

## Cave Maps As Geographical Information Systems: An Example From Oregon Caves National Monument

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Land is managed using computer-run Geographical Information Systems (GIS). In such a system information is cataloged by location and type. This can then be applied to a display or tabular report on request. Cave management can be based on such a system. The following is a brief report on the development of a GIS for Oregon Caves, a medium-sized (3.5 miles) cave in southern Oregon.

Early in 1993 John Roth, Resource Specialist at Oregon Caves National Monument decided to commit resources to creation of a GIS for Oregon Caves. Crews of Earth Watch volunteers proceeded to do an inventory of 99 selected features in the cave. This information was dutifully fed into **DBASE 3**. These database files can then be utilized by **SMAPS 5.2** to create displays of the inventoried features on a line plot of the cave.

On the line plot the occurrence of a feature at a given location is indicated by a symbol, such as a circle, on the survey station near which the feature is located. The symbol can be made larger or smaller to reflect the feature quantitatively. Two or more features can be included in a display to indicate relationships. Thus we have achieved a GIS giving feature distributions, but only as stations on a line plot.

Such a GIS is very useful but after the inventory season we gained the capability of putting the line-plot from SMAPS into Garry Petrie's **KARST** program from which it could be exported via DXF format into **AutoCAD**. It was decided to continue with the Earth Watch program and set the volunteers to work resketching the cave in great detail, placing the physical features of the cave at their correct locations in the sketch. The cave would then be drawn on **AutoCAD** with a layer for each feature. After three summer work seasons, this GIS is nearly complete.

The cave was drawn on **AutoCAD 12** and is at this point (nearly finished) almost 8 megabytes in file size with 96 different layers. On a 166 megahertz computer with 32 meg of ram and a 2 meg vram video card, such a file loads in about 50 seconds with regen time a little less. With appropriate video drivers the zooms and pans are essentially

instantaneous. It must be emphasized that this is NOT a "map" of the cave but a GIS, with the ability of displaying selected information or relationships by the on/off manipulation of layers, and in/out zoom. Because of the ease of adding information it of course will be the instrument for recording newly found cave information, physical extensions to the cave, or any information related to sites in the cave.

The only advice I would pass on directly is that one should do all things possible to keep the file size down and the regeneration/loading time as short as possible. AutoCAD has many such. The only technique I didn't find in a manual was using what I call an "array" to easily add information to different layers when I'm working on a particular area of the cave without going through the laborious business of changing layers. First, you create the "array" by bringing together the symbols for what is on the different layers with each symbol still on its layer. Then you make a "block" of this collection. When you want to place a symbol for one of these items somewhere in the cave but don't want to change layers (for instance if you are adding a lot of symbols to a particular area), just insert the array, explode it and then copy the symbol of your choice to the appropriate spot in the cave passage. The copy will be on the correct layer. When you are done, erase the array.

This project was started on a 486/33 and is now on a Pentium 166. The load/regen times are quite workable yet processor speeds will increase. In the future, even large caves can be done with a workable result.

The next step in our project will be the integration of this .DWG file into true GIS software. **ARCVIEW** now imports DWG but it remains to be seen if the imported entities are treated the same as entities in ARCVIEW. If they are, this will take the drawing into true, current GIS, since entities in ARCVIEW can be queried with reports in graphic and/or tabular form.

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