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INCREASING BOREHOLE LOGGING EFFICIENCY AT THE PAILAS GEOTHERMAL FIELD - A RECENTLY DESIGNED DIGITAL BOREHOLE LOG DATA SHEET USING MICROSOFT EXCEL

Hakanson, Edward Charles

Instituto Costarricense de Electricidad
Centro de Servicio Recursos Geotérmicos
Guayabo de Bagaces
Guanacaste, Costa Rica

e-mail: Echarles@ice.go.cr

ABSTRACT

Up until recently all of the borehole log data compiled at the Pailas Geothermal Borehole Field (rate of penetration, weight on bit, mud temperature, pump pressure and revolutions per minute) were taken down manually from daily borehole drilling parameter sheets prior to being copied to the log sheets (previously taken down by hand) and then transferred by hand to 60 cm x 150 cm strip sheets maintained on site during the drilling process of the well. A hand drawn lithologic column accompanied by a column for the lithologic description of the rock cuttings and an additional column for added comments was included on the log sheet. Upon well completion the borehole log data was sent to an AutoCAD technician to be redrawn which commonly led to confusions regarding penmanship. Also, delays in the completion of the final document caused by numerous revisions of the AutoCAD copy resulted in extremely long turn-around times between borehole and data log sheet completion.

To help speed up the process of the borehole log data sheet completion, all well drilling parameter data is now recorded electronically in a Microsoft Excel data sheet which follows the same format as the previously used hand drawn log sheets. Additionally, a PC unit on the rig floor is used to directly enter well parameter data. This data is copied to a flash disk and transferred to a PC unit in the Geology Trailer where it is incorporated into the digital well data log sheet.

This document discusses how this well log data sheet in Excel was created and how it's implementation has increased efficiency at the well site as well as in the office.

INTRODUCTION

The Pailas Geothermal Field is located on the southern face of the Quaternary age Rincón de la Vieja volcanic complex in northwestern Costa Rica. The developed part of the field is about eight kilometers squared (Figure 1). Since 2009 this field has become the first borehole field in the country to employ directional drilling (Hakanson et al 2011).

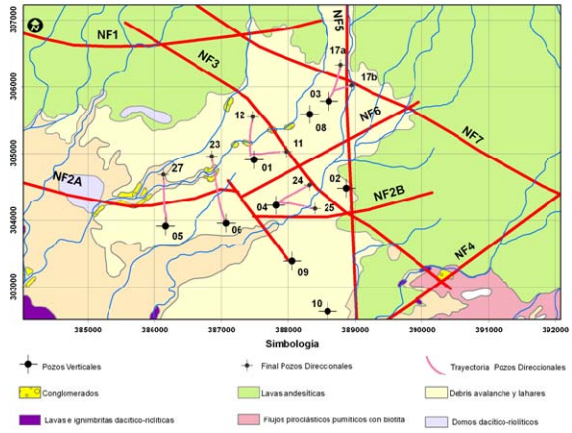

Figure 1: Pailas Geothermal Borehole Field (Geologic base map from the Centro de Servicio Recursos Geotérmicos with the structural model proposed by WestJEC 2010).

The geologists job at the wellsite includes more than just describing at rock cuttings. Among the many duties there are, co-ordinating well casing depths based on lithological data, recollection of mud logging parameters, one-on-one contact with the tool pusher and drilling engineer, report writing, sample selection for laboratory analysis and more recently, collaboration with the directional driller, as well as

filling out a borehole log data sheet. The borehole log data sheet is considered as the primary source of information regarding geological activity and interpretation at the wellsite and forms an integral part of the official documentation produced by the geologist. Therefore it is imperative that later geological documents be consistent with it. More efficient logging at the wellsite is beneficial to the geologist and all co-workers. For many years, lithologic descriptions, drilling parameters and mud logging data were hand plotted on large cumbersome 60 cm by 150 cm borehole log sheets which were later given to an AutoCAD technician to be drawn up for final submission as an official document (Figure 2).

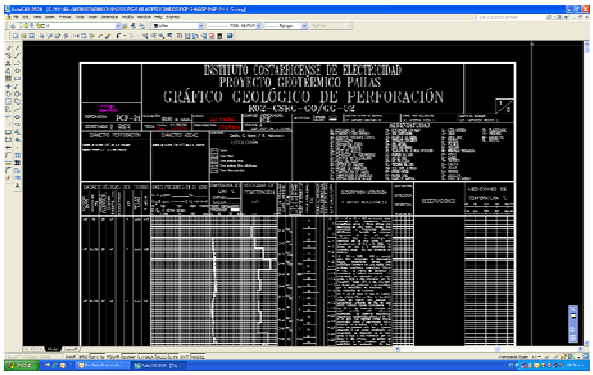

Figure 2: Screen capture of the borehole data sheet drawn up in AutoCAD.

Experience has shown that the turn-around of these log sheets can be very long and therefore a faster way of creating the borehole log sheet was designed so that the geologist can fill it out at the wellsite and then have it printed out on a plotter for revision without having to wait for it to be drawn up in AutoCAD. Once revised and corrected by the geologist, the digital log sheet is saved as a pdf file and submitted as an official document. This new methodology has increased the turn-around time of the log sheets many-fold, thus making it possible to have the final document completed in less than one month after borehole completion.

SOFTWARE USED

Using Microsoft Excel a template has been created which follows the same layout as the previously used borehole log data sheets. The template is easily filled out by simply entering the values for each of the mud logging parameters, temperature, and drilling parameters. Additionally, line graphs, bar charts and lithologic symbols are simply drawn on the template where needed (Figure 3).

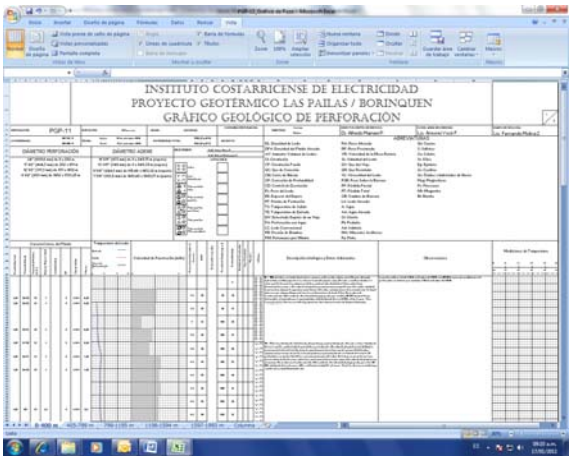

Figure 3: Screen capture of the template designed in Microsoft Excel for entering downhole logging parameters.

On the rig floor an additional PC unit is also installed to record drilling parameters using Microsoft Excel. This data can be copied to a flash disk and either printed out or opened up and copied into the digital borehole log sheet in the geology trailer. Lithologic descriptions are still done by hand while observing the rock cuttings and cores, however this information is easily transferred into the digital log sheet and then remains available to copy and paste into future reports and applications, thereby reducing re-typing of information.

Each sheet of the digital borehole log covers 400 meters of downhole data. Once a sheet is completed it can be saved as a pdf file and sent to the plotter for printing at the established dimensions of 60 cm by 150 cm so that it can be reviewed cautiously and all changes/corrections can be directly inserted into the original Excel data sheet. Once corrections are made the final draft is once again saved in pdf format and sent to the plotter so that a required number of hard copies can be printed out and then the digital copy remains on file (Figure 4).

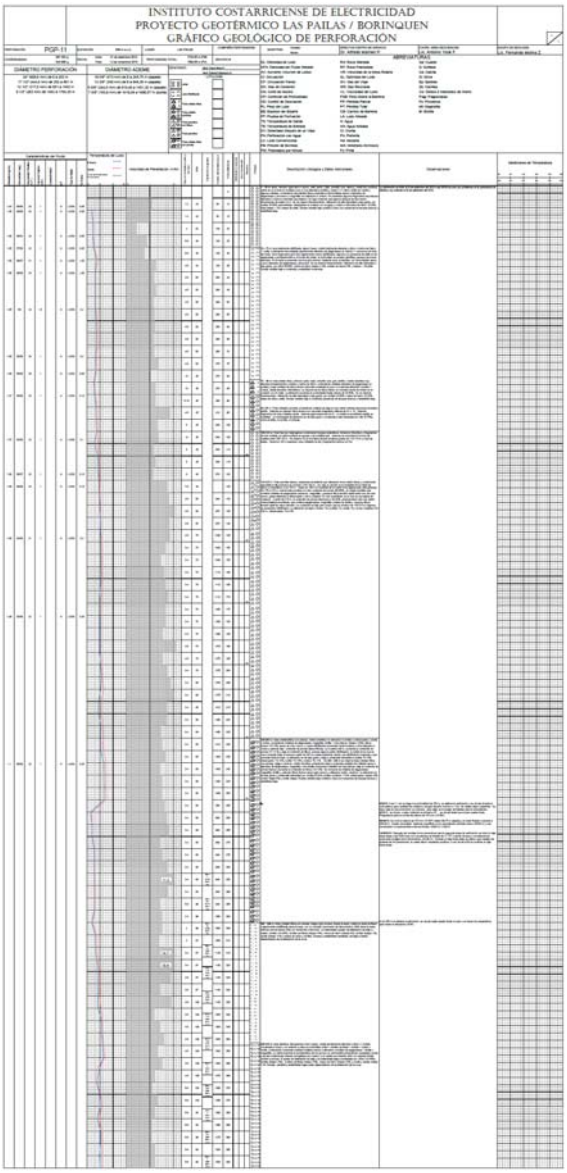

Figure 4: View of a completed digital borehole log sheet saved in pdf format covering 400 meters depth.

Using a different sheet in the same Excel file a lithologic column can be constructed during the drilling process and used in bi-weekly well update reports (Figure 5).

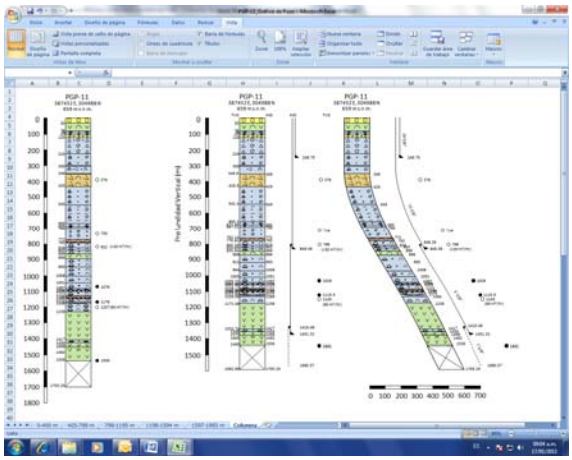

Figure 5: Screen capture of lithologic column construction utilizing Microsoft Excel.

FINAL COMENTS

The borehole log data sheet is an official document produced by the wellsite geologist and includes lithological, mudlogging, and drilling parameters. Although the type of data recorded in these parameters has changed little over the years, data manipulation has been facilitated with new technologies.

With Microsoft Excel it was possible to generate a template nearly identical to the previously used borehole log data sheets at the Miravalles and Pailas Geothermal Fields.

Microsoft Excel is a program common to nearly all users of Microsoft-based software and therefore does not require special licensing or training and can be found on almost any computer.

The advantages of filling out the borehole log data sheet electronically are many-fold: 1) it eliminates the need to hand copy well parameter data (thus reducing the probability of human error); 2) it speeds up the revision process; 3) it facilitates a faster and more coherent completion of daily and bi-weekly geological well update reports and 4) it makes it easier to maintain consistency between the borehole data log sheet and later geological documents and reports related to the well. Furthermore it eliminates the need to redraw the entire well log data sheet once the well is completed.

Digitizing these data has the additional benefit of easier data transfer to an in-house ArcGIS database.

With only a small amount of practice the average user can fill out this digital borehole log sheet intuitively.

Due to the versatility of Microsoft Excel, the methodology presented in this document can be applied to boreholes in any type of exploration activity (geothermal, water wells, mining, petroleum and even natural gas).

There is still much to be improved in the borehole drilling industry and new technologies along with innovative ideas will continue to increase efficiency in all aspects of work at the wellsite.

REFERENCIAS

Hakanson E. C., Gálvez Orellana M., Mora Protti O., & Rojas Barrantes M. (2011) Directionally Drilled Wells at the Pailas Geothermal Field, Supporting Geological and Structural Data for the Geothermal Model. PROCEEDINGS, Thirty-Sixth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 31 - February 2, 2011