



Avenue to VB: Migrating a Geological Database to ArcGIS

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Abstract

The University of Texas at Austin Gulf Basin Depositional Synthesis Project (GBDS) is a petroleum industry sponsored research project to provide a comprehensive synthesis and interpretation of basin scale sedimentation patterns and history as a tool for oil and gas exploration in the Gulf of Mexico. GBDS began in 1995, and created a GIS database in ArcInfo coverage format. Additionally, custom tools were developed in Avenue as an extension for ArcView to visualize and extract information from the database.

In 2004, GBDS began the migration into ArcGIS 8. Using Visual Basic to develop an ArcMap extension to provide the same functionality as the ArcView GBDS extension proved challenging, and led to several insights. Methodologies were developed for shifting from ArcView's multiple layouts to ArcMap's single layout, handling graphic operations in ArcMap, and tagging objects in an ArcMap document.

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Introduction

As GIS users upgrade from ArcView version 3 to ArcGIS, they quickly learn that custom tools written for ArcView 3 do not operate in ArcMap. The tools, commonly written in the Avenue programming language, must be rewritten in a language compatible with ArcMap. This paper describes insights gained through code migration from Avenue to Visual Basic for the Gulf of Mexico Basin Depositional Synthesis project.

The Gulf of Mexico Basin Depositional Synthesis project (GBDS) is a joint industry sponsored research project to provide a complete and comprehensive picture of basin scale sedimentation as a tool for exploration efforts in the Gulf of Mexico. The project contributes new information to the understanding of the geologic history of the Gulf of Mexico basin. Project goals include refining sequence correlation between the shelf and basin, understanding slope processes better, identifying major sedimentary transport axes, explaining the role of submarine canyons, and improving knowledge of the major controls on deposition.

GBDS was originally supported by a GIS database and custom tools written for ArcView 3. As the database and tools were upgraded for ArcGIS, four key challenges arose relating to code migration and differences between ArcView 3 and ArcMap:

1. How should the tools be organized in ArcMap?
2. What is the equivalent of the Avenue "Tag" property in ArcMap?
3. How can ArcMap elegantly handle the manipulation of large sets graphics?
4. How can the difference between the multiple layout approach of ArcView and the single layout approach of ArcMap be resolved?

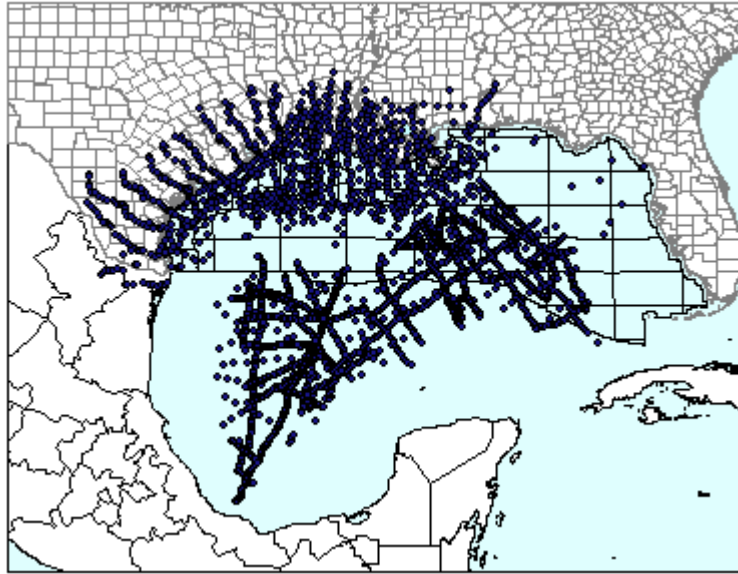
This paper addresses those challenges and presents insights gained from implementing solutions to those challenges. Because this paper deals with the topic of code migration, the reader should have some familiarity with the Avenue and Visual Basic programming languages. The reader should also be aware of differences between the ArcView 3 and ArcMap user interfaces and terminology. For example, the window used to visualize geographic data is called the View in ArcView 3, and the Map in ArcMap.

Outline

This paper is divided into five chapters. The first chapter gives an introduction to the paper. The second chapter describes the GBDS database and toolset. The third chapter describes how the overall code conversion process was managed. The fourth chapter describes each of the four challenges listed above. The fifth chapter provides a summary and recommendations.

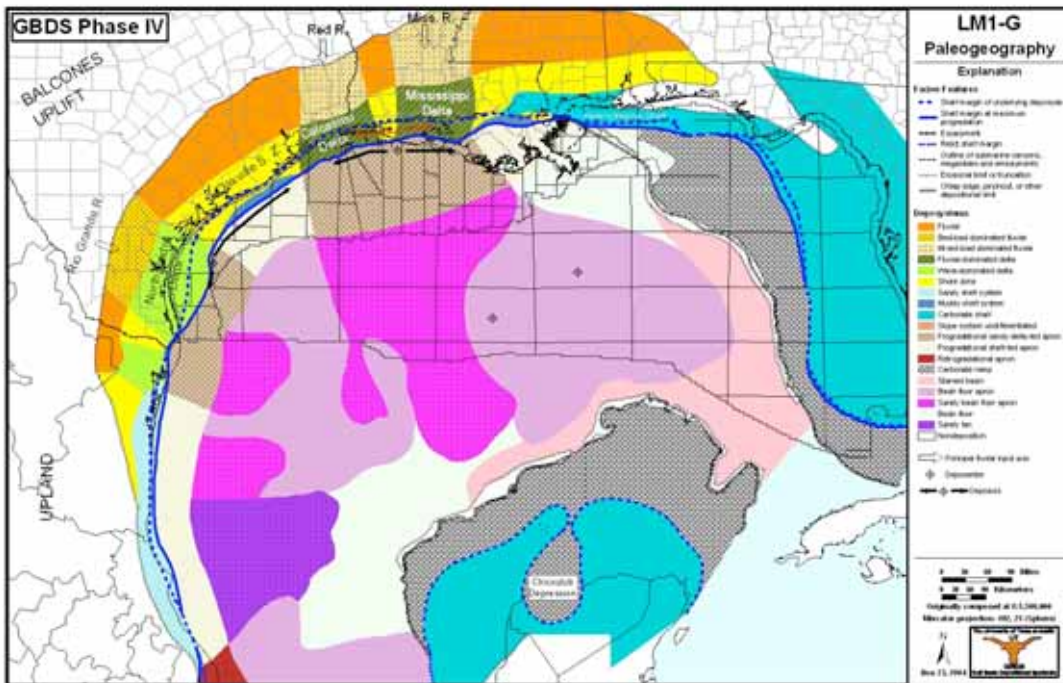
Database and Tool Description

The GBDS database is driven by onshore and offshore well data along the margin of the Gulf of Mexico, and seismic data in the central deep basin. The data include information such as depths to the tops of stratigraphic units, depositional systems, and stratigraphic architecture. These data are stored in tables, and are related to point features representing the locations of well and seismic shot points.



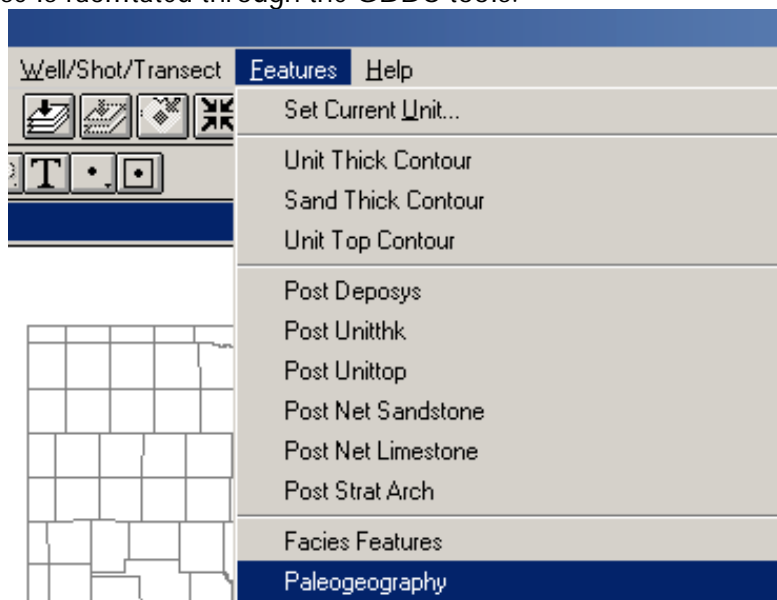
GBDS Well and Seismic Shot Locations

Using these data, the GBDS team creates datasets which further characterize the basin, such as isopach contours, structural features, and paleogeography. These datasets can be added to ArcMap for visualization and analysis.



Sample GBDS Paleogeography Map

The GBDS toolset provides easy access to these data through a set of custom tools, buttons, and menus in ArcView 3. The toolset is implemented as an ArcView 3 extension. With the toolset, the user can add data and automatically apply an appropriate legend, inspect data, and draw geologic cross sections. Virtually all interaction with the GBDS database is facilitated through the GBDS tools.



The Features menu is used to add GBDS data to ArcView 3

Managing the Conversion

The GBDS extension for ArcView was created from 181 Avenue scripts. To bring the extension into ArcGIS, these scripts would need to be rewritten in a language compatible with ArcMap. Visual Basic was chosen due to its ease of use and plentiful documentation. The functionality provided by the scripts is implemented with classes or individual procedures in a single Visual Basic project.

To manage the code migration, it was essential to know the purpose of each script, how the script is accessed through the ArcView user interface, and the Visual Basic counterpart for the script. An Excel spreadsheet called Scripts.xls was created to store this information, as well as the status of each script's conversion, bugs, and other information.

Avenue Name	Done	VB Location	Purpose	ArcView GUI
DrawTransect	y	clsDrawCrossSection.Transect	Draw a transect	Draw Transect Tool
AddLogo	y	modGBDS.AddGbdsLogo	Add logo to layout	Draw Cross Section Tool
Check Qualifier	y	modGBDS.CheckQualifier	Return a modified well qualifier	Draw Cross Section Tool
GetColorDict	n	modGBDS.GetColorDict	Return post colors	Features\Post Menu
LoadElevation	y	clsLoadElev.OnClick	Add Elevation to view	Basemap\Elevation Menu

Simplified Example of Scripts Spreadsheet

The spreadsheet helped the author to take baby steps in addressing one script at a time, until eventually there were all finished. The sorting capabilities of Excel also facilitated the organization of script information in use ways. For example, scripts could be sorted to see what their individual or collective purpose is, or to identify all scripts associated with a particular button on the ArcView user interface.

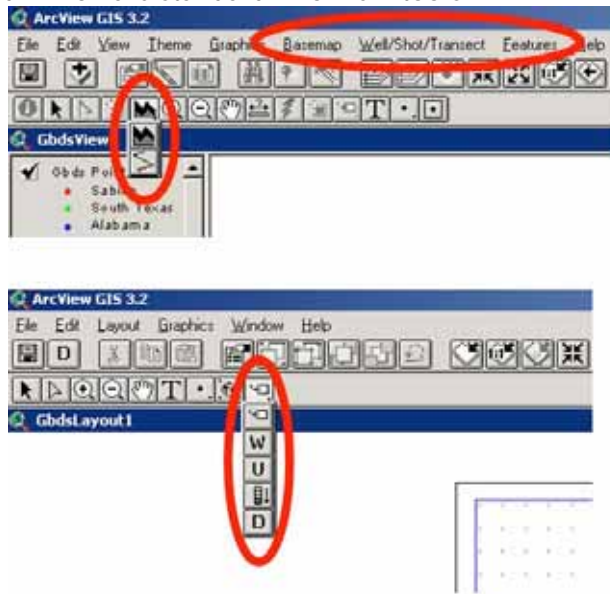
One aspect of the conversion that proved frustrating was trying to understand what the original programmer intended with each piece of code. To alleviate this agony in case a different programmer updates the GBDS tools in the future, a document called "GBDS Tools Developer's Guide" was created to outline the organization and purpose of each part of the GBDS toolset. This document will also prove useful to the current programmer as a reminder to what a particular snippet of code is doing. A user's guide and workshop were also created for the everyday user of the tools. All of this documentation tracks what the developer programmed, permits another developer to decipher what the original developer programmed, and helps people to use what the developer programmed.

Conversion Challenges

As code was migrated, two types of conversions were actually taking place. One is the conversion of Avenue syntax to Visual Basic syntax. In other words, if a statement multiplies x by y in Avenue code, how is equivalent code written in Visual Basic. The second type of conversion deals with the differences in how ArcView 3 and ArcMap work. This type proved to be the more challenging of the two, and lead to the four challenges described below.

Tool Organization

The first challenge involves tool organization. In ArcView 3, the GBDS tools are scattered throughout the user interface. Some tools are visible in a Layout, while others are visible in a View. Unless the user is very familiar with the GBDS project or ArcView, difficulties may arise in identifying which tools are available through the GBDS extension, and which are standard ArcView tools.



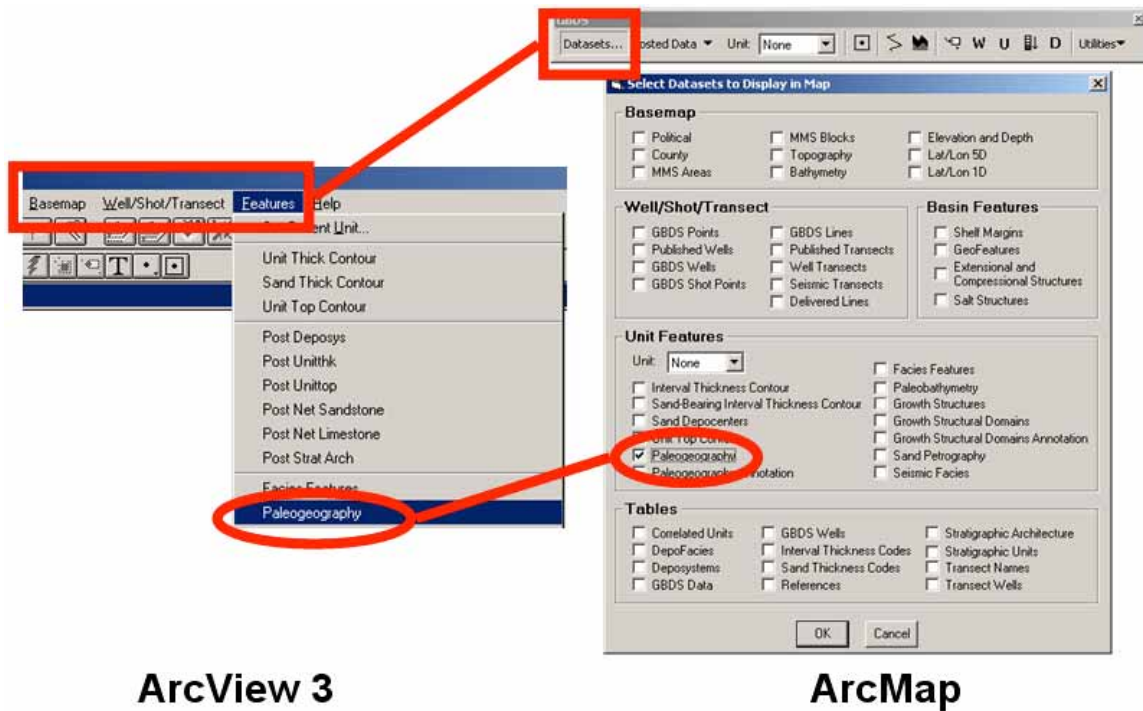
Location of some GBDS Tools in ArcView

For ArcMap, all tools are located in a single toolbar, which is available in layout and data view. This provides an easily identifiable location for accessing the tools.



GBDS Toolbar in ArcMap

Because all tools are located in a single toolbar, careful thought was required to properly organize the tools so that they would all fit. In some cases, this meant leaving out redundant or unnecessary tools, while in other cases, it meant changing the way in which a given tool operates. For example, in ArcView, GBDS data are added to the map through three menus. In ArcMap, a single button on the GBDS toolbar opens a form which is used to access the data.



ArcView 3

ArcMap

Accessing GBDS Data in ArcView vs. ArcMap

Thus, as a result of code migration, the GBDS toolset was cleaned up as well, providing a simpler and better-organized user interface for the user.

Object Tags

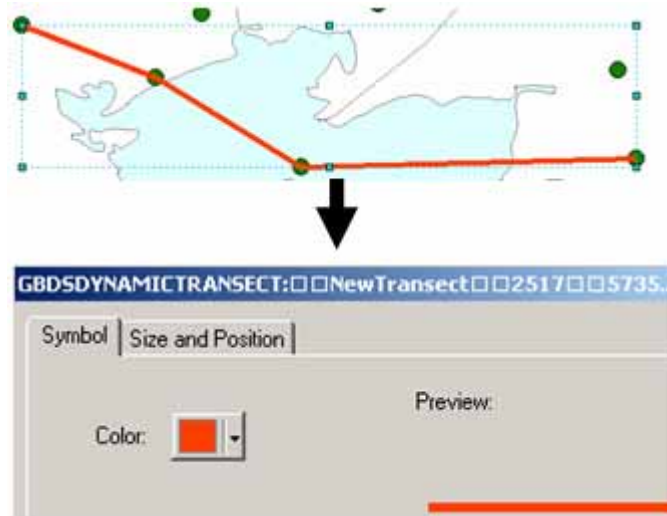
The second issue relates to the user of the "Tag" property in Avenue. In ArcView, once the user adds a GBDS dataset to the View, that menu item is disabled in the GBDS tools. A disabled menu item indicates that the dataset is already in the View. The tools keep track of themes in a View by tagging the themes with the name of the GBDS dataset they represent.

A tag is a property that you can give to a variety of objects in ArcView through code. These tags can be simple text, or they can be objects like lists or dictionaries. Tags are used extensively by the ArcView GBDS tools to manage themes, graphics, and View properties. However, tags are not supported in ArcMap, so alternatives to the Tag property had to be found.

Graphics

Graphics in the map are one type of object for which tags are used. Graphics created by GBDS tools are tagged with information describing what they represent from the database. In ArcMap, all graphics in a map or layout are objects called elements. These elements implement a programming interface called IElementProperties, which allow a Name property to be assigned to the element. A user can see an element's name by double clicking it to show its properties. In the example shown here, a custom transect has been drawn to connect wells for future inclusion in a cross section. The name of the line graphic is actually a delimited string of text which stores the type of data

this line represents, the name given to the line, and the well numbers included in the transect.

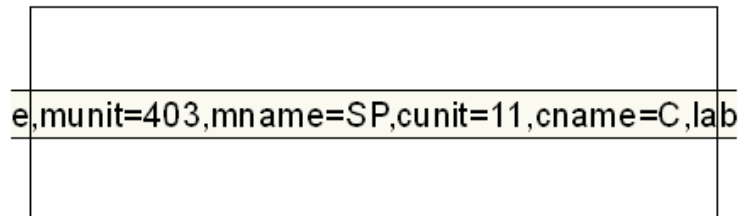


Sample GBDS Graphic and Name in Properties Dialog

Note that graphics also support a property called CustomProperty, which can store more than just simple text. This property is not used by the GBDS tools, but is mentioned in this text for completeness.

Map

The ArcView GBDS tools also tag the View with information describing the current stratigraphic unit shown. In ArcMap, Maps are shown in a MapFrame on the Layout. The MapFrame is also an element, like graphics, and also supports the Name property. In this case, the name of a MapFrame stores a comma delimited list of information describing the stratigraphic unit currently shown in the Map.



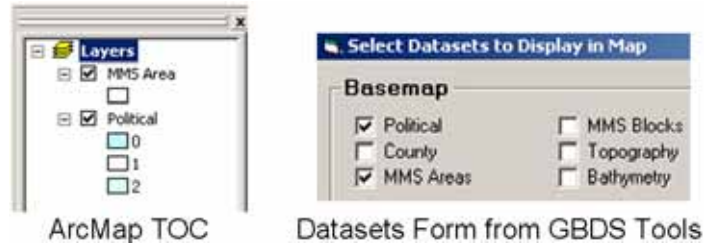
Stratigraphic unit information stored in MapFrame Name for a Map (Note: MapFrame is in Draft Mode to show its Name)

Layers

As mentioned earlier, a theme's tag links that theme to the GBDS tools, so that the tools can recognize when a given GBDS dataset is represented in the map. For ArcMap, the GBDS tools use the layer's name as the tag, rather than use a property that is hidden from the user. This permits the user to break the link between the layer and the tools if desired. This allows the user to manipulate the layer without the GBDS tools subsequently

assigning default layer properties, which would undo any changes to the layer that the user made.

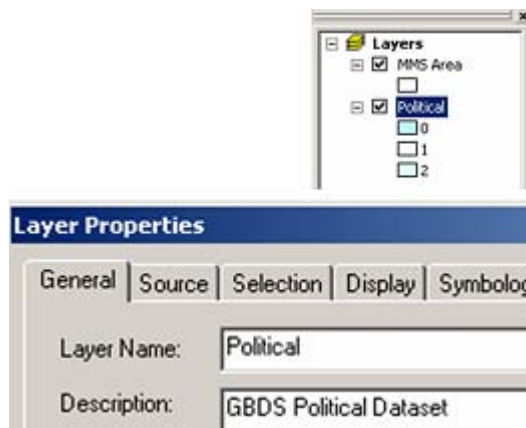
If the GBDS tools recognize a layer name for a dataset in the map, a check will appear next to that dataset in the Datasets form. In the example below, the form indicates that MMS Areas and Political boundaries are already present in the map.



ArcMap TOC Datasets Form from GBDS Tools

GBDS Tools recognize datasets by a layer's name

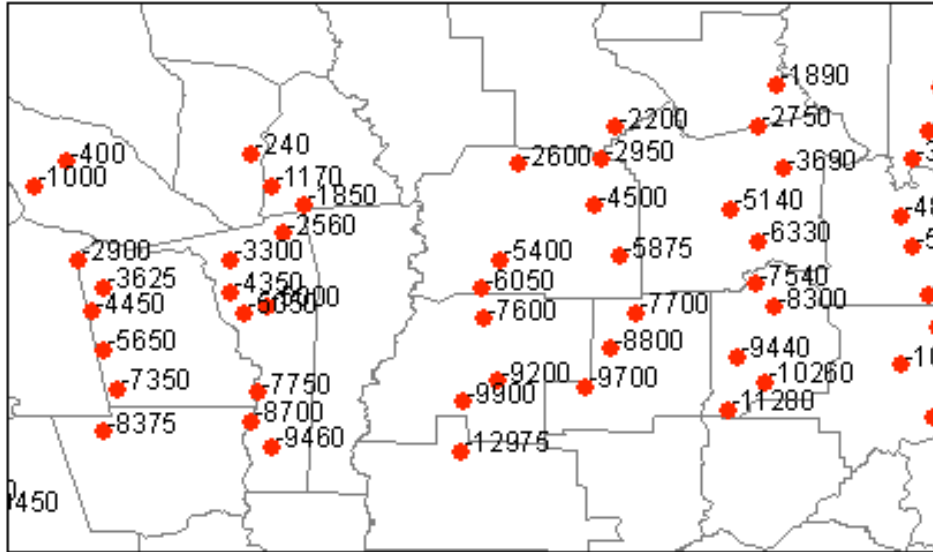
Another alternative for tagging layers is to use the layer's Description as the tag. The description can be viewed by opening the Layer Properties dialog and clicking the General tab. The tag is not quite as visible as the layer's name, but is still editable by the user. This approach isn't used by GBDS, but is mentioned here for completeness.



Potential Use of Description Property for Political Layer

Grouping Graphics

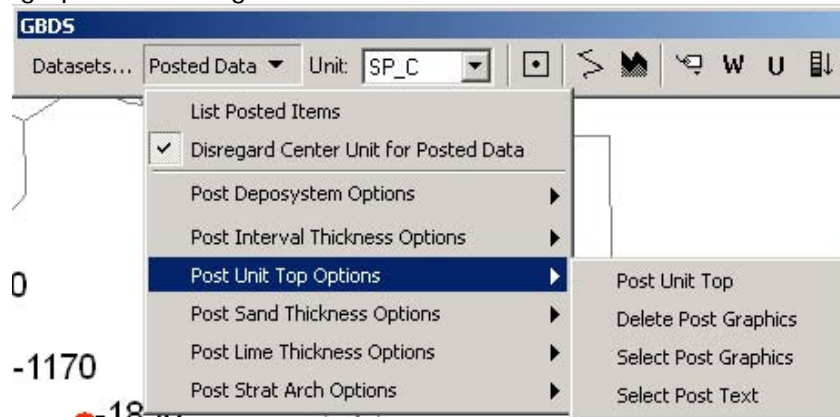
The third challenge involves the grouping of large numbers of graphics. One of the ways of viewing data from the GBDS database is to create graphics in the map showing properties of wells and seismic shot points. This is called posting data. In the picture shown below, the depth to the top of a stratigraphic unit has been posted. The post includes red dots indicating well locations, and text indicating the depth to unit top at those locations.



Unit Top Posted in Map

In ArcView, all graphics for a single post are grouped together. This allows the user to manipulate the font size for the text or the symbol for the dot for all graphics at the same time. Because the graphics are treated as a single unit, they can also be deleted all at once by pressing the delete key.

In ArcMap, grouping large numbers of graphics causes a serious performance lag, so by default, the GBDS tools do not group posted data in ArcMap. Instead, posted graphics are assigned a Name using IElementProperties as described above. The name indicates the unit and characteristic that the graphics represent. Menu items are provided in the GBDS tools for selecting all of the dots or text for a given post, in case the user wants to manipulate them as a group. A menu item also exists to delete the posted graphics. Tagging the graphics through their Name property allows the GBDS tools to treat a set of graphics as a single unit.

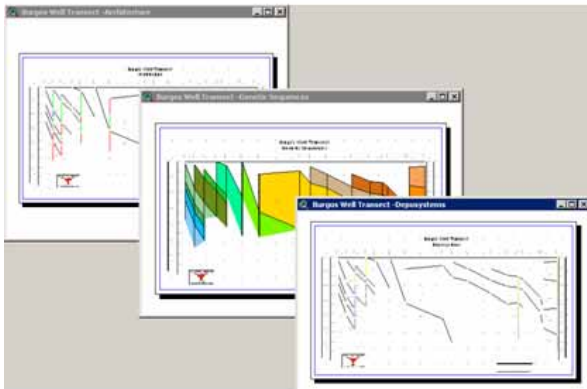


Unit Top Menu Items for Manipulating Posted Graphics

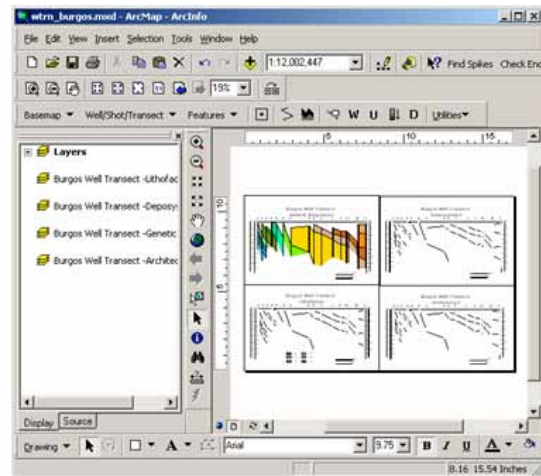
Multiple Layouts

The fourth challenge is a result of ArcView 3 allowing multiple layouts, and ArcMap allowing only one layout. The GBDS tools create graphical cross sections, which show the stratigraphic units present in a vertical slice along a transect. In ArcView, each cross section is drawn in its own layout for quick and easy printing. In ArcMap, there is only one layout. Rather than pile graphics for multiple cross sections on this layout, each cross section is drawn in its own data frame. These data frames can then be resized and repositioned as desired for printing purposes.

This solution works well when the user wants a quick printout. However, if the user wants to modify the cross section graphics manually, such as changing the font size, the modifications must be made by switching to data view for that data frame. Unfortunately, what the user sees in data view does not always match what is shown in layout view, so the user may have to try several adjustments before an acceptable layout is created. Another option is to copy the graphics from the data frame to the layout, but again, this does not always result in a smooth translation. So, while data frames provide a location for each cross section to be drawn, the solution is not entirely elegant.



Multiple Layouts



Single Layout, Multiple Data Frames

Location of Cross Sections in ArcView (left) and ArcMap (right)

Summary and Recommendations

In summary, insights gained in converting an Avenue extension for ArcView 3 to a Visual Basic toolbar for ArcMap have been presented. The most important piece of advice is to document the conversion. A spreadsheet that mapped each Avenue script to its Visual Basic counterpart helps with this task.

Four challenges that arose during the conversion and the solutions to those challenges were also described. The GBDS tools scattered throughout the ArcView user interface are organized into a single ArcMap toolbar. Object tags in ArcView are handled with element and layer names in ArcMap. Instead of grouping graphics as in ArcView, graphics are assigned an element name which identifies them as belonging to a given set or group. And finally, because multiple layouts are not supported in ArcMap, multiple data frames are used, which may be rearranged in ArcMap's single layout.

The author recommends patience and careful documentation along each step of code migration. Take advantage of developer guides for both the languages and software of interest to fully understand how the original code works, and what tools are available to accomplish the same task in the target language and software environment. And if questions cannot be answered through these developer guides, the author recommends searching the ESRI User Forums for help. The link is provided below.

<http://support.esri.com/index.cfm?fa=forums.gateway>

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