

**DISEÑO DE UN PROGRAMA COMPUTACIONAL PARA LA EVALUACIÓN DE
FORMACIONES PETROLÍFERAS MEDIANTE PERFILES DE POZO ABIERTO**

JOSE ORLANDO JARA CESPEDES

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**TRABAJO DE GRADO PRESENTADO COMO REQUISITO PARA OPTAR AL
TITULO DE INGENIERO DE PETROLEOS**

**DIRECTOR:
FREDDY HUMBERTO ESCOBAR MACUALO
INGENIERO DE PETROLEOS
P.h. D. YACIMIENTOS**

**UNIVERSIDAD SURCOLOMBIANA
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NEIVA
2007**

Nota de Aceptación

Presidente del Jurado

Jurado

Jurado

Neiva Agosto de 2007

A los que enseñan sin hablar, a los que no rehusan su ayuda cuando Todos los seres actúan, a los que Producen sin apropiarse del resultado, A los que trabajan sin esperar nada, a los que realizan obras meritorias sin vincularse a ellas, y que justamente porque no se ligan a ellas, subsisten.

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Sensei: Michelle Laserre. “Mi padres me han dado un cuerpo y una educación, mi maestro ha hecho de mí un hombre”....Proverbio Japonés

A los familiares, compañeros y amigos que de una u otra forma hicieron posible la realización de este proyecto.

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RESUMEN

Este trabajo de grado tiene como objetivo, la realización de un programa de computador, para el análisis de perfiles de pozo abierto, utilizando el programa Visual Basic 6.0 (VB6), que es un ambiente gráfico de desarrollo de aplicaciones para el sistema operativo Microsoft Windows. Las aplicaciones creadas con Visual Basic están basadas en objetos y son manejadas por eventos, que permiten generar una interfaz amigable con el usuario, En VB6 fueron incorporadas las ecuaciones para calcular diferentes Variables (Porosidades, Saturaciones, Resistividades, etc.) a partir de registros de pozo, en forma de archivo plano con extensión “.txt” ó “.LAS”. El programa así generado presenta los resultados de manera gráfica para un mejor manejo y entendimiento de los mismos, partiendo de que una imagen vale mas que mil palabras; para la presentación óptima de los gráficos fueron utilizados componentes externos relativos al VB6 llamados CHART2D.

COMPUTATIONAL PROGRAM DESIGN FOR THE EVALUATION OF OIL FORMATIONS WITH OPEN HOLE LOGS

José Jara Céspedes

ABSTRACT

The main purpose of this work consist of designing a computer program, for the interpretation of well log data, using Visual Basic 6.0 (VB6) program, that it is a graphic atmosphere of development of applications for the Microsoft Windows operating system. The applications created with Visual Basic are based on objects and they are managed by events, which allow, to generate a friendly interface with the user, In VB6 there were incorporated the equations to calculate different variables (Porosities, Saturations, Resistivities, etc.) from well logs in plane files with extensions “.txt” or “.LAS”. The program this way generated shows the results in a graphical way for a better handling and understanding, starting from the idea that an image is worth that a thousand words. For the better presentation of the graphics, external components were used, related to VB6 called CHART2D (from Componentone).

INTRODUCCION

Visual Basic se deriva del lenguaje Basic, el cual es un lenguaje de programación estructurado, sin embargo, Visual Basic emplea un modelo de programación manejada por eventos. Un evento es una acción reconocida por los objetos (bloques básicos de construcción de una aplicación con Visual Basic) y este ocurre o se dispara como resultado de la interacción del usuario con el objeto por ejecución del código o por llamado del objeto a partir de otra sección del código. Una parte esencial de la programación manejada por eventos es la inscripción de códigos que respondan a los posibles eventos que pueden ocurrir en una aplicación.

El programa que acompaña este documento, programa denominado B.O.H.A. (**B**asic **O**pen **H**ole **A**nalyzer) se ocupa de los principales registros well-log en hueco abierto, calculando con ellos los parámetros posibles, utilizando la información suministrada del pozo. De manejo fácil y amigable para usuarios con un nivel básico de perfilaje de pozos, sirviendo de práctica a estudiantes y como posible herramienta de trabajo para los profesionales.

Los diferentes cálculos y ecuaciones fueron ingresados de acuerdo al código que reconoce VB6, ejecutándose sus diferentes secciones en respuesta a los diferentes eventos proporcionados por el programa y el usuario. Fueron utilizados varios registros ejemplo de diferentes pozos garantizando así su confiabilidad; estos ejemplos son dados junto con el programa.

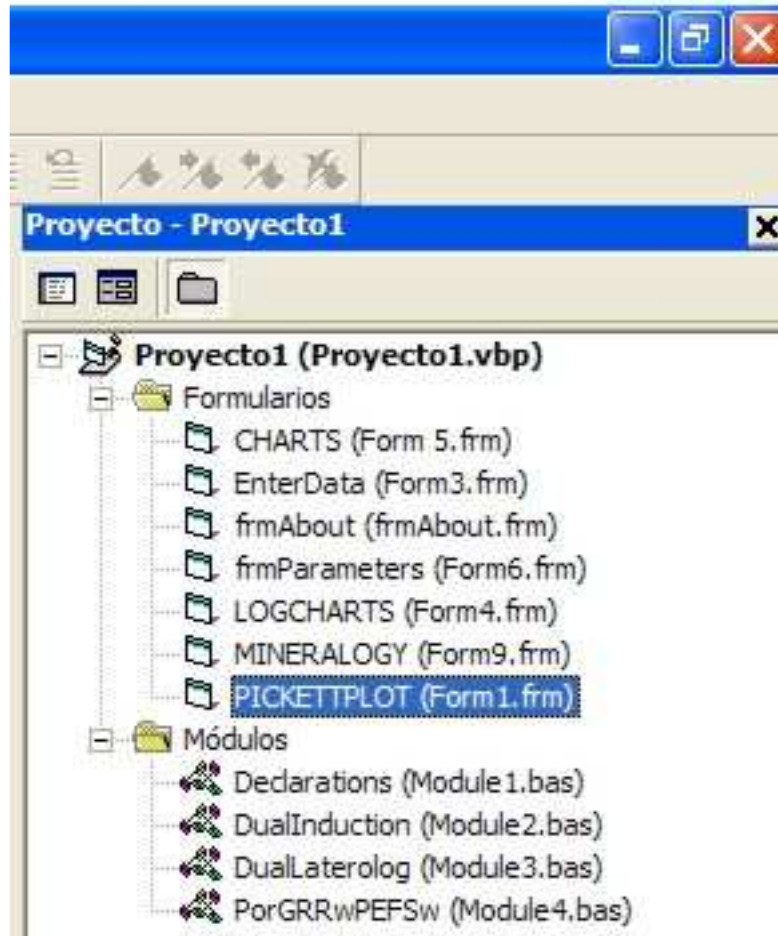


Figura 3. Explorador de Proyectos

La presentación de las pistas (tracks) de datos obtenidos de los archivos de pozo, así como las pistas (tracks) de resultados y demás gráficos, fueron distribuidas en las siguientes pantallas:

1.1 Pantalla de Entrada (ENTER DATAFILE AND PARAMETERS)

En esta pantalla se carga el archivo en el cuadro de fondo azul claro que aparece en la parte izquierda de la pantalla, previamente debe seleccionarse la unidad y la carpeta donde se encuentran los archivos a ser cargados. Mediante un doble-click en el archivo a ser analizado o mediante la selección del menú: **FILE** submenú: **Load File** el programa carga el archivo. Una vez cargado, este se visualiza en el cuadro de texto de fondo azul claro donde el usuario puede ver su contenido. A continuación el usuario puede brindar la información básica para que el programa corra sin problemas o bien puede utilizar los valores ejemplo dirigiéndose al menú: **PARAMETERS** submenú: **Example Parameters** o bien tecleando: **Ctrl.+E**

Sin salir de la aplicación, el usuario, si lo desea, puede cambiar de archivo acudiendo al menú: **FILE** submenú: **Change File** ó bien tecleando: **Ctrl.+C**; una vez realizada esta acción, el programa muestra el listado de archivos nuevamente, permitiendo cargar el archivo que se desee.

1.2 Pantalla de Registros (LOG DATA FROM FILE)

En esta pantalla a la cual se puede acceder, desde el menú **GRAPHICS** submenú: **To Log Data Screen**, muestra en forma gráfica, a modo de pistas (tracks), los registros que el programa reconoce después de haber cargado los datos; también muestra, si el usuario lo desea, los registros corregidos accediendo al menú: **DATA** submenú: **Get Data Corrected**.

El programa permite al usuario cambiar el rango de datos visto en las pistas (tracks) siguiendo la ruta menú: **DATA** submenú: **Change Tracks Range**, mostrándose en la parte superior de las pistas (tracks), un cuadro de texto en el cual aparece la cantidad de pies visibles en la pista, en el cual se puede colocar la cantidad de pies que desee ver por pista. Para poder desplazarse por el registro debe utilizarse la barra de desplazamiento vertical en la parte izquierda de las pistas. Si el usuario desea ir a las demás pantallas de visualización, puede hacerlo dirigiéndose al menú: **GO** y seleccionar la pantalla que desea observar.

1.3 Pantalla de Resultados (RESULTS)

Esta pantalla aparece al acceder al menú **GRAPHICS** submenú: **To Results Screen**, En ella se muestra a manera de pistas (tracks) las variables que el programa es capaz de calcular, también permite cambiar el rango de datos visualizado, de igual forma que la Pantalla de Registros y permite también ir a las demás pantallas de visualización.

1.4 Pantalla de Crossplot de Pickett (PICKETT CROSSPLOT)

Se accede a esta pantalla por el menú **GRAPHICS** submenú: **To PICKETT PLOT**. Aquí se disponen en puntos los datos, según el rango seleccionado por el usuario en un plano log-log de tres intervalos por dos intervalos logarítmicos.

Esta pantalla permite:

- Punteo de tres diferentes relaciones de datos que son: R_t versus $D_t - D_{tma}$ (Res. Profunda contra diferencia velocidad matriz -registro sísmico); R_t versus $P_{ma} - P$ (R_t contra diferencia Densidad matriz – Registro Densidad); R_t versus Porosity (R_t contra Porosidades).

- En el recuadro "Ranges", cambiar el intervalo de datos a ser punteados, así como seleccionar los intervalos de los ejes del plano para visualizar mejor los datos.
- En el recuadro "LINE GENERATIONS" seleccionar la casilla "Make Line" para visualizar una línea recta que empieza y termina en los valores indicados en los cuadros de texto: X1,Y1,X2,Y2 que son las coordenadas que corresponden a los puntos extremos de la recta, para así poder definir el exponente de cementación "m" y la resistividad del agua "Rw", según el principio del Cross Plot de Pickett.
- Ir a las demás pantallas, seleccionando el menú: **GO**.

1.5 Pantalla de mineralogía (POROSITY MINERALOGY)

A esta pantalla se puede acceder desde el menú **GRAPHICS** submenú: **To MINERALOGY**. Sirve para puntear las relaciones mineralógicas según el intervalo de profundidad seleccionado. Esta pantalla permite:

- Puntear las relaciones Bulk Density versus Sonic (RHOB contra DT ó DTSC); Bulk Density versus Neutron Porosity (RHOB contra OCNL ó NPHI); Sonic versus Neutron Porosity (DT ó DTSC contra OCNL ó NPHI).
- Seleccionar el gráfico sobre el cual se haga el punteado según las características del lodo.
- Fijar el intervalo de profundidad a ser punteado.
- Observar en los cuadros de texto del recuadro "POSITION" la posición del puntero del mouse sobre la imagen.
- Ir a las demás pantallas, seleccionando el menú: **GO**.

(Los gráficos sobre los que se puntea, son cartas de mineralogía de HALLIBURTON)

1.6 Pantalla de Parámetros (PARAMETERS)

Esta pantalla es un factor común a todo el programa, a la cual se puede acceder desde el menú: **PARAMETERS** submenú: **GENERAL PARAMETERS**, o a partir de cualquiera de las pantallas de gráficos. Con 6 categorías que son: GAMMA RAY, Rw, RESISTIVITIES, SONIC POROSITY, DENSITY POROSITY, Sw; cada una con factores propios que afectan los cálculos que realiza el programa, según la categoría en que se encuentren.

Estas pantallas (en especial: **RESULTS**) muestran resultados con las respectivas correcciones ambientales necesarias para validar sus cálculos; así las porosidad sónica viene corregida por grado de compactación, volumen de shale y fluidos, la porosidad neutrón y densidad por volumen de shale. Los registros resistivos son corregidos en orden: por efecto de pozo, efecto de espesor de capa y efecto de invasión. El registro Gamma Ray viene corregido por diámetro, posición de la herramienta y por densidad de fluido. Lo anterior ratifica al programa como una herramienta bastante completa y de mucha aplicación en el análisis de registros de hueco abierto.

2. ASPECTOS IMPORTANTES

La corrección de los datos fue realizada utilizando las cartas de corrección propias de las compañías Halliburton y Schlumberger, estas cartas en su mayoría son curvas a las que se entra con un valor predeterminado por uno de sus ejes para luego de cortar la curva correspondiente, leer el valor de corrección y corregir el dato inicial. El programa hace esto mismo pero matemáticamente, se tomó cada carta, y se digitalizó mediante el programa **TableCurve2D** que nos brinda la ecuación que rige la curva. Estas ecuaciones fueron incorporadas al código del programa B.O.H.A. (**Figura 4**) y pueden verse en los anexos.

```
If CALI(z) >= 6 And CALI(z) <= 8 Then
Y = 1
' BoreholeRSFL6in y=(a+cx^(0.5)+ex+gx^(1.5)+ix^2)/(1+bx^(0.5)+dx+fx^(1.5)+hx^2) [NL] r2=0.999820713175622
a = 1.48887221922857
b = 0.942105071219304
c = 0.673938173811162
d = 8.59587029798681E-02
e = 9.75502701802669E-02
f = -2.15065352939582E-02
g = -1.98802522061927E-02
h = 1.51469646812899E-03
i = 1.35702380492523E-03
Y = (a + c * X ^ (0.5) + e * X + g * X ^ (1.5) + i * X ^ 2) / (1 + b * X ^ (0.5) + d * X + F * X ^ (1.5) + h * X ^ 2)
ytemporal = Y
' BoreholeRSFL8in y=a+b*lnx+c*(lnx)^2+d*(lnx)^3+e*(lnx)^4+f*(lnx)^5+g*(lnx)^6+h*(lnx)^7+i*(lnx)^8+j*(lnx)^9+k*(lnx)^10
a = 1.11689158685844
b = -7.23982671830298E-02
c = -9.60125151894221E-02
d = 0.177812423397739
e = -0.12404519987619
f = 4.83101876428329E-02
g = -1.14802893390662E-02
h = 1.69589266565039E-03
i = -1.51812258501314E-04
j = 7.53483965447775E-06
k = -1.59045407754261E-07
Y = a + b * lnx + c * (lnx) ^ 2 + d * (lnx) ^ 3 + e * (lnx) ^ 4 + f * (lnx) ^ 5 + g * (lnx) ^ 6 + h * (lnx) ^ 7 + i * (lnx) ^ 8 + j * (lnx) ^ 9 + k * (lnx) ^ 10
Y = ytemporal + ((Y - ytemporal) * ((CALI(z) - 6) / (8 - 6)))
End If
```

Figura 4. Ejemplo ecuaciones de curvas de corrección

Para ver todo el código, se puede ir por el **Explorador de Proyectos** a cualquiera de los tres módulos, por ejemplo, mediante doble-Click a **DualInduction(Module2.bas)** puede verse, el código que contiene (**Figura 5**) y observar cómo son programadas estas correcciones mediante las ecuaciones de las curvas. Para poder ver todo el código es recomendable dirigirse al programa sin compilar.

```

Option Explicit

'*****BOREHOLE CORRECTION*****
'*****RSFL*****
' la primera corrección es por efecto Borehole en RSFL, se corrige aquí usando la carta Rcor-1 de Schlumberger
' "Log Interpretation Charts" 1985 page 60, de esta carta solo fueron extraídas las curvas asumiendo herramienta
' centrada puesto que son las mismas teniendo standoff para valores hasta de 12in hole
' First correction is for Borehole effect Dual induction runs with RSFL, this log is corrected here using the Rcor-1
' chart from Schlumberger "Log Interpretation Charts" 1985 page 60, from this chart was extracted only curves with
' the tool centered because data remains almost the same for hole smaller than 12in existing an 1 1/2 in standoff
Public Sub CalcRSFLBoreholeCorrections()
'x=RSFL/Rm y= RSFLCorr/RSFL equivalencias de x e y

Dim a As Double, b As Double, c As Double, d As Double, e As Double, f As Double, g As Double, h As Double, i As Dou
Dim j As Double, k As Double, l As Double, m As Double, n As Double, o As Double, p As Double, q As Double, r As Dou
Dim s As Double, t As Double, Y As Double, lnx As Double, ytemporal As Double

For z = 1 To Cnt
ReDim Preserve RSFLcorr(1 To Cnt)

If CALICol = 0 Then
CALI(z) = BS ' Si no se tiene este registro utiliza el diámetro de broca o tamaño de hueco dado por usuario
End If

X = RSFL(z) / Rms
lnx = Log(X) / Log(2.718282)
If X < 1 And X > 10000 Then ' En caso de estar por fuera del rango de corrección de la carta
RSFLcorr(z) = RSFL(z)
GoTo read:
End If

```

Figura 5. Código del programa, módulo DualInduction (Module2.bas)

El programa B.O.H.A. solo responde a archivos planos de texto, en los cuales además de contener las columnas de datos, es importante, tengan una estructura de encabezado (**Figura 6**).

~A	DEPT	RILD	RILM	RSFL	SP	GR	NPHI
	15630.0000	2.0021	1.9197	1.5005	153.4000	38.8000	0.1470
	15631.0000	2.3834	2.1575	1.5620	150.5000	37.1000	0.1390
	15632.0000	2.6841	2.3618	1.6988	148.1000	37.1000	0.1210
	15633.0000	2.9674	2.5188	1.9413	146.1000	38.4000	0.1180
	15634.0000	3.0061	2.6082	2.1420	144.8000	41.2000	0.1180
	15635.0000	3.0236	2.6555	2.2981	144.1000	42.7000	0.1220
	15636.0000	3.0224	2.6307	2.3862	144.0000	43.3000	0.1250
	15637.0000	2.9632	2.6141	2.4159	144.6000	41.5000	0.1280
	15638.0000	2.8930	2.6129	2.3705	145.5000	37.1000	0.1260

Figura 6. Encabezados de los registros ejemplo

Primero debe ir el símbolo (~A) y luego los encabezados indicando a que tipo de registro corresponde cada uno, de acuerdo, a la siguiente convención (Estos encabezados representan los registros que el programa lee y procesa con sus unidades):

- DEPT (Depth F “pies”)
- RILD (Deep Induction OHMM “Ohmio.metro”)
- RILM (Medium induction OHMM “Ohmio.metro”)
- RSFL (Spherically Focused Log OHMM)

MSFL	(Micro Spherically Focused Log OHMM)
RLLD	(Deep Laterolog OHMM)
RLLS	(Shall Laterolog OHMM)
GR	(Gamma Ray GAPI unidades API)
OCNL	(Old Compensated Neutron Log V/V)
NPHI	(Neutron Porosity – Limestone V/V)
RHOB	(Bulk Density G/C3)
DRHO	(Density Correction G/C3)
DT	(Sonic Travel Time US/F)
DTSC	(Delta T – Short Compressional US/F)
PEF	(LDT PhotoElectric Factor B/V)
CALI	(Caliper IN)
SP	(Spontaneous Potential MV)
MIC1	(Microlog 1 Inch) micro inverso
MIC2	(Microlog 2 Inch) micronormal
RESTEMP	(Reservoir Temperature DEGF)

La cantidad máxima de columnas que el programa lee son 17 y como mínimo debe tener las columnas de profundidad y de Resistivos. Para mayor entendimiento ver cualquiera de los Archivos ejemplo (**Figura 7**).



Figura 7. Archivos ejemplo brindados junto con el programa

En ellos obsérvese también que dichos encabezados están debidamente posicionados sobre su columna de datos correspondiente, la primera columna de datos debe ser la de profundidad y debe estar separada del borde izquierdo tres (3) espacios (**Figura 6**).

3. GENERALIDADES DEL PROGRAMA

3.1 Limitaciones del Programa B.O.H.A.

Las cartas tornado, desde un principio del proyecto quisieron ser incorporadas al programa de forma matemática a través de la solución de un sistema de tres ecuaciones con tres incógnitas, utilizando el factor geométrico en función del diámetro de invasión, como se cita en el capítulo RESISTIVITY LOGS páginas 117-118 del libro de Saki Bassiouni, (1994), avalado por la SPE. Pero al realizar varios cálculos de prueba, resultó que tales funciones no predecían los valores de corrección de una carta tornado normal, ante tal problema se acudió en búsqueda de expertos que nos permitieran las funciones o relaciones reales, para generar las cartas tornado, acudiéndose a dos expertos: André Cayam (Halliburton) y Juan Nóbile (Schlumberger), ambos fueron muy claros respecto al tratamiento de las ecuaciones generadoras de las cartas tornado, al indicar que hacen parte de la producción intelectual de la compañía y por tal razón la misma había invertido mucho dinero en su desarrollo como para cederse a cualquier persona; incluso ambos comentaron que ni ellos mismos tenían acceso a tal información, solo podían usar su producción de datos.

Ante tal problema, la alternativa fue colocar la mayor cantidad de datos de cada carta tornado en un archivo que el programa pudiera llamar para comparar datos, y seleccionar entre estos, los datos de corrección más cercanos dentro del archivo. Estos aparecen en la carpeta de archivos sin compilar **(Figura 8)**



Figura 8. Algunos archivos de cartas tornado

No todas las áreas de las cartas tornado fueron tomadas en cuenta, por ejemplo, se tomaron los valores desde una relación $R_t/RILD = 1$ es decir, a partir de valores cuando la lectura de resistividad profunda es igual al valor de resistividad de la formación o de otra manera expresado: $RILD = R_t$ hasta relaciones $R_t/RILD = 0.7$, cuando el registro profundo todavía lee en una zona con poca invasión de fluido. Para ver cuales puntos de cada carta fueron incorporados al programa,

basta con abrir cualquiera de los archivos mencionados arriba y comparar con cada carta tornado.

3.2 Manual del Usuario

Para instalar el programa, activar el setup, seguir los pasos de instalación, así al final aparecerá en la lista de programas el icono del B.O.H.A. (Figura 9).



Figura 9. Setup de instalación e ícono del programa B.O.H.A.

Al abrir el programa puede verse el menú del programa en la parte superior izquierda y tres objetos para buscar el archivo a ser cargado por el programa (Figura 10). El archivo se carga mediante Doble-Click sobre el mismo o por el menú: FILE submenú: Load File.

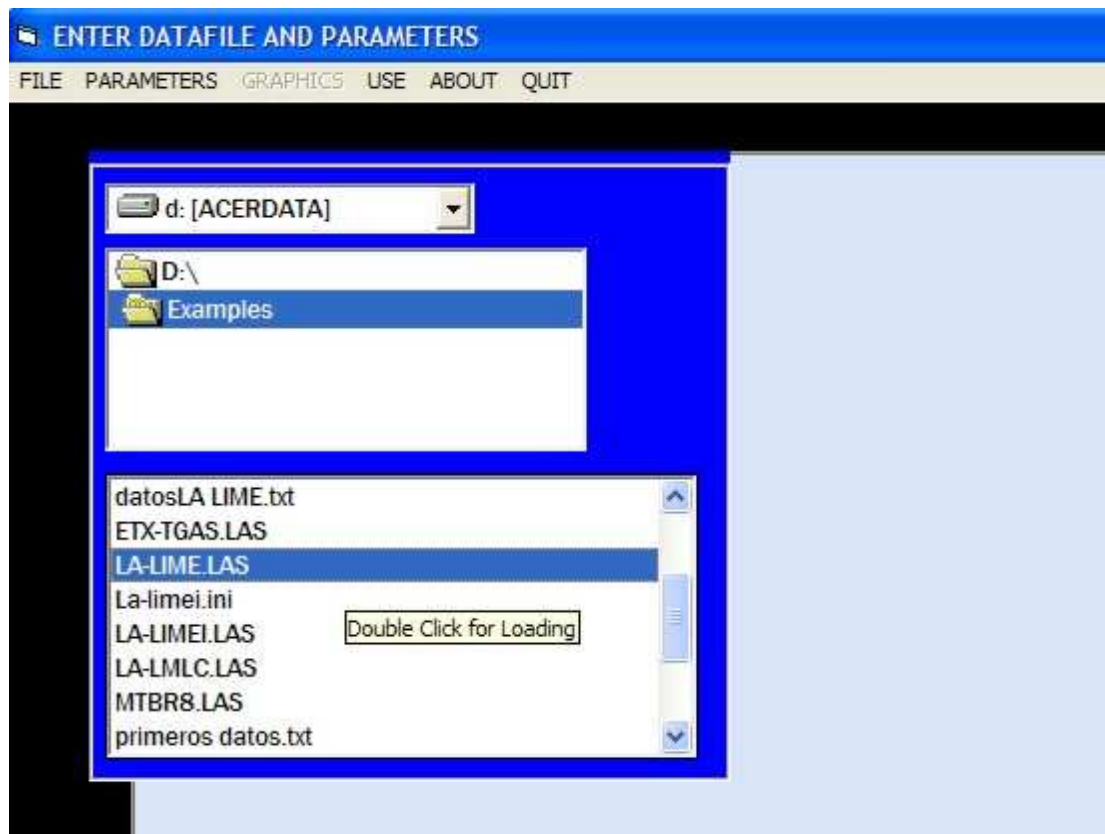


Figura 10. Pantalla inicial y selección de archivos

Luego el programa carga el contenido del archivo en la pantalla; una vez realizado esto, el usuario puede dirigirse al menú: **PARAMETERS**, en donde encuentra cuatro submenús (**Figura 11**).

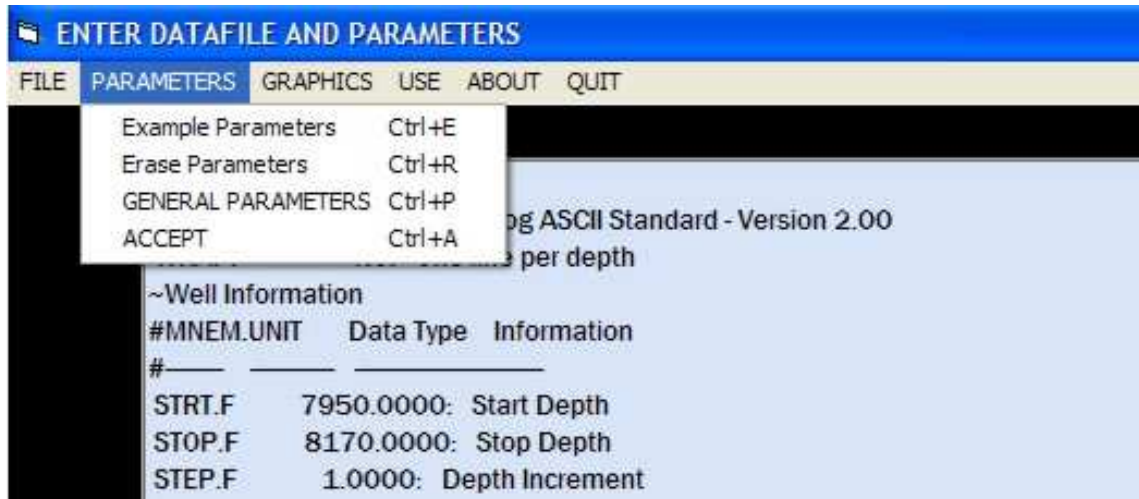


Figura 11. Archivo cargado y administración de parámetros

Con el primero (**Example Parameters**) se cargan los datos ejemplo que trae el programa, llenando los cuadros de texto del recuadro: “**BASIC INFORMATION**” en la parte derecha de la pantalla (**Figura 12**), con el segundo (**Erase Parameters**) se vacían los cuadros de texto y con el tercero (**GENERAL PARAMETERS**) se llama la pantalla de parámetros generales (**PARAMETERS**) (**figura 13**).

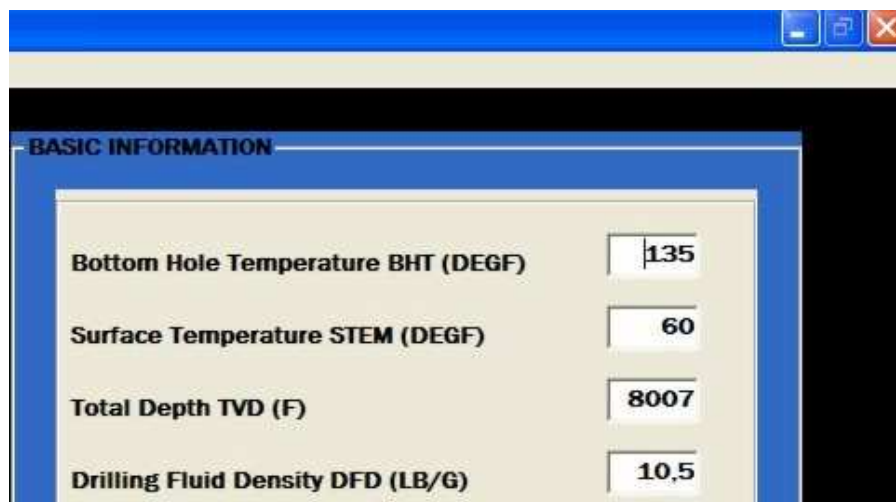


Figura 12. Recuadro: BASIC INFORMATION

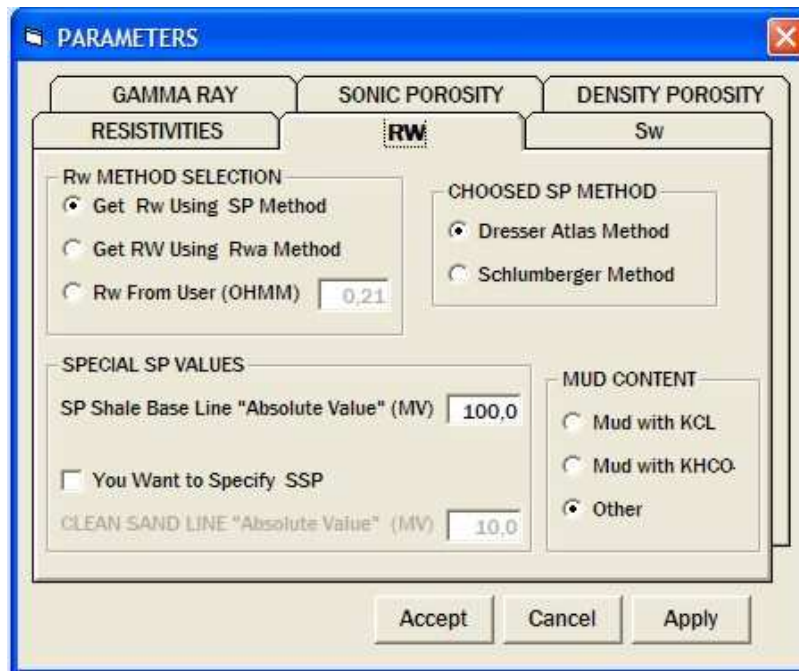


Figura 13. Pantalla de Parámetros generales

Con el cuarto submenú (**ACCEPT**), el programa corre el código y calcula todas las variables. Ahora, en el menú aparece disponible “**GRAPHICS**” (**Figura 14**), que al ser seleccionado, despliega cuatro submenús, cada uno lleva al usuario a una de las cuatro pantallas de gráficos (**Figura 15**).

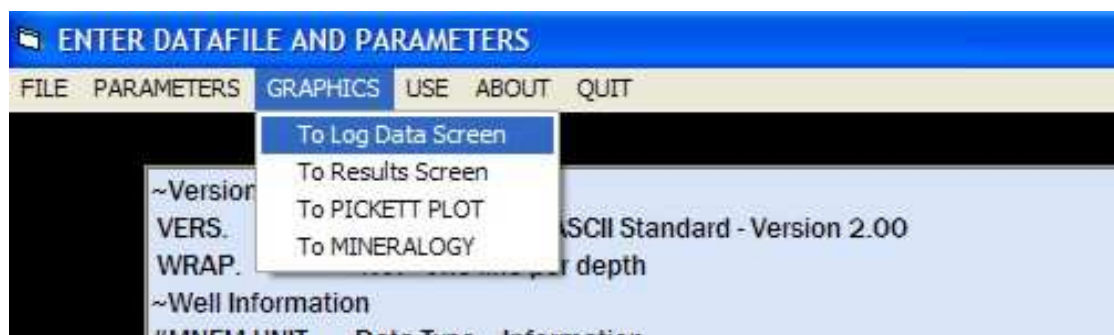


Figura 14. Selección de pantallas gráficas

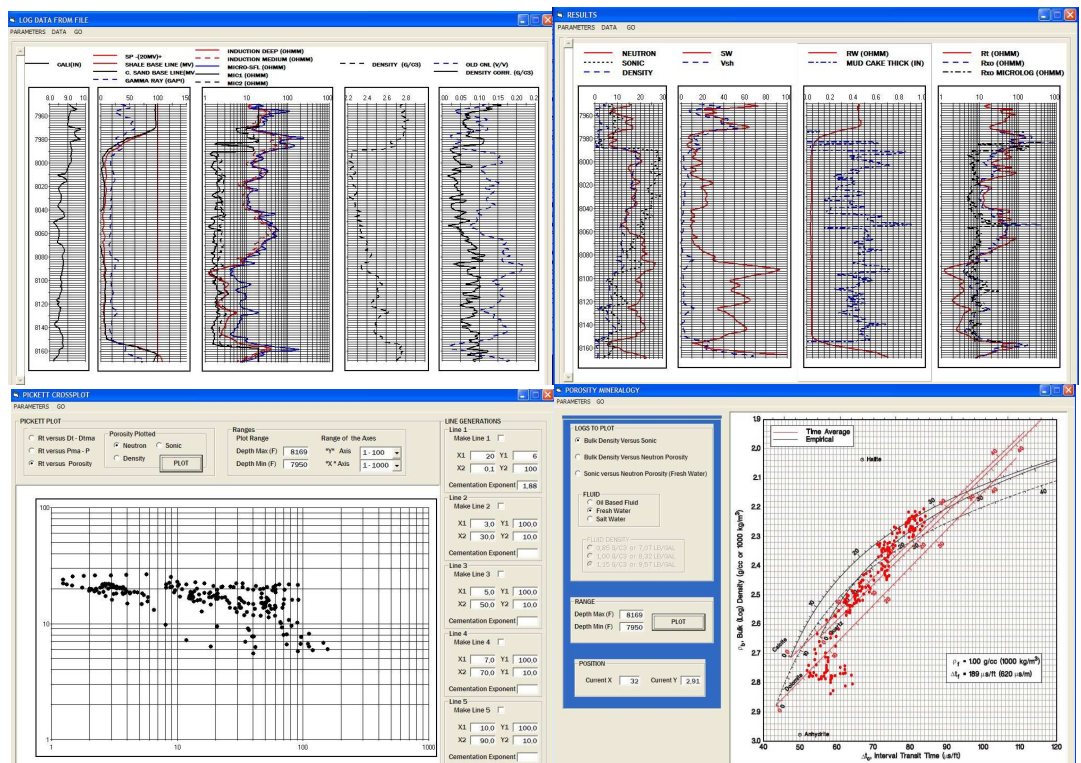


Figura 15. Pantallas de visualización gráfica del programa B.O.H.A.

Es aconsejable que primero el usuario se dirija a la pantalla “LOG DATA FROM FILE” donde puede ver las pistas (tracks), con los datos que el programa encontró en el archivo cargado. El menú permite mostrar la pantalla **PARAMETERS**, también puede cambiar el número de pies vistos en la pista mediante el menú: **DATA** submenú: **Change Tracks Range** (Figura 16).

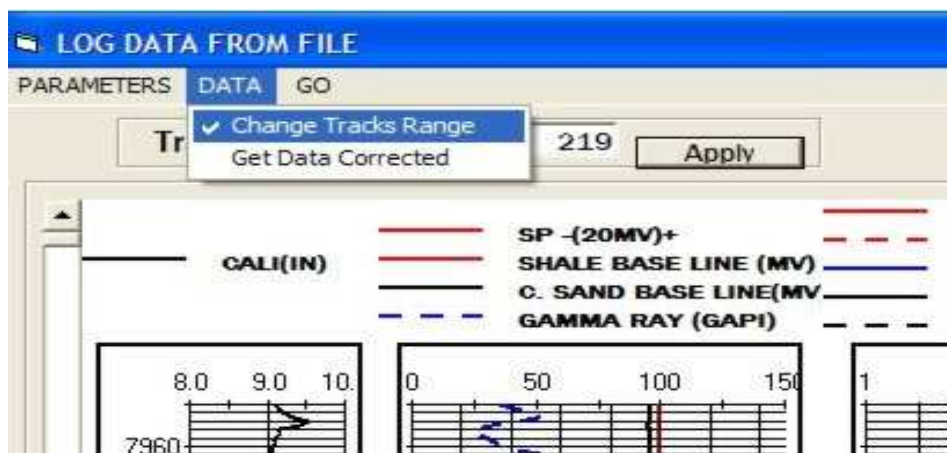


Figura 16. Rango de datos, Pantalla: LOG DATA FROM FILE

Entonces, aparecerá el recuadro “**Tracks Range**” en donde el usuario puede cambiar el valor del cuadro de texto y oprimir el botón “**Apply** “; se verá el nuevo rango aplicado a cada una de las pistas (tracks) de la pantalla, por ejemplo, si el usuario digita 50 (**Figura 17**) verá las pistas (tracks) con el rango de datos dado (**Figura 18**). Para ver los siguientes o anteriores datos, al lado izquierdo de la pantalla se encontrará una barra de desplazamiento vertical.



Figura 17. Cambio de rango de las pistas (tracks)

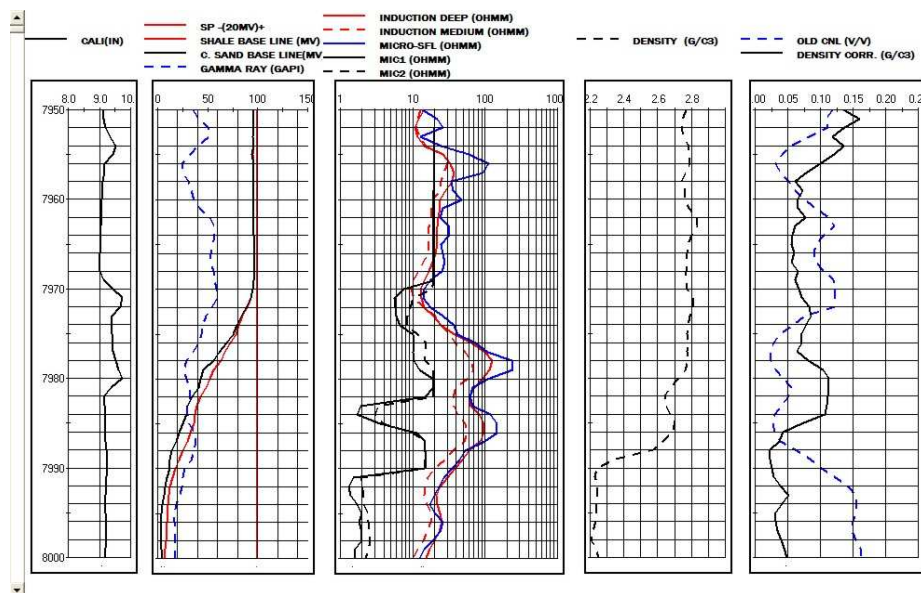


Figura 18. Aplicación del nuevo rango de profundidad

Después, el usuario puede ver los cálculos producido por el programa dirigiéndose a la pantalla “**RESULTS**”. Esta pantalla muestra: porosidades, saturación de agua, resistividad de la roca, etc. sobre pistas (tracks) (**Figura 19**). El menú hace lo mismo que el de la pantalla “**LOG DATA FROM FILE**”. Todas las pantallas gráficas llevan a las demás a través del menú: **GO** y muestran también la pantalla “**PARAMETERS**” a través del menú: **PARAMETERS**.

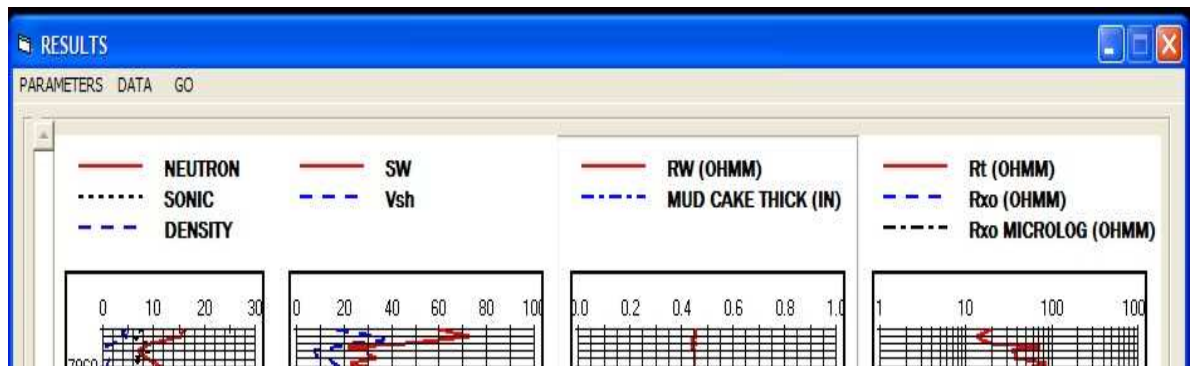


Figura 19. Pantalla de Resultados

El programa no solo muestra pistas (tracks) de registros y cálculos, también ofrece la posibilidad de generar un Cross-Plot de Pickett (pantalla **PICKETT CROSSPLOT**), así como la posibilidad de un análisis mineralógico de los registros (pantalla **MINERALOGY**).

La pantalla “**PICKETT CROSSPLOT**” permite al usuario escoger las variables a puntear, y si es el caso, seleccionar el tipo de porosidad a tenerse en cuenta; también permite en el recuadro “**Ranges**” establecer el rango de profundidad a puntear “Depth Min-Depth Max” así como el rango de los ejes “X” e “Y” (**Figura 20**).

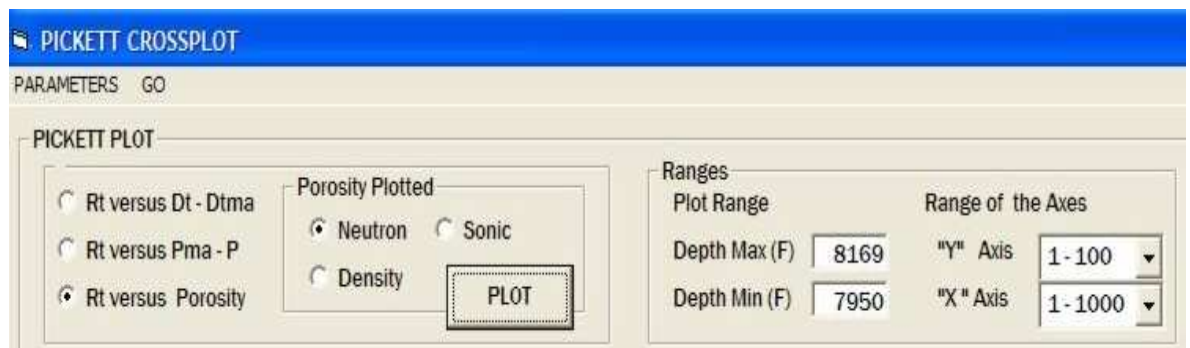


Figura 20. Pantalla: PICKETT CROSSPLOT

De la misma forma, en la parte derecha de la pantalla aparece el recuadro “**LINE GENERATIONS**” que ofrece la posibilidad de graficar líneas de saturación de agua, al seleccionar “**Make Line 1, 2, 3..**” y dar las coordenadas iniciales y finales de la línea en las casillas: **X1,Y1; X2,Y2**. A la par, brinda el exponente de cementación “**m**” (**Figura 21**). Finalmente se obtiene el punteado y las líneas que se hayan seleccionado al oprimir el botón “**PLOT**” (**Figura 22**).

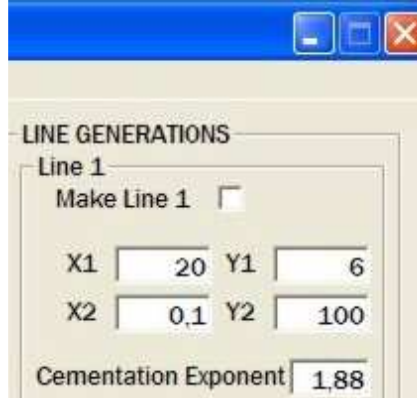


Figura 21. Generación de líneas, pantalla: PICKETT CROSSPLOT

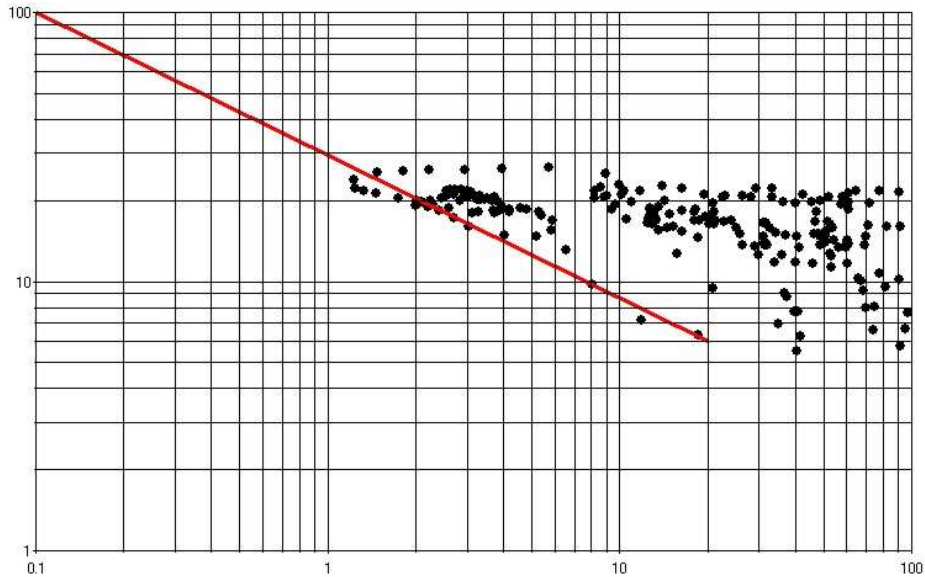


Figura 22. Punteado y línea de saturación

La pantalla “**MINERALOGY**” presenta un menú similar a las demás pantallas. En el recuadro “**LOGS TO PLOT**” en el margen izquierdo, le permite al usuario seleccionar cual combinación desea utilizar para estimar la litología predominante en el rango de profundidad seleccionado en el recuadro “**RANGE**” (Figura 23). Oprimiendo el botón “**PLOT**” se obtiene el punteado de los datos sobre la carta seleccionada. (Figura 24).

LOGS TO PLOT

Bulk Density Versus Sonic

Bulk Density Versus Neutron Porosity

Sonic versus Neutron Porosity (Fresh Water)

FLUID

Oil Based Fluid

Fresh Water

Salt Water

FLUID DENSITY

0,85 G/CC or 7,07 LB/GAL

1,00 G/CC or 8,32 LB/GAL

1,15 G/CC or 9,57 LB/GAL

RANGE

Depth Max (F)

Depth Min (F)

POSITION

Current X Current Y

Figura 23. Combinaciones y rango a puntear

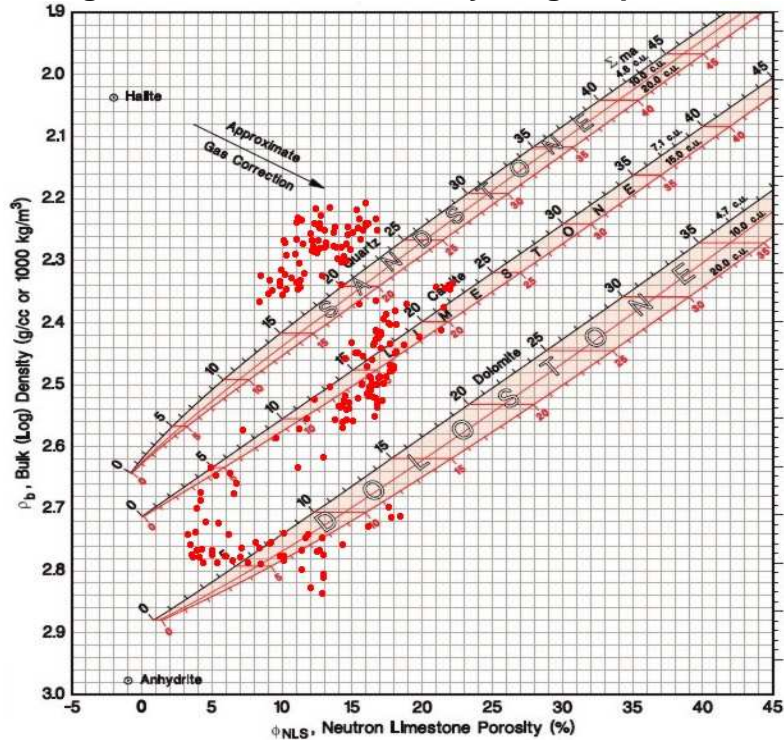


Figura 24. Punteado cartas de mineralogía

3.3 Diagrama de Flujo del Programa

El programa realiza las diferentes subrutinas en un orden, como se muestra (Figura 25), el diagrama de flujo muestra las subrutinas, dentro de las cuales se realizan los diferentes cálculos y correcciones.

En el programa cada subrutina se encuentra comentariada; por motivos de volumen, colocar todos los códigos del programa en los anexos sería inoficioso, tan solo en los anexos se exponen las ecuaciones generadas por el autor a partir de las diferentes cartas de corrección que incorpora el programa, no obstante, todos los códigos se encuentran disponibles en medio magnético, en el disco compacto que se anexa a este documento, donde se entregan tanto el paquete de instalación como el programa sin compilar.

Para poder abordar los códigos se recomienda abrir antes que nada el módulo de declaraciones: **Declarations(Module1.bas)** Este contiene la declaración de todas las variables públicas del programa y su significado para que el programador tenga un acercamiento mas amigable con la estructura de los códigos.

4. CONCLUSIONES

- Se logró desarrollar un programa computacional práctico, fácil de usar y amigable para el análisis básico de registros de pozo abierto,
- Se desarrolló un programa computacional que ofrece visualización de resultados. cuyo mayor valor agregado consiste en poder representar gráficamente las curvas de datos.
- El programa B.O.H.A. es un programa que permite generar cross-plots e histogramas incluyendo correcciones ambientales, como son:
 - Efecto por tamaño de hueco
 - Densidad de lodo
 - Espesor de capa
 - Grado de consolidación de la roca
 - Porosidad Neutrónica verdadera
 - Invasión de fluidos
 - Contenido arcilloso
 - Centralización de la herramienta
 - Contenido de fluidos

5. RECOMENDACIONES

- En el manejo de las cartas tornado, debe aspirarse en una tesis posterior, ya sea como la continuación del programa o como tema aparte, el modelar las ecuaciones, si es viable, que generan las diferentes cartas tornado; según se muestran en el libro de Saki Baussionni, utilizando las curvas de factor geométrico y diámetro de invasión. o simplemente aumentar la cantidad y representatividad de la extracción de datos realizada a las cartas tornado, hecha por el autor de este proyecto.
- En caso de querer mejorar el programa en una tesis futura, este debe realizarse también utilizando el programa Visual Basic.Net, que es la nueva generación de Visual Basic 6.0 y que incorpora una nueva filosofía de programación, así como nuevas y mejores posibilidades de programación.
- Instar a los estudiantes a generar sus propios programas, utilizando Visual Basic. dado que permite programar las tareas propias de nuestra industria, ahorrando tiempo y brindando una mejor presentación al trabajo del ingeniero.

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7. Ejemplos de código propios del autor y del director

4. ANEXOS

Las ecuaciones citadas a continuación, fueron obtenidas por el autor utilizando el programa TableCurve2D a partir de las cartas de corrección que se citan al principio de cada corrección, cada ecuación representa una curva dentro de cada carta, en cada una se brinda su nombre nemotécnico, la estructura de la ecuación, luego su coeficiente de correlación y finalmente los valores de las constantes de la misma.

MODULO DUALINDUCTION

Corrección por efecto Borehole en el registro Spherically Focused Log
Carta Rcor-1 de Schlumberger "Log Interpretation Charts" 1985 page 60

BoreholeRSFL6in

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2) \text{ [NL]}$$

$$r2=0.999820713175622$$

$$a = 1.48887221922857$$

$$f = -2.15065352939582E-02$$

$$b = 0.942105071219304$$

$$g = -1.98802522061927E-02$$

$$c = 0.673938173811162$$

$$h = 1.51469646812899E-03$$

$$d = 8.59587029798681E-02$$

$$i = 1.35702380492523E-03$$

$$e = 9.75502701802669E-02$$

BoreholeRSFL8in

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10} \text{ } r2=0.9980798111290018$$

$$a = 1.11689158685844$$

$$g = -1.14802893390662E-02$$

$$b = -7.23982671830298E-02$$

$$h = 1.69589266565039E-03$$

$$c = -9.60125151894221E-02$$

$$i = -1.51812258501314E-04$$

$$d = 0.177812423397739$$

$$j = 7.53483965447775E-06$$

$$e = -0.12404519987619$$

$$k = -1.59045407754261E-07$$

$$F = 4.83101876428329E-02$$

BoreholeRSFL10in

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \text{ } r2=0.9988541696776642$$

$$a = 1.11730724146884$$

$$g = -0.144902314862965$$

$$b = -0.960444651590884$$

$$h = 1.20075106684927E-02$$

$$c = -1.12069699705179$$

$$i = 1.47304429845632E-02$$

$$d = 0.531166272720529$$

$$j = -4.51656099313071E-04$$

$$e = 0.630912526868625$$

$$k = -5.58213400516649E-04$$

$$F = -0.11978881158517$$

BoreholeRSFL12in

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.999646003335368$

a = 1.12969587109727	g = -3.98652318234751E-03
b = -4.13575883213053E-02	h = 7.03451201095091E-04
c = 7.63839084530468E-02	i = -7.04700620199067E-05
d = -2.18381775571061E-02	j = 3.76926998235475E-06
e = -1.42893979742177E-02	k = -8.36949114281616E-08
F = 0.012244812229034	

BoreholeRSFL14in

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9995443426774622$

a = 1.14794369038077	g = 4.67512254085544E-03
b = 5.32643207803157E-03	h = -5.68338372390154E-04
c = 0.10053795243222	i = 4.05450671217118E-05
d = -0.1150089858248	j = -1.55786621831606E-06
e = 6.77203640870065E-02	k = 2.48260251867633E-08
F = -2.30812101867338E-02	

BoreholeRSFL16in

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9998561479235844$

a = 1.15861436096308	g = 5.74328087625051E-03
b = 7.88656094707489E-02	h = -8.64462441641926E-04
c = 6.20365317319262E-02	i = 7.92275597287442E-05
d = -9.26666767062211E-02	j = -4.07347242038781E-06
e = 6.02917421013995E-02	k = 9.05590181593571E-08
F = -2.36901761681151E-02	

MODULO DUALINDUCTION

Corrección por efecto Borehole en el registro Micro-Spherically Focused Log
Carta Rxo-3 manual Schlumberger "Log Interpretation Charts" 1985 página 57

MSFLmudcakecorr0in

$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5)$ [NL] $r^2=0.9983795647747708$

a = 0.588032122734287	g = 0.322454862923049
b = -0.942640501732286	h = -0.13073403261486
c = -0.316291156316745	i = -0.144985075774577
d = 0.394791949190607	j = 1.88039451702535E-02
e = -9.19064011376519E-02	k = 1.83665862975063E-02
F = 0.17007205792503	

MSFLmudcakecorr1/8in

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9996713587477853

a = -1.68775201846674	g = 1.42704684244054
b = 1.80837632442454	h = -0.36539759883525
c = 5.03488162265058	i = -0.395411667337365
d = -1.85918849964601	j = 5.01479880708898E-02
e = -3.49523347148816	k = 4.86427425320924E-02
F = 1.03843447590202	

MSFLmudcakecorr1/4in

$$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$$

r2=0.9995780281316342

a = -2.14885913356203	g = -3.86553067708706E-02
b = 5.80400104277963	h = 4.32744857052952E-03
c = -5.10427173370194	i = -3.10147339602199E-04
d = 2.71661874900548	j = 1.28111025004611E-05
e = -0.959215172768206	k = -2.31353642979234E-07
F = 0.232290577873738	

MSFLmudcakecorr1/2in

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9996571101622753

a = -4.41926283711889	g = -3.44345518668263
b = 0.283365366436301	h = 0.373118320051026
c = 2.0949615758414	i = 0.319959891641259
d = 8.96699150713151	j = 7.25569079341807E-03
e = 8.08009009269571	k = 8.50590953845918E-03
F = -3.8223072747553	

MSFLmudcakecorr3/4in

$$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$$

r2=0.9999451699378544

a = -3.9897097352385	g = -5.84367807359118E-02
b = 10.2611936663042	h = 5.69889193927607E-03
c = -9.54601461766534	i = -3.47882319622534E-04
d = 5.13754104530135	j = 1.19833031074472E-05
e = -1.7503585767279	k = -1.76283695548682E-07
F = 0.392400503165793	

MSFLmudcakecorr1in $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}$

r2 = 0.999969996614434

a = -2.39773386315386	d = 1.77729064426896
b = 5.8645338738871	e = -0.415370026585656
c = -4.38881873802404	F = 5.68750115765821E-02

$$g = -4.22902844593974E-03$$

$$h = 1.35783658614443E-04$$

MODULO DUALINDUCTION

Correcciones por efecto Borehole tanto para RILD como para RILM

Carta Rcor-4 del manual de Schlumberger "Log Interpretation Charts" 1985 página 64

ILDboreholecorrstandoff0,0in

$$y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$$r2=0.999981049156887$$

$$a = 2.27159482896333E-03$$

$$F = -3.66251991675949E-03$$

$$b = -0.325637668362095$$

$$g = -1.46980862100571E-05$$

$$c = -1.10031775041844E-03$$

$$h = 1.499124392416E-04$$

$$d = 4.67064396807853E-02$$

$$i = 4.04824841915122E-07$$

$$e = 1.94037819949789E-04$$

$$j = -2.39776737516531E-06$$

ILDboreholecorrstandoff1,5in

$$y=a+bx^2+cx^4+dx^6+ex^8+fx^{(10)}+gx^{(12)}+hx^{(14)}+ix^{(16)}$$

$$r2=0.999986966956499$$

$$a = 2.3057243595266E-03$$

$$F = -4.3401395709512E-13$$

$$b = -1.01092910302597E-04$$

$$g = 1.02696343731686E-15$$

$$c = 1.75149918636872E-06$$

$$h = -1.31485900409141E-18$$

$$d = -1.71369060908159E-08$$

$$i = 6.94969582663404E-22$$

$$e = 1.09303319272879E-10$$

ILMboreholecorrstandoff0,0in

$$y=a+bx^2+cx^4+dx^6+ex^8+fx^{(10)}+gx^{(12)}+hx^{(14)}+ix^{(16)}+jx^{(18)}+kx^{(20)}$$

$$r2=0.9999711070996464$$

$$a = -7.1041578727854E-04$$

$$g = -1.22087257482608E-12$$

$$b = -1.20256347551124E-05$$

$$h = 8.76631739360314E-15$$

$$c = 3.37567809547693E-06$$

$$i = -3.76987698973885E-17$$

$$d = 6.08656507469008E-08$$

$$j = 8.97099471165746E-20$$

$$e = -4.61846002358733E-09$$

$$k = -9.09753848752561E-23$$

$$F = 1.01878539823347E-10$$

ILMboreholecorrstandoff1,5in $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3+hx^4) \text{ [NL]}$

$$r2=0.9999578757856823$$

$$a = -2.27942359333251E-03$$

$$e = -6.3031348774683E-05$$

$$b = -0.268462934060642$$

$$f = -1.62737113191034E-03$$

$$c = 6.0802969361233E-04$$

$$g = 2.80420174797317E-06$$

$$d = 0.030788821192613$$

$$h = 3.69274486234825E-05$$

MODULO DUALINDUCTION

Correcciones por espesor de capa "Bedtickness" tanto para RILD como para RILM

Cartas DILTA 3a and 3b del manual Halliburton Chart Book EL 1001 páginas 205 y 206

$$ild10,2 \ y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5$$

$$r2=0.9973489210149676$$

$$a = 8.94916418287317$$

$$b = -1.03771723359003$$

$$c = -40.2997640501425$$

$$d = 6.99412331743766E-02$$

$$e = 105.196705256729$$

$$f = -2.70997483854136E-03$$

$$g = -147.4929257444$$

$$h = 5.66922428873677E-05$$

$$i = 85.0243726150978$$

$$j = -4.9796300136006E-07$$

$$ild10,3 \ y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9 \ r2 =$$

$$0.999224838933895$$

$$a = 0.10935767071844$$

$$b = -3.21732218388364E-02$$

$$c = 8.22939125706432E-02$$

$$d = -2.51442125594575E-02$$

$$e = 3.6179462530086E-03$$

$$f = -2.97640469415005E-04$$

$$g = 1.47886587975632E-05$$

$$h = -4.39328630936429E-07$$

$$i = 7.19018696533258E-09$$

$$j = -4.99030694192406E-11$$

$$ild10,5 \ y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9$$

$$r2=0.9996219970398566$$

$$a = 0.147093937483508$$

$$b = 4.11777619071404E-02$$

$$c = 7.43793236853429E-02$$

$$d = -2.73518776102925E-02$$

$$e = 4.33800386292519E-03$$

$$f = -3.84969117267584E-04$$

$$g = 2.04151700164487E-05$$

$$h = -6.42337340832581E-07$$

$$i = 1.106068294318E-08$$

$$j = -8.02773366170502E-11$$

$$ild12 \ y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8$$

$$r2=0.9996018108053026$$

$$a = 1.16792626058368$$

$$b = 64.2068668485862$$

$$c = -1870.12144866658$$

$$d = 29000.9788806319$$

$$e = -269954.643792957$$

$$f = 1526086.54845915$$

$$g = -5076290.21117304$$

$$h = 9097718.79954939$$

$$i = -6754731.32378419$$

$$ild14 \ y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$$

$$r2=0.9989958785258934$$

$$a = 16155.4598143706$$

$$b = -1259.37041718409$$

$$c = -136113.692313372$$

$$d = 63.7108834302297$$

$$e = 745206.5425174$$

$$f = -2.0033863007052$$

$$g = -2543402.45010943$$

$$h = 3.54310995566673E-02$$

$$i = 4901709.82630895$$

$$j = -2.68390683987302E-04$$

$$k = -4061224.30404475$$

ild16 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$
r2=0.9993780445351302

a = 152.024204210195	g = 23912455610.5202
b = -16316.9463501269	h = -109137650047.01
c = 768393.409042931	i = 313720313060.779
d = -20121103.0303016	j = -514742033366.245
e = 326088913.609398	k = 367283343016.413
F = -3434417142.83717	

ild18 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$
r2=0.9985915719120004

a = -127.737893501496	g = -31425198129.0997
b = 15313.5302016201	h = 154051007158.693
c = -752238.742977979	i = -473490691383.756
d = 21041412.2276618	j = 826794139113.734
e = -367863359.377117	k = -624922477930.258
F = 4186195368.7203	

ild110 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
r2=0.9953871349515

a = -476.504827236556	g = -2.39728212420974E-02
b = 467.424050377403	h = 8.73332021853793E-04
c = -183.325405783669	i = -2.00689622136507E-05
d = 39.1669551414039	j = 2.63946889513116E-07
e = -5.1153024406636	k = -1.51487246834925E-09
F = 0.431286056006954	

ild115 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
r2=0.9972896327563005

a = -744.581120406499	g = -4.35017090428364E-02
b = 777.656000869054	h = 1.58682928549309E-03
c = -316.523070035289	i = -3.64191650400678E-05
d = 69.1754605107602	j = 4.77379150435603E-07
e = -9.16278966256199	k = -2.72589147414534E-09
F = 0.779143180539219	

ild120

$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$
[NL] r2=0.9884058422906362

a = 1824.8094415734	F = 14.3914326072198
b = 23.4792160720575	g = -58.4609023647114
c = -2020.35243152654	h = -2.93752611258973
d = -30.5627757402542	i = -15.1022544180074
e = 721.701735347423	j = 0.2200697112561

$$k = 2.27347115052041$$

$$\text{ild130 } y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

$$[\text{NL}] \text{ r2}=0.9980627714087406$$

a = -38.2997830079134	F = -0.336787900408
b = -1.64716762806506	g = 4.36909455389295
c = 47.511796872144	h = 5.27913160841238E-02
d = 1.061008355181	i = -0.323265334600712
e = -21.7943597426229	j = -3.27004539722719E-03

$$\text{ild20,2 } y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$\text{r2}=0.9999377534588089$$

a = 0.249813242938157	F = -6.93476237501785E-04
b = -0.266620589963826	g = 3.97224425176777E-05
c = 0.190301505800495	h = -1.45665669575499E-06
d = -5.21982720362881E-02	i = 3.30841069802101E-08
e = 7.71315829231003E-03	j = -4.23384853168857E-10

$$\text{ild20,3 } y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$\text{r2}=0.9980839773986915$$

a = 2.04169484282154E-03	g = 6.68472752957507E-06
b = 6.57026740541464E-02	h = -9.82055046710083E-08
c = 4.54381879302953E-02	i = -1.76814206588584E-09
d = -1.66553634159559E-02	j = 8.32306255789395E-11
e = 2.34704896521997E-03	k = -8.53962116948768E-13
F = -1.72564590028472E-04	

$$\text{ild20,5}$$

$$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$$

$$\text{r2}=0.9993441278675842$$

a = -457.303291334237	g = -119.325174490438
b = 1604.38829830881	h = 20.5306901851744
c = -2461.24654694591	i = -2.27154713223848
d = 2177.01471749746	j = 0.146149808497694
e = -1230.7009471027	k = -4.15784460984367E-03
F = 465.280694560526	

$$\text{ild21 } y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$$

$$\text{r2}=0.9999746755683504$$

a = -110.183771036347	g = -31.2939588118921
b = 397.10328164101	h = 5.37234440078322
c = -622.303757185276	i = -0.591499072641518
d = 560.113525474693	j = 3.78002697441236E-02
e = -320.354819673122	k = -1.06684991272119E-03
F = 121.852374500015	

ild24 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5$

$r^2=0.9999529208714083$

a = 2597.43525199914
b = -261.098009658554
c = -15840.0283715476
d = 16.2219532362264
e = 57277.6433209132

F = -0.602703695311477
g = -111529.463193027
h = 1.22197850146237E-02
i = 89826.8743209622
j = -1.03621162720473E-04

ild26 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9998104072222391$

a = -1.30182492706927
b = 32.4637202115021
c = -19.0658274281677
d = 4.9934009813557
e = -0.739272304171184
F = 6.79859126715814E-02

g = -4.03488065862805E-03
h = 1.54963987720196E-04
i = -3.72423077612348E-06
j = 5.09539830362477E-08
k = -3.03090075575632E-10

ild28 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$

$r^2=0.9993936183284926$

a = 89083.1981290828
b = -267255.748271955
c = 357476.925827343
d = -280409.841202906
e = 142733.254532463
F = -49236.2441274494

g = 11653.0549385684
h = -1868.34432274987
i = 194.22024346766
j = -11.8229515820392
k = 0.320135791492547

ild210 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$

$r^2=0.9999587849087958$

a = 10743.1056486145
b = -963.139420456269
c = -74748.4085284337
d = 54.1444815545252
e = 314160.919232061
F = -1.84470516230656

g = -728176.383479352
h = 3.46996683585202E-02
i = 717482.651248072
j = -2.75807724855237E-04
k = 4887.47675029756

ild215 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9968460336804778$

a = 366.533109493839
b = -119.322173172144
c = -6.41902670769113
d = 8.93331971976065
e = -1.86260677008734
F = 0.200544524484469

g = -1.30210072429964E-02
h = 5.29364688501845E-04
i = -1.32195489938098E-05
j = 1.85806883559657E-07
k = -1.12703852918133E-09

ild220 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9976180788043918$

a = 288.788213953545
b = 144.351030003624
c = -149.963187119089
d = 44.6175332911479
e = -6.90291605506043
F = 0.642587589131251

g = -3.79674295857957E-02
h = 1.43656216851971E-03
i = -3.37606004269131E-05
j = 4.49119975940825E-07
k = -2.5857815349817E-09

ild230 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9923590780917936$

a = -4523.93230371213
b = 4831.81657542253
c = -2008.60069088622
d = 447.344539175173
e = -60.3442321616275
F = 5.22512711899872

g = -0.297150036604934
h = 1.10457285136637E-02
i = -2.58470500780283E-04
j = 3.45585393449334E-06
k = -2.01350552869569E-08

ild40,2 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9999869485348723$

a = 0.499715020926532
b = -0.629136854198361
c = 0.380347100314179
d = -0.102774813717176
e = 1.56168945501748E-02
F = -1.47040404477748E-03

g = 8.91500956395435E-05
h = -3.48877369498128E-06
i = 8.51907666276273E-08
j = -1.18087591082937E-09
k = 7.097376602333E-12

ild40,3 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9999789281781046$

a = 0.143182642880405
b = -0.110460081561916
c = 0.117954197857246
d = -3.07515624508477E-02
e = 3.88701195950944E-03
F = -2.77555515407485E-04

g = 1.15217281054153E-05
h = -2.58393761532649E-07
i = 2.06785987343562E-09
j = 2.38618823817043E-11
k = -4.25013373341034E-13

ild40,5 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9999951691622849$

a = 0.519191813959236
b = -0.641685744457357
c = 0.449913594569991
d = -0.126281057179666
e = 1.94388683087578E-02
F = -1.83755509562792E-03

g = 1.11513776916075E-04
h = -4.36742422194034E-06
i = 1.06877691716671E-07
j = -1.48778051338685E-09
k = 9.00035666049719E-12

ild41 $y=(a+cx^2+ex^4)/(1+bx^2+dx^4+fx^6)$ [NL] $r2=0.9998690945856815$
 $a = 0.465295917915081$ $d = 5.07072029645846E-03$
 $b = -5.08281378453917E-02$ $e = 5.12564946085848E-03$
 $c = -1.73830043541449E-02$ $F = 8.14436008842264E-08$

ild42 $y=(a+cx^2+ex^4+gx^6)/(1+bx^2+dx^4+fx^6)$ [NL] $r2=0.999335078837523$
 $a = -1.37193167049502$ $e = -6.90817948005771E-02$
 $b = 0.861328176160369$ $F = 5.49901259174771E-04$
 $c = 1.87806114364815$ $g = 1.12445436212422E-03$
 $d = -3.38467733547881E-02$

ild46 $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3)$ [NL] $r2=0.9999998282140978$
 $a = 11.4559795139455$ $e = 2.24435841996013$
 $b = -1.09043098595509$ $F = -6.83677889689791E-03$
 $c = -8.58404399573608$ $g = -4.69698107618303E-02$
 $d = 0.334394329171081$

ild48 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}$
 $r2=0.9999377634963211$
 $a = 12969.1261830734$ $F = -3376.76396872005$
 $b = -34647.0698947795$ $g = 631.276878430019$
 $c = 40726.8431647004$ $h = -74.9570334029236$
 $d = -27614.5225866016$ $i = 5.13010501353837$
 $e = 11897.4294321609$ $j = -0.15422334626054$

ild410 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4$ $r2=0.9989297043844535$
 $a = -500.838211111053$ $F = 1.72474099081926E-02$
 $b = 29.8524872764199$ $g = 88369.8280757281$
 $c = 5148.56852517597$ $h = -1.18956646581682E-04$
 $d = -0.995330532194797$ $i = -103948.186052383$
 $e = -29606.6584273995$

ild415 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8$
 $r2=0.9997770979404984$
 $a = 30.1973762336289$ $F = -153403895.525026$
 $b = -1786.61702325893$ $g = 659925104.362543$
 $c = 78646.9675487655$ $h = -1532222049.20422$
 $d = -1700452.68291863$ $i = 1479513628.72746$
 $e = 20927643.1168141$

ild420 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
 $r2=0.9994707890831645$
 $a = 1143.37532613245$ $d = -20.5687739892232$
 $b = -658.740188605602$ $e = 1.51798128184985$
 $c = 159.357156829304$ $F = -6.06796739858965E-02$

$g = 7.70376714791156E-04$ $j = 3.54754449501057E-08$
 $h = 3.84450238575187E-05$ $k = -2.41475838755069E-10$
 $i = -1.95479979681432E-06$

ild440 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$
 $r^2=0.9953588414709242$

$a = -1365037.51503326$ $g = 429122904.605412$
 $b = 84278.4204449427$ $h = -1.19161416161376$
 $c = 14523321.7794872$ $i = -1033870561.55685$
 $d = -3379.74738466209$ $j = 7.23251605529368E-03$
 $e = -100168694.656012$ $k = 1067902060.67701$
 $F = 84.4625720175466$

ild100,2 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
 $r^2=0.9997634243129043$

$a = 0.223446055279869$ $g = 3.10226572163475E-05$
 $b = -0.267625549289571$ $h = -1.00725947260988E-06$
 $c = 0.192910846016202$ $i = 1.95150756870326E-08$
 $d = -5.11189607841356E-02$ $j = -2.00682117346267E-10$
 $e = 7.14260657342593E-03$ $k = 7.93278539689569E-13$
 $F = -5.95883709672511E-04$

ild100,3 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
 $r^2=0.9999997489087259$

$a = 0.254083813341675$ $g = 4.00267190695485E-05$
 $b = -0.276014079750335$ $h = -1.49741406088069E-06$
 $c = 0.204511172011519$ $i = 3.53163912500749E-08$
 $d = -5.46301155668746E-02$ $j = -4.77470803310523E-10$
 $e = 7.86441751716891E-03$ $k = 2.82346378801827E-12$
 $F = -6.97208785197678E-04$

ild100,5 $y=(a+cx+ex^2)/(1+bx+dx^2+fx^3)$ [NL] $r^2=0.9993373098168222$

$a = 0.1300470408393$ $d = 4.85928568787267E-02$
 $b = -0.281590157361723$ $e = 1.49238721485114E-02$
 $c = -6.93408054596753E-03$ $f = -3.59165153555601E-04$

ild101 $y=(a+cx+ex^2)/(1+bx+dx^2+fx^3)$ [NL] $r^2=0.999437716986181$

$a = 1.31671102166792E-03$ $d = 6.86246935874763E-02$
 $b = -0.156886997173056$ $e = 0.051045907651196$
 $c = 0.140484268492678$ $F = -2.96317288939954E-04$

ild102 $y=(a+cx^{(0.5)}+ex+gx^{(1.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)})$ [NL]

$r^2=0.9994557988182274$

$a = -0.808043548791886$ $c = 2.26772978094444$
 $b = -0.167554369820304$ $d = -0.345268358593608$

e = -1.44858346016094
F = 0.130988443505611

g = 0.331492211345941

ild104 $y=a+bx+c/x^{(0.5)}+d/x+e/x^{(1.5)}$ r2=0.9976234414340035

a = -7.09906440807606
b = 0.113733047579263
c = 61.2768100154129

d = -114.050930367994
e = 64.0408569630536

ild106 $y=(a+cx^2+ex^4+gx^6)/(1+bx^2+dx^4+fx^6)$ [NL]

r2=0.9995778488108343

a = 2.8628872251759
b = -2.92864737073224E-02
c = 7.71632411323772E-03
d = 4.30045869845256E-03

e = 0.023109734855206
F = 8.41270151652221E-05
g = 5.03640362119515E-04

ild108 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4$

r2=0.999813645228538

a = 182.765859338958
b = -523.274389217491
c = 633.545198670724
d = -414.671563908436
e = 162.558427061216

F = -39.3976522877348
g = 5.79629039824436
h = -0.475166147266116
i = 1.66678764729545E-02

ild1015 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$

r2=0.9999999677962431

a = 65.4380004950288
b = -2.82943176482473
c = -616.107614451631
d = 0.107365710541794
e = 5152.77466634629
F = -2.6085165729476E-03

g = -26436.5843372359
h = 3.57081008194536E-05
i = 72057.0364879305
j = -1.99141733411216E-07
k = -74957.3955487552

ild1020 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$

r2=0.999999865830515

a = 564.825046197209
b = -28.3907074042182
c = -7135.35033736098
d = 1.08624263311468
e = 59972.1162932101
F = -3.02094892547333E-02

g = -298928.687705314
h = 5.25765565912991E-04
i = 780824.977851415
j = -4.08778883953649E-06
k = -790589.794155365

ild1030

$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$

r2=0.9999639325743399

a = 18581.5881842894	g = 2578.29398889127
b = -52010.5659759972	h = -424.726251502624
c = 68804.9285093409	i = 44.927704056747
d = -55266.610598301	j = -2.75675504386634
e = 29248.9259985696	k = 0.074586925092892
F = -10511.6678682213	

ild1070

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9998030305285517

a = 2.3214316352101	g = -8.76474059878924
b = -1.62338947572432	h = 5.22133621683887E-02
c = -17.699541450267	i = 1.75605647736324
d = 1.04229466256067	j = -3.26146497755652E-03
e = 19.6699017391546	k = -0.131765247106288
F = -0.33141592186498	

ilm10,2 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4$ r2=0.999598378154238

a = 0.587835702737264	e = -0.120770110099847
b = -0.056775435414097	F = -1.13866224880328E-04
c = -0.849733119080836	g = 0.871981314609213
d = 3.72957978850564E-03	h = 1.31544811865155E-06

ilm10,3 $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3)$ [NL] Fval=551.0736362175959

a = -29.4202516026578	e = -12.2321501544376
b = 130.068072070534	F = 4.4101015898053
c = 49.4129782881068	g = 1.34207903337123
d = -37.8183985675564	

ilm10,5 $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3+hx^4)$ [NL]

r2=0.9997435044562664

a = -0.446340994763363	e = -0.21564670041244
b = 1.41078760675689	F = 3.78828905276053E-02
c = 1.06152718277093	g = 2.10257173459606E-02
d = -0.3445374096791	h = 6.84324049312019E-05

ilm12 $y=(a+cx^{(0.5)}+ex)/(1+bx^{(0.5)}+dx)$ [NL] r2=0.999702323527256

a = 2.25442318819642	d = 0.507105606455356
b = -1.41322251755305	e = 1.04680052654821
c = -3.00505794663375	

ilm14 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7$ r2=0.9999981716207873

a = 4.87284420755606	d = -13211.22768288
b = -51.0199894917751	e = 82738.3607566784
c = 1158.11423929582	F = -299928.76872866

$$g = 614274.394390235$$

$$h = -538373.91064094$$

$$\text{ilm16 } y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8$$

$$r2=0.9999949793699133$$

$$a = -5.82143050878734$$

$$F = 60985429.8847553$$

$$b = 1114.990176775$$

$$g = -235906705.072871$$

$$c = -41914.2016543837$$

$$h = 490554427.568544$$

$$d = 820292.073559901$$

$$i = -422120457.635896$$

$$e = -9195226.00583898$$

$$\text{ilm18 } y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7 \quad r2=0.9995120226700138$$

$$a = 6.9460471182214$$

$$e = -3107521.78199282$$

$$b = 220.858784573956$$

$$F = 18842743.790944$$

$$c = -11772.2541415558$$

$$g = -57558104.1349746$$

$$d = 269773.862501675$$

$$h = 70053324.9649079$$

$$\text{ilm110 } y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$$r2=0.9979257667252097$$

$$a = 17.6933354408891$$

$$g = 0.993168470802823$$

$$b = -0.200746473057503$$

$$h = -9.73057295365504E-03$$

$$c = -2.4660420723762$$

$$i = -0.106261231718162$$

$$d = -0.2182723480016$$

$$j = 3.58607470383869E-04$$

$$e = -2.83884108524353$$

$$k = 3.79794032627109E-03$$

$$F = 8.61439003503802E-02$$

$$\text{ilm115 } y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$$

$$r2=0.9999886553142781$$

$$a = 89753.6731264107$$

$$g = -15116878.2418227$$

$$b = -6799.03298974089$$

$$h = 0.175948972830251$$

$$c = -776260.223027317$$

$$i = 29554953.9311299$$

$$d = 333.924087885658$$

$$j = -1.30445308804912E-03$$

$$e = 4347236.22463009$$

$$k = -24711763.2992537$$

$$F = -10.2058558852355$$

$$\text{ilm120 } y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$$

$$r2=0.999925966110265$$

$$a = 26210.5761223237$$

$$g = -2944420.3666108$$

$$b = -1992.20372933532$$

$$h = 4.13187306602229E-02$$

$$c = -213891.691048211$$

$$i = 3874906.36842065$$

$$d = 94.0679544290445$$

$$j = -2.67854004995939E-04$$

$$e = 1056666.36261541$$

$$k = -1243912.8920997$$

$$F = -2.66609175484377$$

$$\text{ilm130 } y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

$$\text{[NL]} \quad r2=0.9982440863300305$$

a = -19.8608023134219	F = -0.293657110354775
b = -1.5477607489848	g = 2.84748838854607
c = 26.0476528692027	h = 4.58880289656104E-02
d = 0.951121550460328	i = -0.234597391576215
e = -12.9217661169561	j = -2.91695070162616E-03

ilm160

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9961970347056967

a = 39.936222289192	g = -11.2076495026306
b = -1.49163703505212	h = 3.67677591199227E-02
c = -61.3935733508432	i = 1.66818836309166
d = 0.878080304216177	j = -2.09808173311371E-03
e = 37.2901153766162	k = -0.098479897492947
F = -0.255431945351466	

ilm20,2 y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5 r2=0.9981273608346281

a = 0.221323741015704	d = -49.9714338740314
b = -0.886094576151849	e = 87.3011444916493
c = 11.179262513943	F = -52.8835902721483

ilm20,3 y=(a+cx^2+ex^4)/(1+bx^2+dx^4+fx^6) [NL] r2=0.999195171280453

a = 0.112646920525639	d = 4.57836222017561E-03
b = 8.07801921653575E-02	e = 1.29252107334862E-03
c = 3.81418005465648E-02	F = -3.45375790113381E-07

ilm20,5 y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3+hx^4) [NL]

r2=0.9996386773457328

a = -2.78634193874116	e = -1.29167336364812
b = 5.69475563703223	F = 0.208803090020518
c = 4.50096805407849	g = 0.126137499016828
d = -2.00907013799771	h = 9.09180456032305E-04

ilm21 y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3) [NL] r2=0.9997686313032746

a = -958.260400274772	e = -591.856169216041
b = 1683.02700535329	F = 58.8114935345849
c = 2035.38187083896	g = 59.7052198844482
d = -557.877229931121	

ilm24 y=(a+cx^(0.5)+ex)/(1+bx^(0.5)+dx) [NL] r2=0.9999899890235828

a = 4.14759409140801	d = 0.461196039505399
b = -1.35401027782922	e = 1.85649592024083
c = -5.46939295236981	

ilm26 $y=(a+cx^{(0.5)}+ex+gx^{(1.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)})$ [NL]

$r^2=0.9999706849927758$

a = 155.298008577789	e = -47.9722101589547
b = 13.5104711975027	F = 4.5259954377103
c = -65.1633657593752	g = 22.8270564514068
d = -15.6077169757151	

ilm28 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4$ $r^2=0.9999786839344305$

a = 384.929706863705	F = -1.41419360082423E-02
b = -23.9696836497166	g = -47824.1399404871
c = -3361.42751846799	h = 8.60613652347067E-05
d = 0.831806478290864	i = 59070.1928953374
e = 17135.0345038259	

ilm210 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7$ $r^2=0.9999977978484899$

a = 0.44326957988511	e = -2678676.85377897
b = 676.025799968624	F = 13169600.1501141
c = -19411.4945561896	g = -33535228.7627511
d = 303328.549777688	h = 34779009.2685174

ilm215 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8$

$r^2=0.9999999086962043$

a = -81.1170524091893	F = 537171858.290037
b = 8669.29280737738	g = -2270296526.90929
c = -321355.38456972	h = 5241937094.35839
d = 6422868.22687794	i = -5082170461.13218
e = -75526130.8581715	

ilm220 $y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$

[NL] $r^2=0.9999978718575747$

a = 10.2765417670445	F = -0.158710608283451
b = -1.32795932458634	g = -1.06709401532922
c = -12.95794725235	h = 1.79934881487613E-02
d = 0.666426821449627	i = 7.00812394444462E-02
e = 5.73519570904498	j = -7.8747315652085E-04

ilm230 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$

$r^2=0.9999771067444423$

a = 150935.293168178	g = -39334203.9280911
b = -10030.2032437939	h = 0.179958572360297
c = -1497655.93060077	i = 90249442.7737164
d = 434.344463323294	j = -1.18911091254655E-03
e = 9700429.79812597	k = -88756517.5742279
F = -11.7514187564313	

ilm240 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$

$r^2=0.9999429791527512$

a = 3411.58746341429	g = 1.12874588921824E-02
b = -1898.35341331028	h = -2.86448711456553E-04
c = 456.17040518985	i = 4.66073971107367E-06
d = -61.7925727443409	j = -4.40134599137844E-08
e = 5.26645326810755	k = 1.8355921133108E-10
F = -0.297049616902786	

ilm270 $y=a+bx+c/x+dx^2+e/x^2+fx^3+g/x^3+hx^4+i/x^4+jx^5+k/x^5$

$r^2=0.997715661421711$

a = -3017630.75119358	g = 1705445325.46987
b = 150001.090038155	h = -0.834479315860173
c = 39286753.9630295	i = -4969877047.26412
d = -4714.65048688026	j = 2.61629859071595E-03
e = -328980924.335068	k = 6216376465.59024
F = 87.8468077147043	

ilm40,2 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4)$ [NL]

$r^2=0.9998723481466588$

a = -0.463244147588762	F = -0.438443942745364
b = 0.501889405212747	g = -0.091377056354566
c = 0.291105362757818	h = 3.79470179149019E-02
d = 1.3152019865527	i = 7.79721189864565E-03
e = 0.267727656843744	

ilm40,3 $y=(a+cx^{(0.5)}+ex)/(1+bx^{(0.5)}+dx+fx^{(1.5)})$ [NL] $r^2=0.999963085847485$

a = 0.20594617148733	d = 0.373291486595466
b = -1.13980872481368	e = 8.61593445653203E-02
c = -0.25299217579981	F = -7.81660469840413E-03

ilm40,5 $y=a+bx+c/x+d/x^{(1.5)}+e/x^2$ $r^2=0.9999984551563648$

a = 0.139582145092588	d = -19.1074252888306
b = 6.37445483852144E-03	e = 11.77139339002
c = 7.91671883677805	

ilm41 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$

$r^2=0.9999994466622804$

a = 14.650843342545	g = -3.44697884823946
b = -30.435140984638	h = 0.695600399568637
c = 16.4873043981347	i = -8.57329038409812E-02
d = 10.2975017209223	j = 5.94748733570425E-03
e = -17.8566085551527	k = -1.78481628306428E-04
F = 10.4739238787482	

ilm42

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

$$r2=0.9999999848025315$$

$$a = 0.849132294750775$$

$$b = -1.54262439846332$$

$$c = -1.50668695440892$$

$$d = 1.0937807056611$$

$$e = 1.34058902889602$$

$$F = -0.398179222087472$$

$$g = -0.573976441510241$$

$$h = 7.07966250872045E-02$$

$$i = 0.112992811232219$$

$$j = -4.73362473096001E-03$$

$$k = -8.0240773164688E-03$$

ilm46 $y=a+bx+cx^3+d/x+e/x^{(1.5)}$ $r2=0.999999990696537$

$$a = 9.49580920373112$$

$$b = -0.107488840333639$$

$$c = 3.2744599480694E-05$$

$$d = -48.3897992524975$$

$$e = 76.9445328879281$$

ilm48 $y=(a+cx^{(0.5)}+ex)/(1+bx^{(0.5)}+dx)$ $r2=0.9999946720499789$

$$a = 8.80385244100223$$

$$b = -1.33660445318382$$

$$c = -11.0970568061087$$

$$d = 0.449250084793624$$

$$e = 3.64193462669024$$

ilm410 $y=a+b/x+c/x^2+d/x^3+e/x^4$ $r2=0.9999998056830071$

$$a = 10.0491250202347$$

$$b = -1.89220950814098$$

$$c = 23.0300011445202$$

$$d = -262.510593085737$$

$$e = 1601.40804910733$$

ilm415 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6$ $r2=0.9999999058801821$

$$a = 17.6457311761385$$

$$b = -181.175825786314$$

$$c = 4445.60537768045$$

$$d = -46649.1924654628$$

$$e = 227569.431020625$$

$$F = -497591.874766729$$

$$g = 431910.816346856$$

ilm420 $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3)$ [NL] $r2=0.9999757808139897$

$$a = 1410.95741569236$$

$$b = 12.6056945229757$$

$$c = -271.386274692168$$

$$d = -5.67629077203401$$

$$e = -56.063035992833$$

$$F = 0.669913801577785$$

$$g = 11.981600342251$$

ilm430 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9$

$$r2=0.9999985532259876$$

$$a = -210.340904396428$$

$$b = 22774.5305359771$$

$$c = -888663.720029194$$

$$d = 18760554.2873562$$

$$e = -235064060.966782$$

$$F = 1811422027.67527$$

$$g = -8567308473.82751$$

$$h = 23806699803.0146$$

$$i = -34630823500.1048$$

$$j = 19226218933.7845$$

ilm480 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4$
r2=0.999661224659071

a = -599534.341562533	F = 48555.7120407344
b = 1343703.27819909	g = -6255.69982643076
c = -1293252.89867306	h = 454.219496226458
d = 698822.227290831	i = -14.2442601448647
e = -232085.388280347	

ilm100,2 $y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}$
r2=0.9999089522471718

a = 6.36105917436968E-02	e = 0.252172597977135
b = -0.676101483714456	F = -4.18820023632201E-02
c = 1.25046254965983	g = 3.4665529913508E-03
d = -0.800592293108404	h = -1.09688390614931E-04

ilm100,3 $y=(a+cx^2+ex^4)/(1+bx^2+dx^4+fx^6)$ [NL] r2=0.9999404033333212

a = 0.125604851672643	d = 4.2917491705753E-03
b = 2.56088833982791E-02	e = 1.16518097341381E-03
c = 1.97085865881474E-02	F = -2.72412064173621E-07

ilm100,5 $y=a+bx+c/x+dx^2+e/x^2+fx^3$ r2=0.9999901738868193

a = 1.05309046529311	d = 2.35893853988844E-03
b = -5.85137083234585E-02	e = 1.00816729660093
c = -1.76155426674478	F = -3.24759896548836E-05

ilm101 $y=(a+cx^{(0.5)}+ex)/(1+bx^{(0.5)}+dx+fx^{(1.5)})$ [NL]
r2=0.9998645882402018

a = 0.658828236083532	d = 0.360213490077079
b = -1.11886782827058	e = 0.265313102347472
c = -0.798441694628464	F = -8.81944879625965E-03

ilm102 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
r2=0.9995548292987359

a = 1.94372037166469	g = 4.04899685907015E-04
b = -1.92462977644737	h = -1.67446670528185E-05
c = 1.33762553387175	i = 4.31762575731557E-07
d = -0.389699492388637	j = -6.31641800746235E-09
e = 6.31568242069718E-02	k = 4.00426631718722E-11
F = -6.31048486489805E-03	

ilm104 $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
r2=0.9995987641622155

a = 3.09954164836525	d = -0.533593197118769
b = -2.15242063754383	e = 0.0890779686137
c = 1.73967683130574	F = -9.08973847561491E-03

$g = 5.9296266360024E-04$ $j = -9.59108042251547E-09$
 $h = -2.48625641873024E-05$ $k = 6.13786443364653E-11$
 $i = 6.48754161517388E-07$

ilm106 $y=(a+cx^{(0.5)}+ex+gx^{(1.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2)$ [NL]
 $r2=0.9999800767855713$

$a = 7.15457389840941$ $e = 5.00351678824584$
 $b = -1.65161691700114$ $F = -0.103726059483667$
 $c = -11.1437023399726$ $g = -0.707181466516631$
 $d = 0.752505060545609$ $h = -9.08079313292702E-04$

ilm108

$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$
 $r2=0.999999978326803$

$a = 56.5747779032428$ $g = 10.6413194105301$
 $b = -191.98656502171$ $h = -1.66653267659566$
 $c = 295.89508613563$ $i = 0.167871306228648$
 $d = -249.600420585566$ $j = -9.84858182436268E-03$
 $e = 131.14510747047$ $k = 2.56078547821804E-04$
 $F = -45.4926060279643$

ilm1015 $y=(a+cx+ex^2)/(1+bx+dx^2+fx^3)$ $r2=0.9998867020477855$

$a = 19.099119362194$ $d = 0.262526071367686$
 $b = -0.921249215987342$ $e = 3.95596518569618$
 $c = -14.3104845407484$ $F = 1.36147822009953E-05$

ilm1020 $y=a+b/x+c/x^2+d/x^3+e/x^4$ $r2=0.9999654796667286$

$a = 22.351174979139$ $d = -7261.16081257366$
 $b = -95.7856779349082$ $e = 12428.002363517$
 $c = 1431.46681543349$

ilm1030 $y=(a+cx+ex^2+gx^3)/(1+bx+dx^2+fx^3)$ [NL] $r2=0.9998878179300192$

$a = 67.3755288857154$ $e = 3.53190917741659$
 $b = -0.502296069841237$ $F = 4.17261875510103E-03$
 $c = -28.645279236809$ $g = 8.87672648515043E-02$
 $d = 0.066395852303225$

ilm1090 $y=(a+cx^{(0.5)}+ex+gx^{(1.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)})$ [NL]

$r2=0.9986609205434149$

$a = 56.0219612996787$ $e = 35.0470275489174$
 $b = -1.20823173289328$ $F = -6.17593415419685E-02$
 $c = -79.8331586144127$ $g = -4.98299903019805$
 $d = 0.474624810407928$

MODULO DUALLATEROLOG

Corrección por Borehole para Duallaterolog (RLLD-RLLS) corrido con MSFL
Cartas DLTF-1a y DLTF-1b manual Halliburton "Halliburton_Chart_Book" 2001
páginas 273 y 275

DLLboreholecorr6incentered

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$
$$r2=0.9999895533796914$$

a = 1.54043399192722	F = 0.663960318702376
b = 1.86199409260573	g = 0.605934453795052
c = 1.33452733747181	h = -2.54473369836614E-03
d = -0.543764192999782	i = -3.25639369866728E-03
e = -0.299833513762883	j = -6.29211287414058E-06

DLLboreholecorr8incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$
$$r2=0.9999964824537826$$

a = 1.06708515774019	g = 1.67608045905638E-05
b = -3.67061843765092E-02	h = -2.02621672971875E-05
c = 7.6326491943741E-03	i = 3.36714630827268E-06
d = 1.38576111073357E-03	j = -2.40770986813308E-07
e = -1.82917291956395E-03	k = 6.57211310864518E-09
F = 4.04667835020185E-04	

DLLboreholecorr10incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$
$$r2=0.9999481075045988$$

a = 1.0704253460709	g = 9.93735876964924E-05
b = 1.1845853763712E-03	h = -3.69904660016121E-05
c = -0.010341014450277	i = 5.0845582239317E-06
d = 6.27940285457669E-03	j = -3.28517315776073E-07
e = -2.43801796009897E-03	k = 8.31342857135454E-09
F = 2.63311566333507E-04	

DLLboreholecorr12incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$
$$r2=0.9999682590134187$$

a = 1.07325266986348	g = 1.53906278559491E-04
b = 3.95548211922048E-02	h = -3.32731187969052E-05
c = -2.74584414182098E-02	i = 3.48165368425575E-06
d = 8.55118081860976E-03	j = -1.79000846074672E-07
e = -1.50304530269626E-03	k = 3.5710685982107E-09
F = -1.75187314905337E-04	

DLLboreholecorr14incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9$$

$r^2=0.9998755684175624$

a = 1.07517123148257	F = -4.68514055213083E-04
b = 7.07191168739713E-02	g = 1.78897987091385E-04
c = -4.02229829912403E-02	h = -2.85801600172945E-05
d = 9.43459054916075E-03	i = 2.19074124359189E-06
e = -6.22509669501504E-04	j = -6.55534898984967E-08

DLLboreholecorr16incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$

$r^2=0.9999856504155199$

a = 1.07768514994491	e = 0.288766675331006
b = 9.98414721145559E-02	F = -6.1399374309761E-03
c = -4.96743560584422E-02	g = -0.005119479580709
d = 7.08163528840234E-03	h = 2.21278235517238E-04
e = 4.5433343636252E-04	i = 1.87068671923107E-04
F = 1.32391777212924E-04	
g = -2.44671578682036E-04	
h = 7.46875441110097E-05	
i = -1.04562614926731E-05	
j = 7.17757302156887E-07	
k = -1.95622546637808E-08	

SLLboreholecorr8incentered

$$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9$$

$r^2=0.9998262633781084$

a = 1.06361325778371
b = -7.97907451437648E-03
c = -1.19861536435901E-02
d = 3.22372479232503E-03
e = -2.76339569280881E-04
F = -4.16182423711628E-06
g = 6.63394122828091E-06
h = -1.76006322493864E-06
i = 1.95681446707442E-07
j = -7.53383889801092E-09

SLLboreholecorr6incentered

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+b$$
$$x^{(0.5)}+dx+fx^{(1.5)}+hx^2) [NL]$$

$r^2=0.999965676461206$

a = 1.08990142800612
b = 0.230202992991813
c = 0.282283165097601
d = 0.334585277619675

SLLboreholecorr10incentered

$$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) [NL]$$

$r^2=0.9999148281243118$

a = 1.06579037075814	g = 1.79397394910247E-02
b = 9.26959362862959E-02	h = -2.27740543225289E-03
c = 0.133888094020411	i = -3.33460439885638E-03
d = 7.33072349045787E-02	j = 4.1393755405569E-05
e = 5.48844598989598E-02	k = 9.50505542273511E-05
F = 1.13792718143057E-02	

SLLboreholecorr12incentered

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5)$$

[NL] r2=0.9999691212293262

$$a = 1.06842166343488$$

$$F = -1.86100549432868E-02$$

$$b = 0.287055973021104$$

$$g = -1.98823385482662E-02$$

$$c = 0.385126372534767$$

$$h = 1.47422116043336E-03$$

$$d = 4.23206359369323E-03$$

$$i = 1.83201940413374E-03$$

$$e = -1.39173217422242E-02$$

$$j = 1.43690581789632E-05$$

SLLboreholecorr14incentered

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$

r2=0.9999804021779799

$$a = 1.07204162893323$$

$$g = 2.74499150473654E-04$$

$$b = 0.124478545932391$$

$$h = -5.4306478684896E-05$$

$$c = -5.41778942811772E-02$$

$$i = 6.1472260699423E-06$$

$$d = 1.15324705201231E-02$$

$$j = -3.73636398545641E-07$$

$$e = -3.45711392225663E-04$$

$$k = 9.46029137611481E-09$$

$$F = -7.06231235407498E-04$$

SLLboreholecorr16incentered

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9$$

r2=0.9999568109261551

$$a = 1.07303422383644$$

$$F = 3.34437844405812E-04$$

$$b = 0.165185172738194$$

$$g = 2.70601546301935E-05$$

$$c = -6.33295247779412E-02$$

$$h = -1.84040600326421E-05$$

$$d = 1.37654827714884E-02$$

$$i = 2.42488567487079E-06$$

$$e = -2.52420453140628E-03$$

$$j = -1.02179881600126E-07$$

DLLboreholecorr6instandoff

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4)$$

[NL] r2=0.9999813303873495

$$a = 1.06475409608859$$

$$e = 0.125028001702656$$

$$b = 0.508753667035078$$

$$F = -9.19946364620005E-03$$

$$c = 0.475624550972145$$

$$g = -9.74906118160309E-03$$

$$d = 0.136217742718707$$

$$h = 4.60037060396834E-05$$

DLLboreholecorr8instandoff

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$$

r2=0.999992785460621

$$a = 1.066471846573$$

$$g = -2.37897670592718E-06$$

$$b = -3.68407113640834E-02$$

$$h = -3.37499206533993E-06$$

$$c = 6.37391958063021E-03$$

$$i = 1.70302894267963E-07$$

$$d = 1.6510927380176E-03$$

$$j = 1.77527914684462E-08$$

$$e = -1.42677863485656E-03$$

$$k = -1.254846095535362E-09$$

$$F = 2.59326885163578E-04$$

DLLboreholecorr10instandoff

$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9999901800513203$

a = 1.06892246195719	g = 2.53055220855131E-05
b = -4.9585421008969E-03	h = -1.88869896420171E-05
c = -5.46234499268738E-03	i = 2.91646108618368E-06
d = 3.80479697658906E-03	j = -1.98094911937611E-07
e = -1.88398952287713E-03	k = 5.16251819661403E-09
F = 3.37602260914545E-04	

DLLboreholecorr12instandoff

$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9999892223624996$

a = 1.07002573639195	g = 8.46561778207357E-05
b = 1.77583843663486E-02	h = -4.02289534703773E-05
c = -1.24365559260608E-02	i = 6.20930573116091E-06
d = 4.85655858786991E-03	j = -4.38983200954549E-07
e = -2.16508296294082E-03	k = 1.20154048568062E-08
F = 3.3183444205913E-04	

DLLboreholecorr14instandoff

$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8$
 $r^2=0.9999261181779197$

a = 1.07194496177267	F = 1.55995905869129E-04
b = 3.57452377250192E-02	g = -1.37177783394062E-05
c = -2.00531102030395E-02	h = 4.79025832660146E-07
d = 4.67030351073596E-03	i = 8.48464399517763E-10
e = -1.00308318239294E-03	

DLLboreholecorr16instandoff

$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5)$
[NL] $r^2=0.9999759610284871$

a = 1.07236501788519	F = 1.55271203124061E-02
b = -0.250311809064883	g = 2.52302542233671E-02
c = -0.217695421673076	h = 1.05607753966421E-05
d = -2.78535705530303E-02	i = -5.51414342957545E-04
e = -6.56083727326846E-02	j = 3.84487670071508E-05

SLLboreholecorr6instandoff

$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2)$ [NL]
 $r^2=0.9999588502950109$

a = 0.995101849594243	d = 3.01798665260774
b = 9.87615171190246	e = 2.92178297187931
c = 11.2152577349274	F = 2.14356242369835

g = 1.90482947909814
h = 0.018204175498231

i = 1.46430887705063E-02

SLLboreholecorr8instandoff

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ r2=0.9999349425780873

a = 1.06448052891371
b = -5.78409675058132E-03
c = -0.014261827713743
d = 2.71861747530206E-03
e = 4.15965806612982E-04
F = -8.00259161326238E-05

g = -4.63481284151911E-05
h = 1.66194334448973E-05
i = -2.25354302753447E-06
j = 1.43974640846352E-07
k = -3.59815874394291E-09

SLLboreholecorr10instandoff

$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5)$ r2=0.9999744688237307

a = 1.06458474233426
b = 7.17122738648323E-02
c = 0.104346539084798
d = -9.85681526393491E-03
e = -2.92698245292645E-02

F = -4.81394100181615E-03
g = -1.39611519635026E-03
h = 5.02018069940007E-04
i = 2.34688724030415E-04
j = -8.50677258717752E-06

SLLboreholecorr12instandoff

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ r2=0.999980797325968

a = 1.06548068555593
b = 6.23161518583995E-02
c = -2.72156523995669E-02
d = 4.79221166910118E-03
e = -1.45976441579729E-04
F = 5.30452000628391E-05

g = -1.04139986138584E-04
h = 4.26299453205095E-05
i = -7.90849241336759E-06
j = 7.02475516634919E-07
k = -2.34764505709275E-08

SLLboreholecorr14instandoff

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9$ r2=0.9999600987430912

a = 1.06919864019571
b = 8.90928106591462E-02
c = -3.08472284854368E-02
d = 8.0254874264527E-03
e = -2.14802096319192E-03

F = -1.8637075466399E-04
g = 4.57887103293729E-04
h = -1.43048561274275E-04
i = 1.79763860646142E-05
j = -7.81446562736126E-07

SLLboreholecorr16instandoff $y=a+bx+cx^{(0.5)}+d/x^{(0.5)}+e/x$

r2=0.9999667694306011

a = 1.38237565551289
b = 5.60409603225448E-03

c = -3.78522578297914E-02
d = -0.290939069093519

$$e = 0.010236718926443$$

MODULO DUALLATEROLOG

Corrección por espesor de capa "BedThickness" para Duallaterolog (RLLD-RLLS)
 Cartas DLTF-2a, DLTF-2c y DLTF-2e del manual "Halliburton Chart Book" 2001
 páginas 277, 279 y 281

LLDbedthickness0,2-0,1

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9997950092894248

a = -5.90217480320445	g = 12.1344124456705
b = -0.82828007995639	h = -1.6430315674525
c = 17.6225316636755	i = -3.64066285299427
d = -1.3428880156596	j = 0.355573449515459
e = -20.6240270035808	k = 0.448846767072452
F = 2.64953615548243	

LLDbedthickness0,2-0,2

$$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5)$$

[NL] r2=0.9987002126814638

a = -95.3535957280221	g = 1524.65693382815
b = 494.130173909209	h = -463.082244116329
c = 814.249505427259	i = -681.309967417559
d = -1187.09409114964	j = 102.248829798524
e = -1671.19446115456	k = 129.416712221263
F = 1077.52004838682	

LLDbedthickness0,2-0,5

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5)$$

[NL] r2=0.9967542316039106

a = 0.504434890177777	g = 3.32107230655351E-02
b = -0.935826449103472	h = -6.83701339113071E-03
c = -0.351809710351872	i = -9.15929604451182E-03
d = 0.276706243773406	j = 6.67152711531371E-04
e = 3.76222936971365E-02	k = 6.65270009891391E-04
F = -6.25617329641588E-03	

LLDbedthickness0,2-2

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9987052183810082

a = -8.17148262143621	e = 6.69140060482971
b = -11.5605313893483	F = -18.2143508186084
c = 8.27038332112379	g = -12.1841834981276
d = 22.8265708942473	h = 6.46821841786709

i = 5.48792498532186
j = -0.853529598577969

k = -0.809171363865534

LLDbedthickness0,2-5

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9963104625707146

a = 44.4344774144279
b = -4.89911170706562
c = -50.7550037800612
d = 5.09269043849186
e = 21.2814939417421
F = -0.712009711089725

g = -2.94720540909902
h = -0.051080627723333
i = 7.82114111663468E-02
j = 1.38937852347141E-02
k = 1.33542688365799E-02

LLDbedthickness0,2-10

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

r2=0.9969032928676544

a = 0.976319046599152
b = 6.03555761784793
c = 197.258413720694
d = -8989.28093695662
e = 139029.792120149
F = -1064747.47289875

g = 4593111.49955167
h = -11741573.9016442
i = 17684697.177036
j = -14523176.1479231
k = 5021546.55755672

LLDbedthickness0,2-20

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

r2=0.9986848102380041

a = 0.970352363025887
b = 5.96434663232933
c = 248.253911163352
d = -10280.4023087191
e = 153257.165041478
F = -1151241.82701862

g = 4921704.88669836
h = -12566863.5211025
i = 19030916.2571961
j = -15804845.0419506
k = 5554466.92551703

LLDbedthickness0,2-50

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9984219556199767

a = 0.577395932286913
b = -2.13621294652964
c = -1.38682343554531
d = 1.74099856627955
e = 1.26390534330021
F = -0.675624683298776

g = -0.542571086881962
h = 0.124202058664699
i = 0.108061379110046
j = -8.81887403123917E-03
k = -8.20407166933394E-03

LLDbedthickness0,2-100

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \text{ [NL]} \quad r2=0.9977531785125278$$

a = 0.23465467709478	g = -1.65707843048795
b = -3.51053554616145	h = 0.835888154095776
c = -1.23205443757158	i = 0.579332003610007
d = 4.57547792093458	j = -9.41156308272934E-02
e = 2.12060566723258	k = -7.40287308735482E-02
F = -2.83791066734617	

LLDbedthickness1-0,02

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)}) \text{ [NL]} \quad r2=0.9991809640335774$$

a = 0.118411402351839	g = 0.112735010070133
b = -1.4137679174196	h = -1.83112975972776E-03
c = 5.24048815858255E-02	i = -2.28008555920275E-02
d = 0.646823772881838	j = 8.71350854495734E-04
e = -0.201827529110723	k = 1.57334606857246E-03
F = -0.091642929617052	

LLDbedthickness1-0,05

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \text{ [NL]} \quad r2=0.9988254788207851$$

a = 0.373870250624772	g = 0.247592237535143
b = -2.32063418316688	h = 7.01328139990054E-02
c = -0.46315206866953	i = -0.106810798076724
d = 1.92702544152251	j = 5.27225398035554E-04
e = -2.73997966179476E-02	k = 1.33910916483613E-02
F = -0.634907468737026	

LLDbedthickness1-0,1 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4+jx^5)$

$$\text{ [NL]} \quad r2=0.9955281806118544$$

a = 0.466936881971938	F = -4.17208747342049E-02
b = -0.802733617175394	g = -3.54184109853528E-02
c = -0.390757808505675	h = 5.93984002725196E-03
d = 0.24147282656386	i = 4.03874564894637E-03
e = 0.157491725575969	j = -1.43399248862046E-05

LLDbedthickness1-0,2

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$$r2=0.9948799574758204$$

a = 0.301500789446625	e = -4.17616512367072E-02
b = -0.730475566202244	F = 5.21612833073062E-03
c = -6.82697431312514E-02	g = 2.02205714168689E-02
d = 0.146912138793974	h = -1.12364055401807E-03

i = -1.54799160300051E-03
j = 3.97346326088295E-05

k = 4.05458783266543E-05

LLDbedthickness1-0,5

$$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$$

[NL] r2 = 0.985688035278315

a = -3.31551113627551

F = -9.42344560517597

b = 33.8716963526638

g = -9.96122873140854

c = 40.4219167658831

h = 9.37005793376841

d = -28.6708193846563

i = 8.84422755969306

e = -29.5067323418153

j = -7.79282155846558E-02

LLDbedthickness1-2 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4+jx^5)$ [NL]

r2=0.9963103668886645

a = 1.50503611048583

F = -0.121766295359588

b = -1.37356233077609

g = -0.145495159007483

c = -1.90711594216073

h = 7.74802605253578E-03

d = 0.686450824300041

i = 8.96199310490383E-03

e = 0.869744027005829

j = 8.54085739133257E-06

LLDbedthickness1-5

$$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$$

[NL] r2=0.9980581471620233

a = -6.93355321179264

g = 5.83083952177864

b = -8.62201612475105

h = 4.90224196704058

c = 18.1126872142851

i = 0.673367634657255

d = 13.9879643380289

j = -0.812577015995741

e = -18.3101092193031

k = -0.448545908162387

F = -11.5987419052938

LLDbedthickness1-10

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5+mx^6+ox^7+qx^8+sx^9)/(1+bx+dx^2+fx^3+hx^4+jx^5+lx^6+nx^7+px^8+rx^9)$$

r2=0.9994930738009797

a = 0.32105484214315

k = -6.34965896921326E-03

b = -1.56129884425454

l = 5.82203462955415E-04

c = -0.665486815654414

m = 5.02864532733616E-04

d = 0.974487934345128

n = -2.50861022119629E-05

e = 0.511942063997096

o = -2.29517191643885E-05

F = -0.328484376599963

p = 5.7685717808068E-07

g = -0.206269461476772

q = 5.5160681118216E-07

h = 6.54788794420363E-02

r = -5.54315148674578E-09

i = 4.72600162203613E-02

s = -5.5113142639172E-09

j = -7.93277476709696E-03

LLDbedthickness1-20

y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5) [NL] r2=0.9941399757417045

- a = -3.82193850889888, b = -3.63593863350569, c = 11.4060171307241, d = 4.54561302218086, e = -12.5756395636848, F = -3.16772190774203, g = 5.66735270739309, h = 1.18904434122482, i = -0.895945550075767, j = -0.188230220682791, k = -9.64573537372685E-03

LLDbedthickness1-50

y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^(10) r2 = 0.994323622500122

- a = 0.868836505119018, b = 19.6095372351925, c = -200.849615393277, d = -7469.42526773975, e = 207634.381956879, F = -2195706.79903818, g = 12615337.6477614, h = -42960549.7489202, i = 86811600.860971, j = -96344181.9268158, k = 45285027.916702

LLDbedthickness1-100

y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^(10) r2 = 0.993658250145151

- a = 1.01033758005602, b = -0.829112874899202, c = 928.307861788342, d = -37471.1184415706, e = 652769.965620923, F = -6179454.75341012, g = 34937911.8841494, h = -121719780.642509, i = 256595241.73287, j = -300455132.970619, k = 150084982.921288

LLDbedthickness10-0,02

y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) [NL] r2=0.9958472956547718

- a = 0.187409908647205, b = -0.656020750678529, c = 7.3761872771894E-03, d = 0.130130232238469, e = -3.55635068239773E-02, F = -1.7728862015842E-03, g = 9.80043456502179E-03, h = -2.24193187281428E-04, i = -5.64296093375247E-04, j = 1.31087410590479E-05, k = 1.35095251950634E-05

LLDbedthickness10-0,05

y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5) [NL] r2=0.9948357195239408

- a = 0.379172964185712, b = -2.31499474520831, c = -0.489435532431378, d = 2.01540200835684

$e = 6.25489890639354E-02$ $i = -0.101834288740449$
 $F = -0.731185935389814$ $j = -8.89970977382507E-04$
 $g = 0.196488838034762$ $k = 0.014586560813914$
 $h = 9.73164195240906E-02$

LLDbedthickness10-0,1

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$r^2=0.994557280705021$

$a = 0.345244277703245$ $g = -8.39967547397204E-03$
 $b = -0.884243383952236$ $h = 1.02178572469824E-03$
 $c = -0.248901729267236$ $i = 1.45719229564069E-04$
 $d = 0.289586773907763$ $j = 1.43701509908844E-05$
 $e = 9.14756343762408E-02$ $k = 1.85697441403311E-05$
 $F = -0.030101369017455$

LLDbedthickness10-0,2

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$r^2=0.9920376336929085$

$a = 0.398329424146406$ $g = -6.59087197375832E-03$
 $b = -0.85679645540481$ $h = 7.88478822208207E-04$
 $c = -0.277633293154348$ $i = 6.61855843344965E-05$
 $d = 0.275536180528323$ $j = 1.7077634155115E-05$
 $e = 9.95677551426194E-02$ $k = 2.07532964327091E-05$
 $F = -2.50268318322377E-02$

LLDbedthickness10-0,5

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9$$

$r^2=0.9942105257577581$

$a = 1.10934918497094$ $F = -4.32096279669732$
 $b = -3.21657543201841$ $g = 1.00302823591892$
 $c = 10.7969100665588$ $h = -0.126891258731774$
 $d = -14.9310310857359$ $i = 7.29559435508214E-03$
 $e = 10.6863486255562$ $j = -8.7950890000147E-05$

LLDbedthickness10-2

$$y=a+blnx+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5$$

$r^2=0.9993212626377689$

$a = -101.086680825716$ $g = 34.1010710302609$
 $b = 66.896443422655$ $h = -0.990976177371446$
 $c = 105.488332315888$ $i = -8.77333453627457$
 $d = -28.2306856216678$ $j = 5.63900253789941E-02$
 $e = -74.6026494130802$ $k = 0.94853319318959$
 $F = 7.18719717231398$

LLDbedthickness10-5

$$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5 \quad r^2=0.9987235462334189$$

a = 1847.81608043124	g = -1736.18712214832
b = -783.400268734622	h = 3.19107312699211
c = -2832.12158693569	i = 606.163401146413
d = 212.388460288726	j = -0.120848474183982
e = 2809.25989225269	k = -90.8603981400908
F = -35.1125452983171	

LLDbedthickness10-10

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10} \quad r^2=0.9980724253901383$$

a = 0.854231214164361	g = 4271185.05475543
b = 25.020873708375	h = -16270787.3970768
c = -643.783950877022	i = 34820435.2709279
d = 5305.61472337171	j = -39824964.9825722
e = 16650.1509082878	k = 18994144.4217156
F = -574308.067648193	

LLDbedthickness10-20

$$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5 \quad r^2=0.9984505992305252$$

a = 9588.92682956796	g = -10550.83022471
b = -3954.84723992002	h = 17.0690834594063
c = -15373.3371395219	i = 3893.18785525452
d = 1065.04981506303	j = -0.699408327847239
e = 16107.3286637918	k = -611.379537658286
F = -179.309762272043	

LLDbedthickness10-50

$$y=a+b/\ln x+c/(\ln x)^2+d/(\ln x)^3+e/(\ln x)^4+f/(\ln x)^5+g/(\ln x)^6+h/(\ln x)^7+i/(\ln x)^8+j/(\ln x)^9+k/(\ln x)^{10} \quad r^2=0.9926102939370306$$

a = 293.102886659335	g = 3564353.21097614
b = -6327.29793527901	h = -3565662.8402257
c = 59199.9596538067	i = 2279192.36453373
d = -315482.97165627	j = -842430.259956931
e = 1063071.00423552	k = 136996.570542824
F = -2373201.41141019	

LLDbedthickness10-100

$$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5 \quad r^2=0.9915748250828497$$

a = -3623.78072649303	c = 9754.16378364705
b = 746.933120479279	d = -53.2314883460333

e = -15828.7334550654	i = -8318.63250635425
F = -9.10058784348076	j = -0.12020059554303
g = 15420.8906580201	k = 1911.65779734517
h = 2.08945982915717	

LLDbedthickness1000-0,002

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9984216393513717$

a = -2.64575740558946	g = -53.8922922549035
b = 24.9639797539379	h = 15.1121557390016
c = -86.1526966828283	i = -2.62231997810061
d = 161.542467117499	j = 0.256590183048913
e = -178.738338390175	k = -0.01082711212749
F = 122.843030173115	

LLDbedthickness1000-0,005

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.994177327273518$

a = -2.34177896666836	g = -35.9934495924716
b = 21.1197055792759	h = 9.68546024178615
c = -68.1672644314984	i = -1.60945877774685
d = 121.622799646894	j = 0.150519054457928
e = -129.120526151497	k = -6.06099610320286E-03
F = 85.3495468913895	

LLDbedthickness1000-0,01

$y=a+b\ln x+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10}$ $r^2=0.9961543365071196$

a = -0.224460991480266	g = -13.2858741480339
b = 5.30081581269729	h = 3.56750712776381
c = -18.804311798269	i = -0.583065013445787
d = 38.3621303794879	j = 0.053069204710543
e = -44.5892510271698	k = -2.06345058586412E-03
F = 30.9304221744459	

LLDbedthickness1000-0,02 Chebyshev=>Std Rational Order 6/7

$r^2=0.9991538972434628$

a = 0.424965826676921	h = 0.004504792917722
b = -1.0189958375908	i = 2.47134579881851E-03
c = -0.457298758321156	j = -1.28021895437696E-04
d = 0.412367144055319	k = -6.91534876004035E-05
e = 0.208995987226702	l = 1.46659109907195E-06
F = -6.54846679589845E-02	m = 7.11379256467182E-07
g = -3.51047973925429E-02	n = -2.82444455679854E-09

LLDbedthickness1000-0,05

$$y=a+blnx+c(\ln x)^2+d(\ln x)^3+e(\ln x)^4+f(\ln x)^5+g(\ln x)^6+h(\ln x)^7+i(\ln x)^8+j(\ln x)^9+k(\ln x)^{10} \quad r^2=0.9977300804958163$$

a = 1.72483975864601	g = 6.8762414067881
b = -9.38563602879996	h = -1.64314423355259
c = 28.03897897919	i = 0.250953550987621
d = -40.9279581734978	j = -2.21940196501979E-02
e = 34.9825508716455	k = 8.63765664949239E-04
F = -19.0685801451731	

LLDbedthickness1000-0,1

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \quad r^2=0.9990108255769806$$

a = 0.533090341159739	F = -1.03956093451372
b = -2.48337444896871	g = -0.562398590234494
c = -1.28257406412165	h = 0.154528864987368
d = 2.65236141069782	i = 6.74711549559648E-02
e = 1.48713453059889	j = -5.77412616440917E-03

LLDbedthickness1000-0,2

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \quad r^2=0.9998299760674057$$

a = 0.708050565648662	g = -1.70661980405483
b = -3.25294709308716	h = 0.435563305659109
c = -2.4486799909903	i = 0.363305507299942
d = 4.19327447024902	j = -3.28448201160716E-02
e = 3.3554649567262	k = -2.76289049573527E-02
F = -2.07565960015771	

LLDbedthickness1000-0,5 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4)$ [NL]

$$r^2=0.9998314818138221$$

a = 0.909720301794302	F = -1.40124686894677E-02
b = -1.17720060396171	g = -1.34210036094283E-02
c = -1.09724614300035	h = 1.64118583241627E-04
d = 0.39119266623103	i = 1.57420204790873E-04
e = 0.370271712077472	

LLDbedthickness1000-2

$$y=(a+clnx+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4)/(1+blnx+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \quad r^2=0.9999836773905587$$

[NL]

a = 225.892354777662	e = 242.757659365045
b = 258.065935594401	F = 388.387879752648
c = -407.988729606358	g = -17.9095929239714
d = -512.465973063658	h = -79.6710662539852

$$i = 24.3790697559247$$

$$j = 9.55377739741486$$

LLDbedthickness1000-5

$$y=a+blnx+c/lnx+d(lnx)^2+e/(lnx)^2+f(lnx)^3+g/(lnx)^3+h(lnx)^4+i/(lnx)^4+j(lnx)^5+k/(lnx)^5 \quad r^2=0.9999989978774138$$

$$a = -2198.79044950846$$

$$g = 1842.84146775634$$

$$b = 997.919515615597$$

$$h = -5.88054200852887$$

$$c = 3215.22447940798$$

$$i = -627.241850878545$$

$$d = -296.720647161605$$

$$j = 0.269388372400534$$

$$e = -3074.74092905228$$

$$k = 92.8044743522803$$

$$F = 55.4264165675455$$

LLDbedthickness1000-10

$$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4) \quad [NL]$$

$$r^2=0.9998777928263002$$

$$a = 1.18125371140271$$

$$F = -0.81039876740167$$

$$b = -2.7845396140052$$

$$g = -0.927863039740198$$

$$c = -3.24265595205121$$

$$h = 8.54393639046272E-02$$

$$d = 2.52625314355117$$

$$i = 0.097391323685621$$

$$e = 2.91193681755169$$

LLDbedthickness1000-20

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \quad [NL]$$

$$r^2=0.999754039433869$$

$$a = 4.90609513099448$$

$$g = 0.347386396472363$$

$$b = -0.276100595581294$$

$$h = -7.15173614694726E-03$$

$$c = -3.05896032264644$$

$$i = -4.67612774899828E-03$$

$$d = -0.895787005281348$$

$$j = 2.40392414567815E-04$$

$$e = -0.354445001987703$$

$$k = 2.56443661154363E-04$$

$$F = 0.361473799060725$$

LLDbedthickness1000-50

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)}) \quad [NL]$$

$$r^2=0.9999738268224296$$

$$a = 1.29322432559296$$

$$F = -0.134808906812188$$

$$b = -1.50353801002327$$

$$g = -0.18282598538357$$

$$c = -1.94938828219294$$

$$h = 8.40731536416073E-03$$

$$d = 0.743269855138576$$

$$i = 1.27342482251688E-02$$

$$e = 0.973821134703138$$

$$j = 9.21747727215846E-05$$

LLDbedthickness1000-100

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)}) \quad [NL]$$

$$r^2=0.9999868554825075$$

$$a = 1.29657920198122$$

$$c = -1.89099403763154$$

$$b = -1.46020575467099$$

$$d = 0.696868572057577$$

e = 0.903247632531489
F = -0.121168678638147
g = -0.158703684213372

h = 7.60715276969509E-03
i = 1.05424532132328E-02
j = 3.7945661441334E-05

LLSbedthickness0,2-0,1

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$ [NL] r2=0.9987258539464429

a = 4.55949284964004E-02
b = 0.616532736944616
c = 3.48558636726216
d = -5.69824071175477
e = -8.48916298252085
F = 6.67174766892467

g = 7.67291704728289
h = -2.90529724251505
i = -3.02431351086634
j = 0.447095619842474
k = 0.448052494719087

LLSbedthickness0,2-0,2

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$
r2=0.9965197110847069

a = 0.593058918460173
b = -2.7530717205682
c = -1.43663871512388
d = 2.86989137158112
e = 1.38041816664143

F = -1.28771968153091
g = -0.565879565095961
h = 0.243784427260764
i = 0.088605855239064
j = -1.21865040039605E-02

LLSbedthickness0,2-0,5

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$ r2=0.9993004718931878

a = 0.679662937325188
b = -2.69033431359542
c = -1.67202611512839
d = 3.07127581939527
e = 1.93049513849696
F = -1.57946036681008

g = -1.02971793853892
h = 0.377140900691227
i = 0.259303141093787
j = -3.09255984695024E-02
k = -2.16836967636658E-02

LLSbedthickness0,2-2

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$ [NL] r2=0.9986037458354233

a = 37.601233863292
b = 159.858519477673
c = 67.4014057277686
d = -484.306222674792
e = -423.200842220622
F = 624.190140730838

g = 626.374522979183
h = -331.980652135685
i = -340.816823814956
j = 65.010215561025
k = 66.3445596129394

LLSbedthickness0,2-5

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

$$r^2=0.998950699933317$$

$$\begin{aligned} a &= 1.01077401160419 \\ b &= -0.946215976783877 \\ c &= -22.6024080744009 \\ d &= 461.832501543468 \\ e &= 3005.55803383164 \\ F &= -71070.2944040371 \end{aligned}$$

$$\begin{aligned} g &= 433986.340770428 \\ h &= -1321497.24541319 \\ i &= 2209745.19595714 \\ j &= -1942426.02309663 \\ k &= 703169.195338278 \end{aligned}$$

LLSbedthickness0,2-10

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

$$r^2=0.997866977434675$$

$$\begin{aligned} a &= 1.05370357594741 \\ b &= -7.21351350082032 \\ c &= 252.587735707822 \\ d &= -4854.38142106955 \\ e &= 57510.8713782766 \\ F &= -396894.915296339 \end{aligned}$$

$$\begin{aligned} g &= 1630558.01766111 \\ h &= -4067105.2132877 \\ i &= 6057231.49465142 \\ j &= -4960590.21254933 \\ k &= 1720512.24997747 \end{aligned}$$

LLSbedthickness0,2-20

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

$$r^2=0.9981358366271469$$

$$\begin{aligned} a &= 1.51486443139388 \\ b &= -5.57916058551633 \\ c &= -0.599024475081062 \\ d &= 4.83184240855846 \\ e &= 0.176810265643167 \\ F &= -1.16642451996708 \end{aligned}$$

$$\begin{aligned} g &= 1.57748629876541E-02 \\ h &= 5.28534128633845E-02 \\ i &= -2.08373016783266E-02 \\ j &= 1.77912781321605E-02 \\ k &= 1.85566371199611E-02 \end{aligned}$$

LLSbedthickness0,2-50

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

$$r^2=0.9981906846592423$$

$$\begin{aligned} a &= 0.98640641958859 \\ b &= 3.91165716841587 \\ c &= -322.171580452595 \\ d &= 8462.65834351071 \\ e &= -107835.246388181 \\ F &= 808017.199902168 \end{aligned}$$

$$\begin{aligned} g &= -3753321.98368014 \\ h &= 10833808.8651284 \\ i &= -18823728.1464138 \\ j &= 17985775.2616063 \\ k &= -7251208.94026383 \end{aligned}$$

LLSbedthickness0,2-100

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

$$r^2=0.9990144044974942$$

$$a = 0.935322954463171$$

$$b = 11.623353014893$$

c = -743.525802340773
 d = 18943.4548978678
 e = -247136.610459722
 F = 1896529.67555529
 g = -8994770.27753749
 h = 26556899.9957617
 i = -47423237.3604718
 j = 46828508.0143953
 k = -19614095.6392318

LLSbedthickness1-0,02

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$ [NL] r2 = 0.999860547619522

a = 0.361752432316038
 b = -2.2098106002605
 c = -0.202327731982598
 d = 1.68412071526247
 e = -0.487641452570549
 F = -0.373304018974134
 g = 0.637362178121871
 h = -6.18654584425384E-02
 i = -0.270513183334224
 j = 2.48690649807486E-02
 k = 4.05822559064728E-02

LLSbedthickness1-0,05

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$
 r2 = 0.999791908413318

a = 0.525467220057476
 b = -2.63852789302553
 c = -1.21455376876601
 d = 2.60305904779585
 e = 1.08267613859782
 F = -1.12984149566758
 g = -0.417239398267847
 h = 0.211161023080847
 i = 6.11758366636403E-02
 j = -1.15925516880314E-02

LLSbedthickness1-0,1

$y=(a+clnx+e(lnx)^2+g(lnx)^3+i(lnx)^4+k(lnx)^5)/(1+blnx+d(lnx)^2+f(lnx)^3+h(lnx)^4+j(lnx)^5)$ r2=0.9978336523664971

a = 0.482941479115958
 b = -2.69553357335479
 c = -1.09562157577224
 d = 2.77306581482301
 e = 1.01694403241641
 F = -1.22159895873672
 g = -0.382271834655021
 h = 0.222318863418193
 i = 4.30208516224532E-02
 j = -1.00415449835902E-02
 k = 3.99588355966981E-03

LLSbedthickness1-0,2 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4)$ [NL]
 r2 = 0.992799915262375

a = 0.643267974755729
 b = -0.995235346985759
 c = -0.669604357801542
 d = 0.335000895337388
 e = 0.249547176415548
 F = -0.037334102702319
 g = -3.20615422823545E-02
 h = 2.06452855798831E-03
 i = 2.01222086303382E-03

LLSbedthickness1-0,5 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4)$ [NL]
 r2 = 0.999981204107992

a = 0.84549913673398	F = -5.15942242220291E-02
b = -1.11196078023276	g = -4.90436586597931E-02
c = -0.969105447501918	h = 2.74662234854365E-03
d = 0.411018161286489	i = 2.70948796825731E-03
e = 0.372786847221763	

LLSbedthickness1-2 $y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4+jx^5)$ [NL]
 $r^2 = 0.999904814734601$

a = 1.12636978141269	F = -0.113634612563012
b = -1.36967210838589	g = -0.10369409939577
c = -1.43098112351693	h = 9.75264884228263E-03
d = 0.646317294749597	i = 9.03713806975991E-03
e = 0.628513102824124	j = -6.02669480913503E-06

LLSbedthickness1-5

$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5$ $r^2=0.999971162180877$

a = 248.988510316574	g = -138.331091389444
b = -106.568514342528	h = 0.110913597806591
c = -341.669512272412	i = 36.9393701020767
d = 25.9605462277278	j = 6.38293865958741E-03
e = 282.7578809119	k = -4.11970261740475
F = -3.16067486562309	

LLSbedthickness1-10

$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4+j(\ln x)^5+k/(\ln x)^5$ $r^2 = 0.999728241440906$

a = -121.238136784981	g = 268.877417388907
b = 36.2848815336265	h = -0.202806571926883
c = 269.533821400419	i = -107.104013867663
d = -8.2466664785198	j = 1.18405073456662E-02
e = -356.182192969535	k = 17.584811595389
F = 1.56104504401716	

LLSbedthickness1-20

$y=a+b/\ln x+c/(\ln x)^2+d/(\ln x)^3+e/(\ln x)^4+f/(\ln x)^5+g/(\ln x)^6+h/(\ln x)^7$ $r^2 = 0.99967783972722$

a = -2.66754890128299	e = -1722.91509757704
b = 57.0698407507968	F = 1558.89373655587
c = -345.710919938417	g = -730.403673648301
d = 1048.07133712424	h = 138.565664064789

LLSbedthickness1-50

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

$$r2=0.9998487928090398$$

a = 0.98491284495737	g = 4220392.65991186
b = 2.16938430447704	h = -18300698.8777269
c = -138.187249659222	i = 44215445.8377344
d = 1550.76846628925	j = -56406268.207975
e = 19973.3342041405	k = 29649970.2993589
F = -506988.412533534	

LLSbedthickness1-100

$$y=a+b/\ln x+c/(\ln x)^2+d/(\ln x)^3+e/(\ln x)^4+f/(\ln x)^5+g/(\ln x)^6+h/(\ln x)^7+i/(\ln x)^8+j/(\ln x)^9+k/(\ln x)^{10} \quad r2 = 0.968156853308414$$

a = -18.2907320304218	g = 46664.8053057914
b = 308.214721005477	h = -71828.1276344971
c = -1932.78238325343	i = 58994.1262698542
d = 5768.5091802766	j = -25699.7771823435
e = -6271.64143394676	k = 4682.77650008863
F = -10666.8089767282	

LLSbedthickness10-0,02

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

$$[NL] \quad r2=0.9971149005101876$$

a = 6.39480147066123	g = -9.43823950232378
b = -9.10780473180547	h = 2.03753906721106
c = -18.2990253712721	i = 2.21746702463538
d = 13.4743654004082	j = -0.193910085219023
e = 19.1304202758583	k = -0.201478414639347
F = -7.90893750735953	

LLSbedthickness10-0,05

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

$$[NL] \quad r2=0.9971149005101876$$

a = 6.39480147066123	g = -9.43823950232378
b = -9.10780473180547	h = 2.03753906721106
c = -18.2990253712721	i = 2.21746702463538
d = 13.4743654004082	j = -0.193910085219023
e = 19.1304202758583	k = -0.201478414639347
F = -7.90893750735953	

LLSbedthickness10-0,1

$$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \quad [NL] \quad r2=0.9994368167538802$$

a = 0.421849468860481	c = -0.646080903569415
b = -2.29593640426855	d = 2.04788132684531

e = 0.341224789506077
 F = -0.691213319528463
 g = 9.45390107132619E-02
 h = 0.033423443478521
 i = -0.129810783787122
 j = 1.63946059795517E-02
 k = 2.88803352135509E-02

LLSbedthickness10-0,2

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9973618994205482

a = -1.14353244261898
 b = 1.10650024736321
 c = 2.77959733338861
 d = -1.19763707647122
 e = -1.54668608883676
 F = 0.420951817231417
 g = 0.426709713861908
 h = -4.59156124534778E-02
 i = -4.46369953910912E-02
 j = 1.88817267492107E-03
 k = 1.86650780884879E-03

LLSbedthickness10-0,5

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9991583099237455

a = 6.28825315886534E-02
 b = -0.181316533154574
 c = 0.580686256486463
 d = -0.100582429390924
 e = -0.280151165089434
 F = 0.109873503872888
 g = 0.11952376685329
 h = -1.19686094506866E-02
 i = -1.19628440723025E-02
 j = 6.38139741915152E-04
 k = 6.36773674350919E-04

LLSbedthickness10-2 $y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9$

r2 = 0.999928258018598

a = 0.997075821818274
 b = 0.605910089520607
 c = -42.1240023064274
 d = 953.600973954097
 e = -9084.9501493703
 F = 45735.4735505417
 g = -132356.039761556
 h = 221135.547051711
 i = -197843.346016961
 j = 73241.1205506432

LLSbedthickness10-5

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

r2=0.999665671116991

a = 0.998462464204216
 b = 0.595268659708473
 c = -59.4901543021216
 d = 1494.33907087746
 e = -14296.9276394395
 F = 65242.9083377908
 g = -127178.093572428
 h = -60444.9955532181
 i = 734223.563334647
 j = -1227549.17387513
 k = 688522.996513632

LLSbedthickness10-10

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{10}$$

r2=0.9997353890152301

a = 0.99972165501541	g = 972374.554980381
b = 0.404358164040567	h = -4049199.32139678
c = -54.6141812202319	i = 9146652.50020673
d = 957.945070112324	j = -10821676.9150992
e = 609.877520376769	k = 5273143.45994029
F = -110077.636794044	

LLSbedthickness10-20

$$y=a+b/\ln x+c/(\ln x)^2+d/(\ln x)^3+e/(\ln x)^4+f/(\ln x)^5+g/(\ln x)^6+h/(\ln x)^7+i/(\ln x)^8+j/(\ln x)^9+k/(\ln x)^{10}$$

r2=0.9998208005878514

a = 8.38299117710717	g = 221765.120750644
b = -213.934180245762	h = -227567.206440185
c = 2481.06798057226	i = 146655.614493775
d = -15488.6247083399	j = -53922.2640135579
e = 58424.6075848757	k = 8633.02569406099
F = -140774.636041149	

LLSbedthickness10-50

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9989197369435867

a = -2.48785058223042	g = -3.0743160884855
b = -4.19446760594317	h = 0.999453912598413
c = 1.27086152068789	i = 0.946697369009941
d = 6.06539138427573	j = -0.106659562728107
e = 3.09928913066072	k = -0.105500815589138
F = -3.72249282427957	

LLSbedthickness10-100

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9993520805481453

a = 23.3264436107811	g = 5.57925289543709
b = 6.17639025255519	h = -2.68715625606811
c = -29.1689863391561	i = -2.2403704313315
d = -14.9070222935869	j = 0.285982929080608
e = 4.82016446118652	k = 0.271340875210234
F = 10.2047286253408	

LLSbedthickness1000-0,002 7068 High Precision Rational Order 9/9 r2 = 0.99999906218186

a = -0.729651974597557	d = -0.755363116083724
b = 0.118339750261309	e = -1.48565973210294
c = 1.89781955873273	F = 0.437612512431051

g = 0.588017268047899	n = 6.37427958068282E-05
h = -0.11641441946649	o = 6.56905981587053E-05
i = -0.133389973052982	p = -1.48093803161054E-06
j = 1.69191872441347E-02	q = -1.51845164426808E-06
k = 1.80496501891092E-02	r = 1.67696689540159E-08
l = -1.39695706356952E-03	s = 1.70056142868039E-08
m = -1.44949761652305E-03	

LLSbedthickness1000-0,005

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9992804083029715

a = -3.02735719077069E-02	g = -1.19386130757081E-02
b = -0.546630437839556	h = 1.57215201373654E-03
c = 0.190216385741992	i = 1.10868128186979E-03
d = 0.206089579933123	j = 3.40516557255227E-05
e = 9.56322851633237E-03	k = 3.69485576373374E-05
F = -3.00990995436481E-02	

LLSbedthickness1000-0,01

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9991999643656107

a = -1.66583165471762	g = 8.33782638694002E-02
b = 0.956266803449952	h = -3.59209049180326E-03
c = 2.57812624219403	i = -4.49900197823452E-03
d = -0.326432625384635	j = 2.11505949484933E-04
e = -0.726317161256115	k = 2.17848884474463E-04
F = 4.80005163327022E-02	

LLSbedthickness1000-0,02

$$y=(a+c\ln x+e(\ln x)^2+g(\ln x)^3+i(\ln x)^4+k(\ln x)^5)/(1+b\ln x+d(\ln x)^2+f(\ln x)^3+h(\ln x)^4+j(\ln x)^5) \text{ [NL]}$$

r2=0.9995348775836026

a = 0.195742129298673	g = 0.435094159822235
b = -1.23530453478724	h = 3.32717470484568E-02
c = 0.485035097184204	i = -0.104444442520911
d = 0.707423554494136	j = 1.86845408226098E-03
e = -0.829855681756319	k = 1.25008822129142E-02
F = -0.234647081919709	

LLSbedthickness1000-0,05

$$y=(a+cx+ex^2+gx^3+ix^4)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.99984898500451

a = 0.463487169691265	e = 0.381612473799475
b = -1.09292491483991	F = -7.47044362784832E-02
c = -0.64814688594581	g = -6.18289324236831E-02
d = 0.527615051896157	h = 4.04760854677912E-03

$$i = 3.75841029700625E-03$$

$$j = -1.54012038255157E-06$$

LLSbedthickness1000-0,1

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2+kx^{(2.5)})/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)})$$

[NL] r2=0.9996183532856606

$$a = 1.17398057886854$$

$$g = -2.25858066696207$$

$$b = -3.31522596209751$$

$$h = 0.604576945858421$$

$$c = -3.55406239768946$$

$$i = 0.595693309892036$$

$$d = 4.01772755439683$$

$$j = -6.18305176945558E-02$$

$$e = 4.09709550070063$$

$$k = -6.10175355235981E-02$$

$$F = -2.27264193649264$$

LLSbedthickness1000-0,2

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9992414768441855

$$a = -1.63406058987478$$

$$g = 1.06094300728235$$

$$b = 2.76271450412445$$

$$h = -0.127633769871742$$

$$c = 4.606418952872$$

$$i = -0.123933739824742$$

$$d = -2.85807029610952$$

$$j = 5.83049048207651E-03$$

$$e = -3.19618381092969$$

$$k = 5.77203146296752E-03$$

$$F = 1.08721298197504$$

LLSbedthickness1000-0,5

$$y=(a+cx^{(0.5)}+ex+gx^{(1.5)}+ix^2)/(1+bx^{(0.5)}+dx+fx^{(1.5)}+hx^2+jx^{(2.5)}) \text{ [NL]}$$

r2=0.9998515394378389

$$a = 0.880635414847892$$

$$F = -0.442548256139283$$

$$b = -2.04174519328559$$

$$g = -0.404822079865244$$

$$c = -1.82727659483298$$

$$h = 4.98741636983944E-02$$

$$d = 1.47793077252302$$

$$i = 4.54666025916079E-02$$

$$e = 1.33997277230766$$

$$j = -1.72160906373374E-04$$

LLSbedthickness1000-2 $y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3$

r2=0.9999231556265524

$$a = 12.3463505253515$$

$$e = 7.13612924922862$$

$$b = -4.73416427264838$$

$$F = -7.06196866258631E-02$$

$$c = -13.279887503374$$

$$g = -1.29748803001776$$

$$d = 0.938775012109326$$

LLSbedthickness1000-5

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9$$

r2=0.9999378111666827

$$a = 0.985513035244931$$

$$d = 4273.85845470847$$

$$b = 3.0945708466204$$

$$e = -46914.7563581351$$

$$c = -179.736514403675$$

$$F = 279445.234530673$$

g = -964891.067018342
h = 1932532.78333674

i = -2085320.24304302
j = 939475.170512599

LLSbedthickness1000-10

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9999257730780938

a = 15.4760396022986
b = 24.2775107338024
c = 12.6860598825709
d = -25.7832757326974
e = -22.8858395305081
F = 8.78639993808733

g = 8.54020459153563
h = -1.07335005420931
i = -1.05592061620703
j = 5.08980313699585E-02
k = 5.05826442270848E-02

LLSbedthickness1000-20

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

r2=0.9999903822264201

a = 1.01507156635975
b = -3.47657542677429
c = 177.552779771804
d = -4444.89209206064
e = 75797.4133575793
F = -795874.66789344

g = 5069292.09725195
h = -19713587.6541362
i = 45844659.9238401
j = -58673658.3606116
k = 31845973.637688

LLSbedthickness1000-50

$$y=(a+cx+ex^2+gx^3+ix^4+kx^5)/(1+bx+dx^2+fx^3+hx^4+jx^5) \text{ [NL]}$$

r2=0.9998808289053417

a = 14.7942341478516
b = -4.27753026334442
c = -14.1794800887567
d = -1.05818927917538
e = 0.944096319857044
F = 1.31135276025174

g = 1.25070518393823
h = -0.157587387461055
i = -0.155416215924232
j = 9.40283706443438E-03
k = 9.33813770500542E-03

LLSbedthickness1000-100

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

r2=0.9267610132941868

a = 1.02185742735518
b = -4.03304064489834
c = 214.791975310821
d = -6110.58252080572
e = 120741.574922795
F = -1462126.28564655

g = 10728492.3437946
h = -48097751.8656758
i = 128967208.407455
j = -190077595.845139
k = 118480992.211124

MODULO PORGRRWPEFSW

Corrección por litología para registro Neutrón y Compensated Neutron Log
 Carta Por5 de "Schlumberger Chart Book" 2004 página 207 misma Por-13 del
 Schlumberger "Log Interpretation Charts 1985" página 21

CNLdolomite $y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{10}$
 $r^2=0.9999958533317079$

a = 1.02270920735479	g = 6.97819747763362E-05
b = -1.53829307434723	h = -2.21872675981286E-06
c = 0.721536584406837	i = 4.36082599686173E-08
d = -0.146456934293905	j = -4.81974756111361E-10
e = 1.81327775391505E-02	k = 2.28869429358892E-12
F = -1.40487577534378E-03	

CNLquartzsandstone

$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{10}$
 $r^2=0.9999924669221995$

a = 3.02500052823983	g = 6.6458501190544E-06
b = 1.3616766879169	h = -3.30958547595471E-07
c = -5.55915122236206E-02	i = 8.74663648295019E-09
d = 6.26074143271866E-03	j = -1.19102635268078E-10
e = -9.41226336267689E-05	k = 6.56836415175295E-13
F = -5.92979306477269E-05	

MODULO PORGRRWPEFSW

Corrige el Registro Gamma Ray por efecto "Borehole"
 Carta GR-1 del Halliburton "Log Interpretation Charts" 2001 página 45 para un
 diámetro de herramienta de 4 pulgadas

GAMMARAYboreholecorr8ppgcentered

$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9$ $r^2=0.9999967987492874$

a = -2.74473904081207	F = 4.10473190538997E-03
b = 3.36044908597704	g = -2.37391506533971E-04
c = -1.38217702318819	h = 8.49476157493075E-06
d = 0.319951966590804	i = -1.71216844730487E-07
e = -4.53901526772964E-02	j = 1.48547367097118E-09

GAMMARAYboreholecorr10ppgcentered

$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{10}$
 $r^2=0.9999950669662629$

a = 13.9798775656845	F = -2.37140291227911E-02
b = -13.5874439856013	g = 1.64125665090955E-03
c = 5.95224012713179	h = -7.54392332242646E-05
d = -1.47276172390724	i = 2.2091440492722E-06
e = 0.229888020876885	j = -3.73019849401157E-08

$$k = 2.76385233184507E-10$$

GAMMARAYboreholecorr12ppgcentered

$$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$r2=0.9999925246288421$$

$$a = 2.53369016419029$$

$$g = 1.26734546917001E-04$$

$$b = -1.84820076419667$$

$$h = -5.68862694204058E-06$$

$$c = 0.745455102824955$$

$$i = 1.73417557536221E-07$$

$$d = -0.159749031861136$$

$$j = -3.22837621401994E-09$$

$$e = 2.16871023353271E-02$$

$$k = 2.74857366503122E-11$$

$$F = -1.98455829975728E-03$$

GAMMARAYboreholecorr14ppgcentered

$$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$r2=0.9999924894442296$$

$$a = -2.46489645813956$$

$$g = -8.67762564322982E-04$$

$$b = 3.41521233353013$$

$$h = 4.51038421099896E-05$$

$$c = -1.7096007232526$$

$$i = -1.47908442757125E-06$$

$$d = 0.502350249380212$$

$$j = 2.77279386281956E-08$$

$$e = -9.18873143116154E-02$$

$$k = -2.26375299175539E-10$$

$$F = 1.09669670970582E-02$$

GAMMARAYboreholecorr16ppgcentered

$$y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9+k/x^{(10)}$$

$$r2=0.9999976741705612$$

$$a = 13.2180971238276$$

$$g = -366151557.148613$$

$$b = -254.302028159172$$

$$h = 1650555259.15568$$

$$c = -3035.76697380251$$

$$i = -4616603281.72081$$

$$d = 223358.022956702$$

$$j = 7307711932.57888$$

$$e = -4560925.9010611$$

$$k = -5004771660.34$$

$$F = 51770973.8829534$$

GAMMARAYboreholecorr18ppgcentered

$$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$r2=0.9999961487365893$$

$$a = 7.20035162211202$$

$$g = 1.83220205243941E-03$$

$$b = -8.3005497441806$$

$$h = -9.25977156358786E-05$$

$$c = 4.24029723266357$$

$$i = 2.96438579642681E-06$$

$$d = -1.18772097659135$$

$$j = -5.44299412656381E-08$$

$$e = 0.208162747068738$$

$$k = 4.36363229383895E-10$$

$$F = -2.39254439744224E-02$$

GAMMARAYboreholecorr8ppgeccentered

$$y=a+b\ln x+c/\ln x+d(\ln x)^2+e/(\ln x)^2+f(\ln x)^3+g/(\ln x)^3+h(\ln x)^4+i/(\ln x)^4$$

$$r2=0.9999671280640065$$

a = 17882.491241535	F = -185.775019567989
b = -6500.77824762643	g = -20310.8829623322
c = -31125.195831189	h = 10.2380949232913
d = 1461.22321193762	i = 5326.90435741809
e = 33463.8485247553	

GAMMARAYboreholecorr10ppgecentered

$y=a+bx^{(0.5)}+cx+dx^{(1.5)}+ex^2+fx^{(2.5)}+gx^3+hx^{(3.5)}+ix^4+jx^{(4.5)}+kx^5$
 $r2=0.9999296933995927$

a = 6452.85645375498	g = 1132.38078917014
b = -20305.0022007975	h = -192.05715544696
c = 28460.2558304438	i = 21.1880636024754
d = -23401.2550607821	j = -1.37338259312214
e = 12502.8897606752	k = 3.97302709719963E-02
F = -4536.56210682279	

GAMMARAYboreholecorr12ppgecentered

$y=a+bx^2+cx^4+dx^6+ex^8+fx^{(10)}+gx^{(12)}+hx^{(14)}+ix^{(16)}$
 $r2=0.9999993053049105$

a = 0.705589527792281	F = -8.84517277548442E-12
b = 6.40159802588175E-03	g = 2.81625214575631E-14
c = -3.71939132338523E-05	h = -4.21948890029066E-17
d = 6.57628863964607E-08	i = 2.44953746781083E-20
e = 1.10759324674298E-09	

GAMMARAYboreholecorr14ppgecentered

$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
 $r2=0.9999692267902391$

a = -16.8716177497315	g = -1.88271924368571E-03
b = 17.5891189685091	h = 8.33848595109597E-05
c = -7.54884677772438	i = -2.34330265513248E-06
d = 1.83644077717177	j = 3.78207453359166E-08
e = -0.280226993362124	k = -2.66783800144535E-10
F = 2.81089972289153E-02	

GAMMARAYboreholecorr16ppgecentered

$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$
 $r2=0.9999797539161382$

a = 6.054177716210852	g = 1.2096144530276E-03
b = -5.96299158961207	h = -6.27393439451927E-05
c = 2.85758865388127	i = 2.07575962533097E-06
d = -0.777289301733913	j = -3.95769041270225E-08
e = 0.134676932622025	k = 3.3042164955849E-10
F = -1.55394983332211E-02	

GAMMARAYboreholecorr18ppgeccentered

$$y=a+bx+cx^2+dx^3+ex^4+fx^5+gx^6+hx^7+ix^8+jx^9+kx^{(10)}$$

$$r2=0.9999903059353319$$

a = -13.0536615728194
b = 14.2828588051793
c = -6.45000332079308
d = 1.66967189679773
e = -0.273122523177525
F = 2.95487431603097E-02
g = -2.14506625999971E-03
h = 1.03364918040749E-04
i = -3.17019684181071E-06
j = 5.59877249451567E-08
k = -4.33173993734665E-10