

Plate Tectonics, “Hotspots”, and Google Earth: A Proposal for a New Data Sharing and 3D Visualization Initiative

Rex Pilger

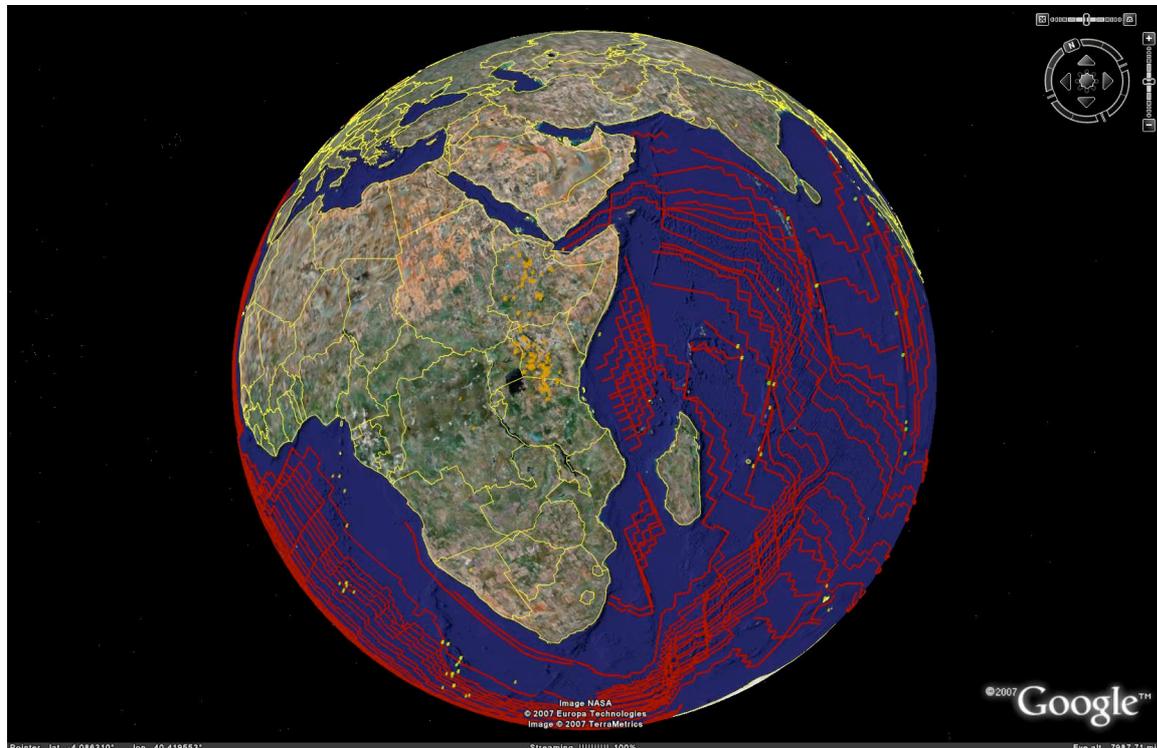
Arvada, Colorado, USA

September 24, 2007

Shortcut: Google Earth Plate Tectonic Data Sets (KMZs) [July 28, 2007]
(<http://earth.google.com/>)

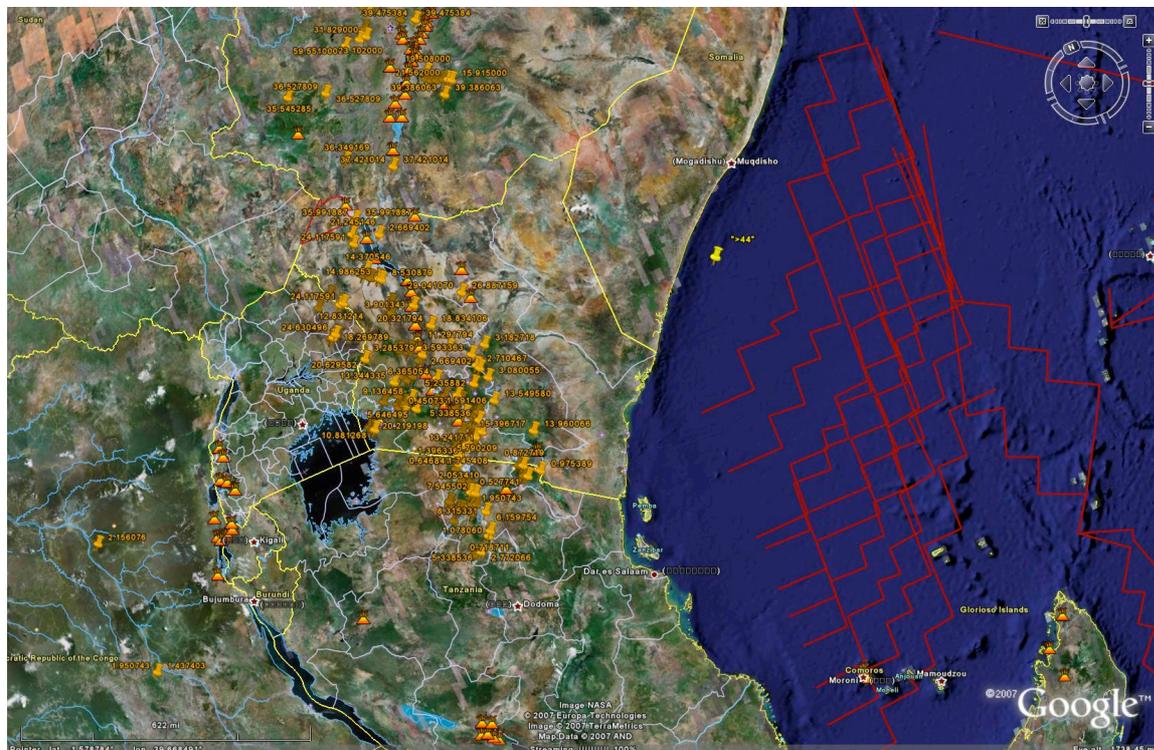
Geophysicists and geologists have a new tool for visualizing, interpreting and sharing data: Google Earth. Data points, line segments, and graphics in support of published research can be delivered as readily visualized at a full range of scales. Much of the data critical to understanding plate tectonics in general, and the origin of “hotspots”, in particular, are best visualized in three dimensions.

Google Earth (<http://earth.google.com/intl/en/>) (GE; formerly "Keyhole") provides easy visualization and sharing of spatial information in three dimensions, including geological and geophysical data. From global to zoomed in local view, GE provides for the display of data points, line segments, polygons, images, and, with the help of related products, even 3D objects such as buildings, bridges, and mines. Descriptive tags and metadata can be attached to data points and other objects as well, along with links to source publications.

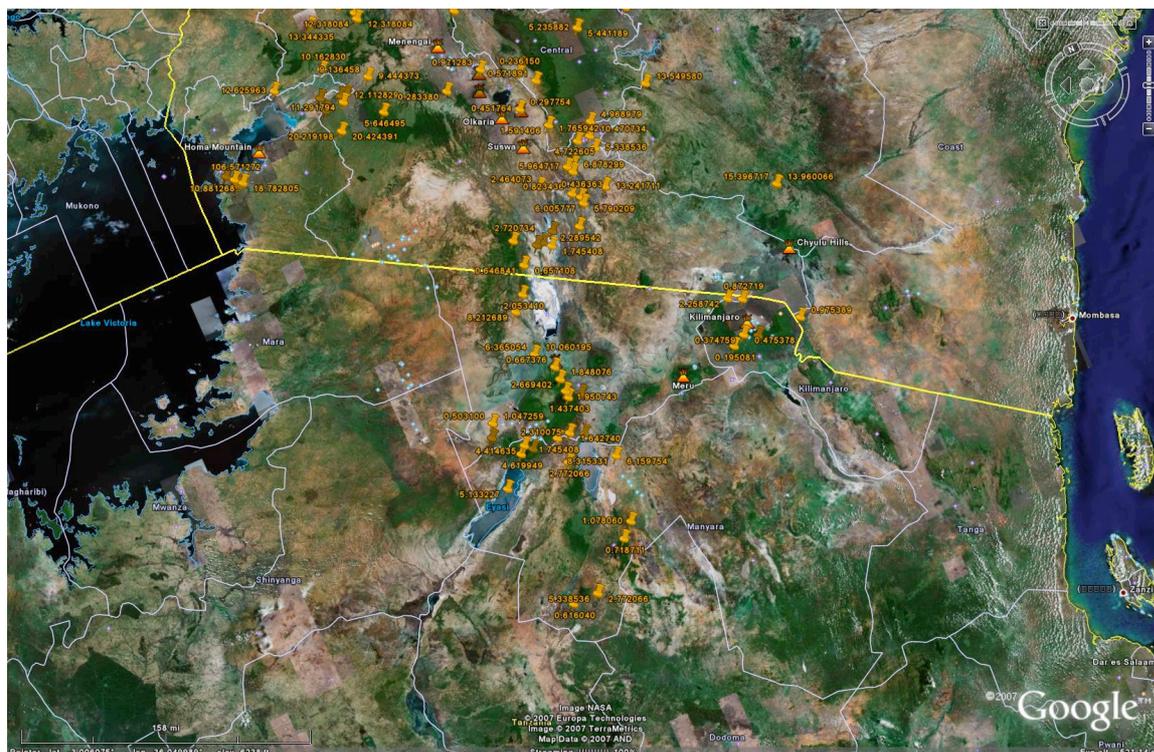


When GE is downloaded, installed, and launched, a variety of data sets is immediately accessible. In addition, an immense number of user-generated data sets (KMZs) can also be downloaded from the GE User Community. (Registration is required at

<http://bbs.keyhole.com/entrance.php?Cat=0> in order to access posted data sets.) KMZs are compressed KMLs (Keyhole Mark-up Language). KMLs are XML-compliant ASCII files (which may link to images, e.g., jpegs) with geographic location, properties, and descriptions. The KML format and usage are described in the Google Earth User Guide (<http://earth.google.com/userguide/v4/>).



Google Earth is FREE in basic user mode.



Google Earth: A Vehicle for Sharing Tectonic Research?

I have been experimenting with GE for about a year. There are other virtual Earth visualization engines, such as NASA's World Wind (<http://worldwind.arc.nasa.gov/>). However, World Wind and the commercial applications seem to be more oriented towards developers of customized imagery applications rather than discrete data sets, which are my primary interest. Also, GE has a much broader user base so that issue repairs and enhancements appear frequently.

Plate Tectonics and "Hotspot"-related Data Sets in Google Earth

As a test bed for seeing if Google Earth can serve the plate tectonic research community, I have prepared a number of data sets (KMZs) that are relevant especially to the origin of "hotspots". I have uploaded them as addenda to brief postings that describe them onto the Google Earth User Community web (registration required, at <http://bbs.keyhole.com/entrance.php?Cat=0>).

The postings and KMZs include interpreted global magnetic isochrons, compilations of isotopic dates from inferred "hotspot" traces, and restoration of such dates in the hotspot reference frame. Several of the data sets are taken directly from tables in published technical articles or from supporting data sets that workers have made available on various web servers.

I have calculated, compiled, or at least translated these data sets into KMZs. In some cases, supporting documentation is limited at present. I plan to provide more complete documentation in time.

I have also created a personal web log (<http://plate-frames.blogspot.com/>) independent of the Google Earth user community as a means of more easily finding the data sets I have posted and that, I hope, other Earth scientists will post.

Future Plans

I intend to post additional KMZs and update those already posted with more documentation. I see this as an experiment that, ideally, will involve a number of workers. It might be desirable to develop concrete metadata standards beyond the GE definitions for supporting documentation. It is my hope that other Earth scientists will consider preparation of KMZs of their data sets, too.

I propose the following preliminary "standards" for those who decide to post their own KMZs:

- In the Description field:
 - The original data source reference
 - A hyperlink to the source and/or source data (if possible)
 - Color coded legend, if pertinent
 - Absolute "elevation" conversion factor (the elevation at which data points or line segments are displayed; in most of my data sets I use 5000 m per m.y.)

- Consistency in significant figure annotation
- In large data sets, clustering of like quantities into named folders

How to Use GE and Create KMZs:

- If you haven't already, download Google Earth and become familiar with it.
- Study the KML definition in the User Guide (link is under GE Help).
- Load some of the KMZs below.
- After loading a KMZ, right-click on one of the folders or data points in it and select Properties. You'll see the metadata included with the object.
- Right-click one of the objects and select Save as, and select KML. Select the desired target folder and Save.
- Navigate to the saved KML file. Right-click on the file and select Open in a text editor (such as Word or Visual Studio's IDE). You'll readily see the structure of the KML file.
- If you are an XML expert, you can create your own KMLs with an XML editor, perhaps even importing data from a database.
- Alternatively, you can use a combination of Excel and Word to create KML files.
- Else, you can create KML files as output from your own C, C++, or Java program.
- Lastly, if you have Google Earth Plus (costs only a modest amount), you can create and edit data points with desired values.
- Once created and loaded, KMLs can be saved as KMZs.

Uploading KMZs:

- Join the GE User Community (link is under GE Help).
- Saved KMZs can then be uploaded as attachments to postings on the GE Community bulletin board (Active Topics).
- Once uploaded, send the link to the posting to me rexpilger@yahoo.com.
- I will download the link and test it in GE.
- Then I will add it to the list of KMZ postings for posting at <http://www.mantleplumes.org/> and my weblog (<http://plate-frames.blogspot.com/>).

For corrections, ideas, and/or suggestions, please contact rexpilger@yahoo.com. If there are KML questions, I will also attempt to answer them, as well.

Links to Google Earth Community postings with plate tectonics data sets (KMZs; registration required) [Updated September 24, 2007]:

Isotopic Dates from East African Volcanics

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224296&amp;F_Board=EarthNature&Thread=994229&partnumber=1&postmarker=)

US Cordilleran Igneous Isotopic Dates LT 40 Ma

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&amp;Entry=224299&F_Board=EarthNature&Thread=994232&partnumber=1&postmarker=)

Isotopic Dates from Global "Hotspot" Traces

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224300&F_Board=EarthNature&Thread=994233&partnumber=1&postmarker=)

Average Ages for Pacific Hotspot Sample Locations

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224301&F_Board=EarthNature&Thread=994234&partnumber=1&postmarker=)

Stresses - Present to 130 Ma

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224302&F_Board=EarthNature&Thread=994235&partnumber=1&postmarker=)

Hotspot rotback

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224303&F_Board=EarthNature&Thread=994236&partnumber=1&postmarker=)

Isotopic Dates from Baksi (1999) - Original Data

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224304&F_Board=EarthNature&Thread=994237&partnumber=1&postmarker=)

Recalculated Isotopic Dates from Baksi (1999)

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224305&F_Board=EarthNature&Thread=994238&partnumber=1&postmarker=)

Isotopic Dates Compiled by O'Neill et al (2005)

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224306&F_Board=EarthNature&Thread=994240&partnumber=1&postmarker=)

Magnetic Isochrons from Müller et al (1997)

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224307&F_Board=EarthNature&Thread=994243&partnumber=1&postmarker=)

Ar/Ar Dates from Hawaiian-Emperor Chain

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224308&F_Board=EarthNature&Thread=994244&partnumber=1&postmarker=)

Don Anderson's Hotspot Compilation

(http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224309&F_Board=EarthNature&Thread=994245&partnumber=1&postmarker=)

SWOOSH: Plate-Hotspot Motions, Tristan-No. America

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224310&F_Board=Earth Nature&Thread=994248&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224310&F_Board=EarthNature&Thread=994248&partnumber=1&postmarker=))

SWOOSH: Plate-Hotspot Motions, Hawaii-No. America

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224311&F_Board=Earth Nature&Thread=994249&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224311&F_Board=EarthNature&Thread=994249&partnumber=1&postmarker=))

SWOOSH: Plate-Hotspot Motions, Tristan-No. Africa

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224312&F_Board=Earth Nature&Thread=994251&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224312&F_Board=EarthNature&Thread=994251&partnumber=1&postmarker=))

SWOOSH: Plate-Hotspot Motions, Tristan-Cen. Africa

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224313&F_Board=Earth Nature&Thread=994252&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224313&F_Board=EarthNature&Thread=994252&partnumber=1&postmarker=))

SWOOSH: Plate-Hotspot Motions, Tristan-So. America

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224314&F_Board=Earth Nature&Thread=994254&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224314&F_Board=EarthNature&Thread=994254&partnumber=1&postmarker=))

SWOOSH: Plate-Hotspot Motions, Tristan-Australia

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224315&F_Board=Earth Nature&Thread=994255&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224315&F_Board=EarthNature&Thread=994255&partnumber=1&postmarker=))

Pacific "Hotspot" Isotopic Ages by Koppers et al

([http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224316&F_Board=Earth Nature&Thread=994256&partnumber=1&postmarker=](http://bbs.keyhole.com/ubb/favlinker.php?Cat=0&Entry=224316&F_Board=EarthNature&Thread=994256&partnumber=1&postmarker=))

Isotopic Dates: Andean Igneous Rocks LE 150 Ma

(<http://bbs.keyhole.com/ubb/showflat.php/Cat/0/Number/994404/an/0/page/0#994404>)