CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

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AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 3, 1973

Memorandum to: W. L. Kurtz

From: F. T. Graybeal

Use of a Form for
Quantitative Geologic Logging

INTRODUCTION

The need for quantifying geologic observations is becoming increasingly apparent for proper interpretation of data within the framework of recent advances in the knowledge of zoning in porphyry copper deposits. This is particularly so for the deep targets where costs often permit one or only a few drill holes, emphasizing that the maximum amount of information should be obtained from the core. Use of semi-quantitative terms such as "some", "moderate", or "occasional" should be avoided wherever possible.

To this end I have modified a geologic log developed 12 years ago for the Imperial drilling program at Silver Bell which enables most geologic data to be recorded in a quantitative way but still permits lengthy description where necessary. The size of the new log has been somewhat increased and the columns left blank to provide maximum flexibility. Comments by J. D. Sell and S. R. Davis have improved the overall format.

The log form is drawn on mylar from which sepia prints are made. Logging is then done directly on the blank sepia in H pencil, and, when done with reasonable care and moderate pressure, will print a useable and permanent blue or black line copy. A pen can be used for a darker print; however, this makes erasures more difficult. The H pencil erases well, does not smear easily, and is rather permanent. The sepia will stand some wetting, but this should be avoided. Long exposure to sunlight darkens the sepia, but does not significantly alter the quality of the prints. The log folds to 8-1/2" wide and 11" high including a margin for binding in a report folder.

THE LOG

A blank copy of the drill log is attached to this memorandum. The depth intervals can be small or large according to the complexity of the geology and are selected to conform to the assay. The blank column to the left of ASSAY can be used for specific gravity, core size, assay averages, or whatever. Extra assay columns can also be used for assay averages, composite assays, or geochemical data. The units of the assay (%, oz., or ppm) can be written in at the top of the column. Notes such as the laboratory or method of analysis can be written in the blank area at the upper left of the log sheet.

Ore minerals are logged according to the volume % present. Where assays are available, the weight % metal is apportioned in the proper relative proportions in each mineral. If no ore mineral is seen (in the case of very low assays) this space is left blank. The initial volume % notation will give the proper ratio and also serves as a check on the assay. This generally involves erasing and emphasizes the preference for logging with a pencil.

Gangue minerals, including pyrite, are all logged in volume %. The type of occurrence can be illustrated by logging the amount disseminated and the amount in veins. This section can also be used for rock-forming as well as alteration minerals, for % of rock types in breccias or clastic rocks, or for % vugs in a breccia according to the particular needs of the project.

The structure columns are used when needed for such things as number and dip of veins, joints, fault zones, breccias, and shears to provide a somewhat graphic picture of their distribution. Additional space may be necessary under this heading, although no changes are presently contemplated.

Notations in the column for rock type and remarks are not limited to the line corresponding to a specific assay interval. Rather as much -- or as little -- space is used for features which are not easily quantified, such as depth of rock types and textural and paragenetic descriptions of rock types, alteration, mineralization, and structures. Summary comments for specific intervals concerning such things as alteration types or comparisons with other holes are also included here. For clarity the rock type names are capitalized and additional notes under a given heading are indented. The blank area to the right of REMARKS can be used for a diagrammatic lithologic log if the geologist so wishes.

The procedure at Silver Bell was to log rock type and structure before splitting and to make all gangue and ore mineral estimates after splitting. This enabled the geologist to see more freshly broken surfaces and probably permitted more accurate estimates to be made, although it was more time consuming. Again, the optimum procedure is up to the individual's needs.

DISCUSSION

The Silver Bell log permits a large body of data to be recorded on a single sheet without overcrowding. By quantifying mineralogy and, to a lesser extent, structure rapid determination of geologic changes can be made eliminating tedious searches for particular features. It also permits a rapid correlation of assays with the geology. In addition, the log forces the geologist to record all the features for every assay interval which is an advantage in complex rocks where certain facts may be unintentionally omitted from long descriptions. The log is also set up to provide a consistent record of the non-occurrence of specific features, an observation often not present in standard logs. Although quantitative in form the method of recording of data is sufficiently obvious so that no instruction in its use is necessary. Finally, a singular advantage is that use of this form eliminates the need for copying or typing.

Certain disadvantages are also present. Care must be taken to keep the log neat, although I find this does not noticeably lengthen the time spent writing. The logs are large and can't be carried in a normal clipboard, making them difficult to have at hand in remote areas where logging may suddenly be necessary -- too bad. Finally, the soft pencil needed for maximum reproducibility requires frequent sharpening. Diazo mylar logs which give better prints and are more durable than sepia are far more abrasive to the pencil and good blank prints from the original tracing are said to be harder to obtain than sepias.

I am convinced that the advantages of this log far exceed the disadvantages. Data of use to the milling department were recently obtained from the Silver Bell logs and would not have been available from a conventional log form. Zonal changes in alteration mineralogy and sulfide occurrence in the recently completed TR-10 are very clearly evident upon brief examination even to those unfamiliar with the project.

A somewhat similar approach was recently suggested by P. H. Blanchet and C. I. Godwin (Econ. Geol., 1972, p. 796-813). Their logging system is set up to record data in a format suitable for key punching and computer analysis. The suggested form is very comprehensive although it does not provide the flexibility of the Silver Bell log and is almost useless for one not intimately familiar with the format and notations used. Logging using their format is apparently quite slow as they remark that with experience and under good conditions a speed of 1 ft./minute is possible.

In the initial stages of a drill project and for those projects with relatively fewer holes, such as the deep targets, I feel the Silver Bell form is more flexible, faster, and requires far less instruction than the form suggested by Blanchet and Godwin. In addition, visual interpretation of data and initial construction of zoning patterns from a few drill holes is probably more usefully done by hand due to the intuitive nature of the interpretation. The computer format appears to be useful particularly for the detailed study of a mineral deposit once it has been located and its limits and characteristics have been well defined. The Silver Bell form allows greater flexibility, making it more suitable for exploration for and delineation of a mineral deposit and is, therefore, believed to be the more practical of the two.

F. T. Graybeal

FTG:lab
Attach.

GEOLOGIC LOG

PROJECT____________

PROJECT____________ HOLE NO.________
Collar elev.________ Final depth________
Coord N.________ Coord E.________
Inclination________ Page____of____
Logged by________
Date start________ Date finish________

DEPTH			% CORE RECOV.	ASSAY	ORE MINERALS	GANGUE MINERALS	STRUCTURE	ROCK TYPE and REMARKS
from	to	int'vl						

mn 2555 dm

J.H.C
JUN 30 1969

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 27, 1969

Mr. J.H. Courtright, Supervisor
Exploration Department
B U I L D I N G

Core Board Preparation
at the Sacaton Project

Dear sir:

It was felt that the experience obtained in making core boards at the Sacaton Project should be summarized in the event that future drilling projects could use this information. An additional reference to this subject can be obtained from a report written by yourself and Mr. Kenyon Richard titled, "Drilling and Sampling, Mission (East Pima) and San Xavier projects, Pima County, Arizona."

N.P. Whaley and R.H. Luning supervised the core board preparation on the Sacaton Project.

Very truly yours,

Sergei E. Zelenkov

Sergei E. Zelenkov

SEZ:lzb
Encl.

cc: NPWhaley

CORE BOARD PREPARATION

PHOTOGRAPHS

No. 1 Core Boards

No. 2 Sheet Metal Boats

No. 3 Screens

ATTACHMENTS

Figure 1. Core Boards

Figure 2. Core Board Blank

CORE BOARD PREPARATION AT THE SACATON PROJECT

Supplies:

PAINTS: All of the painting was done with the standard pressurized spray can. A white appliance paint was needed to finish any un-used parts of the core board. Krylon clear plastic spray was used to protect any lettering or numbering on the core board.

LETTERING GUIDES: Rapido lettering guides were used. The project name used 3/16 size. Assay intervals and assay values used 5/64 size. The rest of the lettering (diamond drill hole No., core fragments, core concentrate, and depth and copper values) used 1/8 size. See Figure 1.

PENS: Two sizes of rapidigraph pens were used. The title used size one and a double "0" was used for everything else.

GLUE: The fragments and core concentrates were glued with Duratite formula 65A household cement. This is a very fast drying glue.

TAPE: Masking tape was used to protect portions of the core board during the gluing and painting steps.

T-SQUARE: A home-made T-square was used to draft the horizontal lines onto the core board. The use of the T-square enhanced the appearance of the finished product and decreased drafting time.

FRAGMENT BOATS: Crushed core fragments are dried in these trays. See photograph No. 2.

CORE BOARDS: Preiningers cabinet shop in Tucson made the white pine core board blanks which measured 48" x $3\frac{1}{2}$" x 7/16". See Figure 2. Each core board was painted white on all of its sides with the exception of the face side. The core board face was painted completely for the first three inches from the top, and then a 1-3/16 strip was painted on the right-hand side.

SCREENS" Three screen sizes were used (a $\frac{1}{4}$" screen, a household strainer, and a 24 Tyler mesh screen). See photograph No. 3. The large fragments were obtained either by hand picking the fragments retained on the $\frac{1}{4}$" screen or by hand sorting the minus $\frac{1}{4}$" fragments retained on the household screen. It was found that the plus $\frac{1}{4}$" fragments gave a better view of the rock texture and allowed a better distribution of the intermediate sized fragments on the board. The intermediate fragments were those particles that passed the household screen but were retained on the 24 mesh screen. The fine fragments were the panned sample that passed the 24 mesh screen.

Sample Preparation:

A Jones splitter should be used, time permitting, to get a representative sample. The sample should weigh from one-half to one pound. The following procedure was then followed:

Sample Preparation, cont'd.

A) Coarse fragments: The sample from the coarse reject was screened in a large tub of water using a $\frac{1}{4}$" screen. The fragments that passed through the $\frac{1}{4}$" screen were caught in a pan. The plus $\frac{1}{4}$" particles were hand selected and the rest of the sample was rejected. The retained sample was placed in the sheet metal boat to dry.

B) Intermediate fragments: The minus $\frac{1}{4}$" fragments were screened in a tub of water using a household screen. The fragments retained on this screen were rejected; and the remaining sample was screened again in water using the 24 mesh Tyler screen. The intermediate fragments were retained on this screen.

C) Fine fragments: The fine fragments that passed the 24 mesh screen were panned to a concentrate weighing about three grams. For the Sacaton samples, a well panned concentrate would not dry with a hard crust on it. In other words, most of the clay would be washed out.

D) Comments: After the sample was prepared for each interval and placed in the sheet metal boat to dry, an identification tag was placed in the boat with the hole number and interval it represented. See photograph No. 2.

Core Board Procedure:

To facilitate matters for assemblying core boards, the procedure will be explained in a step by step format.

A) List all the intervals with their respective copper values (sulfide and non-sulfide values) which are to be drafted onto the core board. Check the intervals.

B) Scale off all the intervals using a black dot to mark each interval. The starting point for the first interval should be $2\frac{1}{2}$" from the top. See Figure 1. The scale is 1"=10'. A total of 435 feet can be put on each board, which will allow $1\frac{1}{2}$" at the bottom of the board.

C) Using a T-square ink in a horizontal black line at each dot mark.

D) Ink in the numerical ending point of each interval in black and the total copper assay value and oxide value in red. See Photograph No. 1. One-half inch gap was allowed above the initial starting point of the first interval to be drafted.

E) Ink a red ore intercept line (+0.40% Cu) on the right-hand side of the board. See Figure 1.

Core board procedure, cont'd

F) Ink in "No Recovery" on the intercepts where a sample was not obtained, and draft "Continued" after the bottom intercept if more than one core board is required, or, else, draft "Bottom" if only one core board is made.

G) Mask all unpainted areas and spray on "Krylon Clear Plastic Spray" over all lettering and numbering. Allow plastic to dry.

H) Remove masking tape put on in step "G" with the exception of the "No Recovery" areas. Draft a penciled line (11/16" wide) defining the column for the core concentrate zone. See Figure 1.

I) Mask all painted areas bordering unpainted surfaces.

J) Put a liberal amount of glue on the first "Core concentrate" area and sprinkle the panned fines over the glue.

K) Dump the excess fines off board and trim up the boundaries with a razor blade before the glue dries.

L) Put a generous quantity of glue on the first "Core Fragments" zone. Set the large fragments on the board; and then fill in the remaining spaces between the large fragments with the intermediate particles by sprinkling them over the remaining exposed glue. Dump the excess material off the board and trim the boundaries with a razor blade before the glue dries.

M) Repeat steps J, K, and L for the remaining intervals. Leave $1\frac{1}{4}$" at the bottom of the core board, if possible so it will fit into a storage rack without damaging the glued fragments.

N) Write the project name, hole number, and the board number in ink on the left edge of the completed core board so it can be identified in a storage rack.

P) If the completed core boards are to be hung in a rack, install a hook at the top of the board. See Figure 2.

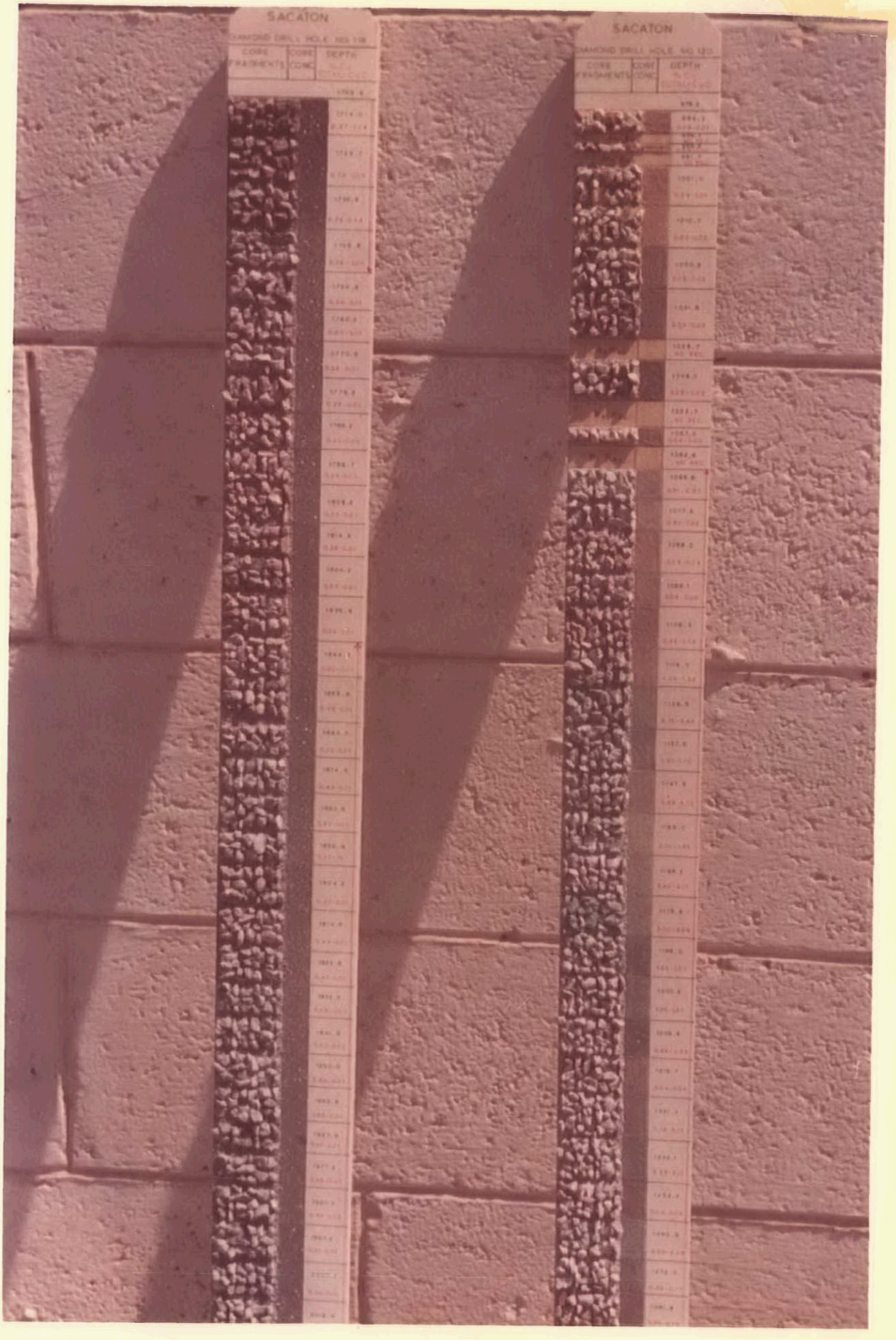
Q) If the completed boards are to be shipped, place two of them face to face with a NX block at their tops and bottoms, and tape them together with masking tape.

Comments:

The Sacaton core board technician spent a week at the Silver Bell Unit studying their method of making core boards, and then he spent another week experimenting with a practice core board. The purpose of this report was to provide a system in the initial stages of a program, thereby saving time and enhancing the appearance of the first sets of finished core boards.

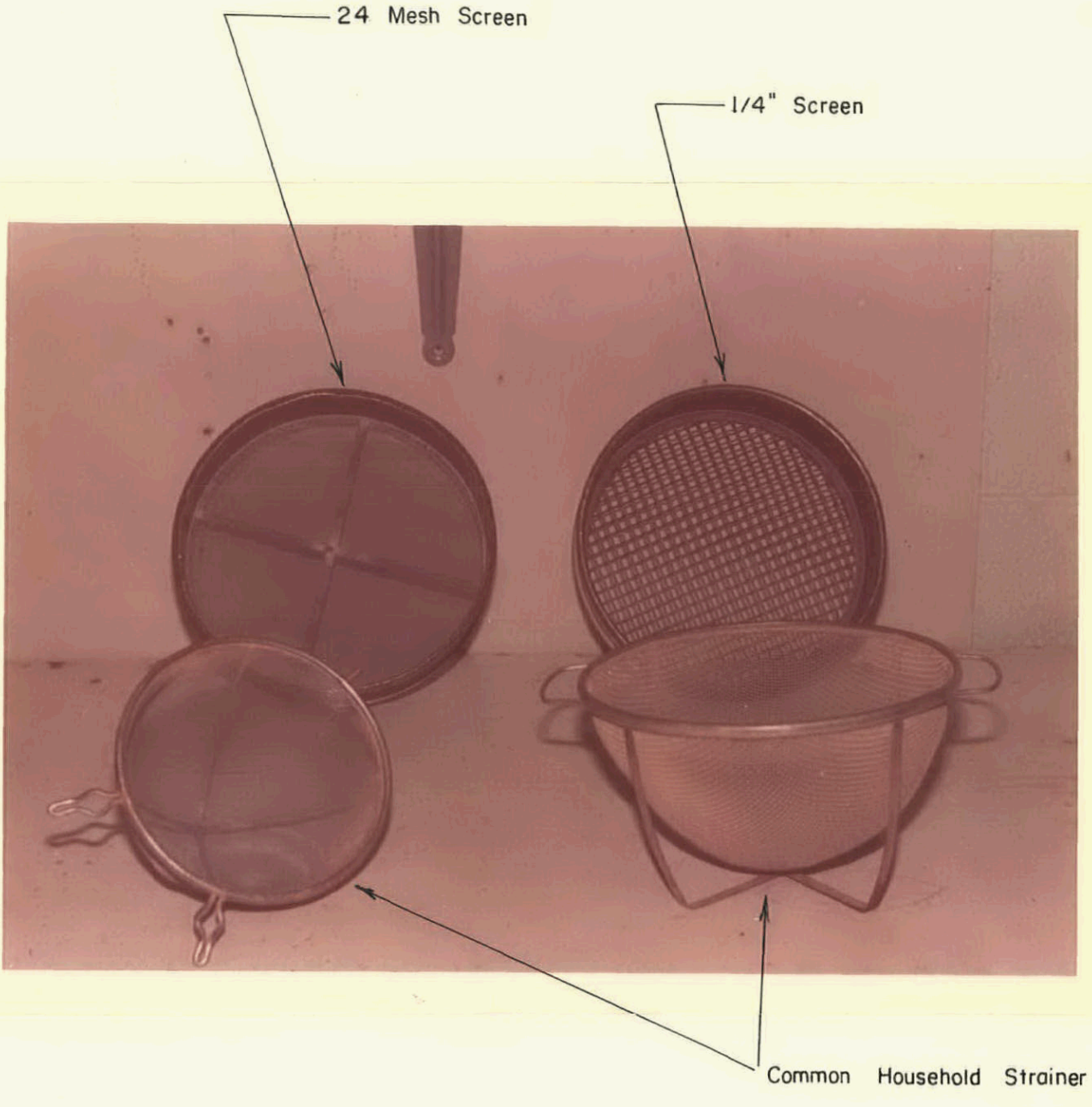
SEZ:lzb

S.E. Zelenkov



CORE BOARDS

SHEET METAL BOATS



SCREENS

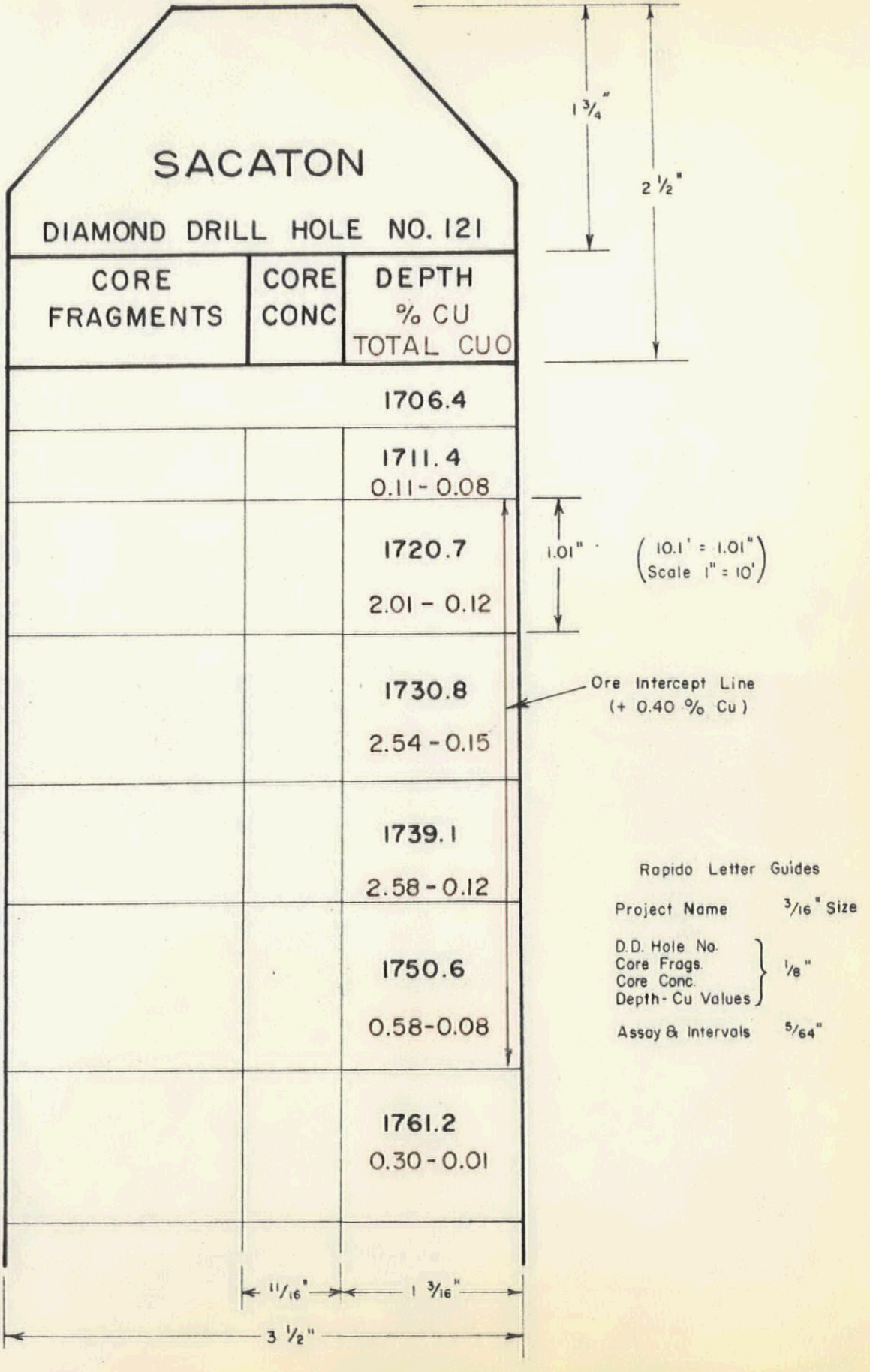


FIGURE 1 CORE BOARD

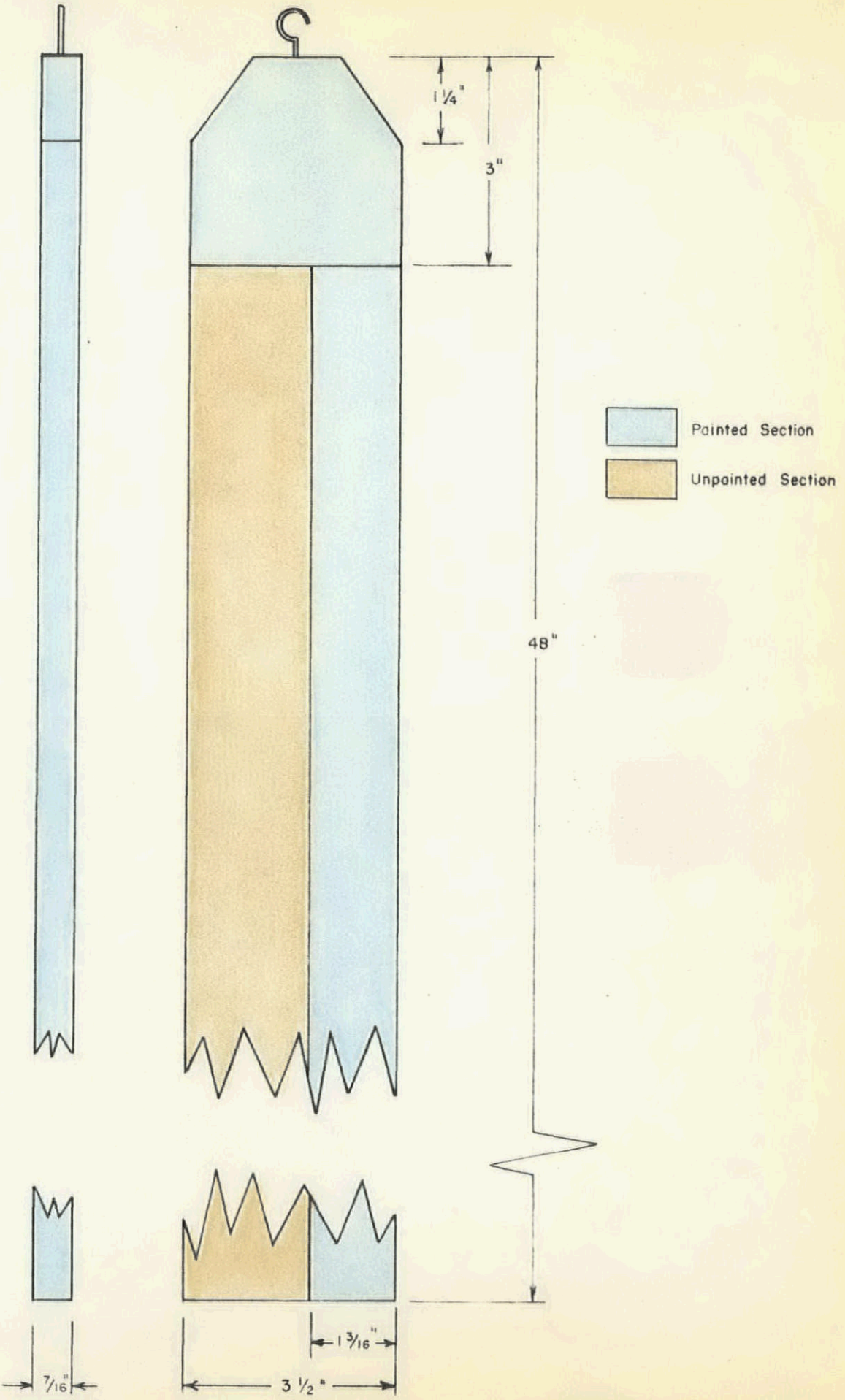


FIGURE 2 CORE BOARD BLANK