# Working with Global Topography Data and the King Map

#### **Overview**

I apologize for how poorly last week's class went... I should have refamiliarized myself with the Geologic Map of the U.S. With this lesson, I hope to get back on track with a look at how to work with the wonderful global datasets that have become available recently as well as start working with geologic maps.

#### <u>Global Topography</u>

Some fascinating global topography data has recently become available. Much of it was originally compiled by the Defense Mapping Agency and was classified. In the past, the best data was a raster with 5 arc-minute spacing. Now there is a more accurate dataset with a spacing of 30 arc seconds. Not only is the elevation data more accurate but the topography of the ocean basins is included.

ETOPO2 is a dataset with 2 arc-minute spacing (<u>http://www.ngdc.noaa.gov/mgg/image/2minrelief.html</u>) and includes the topography of the ocean basins. The entire dataset is ~111MB and may be downloaded in DOS binary form from <u>http://www.ngdc.noaa.gov/mgg/global/relief/ETOPO2/</u>. Once downloaded, it may be read by Global Mapper.

Global Mapper does not automatically recognize this (ETOPO2.dos.bin) as readable and will not list it as "openable" unless file type is specified as "All Files (\*.\*)".

| Open   |   |                 |                                    |           | ? ×    |
|--|---|-----------------|------------------------------------|-----------|--------|
| Look in:   | 🗹 Desktop   |                 | •                                  | + 🛍 💣 🎟 - |        |
| History<br>History<br>Desktop<br>My Documents<br>My Computer | ETOPO2.dos<br>fortPnts.DBF<br>gb_export<br>ITIE request<br>Pringle DEM<br>pringle plan<br>pringle<br>pyramid<br>rational<br>Rick triangle | ngavailability  | Rubbish<br>schema<br>Visual Studio | Projects  |        |
|  | File name:  | ETOP02.dos      |                                    | •         | Open   |
| My Network P   | Files of type:  | All Files (*.*) |                                    | •         | Cancel |

When the file is selected, Global Mapper does not know what it is so asks you to specify the data's type.



Specify "ETOPO2 File" and it will be read.



It is a WGS84 dataset (*i.e.*, unprojected).

To make it readable in ArcMap, it must be exported as an ESRI ASCII grid and the file path of the directory to which it is written must not have spaces or special characters. The entire dataset or any rectangular area of it may be exported. To select a portion to be exported, select File>Export Raster and Elevation Data>Export Arc ASCII Grid and click "Export Bounds"

| Arc ASCII Grid Export Options                              | × |
|--|---|
| General Export Bounds                                      |   |
| All Loaded Data  |   |
| C All Data Visible On Screen Draw a Box                    |   |
| C Lat/Lon (Degrees)  |   |
| North 90 -180 West   |   |
| South -90 180 East   |   |
| O Global Projection (Geographic (Latitude/Longitude) - arc |   |
| North 89.98333333333 -179.9833333333 West                  |   |
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| MGRS (Military Grid Reference System) Bounds               |   |
| Top Left Coordinate out of range                           |   |
| Coordinate out of range Bottom Right                       |   |
| Reset to Last Exported Bounds                              |   |
| OK Cancel Apply Help                                       |   |

Clicking "Draw a Box" will permit you to a box around the area to be exported.

It will take a while to export the data, particularly if you export the whole thing (it's a big dataset). Use ArcToolbox Import to Raster>ASCII to Grid to convert the data to an ESRI raster file. Use ArcToolbox>Projects>Define Projection Wizard (coverages, grids, TINs to define the "projection" as WGS84.



**Globe** is another fascinating dataset

(<u>http://www.ngdc.noaa.gov/seg/topo/globeget.shtml</u>). Although it only has the topography of Earth's land surface, it has a 30 arc-second resolution. The dataset is broken into sixteen downloadable "tiles"

(<u>http://www.ngdc.noaa.gov/seg/topo/gltiles.shtml</u>). Unfortunately, these data are not quite as straightforward as ETOPO2. After downloading the data, the corresponding "header" and ARC/INFO palette files must be downloaded as well from ftp://ftp.ngdc.noaa.gov/GLOBE DEM/data/elev/esri/hdr/ and

ftp://ftp.ngdc.noaa.gov/GLOBE\_DEM/data/elev/esri/clr/ respectively. For instance, if you downloaded tile f10g, you would also need to download f10g.hdr and f10g.hdr and f0llow the procedure outlined in

<u>http://www.ngdc.noaa.gov/seg/topo/report/s11/s11Gix.html</u>. Note that the suffix .bil must be added to the "Tile's" file name (e.g., f10g must be renamed f10g.bil). Once this has been done, the data will be recognized as in a readable form by Global Mapper.

# Global Topography Data and the King Map





## Shaded relief maps of large areas

Tom Lowell and his students have produced a number of interesting shaded relief maps of the entire Midwest of the US. I believe these maps were produced from the NED data we've used before (and, therefore, ultimately from 7.5' DEM's). Although these data are unsurpassed in detail, coverage of a large area means an immense dataset. If we wanted to make a shaded relief map for the entire US, it would be impractical to use a 30m spacing. The global topography datasets are ideal for this purpose. Use the same steps we used when processing the DEM and NED data.

- Get the data grid into ArcMap
- Create or use an existing cookie cutter
- Clip using Spatial Analyst (same procedure used previously)
- Use hillshade on the clipped file but use a small Z Factor (I used a factor of 0.001 for the map shown below.



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Spatial Analyst -

3D Analyst ▼

Display Source

#### Working with the King Map

Although now a bit dated, the geologic map compiled by P.B. King is still a marvelous resource. You can read about the map at <u>http://geopubs.wr.usgs.gov/open-file/of00-443/</u>. A version of the map in ArcView 3.2 format may be downloaded from <u>http://pubs.usgs.gov/dds/dds11/kb.tar.gz</u>. Once unzipped, the map may be imported into ArcMap by File>Import from ArcView Project...

| Import from ArcView 3.2 Project                    | ? ×     |
|--|---------|
| Enter or browse for an ArcView project file (.apr) |         |
|  | <b></b> |
| Choose which documents to import                   |         |
| Layouts (choose one)                               |         |
| <b>▼</b>   |         |
| Views:   |         |
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| OK Can   | cel     |

Use the browser in the resulting dialog box to locate the King ArcView project (it's very deeply buried ...\king\home10b\resdgs2\pschruben\arc7\kb.apr). Once selected, another dialog will appear.

| Import from ArcView 3.2 Project                    | ? ×      |
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| Enter or browse for an ArcView project file (.apr) |          |
| D:\King Map\kb.apr                                 | <b>2</b> |
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| geology key view                                   |          |
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| OK Can   | cel      |

## Global Topography Data and the King Map

Select "map view" and the ArcView Project should open. Select the properties of the "Geology Polygons" then the "Symbology" tab. You can automatically assign a color to a particular rock group.

| Layer Properties              |               |                                |                                |                |  |
|-------------------------------|---------------|--------------------------------|--------------------------------|----------------|--|
| General Source Select         | ion   Display | y Symbology Fields De          | finition Query   Labels   Joir | ns & Relates   |  |
| Show:                         | Draw ca       | tegories using unique va       | alues of one field.            | Import         |  |
| Features                      | View Field    |                                |                                |                |  |
| Lategories                    |               | iu                             |                                |                |  |
| Unique values                 | ROCK          |                                |                                |                |  |
| Unique values, many l         |               |                                |                                |                |  |
| Match to symbols in a         | Symbol        | Value                          | Label                          | Count 🔺        |  |
| Quancicies                    |               | <all other="" values=""></all> | <all other="" values=""></all> |                |  |
| Unarts<br>Multiple Attributes |               | <heading></heading>            | ROCK                           | 12934          |  |
| Multiple Attributes           |               | 1 water water                  | 1 water water                  | 19             |  |
|                               |               | 2 Qh Holocene                  | 2 Qh Holocene                  | 485            |  |
|                               |               | 3 Qp Pleistocene               | 3 Qp Pleistocene               | 508            |  |
|                               |               | 4 Q Quaternary                 | 4 Q Quaternary                 | 272            |  |
|                               |               | 5 Qv Quaternary volcanic       | 5 Qv Quaternary volcani        | (166 📃         |  |
| MR F                          |               | 6 Qf Quaternary felsic vo      | 6 Qf Quaternary felsic vo      | 9              |  |
| and have                      |               | 7 Tp Pliocene                  | 7 Tp Pliocene                  | 46             |  |
| K. France                     |               | 8 Tpc Pliocene continent       | 8 Tpc Pliocene continent       | 401            |  |
| 1 43-4 1/3                    |               | 9 Tpv Pliocene volcanic r      | 9 Tpv Pliocene volcanic        | r 338 🔻        |  |
| S / 4                         | Add All Va    | alues Add Values               | Remove Remove                  | All Advanced - |  |
|                               |               |                                |                                |                |  |
|                               |               |                                | OK Can                         | cel Apply      |  |

Unfortunately for us, however, the colors are not appropriate. The appropriate colors are agreed upon by an international committee. A draft proposal on standards (very lengthy) may be viewed at

http://ncgmp.usgs.gov/fgdc\_gds/mapsymb/mapsymbpdfs.html. The USGSapproved color scheme may be viewed here <u>http://www.stratigraphy.org/codus.pdf</u>.

Well, this is a problem to which, I'm sure, there's an easy solution. We should be able to import the legend file (\*.avl) from the King map. Unfortunately, it doesn't work (at least I was unable to get it to work). The only way I know of fixing the problem is to open the map in ArcView 3.2. Soooo.... Open ArcView 3.2 from the start menu and open the King map.



Double clicking on "Geology polygons" brings up the layer's properties dialog.

| 🔍 Legend Editor 📃 🔲 🗙            |                    |                    |          |  |
|----------------------------------|--------------------|--------------------|----------|--|
| Theme: Geology polygons          |                    |                    |          |  |
| Legend Typ                       | e: Unique Value    | <b>_</b>           | Save     |  |
|                                  |                    | Ē                  | Default  |  |
| Values Field                     | Rock               | <b>_</b>           |          |  |
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|                                  | 1 water water      | 1 water water      | <b>_</b> |  |
|                                  | 2 Qh Holocene      | 2 Qh Holocene      |          |  |
|                                  | 3 Qp Pleistocene   | 3 Qp Pleistocene   |          |  |
|                                  | 4 Q Quaternary     | 4 Q Quaternary     |          |  |
|                                  | 5 Qv Quaternary v  | 5 Qv Quaternary v  |          |  |
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|                                  | 7 Tp Pliocene      | 7 Tp Pliocene      | -        |  |
| + 🗶                              |                    | 邮 档 🧐              |          |  |
| Color Schemes: Bountiful Harvest |                    |                    |          |  |
| Advance                          | d Statistics       | Undo               | Apply    |  |

Click the save button and create a new legend file.

| 🔍 Save Legend  |  | ×            |
|--|--|--------------|
| File Name:<br>legend that works avl<br>geol2500_alb-s.avl<br>geol2500_alb avl<br>i bgo2 1.avl<br>i bgond'i avl | Directories:<br>c:\docume~1\administrator\desktop\<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c:\docume~1\administrator\desktop<br>c | OK<br>Cancel |
|  | Drives:  |              |

Close Arcview 3.2 and re-import the project into ArcMap. Bring up symbology for the Geology polygons layer and click the "Import" button". Click the radio button

| Import Symbology   |  |  |  |  |
|--|--|--|--|--|
| C Import symbology definition from another layer in the map or from a layer file:      |  |  |  |  |
| <ul> <li>Import symbology definition from an ArcView 3 legend file (*.avl):</li> </ul> |  |  |  |  |
| Legend file:   |  |  |  |  |
| What do you want to import?  |  |  |  |  |
| <ul> <li>Complete symbology definition</li> </ul>                                      |  |  |  |  |
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| Thesi or type. [ArcView 3 legend file(".avi)   |  |  |  |  |

Once opened, a last dialog box appears. Click "OK".

| Import Syml         | oology M        | atch      | in <mark>?   ×</mark> |
|---------------------|-----------------|-----------|-----------------------|
| The Symbology yo    | u chose uses ti | he follov | ving field(s):        |
| Value Field<br>ROCK |                 |           |                       |
| ROCK                |                 | •         |                       |
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|                     |                 | ~         |                       |
| Value Field         |                 |           |                       |
|                     |                 | ~         |                       |
|                     | OK              |           | Cancel                |

## Global Topography Data and the King Map



Let's add a legend. First switch to the layout view then select Insert>Legend. Let's only label the geology polygons. In the right window select everything but "Geology polygons" and click "<" so only "Geology polygons" shows in the right window. Specify four columns in the column number box and click "Next"

| egend Wizard  | nt to include in your legend   |  |  |  |
|---|--|--|--|--|
| Map Layers:<br>Grid<br>Limits of Pleistocene glacia<br>Faults, dikes, and hidden of<br>Coastlines<br>States<br>Geology arcs<br>Geology, metamorphic ove<br>Geology polygons | Legend Items          Srid       Imits of Pleistocene glacia         States       Geology arcs         Geology polygons       Geology polygons |  |  |  |
| Set the number of columns in your legend:   |  |  |  |  |
|   | < Back Next > Cancel   |  |  |  |

Because it's pretty obvious what the legend is, I don't specify a legend title. Click "Next".

| Legend Title                      |  |  |
|-----------------------------------|--|--|
| Legend Title font properties      | Title Justification  |  |
| Color:<br>Size: 24<br>Font: Arial | You can use this to<br>control the justification<br>of the title with the rest<br>of the legend. |  |
| BZU                               |  |  |
| Preview                           |  |  |
|                                   |  |  |

A border around the legend? Sure, why not!

| Legend Wizard | ×      |
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| Legend Frame  |        |
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Finish! Now add title, scale, north arrow, frame, text, etc. etc. (be a lot more complete than I have been).



| 1 water water                                | 41 uK Upper Cretaceous                                 | 82 cat Catacalastic rocks                            | 122 SO   | <ul> <li>Silurian and Ordovician eugeosynclinal</li> </ul> |
|--|--|--|----------|--|
| 2 Qh Holocene                                | 42 Kc Cretaceous continental                           | 83 PP4 Virgilian Series                              | 123 03   | Upper Ordovician (Cincinnatian)                            |
| 3 Qp Pleistocene                             | 43 Ke Cretaceous eugeosynclinal                        | 84 Pzg3 Upper Paleozoic granitic rocks               | 124 IPz  | Lower Paleozoic  |
| 4 Q Quaternary                               | 44 Kv Cretaceous volcanic rocks                        | 85 PP3 Missourian Series                             | 125 O2   | Middle Ordovician (Mohawkian)                              |
| 5 Qv Quatemary volcanic rocks                | 45 Kg Cretaceous granitic rocks                        | 86 PP2 Des Moinesian Series                          | 126 O    | Ordovician   |
| 6 Qf Quaternary felsic volcanic rocks        | 46 uK1 Woodbine and Tuscaloosa groups                  | 87 PP Pennsylvanian                                  | 127 Oe   | Ordovician eugeosynclinal                                  |
| 7 Tp Pliocene                                | 47 Kgn Cretaceous border gneiss of Idaho batholith     | 88 ms schist and phyllite                            | 128 Ov   | Ordovician volcanic rocks                                  |
| 8 Tpc Pliocene continental                   | 48 K3 Washita Group                                    | 89 PP1 Atokan and Morrowan Series                    | 129 Pzg  | 1 Lower Paleozoic granitic rocks                           |
| 9 Tpv Pliocene volcanic rocks                | 49 IK2 Fredericksburg Group                            | 90 uPz Upper Paleozoic                               | 130 O1   | Lower Ordovician (Canadian)                                |
| 10 Tpf Pliocene felsic volcanic rocks        | 50 IK Lower Cretaceous                                 | 91 uPze Upper Paleozoic eugeosynclinal               | 131 015  | Lower Ordovician (Canadian)                                |
| 11 Tm Miocene                                | 51 Kg1 Lower Cretaceous granitic rocks                 | 92 mm1 felsic paragneiss and schist                  | 132 O1a  | Lower Ordovician (Canadian)                                |
| 12 Tmc Miocene continental                   | 52 Ki Cretaceous intrusive rocks                       | 93 PP1a Atokan and Morrowan Series, Jackfork SS      | 133 OC   | Lower Ordovician and Cambrian carbonate rocks              |
| 13 Tmoe Miocene and Oligocene eugeosynclinal | 53 IK1 Trinity group                                   | 94 uPzc Upper Paleozoic clastic wedge facies         | 134 C    | Cambrian   |
| 14 uTa Upper Tertiary andesite               | 54 uMze Upper Mesozoic eugeosynclinal                  | 95 mm2 mafic paragneiss (=hornblendite, amphibolite) | 135 Ce   | Cambrian eugeosynclinal                                    |
| 15 Ti Tertiary intrusive rocks               | 55 J Jurassic  | 96 mm3 migmatite                                     | 136 Cv   | Cambrian volcanics   |
| 16 To Oligocene                              | 56 Jc Jurassic continental                             | 97 M3 Chesterian Series                              | 137 Cg   | Cambrian granitic rocks                                    |
| 17 Toc Oligocene continental                 | 57 IMzv Lower Mesozoic volcanic rocks                  | 98 Pzmi Paleozoic mafic intrusives                   | 138 Cq   | basal Lower Cambrian clastic rocks                         |
| 18 Toee Oligocene and Eocene eugeosynclinal  | 58 Jg Jurassic granitic rocks                          | 99 mm4 felsic orthogneiss (=granite gneiss)          | 139 Z    | Z sedimentary rocks  |
| 19 Tmv Miocene volcanic rocks                | 59 Jmi Jurassic mafic intrusives                       | 100 M2 Meramecian Series                             | 140 Zg   | Z granitic rocks   |
| 20 Tmf Miocene felsic volcanic rocks         | 60 JTr Lower Jurassic and upper Triassic               | 101 M Mississippian                                  | 141 Zv   | Z volcanic rocks   |
| 21 Te3 Eocene Jackson Group                  | 61 IMz Lower Mesozoic                                  | 102 M1 Osagean and Kinderhookian Series              | 142 Y 3  | Missoula group   |
| 22 Tec Eocene continental                    | 62 IMze Lower Mesozoic eugeosynchial                   | 103 D3 Upper Devonian                                | 143 Y    | Y sedimentary rocks  |
| 23 Tee Eocene eugeosynclinal                 | 63 Trv Mafic Lava interbedded in Triassic Newark Group | 104 D3c Upper Devonian continental                   | 144 Yv   | Y volcanic rocks   |
| 24 ITv Lower Tertiary volcanic rocks         | 64 Trg Triassic granitic group                         | 105 Pzg2 Middle Paleozoic granitic rocks             | 145 Yg2  | Younger Y granitic rocks                                   |
| 25 ITf Lower Tertiary felsic volcanic rocks  | 65 Tri Triassic mafic intrusives                       | 106 D2 Middle Devonian                               | 146 Ys   | Syenite  |
| 26 Te2 Eocene Claiborne Group                | 66 Tr Triassic   | 107 D Devonian                                       | 147 Ym   | Paragneiss and schist                                      |
| 27 Te Eocene                                 | 67 TrPe Triassic and Permian eugeosynclinal            | 108 D2c Middle Devonian continental                  | 148 Y2   | Wallace, Siyeh and Helena Formations                       |
| 28 Teb Eocene Marine pillow basalt           | 68 P4 Ochoan Series                                    | 109 De Devonian eugeosynclinal                       | 149 Ya   | Anorthosite  |
| 29 ITa Lower Tertiary andesite               | 69 P3b Upper part of Guadalupian Series                | 110 Dv Devonian volcanic                             | 150 Y 1  | Ravalli Group and Prichard Formation                       |
| 30 Te1 Eocene Wilcox Group                   | 70 P3 Guadalupian Series                               | 111 D1 Lower Devonian                                | 151 Yg1  | Older Y granitic rocks                                     |
| 31 Tel Eocene lacustrine                     | 72 P3a Lower part of Guadalupian Series                | 112 DS Devonian and Silurian                         | 152 Y mi | Mafic intrusives   |
| 32 Tx Paleocene                              | 73 P Permian   | 113 DSe Devonian and Silurian eugeosynclinal         | 153 Ygr  | Orthogneiss  |
| 33 Txc Paleocene continental                 | 74 Pe Permian eugeosynclinal                           | 114 DSv Devonian and Silurian volcanic rocks         | 154 X    | X metasedimentary rocks                                    |
| 34 uK4 Navarro Group                         | 75 P2b Upper part of Leonardian Series                 | 115 Se Silurian eugeosynclinal                       | 155 Xv   | X volcanic rocks   |
| 35 uK3 Taylor Group                          | 76 um Ultramafic rocks                                 | 116 Sv Silurian volcanic                             | 156 Xg   | X granitic rocks   |
| 36 uK3b Taylor Group                         | 77 P2a Lower part of Leonardian Series                 | 117 S3 Upper Silurian (Cayugan)                      | 157 Xm   | Orthogneiss and paragneiss                                 |
| 37 Kg3 Latest Cretaceous granitic            | 78 P2 Leonardian Series                                | 118 S2 Middle Silurian (Niagaran)                    | 158 W    | W metasedimentary rocks                                    |
| 38 uK3a Taylor Group                         | 79 P2ac Early Leonardian continental                   | 119 S Silurian                                       | 159 Wv   | W volcanic rocks   |
| 39 uK2 Austin and Eagle Ford Groups          | 80 P1 Wolfcampian Series                               | 120 IPze Lower Paleozoic eugeosynchinal              | 160 Wg   | W granitic rocks   |
| 40 Kg2 Upper Cretaceous granitic             | 81 P1c Wolfcampian Series continental                  | 121 S1 Lower Silurian (Alexandrian)                  | 161 Wm   | i W mafic intrusives                                       |
|  |  |  | 162 Wg   | Orthogneiss and paragneiss                                 |

# Geologic Map of US