

Global Magnetic Mapping of LIPs from EMAG2 version 3

T166. Large Igneous Provinces (LIPs) in the Solar System

Rick Saltus (rick.saltus@noaa.gov)
Gordi Oakey (gordon.oakey@canada.ca)
Brian Meyer (brian.meyer@noaa.gov)



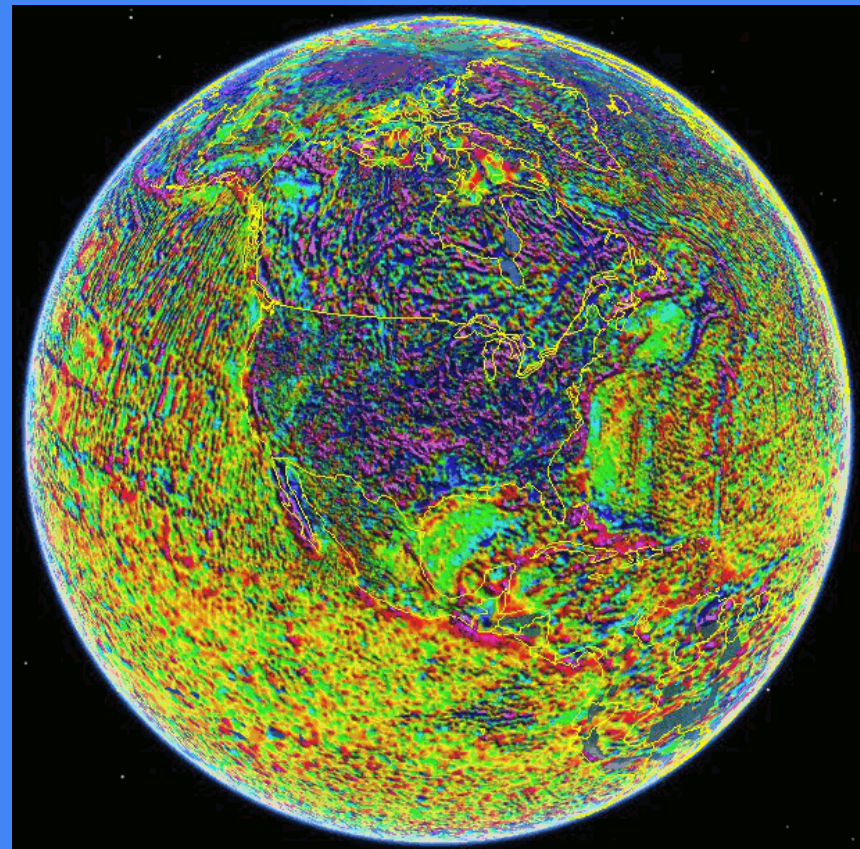
Outline

- EMAG2 version 3 (2016) – Global compilation of lithospheric magnetic anomalies
- Arctic magnetic anomalies and the High Arctic Large Igneous Province
- Other notable LIPs and their magnetic expression
- A first look at the global magnetic expression of LIPs
- Audience participation – Yes/No/Maybe vote

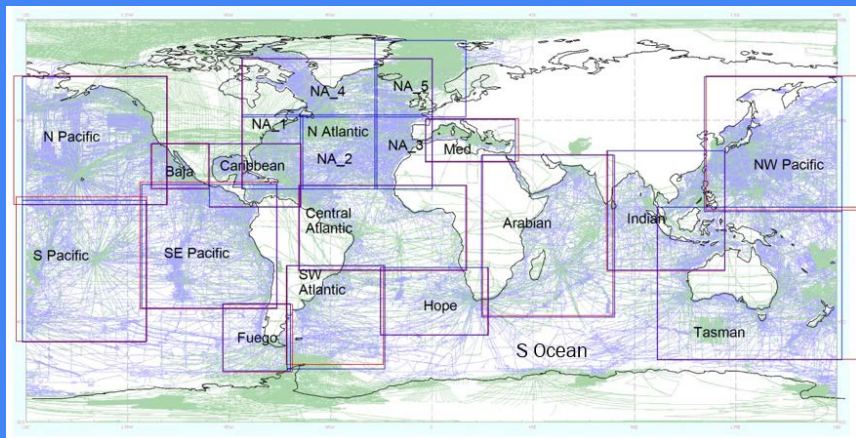


EMAG2 – Version 3

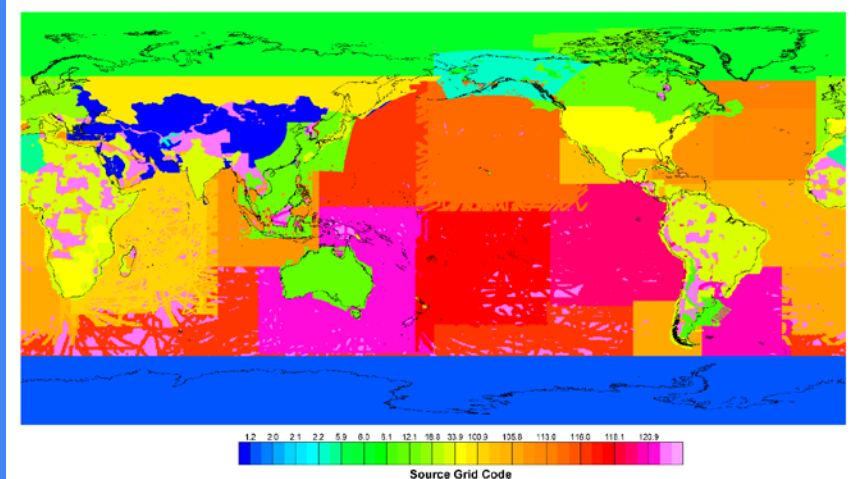
- 2-Arc Minute (~4 km) resolution
- Levelled to MF7 (long wavelength crustal anomaly field from satellite data)
- No *a-priori* ocean age model included
- Arctic from IPY CAMP-GM grid
- Antarctic from ADMAP
- www.ngdc.noaa.gov/geomag/emag2.html



EMAG2v3 – a few details



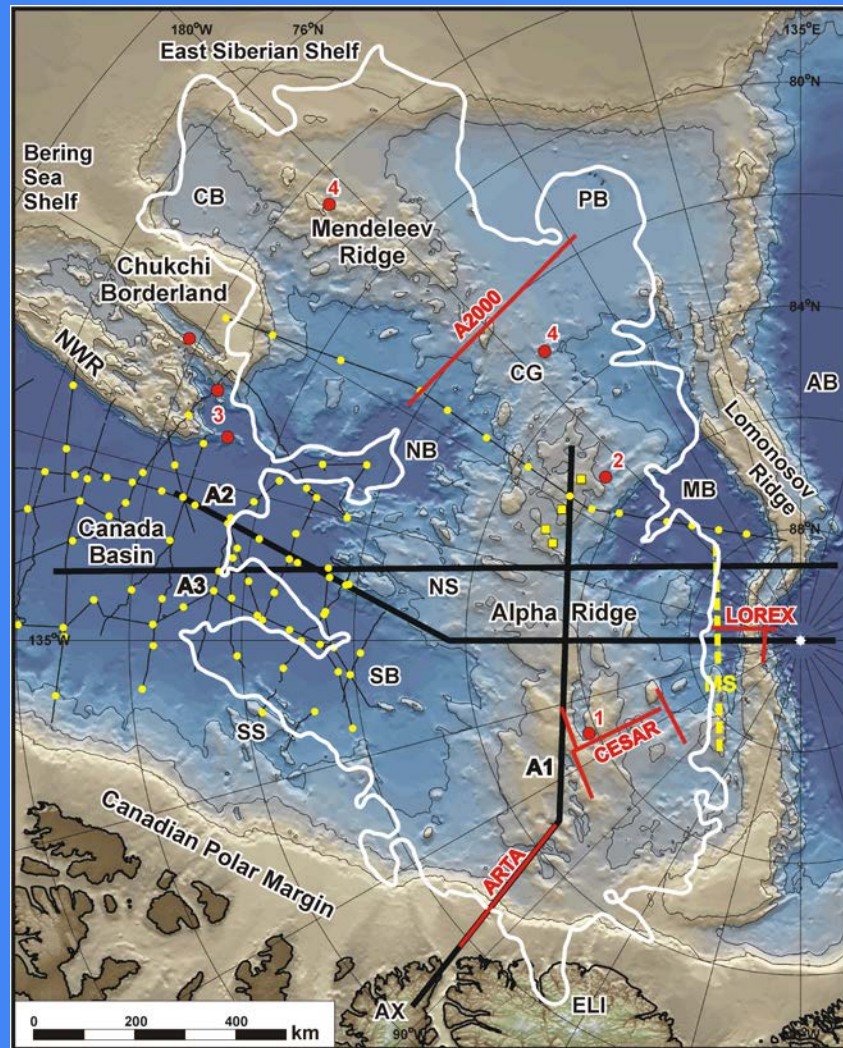
- Ocean coverage from new processing and leveling of NCEI (formerly NGDC) trackline coverage



- Continents from best-available regional compilation grids

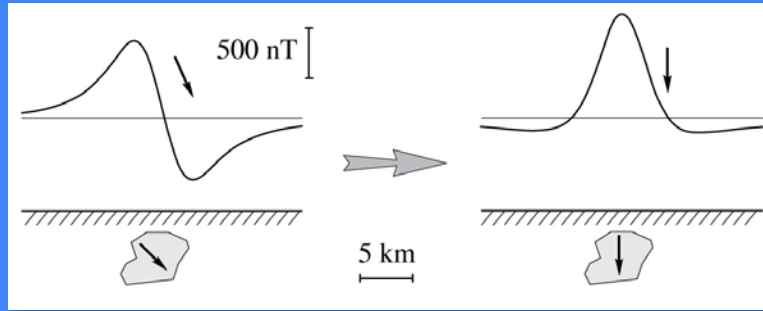
High Arctic location

Oakey and Saltus, 2016



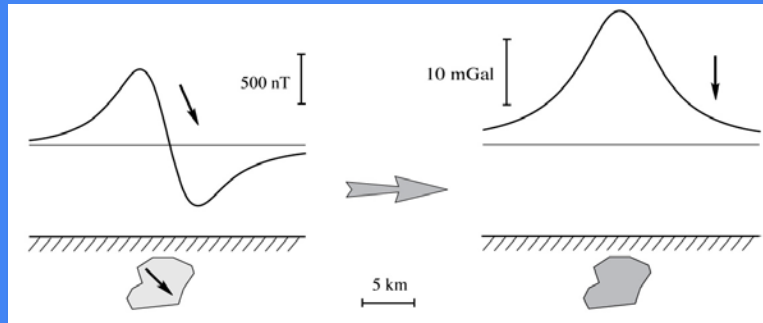
<http://dx.doi.org/10.1016/j.tecto.2016.08.005>

Magnetic transformations



Reduction to the pole (RTP):

$$F[h_p(x, y)] = F[h(x, y)] \frac{-2\pi}{\theta(k_x, k_y)}$$



Pseudogravity transformation:

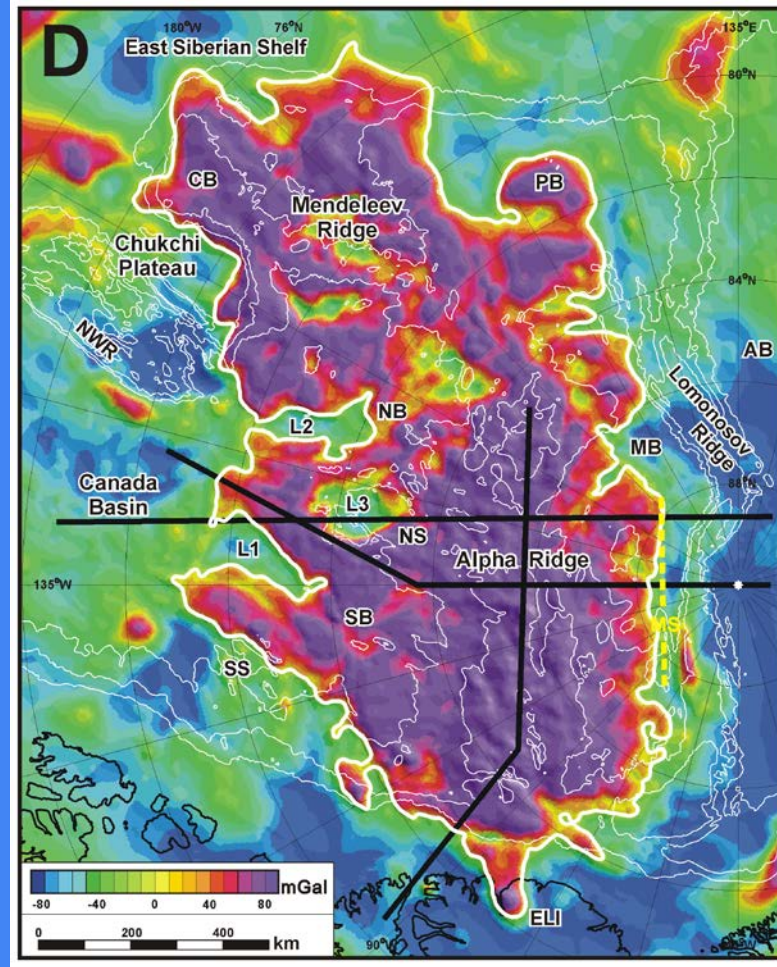
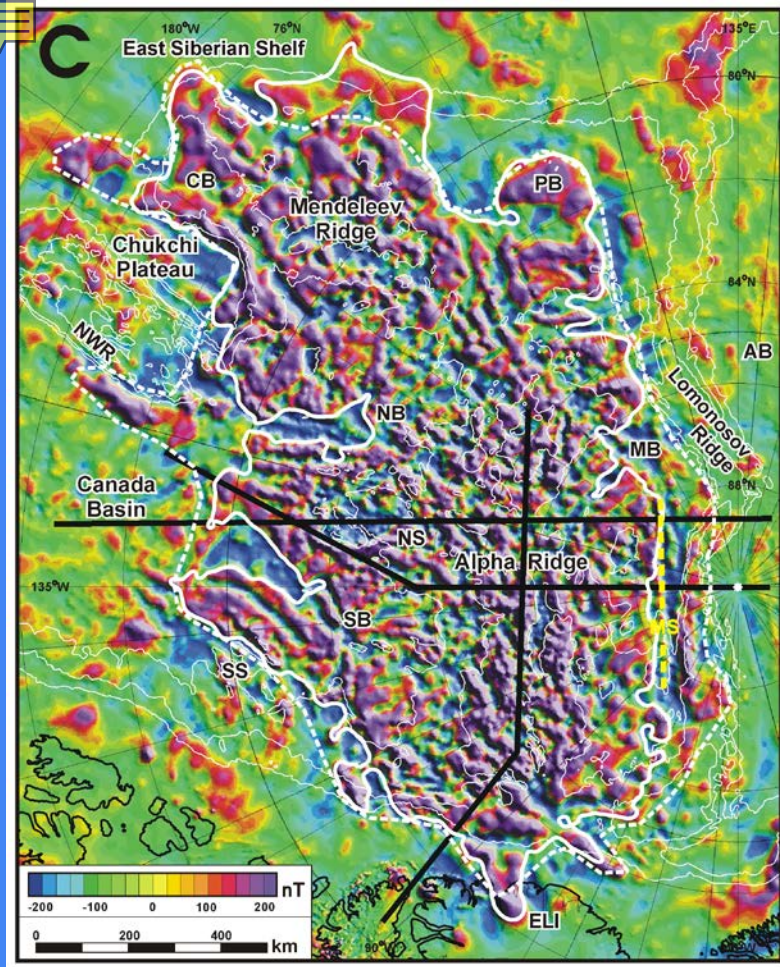
$$F[h_{PSG}(x, y)] = F[h(x, y)] \frac{-2\pi}{\theta(k_x, k_y)} \frac{A}{|k|}$$

Blakely, 1995

k = wavenumber,

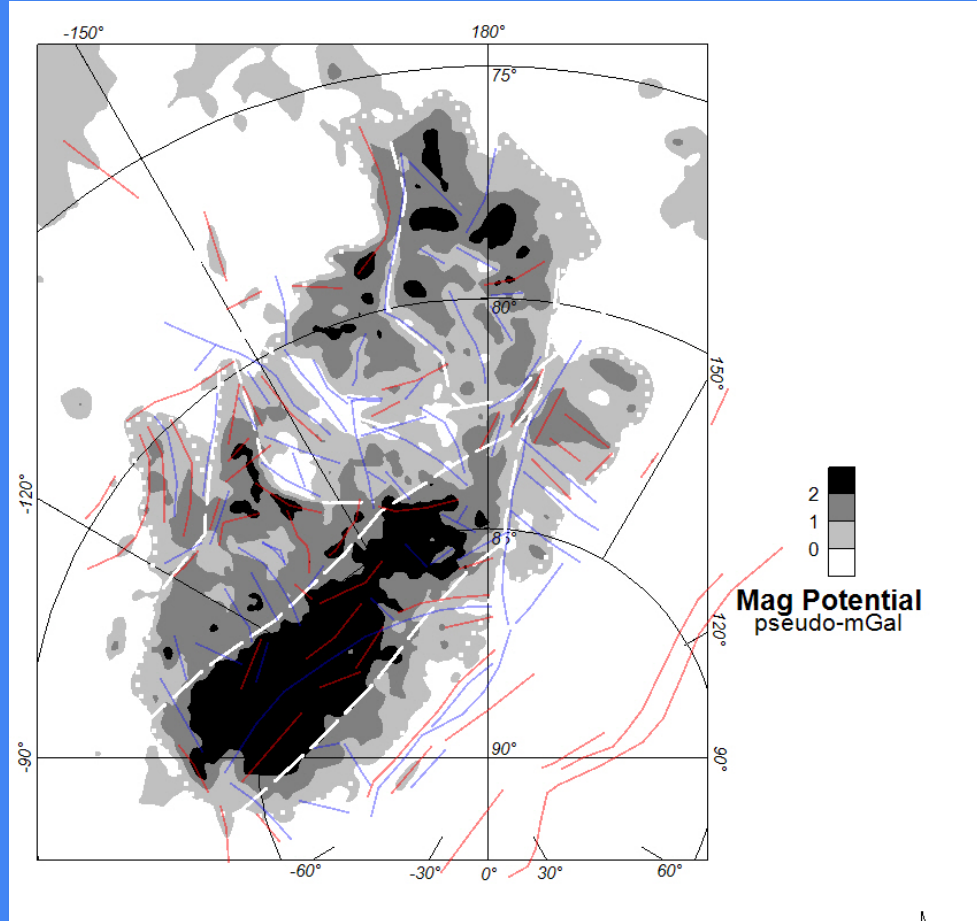
$\theta(k_x, k_y)$ = a complicated function that depends only on the direction and magnitude of the Earth's magnetic field.

A = a constant based on the expected ratio of pseudo-density to magnetization

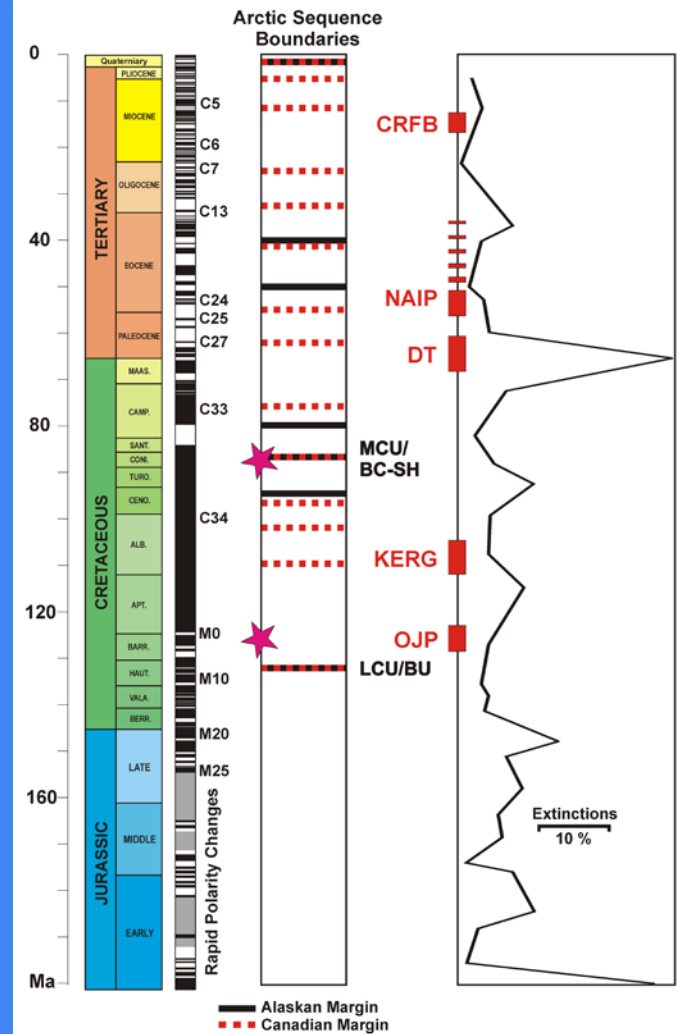
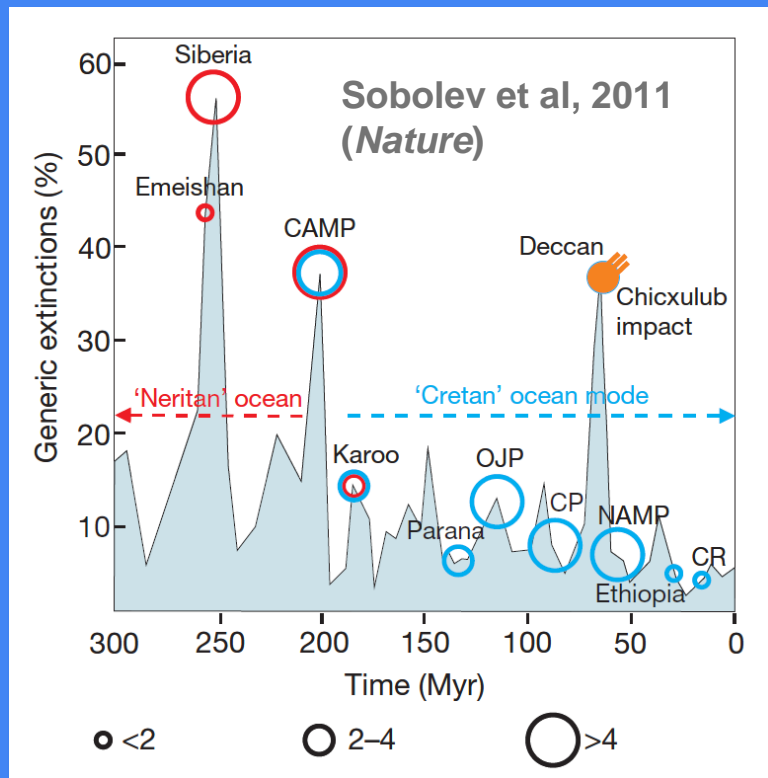


High Arctic Magnetic High (HAMH) – Oakey and Saltus, 2016

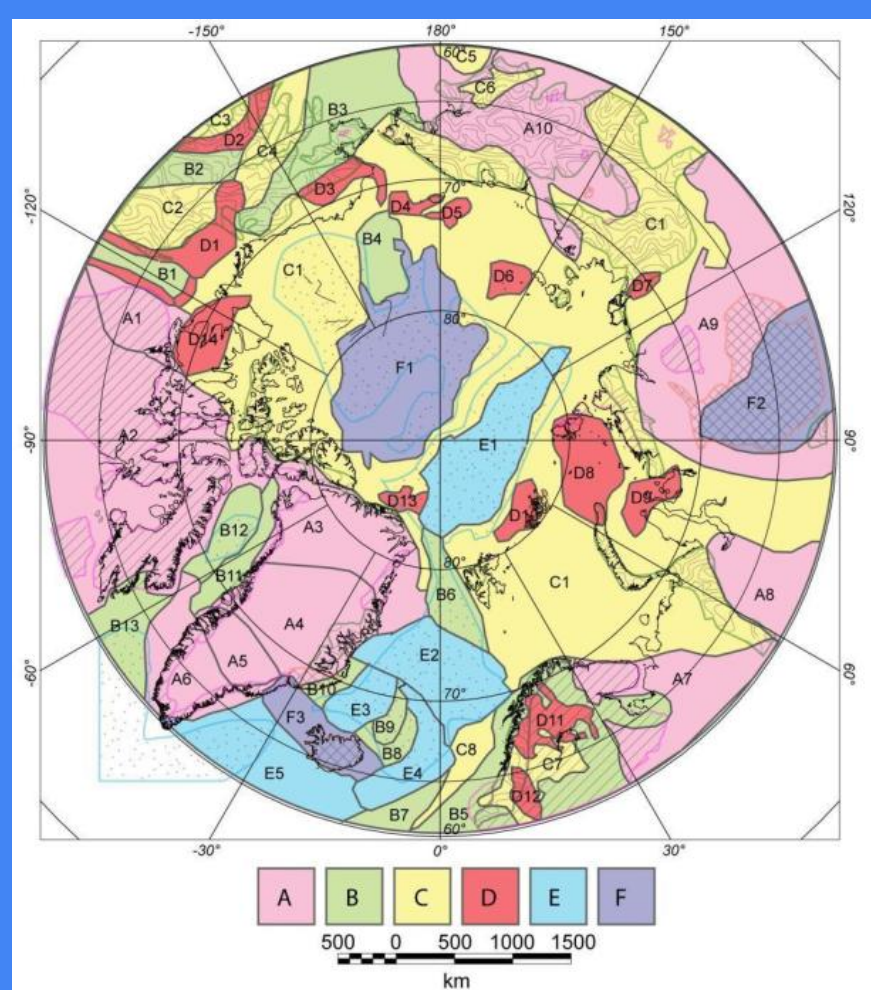
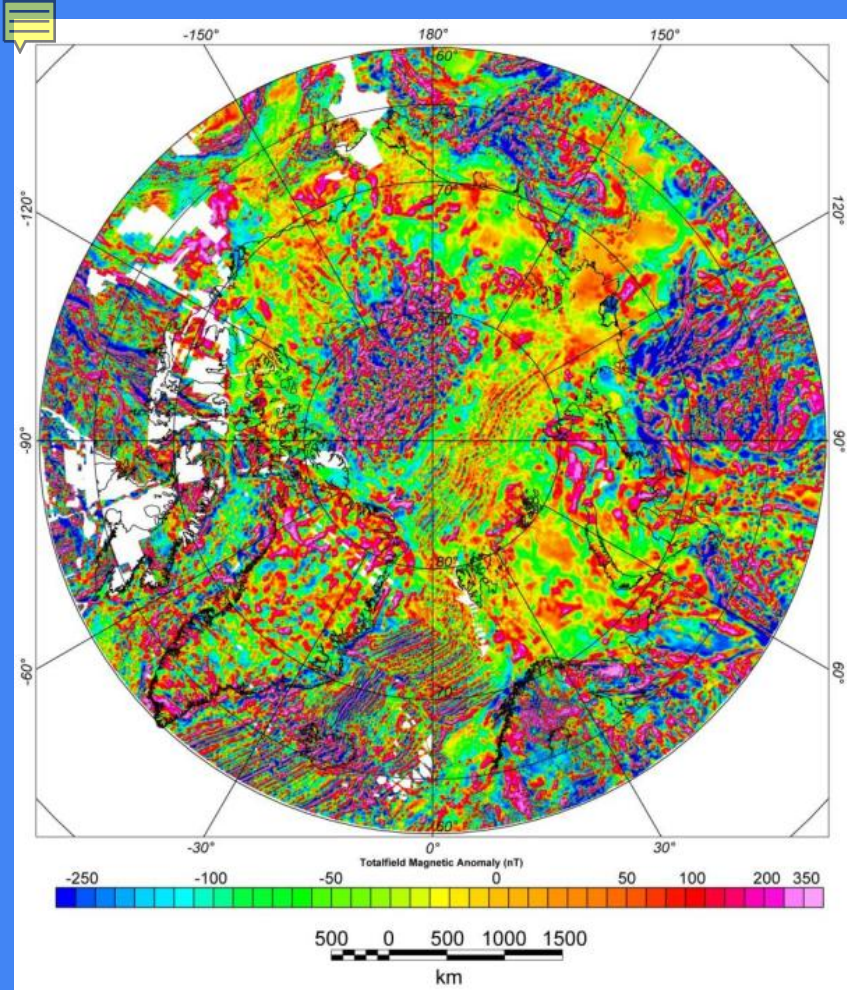
Magnetic Potential (pseudo-gravity)



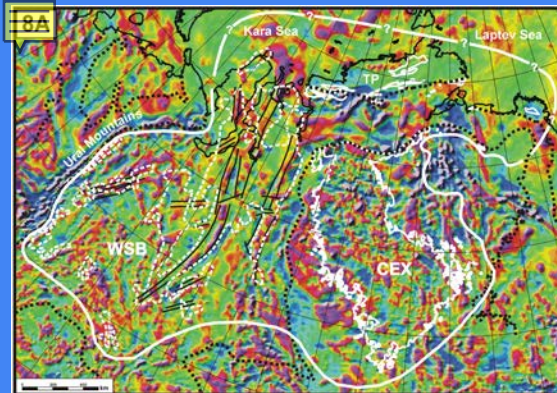
2 Plume
Events???



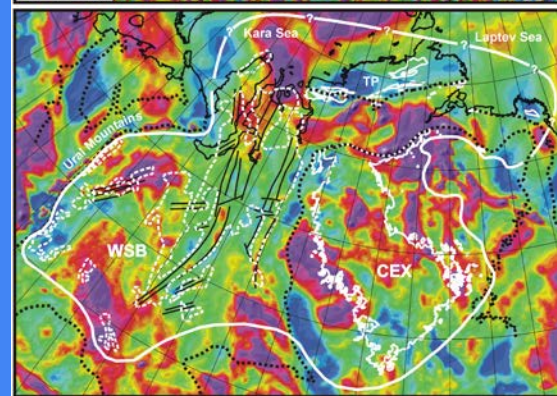
Association of HALIP with extinctions



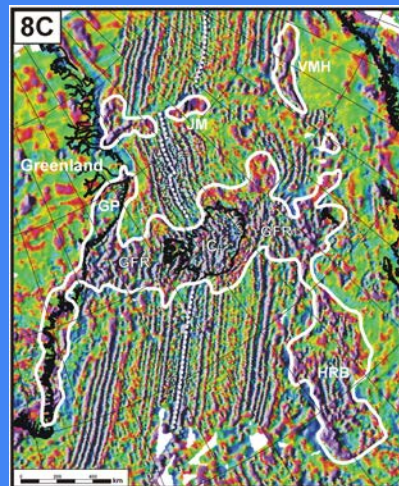
Arctic magnetic domains – F = LIP (Saltus et al, 2011)



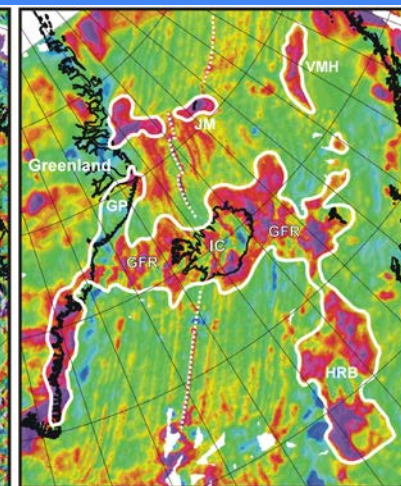
Siberia



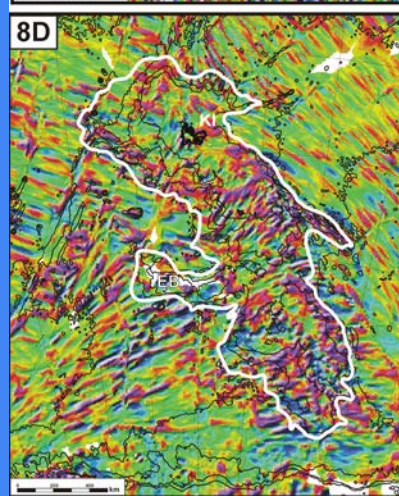
Columbia Plateau



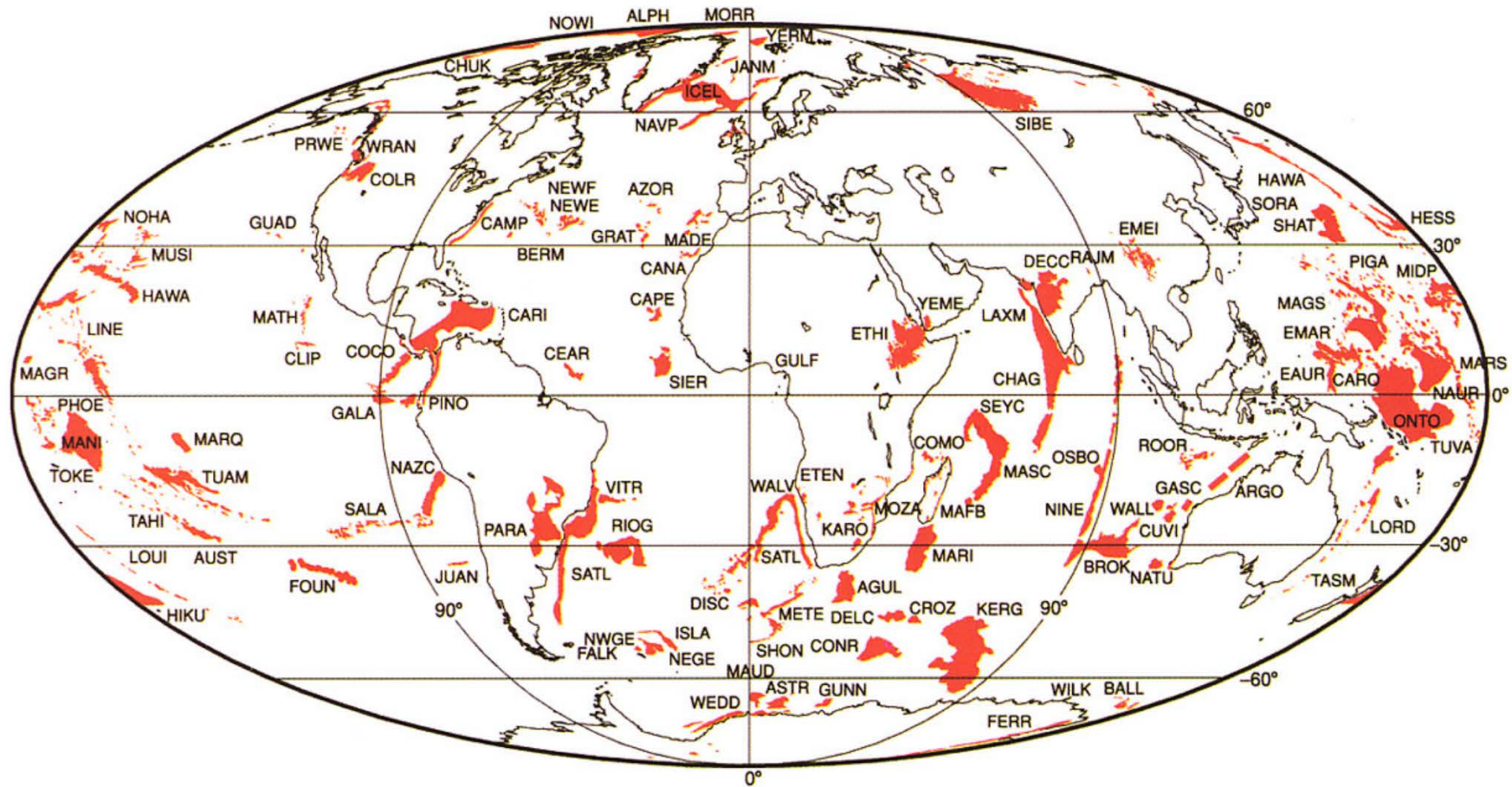
Iceland

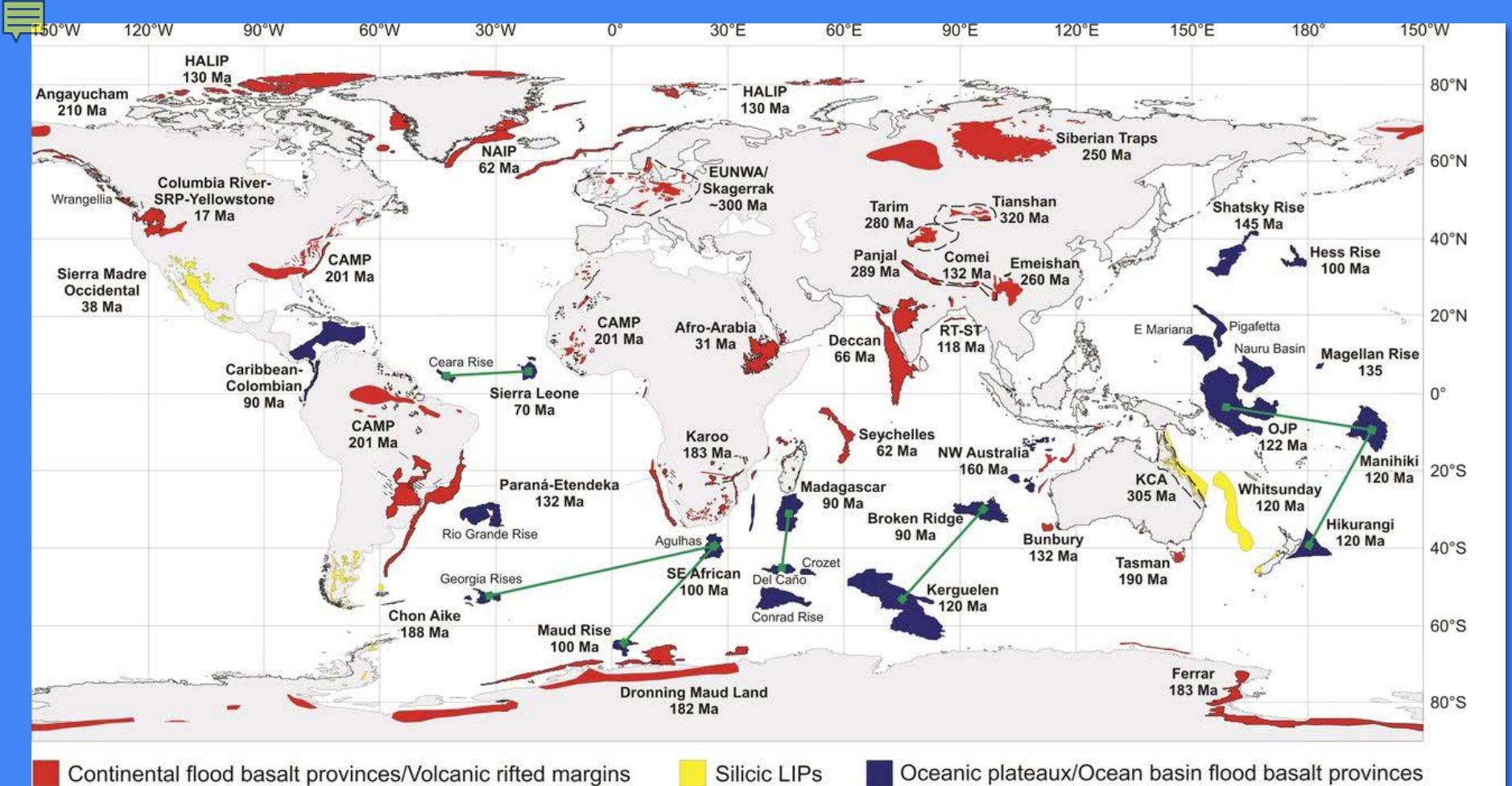


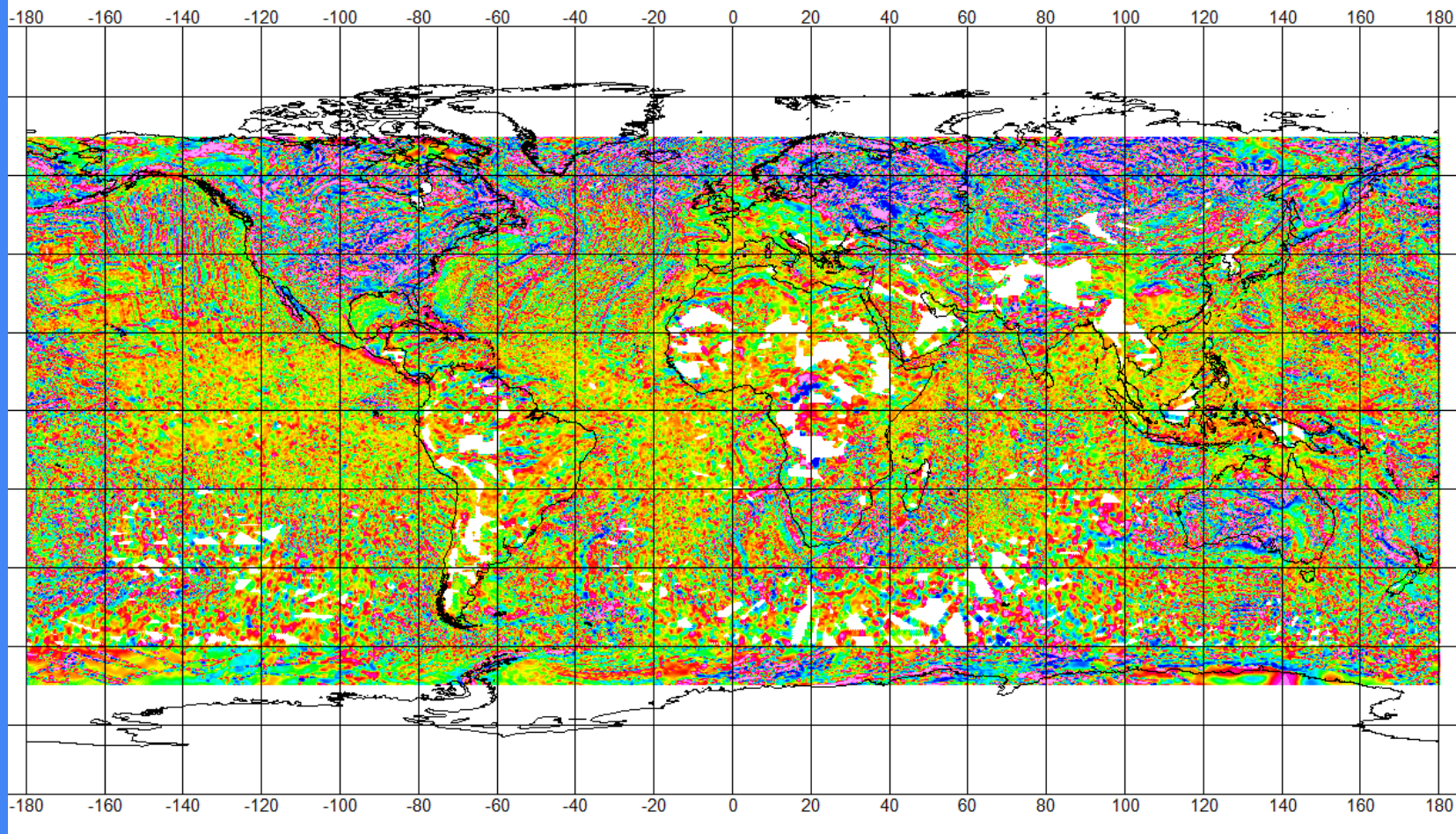
Kerguelen

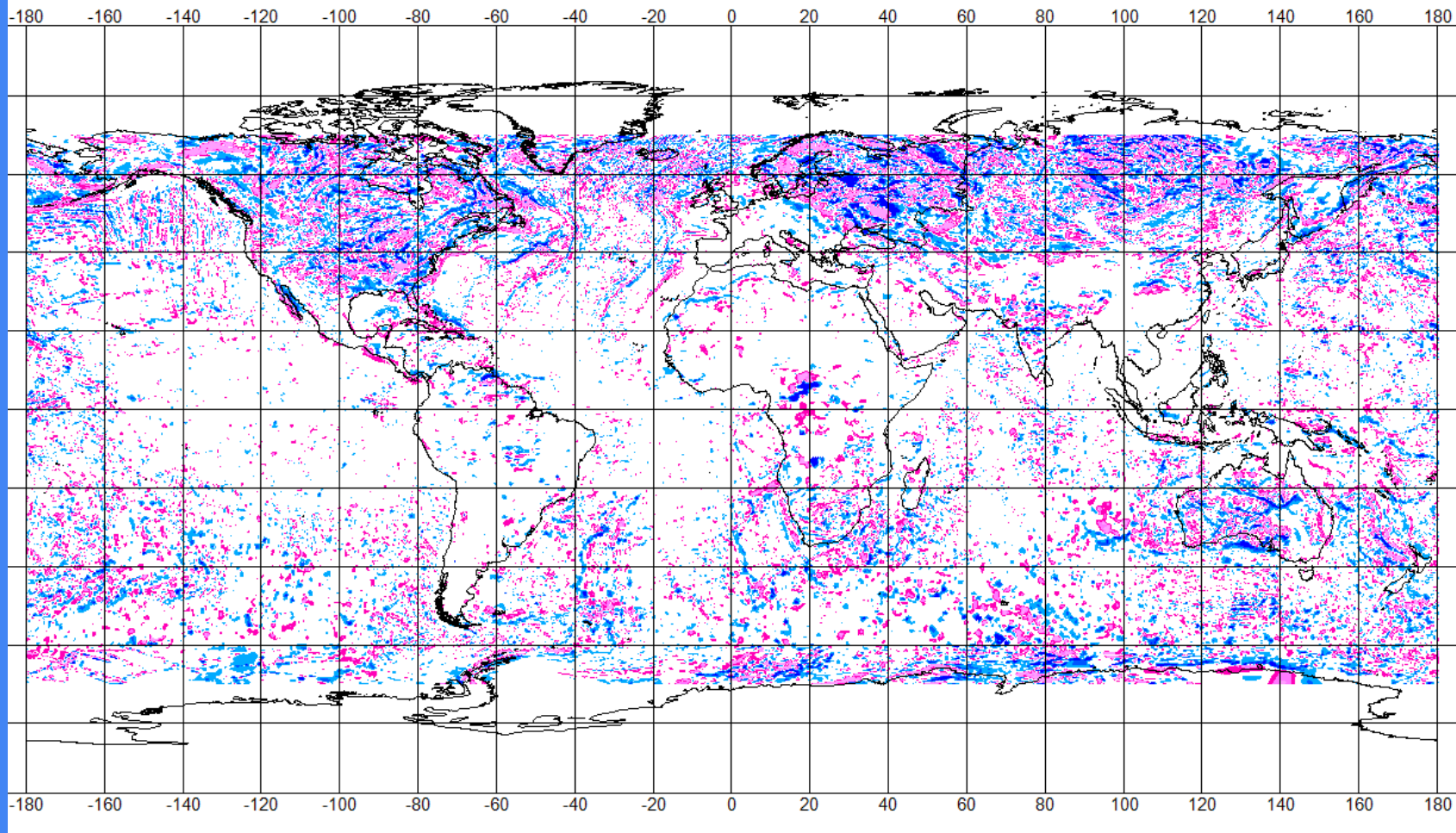


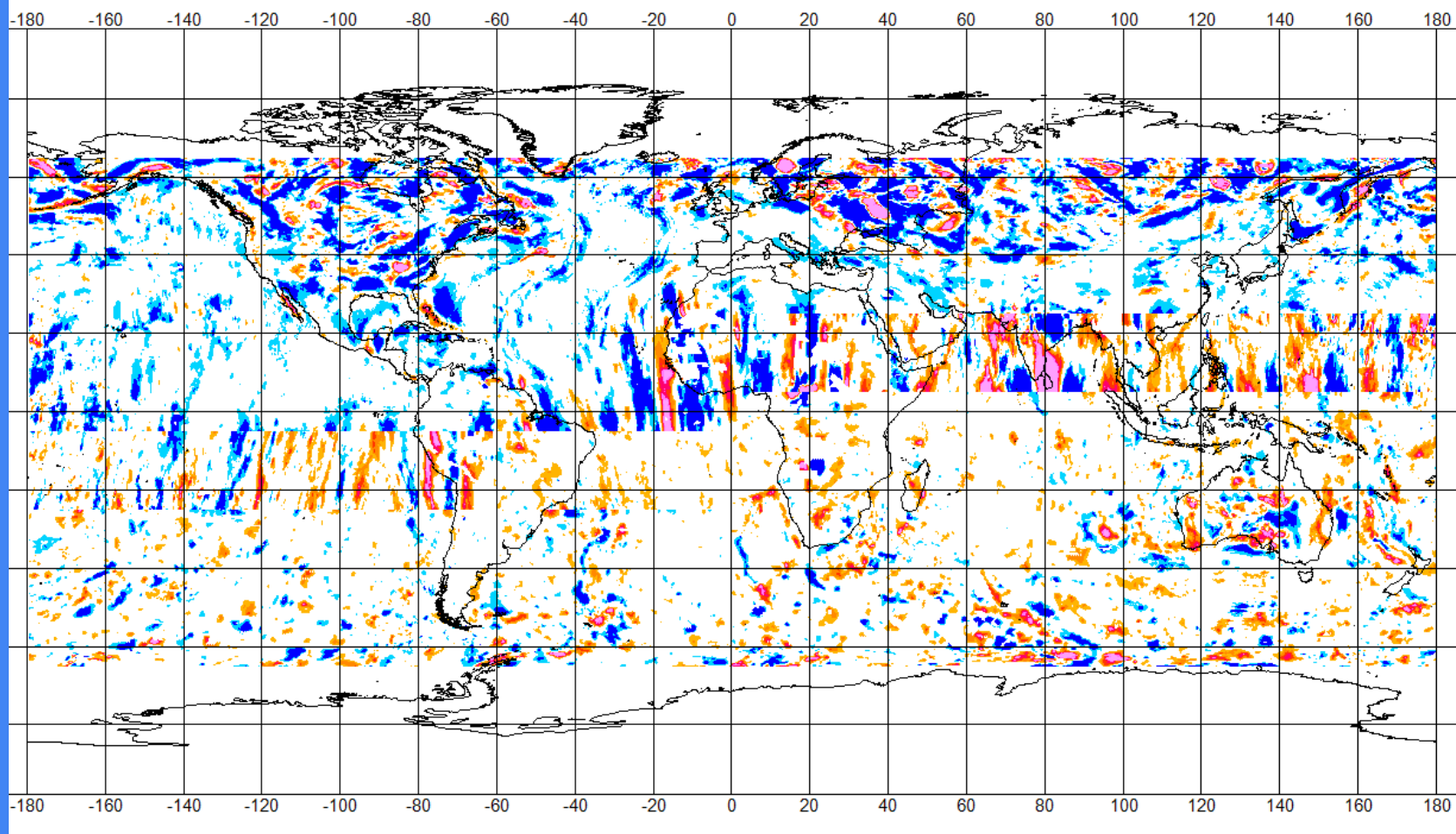
Some global examples based on careful study (Oakey and Saltus, 2016)



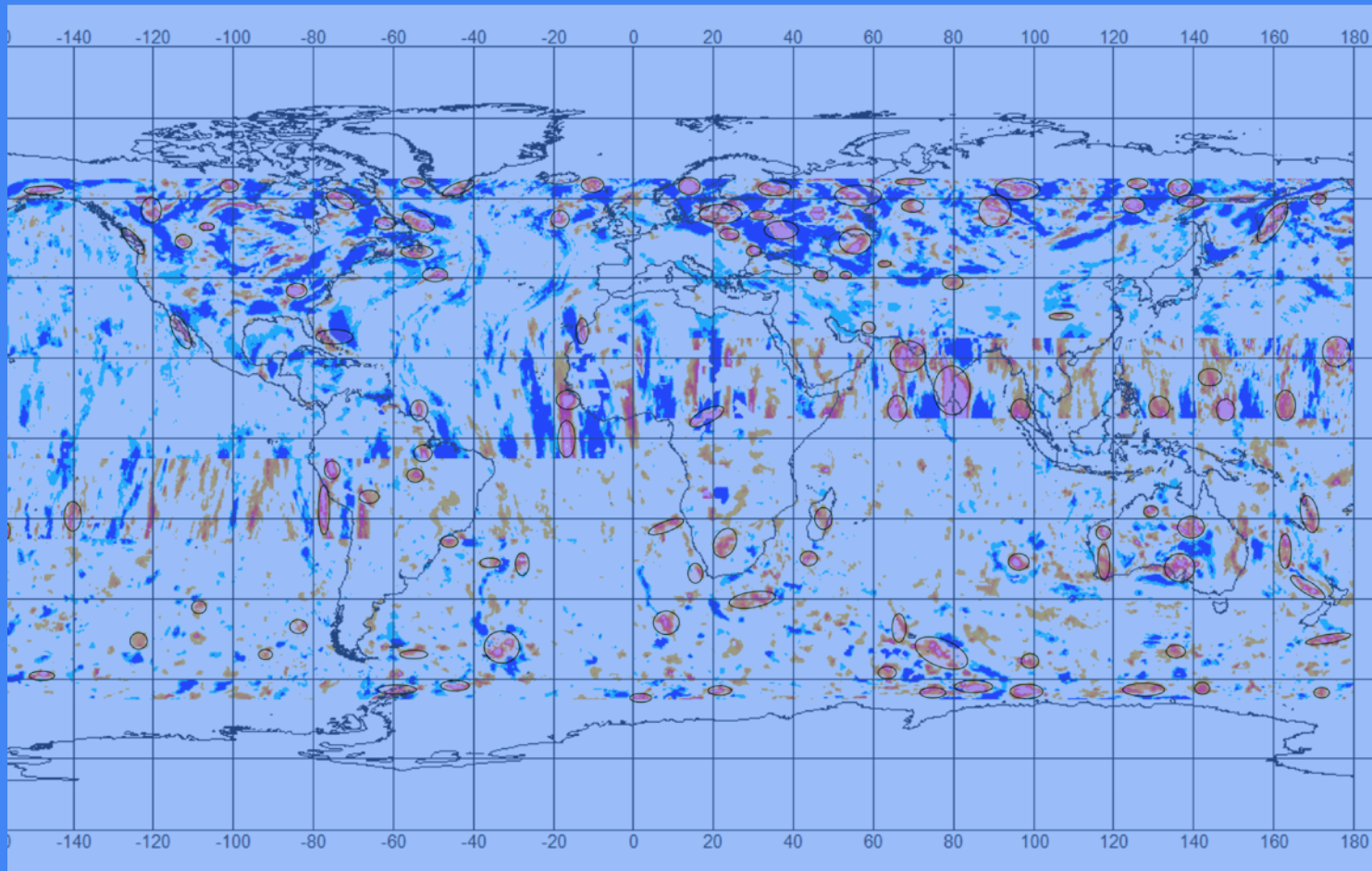




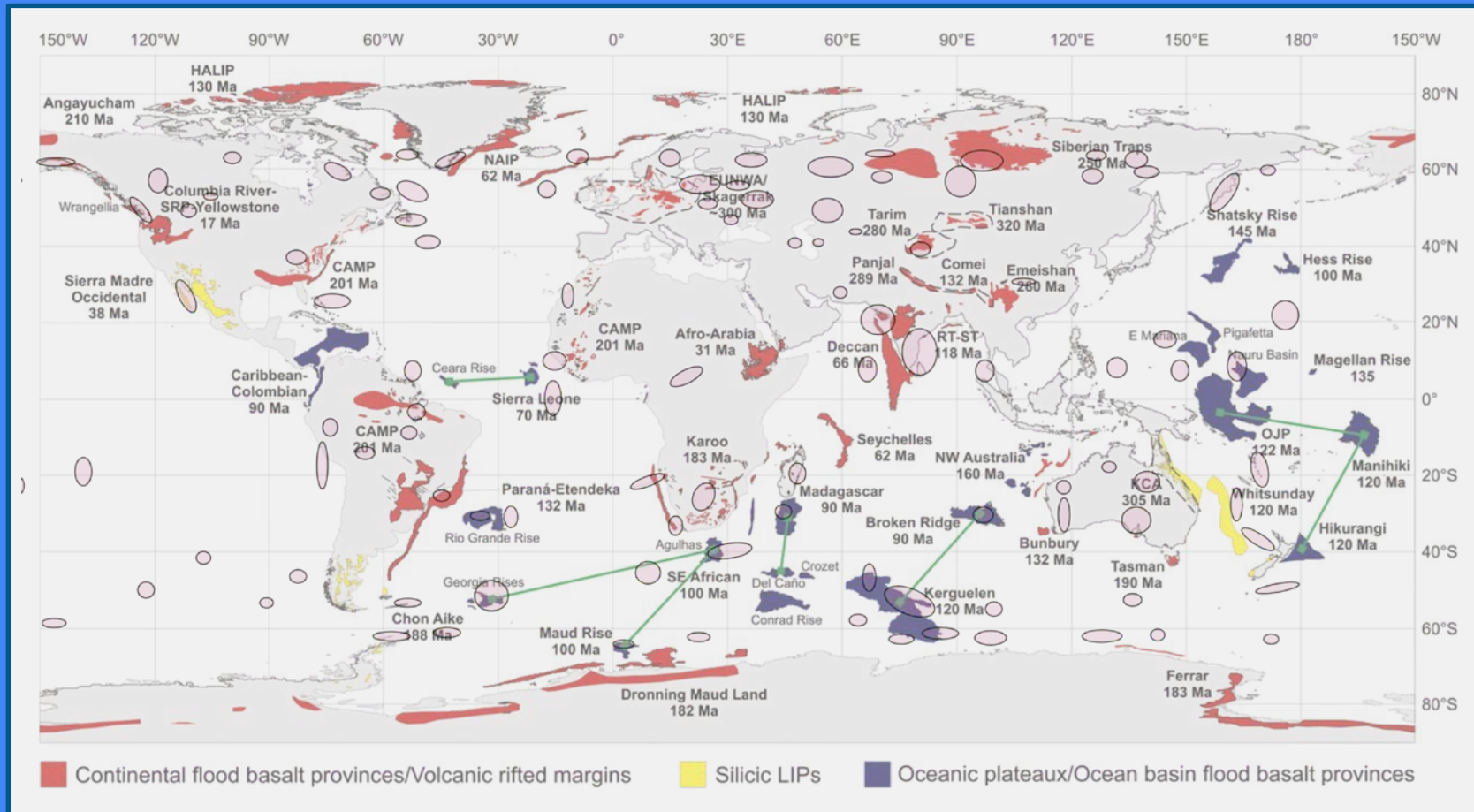




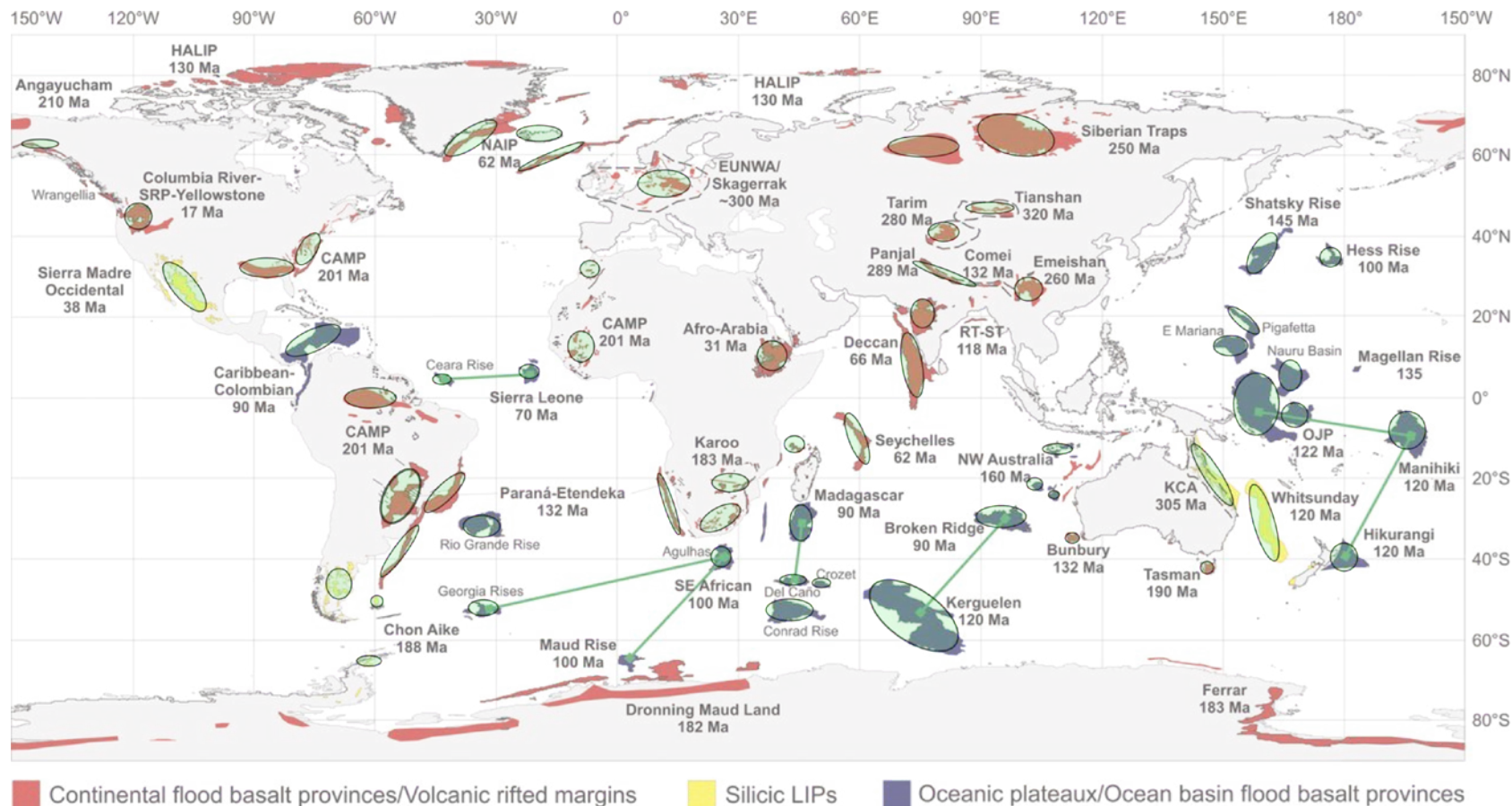
Pseudogravity (Beta version) from EMAG2v3 – Calculated using overlapping 40deg tiles



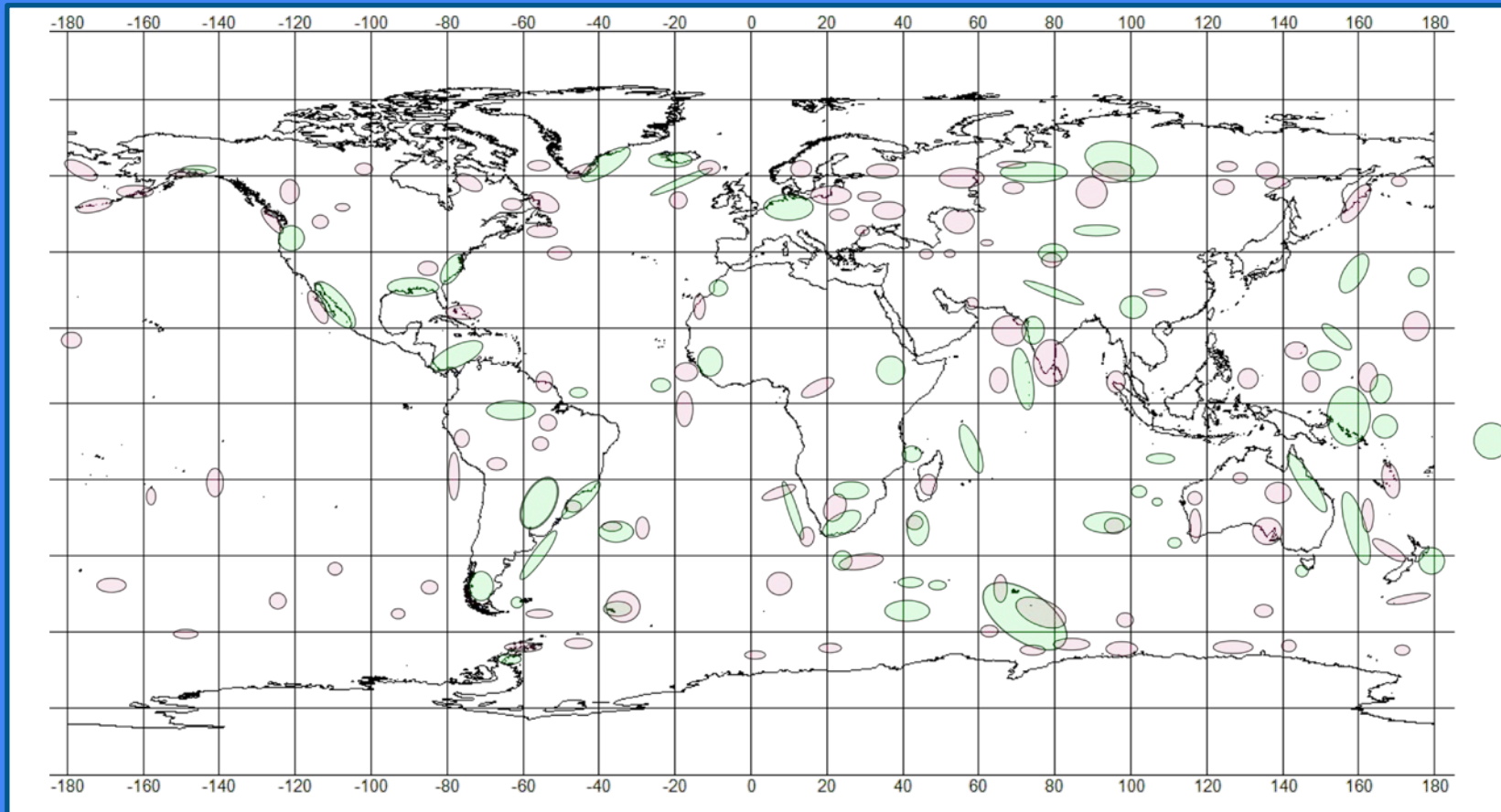
Visual identification of pseudogravity highs (aka “deep magnetic highs”)



Drumroll please... Pseudogravity highs plotted on Bryan and Ferrari 2013 LIP map 19



Circles marking Bryan & Ferrari LIP locations



Pseudogravity highs and mapped LIPs

Discussion and vote:

Is magnetic anomaly data diagnostic for LIP identification?



YES

- Reasonable expectation based on physical properties and mafic volumes
- Works in a number of well-documented cases
- Maybe it works reliably when you have good quality data



NO

- Not convinced that EMAG2 pseudogravity highs match global LIP polygons very well
- Geology is usually messier than theory would predict
- What about remanence, Curie depth, alteration, etc.?

DON'T KNOW YET

- EMAG2 resolution isn't sufficient yet
- Need a better map of global LIP polygons
- Need a better pseudogravity calculation

**YOUR VOTE
MATTERS**

CIRES GEOMAGNETIC RESOURCES



The screenshot shows the homepage of the CIRES Geomagnetism website. At the top, there is a logo for "Geomagnetism" and "CIRES" with a search bar. Below the logo is a navigation menu with links: HOME, INTRODUCTION, CALCULATORS, MODELS, DATA, PUBLICATIONS, and ABOUT US. The main content area features a large image of the Earth with magnetic field lines and a smartphone icon. Below this image is a text box that says "Click the image to learn more about the Earth's magnetic field." Further down, there is a paragraph of text about the CIRES/NCI geomagnetism team's research and a link to a companion website. At the bottom, there is a CIRES logo and contact information for the Cooperative Institute for Research in Environmental Sciences at the University of Colorado at Boulder.

Geomagnetism CIRES

HOME INTRODUCTION CALCULATORS MODELS DATA PUBLICATIONS ABOUT US

Click the image to learn more about the Earth's magnetic field.

The CIRES/NCI geomagnetism team conducts basic and applied research in the field of Earth magnetism. We develop data-based models and calculators of the various magnetic fields originating within the Earth (in the core, mantle, lithosphere and oceans) and in the near-Earth space environment (in the ionized layers of the atmosphere and the magnetosphere). Such models have a wide range of scientific and technical uses, from investigating physical processes associated to a particular source, for example core flows, to providing accurate headings for aircraft navigation and directional drilling. The group is based out of NOAA's Boulder campus and is primarily funded by the NOAA National Centers for Environmental Information (NCEI) through an agreement with the National Geospatial-Intelligence Agency (NGA).

A companion website provides access to official NOAA data products, models and online calculators. This website is more focused on the research activity of our group and includes, for example, research models that have not (yet) been transitioned to operations, publications, and cloud-based calculators. Both sites include various outreach and educational resources in the field of geomagnetism. Feel free to explore and contact us if you have any questions!

CIRES

Cooperative Institute for Research in Environmental Sciences
University of Colorado at Boulder - ©All Rights Reserved, 2015
216 UCB Boulder, CO 80309-0216
303-492-1143 Fax: 303-492-1149
Login

geomag.colorado.edu



Magnetic data and models