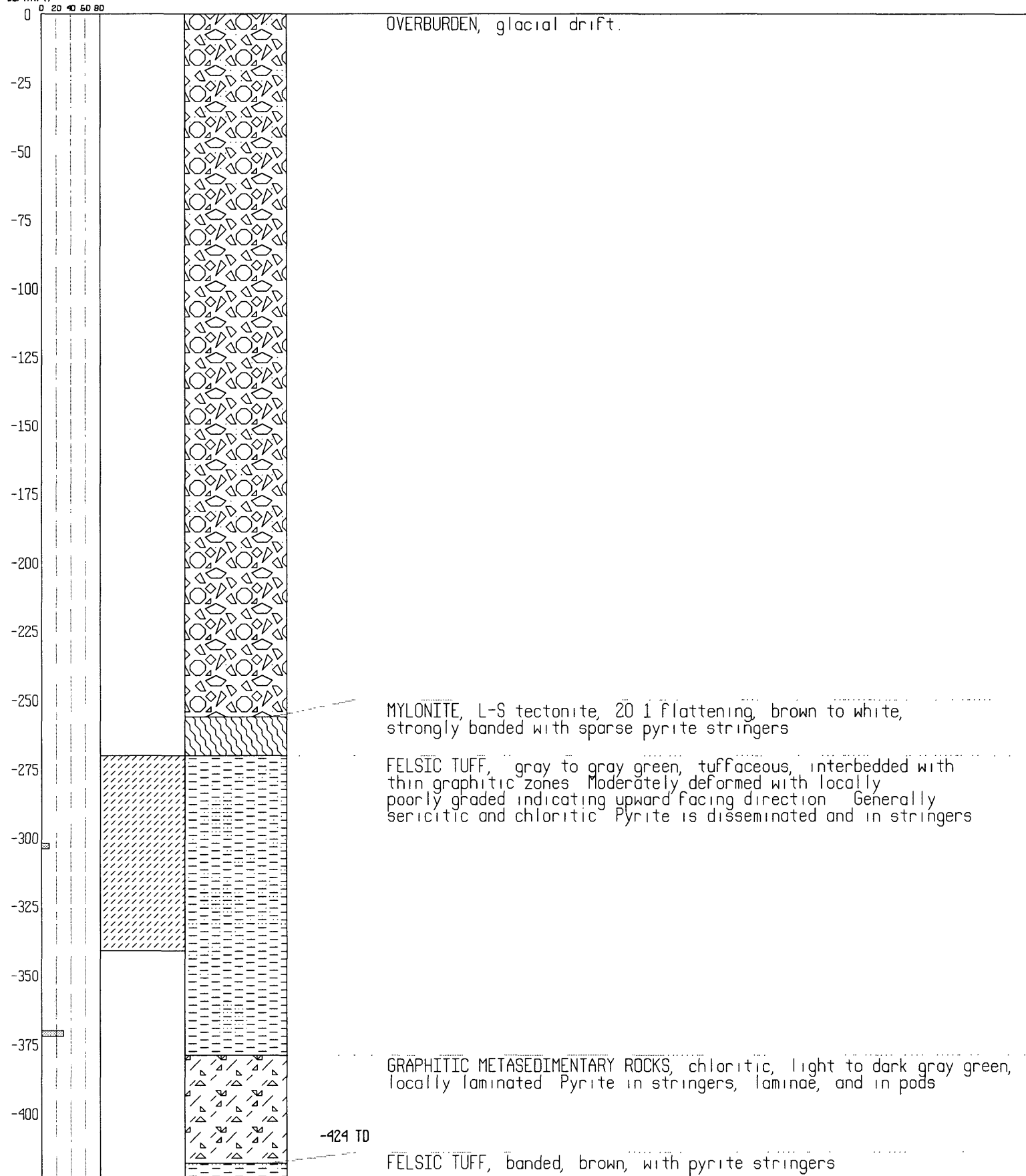


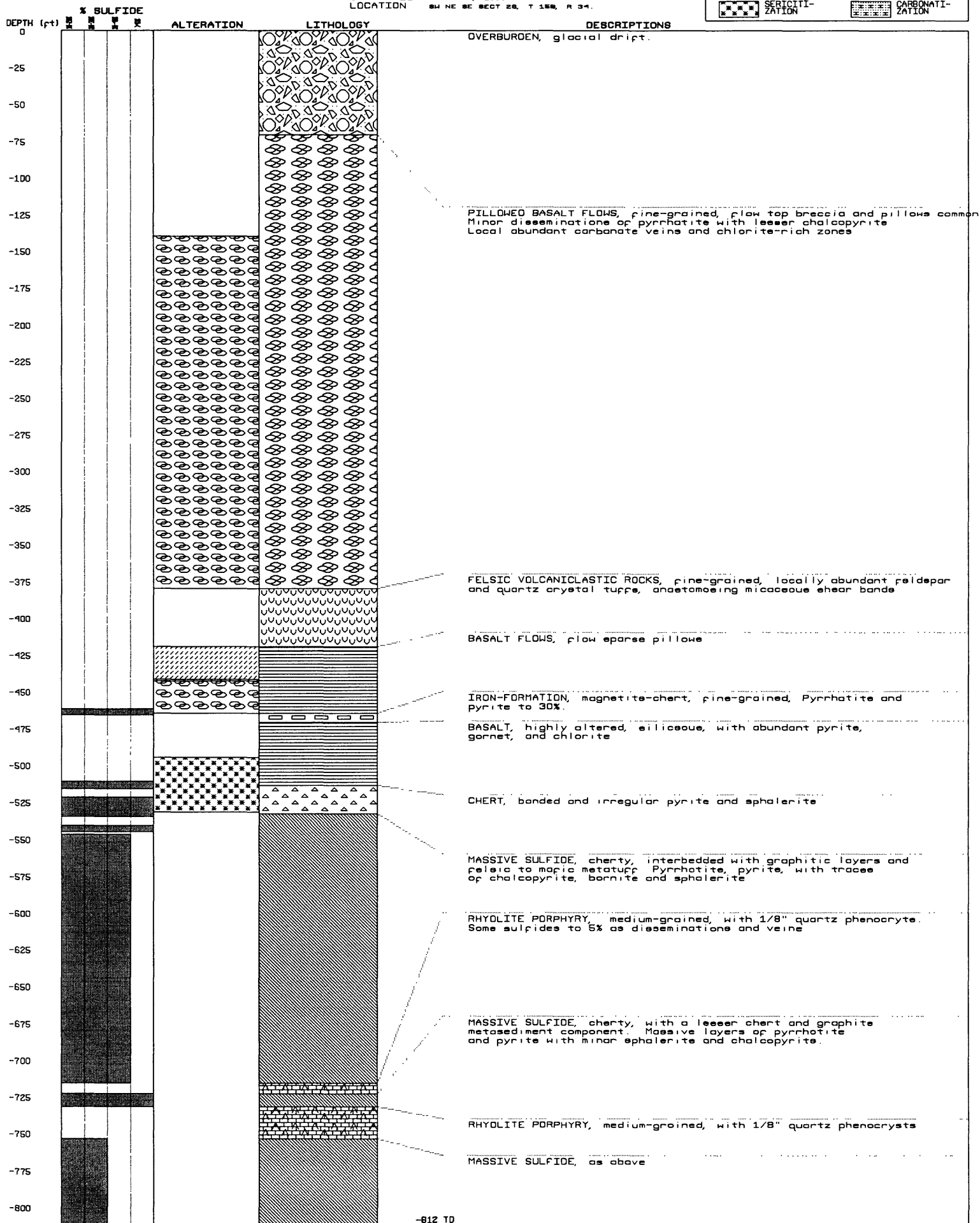
Fig. 30
DRILL HOLE BD-N-1

OPERATOR
COMPLETED
LOCATION

DUVAL
MARCH 24, 1988
SW NE SE SECT 28, T 18N, R 34E

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



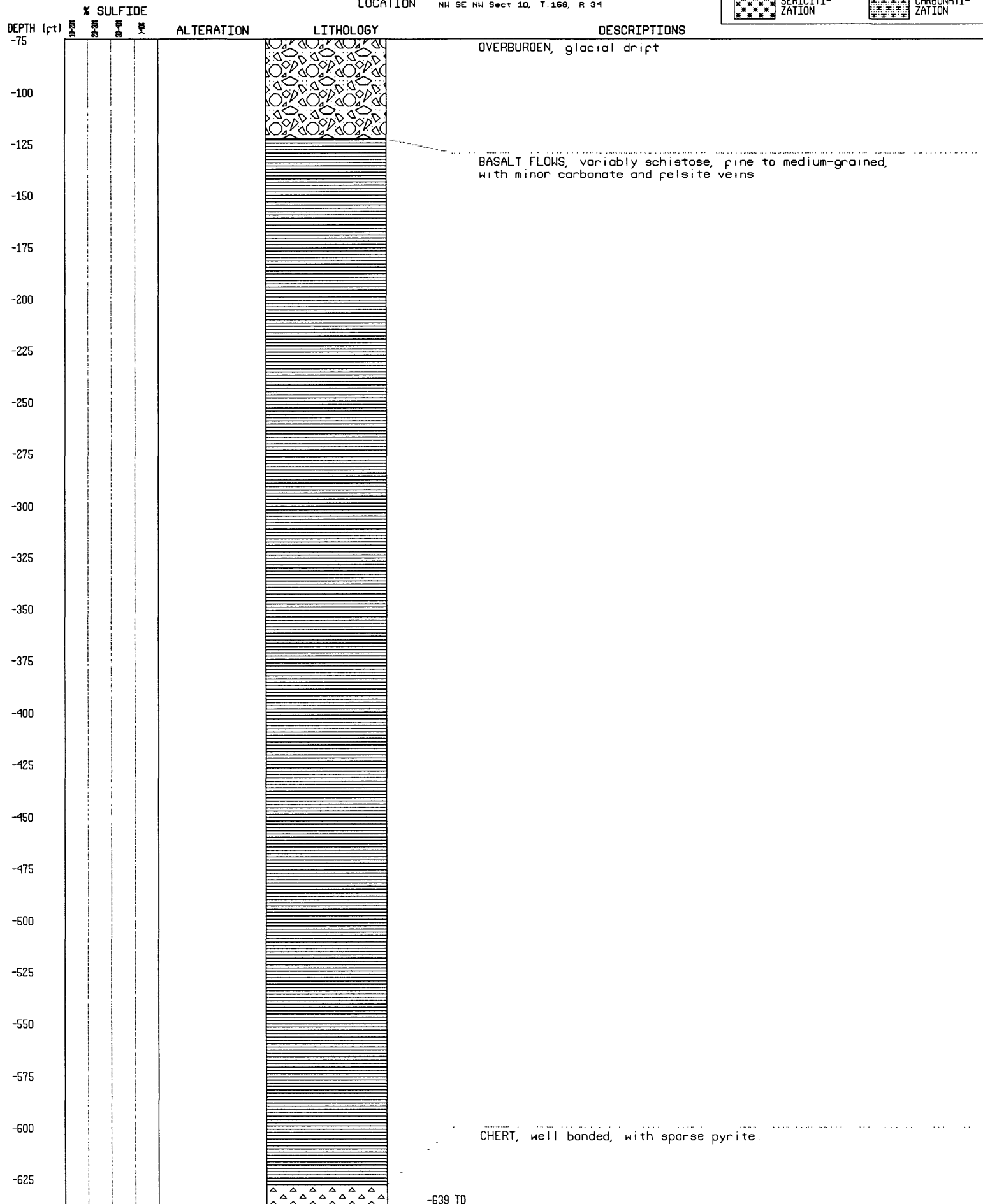
ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 31

DRILL HOLE BD-P-2

OPERATOR: DUVAL CORPORATION.
 COMPLETED: MARCH 28, 1986.
 LOCATION: NW SE NW Sect 10, T.16N, R.34



-639 TD

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 32

DRILL HOLE B-Q-1

OPERATOR: W S MOORE CO
 COMPLETED: OCTOBER 22, 1970
 LOCATION: 54 SE SECT 11, T.150N, R 34W

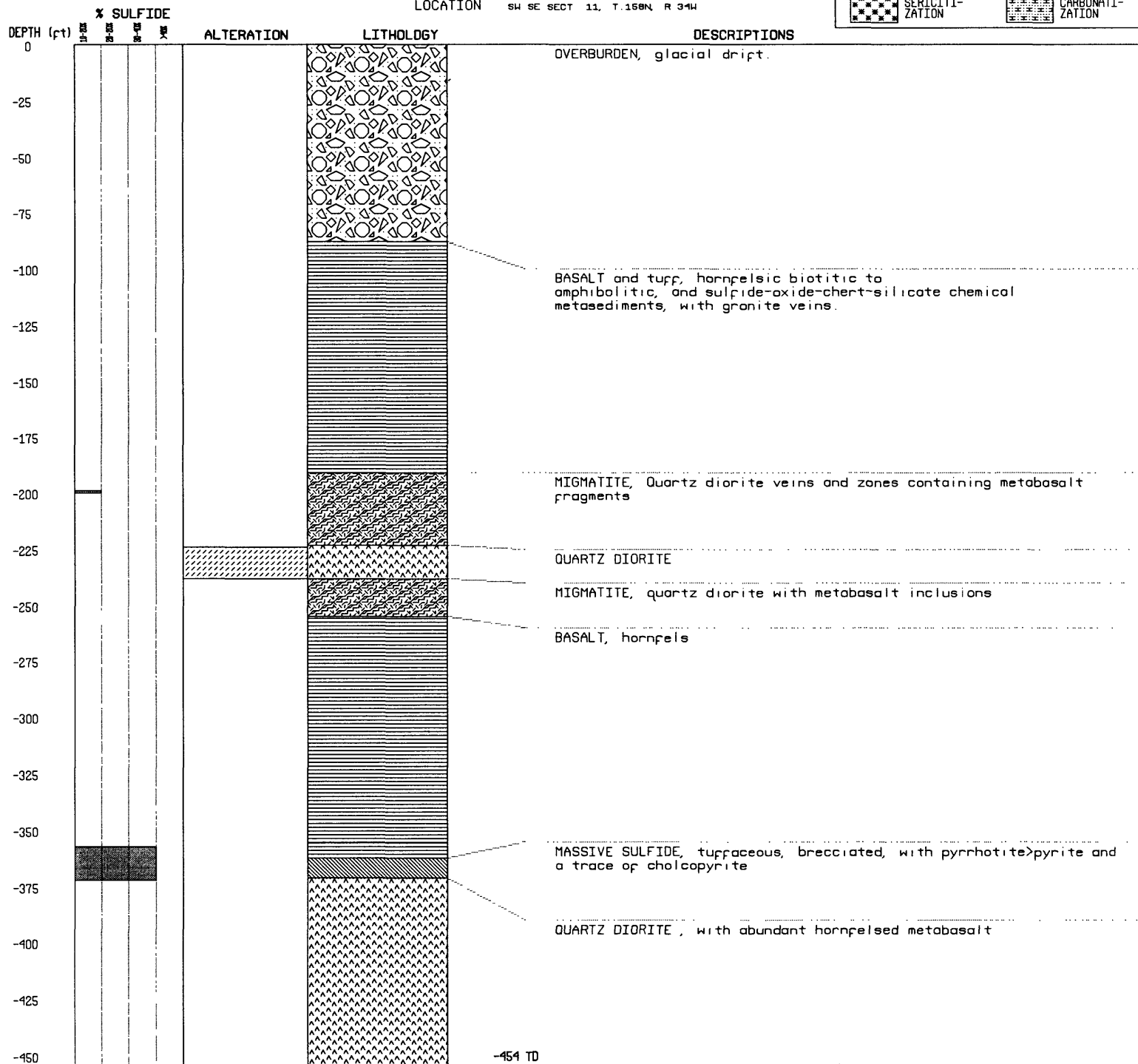


Fig. 33
 DRILL HOLE C1-83.

OPERATOR
 COMPLETED
 LOCATION

TEXASGULF MINERALS AND METALS, INC
 DECEMBER 17, 1983
 SW NE SECT 36, T.181N, R.32W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

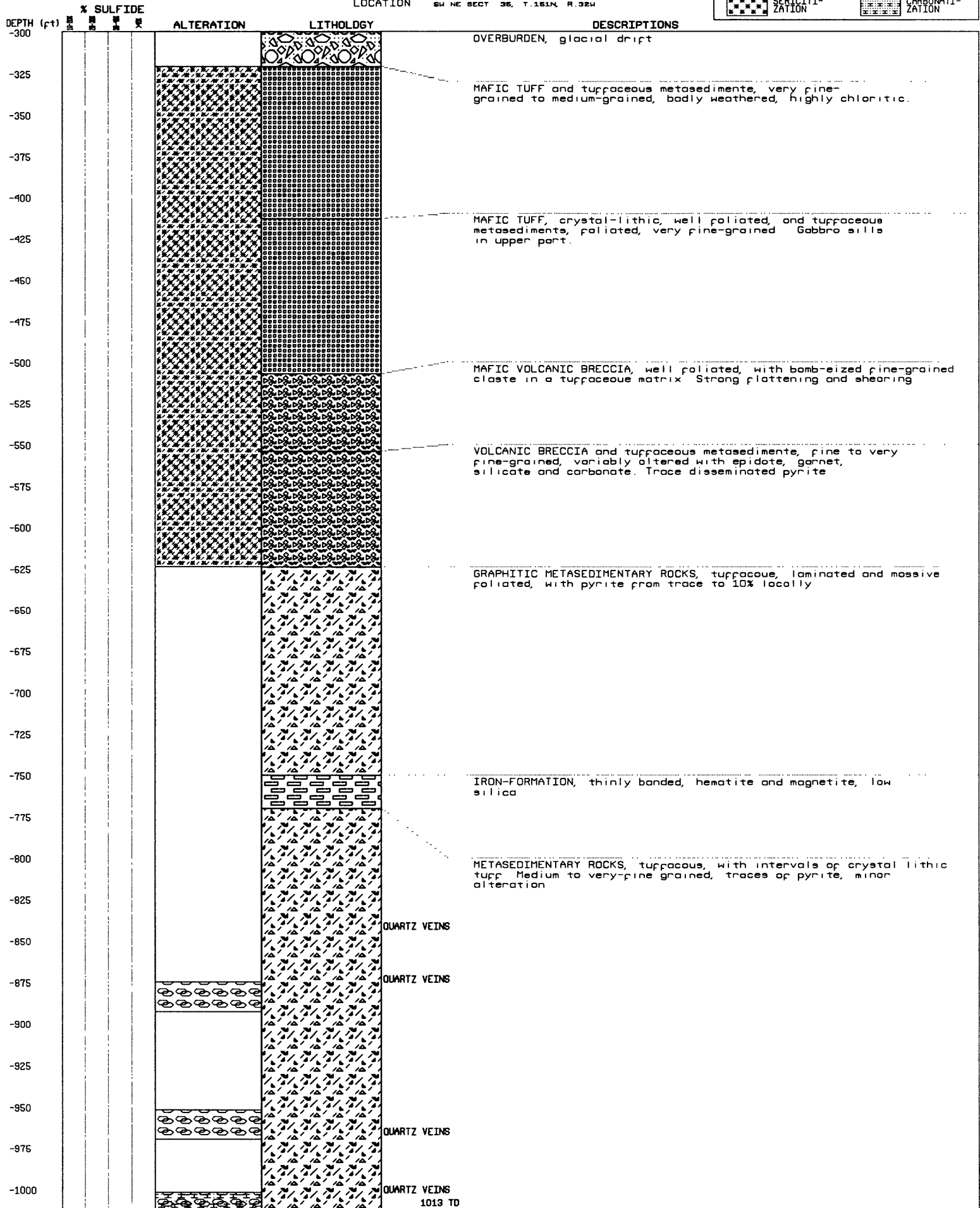


Fig. 34

DRILL HOLE CON-1.

OPERATOR: LEHMANN
 COMPLETED: DECEMBER 14, 1993
 LOCATION: SE NW SECT. 21, T.152N, R. 30W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
-125				OVERBURDEN, glacial drift.
-150				
-175				
-200				
-225				
-250				
-275				
-300				
-325				MYLONITE, gray to greenish-gray, very fine-grained, thinly banded, highly sheared, several quartz veins and quartz augen with pyrite in centers.
-350				
-375				
-400				GRAYWACKE, sheared and recrystallized, dark gray to greenish-gray, fine to medium-grained, thin bedded to massive.
-425				
-450				
-475				GRAYWACKE, mostly recrystallized, fine-grained, massive, streaky S-C fabric, trace to 4% pyrite
-500				
-525				
-550				GRAPHITIC ARGILLITE, gray to black, very fine-grained, laminated to massive, highly sheared with fish hook folds, detached veinlets. Pyrite 5% to 8%
-575				
-600				
-625				
-650				GRAYWACKE, thick-bedded, fine to medium-grained, somewhat graphitic, trace to 3% disseminated pyrite and in quartz vein
-675				

Fig. 35 DRILL HOLE FT-3

OPERATOR
COMPLETED
LOCATION

RIDGE MINING COMPANY.
AUGUST 17, 1972.
sec 23, T 158 N, R 36 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

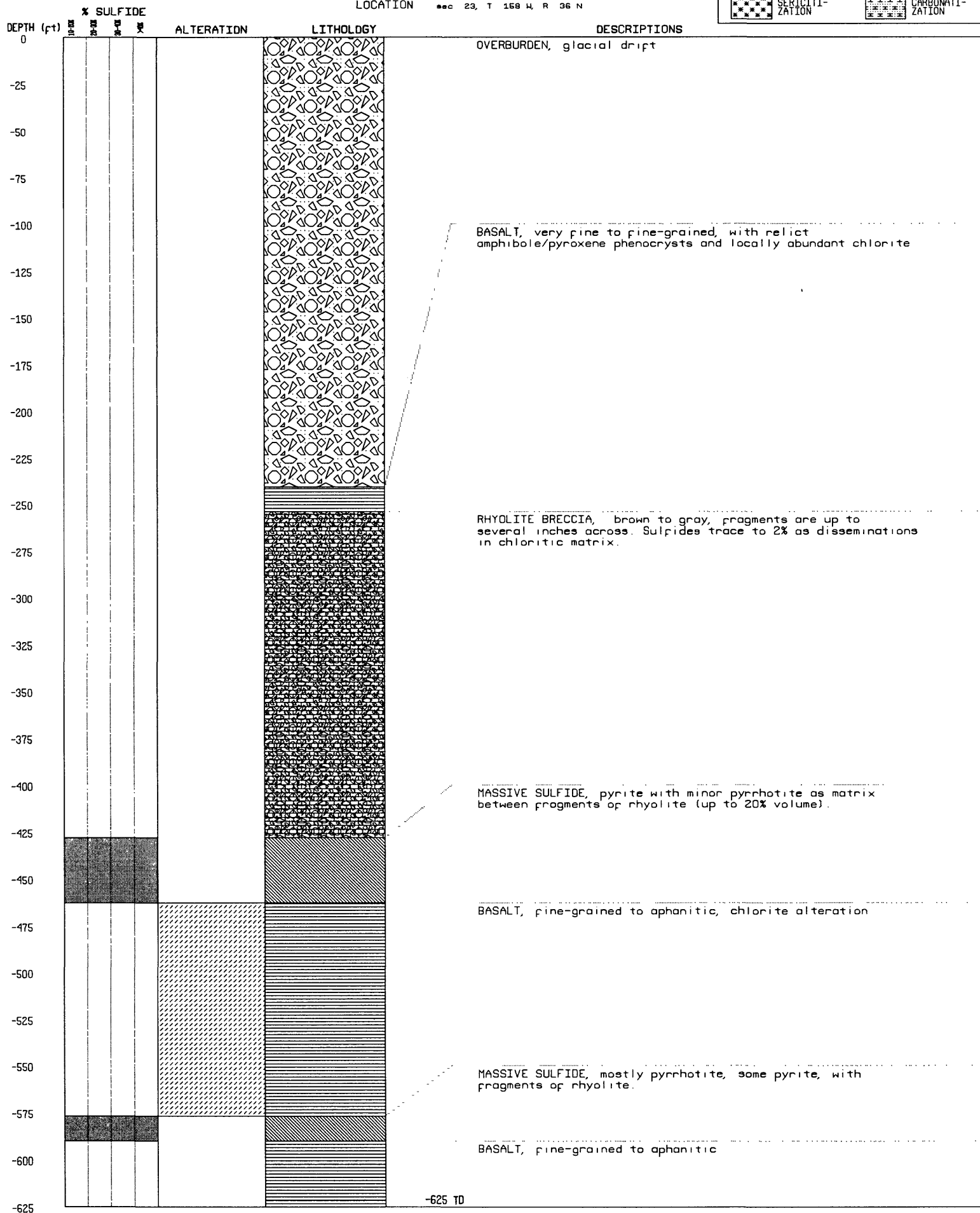


Fig. 36 DRILL HOLE FT-14

OPERATOR
COMPLETED
LOCATION

RIDGE MINING COMPANY.
JANUARY 12, 1973
sec 13, T 158, R 36

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

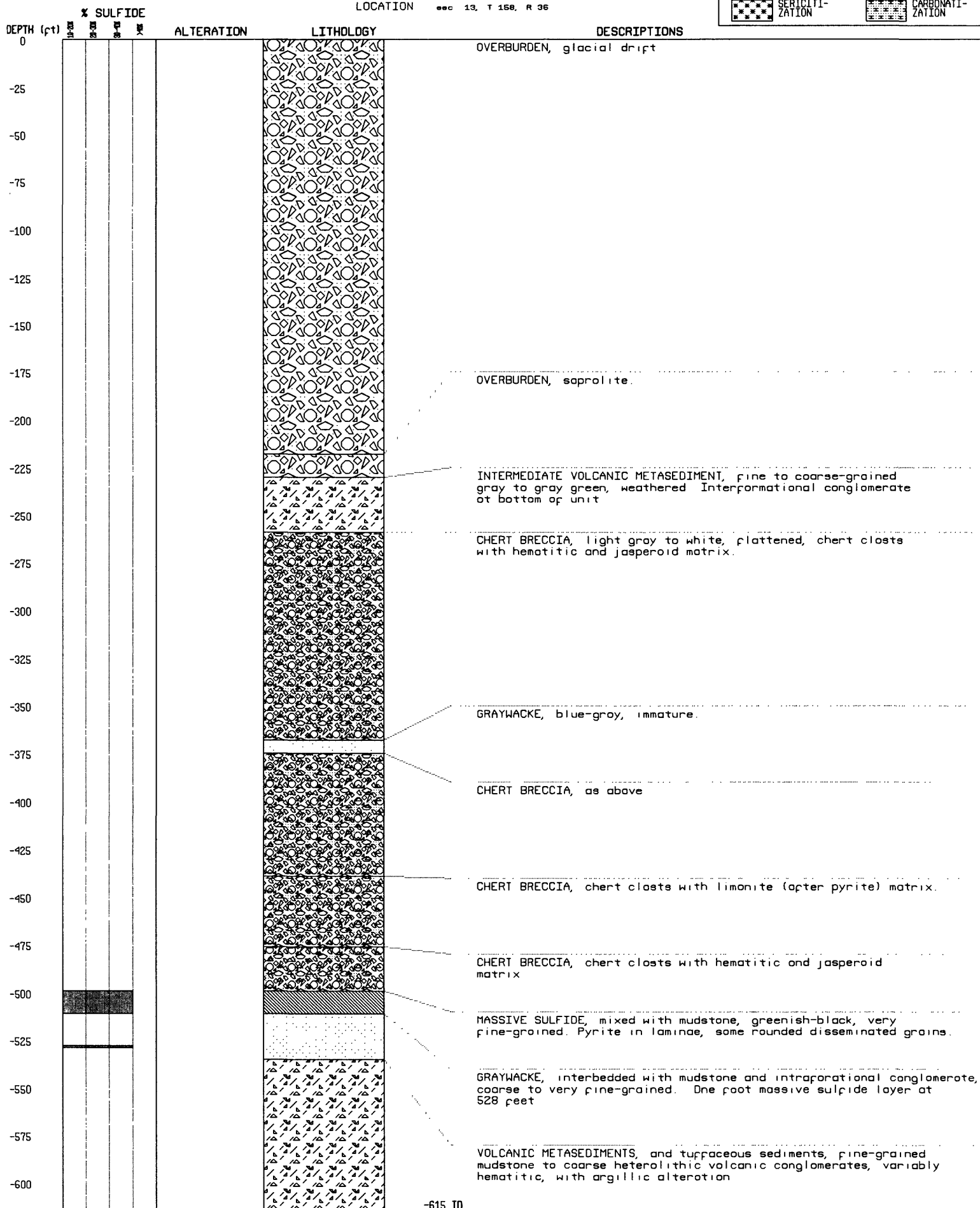


Fig. 37
 DRILL HOLE FT-18

OPERATOR
 COMPLETED
 LOCATION:

RIDGE MINING COMPANY.
 JANUARY 12, 1973
 sec. 24 T 167 N. R. 36 W

ALTERATIONS



SILICIFI-
 CATION
 SERICITI-
 ZATION



CHLORITI-
 ZATION
 CARBONATI-
 ZATION

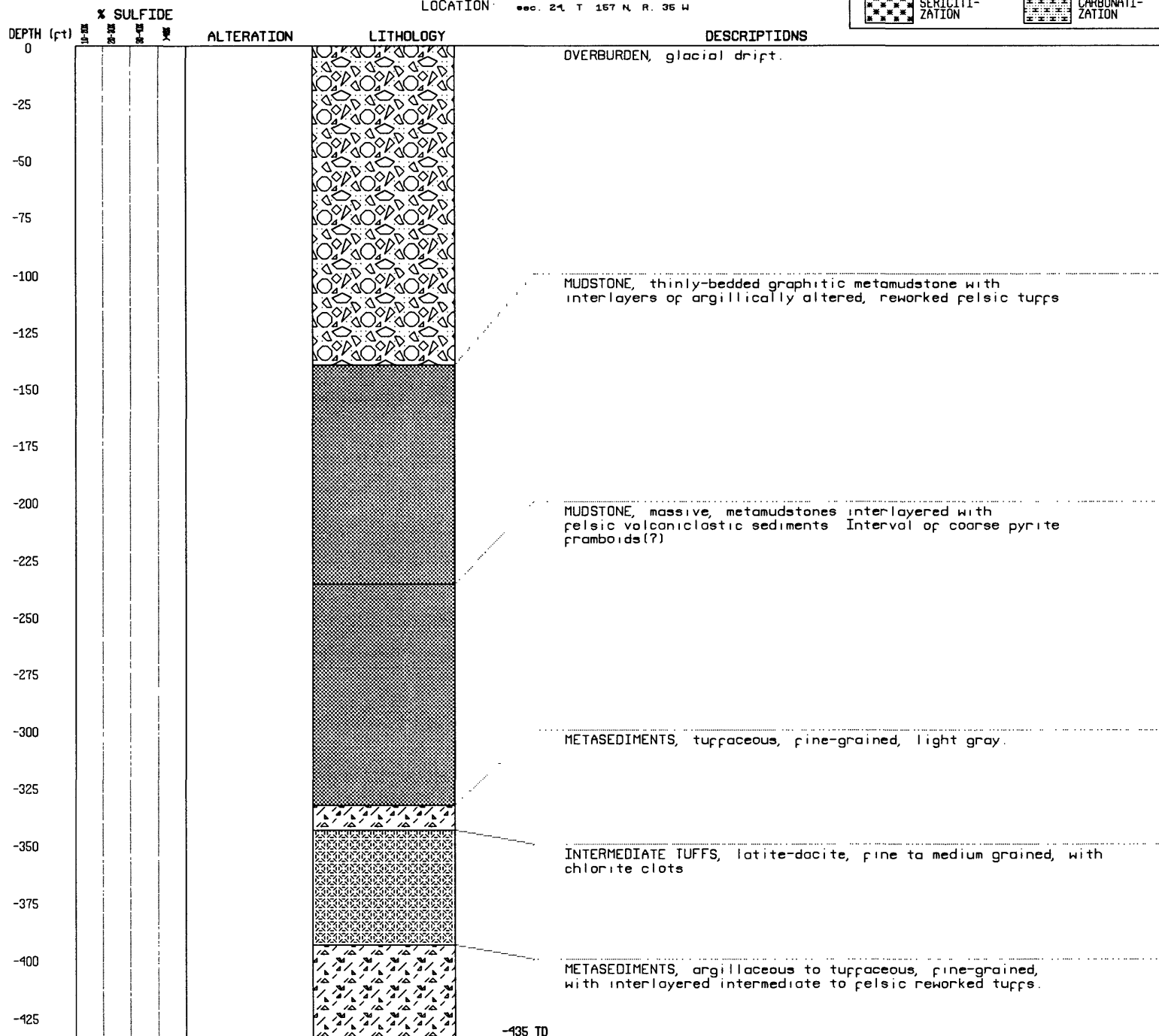


Fig. 38
DRILL HOLE HAD-1.

OPERATOR
COMPLETED
LOCATION

LONGYEAR
AUGUST 4, 1982
NH GE SECT 10, T 151N, R 31W.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

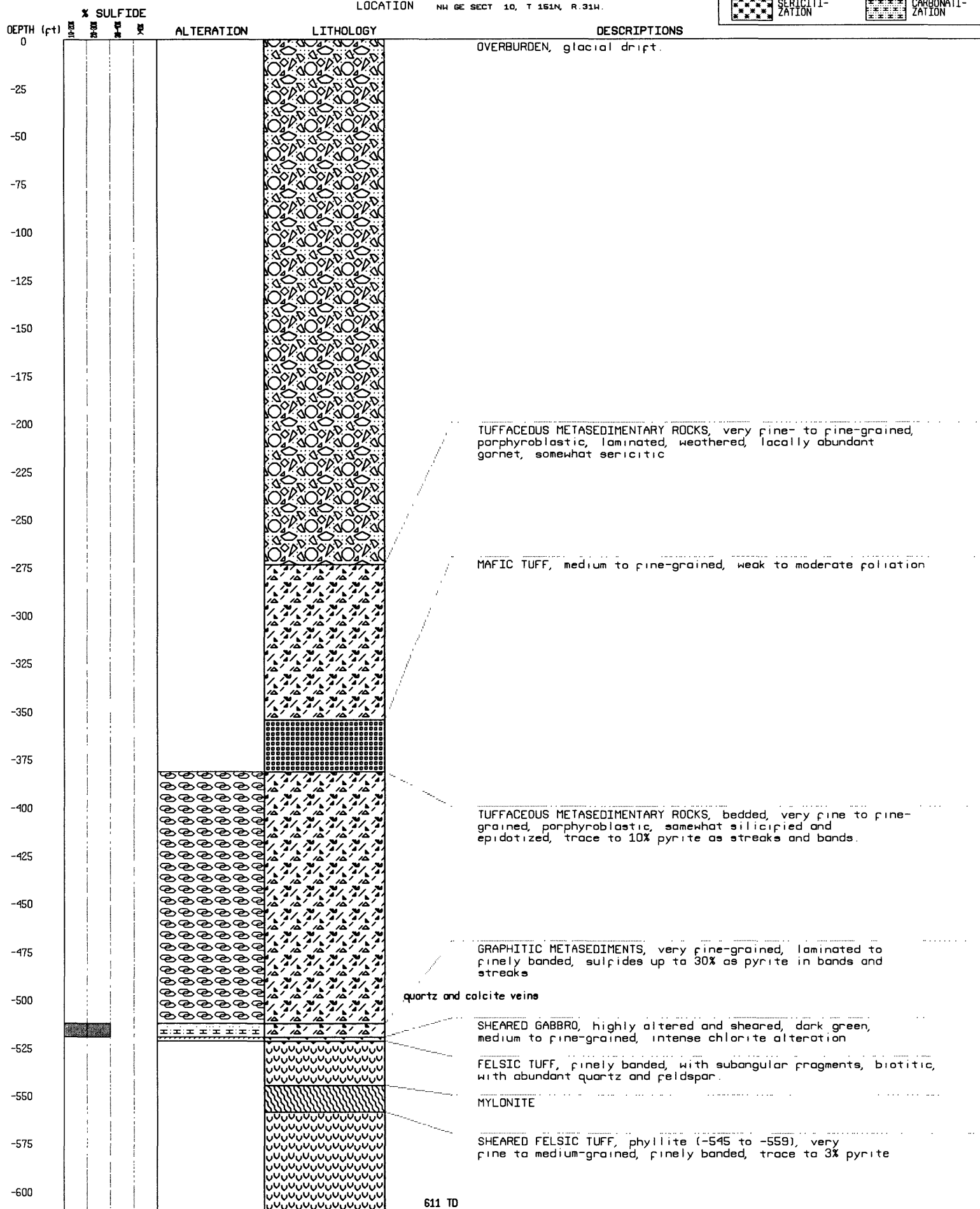


Fig. 39

DRILL HOLE HAD-2.

OPERATOR LEHMANN
 COMPLETED AUGUST 12, 1982
 LOCATION NW SE SECT 10, T. 161N, R. 31W.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

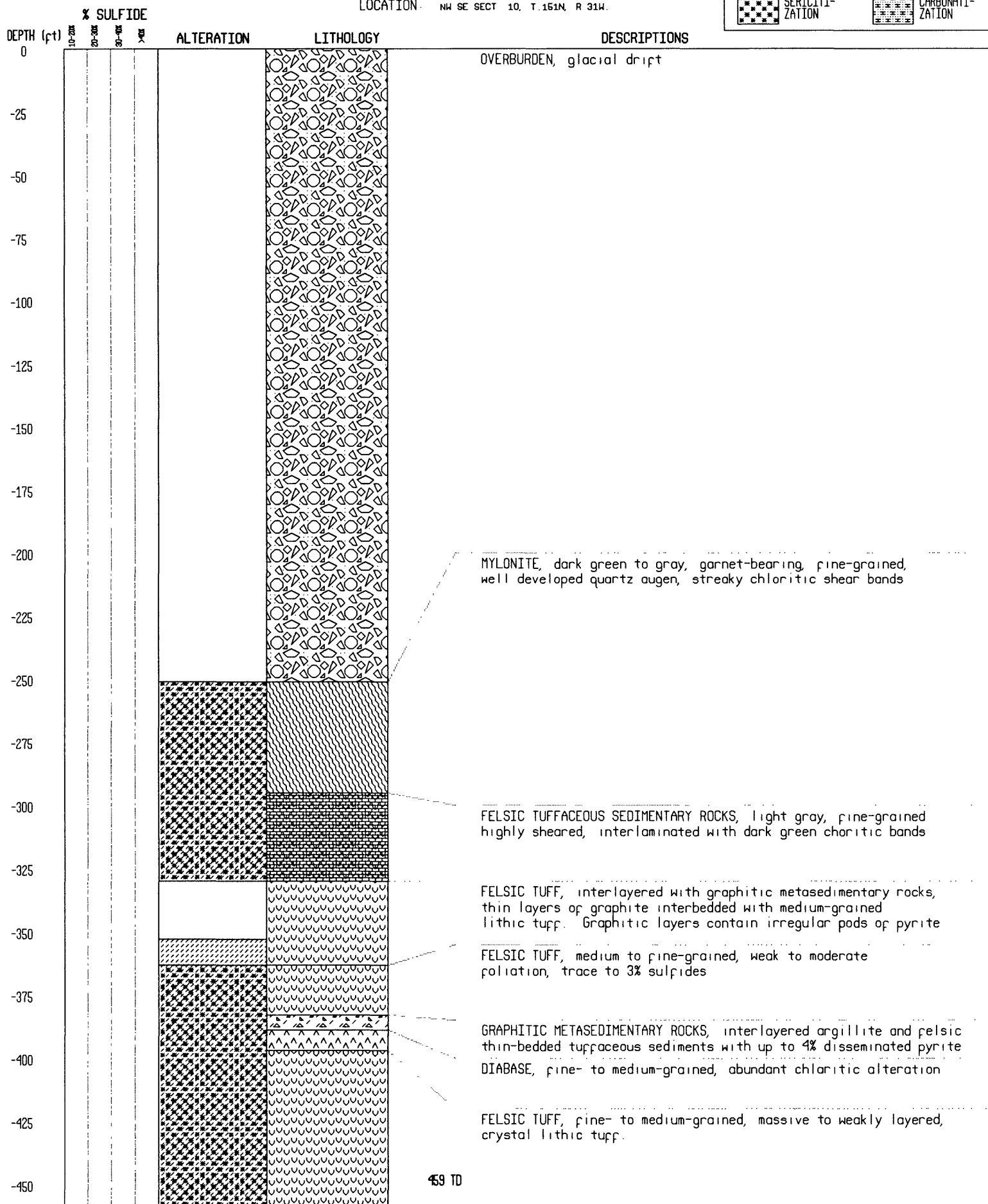








Fig. 40

DRILL HOLE HAD-3.

OPERATOR LONGYEAR

LOCATION NW SE SECT 10, T 151N, R 31W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

%SULFIDE
DEPTH(Ft) ALTERATION LITHOLOGY

DESCRIPTIONS

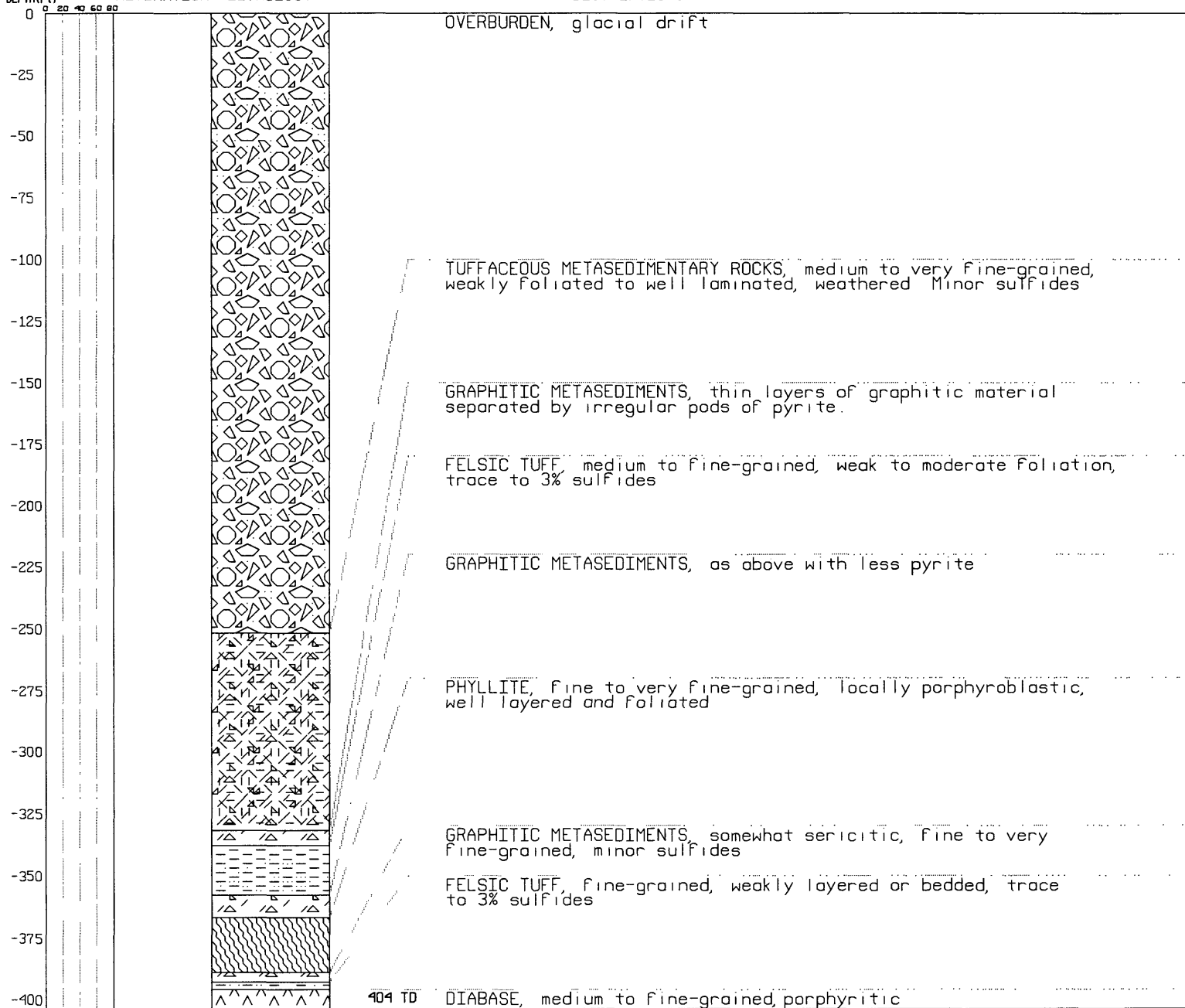


Fig. 41
DRILL HOLE LW346-1

OPERATOR ST. JOE AMERICAN CORP.
COMPLETED JANUARY 26, 1984
LOCATION SE NE Sect. 14, T 16S, R 32E

ALTERATIONS

	SILICIFICATION		CHLORITIZATION
	SERICITIZATION		CARBONATIZATION

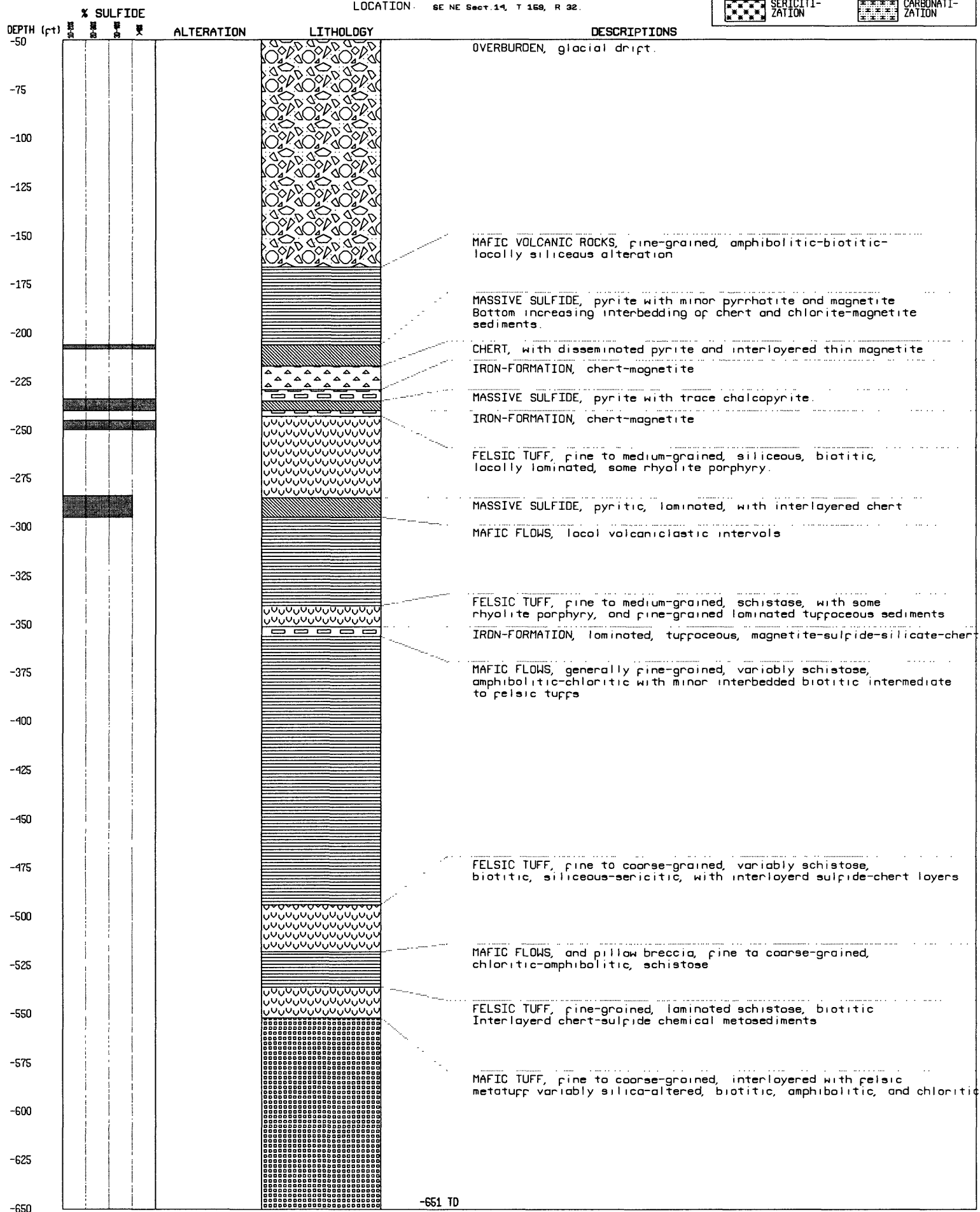


Fig. 42

DRILL HOLE LW346-2

OPERATOR ST JOE AMERICAN CORP
COMPLETED FEBRUARY 12, 1984
LOCATION SW NE Sect 14, T 15N, R 32

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

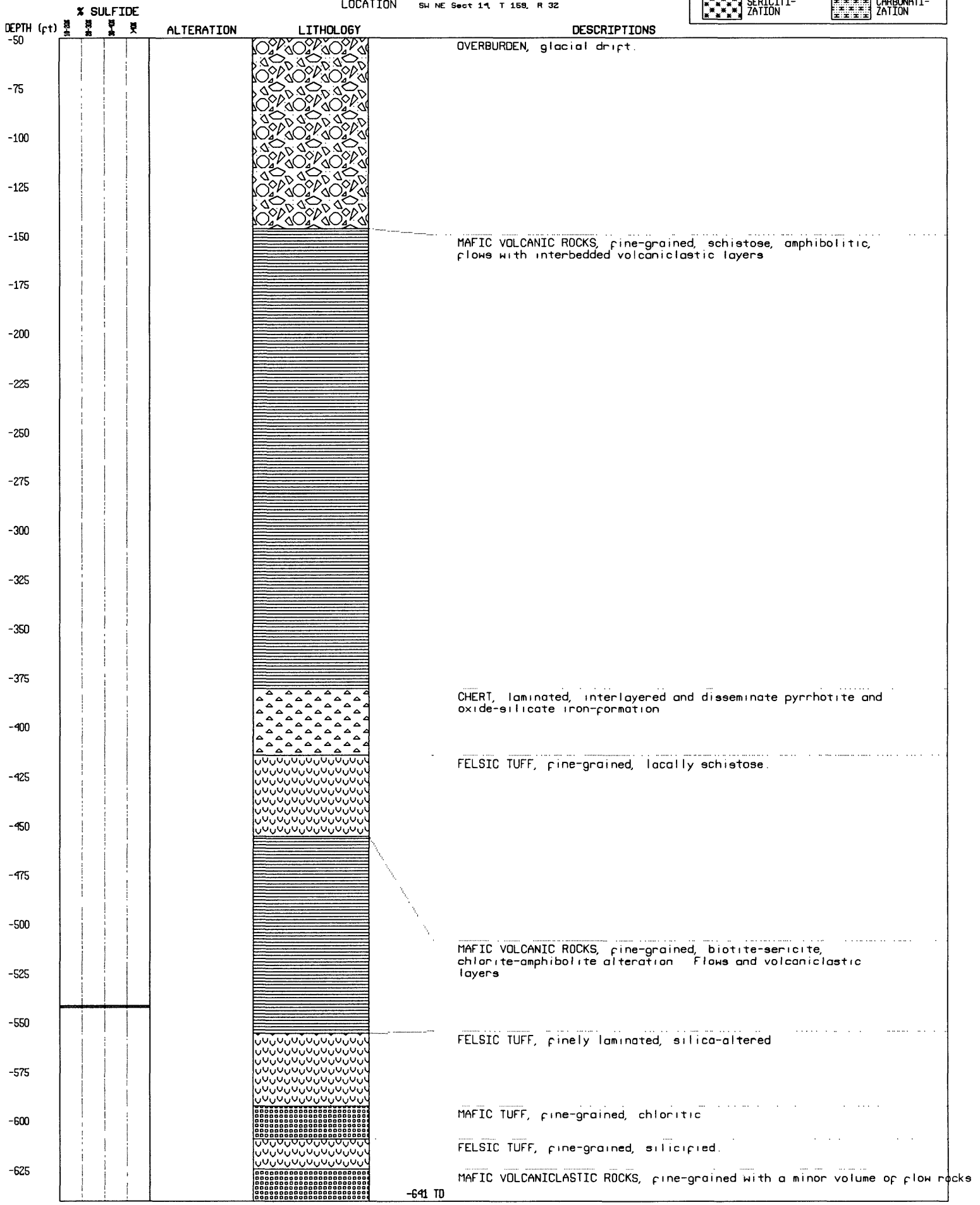
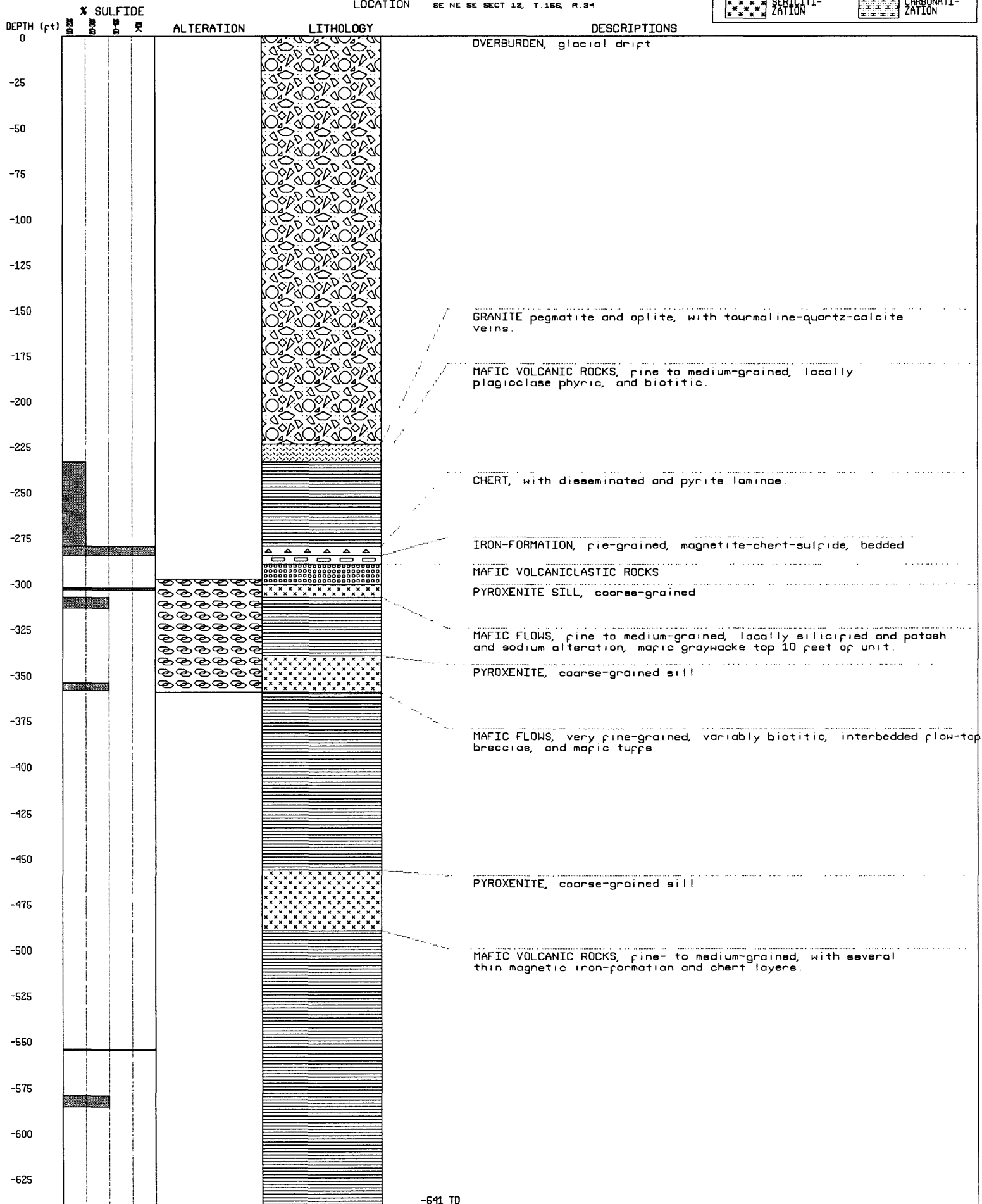


Fig. 43
DRILL HOLE MDD-1

OPERATOR: AMSECO
COMPLETED: FEBRUARY 3, 1982
LOCATION: SE NE SE SECT 12, T.15S, R.34

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 44

DRILL HOLE MED-1

OPERATOR
COMPLETED
LOCATION

AMSELCO
FEBRUARY 3, 1992.
NW NW SECT. 32, T. 158, R. 33.

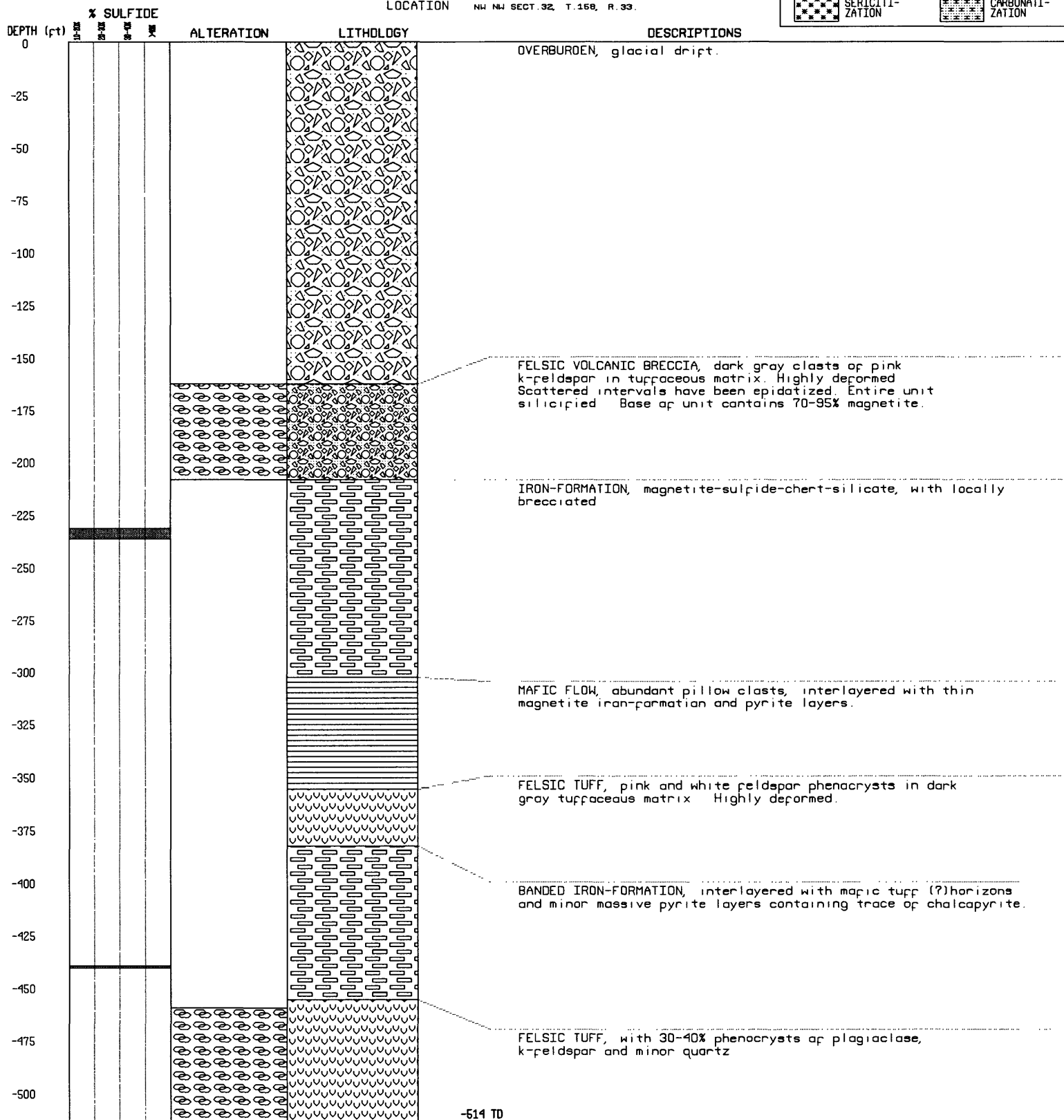


Fig. 45 DRILL HOLE MMD-1

OPERATOR: AMSELCO.
COMPLETED: 3/13/82.
LOCATION: SECT 25, T 158N, R 34W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

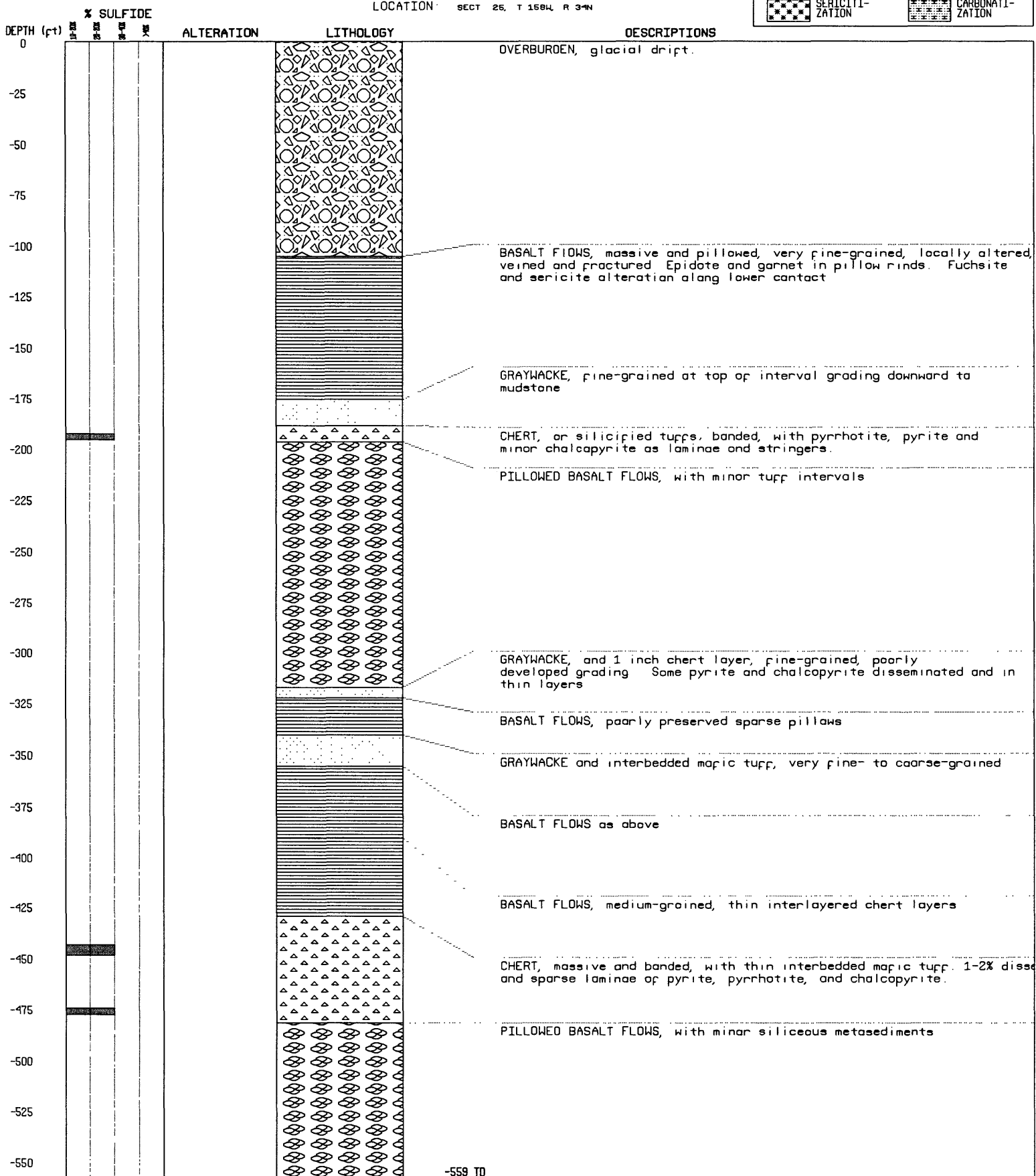


Fig. 46 DRILL HOLE MQD-1

OPERATOR
COMPLETED
LOCATION

ANSELCO
FEBRUARY 14, 1982
SE SW SECT. 11, T. 158 N, R. 34 N

ALTERATIONS

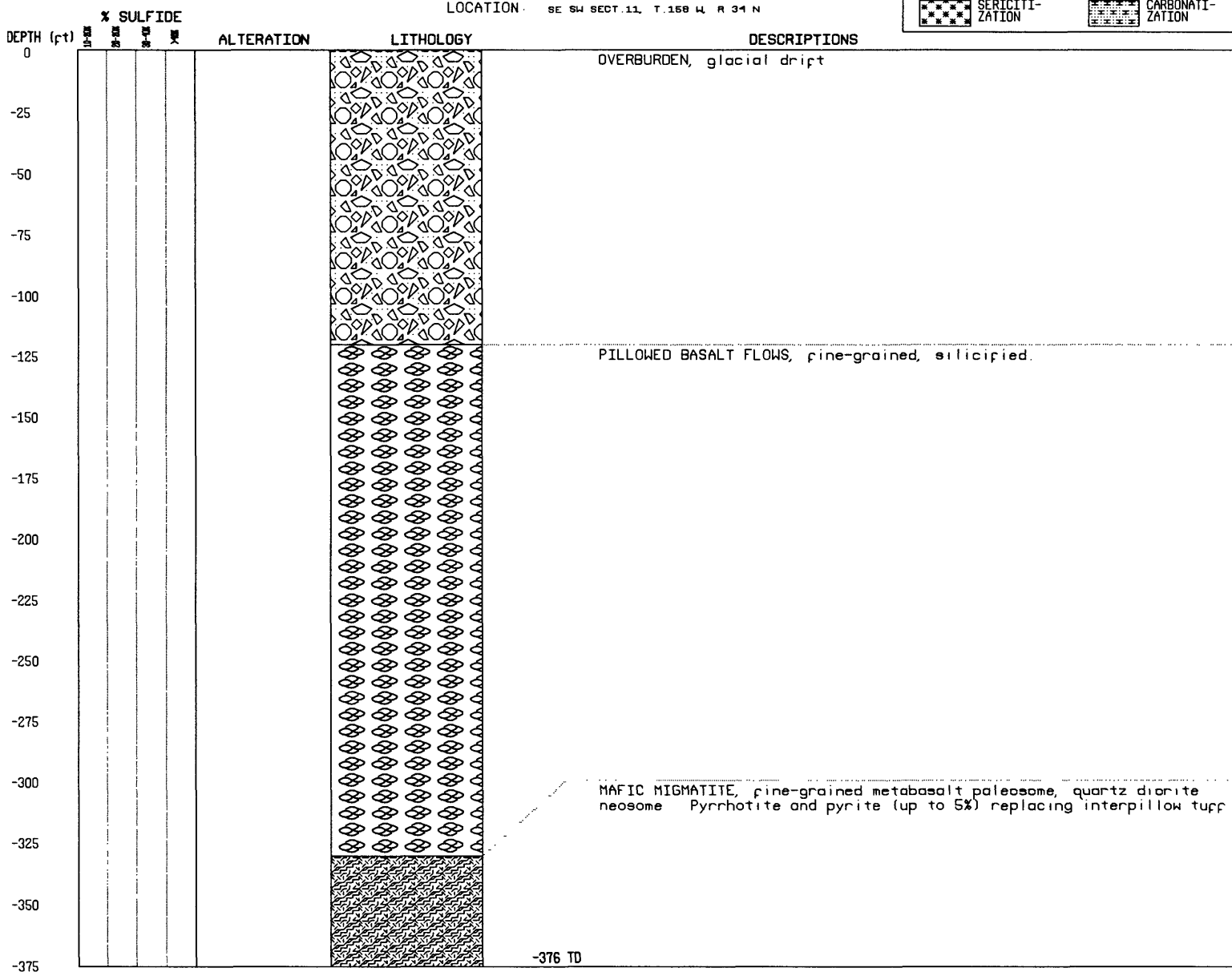
SILICIFI-
CATIONCHLORITI-
ZATIONSERICITI-
ZATIONCARBONATI-
ZATION

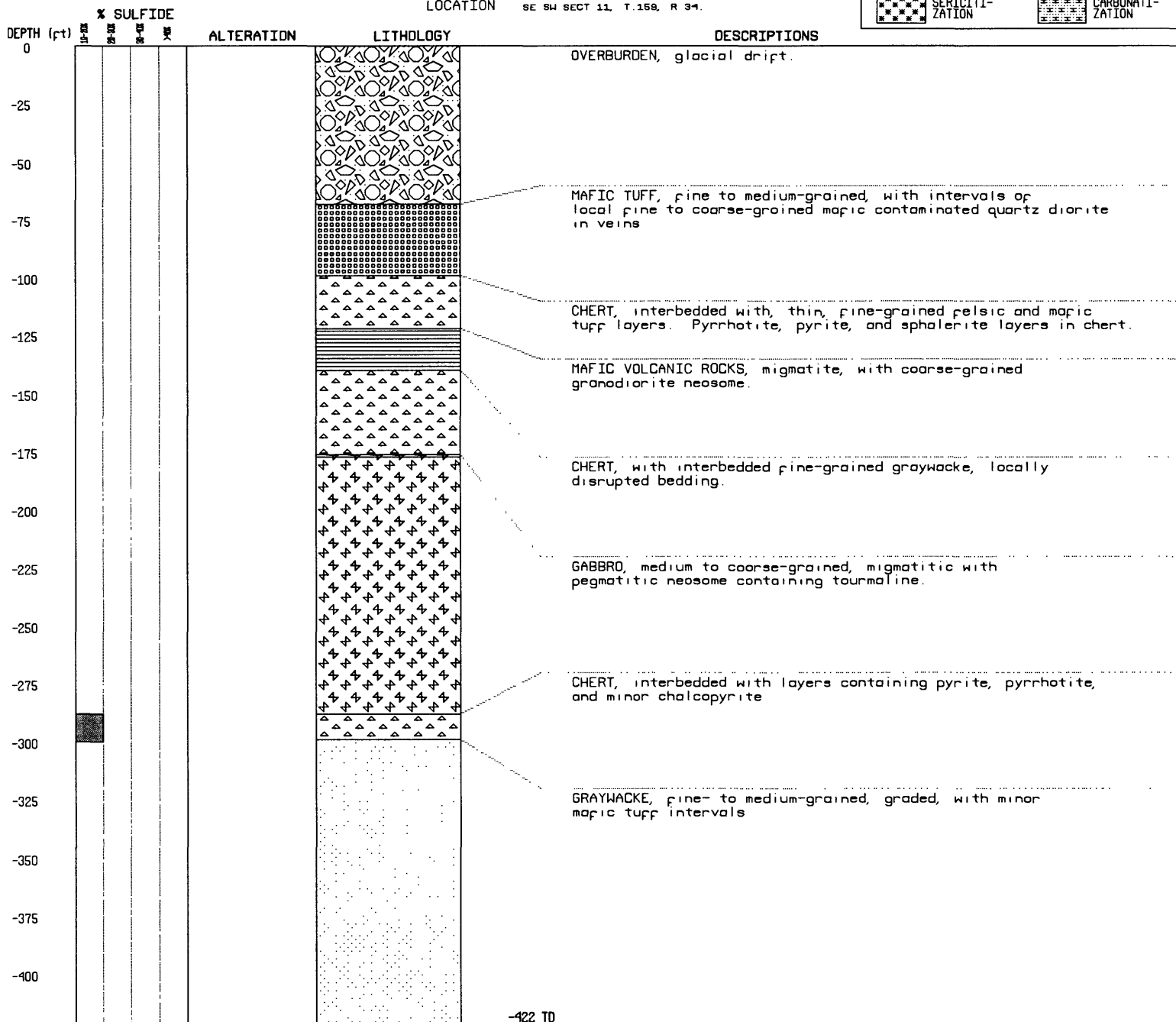
Fig. 47
DRILL HOLE MQD-2

OPERATOR
COMPLETED
LOCATION

AMSELCO
FEBRUARY 22, 1982
SE SW SECT 11, T.15N, R.34.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



-422 TD

Fig. 48
DRILL HOLE MSD-1

OPERATOR
COMPLETED
LOCATION
AMSELCO
FEBRUARY 22, 1992
SE SW SECT 11, T. 16N, R. 34

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

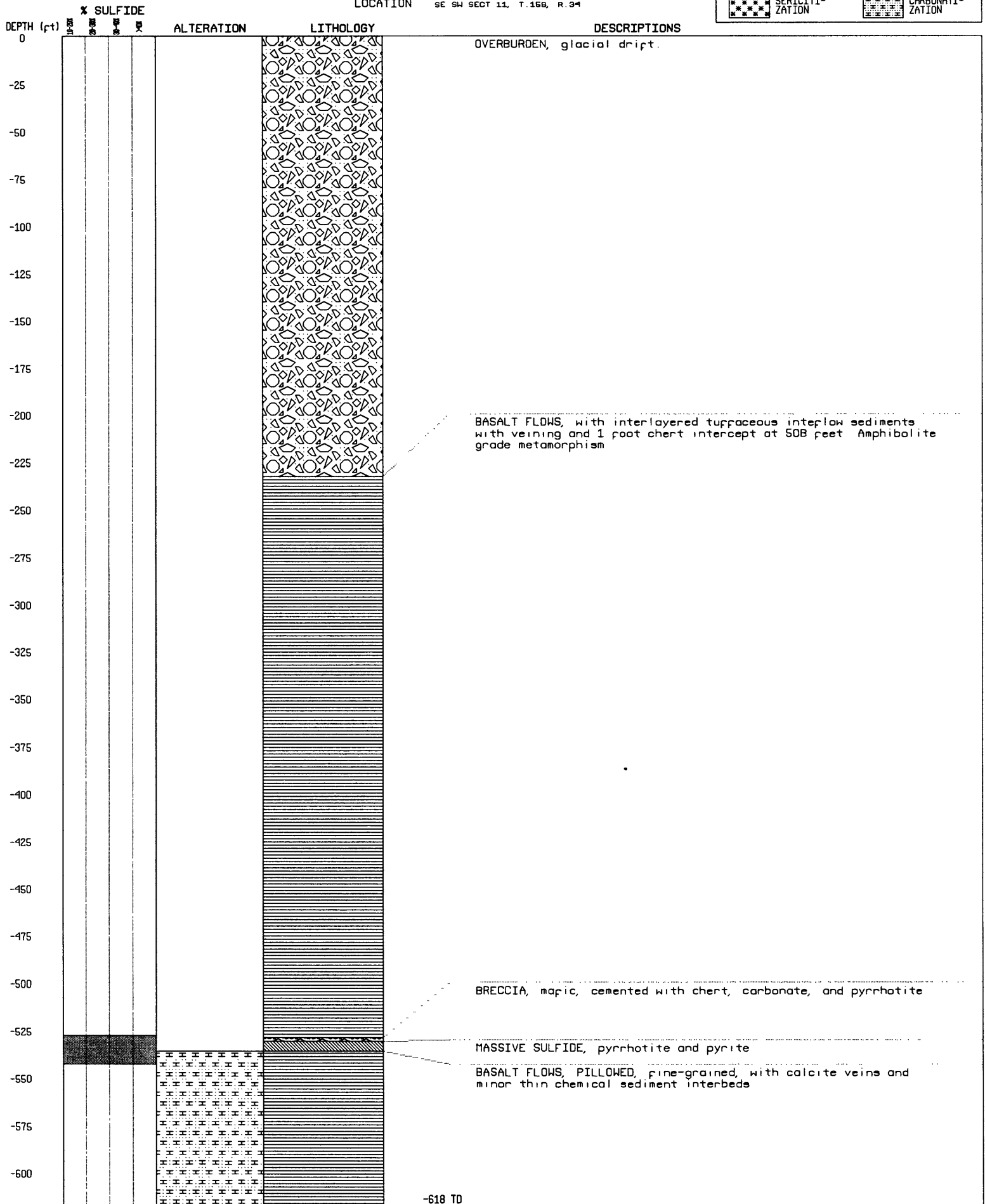


Fig. 49
DRILL HOLE R-2-2.

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO.
SEPTEMBER 18, 1969
NE SECT 21, T 159N, R. 27W.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

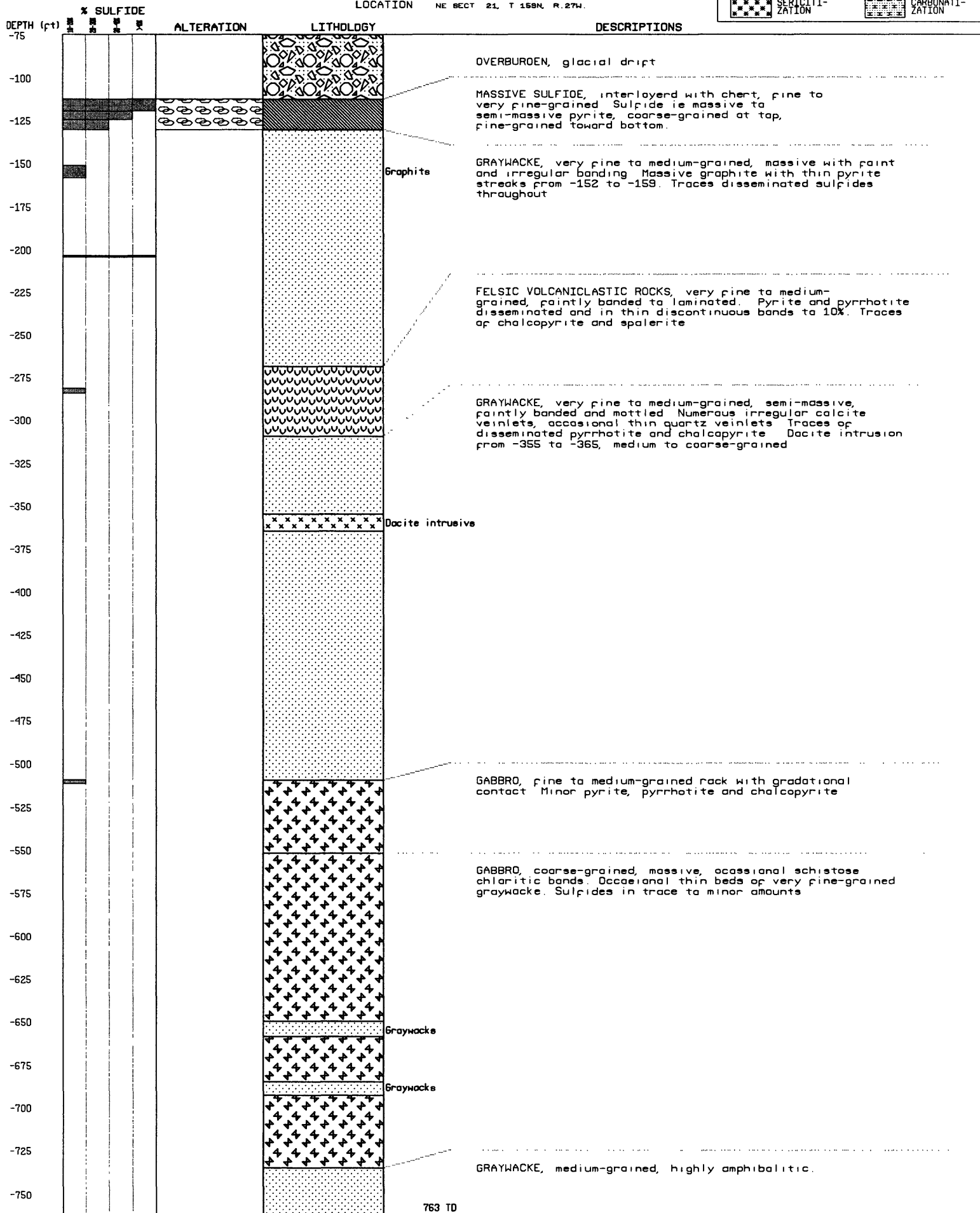


Fig. 50
DRILL HOLE R-3-4

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
APRIL 14, 1970
NW NW SECT. 30, T.158N, R.27W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION





DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
0				GRAYWACKE, fine-grained, gray, mostly massive with rare thin-bedded intervals sections
-25				
-50				PILLOWED BASALT FLOWS, greenish-grey, very fine-grained, with occasional intervals containing flow-top breccias and mafic volcanoclastic rocks.
-75				
-100				
-125				
-150				
-175				
-200				
-225				
-250				
-275				
-300				FELSIC TUFF, very fine-grain dark grey-black, thinly laminated, contorted, clasts, slumps. Slightly graphitic. Pyrrhotite, pyrite, and minor chalcopyrite in thin streaks, blebs, clots
-325				
-350				
-375				GRAYWACKE, fine-grained, gray, variably graphitic, massive to thinly laminated, minor interbeds of light gray sandy layers and dark gray very fine-grained bands. Pyrrhotite is in rare thin massive to irregular patches, and thin streaks. Pyrite is finely disseminate
-400				
-425				
-450				
-475				
-500				
-525				
-550				-553 TD

Fig. 51
DRILL HOLE R-5-1

OPERATOR:
COMPLETED
LOCATION

HUMBLE OIL AND REFINING CO
OCTOBER 31, 1989
SE SECT 28, T 150, R 28.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

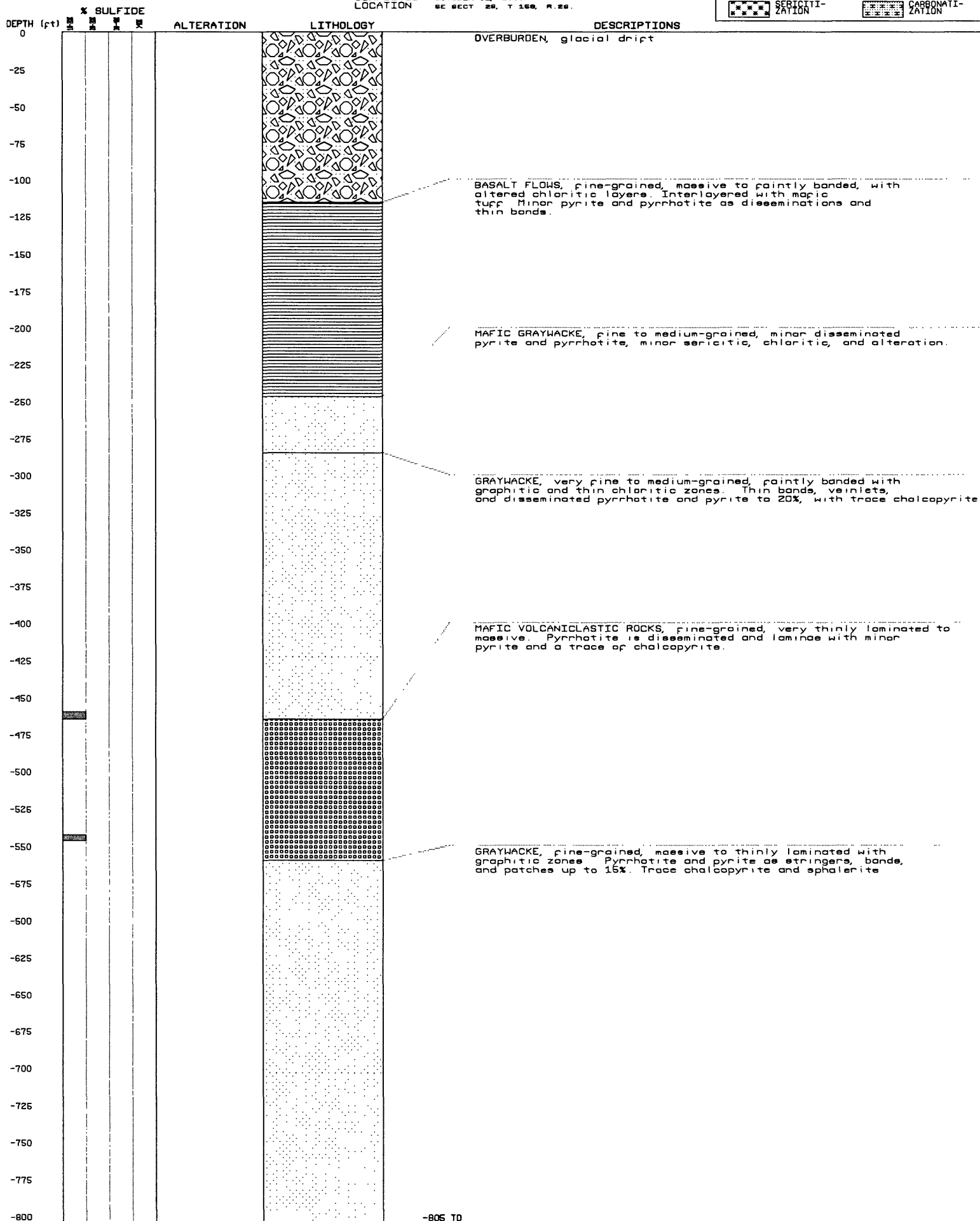


Fig. 52
DRILL HOLE R-5-2

OPERATOR HUMBLE OIL AND REFINING CO..
COMPLETED DECEMBER 1, 1969
LOCATION NW SW SECT. 26, T.16S, R.28.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
0				OVERBURDEN, glacial drift.
-25				
-50				
-75				PILLOWED BASALT FLOWS, fine-grained, massive to faintly banded, interlayered with mafic volcaniclastic rocks. Minor sulphides as disseminations and thin bands.
-100				
-125				
-150				
-175				
-200				GRAYWACKE, very fine to fine-grained, thinly laminated, graphitic, sericitic, some minor sulphides.
-225				
-250				DIABASE, intrusive, massive
-275				
-300				GRAYWACKE, very fine to medium-grained, massive to strongly laminated, variably graphitic, biotitic, and chloritic.
-325				
-350				
-375				
-400				
-425				
-450				
-475				
-500				
-525				
-550				
-575				
-600				
-625				

Fig. 53
DRILL HOLE RL-25

OPERATOR
 COMPLETED
 LOCATION

EXXON CO
 FEBRUARY 21, 1973
 NW NW SECT 36, T 161N, R 32W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

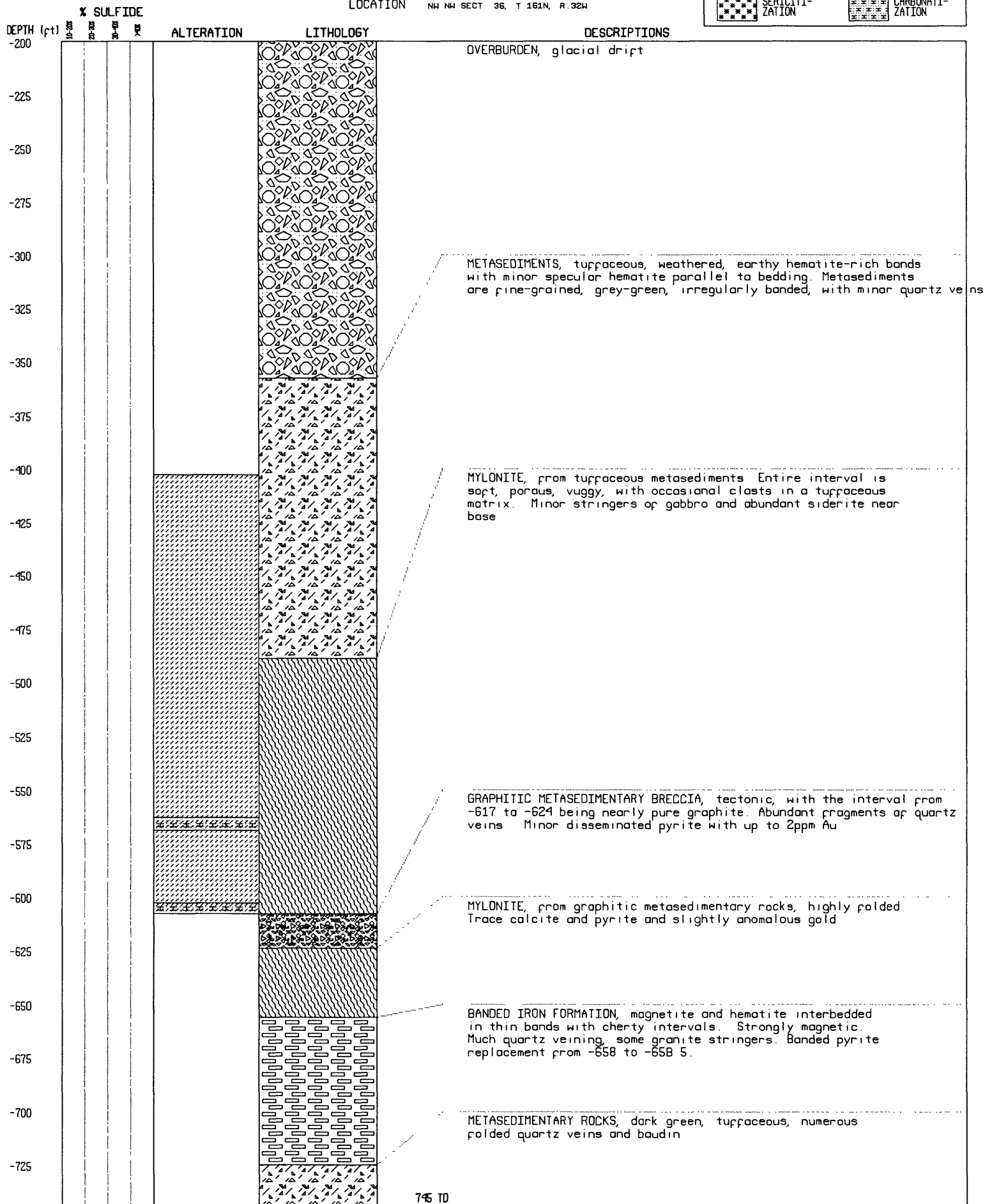
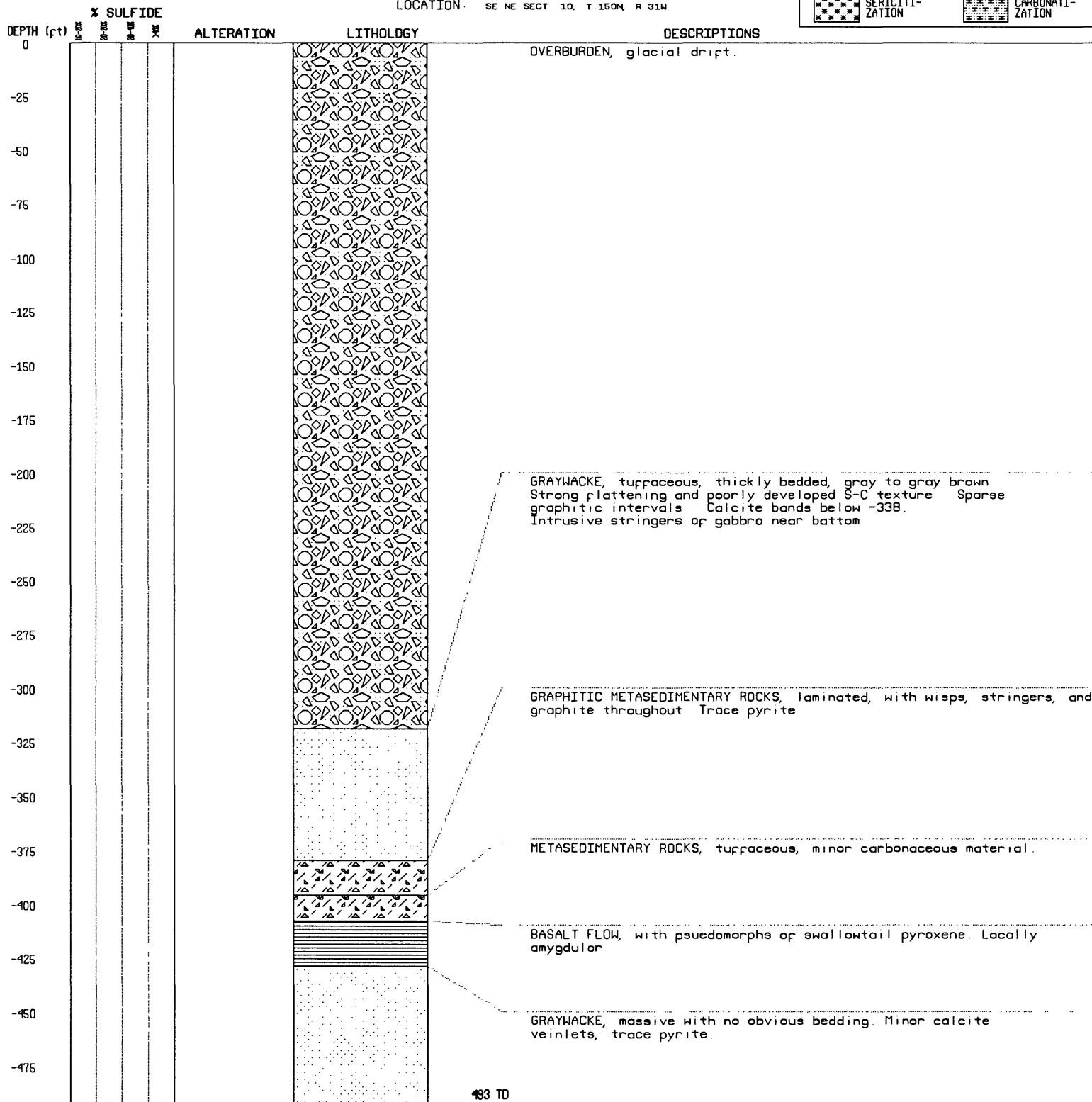


Fig. 54
DRILL HOLE RL-31

OPERATOR: EXXON CO
COMPLETED: MARCH 8, 1973
LOCATION: SE NE SECT 10, T.150N, R.31W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



493 TD

Fig. 55

DRILL HOLE RL43-1.

OPERATOR: EXXON

LOCATION NW NE SECT 8, T 151N, R 30W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

%SULFIDE ALTERATION LITHOLOGY

DEPTH(ft) 0 20 40 60 80

DESCRIPTIONS

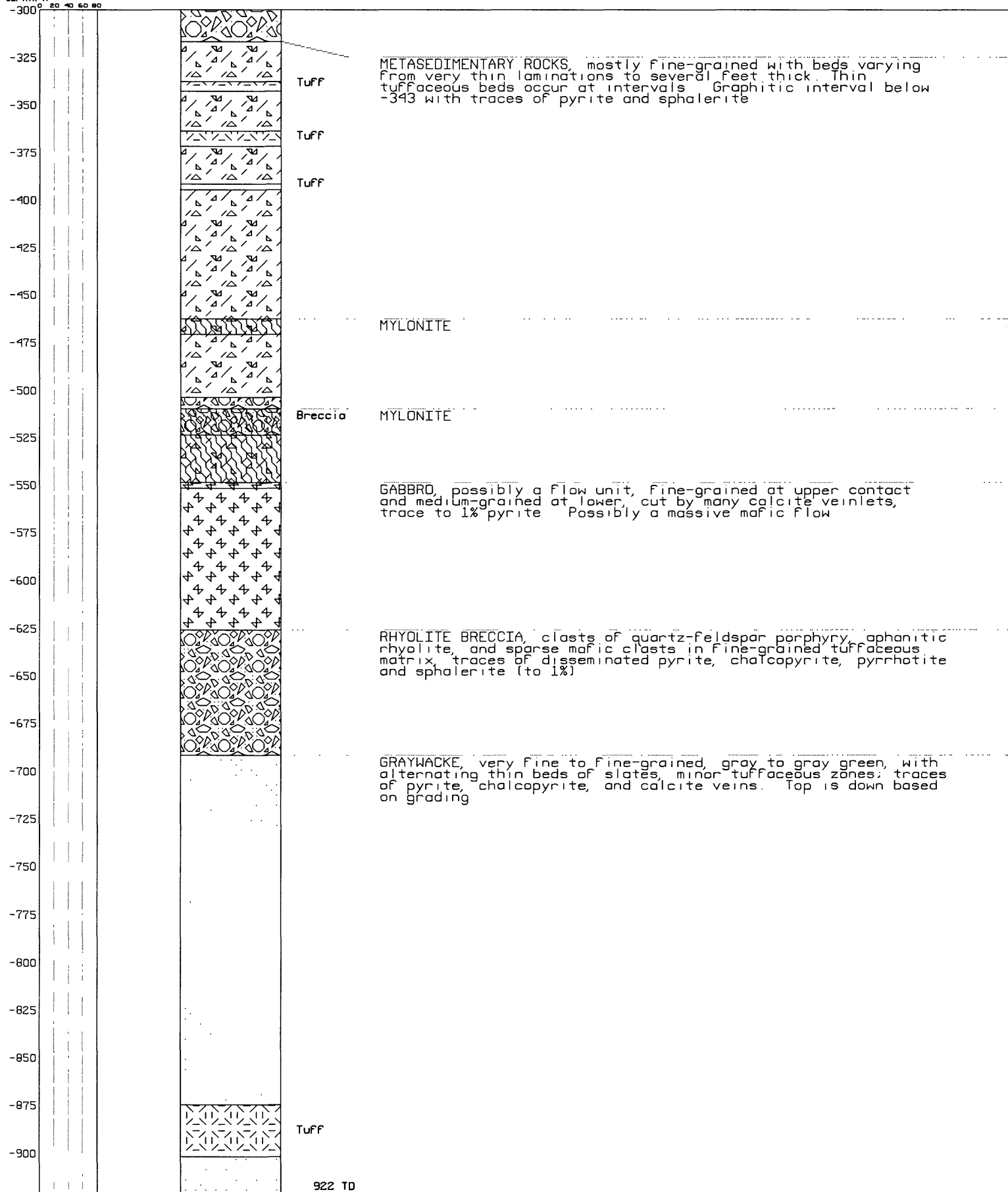


Fig. 56
DRILL HOLE RR16-1

OPERATOR: TEXAS GULF SULFUR

LOCATION: SE NE SECT. 31 T. 160 N. R. 30 W.

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

XSULFIDE
DEPTH (ft) ALTERATION LITHOLOGY

DESCRIPTIONS

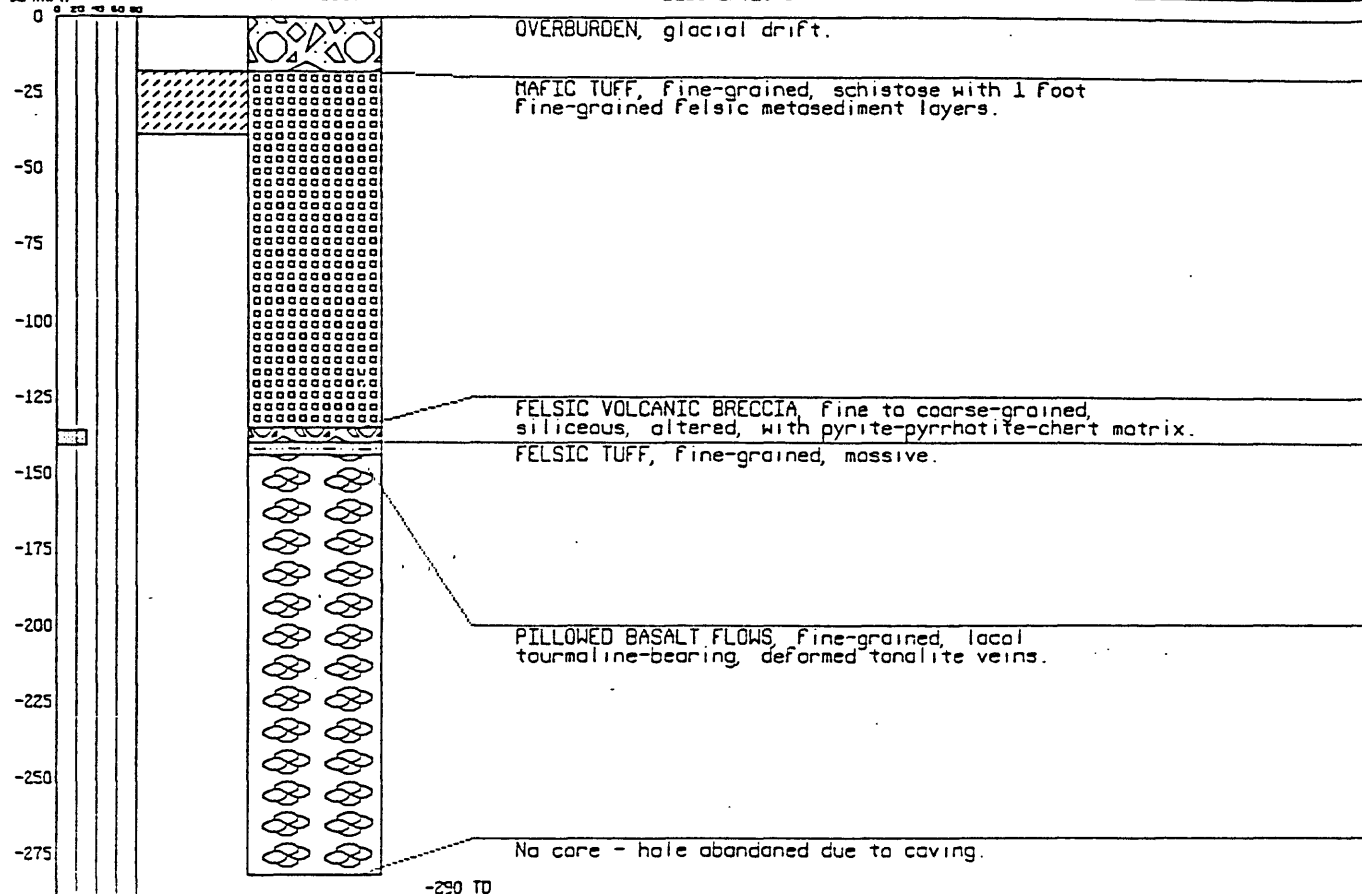


Fig. 57
DRILL HOLE T20-1

OPERATOR
COMPLETED
LOCATION

HUMBLE OIL
JANUARY 31, 1973
SE 84 Sect 18, T 158 N, R 37 W

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

DEPTH (ft)

ALTERATION

LITHOLOGY

DESCRIPTIONS

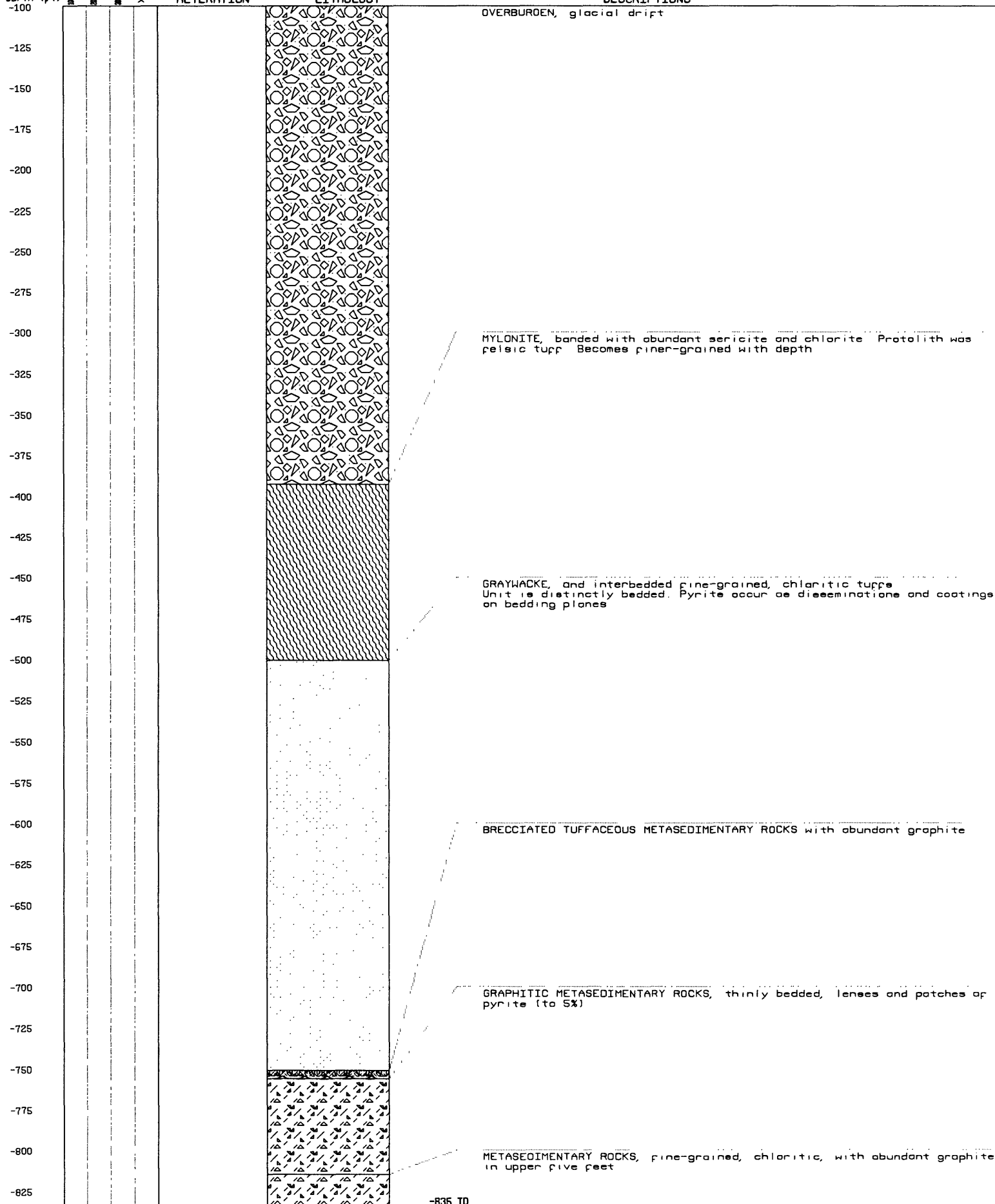


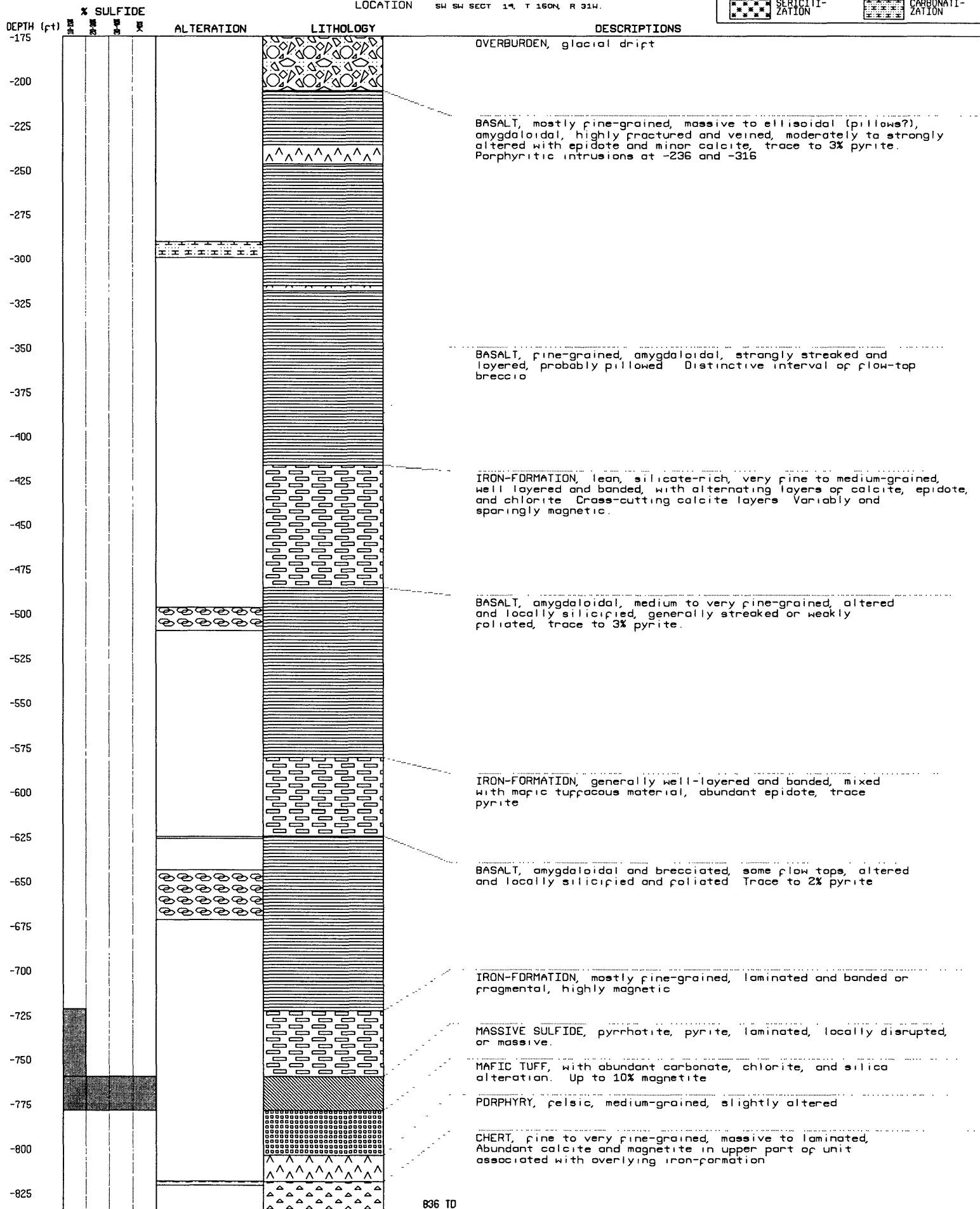
Fig. 58
DRILL HOLE TIT-3.

OPERATOR
COMPLETED
LOCATION

LEHMANN
SEPTEMBER 2, 1981
SW SW SECT 14, T 160N, R 31W.

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

Fig. 59

DRILL HOLE UBD-3

OPERATOR
COMPLETED
LOCATION

BHP
MAY 21, 1999
Sect 28, T 159 N, R 28 W

% SULFIDE

ALTERATION

LITHOLOGY

DESCRIPTIONS

DEPTH (ft)	% SULFIDE	ALTERATION	LITHOLOGY	DESCRIPTIONS
0				OVERBURDEN, glacial drift
-25				
-50				
-75				
-100				
-125				
-150				PORPHYRITIC METAGABBRO, porphyritic, intruded by granite.
-175				
-200				PORPHYRITIC METAGABBRO, gray, massive, 20-30% Massive with minor carbonate filled fractures. Traces of disseminated pyrite and magnetite throughout. Minor pyrite along fractures. No alteration, moderately to strongly magnetic throughout.
-225				
-250				
-275				
-300				
-325				
-350				
-375				
-400				
-425				
-450				
-475				
-500				
-525				
-550				

-573 TD

Fig. 60

DRILL HOLE VAN-3.

OPERATOR LEHMANN

LOCATION NE SE SECT 14, T 150N, R. 31W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

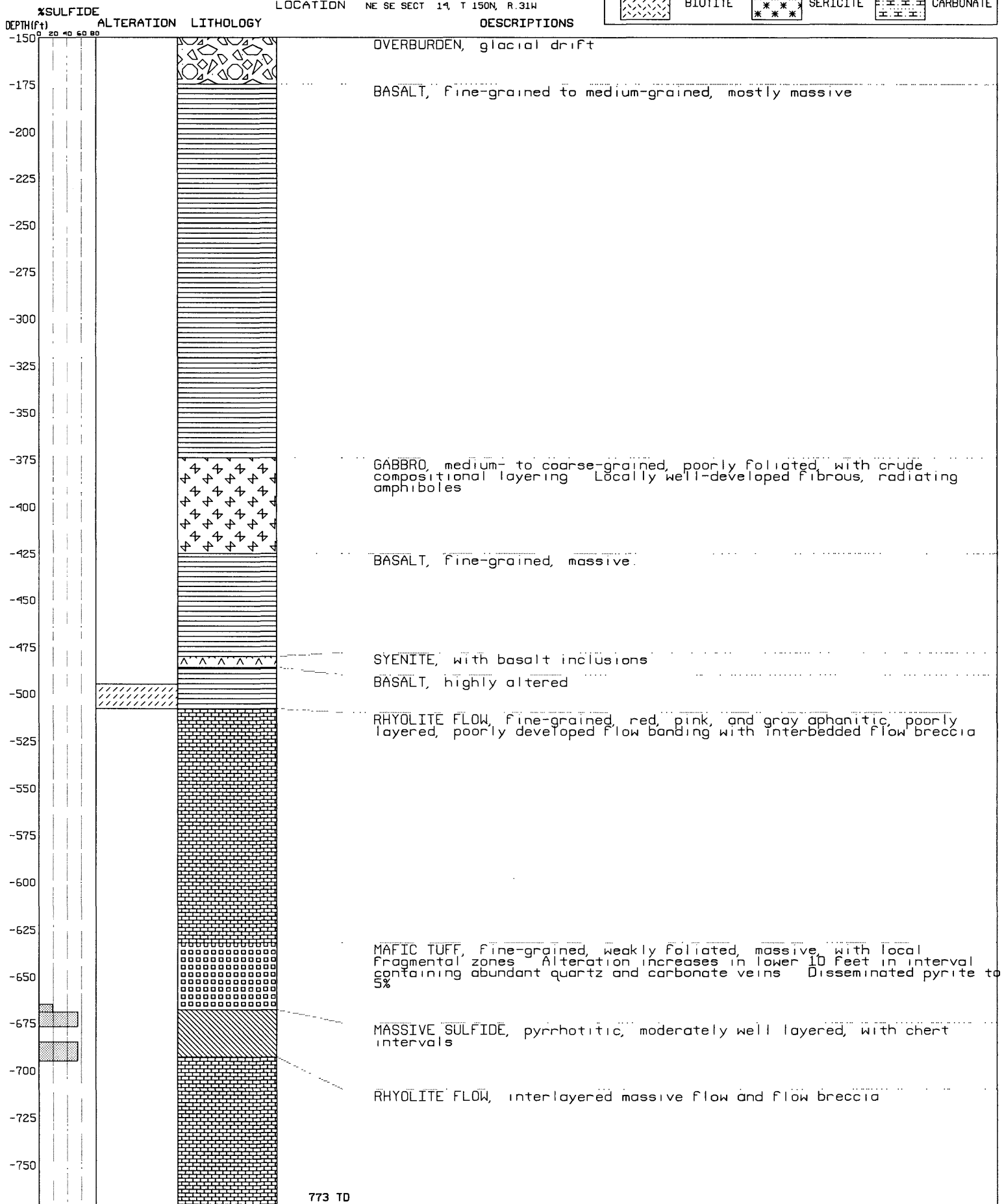


Fig. 61

DRILL HOLE VAN-4.

OPERATOR LONGYEAR
LOCATION NE SE SECT 14, T 150N, R 31W

ALTERATION

	KAOLIN		SILICA		CHLORITE
	BIOTITE		SERICITE		CARBONATE

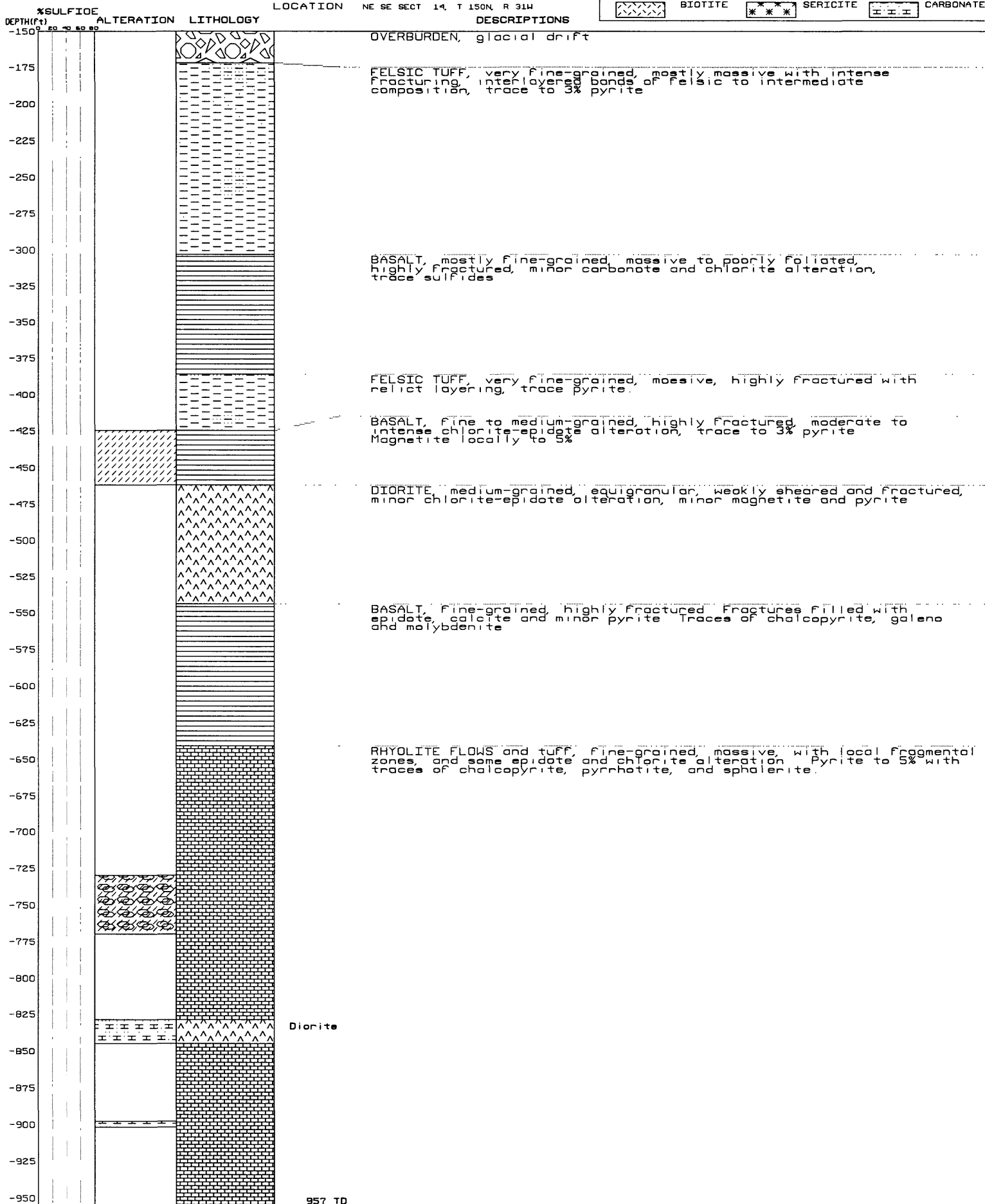


Fig. 62
DRILL HOLE YWL-1

OPERATOR
COMPLETED
LOCATION
TENNECO MINERALS
FEBRUARY 21, 1995
Sect 20, T 160, R 36

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

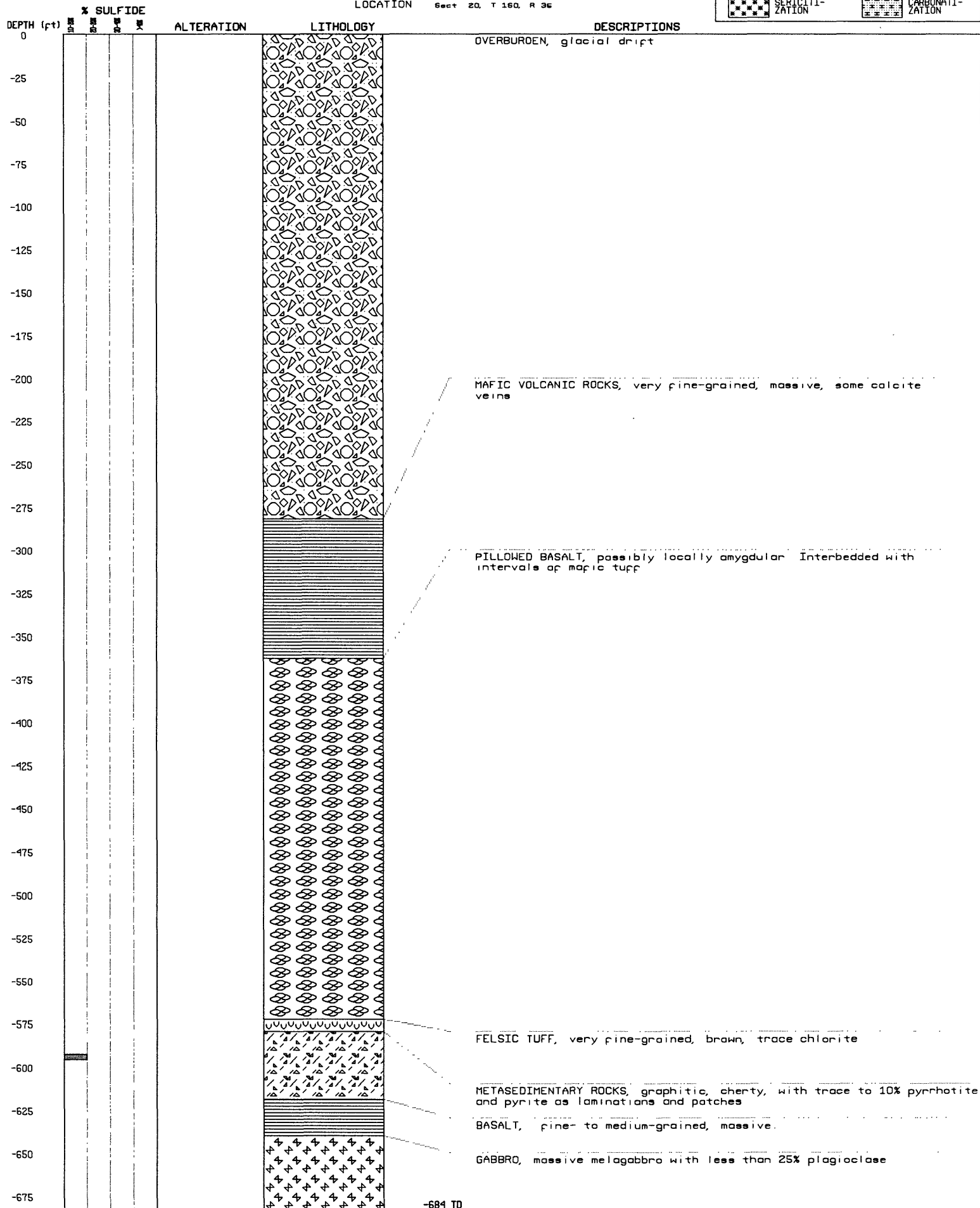


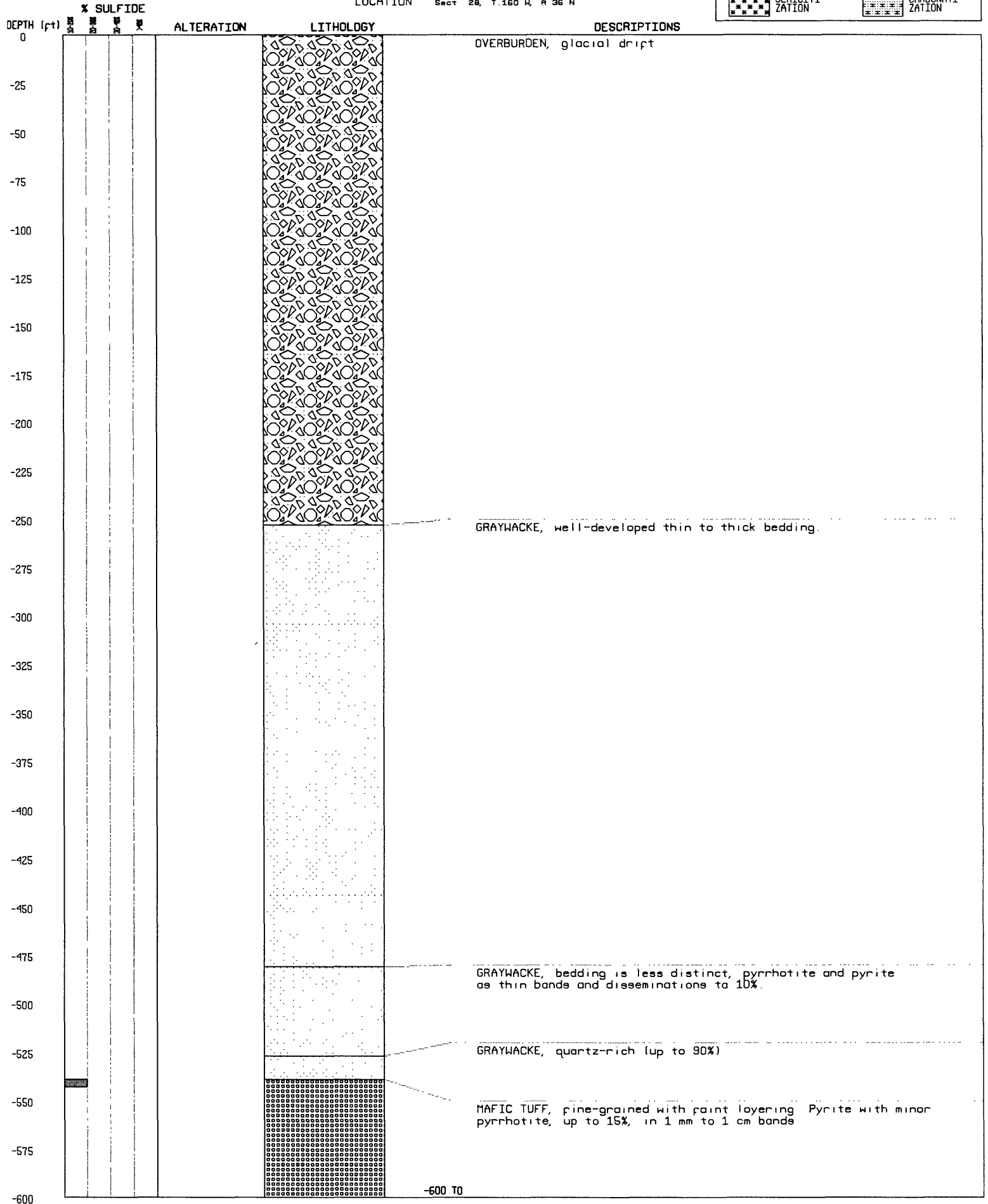
Fig. 63

DRILL HOLE YWM-1

OPERATOR TENNECO MINERALS
 COMPLETED MARCH 1, 1986
 LOCATION Sect 28, T.160 N, R 36 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



-600 TO

Fig. 64

DRILL HOLE YWQ-1

OPERATOR
COMPLETED
LOCATION

HOUSTON INTERNATIONAL MINERALS
MARCH 23, 1991
Sect 15, T 159 N, R. 98 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION

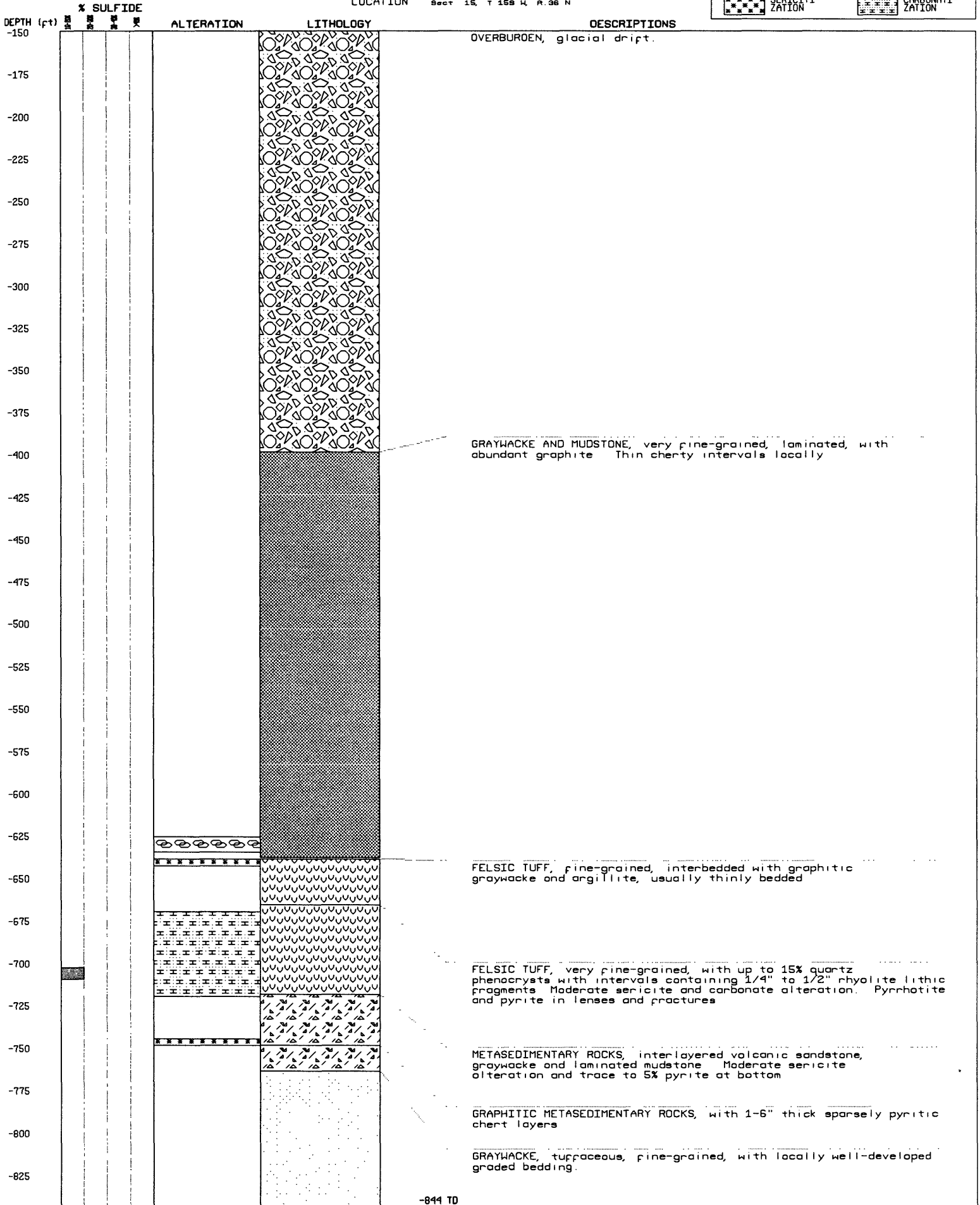


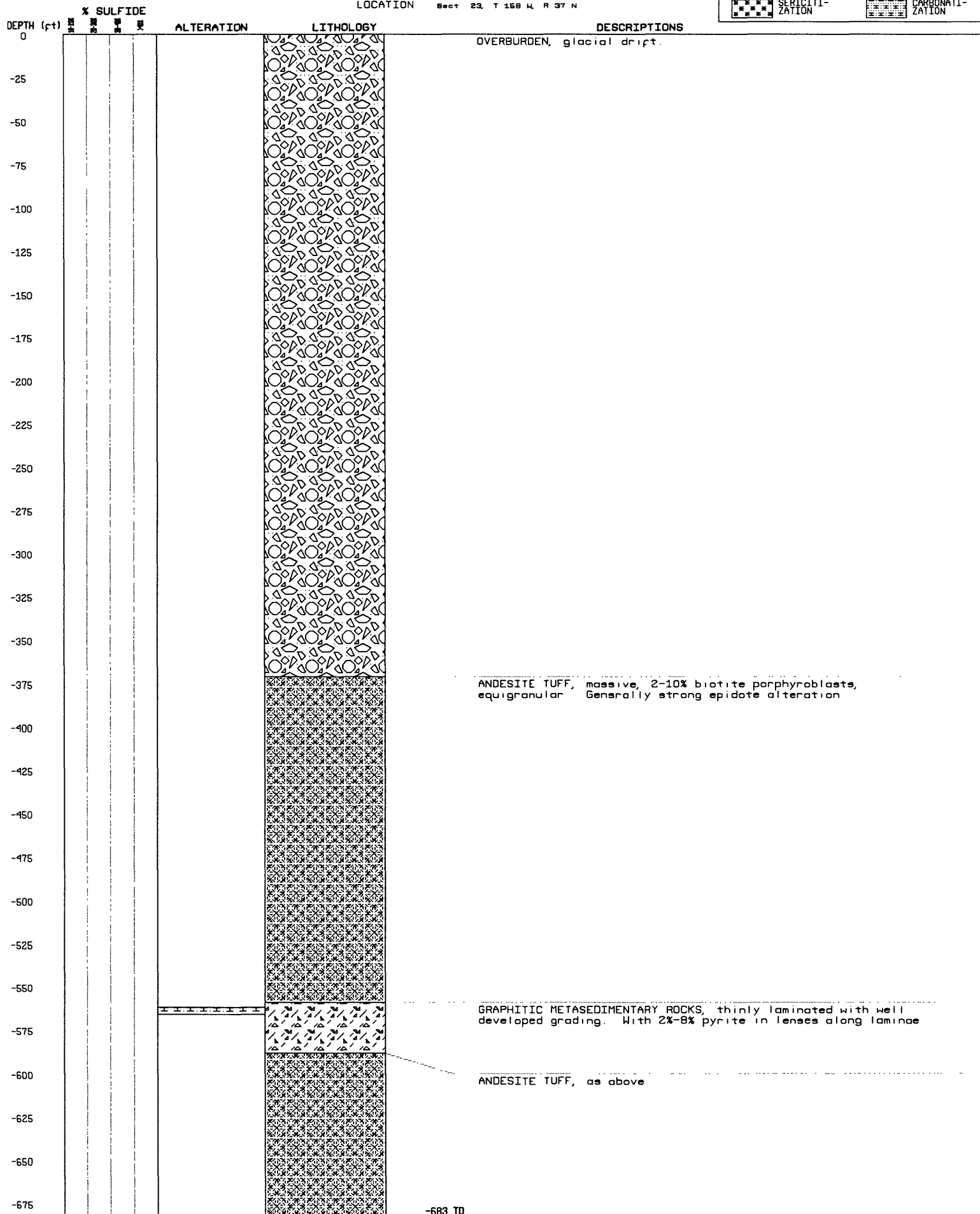
Fig. 65
DRILL HOLE YWT-1

OPERATOR
 COMPLETED
 LOCATION

HOUSTON INTERNATIONAL MINERALS
 FEBRUARY 18, 1984
 Sect 23, T 158 N, R 37 N

ALTERATIONS

	SILICIFI- CATION		CHLORITI- ZATION
	SERICITI- ZATION		CARBONATI- ZATION



-683 TD

Table 1. Drill hole locations in decimal degrees for drill-holes presented in Table 1.

drill-hole	latitude	longitude	drill-hole	latitude	longitude
40918	48.4361	94.9120	MSD-1	48.5264	94.9300
40919	48.5554	94.8257	R-2-2	48.5802	94.1095
40920	48.5573	94.9222	R-3-4	48.5683	94.1627
A6-1	48.4959	94.4185	R-5-1	48.5591	94.1982
A6-2	48.4987	94.4170	R-5-2	48.5619	94.2016
A8-1	48.5129	94.2949	RL-25	47.8579	94.6985
A9-1	48.5275	94.2702	RL-31	47.8241	94.5957
A9-2	48.5241	94.2727	RL-43	47.9181	94.0114
B-3-2	48.6805	94.5223	RR16-1	48.6366	94.5414
B-5-1	48.4691	94.9525	T20-1	48.4827	95.4618
B-21-1	48.5417	94.8685	TIT-3	47.8017	94.5909
B-21-2	48.5428	94.8825	UBD-3	48.4730	94.2682
B-21-3	48.5392	94.8612	VAN-3	47.8052	94.5703
B-24-1	48.4808	94.9321	VAN-4	47.8054	94.5732
B-24-2	48.4808	94.9321	YWL-1	48.6667	95.3014
B-24-3	48.4808	94.9310	YWM-1	48.6436	95.2786
B-24-4	48.4838	94.9312	YWQ-1	48.5956	95.2751
B-31-1	48.4496	95.0518	YWT-1	48.5797	95.3670
B-31-2	48.4511	95.0495			
B-31-3	48.4496	95.0433			
B-31-4	48.4475	95.0431			
B-31-5	48.4493	95.0432			
B-35-1	48.3970	95.0170			
B-54-1	48.5091	95.0568			
B-58-1	48.4579	94.9254			
B-B-2	48.5642	94.7489			
BD-1	48.6014	94.7037			
BD-2	48.5856	94.7449			
BD-3	48.5896	94.7259			
BD-N-1	48.4736	94.9770			
BD-P-2	48.5189	95.0086			
B-Q-1	48.5129	94.9807			
C-1-83	47.8560	94.7090			
CON-1	47.9111	94.5575			
FT-18	48.3739	95.2126			
FT-14	48.5092	95.2197			
FT-3	48.4817	95.2449			
HAD-1	47.9092	94.5960			
HAD-2	47.9095	94.5992			
HAD-3	47.9103	94.5989			
LW-346-1	48.5039	94.7098			
LW-346-2	48.5041	94.7210			
MDD-1	48.5161	94.9518			
MED-1	48.4665	94.9264			
MMD-1	48.4775	94.9568			
MQD-1	48.5137	94.9882			
MQD-2	48.5110	94.9866			