

U. S. NAVY CORE HOLE 26

Location: T. 5 S., R. 95 W., Section 36

Drilled: October 1977

Surface Elevation: 8605 Feet

Total Depth: 1086 Feet

Prepared by:

Ammeralda Resources  
John A. Hartley, Geologist

July 1978



U. S. Navy Oil Shale Reserve No. 1

Core-hole No. 26

Lithologic Description

Prepared by:

Ammeralda Resources: John A. Hartley, Geologist

605.0 TOP OF CORE DESCRIPTION

- 605.0-620.2 Oil shale: light olive-brown to tan, even bedding, excellent competence, slightly to moderately calcareous, slightly brittle to very tough; light gray brown to buff on fresh break; very slightly calcareous on fresh break; few thin asphaltic tuff stringers at 606.0', 606.2', 606.8' and 620.3'; two vertical fractures exuding sticky asphaltic resin at 612.0'; heavy gilsonite replaced plant fossil on core break at 613.4'; asphaltic tuff stringer with several very short 90° fractures .10' at 615.4'; trace gilsonite or carbonaceous flakes on some core breaks; dark olive brown oil shale with slightly streaked to looped bedding from 619.55-620.2'.
- 620.2-626.0 Oil shale: medium olive brown to light brown, even bedding, excellent competence, moderately to very calcareous on core surface; slightly calcareous and medium gray brown on fresh break; trace asphaltic tuff stringers at 625.8' and 625.9'; gradational contact with following oil shale.
- 626.0-659.0 Oil shale: medium olive brown to medium brown, even bedding, excellent competence, moderately to very calcareous on core surface; dark gray brown to black, noncalcareous on fresh breaks; asphaltic tuff stringers at 626.7', 629.3', 637.7', 639.8', 640.7', 657.3', and 658.1'; several zones of short .10-.15' vertical fractures some exuding asphaltic resin scattered throughout unit; buff tuff stringer at 630.6'; gilsonite on break at 630.9'; slight streaked bedding and fairly low density from 632.0-633.0'; from 634.3-634.8' zone of faint possibly depositional breccia with several irregular pyrite sealed fractures and some offset bedding; few very faint irregular 90° pyrite stringers from 643.0-644.0'; buff tuff stringers at 648.8', 653.3' and 653.4'; white to buff tuff stringers at 654.9'; gradational contact with following oil shale.
- 659.0-675.0 Oil shale: medium to dark olive brown, slightly banded, even bedding with some looped bedding, excellent competence, moderately to very calcareous on core surface, dark brown and very slightly calcareous on fresh break; several buff asphaltic tuff stringers scattered throughout unit; faint streaked bedding and fairly low density from 667.3-668.0'; .10' buff tuff stringer at 672.0'.
- Note: 1.0' core loss - same footage interval marked 672/673.

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- 675.0-687.0 Oil shale: light olive brown, even bedding, good to excellent competence, slightly to moderately calcareous on core surface, medium gray brown and light brown slightly to moderately calcareous on fresh breaks; several faint gray pyrite streaks; numerous very short fractures exuding asphaltic material on core breaks at 678.8'; several thin tuff stringers scattered throughout unit; gradational contact with following oil shale.
- 687.0-689.1 Oil shale: dark olive brown, even with trace streaked bedding, excellent competence, very slightly calcareous on core surface, dark brown and noncalcareous on fresh breaks; gradational contact with following oil shale.
- 689.1-693.6 Oil shale: light to medium olive brown, even bedding, good to excellent competence, slightly to moderately calcareous on core surface, medium to dark brown and noncalcareous on fresh breaks; numerous very short 90° closed fractures with asphaltic material scattered throughout unit;  
Note: 1.0' core loss - same footage interval marked 692/693.
- 693.6-696.0 Oil shale: medium to dark gray brown, even bedding, good to excellent competence, slightly to moderately calcareous on core surface, dark brown and noncalcareous on fresh breaks; gradational contact with following oil shale.
- 696.0-701.5 Oil shale: light gray brown, even bedding, good competence, very slightly calcareous on core surface, light gray brown and non-calcareous on fresh breaks; numerous short 90° fractures, sealed and exuding asphaltic resin; several very thin tuff stringers exuding asphaltic resin.
- 701.5-704.2 Oil shale: dark gray brown, even bedding with trace streaked bedding, good competence, moderately calcareous on core surface, dark brownish black and noncalcareous on fresh break; few light brown bands.
- 704.2-711.15 Oil shale: medium gray brown, even bedding, poor to fair competence, slightly to moderately calcareous on core surface, medium gray brown and very slightly calcareous on fresh core break; tuff blebs at 705.5'; .10' asphaltic tuff at 705.9'; zone of several very short (.05-.10') 90° fractures sealed and exuding asphaltic resin from 706.8-707.8' and 708.5-708.8'.
- 711.15-712.5 Oil shale: dark olive brown and light olive brown, even to streaked bedding, good to excellent competence, moderately to very calcareous

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on core surface, dark brown and noncalcareous on fresh breaks;  
gradational contact with following oil shale.

- 712.5-719.35 Oil shale: medium gray-brown, even bedding, poor to fair competence, moderately to very calcareous on core surface; several fractures.
- 719.35-720.6 Oil shale: dark brown to black, even bedding, good to excellent competence, very slightly calcareous on core surface, dark brownish black and noncalcareous on fresh break; gradational contact with following oil shale.
- 720.6-726.35 Oil shale: medium gray brown, even bedding, fair competence, very slightly calcareous on core surface, medium gray brown and very slightly calcareous on fresh breaks; thin tuff stringers with very short asphaltic sealed fractures at 744.9', 725.3', 725.4' and on core break at 725.5'; gradational contact with following oil shale.
- 726.35-728.5 Oil shale: dark olive brown to brownish black, even bedding, good to excellent competence, very slightly calcareous on core surface, dark brownish black and very slightly calcareous on fresh break; thin tuff stringer exuding abundant very sticky asphaltic resin at 726.4'; fairly low density; tuff stringer at 728.5'; gradational contact with following oil shale.
- 728.5-735.7 Oil shale: light to medium gray brown, even bedding with few loop structures, good competence, moderately to very calcareous on core surface, medium brown and light brown banded laminae and moderately calcareous on fresh breaks; granular tuff lens at 729.2'; thin tuff stringer at 735.1' and 735.7'.
- 735.7-742.3 Oil shale: medium gray brown, even bedding, excellent competence, moderately to very calcareous on core surface, dark gray brown and slightly to moderately calcareous on fresh break; thin tuff stringer at 737.2', 738.0', 738.7' and 738.8'; few gray pyrite streaks; numerous thin granular, asphaltic tuff stringers from 740.2-740.9'; .20' granular tuff bed at 740.9'.
- 742.3-745.15 Oil shale: dark olive brown and light olive brown, banded, even bedding, excellent competence, very slightly to slightly calcareous on core surface, dark gray brown to black and noncalcareous to very slightly calcareous on fresh break; heavily "bleeding" asphaltic tuff stringer at 743.4'; tuff stringer at 743.5'; gradational contact with following oil shale.

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- 745.15-750.3 Oil shale: light gray brown to tan, even bedding, good to excellent competence, very calcareous on core surface, medium gray brown and slightly calcareous on fresh break; tan massive marly zone from 745.8-749.25'; oil shale, medium to dark olive brown, slightly streaked bedding from 749.25-749.6'; irregular asphaltic tuff stringer at 749.8' and 749.9'.
- 750.3-754.0 Oil shale: medium to dark olive brown, even bedding with some looped and streaked zones, good to excellent competence, very slightly calcareous and medium brown on fresh break, slightly calcareous on core surface; buff to tan granular tuff stringer at 754.1'; gradational contact with following oil shale.
- 754.0-796.6 Oil shale: medium gray brown to medium olive brown, even bedding, good competence, moderately to very calcareous on core surface, medium gray brown and light gray brown slightly calcareous on fresh breaks; several thin asphaltic tuff stringers from 758.0-759.1'; trace small vugs with white soft chalky mineral coating-kaolinite at 761.9'; tuff stringers with brown asphaltic material at 766.0', 769.3', 772.3' and 772.6'; numerous thin granular tuff stringers and beds with numerous very short (.01-.05') 90° fractures from 767.55-768.65'; several tuff stringers from 769.7-769.9'; light blue-white soft chalky coating (kaolinite) on some fractures from 772.0-796.6'.15' granular asphaltic tuff stringer at 780.35'; few dark gray pyrite streaks scattered throughout unit; irregular asphaltic granular tuff stringer at 785.0', 785.3' and 785.4'.
- 796.6-807.3 Oil shale: light to medium olive brown, even bedding, good to excellent competence, very calcareous on core surface, medium to dark brown and slightly calcareous on fresh breaks; parting with very small spherical casts (oolites) on surface at 804.2'; granular asphaltic tuff stringer at 805.9' and 806.1'.
- 807.3-810.3 Tuff with interbedded oil shale stringers: massive to wavy bedding, fair to good competence, moderately calcareous on core surface and fresh break, granular, asphaltic, numerous short (.10-.15') irregular 90° fractures.
- 810.3-842.0 Oil shale: light to medium olive brown, even bedding, excellent competence, very calcareous on core surface, medium gray brown and slightly to moderately calcareous on fresh break; gilsonite on core break at 812.7'; few gilsonite streaks scattered throughout core; gilsonite on core break at 828.8'; abundant very small "chatter marks" on core surface from 831.8-833.8'; few "chatter marks" scattered throughout core from 839.8-841.0'.

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- 842.0-843.2 Oil shale: light olive brown, even bedding, good to excellent competence, moderately to very calcareous; few dark gray pyrite streaks at 842.1; gilsonite streak at 843.0'; gradational contact with following oil shale.
- 843.2-845.7 Oil shale: dark olive brown to black, even bedding, very low density; gradational contact with following oil shale.
- 845.7-852.8 Oil shale: light to medium olive brown, even bedding, excellent competence, moderately to very calcareous; gradational contact with following oil shale.
- 852.8-853.6 Oil shale: dark olive brown to black, even with looped bedding, very low density, excellent competence; few gilsonite streaks; gradational contact with following oil shale.
- 853.6-857.0 Oil shale: light to medium olive brown, very slightly banded, even bedding, excellent competence, very calcareous; asphaltic brown tuff stringers at 853.9'; gradational contact with following oil shale.
- 857.0-858.0 Oil shale: dark mahogany brown to black, even bedding with some looped bedding, excellent competence, fairly low density.
- 858.0 TOP OF A-GROOVE
- 858.0-860.0 Oil shale, marly: light olive brown, even bedding, abundant dark greenish gray laminae, moderately to very calcareous, excellent competence; gradational contact with following marly oil shale.
- 860.0-861.9 Oil shale, marly: tan and medium olive brown, faintly banded, even bedding, excellent competence; tan marly laminae on parting at 861.4'; gradational contact with following marlstone.
- 861.9-866.0 Marlstone: light olive brown to light gray brown, even bedding with offset and irregular bedding common, poor to fair competence; dark brown asphaltic stringer at 862.6'; 862.75' and 862.8'; trace of leached vugs at 862.6'; solution fracture zone from 864.2-865.4' with numerous gilsonite sealed fractures at various dips, rotated bedding, offset bedding, white translucent slightly calcareous mineral and asphaltic mineral associated in large irregular nodules and patches; abundant asphaltic or carbonaceous material on core break at 865.4'.
- 866.0-872.65 Marlstone: light gray brown, even bedding, very poor to poor competence; numerous planar shaly partings; numerous dark gray pyrite blebs and stringers; small rounded blebs, possibly oolite on core breaks at 868.9', 870.1' and 870.2'.

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872.65 BASE A GROOVE

872-65-873.3 Oil shale: medium olive brown to medium greenish brown, streaked bedding, excellent competence.

873.3-875.3 Oil shale: dark olive brown to medium olive brown, even to looped bedding, excellent competence, very low density; trace white granular tuff stringer at 874.65'.

875.3-878.8 Oil shale: light olive brown, tan and medium olive brown, banded, even to undulating bedding, excellent competence; abundant dark brown tuff streaks and stringers throughout unit; gray pyritic bands from 875.6-875.9'; .20' zone of asphaltic, slightly vuggy, irregular patches and stringers at 875.4' and 876.75'; few dark gray pyrite streaks; trace of asphaltic parafin material exuding from very small fractures at 877.7', 878.2', 878.4' and 878.7'; bedding contorted from 875.15-875.5'; brown asphaltic tuff stringer at 876.4'; trace leached nahcolite vug at 878.25'; gradational contact with following oil shale.

878.8-880.7 Oil shale: dark olive brown, even to looped bedding, excellent competence; bedding warped around irregular asphaltic tuff nodule from 879.9-880.2'; irregular brown asphaltic tuff .15' at 879.45'; irregular to contorted bedding and offset bedding from 879.6-879.9'; very low density oil shale.

880.7-881.8 Tuff: dark brown, massive to streaked bedding, excellent competence, asphaltic; upper contact distinct and irregular; lower contact distinct and fairly planar; several oil shale streaks and stringers.

881.8-883.5 Oil shale: medium mahogany brown to medium olive brown, even with some looped bedding, excellent competence; several brown granular tuff streaks and stringers; moderately to very calcareous.

883.5-885.5 Oil shale: dark mahogany brown to black, even bedding with some looped bedding, excellent competence, tough, very low density; dark gray band at 884.3'; bedding warped around nodule .05' at 884.9'; asphaltic material on core break at 884.85'; brown asphaltic tuff stringer at 885.0'.

885.5-898.2 Oil shale: light mahogany brown grading to medium olive brown at 887.5', even bedding with traces of looped bedding, excellent competence, moderately to very calcareous, slightly calcareous from 894.1-898.2'; asphaltic parafin exuding from very small vertical fractures at 893.1'

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and 893.7'; .35' blue gray massive analcitized tuff with distinct irregular upper contact and distinct planar lower contact and trace small vugs from 893.75-894.1'; .10' brown asphaltic tuff bed with white rounded fairly hard analcime blebs at 885.7'; brown asphaltic streak at 886.7'. Note: Two consecutive feet marked as 886.0'. MAHOGANY MARKER .35' from 893.75-894.10'.

- 898.2-899.45 Oil shale: dark brown black to black, even bedding, excellent competence, very low density.
- 899.45-903.7 Oil shale: light to medium olive brown, even with some streaked bedding, excellent competence, very calcareous, low density; streaked bedding from 899.85-901.0'; dark mahogany brown on fresh break; conchoidal breaks; few "chatter marks"; gradational contact with following oil shale.
- 903.7-907.0 Oil shale: medium and light olive brown, dark mahogany brown to brownish black of fresh conchoidal breaks, streaked, irregular and even bedding, excellent competence, moderately calcareous; abundant irregular horizontal and vertical asphaltic tuff streaks and stringers from 904.85-905.5'; gradational contact with following oil shale.
- 907.0-909.0 Oil shale: light olive brown, medium olive brown and dark brown black, banded, even with some looped bedding, very low density.
- 909.0-913.3 Oil shale: medium olive brown, medium brown on fresh break, even bedding with contorted looped and offset bedding from 909.6-910.7', fair to good competence, slightly to moderately calcareous; several weak shaly partings; solution fracture zone from 909.6-910.7' with numerous very short, very irregular fractures with asphalt and white chalky coating (kaolinite); very low density oil shale; bedding dips 15° from 910.7-911.3'; gradational contact with following oil shale.
- 912.65-913.0 Core loss.
- 913.3-915.35 Oil shale: dark mahogany brown to brownish black, even bedding, excellent competence, very low density; gilsonite on core break at 914.7'; several brown asphaltic tuff stringers from 915.0-915.35'; gradational contact with following oil shale.
- 915.35-919.3 Oil shale: light olive brown, medium mahogany brown on fresh break, even with some looped bedding, good to excellent competence, very calcareous on core surface, fairly low density; white and light blue gray tuffaceous material on core break at 918.6'; gradational contact with following oil shale.

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- 919.3-920.6 Oil shale: brownish black, streaked bedding with some contorted bedding, good to excellent competence, fairly low density; abundant irregular gilsonite streaks and fracture filling; abundant white fairly hard crystal blebs; gradational contact with following oil shale.
- 920.6-924.0 Oil shale: light olive brown, medium mahogany brown on fresh break, even bedding, excellent competence, very calcareous on core surface; gradational contact with following oil shale.
- 924.0-928.9 Oil shale: medium mahogany brown to medium olive brown, dark mahogany brown on fresh break, even and streaked bedding, excellent competence, tough, fairly low density, slightly to very calcareous; tan bands common from 925.3-926.0'; gradational contact with following oil shale.
- 928.9-932.6 Oil shale: light olive brown, medium mahogany brown on fresh break, even bedding, excellent competence, moderately to very calcareous; tan bands common from 925.3-926.0'.
- 932.6-934.0 Oil shale: dark brown black to medium olive brown, irregular bedding, good to excellent competence, dark mahogany brown on break, slightly calcareous from 933.1-934.0'; possible solution fracture zone from 932.7-933.7' with abundant horizontal and vertical gilsonite and pyrite streaks, stringers, and very irregular bedding; gradational contact with following oil shale.
- 934.0-936.3 Oil shale: light to medium olive brown, even bedding, excellent competence, moderately calcareous.
- 936.3-937.6 Oil shale: dark mahogany brown, even bedding with some looped bedding, excellent competence, gradational contact with following oil shale.
- 937.6-942.0 Oil shale: light olive brown, light brown on fresh break, even bedding, excellent competence, moderately to very calcareous, tough to brittle; tan granular tuff stringers at 937.15' and 937.3'; several gray brown tuff streaks from 937.5-938.1'; dark mahogany brown on fresh break at 938.5'.
- 942.0-943.6 Oil shale: medium olive brown, medium mahogany brown on fresh break, streaked bedding, excellent competence, tough, moderately calcareous on core surface; gradational contact with following oil shale.
- 943.6-945.6 Oil shale: light olive brown to tan, light brown on fresh break, even bedding, excellent competence, moderately to very calcareous, tough

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to slightly brittle; dark gray pyrite laminae at 944.75'; streaked bedding from 944.9-945.05'; trace of gilsonite streaks; gradational contact with following oil shale.

- 945.6-947.3 Oil shale: medium olive brown, medium mahogany brown on fresh break, even bedding, excellent competence, fairly tough, very calcareous on core surface; irregular brown tuff streak at 946.7'; trace pyrite streaks; gradational contact with following oil shale.
- 947.3-948.4 Oil shale: light olive brown, medium mahogany brown on fresh break, even bedding, excellent competence, very calcareous on surface, tough.
- 948.4-950.6 Oil shale: medium olive brown to medium mahogany brown, dark mahogany brown on fresh break, fairly low density, excellent competence, tough; numerous gilsonite streaks; gradational contact with following oil shale.
- 950.6-953.4 Oil shale: medium olive brown, even to looped bedding, excellent competence, tough, moderately calcareous; gradational contact with following oil shale.
- 953.4-955.0 Oil shale: medium olive brown and tan, slightly banded, light brown and medium olive brown on fresh break, even bedding, excellent competence, tough to slightly brittle, slightly to moderately calcareous on core surface.
- 955.0-959.35 Oil shale: medium olive brown and light tan to white, banded, medium brown and light white brown on fresh break, even bedding, good to excellent competence, slightly tough to brittle, moderately calcareous, trace gilsonite streaks; trace dark gray pyrite stringers, "chatter marks" common; .10' brown asphaltic tuff stringer at 956.65'; large tan silty inclusion with bedding warped around inclusion .15' at 958.9'; gradational contact with following oil shale.
- 959.35-964.95 Oil shale: medium olive brown, even bedding, medium gray brown on fresh break, slightly tough to brittle, excellent competence, very slightly calcareous on core surface; "chatter marks" common on core surface; few dark gray pyrite stringers; .10' brown tuff at 961.9'; .05' brown granular tuff stringer at 961.9'; thin dark gray pyrite stringer with lemon-yellow oxidation stain at 963.15'; oolites on core break at 963.8'; dark brown asphaltic from 963.55-963.85'.

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- 964.95-966.0 Oil shale: dark olive brown, medium olive brown to dark brown on fresh break, even and looped bedding, slightly banded, excellent competence, few tuff streaks and stringers, very slightly calcareous; gradational contact with following oil shale.
- 966.0-975.25 Oil shale: light to medium olive brown, medium brown and light gray brown on fresh core break, even bedding, excellent competence, slightly tough to brittle, moderately to very calcareous, abundant "chatter marks" from 966.3-968.2'; trace "chatter marks" scattered throughout unit; dark olive brown bands from 969.0-970.35'; gray marly streaks from 969.8-970.05'; tuff streak at 971.0'; .10' buff to tan granular tuff at 973.0'.
- 975.25-976.6 Tuff: light brown, massive to slightly streaked bedding, fairly hard to slightly crumbly; slightly asphaltic; trace pyrite blebs; abundant soft white chalky mineral disseminated throughout unit; slightly oolitic appearance; upper contact planar to slightly undulatory and very distinct; large oolitic material on core break at 976.2'; traces of black carbonaceous material; orange-brown staining on black carbonaceous bleb at 976.6'.
- 976.6-980.15 Oil shale: medium olive brown, medium mahogany brown on fresh break, even with some looped bedding, excellent competence, slightly tough to brittle, very calcareous on core surface, fairly low density; solution fracture zone with numerous irregular sealed fractures and irregular 60° tuff stringer from 977.2-977.7'; .10' gray granular tuff at 978.95'.
- 980.15-983.85 Oil shale: light olive brown and tan, banded, light gray brown and light brown on core break, even with traces looped bedding, excellent competence, slightly brittle, slightly to moderately calcareous; few short incipient asphaltic fractures scattered throughout unit; trace collapsed nahcolite vug at 982.3' with short calcite sealed fracture.
- 983.85-990.0 Oil shale: light brown to medium olive brown, even bedding, medium mahogany brown to medium gray brown on fresh core breaks, tough, good to excellent competence, slightly calcareous; few calcareous blebs at 987.35'; numerous calcite blebs from 988.35-989.85'; numerous very small dark gray pin-point pyrite blebs from 989.4-989.85'; few pyrite streaks; "chatter marks" common from 988.3-989.5'; gray pyritic analcitized tuff stringer at 983.7'; .10' asphaltic tuff zone at 983.8'.

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990.0 TOP B-GROOVE

990.0-992.0 Marlstone: light brown to buff, even bedding, poor competence, brittle, slightly calcareous; buff colored planar shaly partings common throughout unit; numerous very small pyrite blebs from 990.0-992.0'; gradational contact with following marlstone.

992.0-1005.9 Marlstone: buff, even bedding, very poor to poor competence, numerous planar shaly partings, slightly calcareous; several partings with very small oolites; pyrite streaks common throughout unit; trace offset bedding at 992.4'; .20' white granular slightly chalky tuff with abundant pyrite blebs and streaks at 992.9'; abundant very small dark gray pin-point blebs throughout unit probably same as on above partings, and fractures at 994.0' these appear to be very small pyrite or marcasite nodules; trace of leached vug at 994.6'; tuff stringer with leached vugs at 997.9'; .20' blue gray analcitized tuff at 998.0'; very small (pin-point blebs) dark gray pyrite blebs disseminated throughout core from 1001.0-1003.4'; zone of very small lenticular calcite blebs .10' at 1002.1'; numerous dark gray pyrite streaks from 1002.2-1003.3'; pyrite streaks on break at 1003.0'; grades to nearly massive gray brown shale from 1003.7-1005.9'; pyrite streaks and few gilsonite streaks common from 1003.7-1005.9'.

1005.9-1008.6 Shale: very sandy, massive, fairly competent, planar bedding from 1006.0-1006.3'; few dark gray pyrite streaks common; very small pyrite and carbonaceous blebs common throughout unit.

1008.6-1020.9 Marlstone: light brownish gray, even bedding, poor competence; small leached vugs filled with pyrite scattered throughout unit; abundant dark gray to black pyrite or gilsonite streaks throughout unit; numerous partings throughout unit with white opaque soft chalky (kaolinite) coating; medium size pyrite lined vugs at 1011.7' and 1014.4'.

1020.9-1021.4 Marlstone: medium brown gray, massive, very crumbly, brecciated, honeycombed with partly collapsed small leached nahcolite vugs; rubble from 1021.2-1021.4'.

1021.4-1026.1 Core loss.

1026.1-1026.5 Marlstone: as above, brecciated.

1026.5-1030.0 Marlstone: light brownish gray, even bedding, very poor competence; abundant "chatter marks"; abundant partly collapsed leached nahcolite

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vugs; pyrite disseminated throughout vugs; abundant partings and very short 90° fractures associated with collapsed vugs; very small oolitic-like rounded bleb casts on most partings; pyrite on numerous partings.

1030.0-1037.0 Oil shale: light brown, even bedding, poor competence, light gray brown on fresh break; abundant chatter marks throughout unit; numerous dark gray pyrite streaks and stringers throughout unit; pyrite lined vug at 1030.1'; several partings with pyrite; zone of pin-point calcite from 1031.8-1032.15'; partly collapsed nahcolite vug with associated 90° fractures with pyrite from 1032.7-1032.9', at 1033.0' and at 1033.5'; irregular pyrite and gilsonite pod .10' at 1034.9' possibly partly collapsed nahcolite vug; small pyrite nodule at 1035.0' and 1035.1'.

1037.0 End of logged core interval.

THE CLEVELAND CLIFFS IRON COMPANY

PROJECT: NOSR#1

HOLE NO. 26 SHEET 1 OF DATE: 10/4/77 LOGGED BY: D. PAPP COLLAR: TD:

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
605							OIL SHALE, MEDIUM GRADE, LAMINATED
606							SAA BLEBS OF SAND, .14-.80 BLACK OIL SHA SOFT SEDGES
607							SILTSTONE FINELY LAM. TAN
608							SAA 608-619
609							
610							
611							
612							SAA .05-.17 BAND OF BROWN SILTSTONE, WHITE
613							MICR, ORGANIC DEGREE, SL SANDY
614							
615							OIL SHALE, MED → HI GRADE 3A-AA TAR SAND STONE
616							
617							
618							
619							ABOVE .55 SILTSTONE, LT BROWN - BELOW OIL SHALE
620							MED GRADE TO 620.7 620.76-.33 BLEB SANDSTONE
621							620.7 SILTSTONE LT. BROWN
622							SAA
623							SAA
624							SAA
625							SAA 625.74 SAND LAYER
626							626.79 SMALL SAND STRINGER, HIGH GRADE OIL SHALE
627							OIL SHALE, MEDIUM TO HIGH GRADE
628			.56				SAA
629							SILTSTONE, SL. SANDY, BROWN
630							OIL SHALE LT BROWN .58 SAND STRINGER
631							SAA
632							OIL SHALE MED TO HI GRADE, BLACK TO BROWN
633							SAA
634							SAA LOWER GRADE SHALE
635							635-653 OIL SHALE, MED GRADE, LAM, BROWN-GRAY
636							
637							.63 SAND LAMINA GAS BUBBLES
638							
639							.78 SAND LAMINA GAS BUBBLES
640							
641							.60 SAND LAMINA
642							
643							
644							
645							.65-652 LAM. OIL SHALE BROWN
646							
647							
648							.8 SAND BLEB LT. BROWN
649							
650							
651							
652							
653							653-664 OIL SHALE, BROWN TO DK GRAY
654							INTER LAM TO MASSIVE 653.32-.4 VIXOX SANDSTONE

CORE #1  
CUT  
30.2  
REC  
30.2

635.2

CORE #2  
CUT  
30  
REC  
29.05



THE CLEVELAND-CLIFFS IRON COMPANY

PROJECT: NCSR # 1

HOLE NO. 26 SHEET 2 OF \_\_\_\_\_ DATE: 10/5/77 LOGGED BY: D. REEVE'S COLLAR: \_\_\_\_\_ TD: \_\_\_\_\_

D. PAPP  
P. THACKER

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
655							654.85 SANDY SILTSTONE W/ORGANIC DEBRIS
656							657 VUG PARTLY FILLED W/TAR 657.3-4 TUFF BLEB
657							
658							
659							.84 SAND STRINGER
660							SL. HIGHER GRADE DL SHALE, DK GRAY TO DK BROWN
661							SAA
662							SAA
663							SAA
664							SAA
665							SAA
666							665-694 OIL SHALE, LT BROWN TO V. DK. BROWN
667							CALC., MED. TO HIGH GRADE W/10%± DK GR TO
668							BLACK, V. HIGH GRADE OIL SHALE, LAMINA THROUGH.
669							OUT CORE INTERVAL. MINOR CARBON LEAF
670							& THIN 'WOODY' FRAGMENTS OR PARTING PLATES
671							THIN LT BROWN, SILTY TUFF LAMS AT 670.0
672							V. LARGE, LT BRN, SILTY TUFF LAMINA,
673							DISTORTED BEDDING
674							
675							
676							
677			.2				
678							SMALL SANDY LT BROWN TUFF BLEB @ 678.8
679							679.2 THIN, BROWN, SILTY TUFF LAMINA, V. CALC
680							
681							
682							
683							
684							684.95 V. THIN, WH-LT GR, SILTSTONE LAMINA, CALC
685							
686							686.0-688.0 SMALL, V. LT GRAY, SILTSTONE BLEB
687							
688							
689		83335	.4				689.4 SMALL VER FRX, BLEEDING TAR
690							
691							
692							LONG UUG @ 692.3-.8 OPEN
693							693.16-.19 thin lense ss, lt. brn, med-fine grained, non-calc.
694							
695							692.8-702.5 oil shale, lt.-dk grey, mod-highly calc., v. thin
696							lam, predom. low grade w/some high grade mixed in.
697		90°	.94				
698							693.35-701.70 vert. frx. -closed, filled w/ oil some places.
699							
700							
701							
702							702.5-703.87 oil shale, aa, high grade
703							703.87-712.15 oil shale, aa, low grade
704							704.52-705.21 oil shale, aa, predom. high grade w/

CORE #2  
CUT  
30'  
REC  
29.05'

CORE #3  
CUT  
29'  
REC  
30.1'

CORE #4  
CUT  
61'  
REC  
60.4'

T.35

T.70

THE CLEVELAND-CLIFFS IRON COMPANY

PROJECT: NOSR #1

HOLE NO. 26 SHEET 3 OF

DATE: 10/5/77

LOGGED BY: P. Thacker

TD:

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
705							some med. grade mixed in.
706							
707							
708							
709			.54				
710							
711							
712							712.15-713.40 oil shale, aa, high grade w/ some med. grade lam.
713							713.40-716 oil shale, aa, low grade
714							
715		7.4					
716							716-719.34 oil shale, aa, low grade
717							
718							
719							719.34-721.37 oil shale, aa, predom. high grade w/ some med. grade lam., med-highly calc.
720							721.37-726 oil shale, aa, med. grade.
721							
722							
723							715.40-735 + vert. frx - closed w/ some remnant oil & spotted w/ nahcolite.
724		90°					
725							
726							726-729 OIL SHALE HIGH GRADE 4-43 DEGR. D. LAYERS SANDSTONE BLEEDING GAS & TAR LENS OF TUFFACEOUS SAND OIL SHALE LOW TO MED GRADE LT TO DK BROWN FRX FILLED & COATED W/ OIL (TAR) AND NAHCOLITE
727							
728							
729							
730							
731							
732							
733							
734							734-754 OIL SHALE MED TO HIGH GRADE DARK BROWN TO DK GRAY
735		7					735.7 TUFF STRINGER
736							736-742 MORE MASSIVE MED GRADE 122 SAND STRINGER
737							162 TUFF BLEBS
738							
739							
740							740.85-741.10 SANDSTONE TO SILTSTONE LT BROWN
741							
742							742.32-745 OIL SHALE HIGH GRADE BLEBS OF SANDSTONE BLEEDING TAR, LAM BR & GRAY
743							
744							
745							745-751 OIL SHALE MEDIUM GRADE, LT BROWN, MASSIVE
746							
747							
748							
749							125-57 HIGH GRADE SHALE BED
750							
751							HIGH GRADE OIL SHALE - SOFT SEDIMENT DEF
752							LOW GRADE OIL SHALE MASSIVE
753							SAA
754							SAA

CORE #4 CUT 61 REC 60A



DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
755						755.2	755-761 OIL SHALE, LT BROWN TO BLACK MASSIVE
756							
757							
758							.00 BEDDED SANDSTONE, BOTH QTZ, SL CALC, SOME NAHCOLITE & TAR
759							
760							
761							761-765 OIL SHALE, BROWN, MASSIVE
762							
763							
764							
765							OIL SHALE, GRAY
766							SAA
767							SAA SL SAND IN PLACES
768							SAA .00 - .4 INTERBEDDED OIL SHALE & SAND
769							.6 - .64 BEDDED SANDSTONE
770		0-.9					OIL SHALE, MED GRADE, MASSIVE, BROWN
771							SAA
772							SAA
773							OIL SHALE SLIGHTLY HIGHER GRADE GRAY
774							" LOWER GRADE TO 785
775							MASSIVE BEDDING
776							
777							IN FRX HEMITITE STAIN & WHITE MICA
778							
779							
780							780.32 - .43 SANDSTONE LAYER LT BROWN TARRY
781							
782							
783							
784							
785							
786							786A - 786.6 SANDSTONE LAYER
787							OIL SHALE, DK. BROWN, NON CALC
788							
789							
790							
791							
792							
793							OIL SHALE LT. BROWN EVEN LAM, NON CALC.
794							OIL SHALE DK BROWN EVEN LAM, NON CALC.
795							SAA
796							SAA
797							SAA
798							
799							
800							
801							
802							
803							
804							SAA

CORE #5 CUT 60 REC 60A

I

I 0  
5

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
805							OIL SHALE DK. BR. NON CALC.
806					CORE		SAND PARTING.
807					#5		807.5 - 810.3 UPPER WAVY BED
808					CUT		
809					60		
810					REC		OIL SHALE - DK BR. - CALC.
811					60.9		
812							
813							
814							
815						815.6	
816							
817							TO 817.7 - OIL SH. DK BR. SL. CALC. MED GRADE
818					CORE		817.7 - OIL SH. DK BR. VERY CALC. HIGH GRADE
819					#6		OIL SH. DK. BR. CALC
820							
821					CUT		
822					60		822.7 DARK NON CALC BLEBS.
823					REC		OIL SH. DK. BR. CALC.
824					60A		824.3 DARK NON CALC BAND.
825							OIL SH. LT & DK BR. LAM., SL. CALC.
826							825.8 - 828.0 VERT. FRAC. (INDUCED)
827							OIL SH. LT & DK BR. LAM., SL. CALC
828							
829							
830							
831							831.7 - 833.0 VERT. FRAC. (INDUCED)
832							OIL SH. LT & DK BR. LAM. SL. CALC.
833							SAME
834							834.8 - 834.9 DISTORTED LAMINATIONS.
835							
836							836.9 DARK, NON CALC BLEBS.
837							837.6 DARK, NON CALC BAND
838							
839							
840							840.0 - 843.1 LT TO MED BROWN, EVEN LAM., VERY CALC.
841							
842							
843							843.4 - 844.6 DK BR. LAM. / <sup>INDUCED</sup> VERT FRAC. 843 - 845.5
844							844.6 - 844.9 PYRITE 1/2 IN DK BROWN BANDS.
845							844.9 - 845.4 MED. BR. PYRITE @ 845.4
846							845.5 - 852.7 TAN TO GRAY OIL SH. EVEN LAM.
847							VERY CALC.
848							
849							
850							
851							
852							852.7 - 853.7 DK GRAY TO BLACK OIL SHALE NON CALC
853							853.7 - 856.8 TAN TO GRAY OIL SH. VRY CALC.
854							DK NON CALC BAND @ 853.9

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
855							856.8 - 858.0 OIL SH. DK BR TO BLACK NON CALC.
856							SANDY TUFF BED (.05') @ 857.3 GRAY NON CALC.
857							BED (.05') @ 857.2 & (.02) @ 857.6
858							GRAY TO TAN OIL SH, HIGHLY CALC. WITH
859							GRAY NON CALC. BEDS & BLEBS. DISCONTINUOUS
860							LAMINAE @ 861.3, 861.6
861							
862							862.6 - 862.7 POROUS ZONE OF TAN & NON CALC.
863							DARK GRAY ROCK
864							862.7 - 863.7, NATURAL VERT. FRACTURES.
865							864.2 - 864.4 TUFFACEOUS SANDSTONE BED
866							864.6 - 864.7 VRY COARSE GRAINED SAND LAYER.
867							ANGULAR GRAINS & BRACCIATED OIL SHALE
868							866.3 - 866.5 COARSE GRAINED SS LENSE
869							866.5 - 867 TAN TO GRAY OIL SHALE CALC
870							867.0 - 867.1 TUFF.
871							867.1 - 873.3 LT TAN TO GRAY VRY LOW GRADE
872							OIL SHALE WITH GRAY NON CALC. BLEBS
873							873.3 - 875.2 DK BR TO BLK HIGH GRADE OIL SH.
874							875.2 - 875.7 TAN TO DK. BR WAVY BEDDING.
875							875.7 - 875.9 GRAY NON CALC. BED
876							875.9 - 876.4 TAN TO LT GR. OIL SH. CALC.
877							876.4 - 883.5 Oil Sh, lt tan, lo-med.-grade
878							distorted bedding, due to brn., silty, tuff
879							blebs & seams, sh., calc., hard, w/ some
880							lt. gy. - tan Dolostone - marlstone lams.
881							880.7 - 881.8, lt Brn, STS., calc, hard w/ 90%+
882							Volcanic tuff material. (881.0 - 881.8 Tuff SS) <sup>FRX 11/25/77</sup>
883							881.8 - 883.5, OIL SH. AA.
884							883.5 - 885.6, OIL SH, BLK, V. hi-grade, w/ V. minor
885							lams, lt. gy. Dolostone.
886							885.6 - 898.0 Oil Sh. AS AT 876.4 - 883.5
887							w/o silty tuff distortions.
888							
889							
890							
891							
892							
893							
894							894.7 - 895.1, Tuff, silty, Brn, V. gy, calc,
895							minor Bedding distortions. M. M.?
896							
897							
898							
899							
900							
891							
892							
893							
894							

CORE #6 CUT 61 REC 60.4

CORE #7 CUT 42' REC 42.7

576

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
895							895.0-898.2, minor lt. gy Dolostone lams separates, med. grade Oil shale.
896							
897							
898							898.2-906.0, Oil Sh., Brn-Dk. Brn, med to hi-grade, calc. rapidly decreasing in grade w/depth.
899							
900							
901							901.0-904.0, Oil Sh., tan-Brn., calc., Med to hi-grade, w/some tan low-med-grade lams.
902							
903							
904							904.0-918.0, Oil Sh., AA hi-grade?
905							
906							
907							
908							908.7-910.9, Oil Sh. AA., w/major bedding distortions.
909							
910							910.9-918.0, Oil shale, Dk. Brn, Non-calc, hard, med-grade, w/v. minor carb frag.
911							
912							
913							
914							
915							
916							
917							
918							917.0-919.3 Oil Sh. MED-DK BROWN, EVEN LAM.
919							
920							919.3-920.6 OIL SH DK BR H. GRADE SL. CALC.
921							920.6-924.3 OIL SH. BRN TO BR. V. CALC. THIN, WAVY LAMINATIONS.
922							
923							
924							924.3-925.3 OIL SH. DK BR. WITH TAN SAND STRINGERS. <del>VERY</del> CALC.
925							
926							925.3-925.8 - TAN, <sup>to DK BR.</sup> NON CALC. OIL SH.
927							925.8-932.6 TAN TO GRAY OIL SH CALC. THIN EVEN LAMINATIONS. @ 928.0 TO 928.2 DISTORTED BEDDING.
928							
929							932.6-934.0 - OIL SH. TAN TO BLACK DIST. BEDDING NON CALC.
930							
931							934.0-936.5 OIL SH TAN TO GRAY VRY CALC. THIN EVEN BEDDING.
932							
933							936.5-938.0 OIL SH BLACK. NON CALC w/SAND STRINGERS @ 937.15 (0.02) & 937.3 (0.02)
934							
935							938.0 SANDY TUFF BLEBS.
936							938.1-942.0 OIL SH. MED BROWN VRY CALC.
937							942.0-943.8 OIL SH. DK BR w/TAN BLEBS VRY CALC.
938							943.8-945.6 OIL SH TAN TO BR. VRY CALC.
939							945.6-948.4 OIL SH DK BR. NON CALC. w/SANDY TUFF BLEB @ 946.7
940							
941							
942							
943							
944							

CORE #8  
 CUT  
 60'  
 REL.  
 60.13'

10/7/77  
 O. REEVES  
 26-7

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
945							948.4 - 951.2 OIL SH DK BR W/TAN BLEBS
946							DISC. BEDDING SL. CALC.
947							
948							
949							
950							951.2 - 952.4 OIL SH TAN TO DK BR EVEN LAM.
951							952.8 - 953.8 OIL SH DK BR. VRY CALC
952							953.8 - 954.0 TUFF
953							954.0 - 958.5 OIL SH TAN TO DK BR EVEN LAM <sup>VRY</sup> CALC
954							W/SANDY TUFF BLEB @ 956.7
955							958.5 - 958.8 TUFF & OIL SHALE. (False Marker?)
956							958.8 - 963.5 OIL SH TAN TO BROWN CALC.
957							963.5 - 963.8 SANDY TUFF. (FALSE MARKER?)
958							963.8 - 964.9 OIL SH TAN TO GRAY SL. CALC.
959							964.9 - 969.0 OIL SH TAN TO BROWN VRY CALC.
960							
961							969.0 - 970.0 OIL SH BR TO DK BR SL. CALC
962							970.0 - 971.0 OIL SH BROWN VRY CALC.
963							971.0 - 975.2 OIL SH BR TO DK BR SL. CALC.
964							
965							
966							
967							
968							
969							
970							
971							
972							
973							
974							
975							975.2 - 976.7 WHITE - NON CALC. WITH BROWN SPOTS
976							Porous PYRITE BLEBS @ 976.5
977							976.7 - 977.4 OIL SH BR TO DK BR. SL. CALC.
978							977.4 - 981.45 shale, H grey - med bluish grey, highly calc. v. thin lam, high grade
979							981.45 - 986.05 ss. SVR 2/2, bed, <sup>massive</sup> fine grained, massive, slightly calc.
980							986.38 - 95 fix, closed, displaced bedding
981							986.43 - 44 lam ss SB7/1 v. fine grained, non calc.
982							986.05 - 986 oil shale, H grey - 10 YR 6/2, highly calc. v. thin
983							lam <sup>v. thin</sup> <sup>fine</sup> grained. SVR 2/2 w/ some minor high grade lam.
984			.79		CORE # 9		986.3 - .4 <sup>small</sup> <sup>fine</sup> ss. some filled w/ calcite 984.64 - 70 <sup>SS</sup> SB7/1 calc.
985							987.7 - 84 ss SVR 2/2 <sup>fine</sup> grained, massive, irregular bedding in bottom.
986							988 - 70 - 987.78 - fix w/ some gibbsite
987					CUT 60" REC		988.36 - 41.22 v. fine fix filled w/ calcite & gibbsite & pyrite
988							988.32 - .38 tiny vugs filled w/ calcite & pyrite in bedding direction
989							988.35 - 88.87 - tiny vugs filled w/ calcite <sup>fine</sup> <sup>int</sup> 986 - 994 grading into
990							marlstone, H grey - med grey, calc., v. thin lam, flecks pyrite, gib - Hc
991							
992							992.9 - 993.05 claystone, SB7/1 - SB5/1, non calc., massive
993							
994							994.61 - .65 vuggy, some partially filled w/ calcite

DEPTH	±MM	FRX	PP	CORE INDEX	CORE REC.	LITH.	DESCRIPTION
995		.66					995.66 - 998.20 - out frx, closed
996	90						
997							994-1005: <sup>SS</sup> siltstone 10VR4/2, slightly - nucleate, v thin lam, to
998							massive, "early" fracture
999							997.90-.92 - vuggy w/ some calcite filling
1000							998.01-.18 - ss, 5B7/1 - 5B5/1 v. fine grained, vuggy,
1001							nucleate. thin lam.
1002							1001-1002.05 - minor lam gilsbite 1002.08-.13 - tiny vugs filled w/ calcite
1003							
1004							
1005							1005.88-1006.31 inter-bedded siltstone (calc & ss 5VR3/2-5B5/1)
1006							nucleate, thin lam, sm, thin lenses pyrite
1007							1006.31-1008.54 ss. 5VR3/2 <sup>slightly</sup> nucleate. massive, fine grained
1008		.72					1008.54 - 1016 siltstone 10VR4/2 - 5VR3/4 nucleate.
1009							thin lam - massive, black pyrite
1010							1010.91-.96 vugs filled w/ pyrite.
1011							1011.21 - tiny vug filled w/ pyrite
1012							1012.06-.10 vug filled w/ pyrite
1013							
1014							1014.29 lam gilsbite 1014.43-48 - <sup>sm.</sup> vugs filled w/ pyrite 1014.76-1015.11
1015							sm vugs filled w/ pyrite 1015.68-72 vugs filled w/ pyrite
1016							1016 - 1020.61 siltstone calc w/ minor lam gilsbite &
1017							pyrite. 1016.26-.37 vugs filled w/ pyrite 1017.47-57
1018							& .90-.97 sm vugs, some filled w/ pyrite 1018.86 black pyrite
1019							1019.03-.11 sm vugs filled w/ pyrite
1020							1019.03-1021.0, Dolost. lt gr, non-calc. hard, dense
1021							1021.0 - 1030.0, Dolost. lt. Brn., Ext. Vuggy, some
1022							sulfides, pyrite & marcasite along vugs & pp.
1023							1030.0 - 1036.0, Dolost. AA. w/ heavy
1024							sulfides along fractures & parting planes
1025							vuggy w/ some sulfide filling of vugs
1026							sulfide predom. pyrites. Some lo-
1027							med grade oil sh. lam scattered
1028							last 3.0 ft.
1029							
1030							
1031							
1032							
1033		V.5					
1034							
1035							
1036							1036.0-1037. oil sh., med grade, Brown
1037							calc., hard, brittle. w/ v. minor vugs & seams. minor pyrite filling.

CORE #9  
CUT 60  
REC 54.9