Rotating Rasters and Age-Based Masking of Raster Data

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WARNING:

The first time you import an age-coded raster, GPlates will take time to create some cache files (this can take 5 or more minutes).

The cache files that GPlates creates in the same folder are quite large (up to 100 Mb each), meaning that you need to have enough storage space.

Background

GPlates 1.5 includes the functionality to apply age-based masking of raster data. This means any age-grid can be used to mask underlying rasters which in turn can be cookie-cut by polygons and rotated to their position in the past.

In this tutorial we will be working on importing and visualising raster data in GPlates and rotating and masking raster data back through time. The tutorial will use the data included in the GPlates distribution in the Sample data folder (see the "Sample data" section under Appdx.)

Today we will be working with raster files. For all those computer illiterate folk out there, a raster is simply a file which is made of 2-dimensional grid of pixels and is stored as JPEGS or grid files like netCDF. This is different to Vector data we have used in previous tutorial, which is composed of points, lines and polygons.

Included Files

Click here to download the data bundle for this tutorial.

The data bundle should include the following files:
Seton_etal_ESR2012_2012.1.rot
Seton_etal_ESR2012_StaticPolygons_2012.1.gmlz
color etopo1_ice_low.jpg
agegrid_6m.nc

This tutorial dataset is compatible with GPlates 1.5.

Exercise 1: Rotating and cookie cutting raster data

This tutorial will show how to cookie-cut polygons from rasters and rotate them to paleopositions.

In order to split a global raster file into different polygons, load the sample data into GPlates.

1. The global rotation file (Seton_etal_ESR2012_2012.1.rot)

2. The global static polygon file (Seton_etal_ESR2012_StaticPolygons_2012.1.gmlz)

3. The global topography/bathymetry image (color etopo1_ice_low.jpg supplied with this tutorial).

Once this has been done, you should have a something on your GPlates main window which looks like in Fig.1.

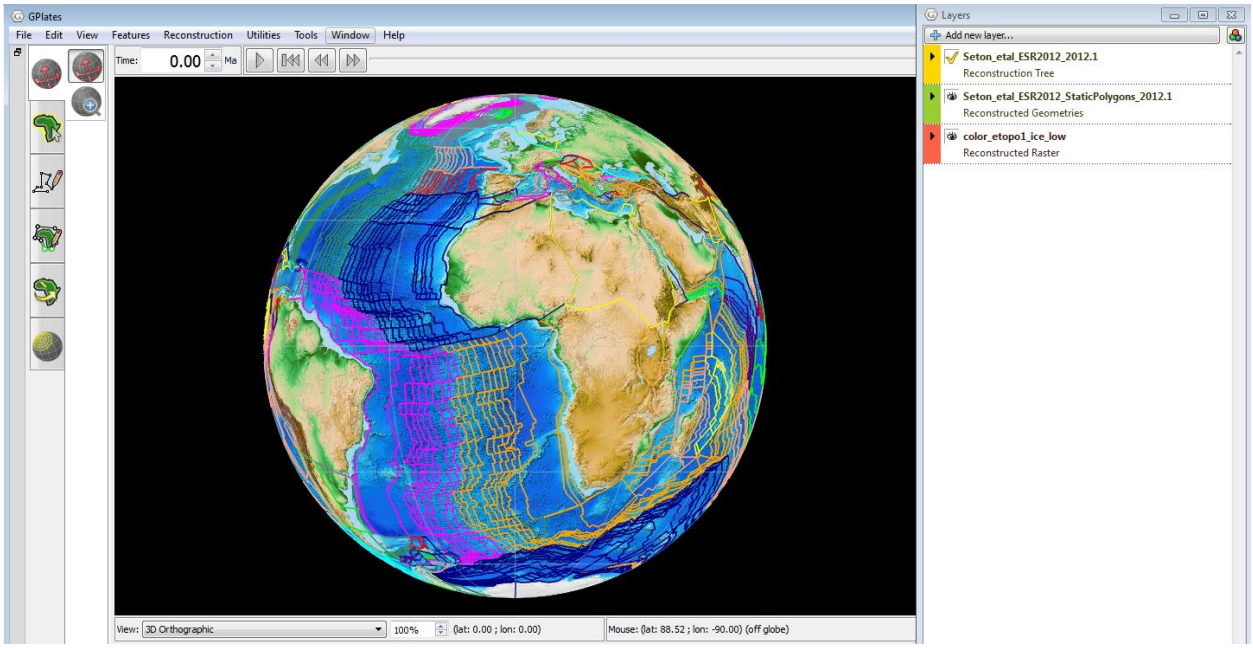

Figure 1. GPlates windows with sample data for tutorial 1 loaded. The global topography/bathymetry image is automatically classified as a "Reconstructed raster".

The next step involves telling GPlates to cut the raster into different pieces by using our global static polygon layer. It is important to note here that the polygon coverage needs to be global and it needs to assign PlateIDs to the individual pieces of the raster in order to be able to rotate them back through time. In case you find this confusing, consult the "Rotations tutorial". To cut the raster into different pieces do the following:

1. Make sure your layers are in the right order with the raster images in the back and the vector data (polygons) on top. If this is not the case, drag the layers into the proper order.

2. Expand the image layer in the Layer window by clicking the little black triangle to the left in the coloured rectangle of the layer.

3. In the "Inputs" section of the layer, click the "Add new connection" button under "Reconstructed Polygons:" and select the static polygons file from the list (Figure 2).

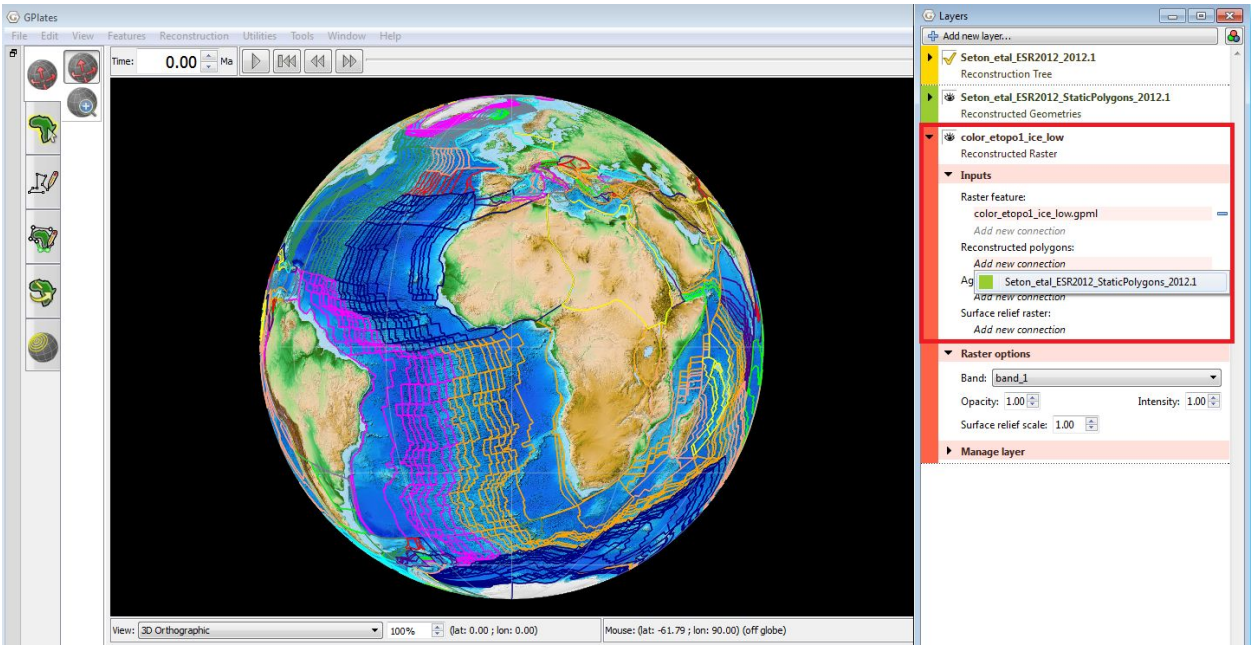

Figure 2. Adding a polygon connection to the Gravity raster (DNSC08GRA_6m.gpml).

4. Depending on your graphics card power, you will see that GPlates will need some little time to think before the main window becomes responsive again.

5. Now you should be ready to go and able to drag the time slider to a desired time (or punch in the numbers) to rotate your global raster data to paleo-positions. See Figure 3 for an example of the dataset rotated back to 50 Ma in an Australia-centric view.

6. If you would like to see only the raster data and not have the polygons superimposed,simply toggle the polygon visibility off in the Layer manager.

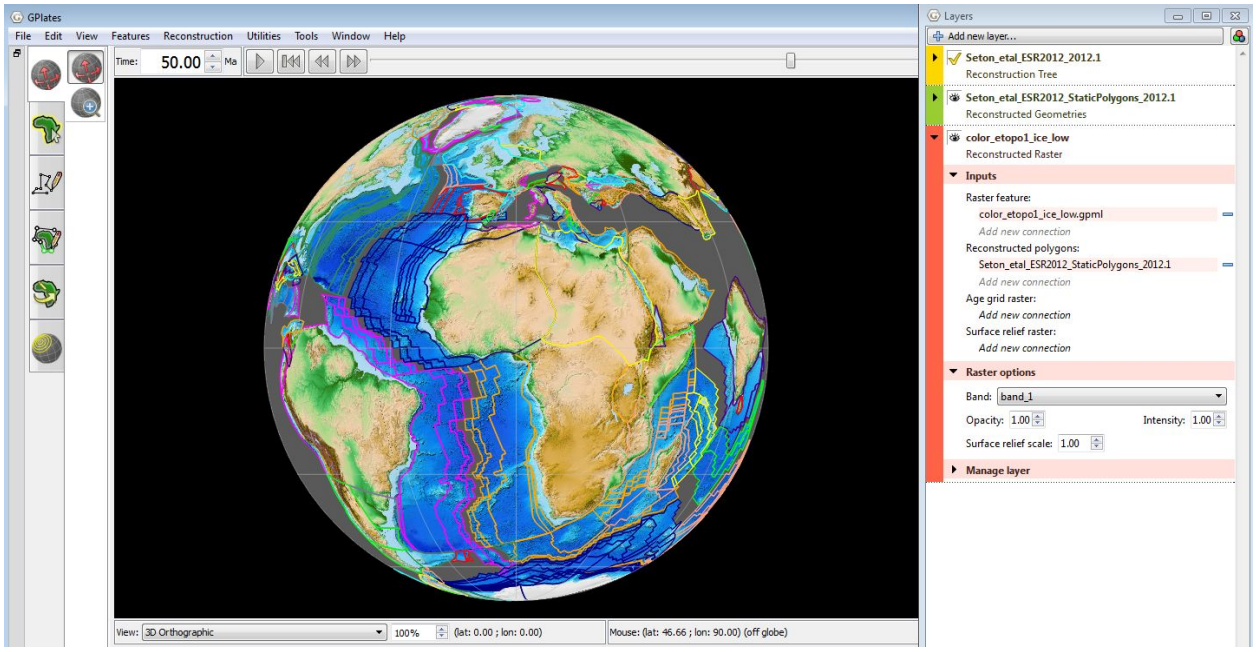

Figure 3. Raster data cut to polygons and rotated back to 50 Ma. Notice that GPlates has automatically removed polygons and raster data which did not exist at this time (using the FromAge and ToAge feature attributes).

Exercise 2: Age -based masking or raster data

Masking a raster files simply means that the sections of the globe which you select will not show the raster changing through time eg.Could mask the continents, if we had a sea floor spreading rotation data as having seafloor spreading data on top of a continent would make little sense.

In this next exercise we will be masking raster data based on age. The Appearance ages of the polygons in color_etopo1-ice_low.gpml- which in the last exercise was derived from the static polygon set (Seton_etal_ESR2012_StaticPolygons_2012.1.gmlz) will be masked and the appearance age data from the seafloor age-grid (agegrid_6m) will be used instead and can be found in the Rasters folder in the GPlates SampleData. This gives a smoother growth of the seafloor through time.

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1. File → Import → Import Raster → select agegrid_6m.nc (Fig.4).

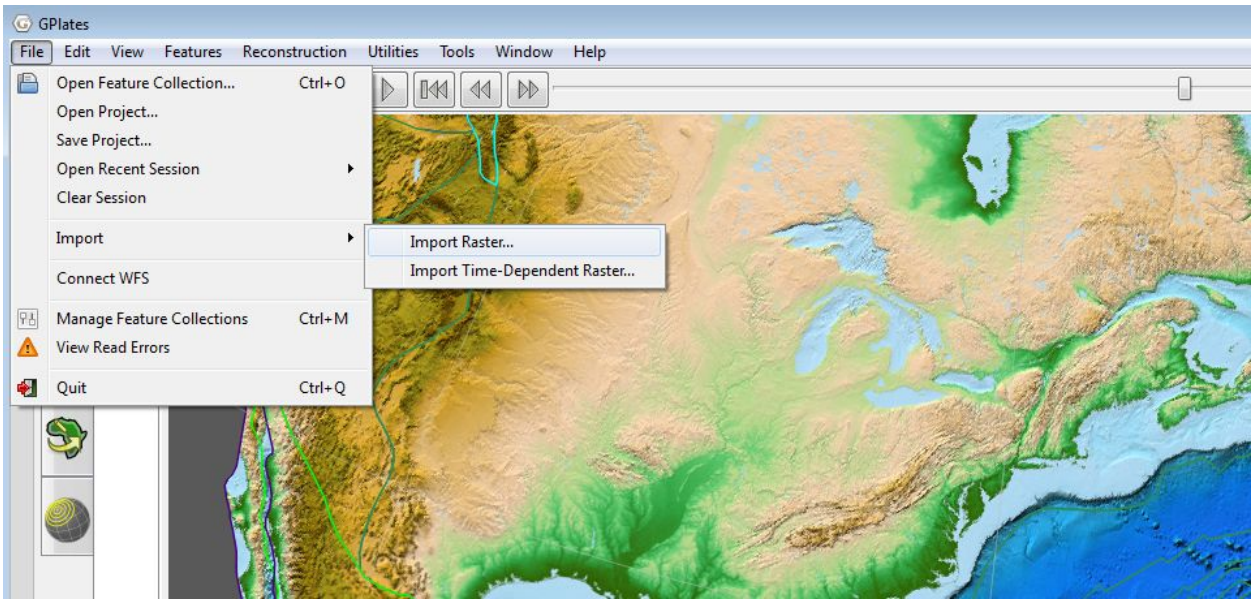


Figure 4. Import raster dialogue. Chose the "age" as the raster band when loading age grids.

2. The age grid is now loaded in the Layer manager. If you expand the layer, by clicking the small black triangle to the left of the eye, you will see that

GPlates recognises this raster as an age grid (Band:age).

3. You now need load the plate rotation file and the static polygon set as described above in Exercise 1 into the GPlates application. This can also be done by dragging and dropping the files into the main GPlates window.

4. In order to be able to rotate the raster data, you will again need to assign plate IDs to subset of the raster by connecting the color_etopo1_ice_low reconstructable raster layer to the static polygon features, as in Exercise 1, Step 3.

5. In addition to assigning a polygon "connection", you will now also connect an age grid feature to the color_etopo1_ice_low reconstructable raster layer. Click the "Add new connection button" below the "Age grid raster" heading in the Inputs subsection of the layer (Fig. 5) and select agegrid_6m.nc from the list.

6. You should now have loaded:

- a rotation file
- a global raster file which has age grid and polygon input channels
- a static polygon file
- an age mask/age grid file

7. You should now be able to reconstruct rasters again back through time, but with the age-based masking functionality enabled. If you interrogate for example the South Atlantic, going back in time, you will see that the seafloor is successively "eaten up" during the reconstruction at any timestep (Fig. 6). The transitions are very smooth and not like the polygon-based disappearance as you have seen in Tutorial 1.

A quick explanation of why it is more smooth when attached to ' seafloor age-grid' is given in the appendix.

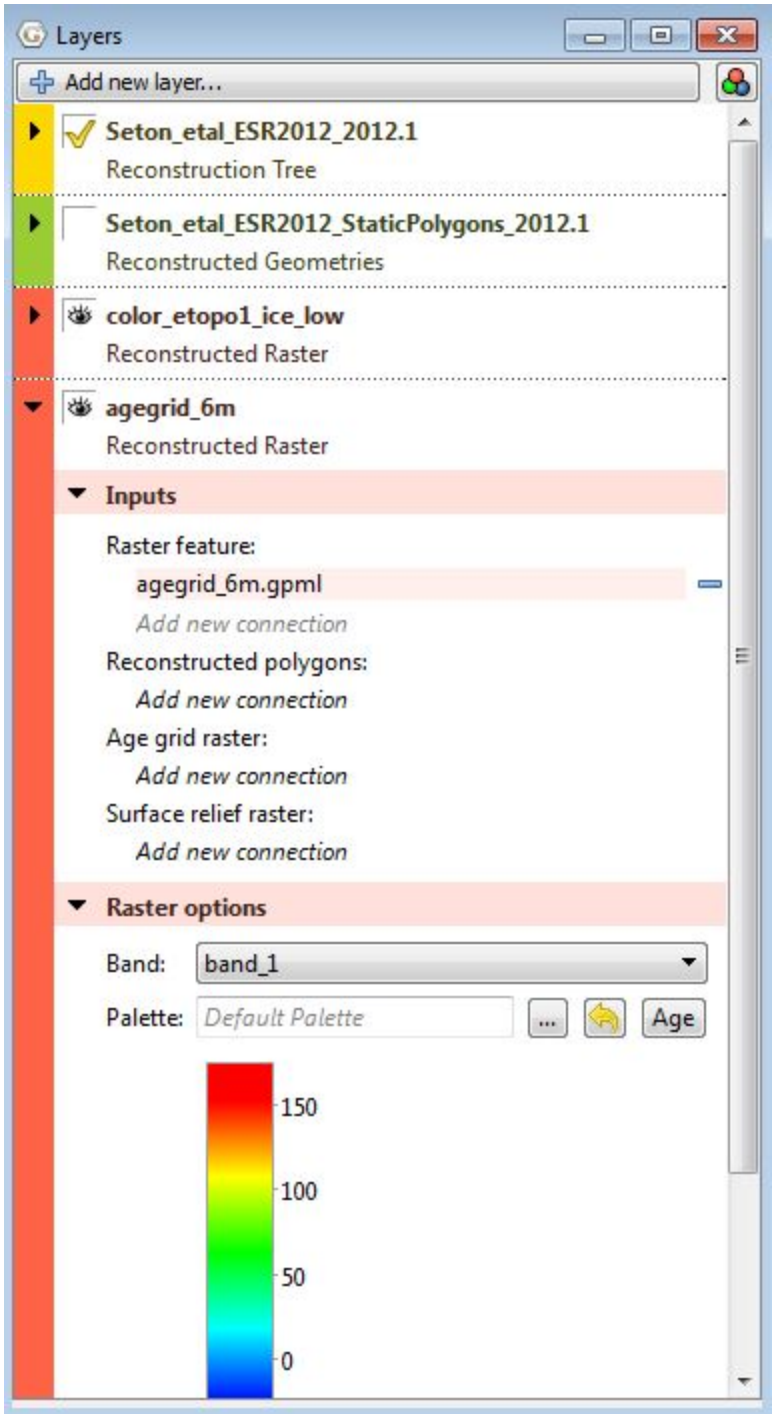
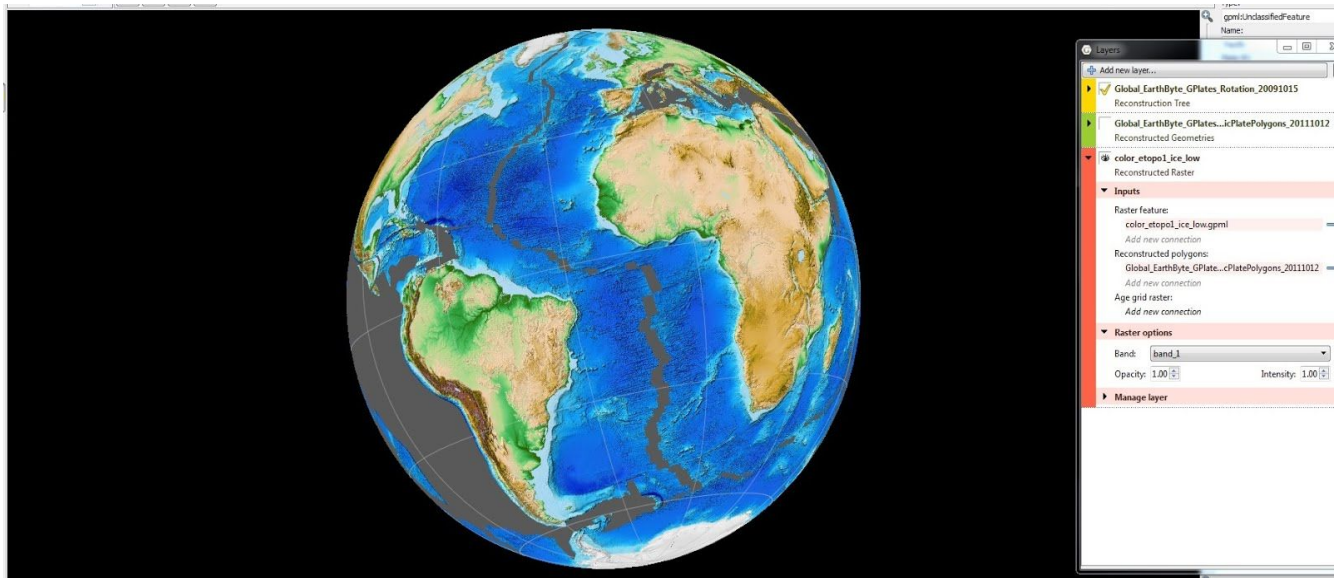


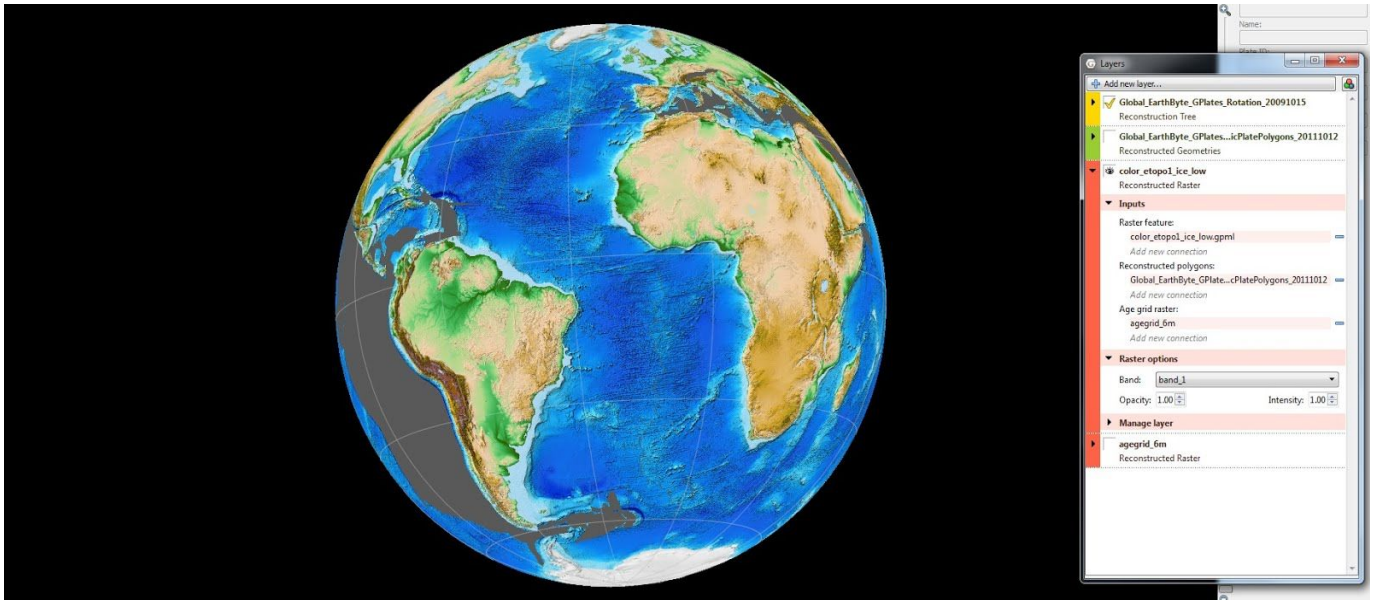
Figure 5. Layer manager with loaded age grid feature.

Appendix

In the first exercise of this tutorial we used the Static Plate polygons to assign plate polygons Id and their respective age of appearance to raster data (color_etopol1-ice_low.gpml). However the plate polygons are large and age of appearance are far apart so that big grey gaps were left at the MOR (fig 6)



6.Color_etop1_ice_low raster at 27ma with no age based masking around MOR. Note the large grey gaps.



7.Color_etop1_ice_low raster at 27ma with age based masking around MOR.

However in the second exercise the time of appearance was gathered from the age_grid6m file. Now each individual pixel in this file, instead of a large polygon, has a respective appearance time according to the colour palette (Dark Red= 150ma, Dark Blue=0ma. Thus the growth of the ocean floor is smooth (Figure 7).

Sample data When you download GPlates from http://www.gplates.org, some sample data is included in your download. On Windows, this will be available after the installation in the GPlates folder at C:\Program Files\GPlates\GPlates [version]\Sample data. For the Mac, the download will leave you with a disk image (*.dmg) file. Mount the file by double-clicking, drag the GPlates application bundle into the Applications folder. The sample data is included as directory ("sample-data") in the top level of the disk image.