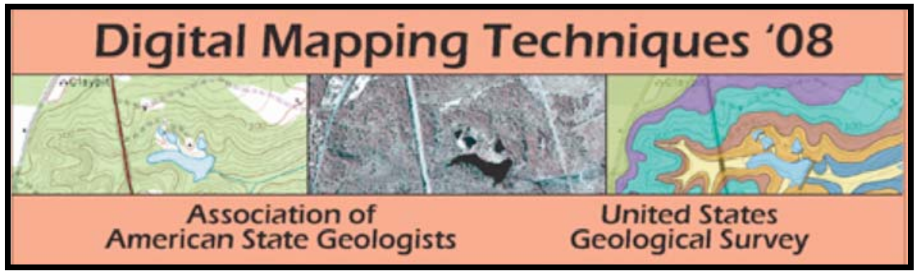
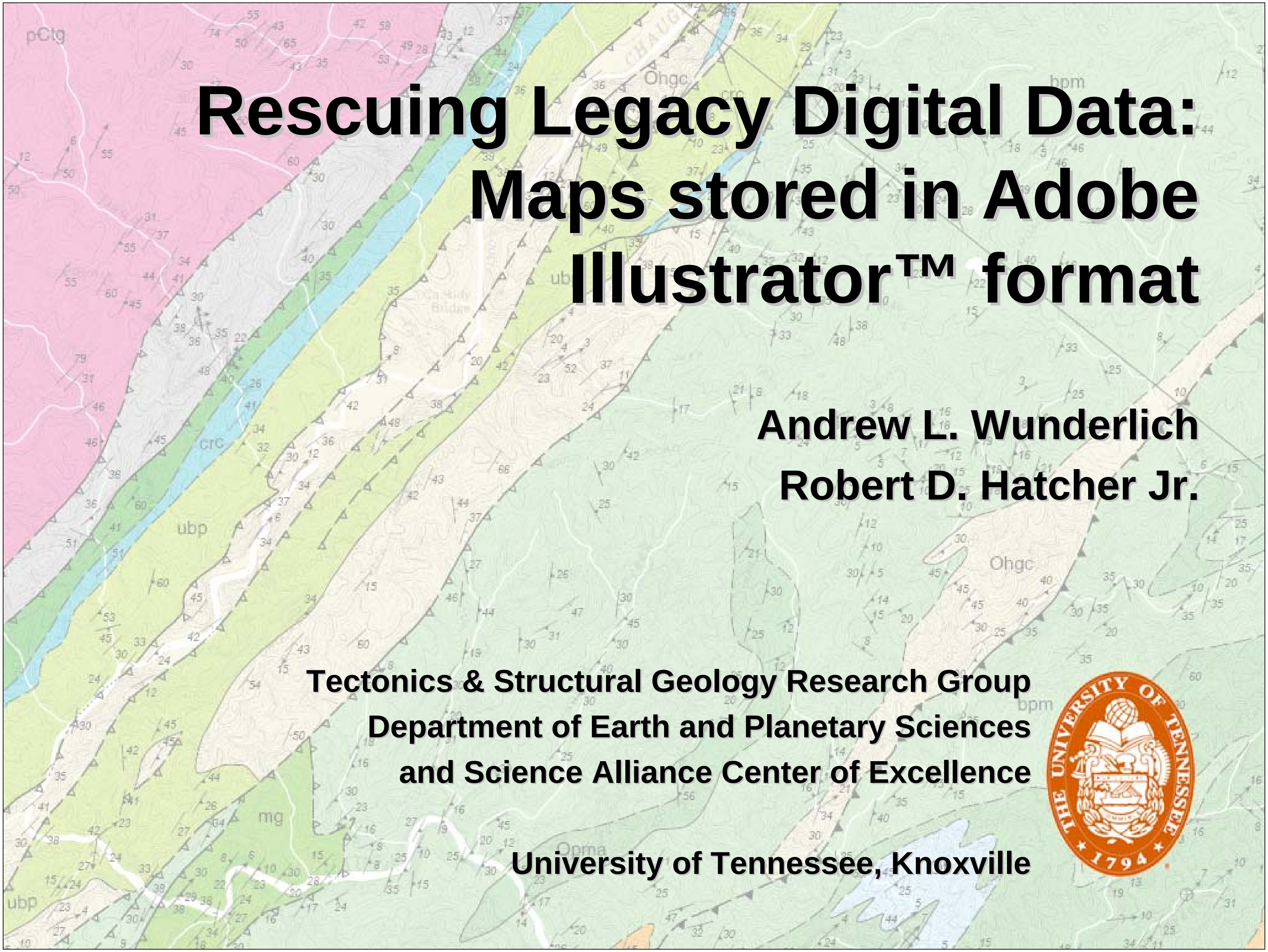


The following was presented at DMT'08 (May 18-21, 2008).

The contents are provisional and will be superseded by a paper in the DMT'08 Proceedings.

See also earlier Proceedings (1997-2007)
http://ngmdb.usgs.gov/info/dmt/



Rescuing Legacy Digital Data: Maps stored in Adobe Illustrator™ format

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Introduction

As GIS databases become the standard for storing spatial data, many organizations may be struggling to integrate “legacy” digital data into modern geospatial databases.

Map information that is stored in older digital data formats without spatial reference or attribution are in danger of being lost for future mapping and analysis purposes if the data are not converted into newer digital geospatial databases.

What are "legacy" data?

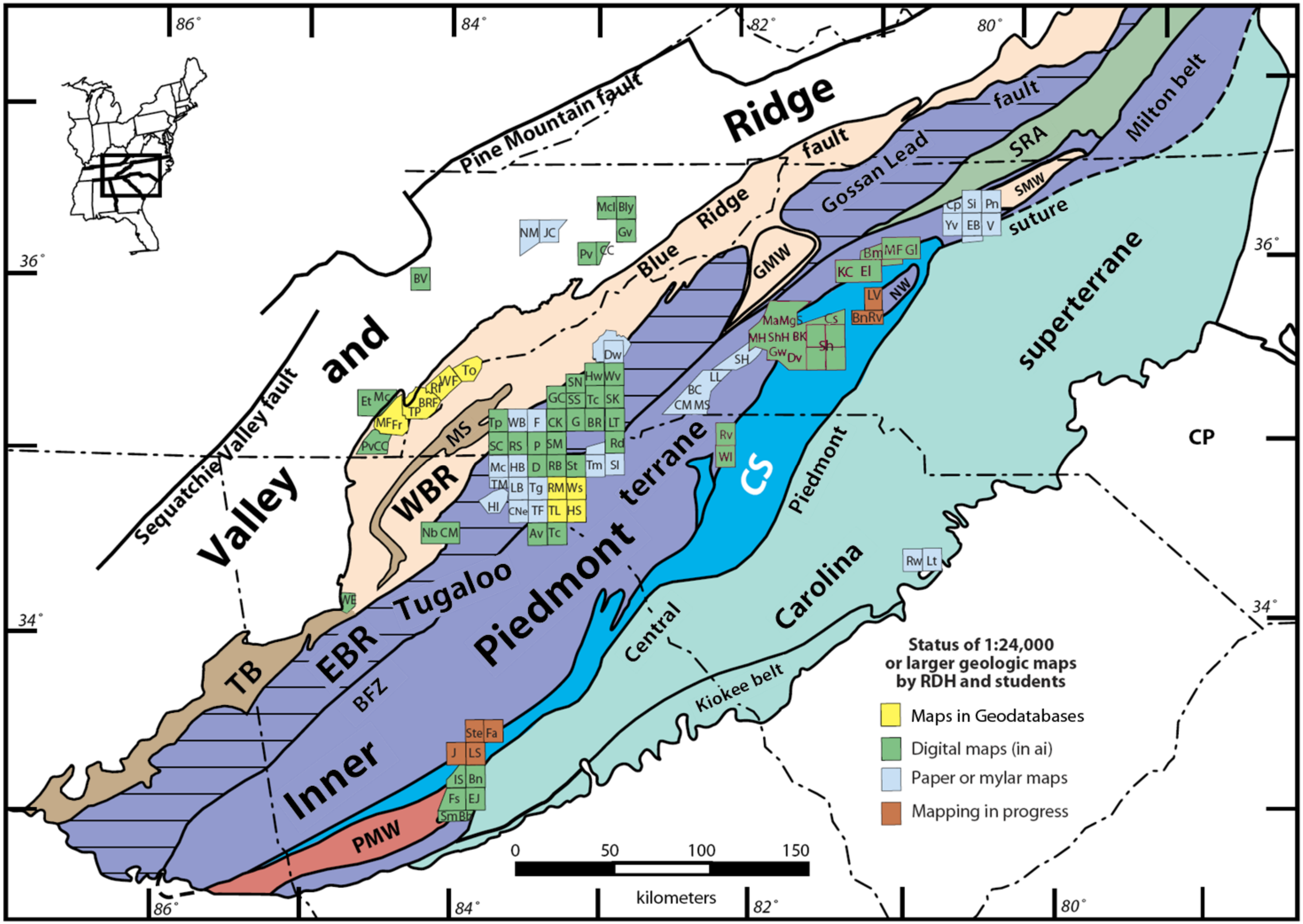
- Digital file formats that do not natively accept storage of geospatial information and feature attributes (Adobe Illustrator files)
- Other older, possibly obsolete digital file formats (programs have been discontinued, superseded by another format, etc.)

Also:

- Attribute data in spreadsheet files, field books, etc…
- Analog map formats such as mylar or paper

Our Problem…

- Large collection of legacy geologic maps covering over 100 7.5-minute quadrangles.
- Maps are accompanied by a wealth of ancillary information that is not easily accessed. (station maps, field books containing detailed structural data and notes, photographs, etc.)
- Over 40 years of detailed geologic mapping (24K or larger scale) in the southern Appalachians is in danger of slipping into obsolescence...



86°
84°
82°
80°
36°
34°
Pine Mountain fault
Ridge
and
Valley
Sequatchie Valley fault
Blue Ridge fault
Gossan Lead fault
SRA
Milton belt
SMW
suture
GMW
NW
MS
WBR
TB
EBR
BFZ
Tugaloo
Inner Piedmont terrane
CS
Central Piedmont suture
Carolina superterrane
Kiokee belt
PMW
CP
Status of 1:24,000 or larger geologic maps by RDH and students
Maps in Geodatabases
Digital maps (in ai)
Paper or mylar maps
Mapping in progress
0
50
100
150
kilometers

Our Goal…

Transform and integrate these legacy data into geospatial databases to:

- Prepare current and future analysis and mapping projects (single quad maps, compilations, cross sections, etc.)
- Enhance the chances for long-term survival of the data
- Make the data available to the larger geologic community

Our Response…

Develop a method to convert these legacy digital data from Adobe Illustrator (and others) to a geospatial database that:

- Makes the process modular, clearly defined, and repeatable
- Retains as many of the existing attributes in the legacy files as possible
- Saves time on repetitive tasks by automating certain procedures with customized software tools
- Uses a template geodatabase for better interoperability with other geologic databases

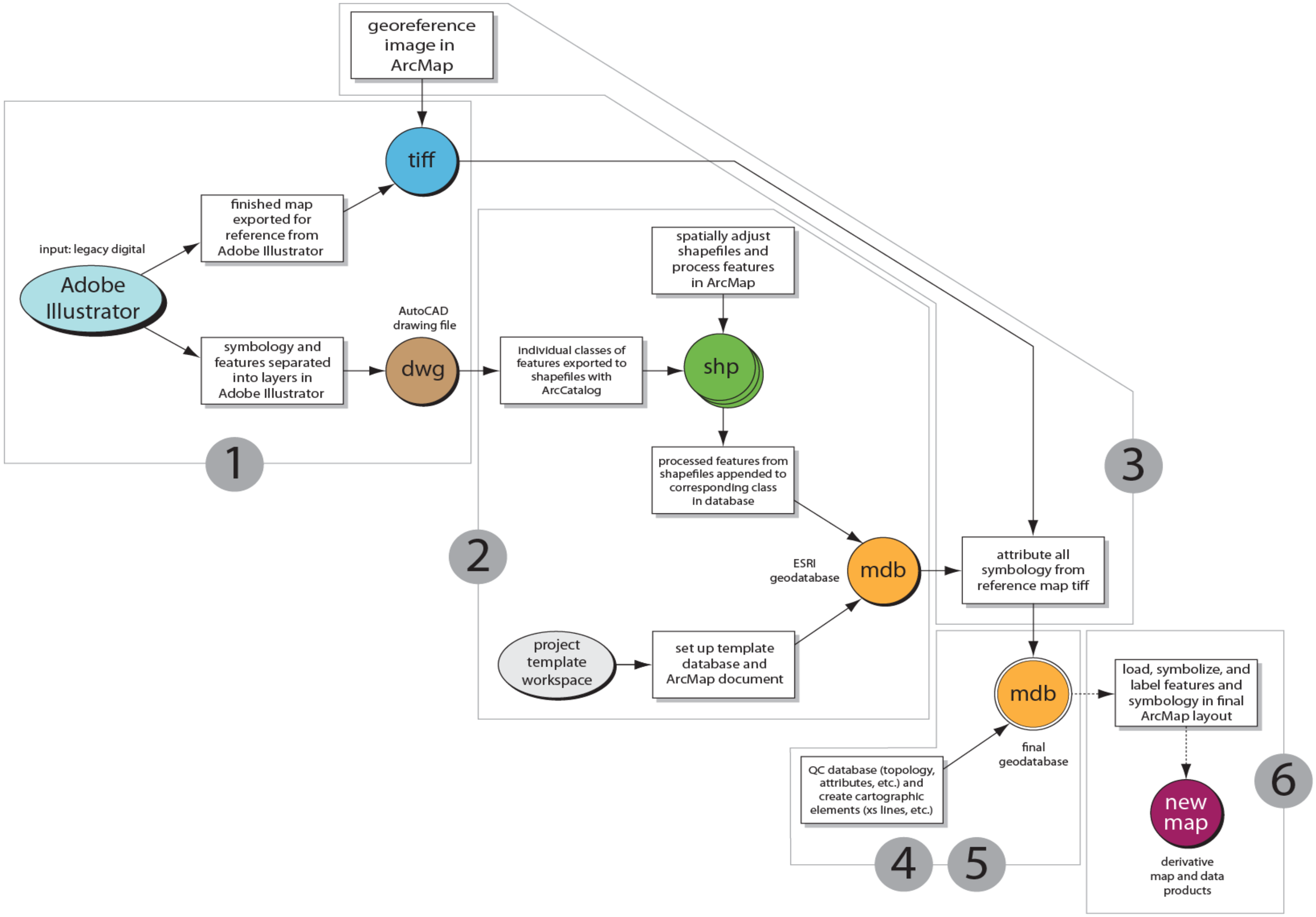
Our Method…

1) The original file is cleaned up and organized into layers in Adobe Illustrator and exported to AutoCAD™ drawings. An image of the map is also exported to be used for attribution.
2) AutoCAD files are converted to shapefiles and spatially adjusted in ArcMap™ and appended into a geodatabase.
3) Geologic point data attributes that were not retained directly are either calculated from the feature (strike/rotation) or added to the features semi-automatically with the help of ArcMap utilities developed in-house (dip/plunge).

Our Method…

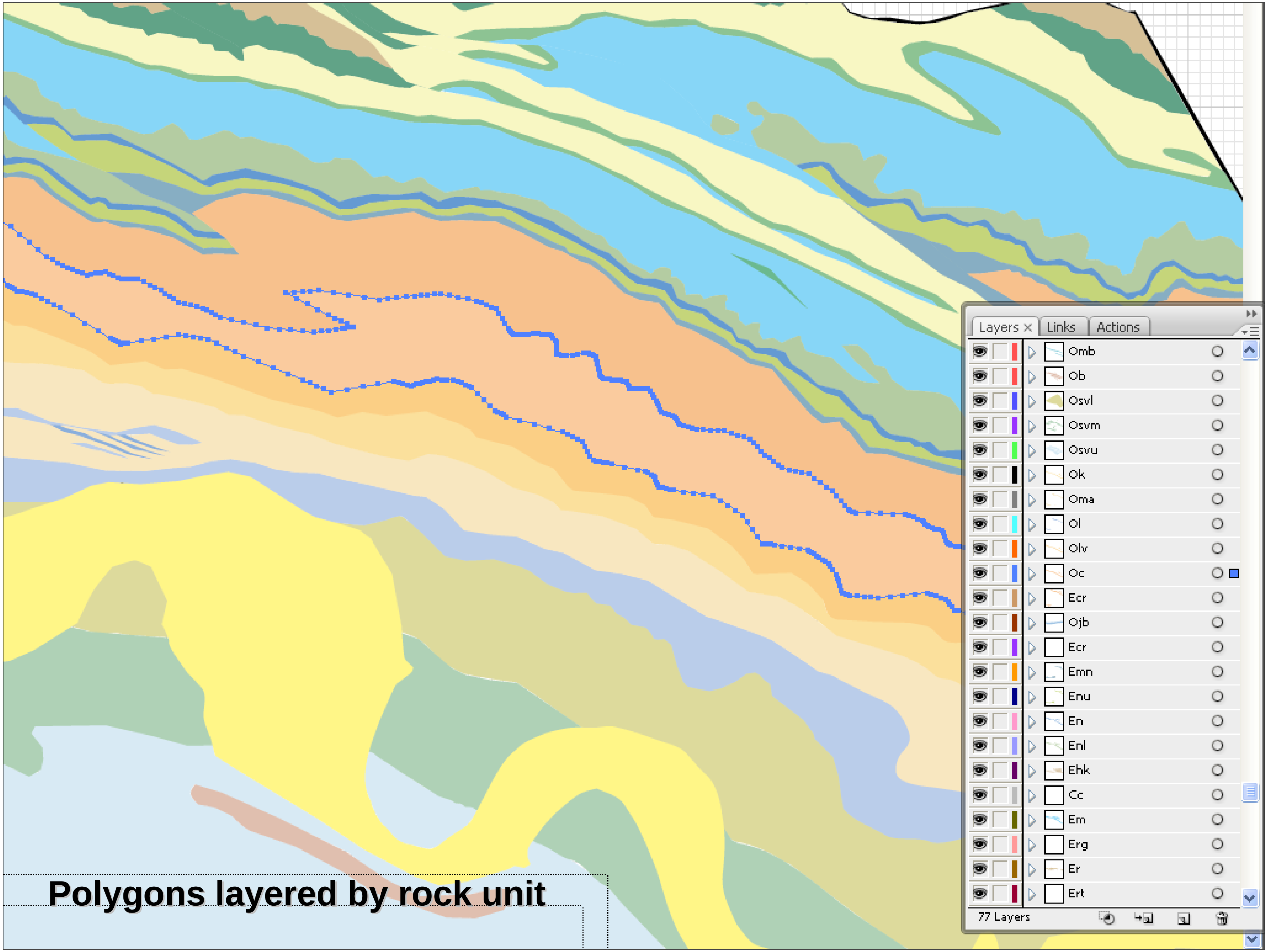
4) The entire database is then checked for topology errors, and if the map being processed is adjacent to existing data, the adjoining edges are reconciled.
5) A round of quality control measures are taken, including correcting mistaken attribution, after which any special considerations are addressed.
6) The finished database is then symbolized, labeled in ArcMap, and exported as a graphic for placement in a final map layout for editing and publication.

Method diagram

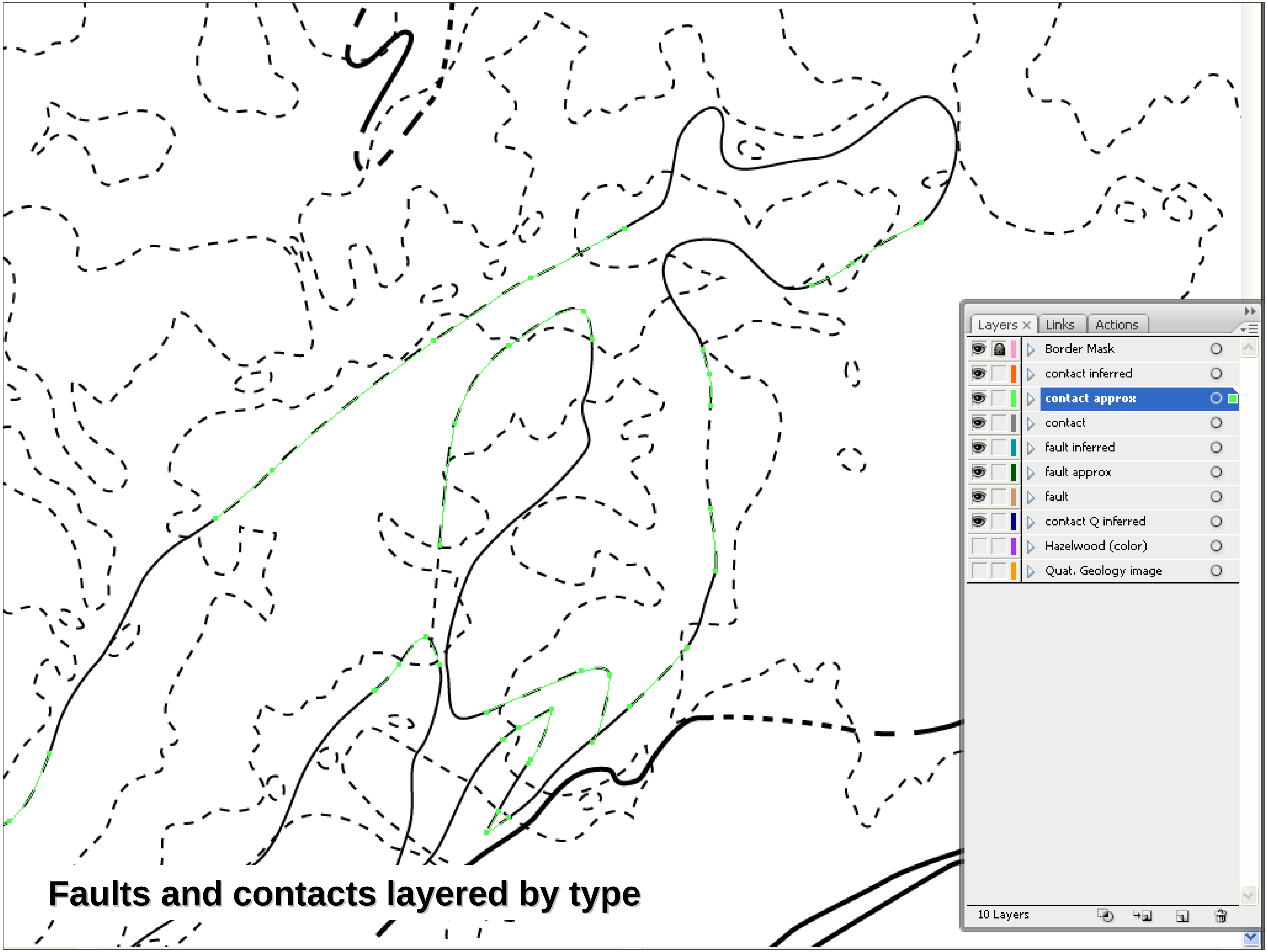


Step 1

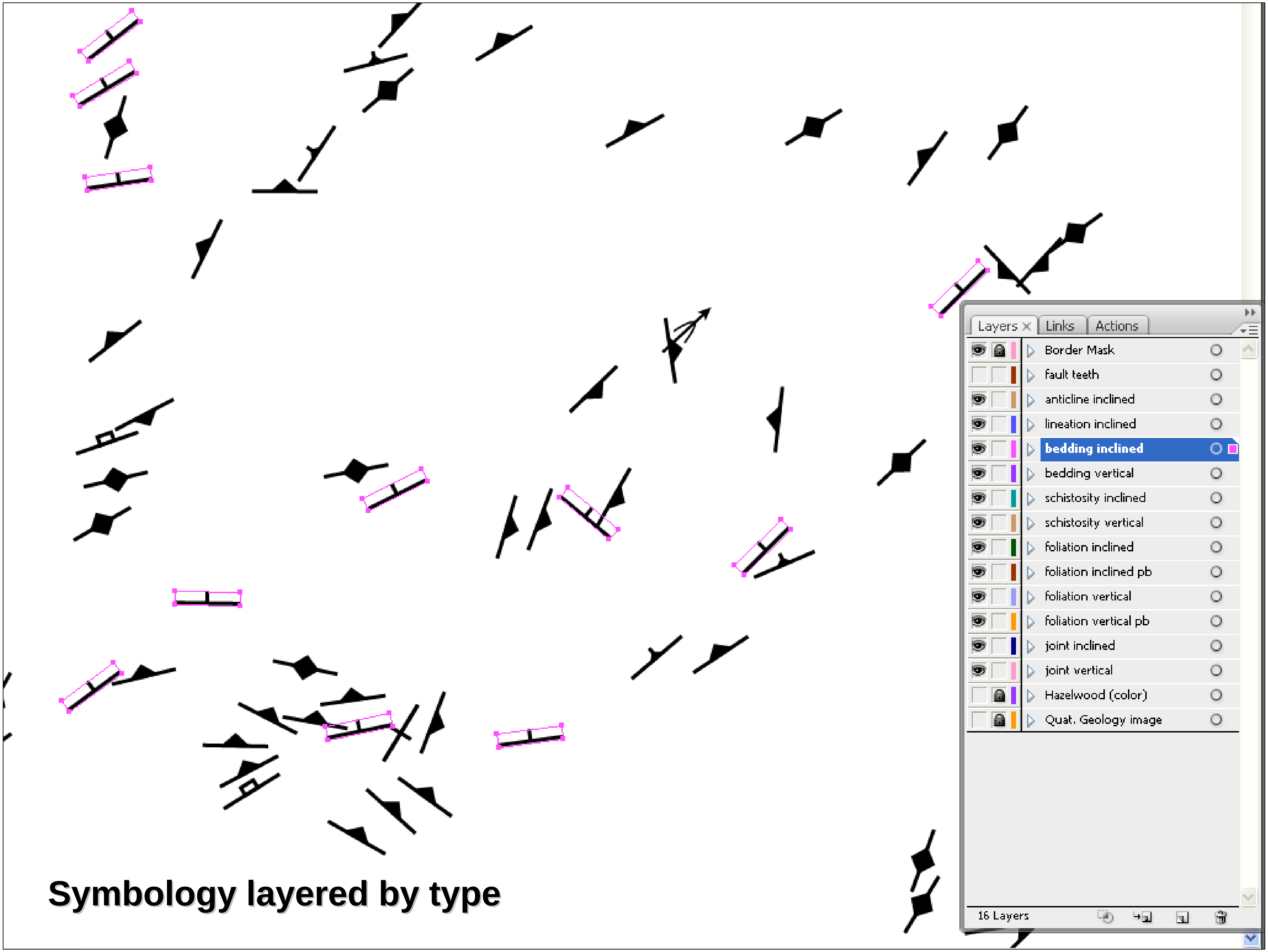
- The original file is cleaned up and organized into layers according to feature type in Adobe Illustrator in order to maintain maximum attribution.
- Line and Polygon features are densified and straightened to remove Bezier curves
- Each topological type is individually exported to an AutoCAD™ drawing.
- A TIFF image of the map is also exported to be used for attribution of dip/plunge in Step 3.



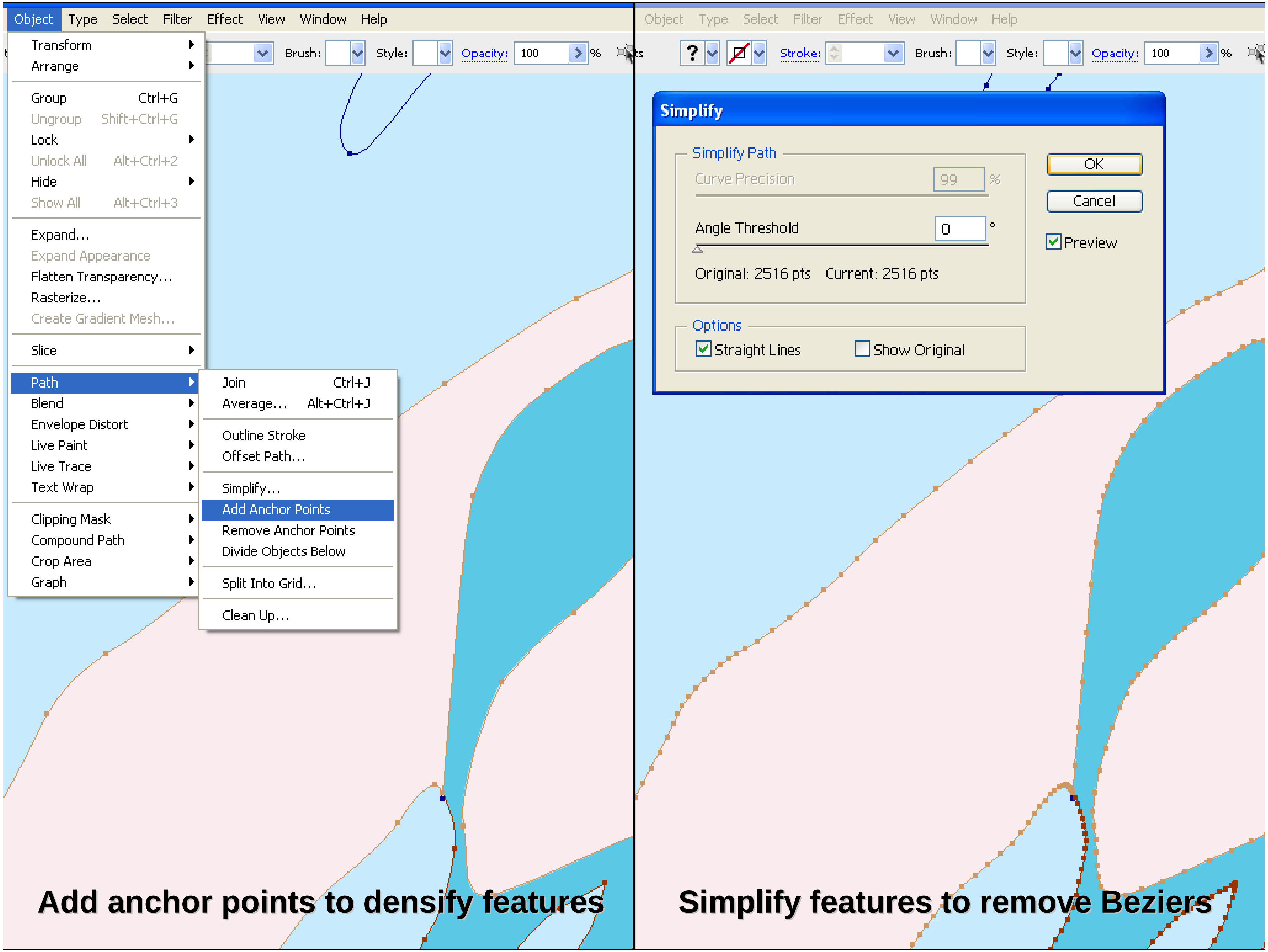
Illustrator file layering of polygons.



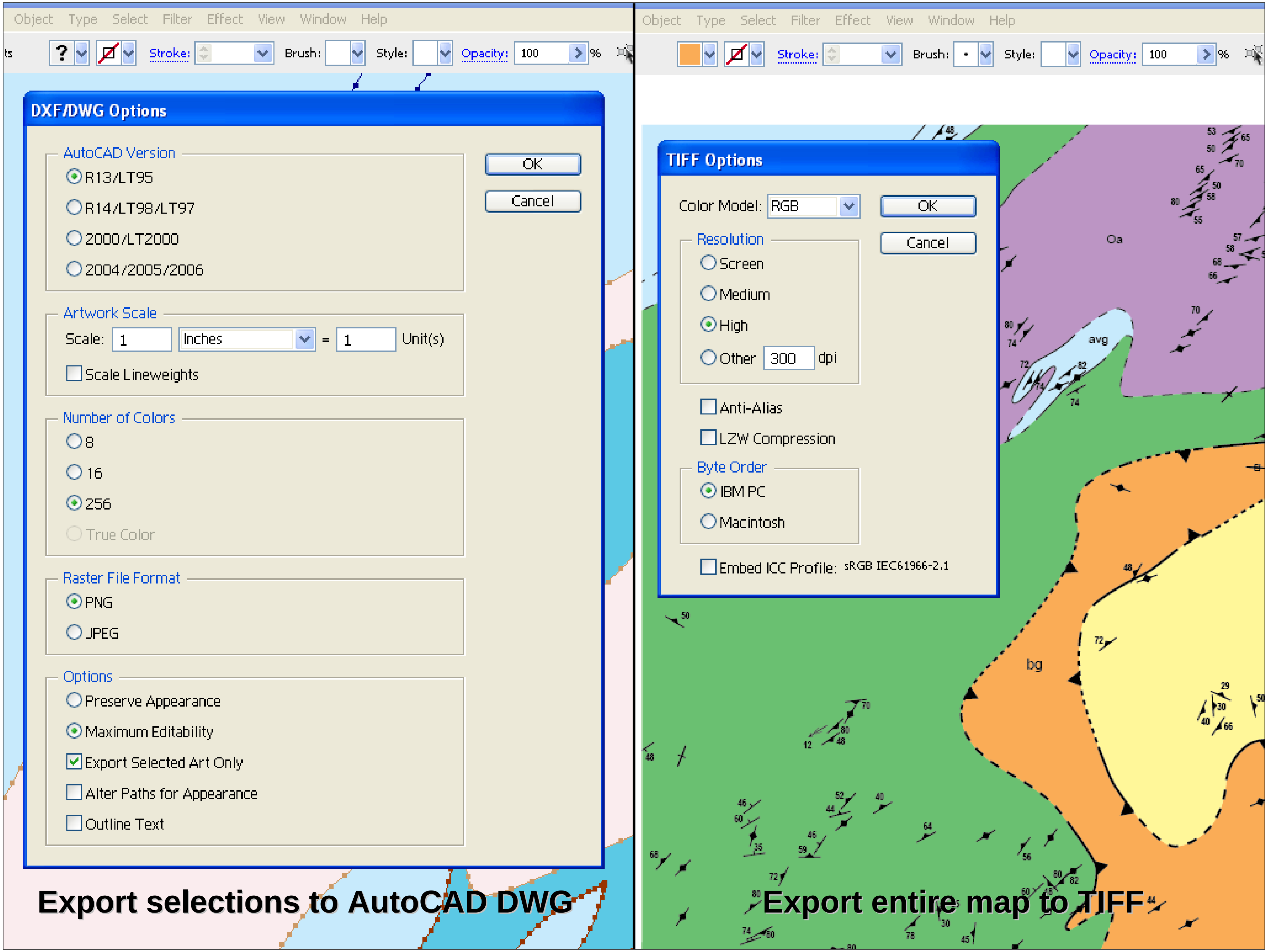
Illustrator file layering of lines.



Illustrator file layering of lines.



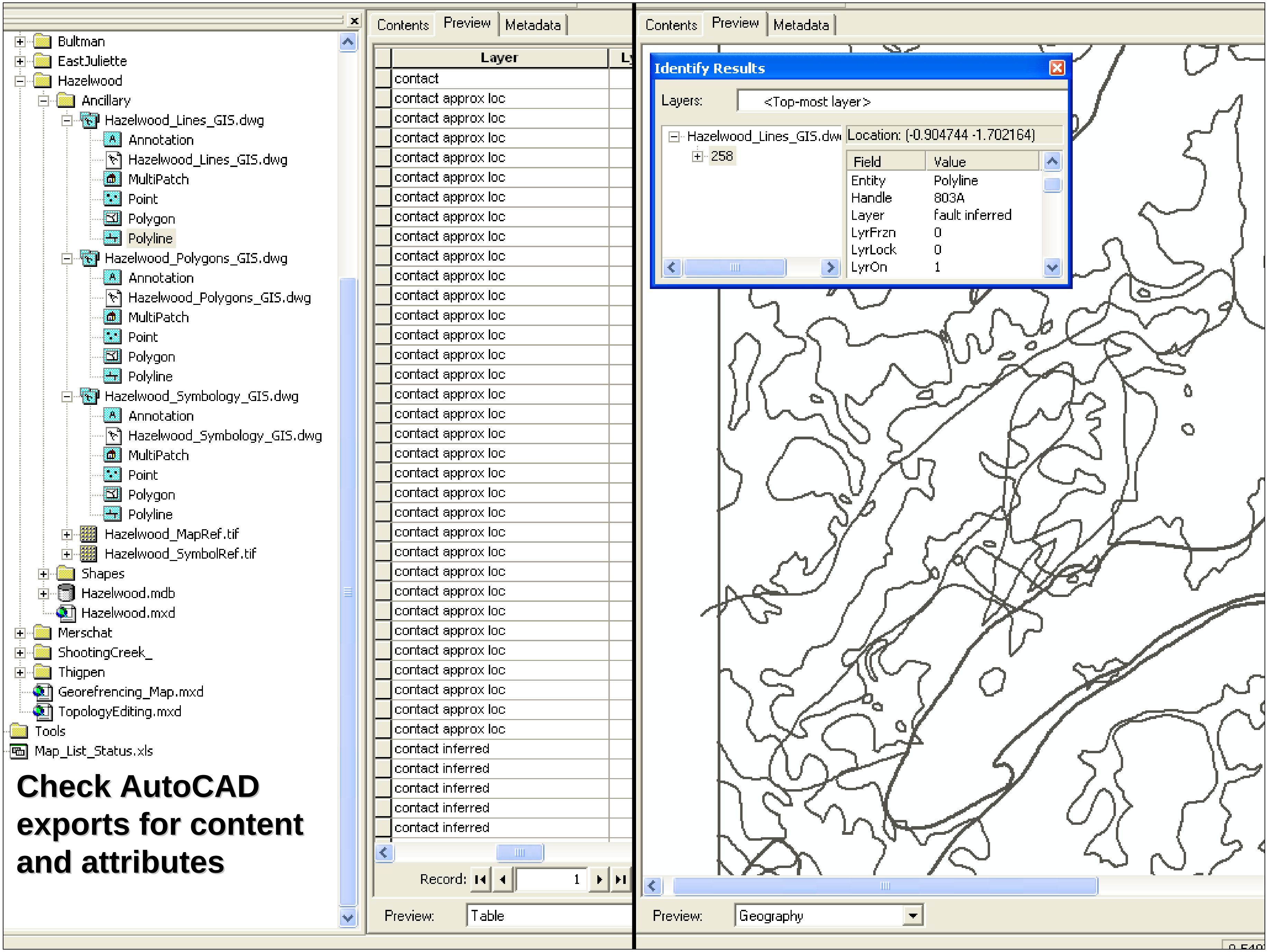
Densify and simplify



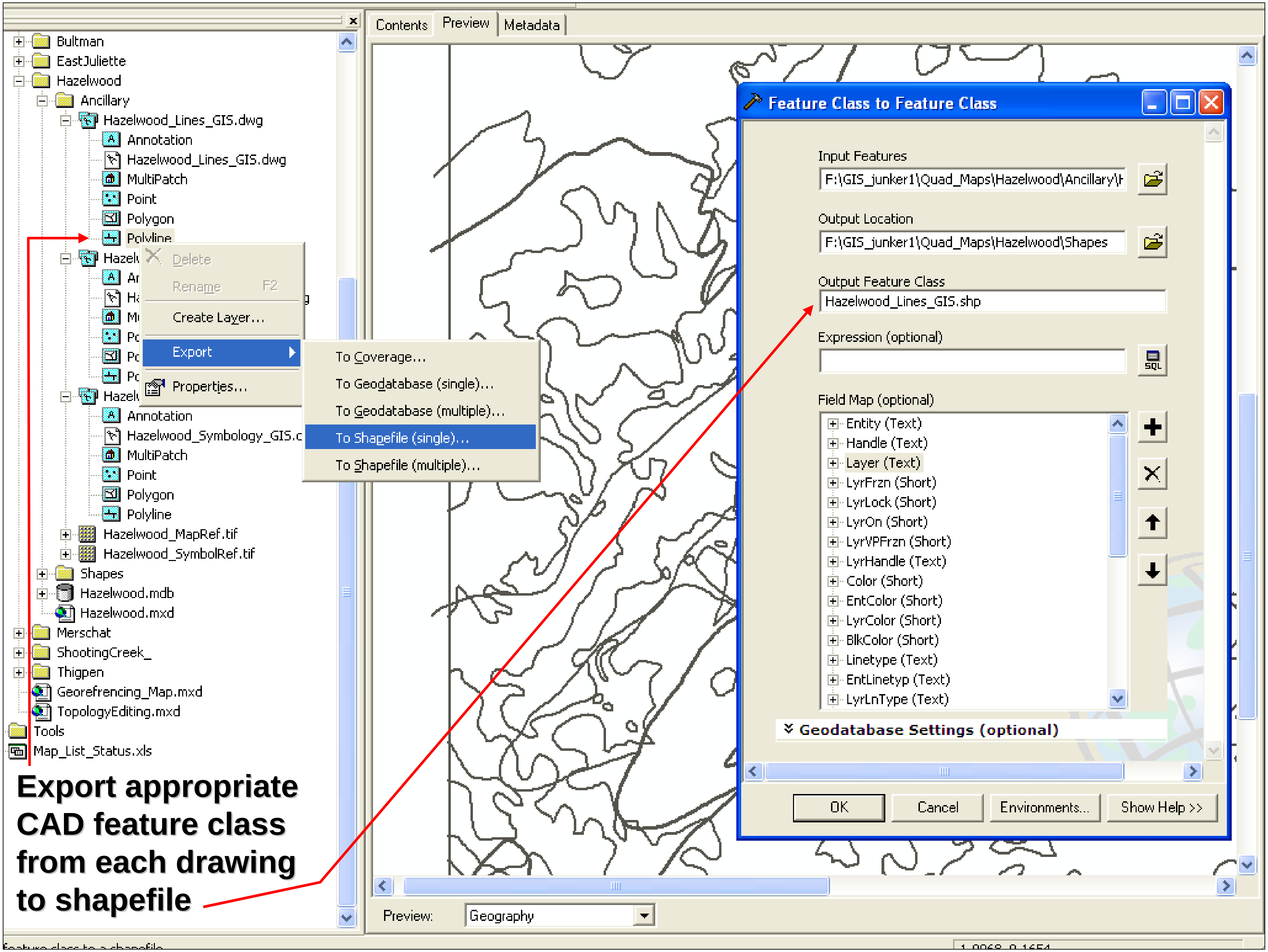
Export to TIFF and export to AutoCAD

Step 2

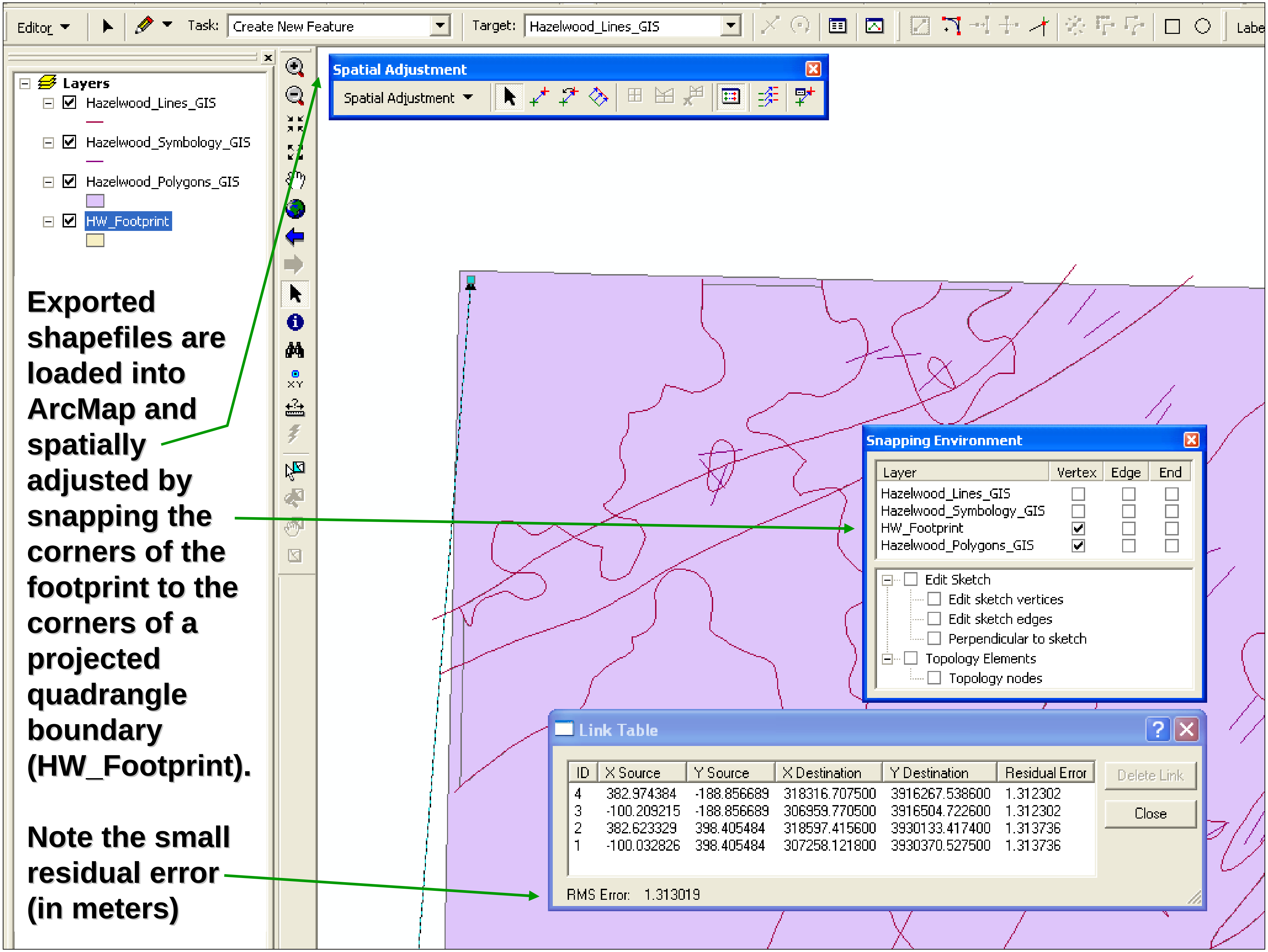
- AutoCAD files are checked in ArcCatalog for errors. (If found, back to Step 1)
- Selected feature classes within each AutoCAD file are converted to shapefiles.
- The shapefiles are spatially adjusted in an ArcMap edit session using the quadrangle boundary as a guide
- The adjusted shapefiles are saved and appended to their corresponding feature classes in a geodatabase



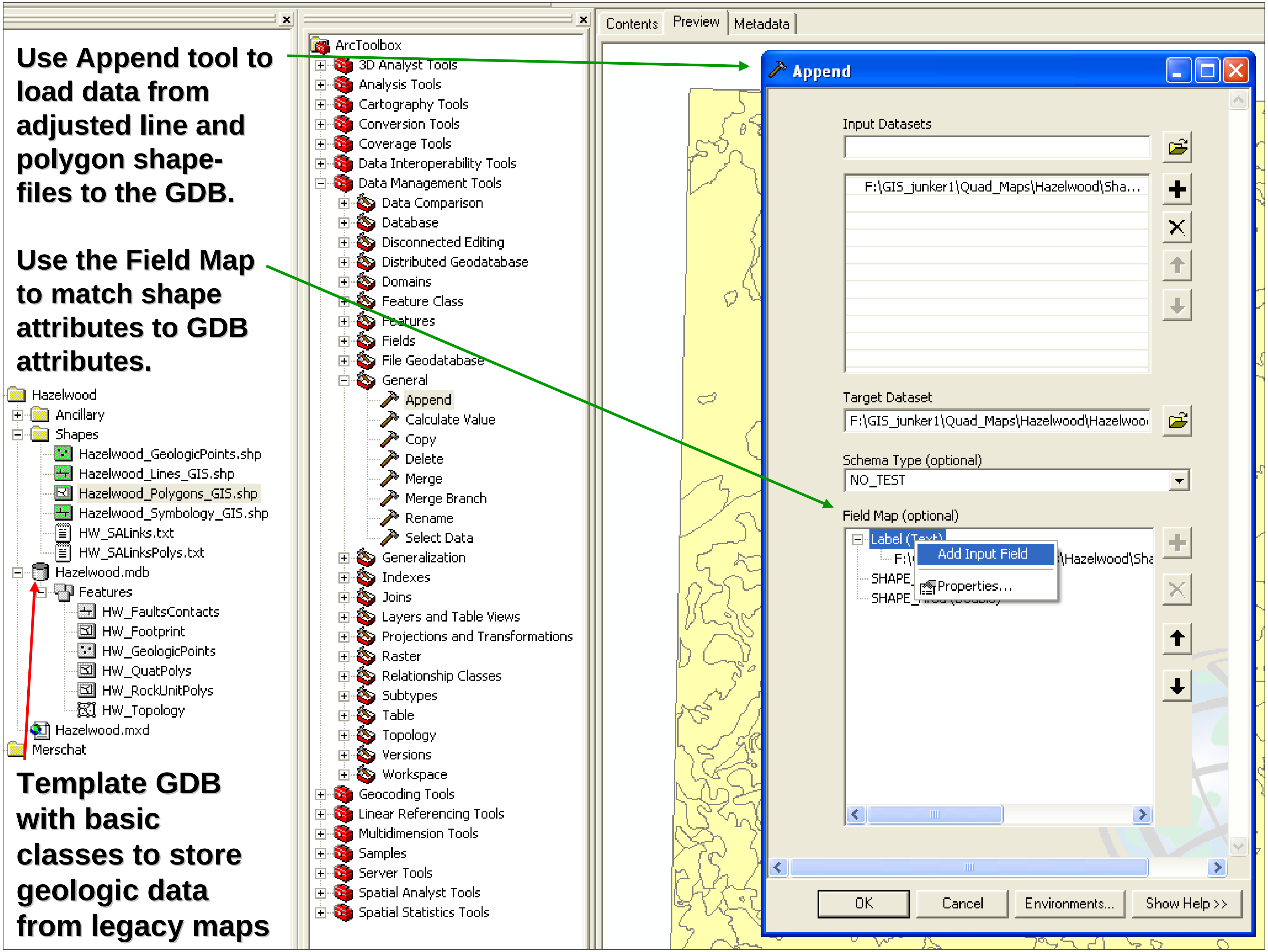
Preview of AutoCAD classes in ArcCatalog. Check exports for content and attributes.



AutoCAD class tree and export to shape dialog



Spatial adjustment in ArcMap

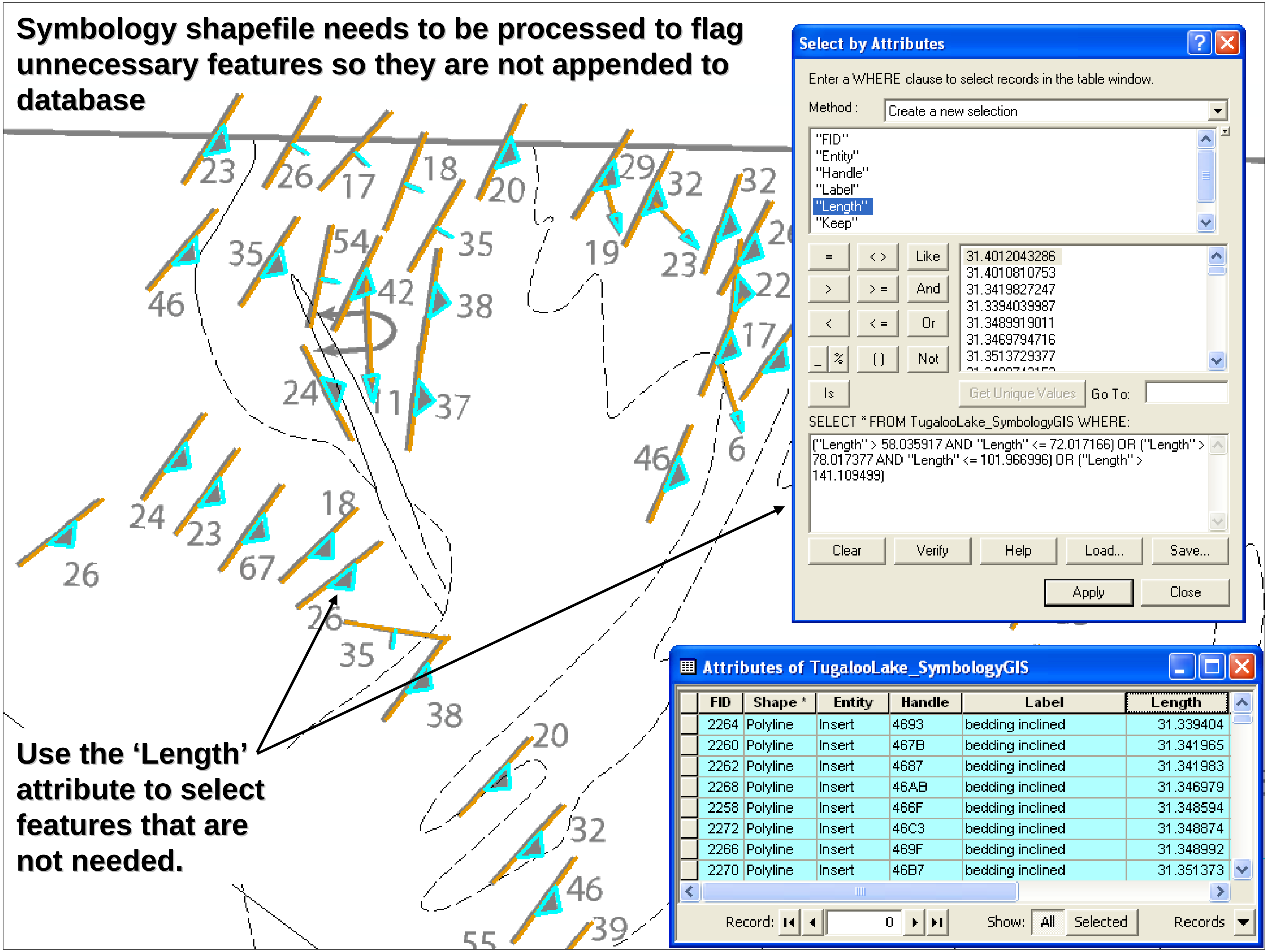


ArcCatalog toolbox and Append to GeoDB showing tree

Step 3

- Symbology shapefile is processed in ArcMap and any unnecessary features are flagged as unneeded (operator intensive).
- Strike/rotation attribute is calculated for each feature using an ArcMap Field Calculator expression.
- Dip/plunge attribute (if applicable) is read from reference TIFF image and added to each feature semi-automatically by an operator with the help of an ArcMap utility developed in-house (AttributeFeatures tool)

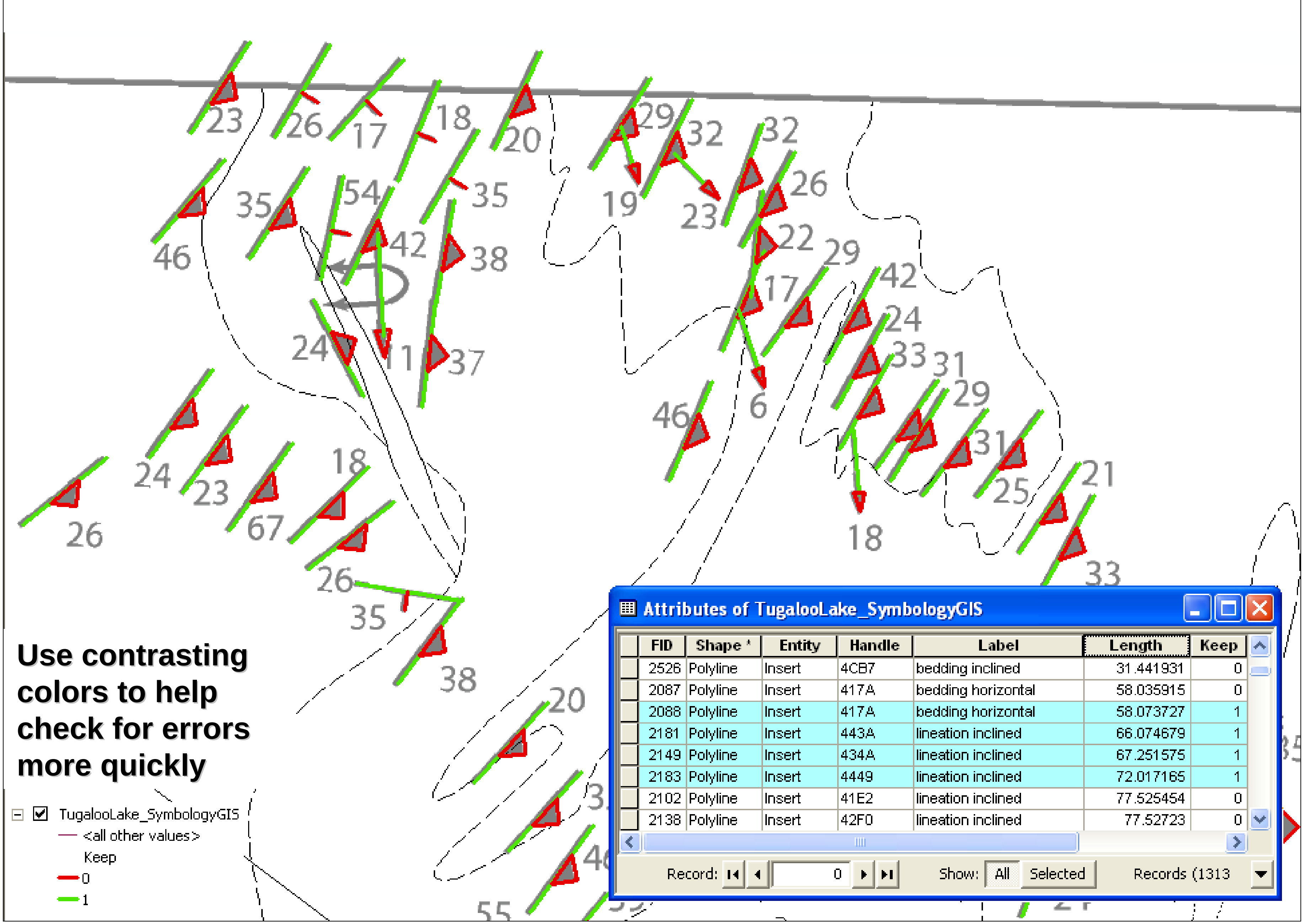
Symbology shapefile needs to be processed to flag unnecessary features so they are not appended to database



Use the 'Length' attribute to select features that are not needed.

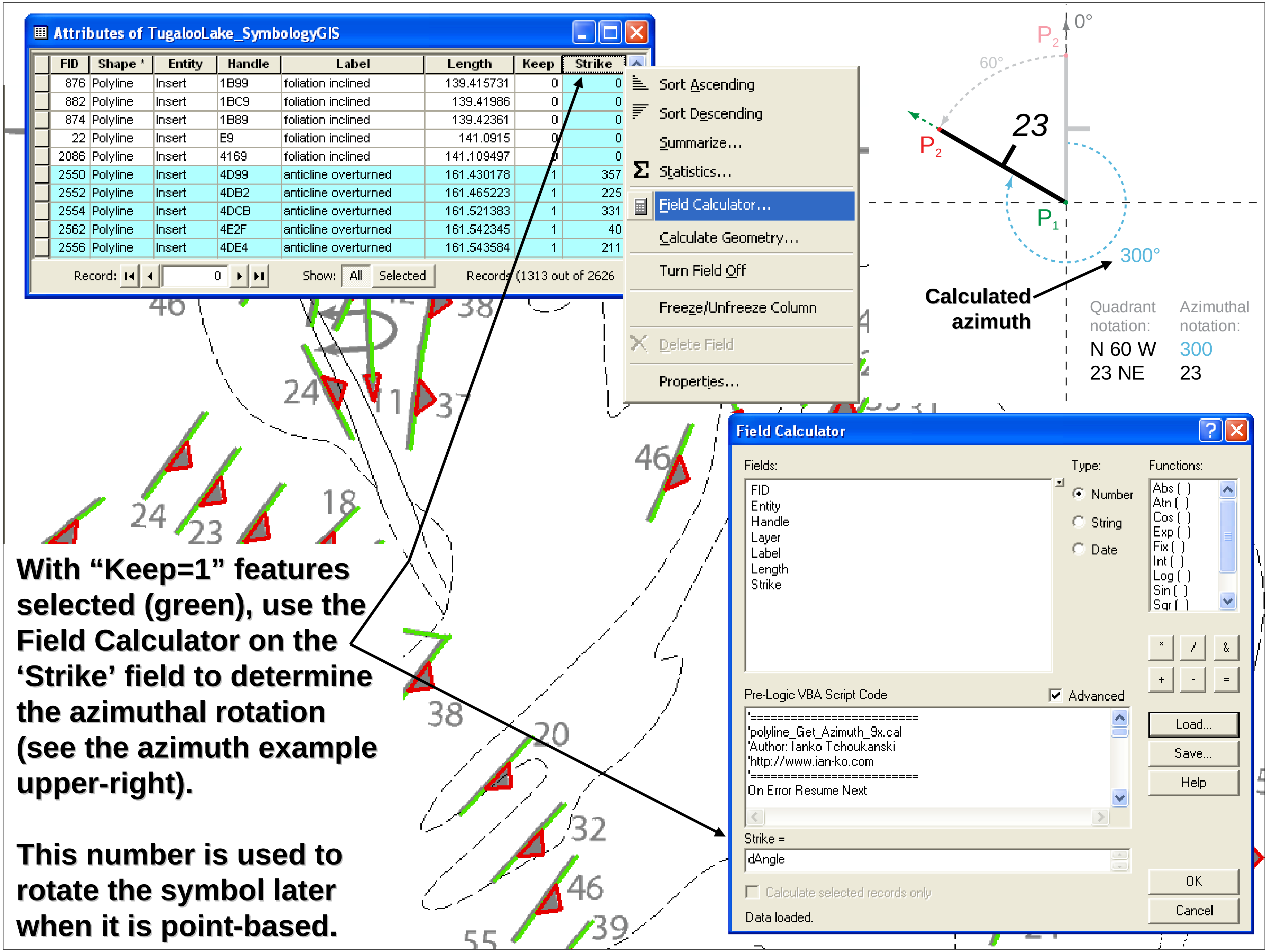
Symbology cleanup in ArcMap 1

Don’t delete anything! Use attributes to flag features. Mistakes can be fixed later…



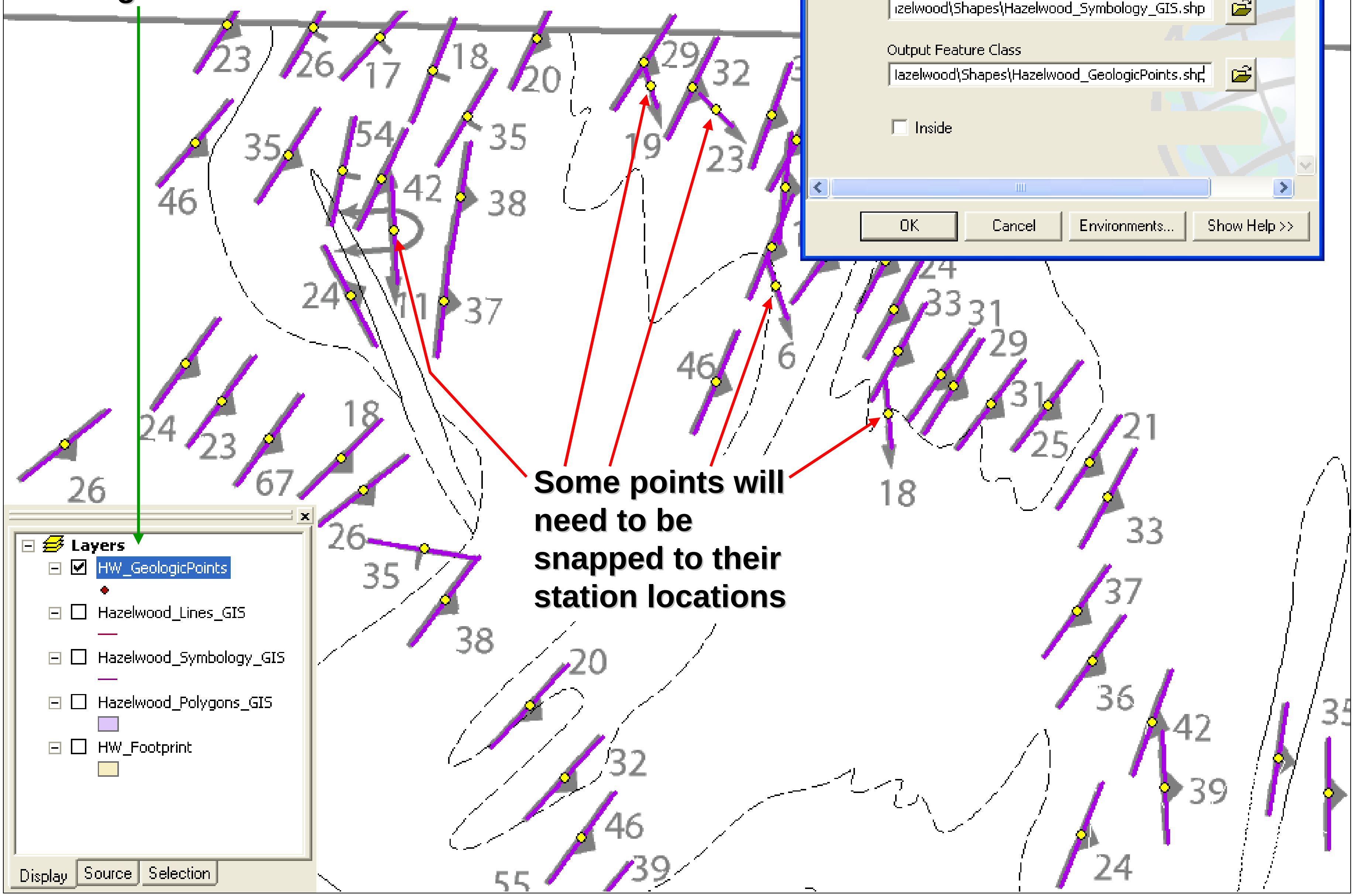
Use contrasting colors to help check for errors more quickly

Symbology cleanup in ArcMap 2

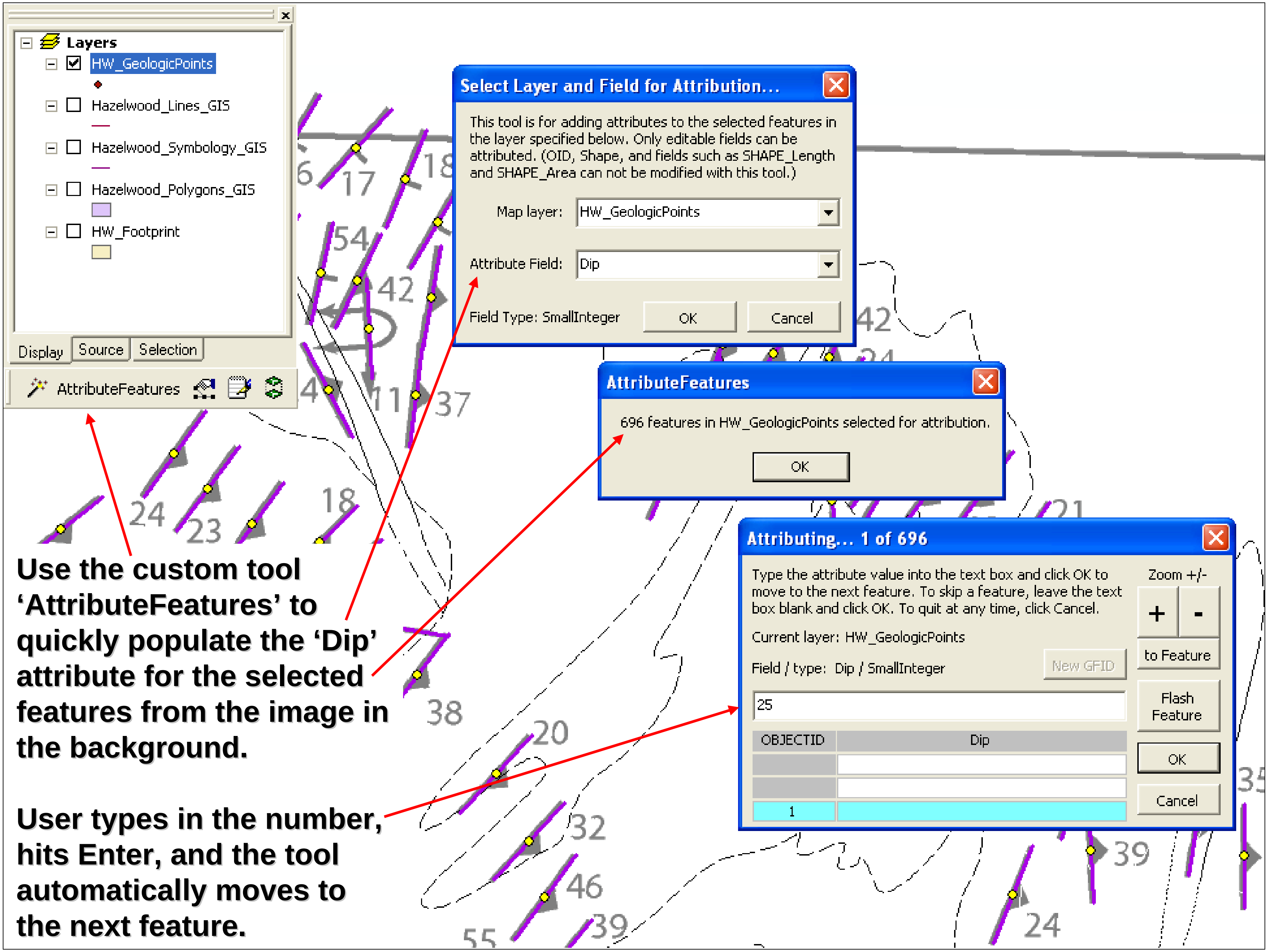


ArcMap Field Calculator for strike/rotation

Once symbology shapefile has been processed, it can be converted to points and appended to the 'GeologicPoints' class in the GDB.

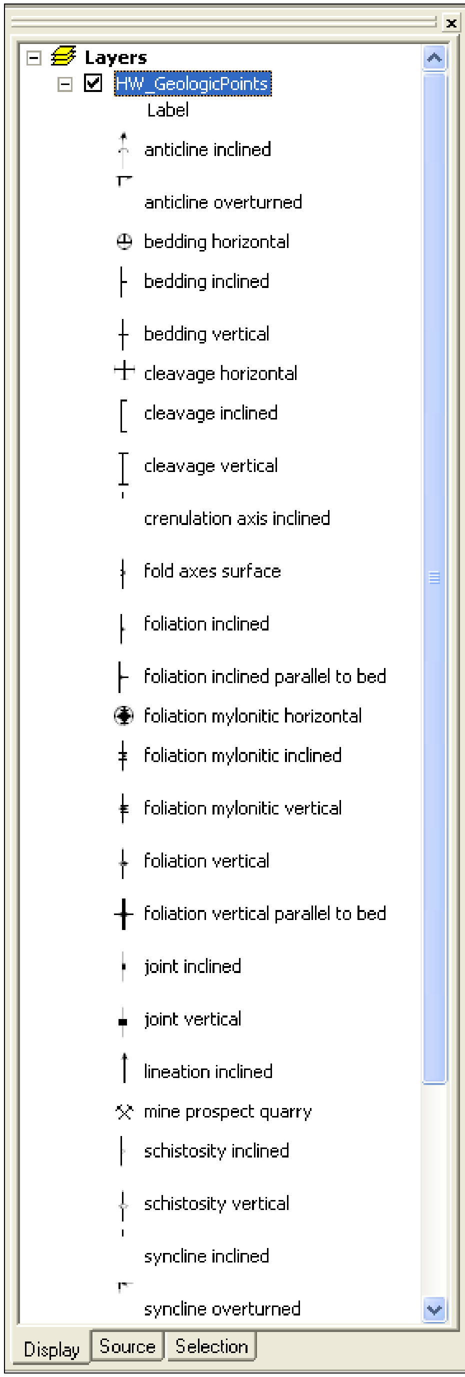


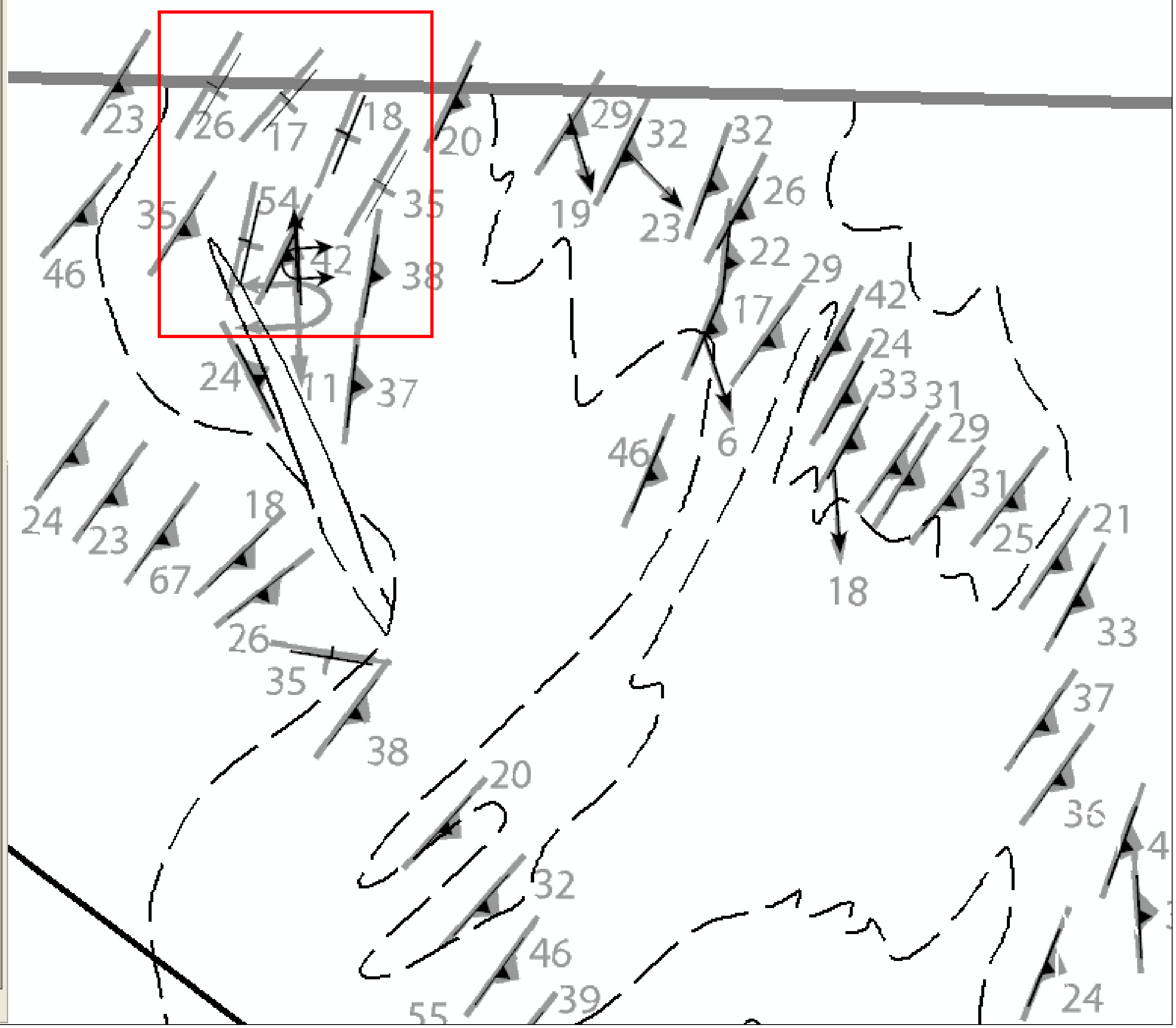
Symbology convert to points in ArcMap



Attribute Features tool

After attribution, the points are symbolized and the rotation checked. Note the inversion of the inclined bedding and overturned antiform symbols. These will have to be corrected.

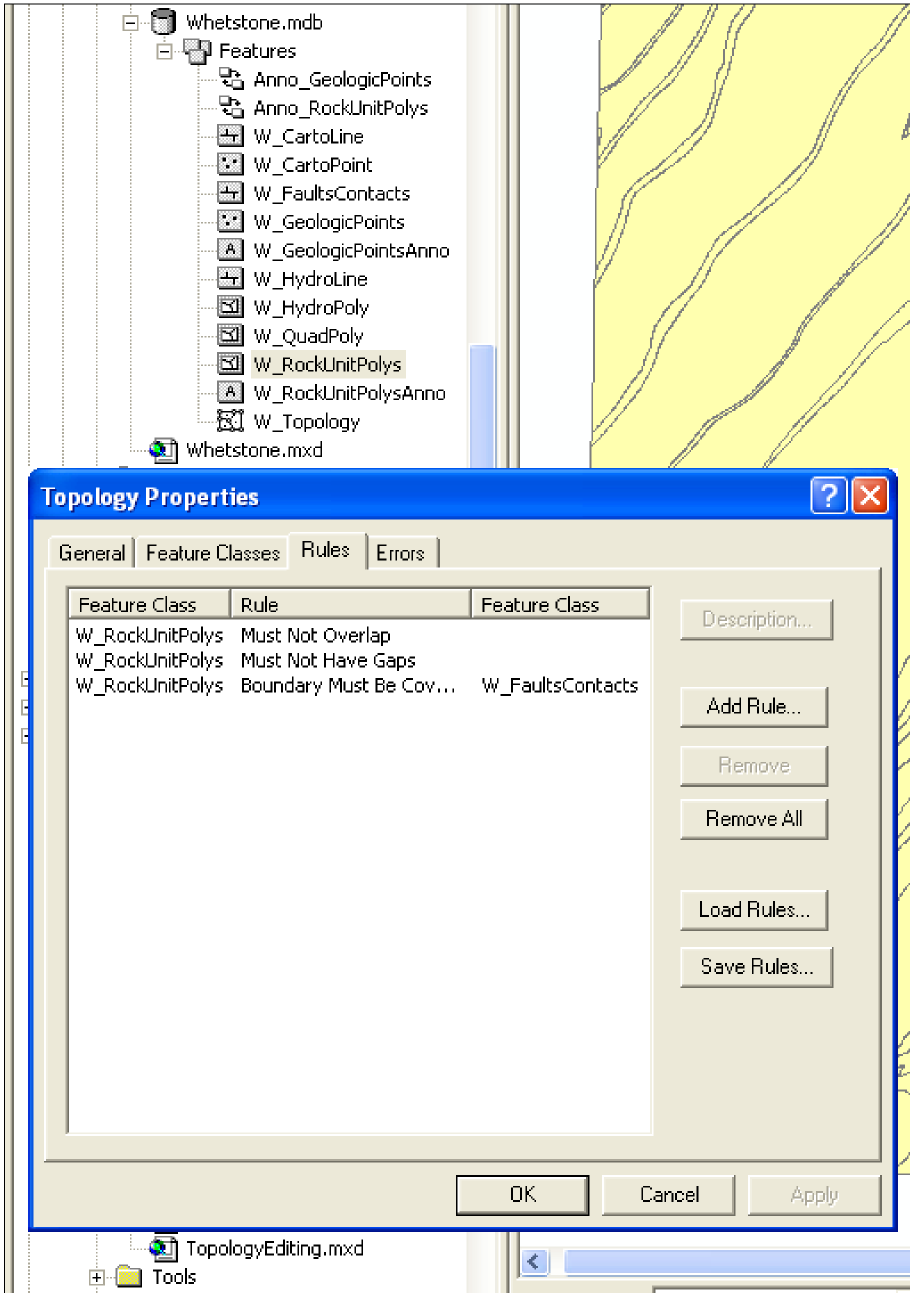




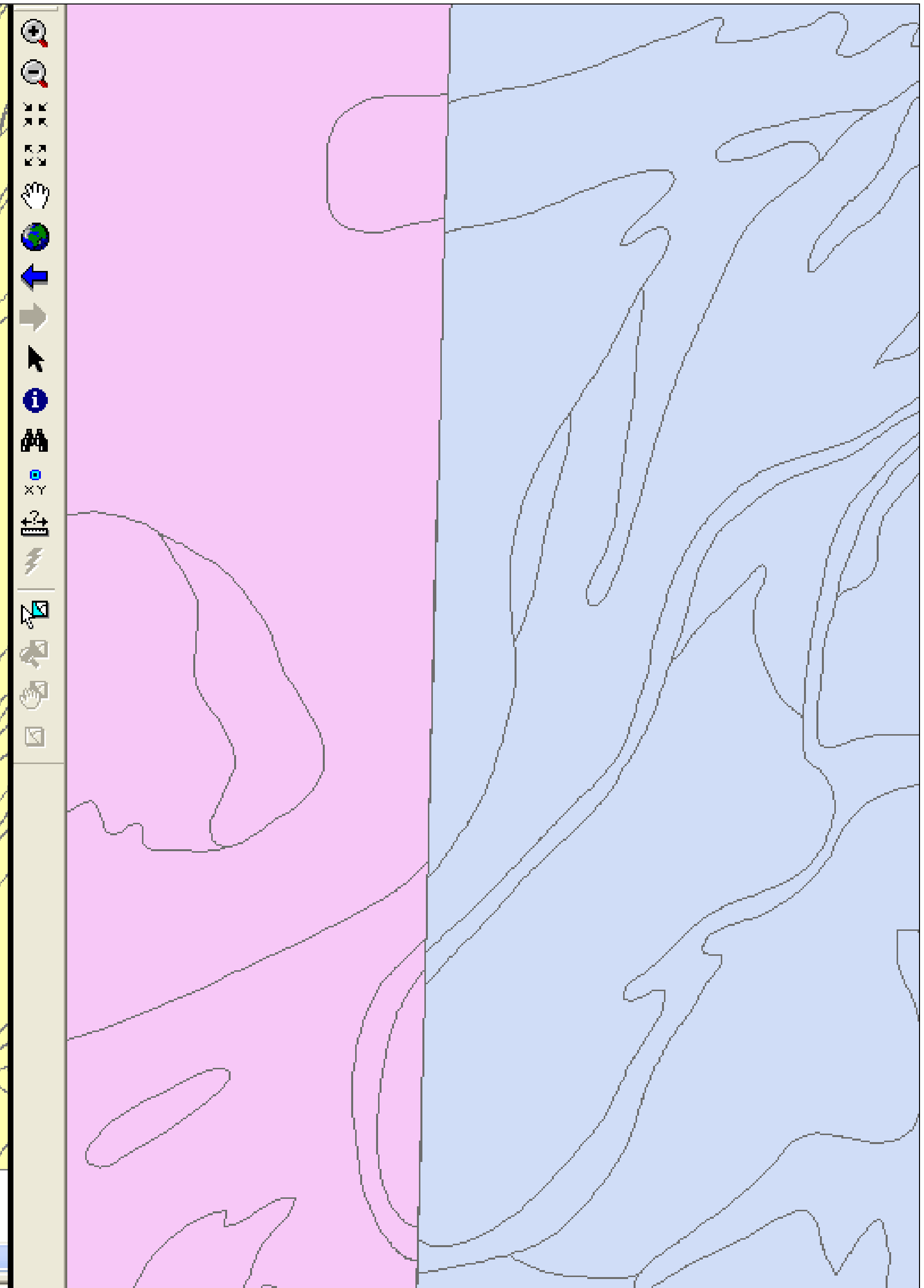
Symbolize and check for errors

Steps 4, 5, and 6

- The database is checked for topology errors and edge-matched to existing data if necessary.
- A round of quality control measures are taken and any special considerations are addressed.
- The database is ready for symbolization and labeling in ArcMap, and can be exported for placement in a final map layout for editing and publication.



Use topology to maintain relationships



Edgematch adjoining quadrangles

Topology rules/Edgematching

QC and Special Items

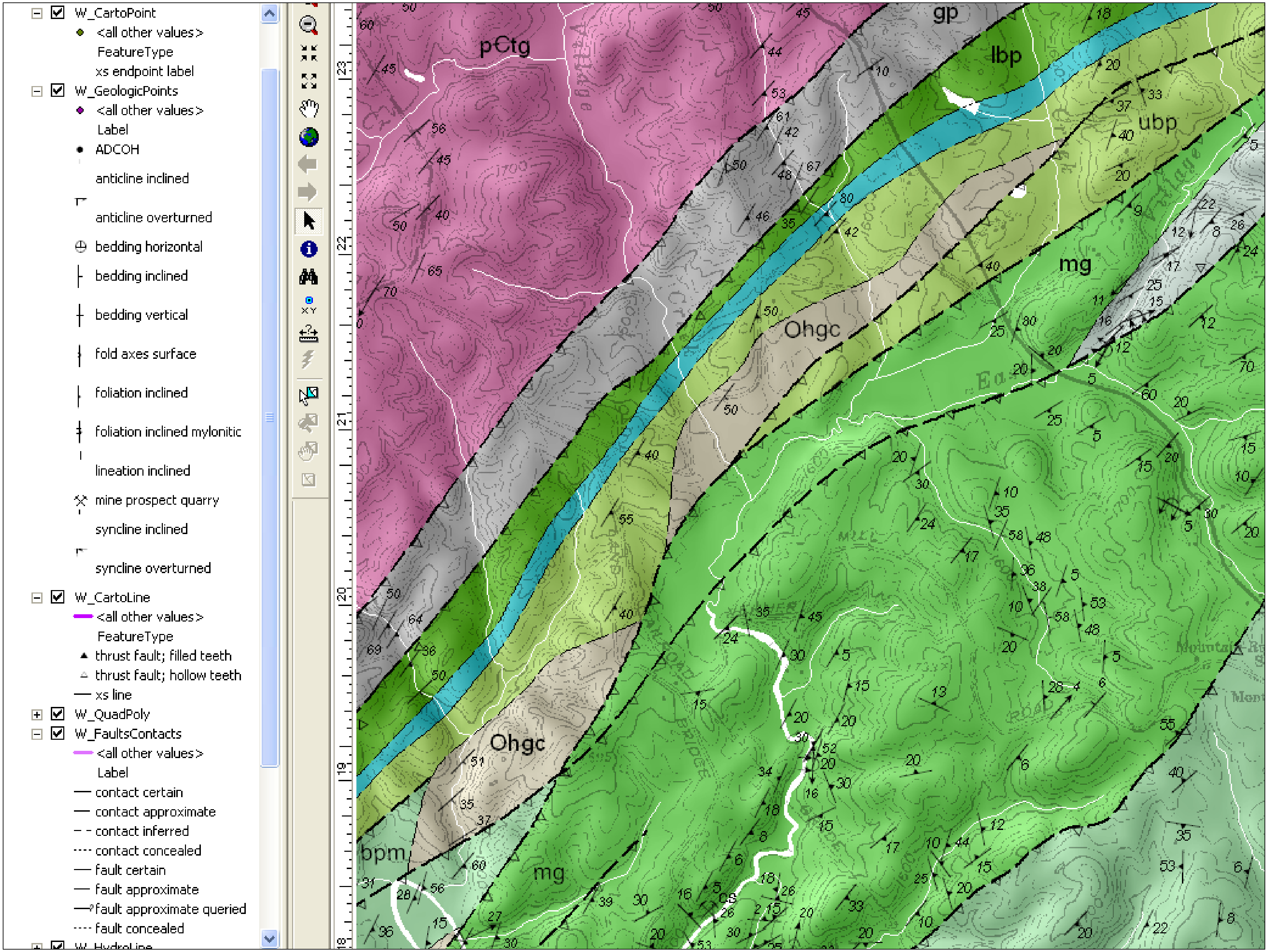
- Quality control can consist of:
  - Checking tables for <null> or incorrect attributes and fixing if found.
  - Comparing to reference map or checking field books to confirm correct attributes.
- Special cartographic or other items:
  - Labels are converted to annotation so they can be positioned by hand.
  - Cross-section lines, label points, fault names, fault teeth, etc. are created and stored.
  - Any other items specific to a particular map.

QC/Cartographic features added

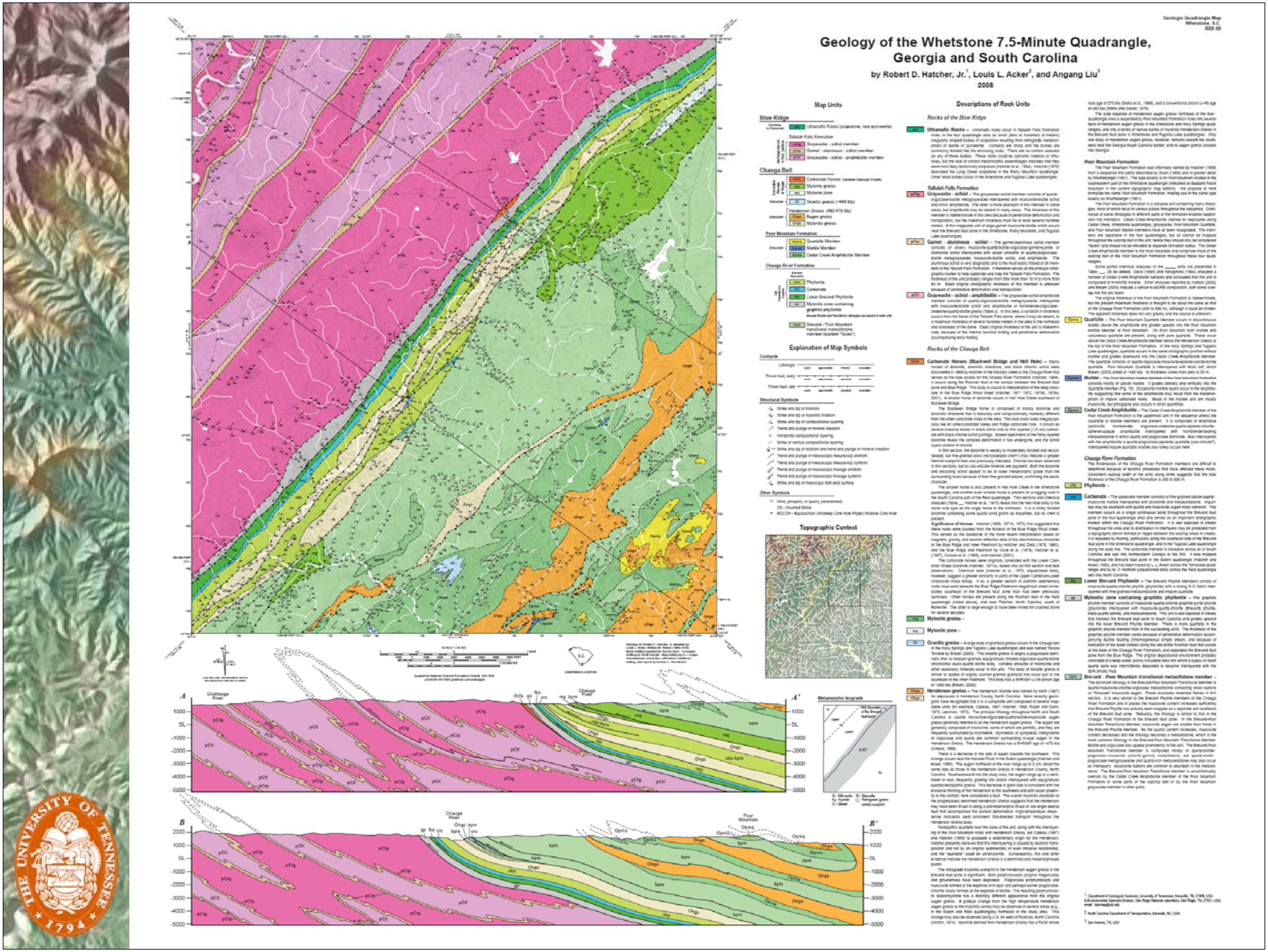
Map symbology and export

- The data are loaded into a template ArcMap layout and the layers are arranged appropriately.
- Layer files allow for implementation of standards and provide consistent replication of colors and symbols.
- DRGs, hillshades, or other data can be added to the map.
- Exports to PDF, Illustrator, or TIFF for placement in a layout for print or editing.

Map symbology labeling etc



Final map and labels in ArcMap



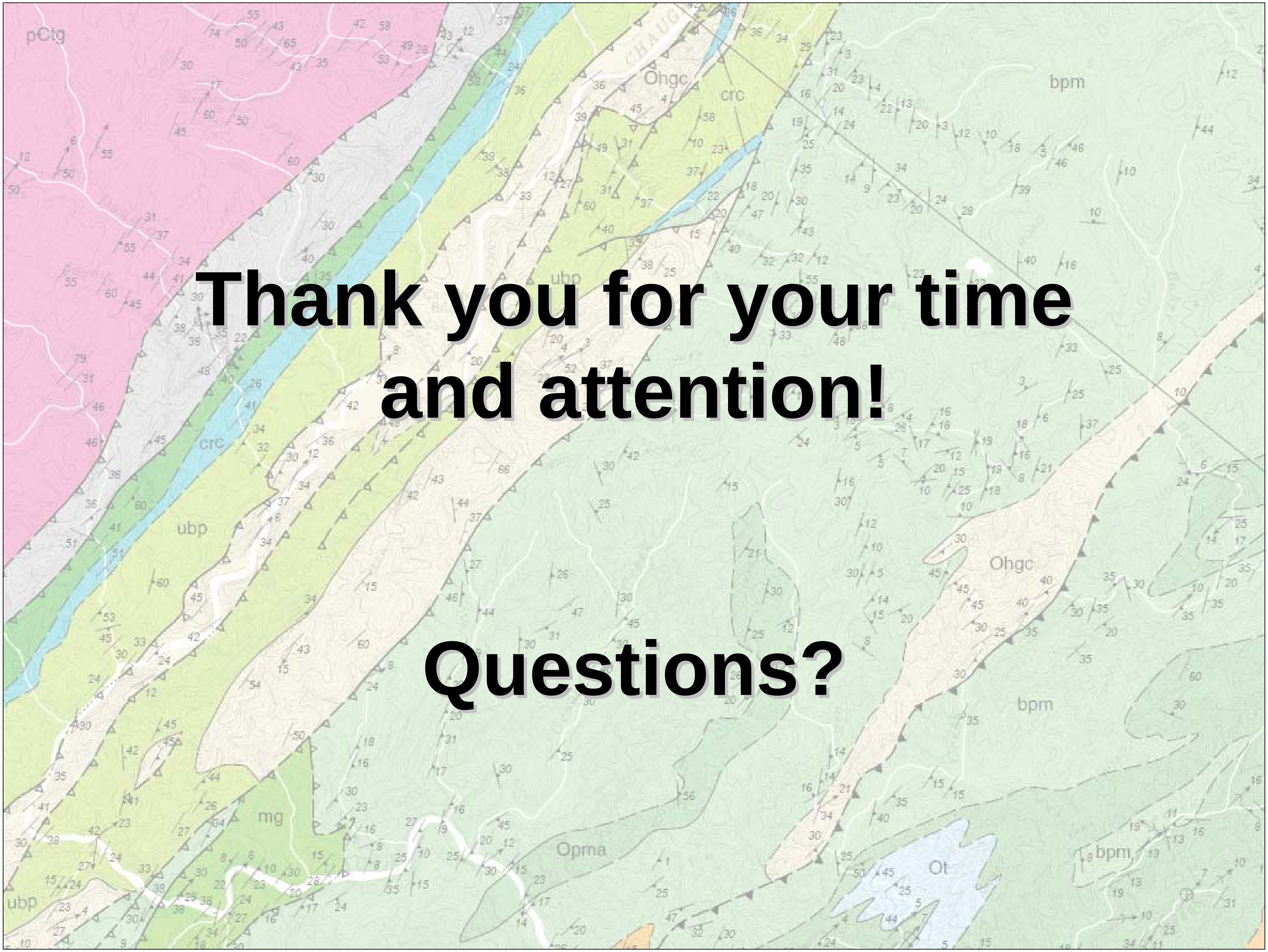
Finished poster

Final Thoughts

- Modular aspect makes it easier for multiple operators to work simultaneously.
- Method is less labor intensive than scratch digitizing, but requires greater care by operator not to lose or change data.
- Process can be tweaked to work with other input formats and different outputs (SDE, ArcIMS, etc.)

Future Developments

- Find a way to link CAD annotation to features to speed attribution.
- Could be automated further if AI files could be dissected programmatically.
- Other suggestions?



Thank you for your time and attention!

Questions?