

Here Be Dragons

How I learned cave cartography in Adobe Illustrator without contemplating suicide

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According to Wikipedia – seriously, what did anyone do before the internet? – *Here Be Dragons* is “a phrase used by ancient cartographers to denote dangerous or unexplored territories, in imitation of the infrequent medieval practice of putting sea serpents and other mythological creatures in blank areas of maps.” In fact, there’s a quote in the associated entry:

"Here also are men having large horns four feet long, and there are even serpents of such magnitude that they can eat an ox whole." – The Borgia Map, circa 1430 AD.

Yikes. At this point, you’re probably starting to wonder what the hell I’m talking about. But when learning how to draw cave maps, things sometimes seem a lot more mysterious than they should be, and while there are some excellent tutorials and resources available to learn by, good luck finding a consensus among fellow cavers as to what software to use, which symbols work best, or what constitutes a good map...you might be better off with the drawing of the sea serpent.

For the line plot, you can use Walls. Or you can use Compass. And the people who use one can’t possibly understand why you’d use the other. The Europeans have their own crazy programs like Toporobot and Survex. Huh? To me, “Toporobot” sounds like a geologically-inclined space invader.

For the map itself, there are innumerable programs available (Xara is the software *du jour* in our home state), but Adobe Illustrator has set the standard for vector-based illustration ever since it finished digging CorelDraw and Freehand’s respective graves. There is no right answer; some people still use AutoCAD, some people use programs I’d never heard of like Inkscape, some people use programs that combine the line plot

The author has recently learned how to draw “big boy” cross sections like this one.

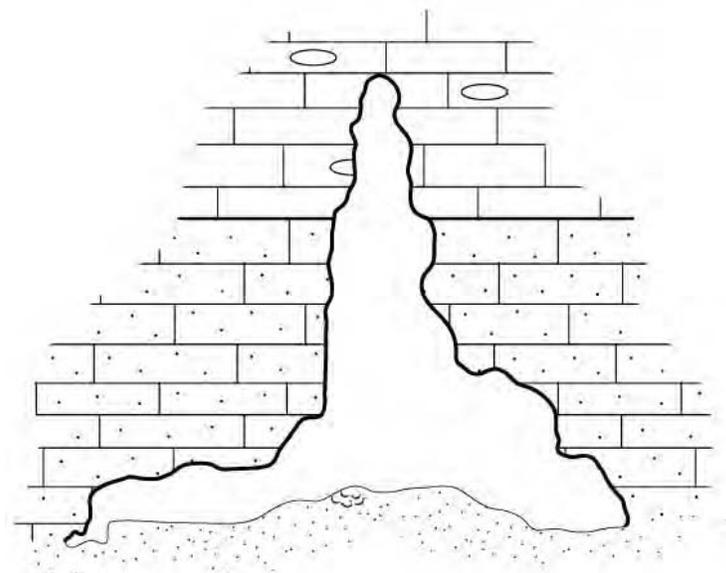
generation and cartography in a single package like Therion.

And then, what constitutes a good map? Some people like thick lines for walls, because they’re the defining limits of the cave, and some people like thin lines because the walls aren’t really something in their own right, they’re the *lack* of something.

Some people like lots of intricate floor detail, while others think too much detail has a negative effect on the map’s usefulness and navigability. Some people stick strictly to the long-established NSS symbol sets, while others are comfortable using techniques that are often more attractive on-screen or in a color output.

Depending on the end use of your map, you may need to include lots of geological information, or you may need to show a detailed list of leads and potential digs, or you may need to show your survey stations with notes about how they are marked and exactly where they are located... you get the picture.

Ultimately, a successful cave map will show what it needs to show, and this will vary by the type of cave, the intended audience, and your personal



preferences about what to include. As such, your choice of software may vary with the breadth of the project and the style with which you choose to portray your map.

The knock against Illustrator is that it can be complicated to learn. Even with some knowledge of how vector art works, or a familiarity with the terminology and workspaces found in Adobe products, it's not the most intuitive program you'll ever come across.

Therefore, while I'm a new cartographer and more qualified for a motivational speech than a real tutorial, hopefully this text will help demystify the "dark art" of Adobe Illustrator. You'll need to determine your own level of involvement and free time; if you're only planning to make one map, or you're just sending in periodic reports on small caves to your state survey database, you do have other options that will require less of your time and effort. You will *not* be successfully cranking out maps in Illustrator after 30 minutes of playing with it.

First things first; there is a legitimate reason that our maps need to be created with a vector-based drawing program. As opposed to bitmap-based drawing programs, like Photoshop, vector doesn't deal with artwork strictly at the pixel level. It creates vectors (or "anchors"), points of data that are then used as the framework for the artwork that you actually see. For our purposes, the primary benefits are:

§ Vector art is infinitely zoomable. Quite often, a cave or cave system will be so large that no detail is visible when looking at an overview. With vector art instead of bitmap art, you can zoom and zoom and zoom, because the program is able to re-draw at each zoom level based on the location and attributes you've given your anchors.

As a fun experiment, open a photo in any photo editing program and zoom in to 300% or 1000%. Not pretty. With vector, it's not uncommon to create minute details at a very high zoom level. When viewing the finished product, people will be able to isolate specific sections of cave for viewing,

One of the great things about Adobe Illustrator is its widespread adoption and use; this means that there are many, many online forums and tutorials you can refer to if you hit a wall or just want to add to your bag of tricks. In addition, because Adobe is the standard-bearer, these forums and support should be around for years and years to come. I learned how to make a double-line stroke by searching, you guessed it: "double line stroke Illustrator" in Google. The information is there. To help you get started, here are some links specific to cave cartography in Illustrator, published with permission from their hosts and/or authors:

<http://www.brandonkowallis.com/Video.htm>

Brandon Kowallis has taken the time to author an excellent series of videos, in which he creates a sample cave map from scratch. These are well worth the time to watch and provided a sturdy jumping-off point for me. This is where I learned keyboard shortcuts, and I feel like I owe him a beer. While you're there, check out his sample maps at <http://www.brandonkowallis.com/Maps.htm> !

<http://www.cavediggers.com/fonts>

Mark Passerby has assembled an extensive collection of resources at [cavediggers.com](http://www.cavediggers.com), not the least of which are his homemade fonts for ceiling heights and pit depths. You won't truly appreciate how helpful these are until you try them.

<http://www.hongmeigui.net/media/surveysymbols>

This site contains several tools for cave cartography in Illustrator, including some nice brushes, swatches, and symbols. The majority of the brushes I currently use began as items in this set and have been slowly changed or replaced over time to suit my specific needs.

or a specific room, or a specific rock, and output a razor-sharp rendering of it.

§ Vector programs create artwork that is easily edited when corrections are necessary. Did you draw that ceiling ledge in the wrong place? Did your sketcher zone out in a semi-hypothermic stupor and draw that wall 10 feet away from where it should be? No worries. Because vector artwork is anchor-based, it's easy to manipulate the anchors as well as their attributes.

Often, edits require nothing more than shifting a line slightly or changing a line width, changes that can be made non-destructively and without having to repeat one's previous work. In fact, vector artwork can be edited *by an external program* according to the SVG standard (scaleable vector graphics)... like, say, the software generating your line plot.

Ok, so I've sold you on using a vector program. But you knew that already. Why Illustrator?

Well, one of the most compelling arguments is the advent of SVG "roundtripping" capability. If using Walls to generate your line plot, you can use this feature to marry the final artwork to the line plot itself. Therefore, if a new loop causes a least-squares shift in your line plot, or if a corrected blunder causes the direction or shape of a passage to change, Walls is able to make these adjustments to both the line plot *and the Illustrator artwork*, preventing you from needing to re-draw anything.

This means that you can start drawing your final map even if the cave is still going-and-blowing, without fear that new passage will connect somewhere and muck up your existing artwork. This is especially helpful in complicated caves with many

loops, like our ongoing project cave which has 50 loops amongst almost eight miles of existing survey data.

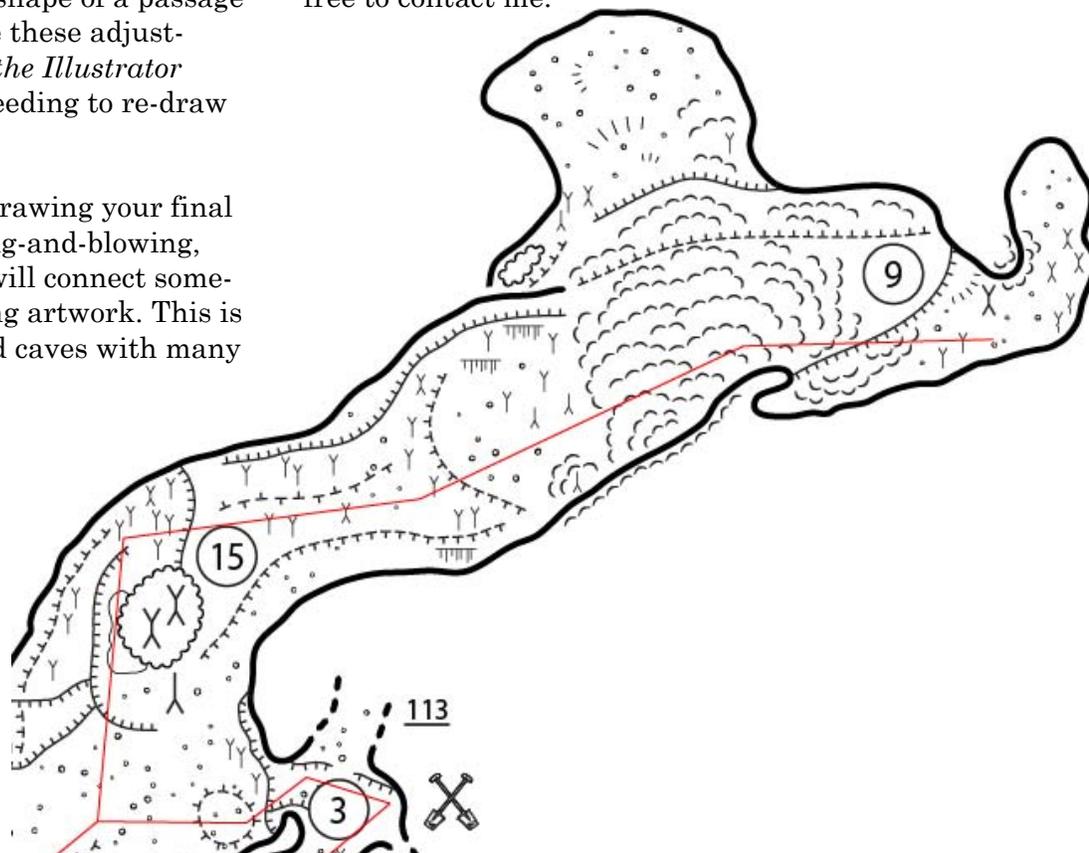
It's also a boon with large caves, where it can be years before the line plot is infallible; the lack of tangible map progress during this time can

lead to waning surveyor interest, and having to repeatedly redraft the working map often leads to a seriously frustrated cartographer!

Roundtripping aside, Illustrator is widely supported throughout different communities of cavers, and as the industry standard you will find tons of helpful forums and reading material online should you hit a snag. Software comes and goes, but Illustrator has been around for quite some time now and appears to be here to stay.

When creating a digital map, you should also consider whether your file will be useful 10 years down the road, should you or someone else need to make a change or add newly discovered passage. It is a full-featured, stable program, capable of doing just about anything you can think of including in your drawing, and a couple years from now when someone dreams up the successor to SVG, you can be sure that Adobe Illustrator will support the emerging technology.

Hopefully, you're now convinced that Illustrator isn't some scary program only intended for professional graphic designers... If I can learn it on my own, anyone can. Most importantly, have fun! Drawing cave maps is fun, and distributing them to happy surveyors and even happier landowners is more fun. And discussing your techniques with other cartographers is fun, so if you have comments or questions about this article, please feel free to contact me.



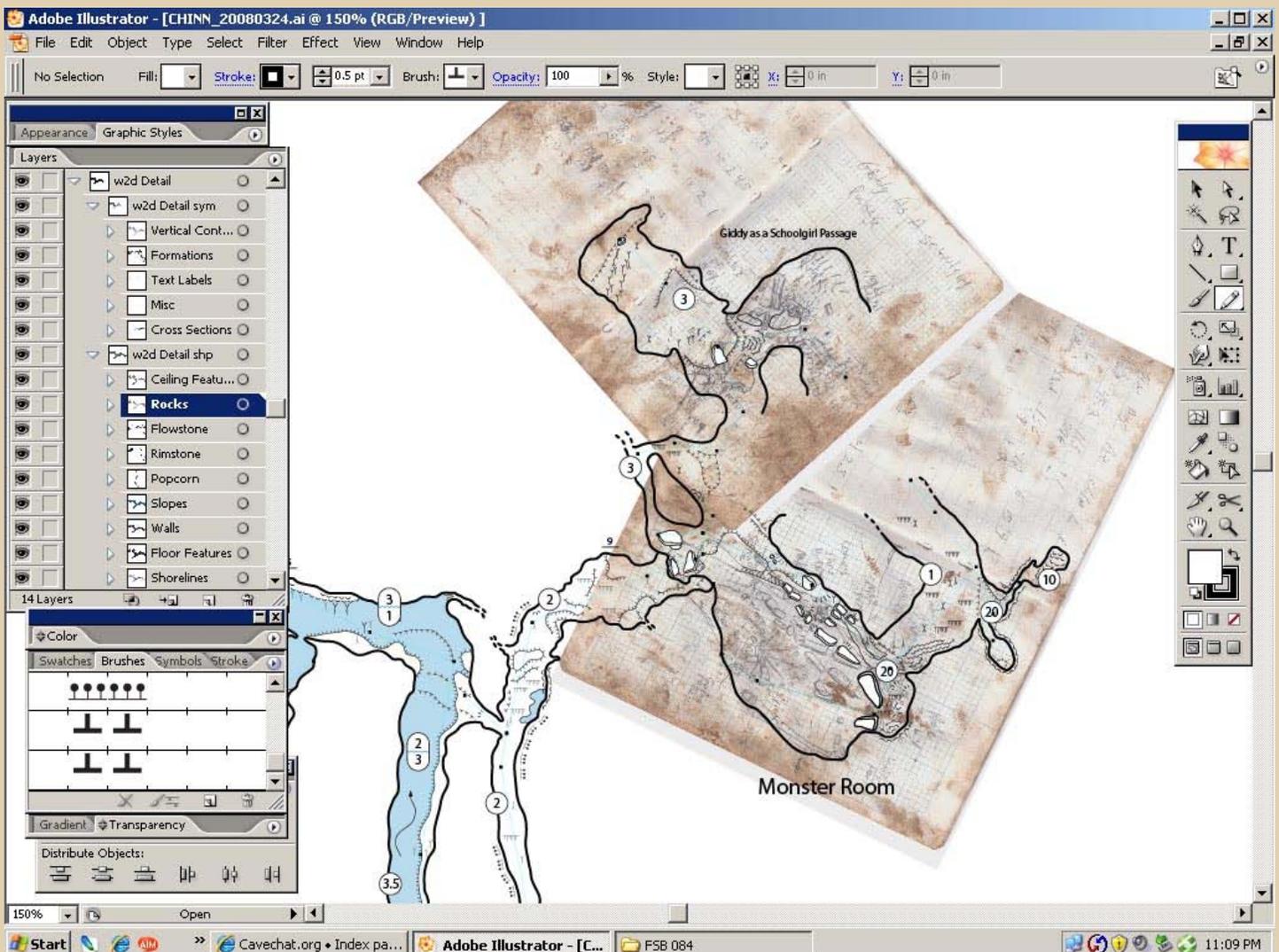
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You're probably looking blankly at your Adobe Illustrator workspace right now, wondering what the heck "stroke" and "fill" mean. When I first opened it, I didn't have any idea how to simply draw a line, and I've been using Photoshop for years! Since drawing a line is pretty important when you're drawing a cave map, needless to say I didn't get a whole lot done until I figured it out. Here is a quick and dirty crash course in how to begin working with the software.

I recommend beginning with the Pencil tool. By far, this is the most common tool that you will use, and it's the most accurate & intuitive option you have for tracing the information on the sketch sheets. With the pencil tool, all you need to do is draw a line, and Illustrator will create and place the anchors for you as necessary. This is signifi-

cantly easier than using the Pen tool, where you click to create the individual anchors. In fact, I am yet to find a valid use for the Pen tool when drawing a cave map, as for straight lines the Line tool is rather adept. I use the Pencil tool for walls, water boundaries, rocks, ceiling ledges & domes, floor ledges & pits, etc.

Select the Pencil tool and draw a line. If the results aren't quite what you were expecting, you can adjust the "smoothness" of the line as well as how sensitive it is to your mouse ("fidelity") by double clicking on the Pencil tool and adjusting these in the options menu. I keep everything as-is except when drawing ceiling or floor ledges, in which case I increase the "smoothness" to a value of 50 so there aren't any ugly kinks in my ledges.

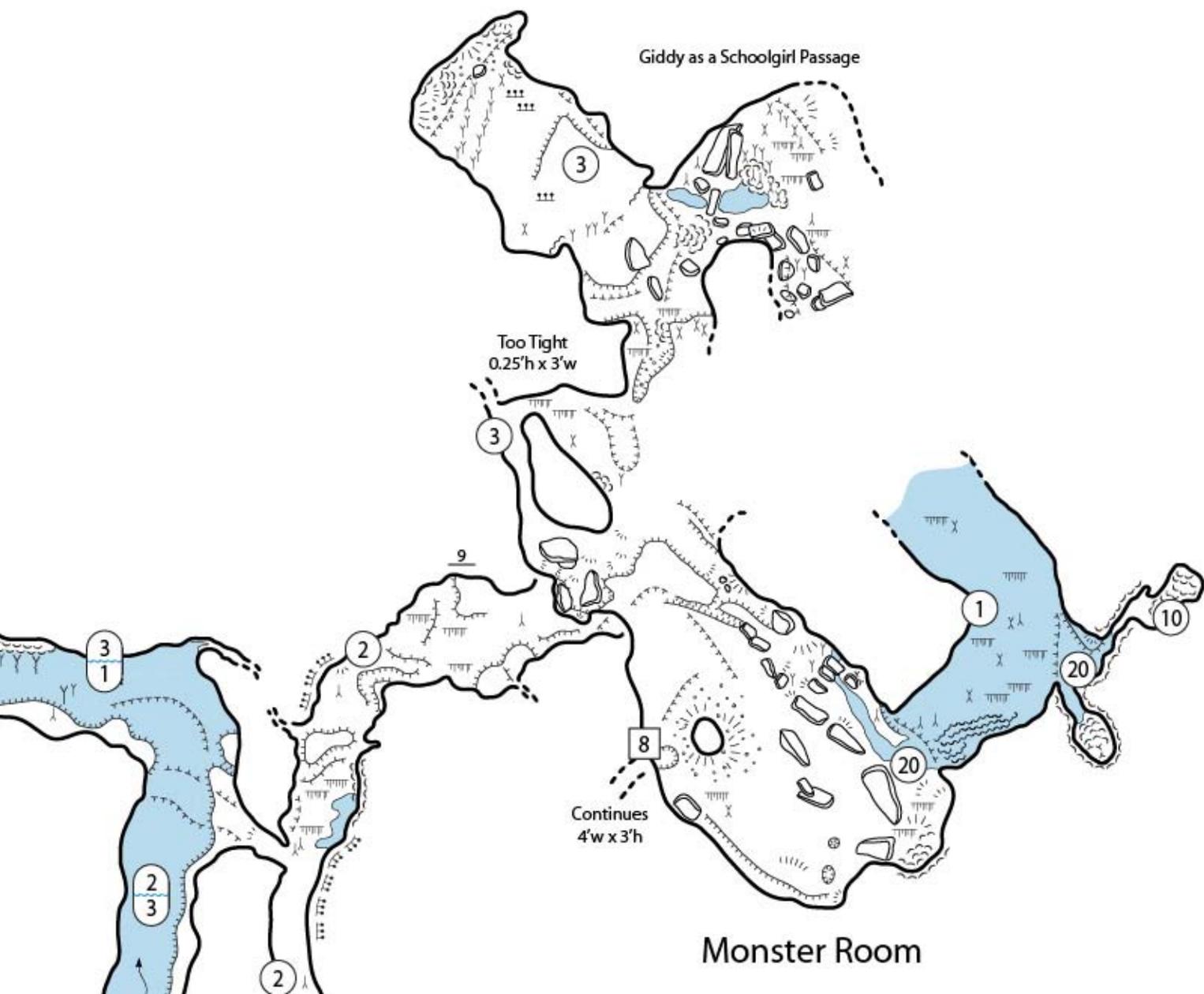


At this point you should have... a line. Wheee! Now, you need to set the attributes for the line. Each line in Illustrator has a Stroke and a Fill. The Stroke sets the width and color of the line, as well as whether it's solid or dashed. Let's say your line is supposed to be the first wall of your cave map; at the top of your screen, select "1 pt" from the drop-down menu and leave the color black. That's it. Fill is primarily used for water and showing the surface materials on the cave floor, so you won't deal with them often. I use .25 pt for rocks, .5 pt for water boundaries, and 1 pt for walls, but this is a matter of personal preference. Likewise, some people use different colors, but I stick almost strictly to black and the occasional shades of gray except for water.

One of Illustrator's best features as it relates to cave cartography is the ability to use Pattern Brushes. You don't have to draw those little tick

marks on your floor and ceiling ledges – you can draw with the pencil tool to set the orientation of the line, and then select the appropriate pattern brush. I'd suggest downloading the Hong Mei Gui Brushes (see link at end of article) to get started so you can see how these work. Illustrator does a fantastic job of adjusting these to your line so that they curve appropriately and line up with each other. You won't have to jump through hoops making sure everything looks natural. Once you've applied a Brush, you can set its color and size just as you would with a normal Stroke.

Just as brushes are a cartographer's best friend, you will find yourself equally pleased with the Symbols and Swatches. Symbols are exactly what they sound like, and help maintain continuity throughout your map. Why draw dozens (or hundreds) of soda straw and helectite symbols, when you can simply paste in a predefined symbol



as necessary? This also has the side benefit of keeping your file size down, as instead of separate vector groups for each symbol, Illustrator only needs to link to the appropriate item on the Symbols menu. These are indispensable for slopes, water arrows, and anything else where you'd find yourself repeatedly drawing the same thing. Swatches, on the other hand, are like Pattern Brushes for your Fills; you can use them to create a diagonal line pattern to denote water, or a sand pattern to fill in the floor of that sandstone cave you're working on. They work the same as Fills.

Another shortcut I've found indispensable is to use the Graphic Styles menu. With Graphic Styles, you can set several attributes for one item. For example, in the map on page 39, I had to draw several handrails, each of which has multiple Strokes. With the graphic styles menu, I can save the settings for the Stroke, Brush, color, and size; all I need to do is select the lines I'd like to be displayed as handrails and click the corresponding entry in the Graphic Styles menu. This really speeds up map-making, as well as cutting down the possibility for inconsistency. I can just draw all the walls from one page at once, and then select them and click the buttons I've created for walls. Likewise for floor ledges or ceiling ledges, and I no longer have to fuss with anything else.

Now that you know which tools you'll be using, you can start working on an actual map. First, you'll want to use the Place command to put your line plot and sketches into your canvas. When placing the sketches, make sure "link" is checked, or the program will embed the bulky image directly into your Illustrator file, slowing down your system and increasing file size tremendously. You'll want to keep everything well-organized, and you do so with the Layers menu.

Imagine your Layers menu like several sheets of clear acetate. You can keep different kinds of artwork on different layers, and view them or edit them individually. This also controls how your items overlay onto each other; you'll want to make sure that your ceiling ledges aren't obscured by rocks, for example, so you'll need to make sure that your ceiling ledge layer is higher up than your rocks layer! Having a well-organized set of Layers also means that you can output different versions of your final map for different purposes... the landowner may not want the survey stations marked on his copy, whereas a survey team might only want the line plot, walls, and the details they'll need to find their tie-in station.

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When working with large, complicated files, keyboard shortcuts are your best friend. Here are the ones I find myself using the most often:

- § Holding down CTRL with any tool selected turns your cursor into the Select tool.
- § Holding down SPACE with any tool selected turns your cursor into the Move tool. Just between these two shortcuts, you can navigate throughout your canvas and select/deselect items as necessary without swapping out the tool you're using.
- § CTRL - zooms out. CTRL + zooms in. This is a big time-saver.

Now that you have a general overview of how the program works, there is absolutely no substitute for experience. Find a small project that needs mapping, and give it a try. Contrary to popular belief, Illustrator isn't the software equivalent of a Franz Kafka novel, though you'll surely hit some bumps in the road. Completing a map you made yourself is tremendously satisfying, and good maps make for happy surveyors!

