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TECHNICAL BRIEF

10.1002/2013GC005176

**Key Points:**
- New open-source, online repository for checked magnetic anomaly identifications
- Sample data set of >64,000 individually picked magnetic anomaly identifications
- Infrastructure to facilitate research in plate tectonic reconstructions

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# Community infrastructure and repository for marine magnetic identifications

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**Abstract** Magnetic anomaly identifications underpin plate tectonic reconstructions and form the primary data set from which age of the oceanic lithosphere and seafloor spreading regimes in the ocean basins can be determined. Although these identifications are an invaluable resource, their usefulness to the wider scientific community has been limited due to the lack of a central community infrastructure to organize, host, and update these interpretations. We have developed an open-source, community-driven online infrastructure as a repository for quality-checked magnetic anomaly identifications from all ocean basins. We provide a global sample data set that comprises 96,733 individually picked magnetic anomaly identifications organized by ocean basin and publication reference, and provide accompanying Hellinger-format files, where available. Our infrastructure is designed to facilitate research in plate tectonic reconstructions or research that relies on an assessment of plate reconstructions, for both experts and nonexperts alike. To further enhance the existing repository and strengthen its value, we encourage others in the community to contribute to this effort.



## 1. Introduction

Marine magnetic anomaly data are one of the primary data sources for the interpretation of seafloor spreading in the world's ocean basins and were instrumental in the development of the theory of plate tectonics [*Dietz*, 1961; *Hess*, 1962; *Vine and Matthews*, 1963]. These data record recognizable patterns formed due to reversals in the Earth's magnetic field over geological time. The majority of marine magnetic anomaly data, collected through marine ship track, aeromagnetic, and helicopter surveys, have been made available to the scientific community through the GEODAS (GEOphysical Data System) archive, developed by the US National Geophysical Data Center (NGDC) [*Sharman et al.*, 2001]. A subset of these data, which have been error-checked for observational outliers, excessive gradients, metadata consistency, and agreement with satellite altimetry-derived gravity and bathymetry grids [*Chandler and Wessel*, 2008, 2012] is available through the MGD77 supplement to the Generic Mapping Tools software suite [*Wessel et al.*, 2013]. Experts in marine geophysical data interpretation compare these magnetic anomaly data against synthetic crustal magnetic models and the geomagnetic reversal time scale to create a set of so-called magnetic anomaly identifications—a spatiotemporal representation of the magnetic anomalies themselves. From these magnetic anomaly identifications, the age and spreading regime of the ocean floor can be ascertained and a plate kinematic model constructed. Often, nonexperts in marine geophysical data interpretation are interested in constructing and/or assessing alternative plate kinematic scenarios but lack the necessary expertise to interpret the raw data. Previous global and regional compilations of magnetic anomaly identifications have been presented as maps with no accompanying digital data [e.g., *Karasik and Sochevanova*, 1981, 1990; *Ségoufin et al.*, 2004] limiting their usefulness for other researchers. The exception is the lineations of *Cande et al.* [1989] which are available through the NDGC website (http://www.ngdc.noaa.gov) but these

  

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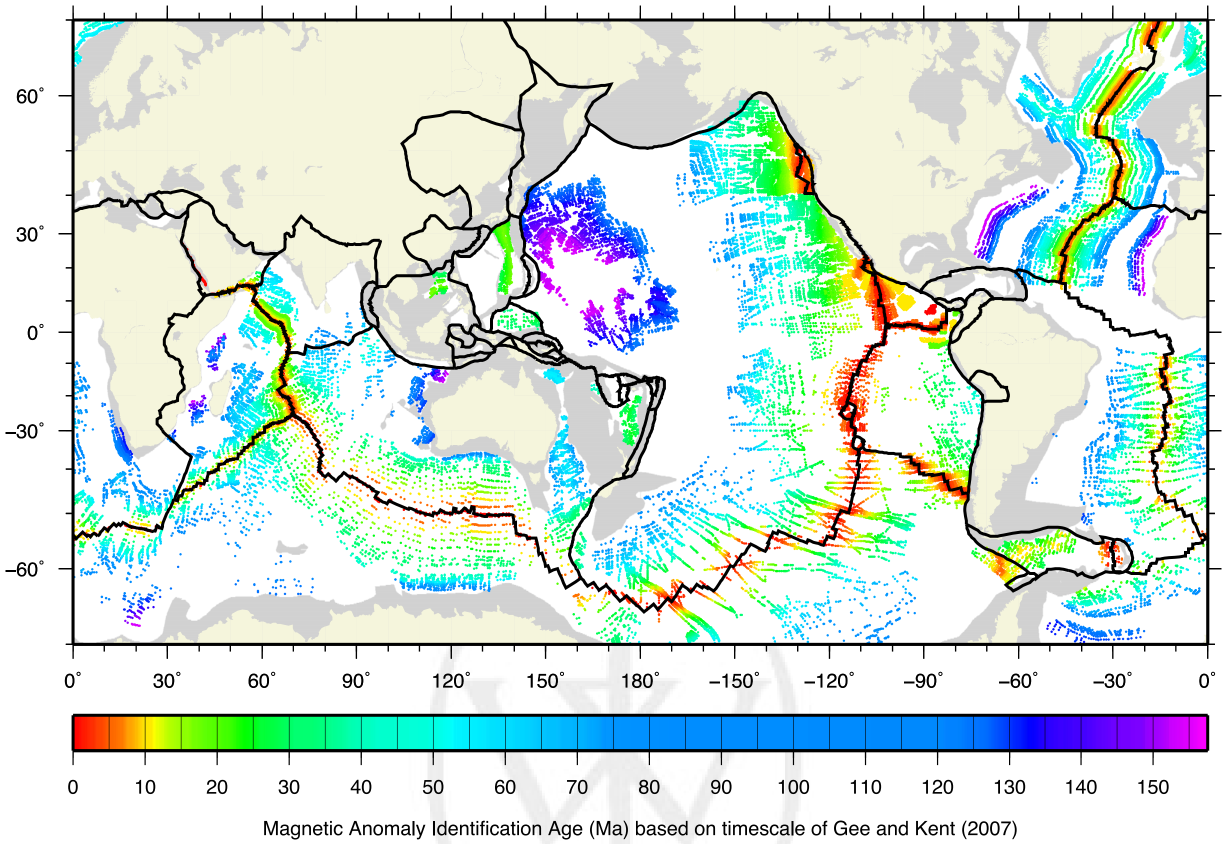


**Figure 1.** The global magnetic anomaly identification data set that is provided as part of our infrastructure. Magnetic anomaly identifications are colored by age based on the time scale of *Gee and Kent* [2007].

are outdated and contain minimal metadata. An infrastructure that houses a freely available, downloadable repository of magnetic anomaly identifications that can be updated indefinitely is therefore of genuine value to the wider scientific community.



We have established a new infrastructure and repository for magnetic anomaly identification data. The infrastructure is open-source and community-driven, where consistent and well-documented information on magnetic anomaly identifications is collected, quality-controlled and made accessible to the public via a dedicated website (http://www.soest.hawaii.edu/PT/GSFML). We have initially populated the repository with a global set of 96,733 published magnetic anomaly identifications (Figure 1), and further additions will make the global database an evolving resource. A team of trusted, expert users are responsible for the addition and/or revision of contributions and overall management of the repository to ensure consistency and integrity of information. All information is stored under version control, allowing the history of the database to be reconstructed. The data are provided in three commonly used file formats: OGR/GMT multisegment files, KMZ Google Earth files, and ESRI Shapefiles. These data can be loaded directly into the plate reconstruction software, *GPlates* [*Boyden et al.*, 2011], for visualization and interrogation or to construct or assess plate tectonic reconstructions. Where possible, we also provide any additional information (such as further details of the picking technique; the data source; processing techniques) in readme files for individual data sets. The infrastructure is complementary to the Global Fracture Zone database [*Matthews et al.*, 2011], which enhances the power of the magnetic anomaly database for plate reconstruction studies.

## 2. Magnetic Anomaly Identifications

Marine magnetic anomaly identifications are an interpretation of the age of the oceanic crust, made by correlating individual magnetic anomaly patterns along profile against a synthetic crustal magnetic model and geomagnetic reversal time scale. The two-dimensional forward modeling of magnetic anomalies [e.g.,

  

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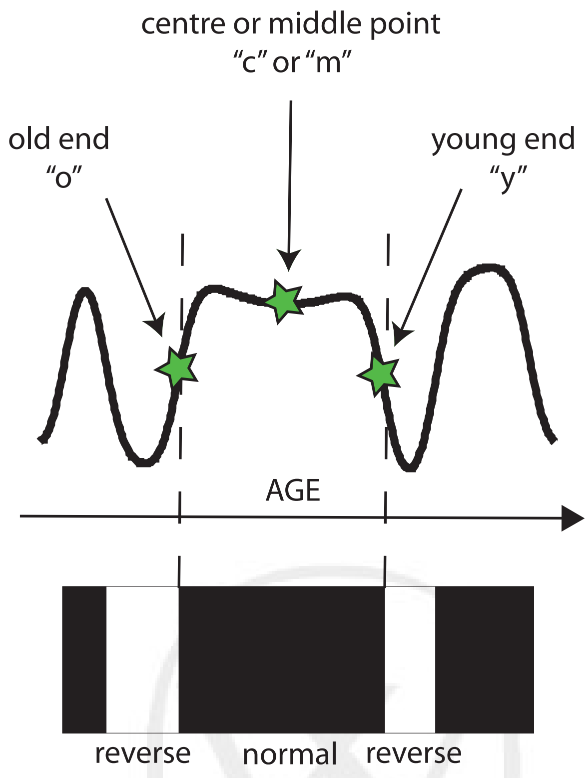


**Figure 2.** Schematic of how to "pick" a magnetic anomaly identification. We track the confidence in the anomaly end assignment using a numerical code, where (1) anomaly end clearly listed in the original paper; (2) some problem exists from the original paper but there is confidence in the anomaly end assignment; (3) anomaly end unclear in original paper and the end has been inferred.

*Blakely*, 1995; ~~*Modmag,*~~ *Mendel et al*., 2005, ~~and *Magan*,~~ *Schettino*, 2012] take into account factors that skew the shape of the magnetic anomalies such as remanent magnetization parameters, ambient geomagnetic field directions, spreading rates, spreading asymmetry, and spreading ridge orientation. Synthetic models predominantly assume a vertical magnetized body. An alternative, but equivalent, approach is to deskew [*Schouten*, 1971] the magnetic anomaly profiles taking into account the same parameters. The technique of "picking" magnetic anomalies and assigning their temporal component has been performed using methods that differ slightly in their design. This has led to inconsistencies in metadata assignment and storage, making it difficult to combine disparate studies into one self-consistent data set. It is therefore often left to individual researchers to collate various data sets and ensure self-consistency.

### 2.1. Picking Technique

The picking technique employed for magnetic anomalies differs between researchers. Picking is made by eye on hardcopy printouts or digitally, or by using numerical approaches to "objectively" pick the location of the magnetic contrasts. Researchers commonly pick the "young" or "old" end of a magnetic chron (Figure 2). As the geomagnetic reversal time scale is calibrated to the start and end of a magnetic chron, assigning an age to a magnetic anomaly identification based on this method is straightforward. In other cases, researchers pick the "center" or "middle" of an anomaly from which to make their magnetic anomaly identification, i.e., at the maximum or midpoint of the peak or trough that constitutes that anomaly (Figure 2). This approach may be valuable in places, where the edges of neighboring anomalies are unclear due to superposition owing to short isochron durations and/or slow spreading rates, even though correlating this type of identification with the geomagnetic reversal time scale becomes problematic. This information is usually depicted as "y," "o," "c," or "m" following the chron number. The absence of this information could potentially lead to tens of km of difference in the location/age association of a magnetic anomaly identification, with serious implications for plate motion studies. It is therefore crucial to preserve the chron end of each magnetic anomaly identification and also a measure of the confidence of this information.

An inherent assumption of magnetic anomaly identifications is that they are based on magnetic anomaly data recorded by elongated bodies formed by seafloor spreading parallel to the ridge axis. However, recent studies [e.g., *Croon et al*., 2008; *Granot et al*., 2009; *Keller*, 2004] have added additional picks using tectonic trends, i.e., abyssal hills from high quality multibeam data. In these cases, two additional picks are identified on the edges of the swath multibeam to define three picks from a single voyage track. The identification method for each pick is noted to distinguish identifications not based on magnetic anomaly data.

### 2.2. Magnetic Chron and Time Scale

The temporal component of a magnetic anomaly identification is based on a geomagnetic reversal time scale. Many alternative time scales exist [e.g., *Cande and Kent*, 1995; *Gee and Kent*, 2007; *Gradstein et al*., 1994, 2004; *Heirtzler*, 1968] and modifications continue as new constraints are obtained [e.g., *Ogg and*



  

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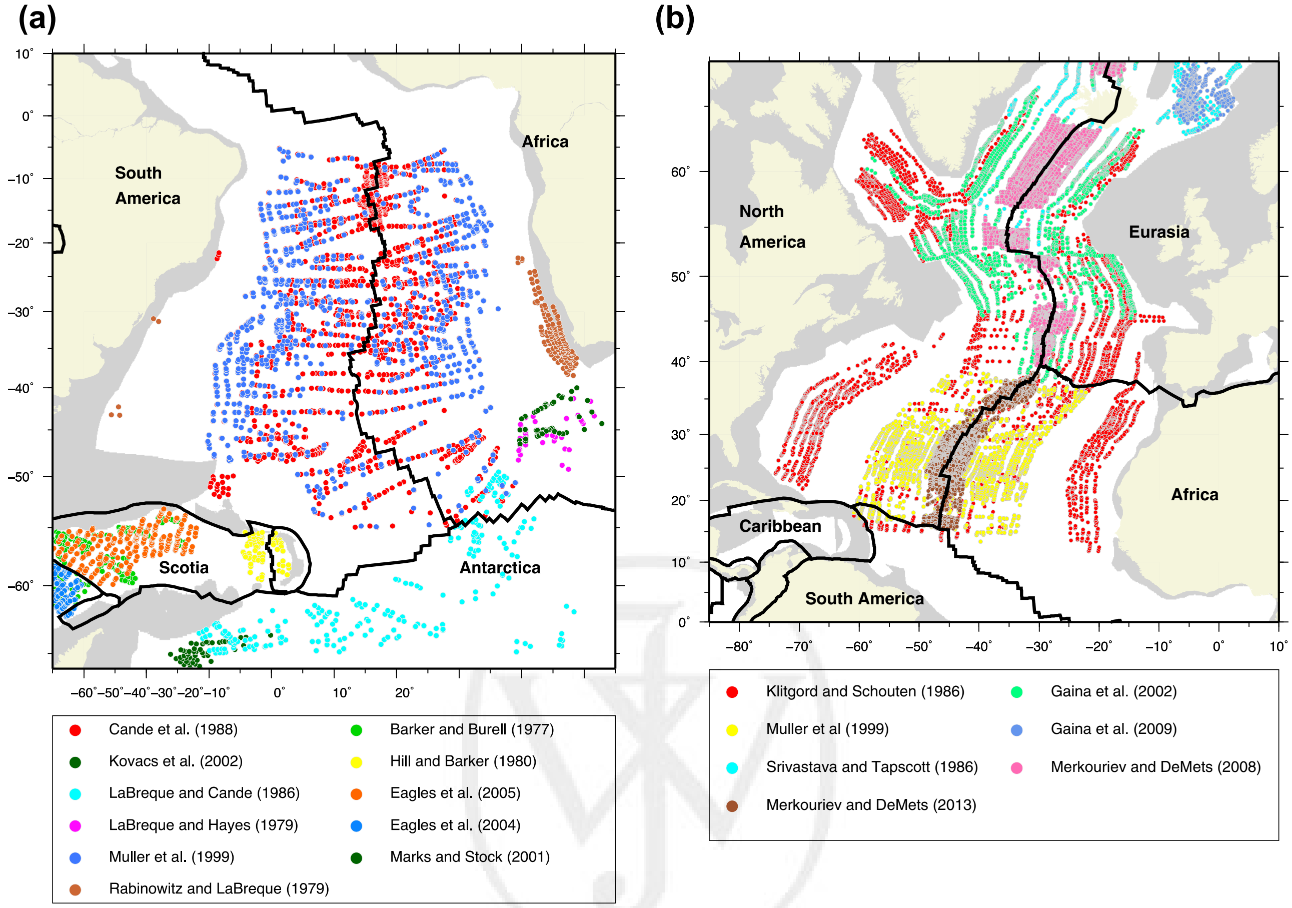


**Figure 3.** Regional maps showing magnetic anomaly identification data sets, colored by reference, which is how the data is provided in the repository. (a) South Atlantic, (b) North Atlantic, (c) Western Indian, (d) Eastern Indian, (e) Western Pacific, (f) Northeast Pacific, (g) Southeast Pacific, (h) South pole, and (i) North pole.



*Lugowski*, 2012]. For this reason, the age of an identification is not explicitly stored but rather, we provide look-up tables for some commonly used time scales, such as [*Cande and Kent*, 1995; *Gee and Kent*, 2007; *Gradstein et al*., 2004], with the option of including other time scales in the future. A planned GMT5 supplement will provide tools to automate the look-up process.

### 2.3. Rotation Parameters

Magnetic anomaly identifications, together with fracture zone traces, can be used to reconstruct palaeopositions and direction of motion through time between two or more tectonic plates described by a rotation model. When two flanks of a spreading system are preserved, a series of stage or finite rotations can be computed using either a visual-fitting technique or, more robustly, the least squares approach of *Hellinger* [1981] and *Royer and Chang* [1991] or *Eagles* [2004]. These approaches compute rotations and their uncertainties based on a set of magnetic anomaly identifications, fracture zones segments, associated uncertainties, and an approximate rotation pole position. The most-widely employed method to estimate uncertainties in plate reconstructions is that of *Hellinger* [1981]. Our infrastructure has been designed to preserve, where available, input files for the "Hellinger" methodology (e.g., magnetic anomaly identifications, fracture zone segments) as well as the output files (e.g., the resultant rotations and covariance matrices). The "Hellinger" output can be converted to GROT format [*Qin et al*., 2012], the native rotation file format of the plate reconstruction software, *GPlates*.

### 2.4. Magnetic Survey Information

Ideally, magnetic anomaly interpretations are made along survey lines but this information is rarely preserved in digital magnetic anomaly identification compilations, especially for older data sets. Our

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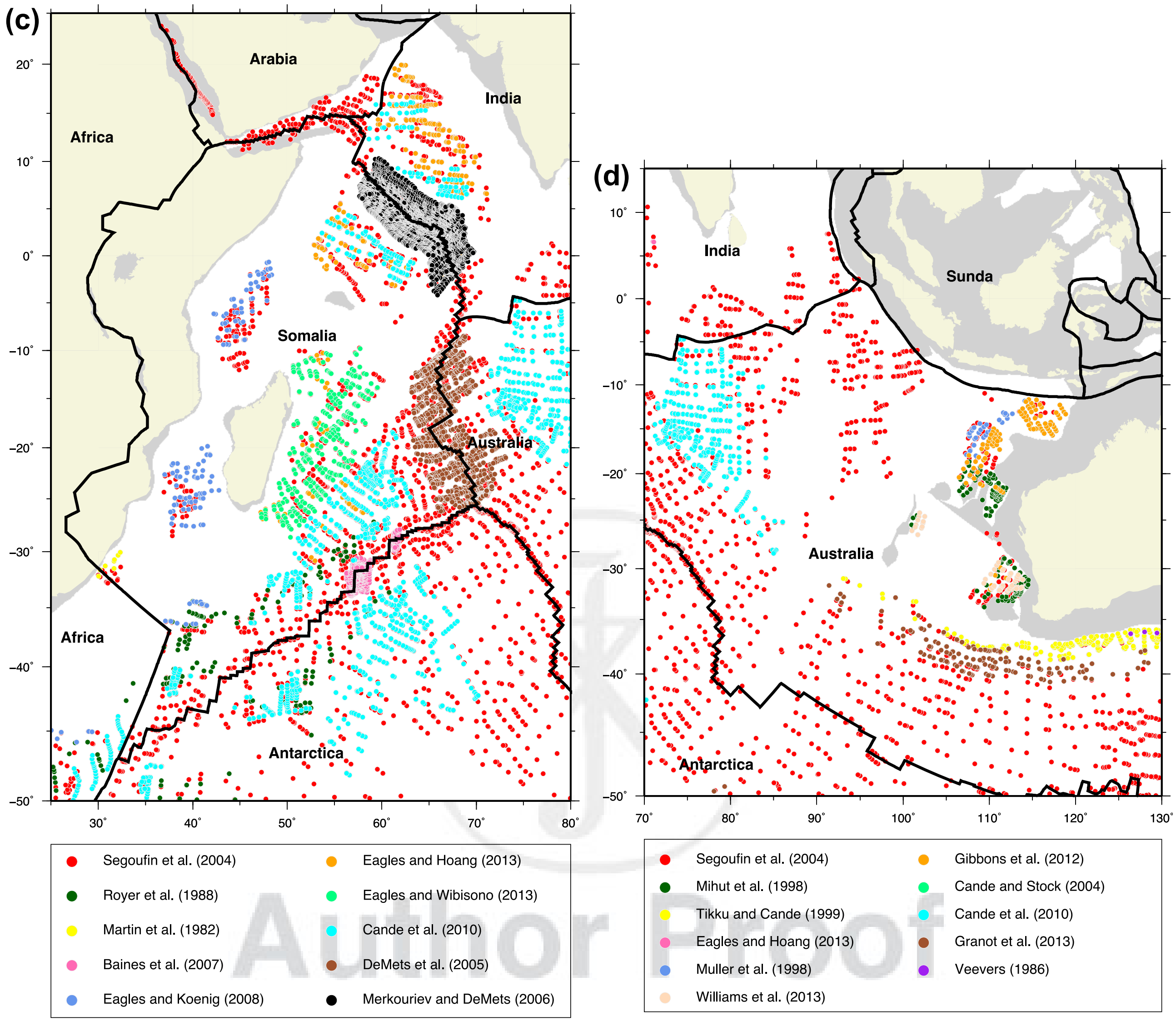


**Figure 3.** (Continued)



infrastructure provides an optional field allowing for the survey line name to be preserved, such that individual magnetic anomaly identifications can easily be traced back to the original source data.

### 2.5. Limitations

Magnetic anomaly identifications are an interpretation of data, with errors stemming from a variety of sources: the original data itself; the interpretation technique; the way the information has been preserved. Source data errors have largely been addressed through error corrections applied to the NGDC data [*Chandler and Wessel*, 2008, 2012], but the errors originating from the source data remain as these corrections have not been propagated through to magnetic anomaly identifications made from the uncorrected data. Sources of error may derive from~~;~~ errors in the location of the measurements, particular for old, pre-GPS data; large skewness angles due to magnetization and the ambient geomagnetic field directions; nonvertical magnetic boundaries within the magnetic source layer. Errors in the "picking" technique mainly arise from digitizing errors; ~~the~~ anomaly end assignment, ~~especially if the center-point of the anomaly was chosen or if this information is not explicitly stored; incorrect chron assignment;~~ and low sampling resolution. Magnetic anomaly misinterpretations are possibly the largest sources of error but are difficult to quantify, especially if there are no alternative reconstructions for comparison. The association of Hellinger input and

  

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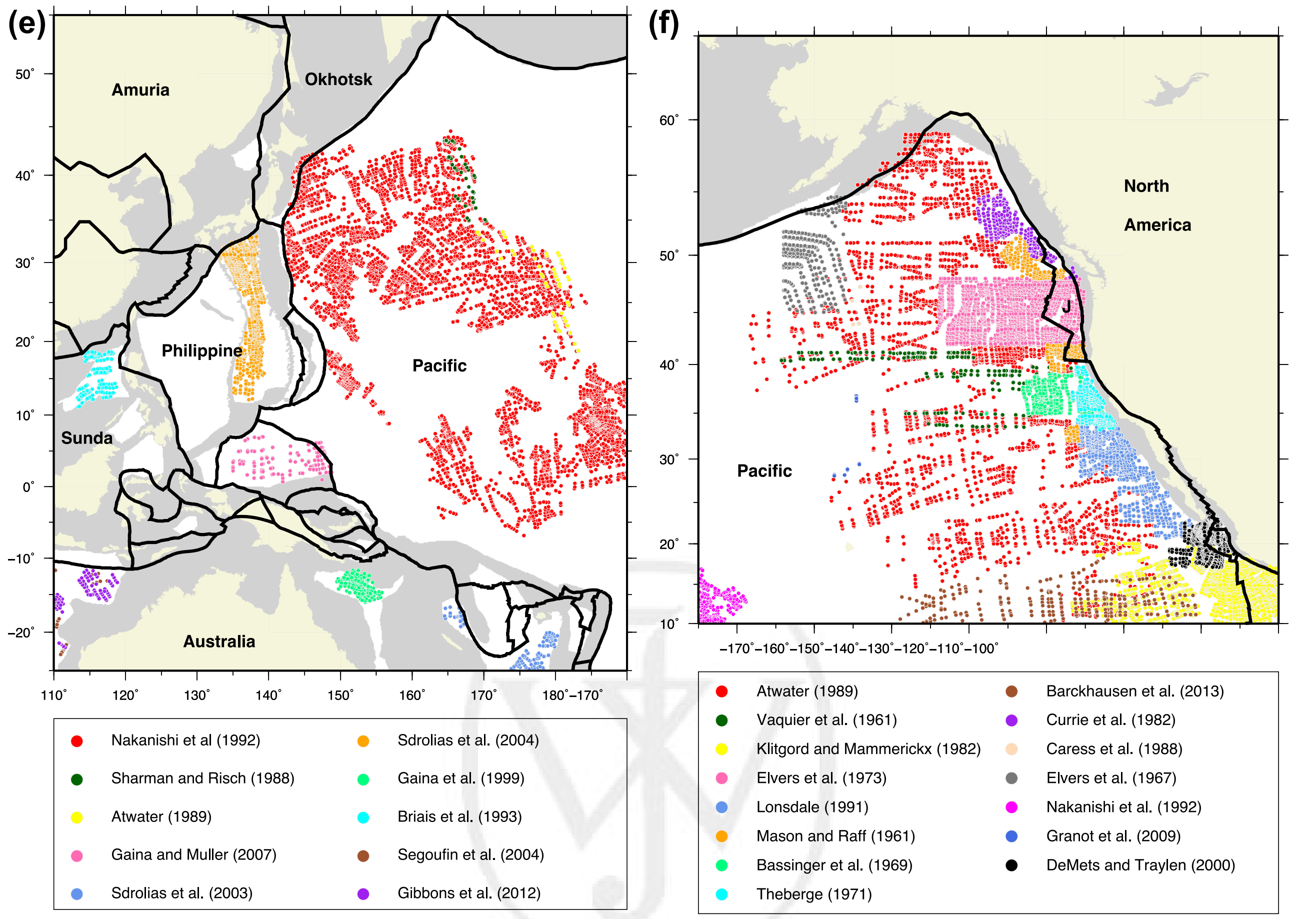


**Figure 3.** (Continued)



output files, where available, may provide confidence for one particular interpretation over another. The establishment of a community-driven repository with multiple, consistently formatted magnetic interpretations for each area may help partly overcome these limitations.

## 3. The Infrastructure and Data Repository

Due to their close relationship, both fracture zone traces (and other seafloor fabric data) and the new magnetic anomaly and Hellinger-format files are accessible from the same top-level website (http://www.soest.hawaii.edu/PT/GSFML). Data files will be presented in GMT/OGR ASCII, KML, and shapefile formats for *GMT*, *GPlates* or general-purpose GIS software and will be distributed via zip files. We provide links to relevant plate reconstruction software and other tools from our site.

## 4. Sample Magnetic Anomaly Identification Data From the World's Oceans

As part of our community magnetic anomaly identification repository, we provide a sample data set of global identifications. This data set has been quality-checked for consistency and only data attributable to a published data source is included. Our magnetic anomaly identification sample data set is by no means complete but rather includes those data that have been provided freely to the community either through publication supplementary data, general online data repositories, or through personal requests from the authors. Many more magnetic anomaly identifications exist that have yet to reach the public domain. Our intention for providing this sample data is to initiate the effort for a globally self-consistent magnetic anomaly identification repository.

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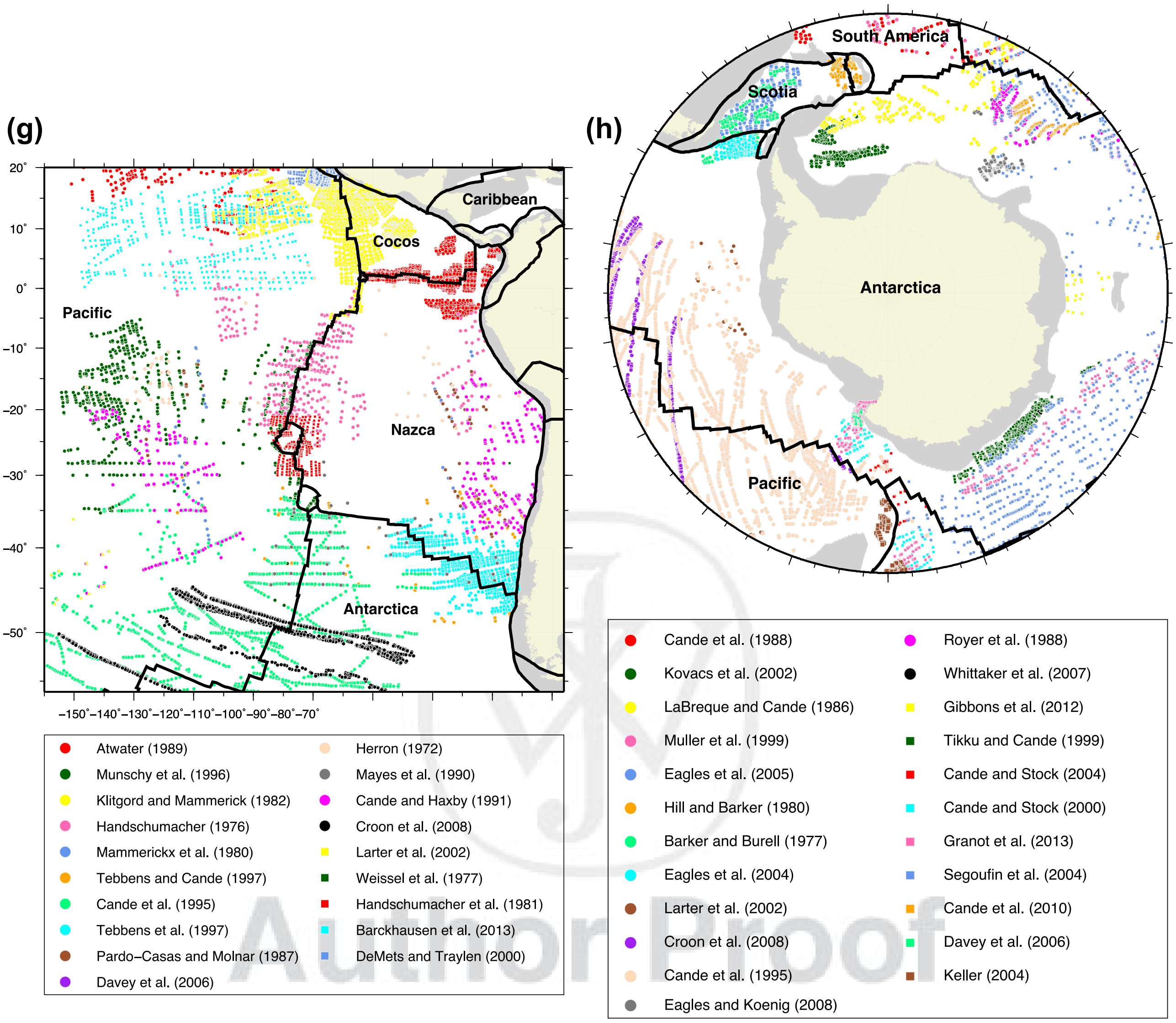


**Figure 3.** (Continued)



### 4.1. Atlantic Ocean

We have collated magnetic anomaly identifications for the Cenozoic South Atlantic from *Cande et al.* [1988] and *Müller et al.* [1999], and from *Rabinowitz and LaBrecque* [1979] for the Mesozoic (Figure 3a). In the southern South Atlantic, magnetic anomaly identifications associated with the Malvinas plate are from *LaBrecque and Hayes* [1979] and *Marks and Stock* [2001]; the Cenozoic South America-Antarctic spreading corridors from *LaBrecque and Cande* [1986] and *Livermore et al.* [2005]; and the early breakup of South America and Africa by *Martin et al.* [1982]. The Mesozoic spreading in the Weddell Sea is represented by magnetic anomaly identifications from *Kovacs et al.* [2002]. Magnetic anomaly identifications for the North Atlantic are from *Klitgord and Schouten* [1986] for the Mesozoic-Cenozoic Central Atlantic; *Müller et al.* [1999] for the Cenozoic Central Atlantic; *Klitgord and Schouten* [1986] and *Gaina et al.* [2002] from Iberia-Newfoundland to Greenland-Eurasia and the Labrador Sea; *Srivastava and Tapscott* [1986] and *Gaina et al.* [2002] for Greenland-Eurasia and the Eurasian Basin; and *Srivastava and Tapscott* [1986] and *Gaina et al.* [2009] for the Norway Basin (Figure 3b). Numerous identifications of Neogene period reversals (20 Ma and younger) for the Arctic basin, the Kolbeinsey and Reykjanes Ridges, and the Mid-Atlantic Ridge north of the Azores triple junction are included from *Merkouriev and DeMets* [2008]. Similarly detailed identifications of Neogene period reversals from the Africa-North America segment of the Mid-Atlantic Ridge (15°N–37°N) are included

  

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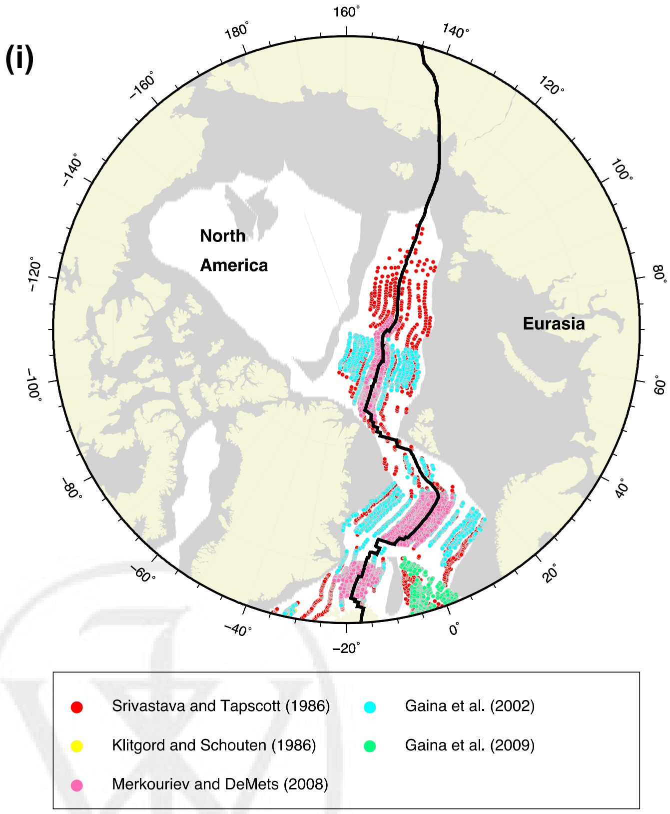


**Figure 3.** (Continued)

from *Merkouriev and DeMets* [2014]. The noticeable absence of magnetic anomaly identifications in the equatorial Atlantic is due to the combined effect of a north-south striking ridge and its position at the equator. AQ1



Where multiple magnetic anomaly identification data sets are available, we prefer the magnetic anomaly identifications of *Müller et al*. [1999] for the Cenozoic South Atlantic and Central Atlantic. In the North Atlantic a combination of identifications from *Merkouriev and DeMets* [2008, 2013] for Chron 6 and younger, and from *Gaina et al*. [2002, 2009] for reversals older than Chron 6, as the latter four studies each include rotations derived using the Hellinger method and rigorously estimated rotation uncertainties. In addition, the data for three of the studies [*Gaina et al*., 2009, 2002; *Merkouriev and DeMets*, 2013] include fracture zone identifications based variously on multibeam, sonar, and satellite altimetry data.

### 4.2. Indian Ocean

We have collated magnetic anomaly identifications in the Indian Ocean from a variety of sources. In the western Indian Ocean, these include *Royer et al*. [1988] for the Southwest Indian Ridge; *Baines et al*. [2007] for two detailed spreading corridor studies proximal to the Southwest Indian Ridge; *DeMets et al*. [2005] and *Merkouriev and DeMets* [2006] for the Central Indian and Carlsberg Ridges; *Cande et al*. [2010], *Eagles and Hoang* [2013], and *Eagles and Wibisono* [2013] for the Central Indian Basin; and *Eagles and Konig* [2008] for the Mesozoic spreading history (Figure 3c). In the eastern Indian Ocean, these include *Cande and Stock* [2004], *Tikku and Cande* [1999], *Veevers* [1986], *Granot et al*. [2013], and *Whittaker et al*. [2007] for the southeast Indian Ridge; *Gibbons et al*. [2013] and *Williams et al*. [2013] for the Mesozoic Enderby Basin; and *Mihut and Müller* [1998], *Müller et al*. [1998], and *Gibbons et al*. [2012] for the Meoszoic anomalies along the western Australian margin (Figure 3d). In addition, we incorporate a data set covering the entire Indian Ocean from the Red Sea to the southeast Indian ridge from *Segoufin et al*. [2004] (Figures 3c and 3d). We acknowledge the existence of many more unpublished magnetic anomaly identifications in the Indian Ocean [e.g., *Yatheesh et al*., 2013], which will be incorporated into our magnetic anomaly repository once they are published.





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Where multiple magnetic anomaly identification data sets are available in the Indian Ocean we prefer a combination of *Whittaker et al*. [2007] and *Tikku and Cande* [1999] for the magnetic anomaly identifications in the southeast Indian Ocean, *Cande et al*. [2010] in areas of data overlap in the Central Indian Basin, the data of *Gibbons et al*. [2012, 2013] for the Mesozoic eastern Indian Ocean, *Royer et al*. [1988] and *Baines et al*. [2007] for the southwest Indian Ridge and *Eagles and Konig* [2008] for the Mesozoic spreading between Africa, Madagascar, and Antarctica. These interpretations were chosen as they were derived using newly collected data, recent fracture zone identifications, provide all the necessary metadata and/or incorporate uncertainties in derived rotations using the Hellinger method.

### 4.3. Pacific Ocean

The Pacific Ocean is vast and many of the magnetic anomaly identifications are old (pre-1980s), poorly documented, and subject to larger data source and digitizing uncertainties than the more recent identifications found in many of the other ocean basins. We have collated magnetic anomaly identifications for the Mesozoic western Pacific from *Nakanishi et al*. [1992], *Sharman and Risch* [1988], and *Atwater* [1989] (Figure 3e); the Mesozoic-Cenozoic northeast Pacific from *Atwater* [1989], *Bassinger et al*. [1969], *Caress et al*. [1988], *Currie and Riddihough* [1982], *Elvers et al*. [1967, 1973], *Klitgord and Mammerickx* [1982], *Mason and Raff* [1961], *Lonsdale* [1991], and *Vaquier et al*. [1961]; and the Cenozoic southeast Pacific from *Atwater* [1989], *Barckhausen et al*. [2013], *Cande and Haxby* [1991], *Handschumacher* [1976], *Handschumacher* et al. [1981], *Herron* [1972], *Klitgord and Mammerickx* [1982], *Mammerickx et al*. [1980], *Mayes et al*. [1990], *Munschy et al*. [1996], *Pardo-Casas and Molnar* [1987], *Tebbens and Cande* [1997], *Tebbens et al*. [1997], *Theberge* [1971], and *Weissel et al*. [1977]. Much recent focus has been on the remote Pacific-Antarctic spreading system due to its crucial role in the global plate circuit. Magnetic anomaly identifications have been made in the following publications: *Croon et al*. [2008], *Larter et al*. [2002], *Wobbe et al*. [2012], and *Cande et al*. [1995]. Magnetic anomaly identifications for West Antarctic-Australia spreading in the Balleny corridor come from *Cande et al*. [2000], *Cande and Stock* [2004], and *Granot et al*. [2013], identifications from the Adare Trough representing spreading between East and West Antarctica come from *Cande et al*. [2000], *Davey et al*. [2006], and *Granot et al*. [2013], identifications around the Macquarie Ridge com from *Keller* [2004]. Finally, picks of Neogene period reversals from the northern end of the East Pacific Rise are included from *DeMets and Traylen* [2000].

Our preferred magnetic anomaly identifications for the southeast Pacific include a combination of the identifications from *Barckhausen et al*. [2013], *Cande and Haxby* [1991], *Handschumacher* [1976], *Munschy et al*. [1996], *Pardo-Casas and Molnar* [1987], *Mammerickx et al*. [1980], *Tebbens and Cande* [1997], and *Weissel et al*. [1977]. For the northeast Pacific, our preferred magnetic anomaly identifications consist of a combination of interpretations from *Atwater* [1989], *Bassinger et al*. [1969], *Elvers et al*. [1967, 1973], and *Vaquier et al*. [1961]. Our preferred set of magnetic anomaly identifications for the Pacific-Antarctic ridge includes a combination of *Croon et al*. [2008], *Wobbe et al*. [2012], and *Cande et al*. [1995] as well as a few identifications from the earlier part of seafloor spreading from *Larter et al*. [2002] for the Pacific-Antarctic spreading system. We use the recent magnetic anomaly identifications for East-West Antarctic motion from *Granot et al*. [2013], which significantly reduces uncertainties in rotation parameters to define this motion compared to *Cande et al*. [2000].



### 4.4. Backarc Basins and Marginal Seas

Seafloor spreading in back-arc basins and marginal seas produce identifiable magnetic anomalies even though spreading is often quite complex with chaotic seafloor spreading fabric, faster seafloor spreading rates, and shorter time sequences of activity. In the southwest Pacific, we have collated the magnetic anomaly identifications for the Tasman Sea [*Gaina et al*., 1998], Coral Sea [*Gaina et al*., 1999], and North Loyalty and South Fiji Basins [Sdrolias et al., 2003]. In southeast Asia, we incorporate the magnetic anomaly identifications for the South China Sea [*Briais et al*., 1993], Caroline Basin [*Gaina and Müller*, 2007] and the Parece Vela and Shikoku Basins [*Sdrolias et al*., 2004]. We have collated magnetic anomaly identifications for the Scotia Sea from *Barker and Burrell* [1977] and *Eagles et al*. [2005] for the Drake Passage and *Hill and Barker* [1980] for the Sandwich plate, eastern Scotia Sea.

## 5. Discussion and Conclusion

Plate tectonic motion models provide the framework to place features on the Earth's surface in their spatio-temporal context and are important for assessing global and regional geological relationships and

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processes. These models are underpinned by magnetic anomaly and fracture zone interpretations. In addition, some key models of real value to the community rely directly on the constraints provided by magnetic anomaly identifications, e.g., the age of the ocean floor [*Müller et al.*, 1997, 2008a], spreading rates and asymmetries [*Müller et al.*, 2008a; *Seton et al.*, 2009], predicted bathymetry [*Müller et al.*, 2008b], and heat flow and hydrothermal flux [Müller et al., 2013].

The open-access, community-driven infrastructure that we have developed provides access to these fundamental constraints for the broader community. Our infrastructure allows for studies requiring the assessment of alternative plate reconstructions to be achieved by nonspecialists or alternatively, for the specialist community to have access to previous interpretations of an area and assess which areas require further data collection and interpretation. We anticipate that the sample data provided with this infrastructure will be continuously updated and we strongly encourage the community to contribute their magnetic anomaly identifications to this effort.

**Acknowledgments**
We would like to extend thanks to the many researchers who have directly or indirectly contributed magnetic anomaly identifications to the wider community and the NGDC for hosting the marine magnetic anomaly data sets. MS and JMW would like to thank support from Statoil, MS for support from Australian Research Council (ARC) grant DP0987713, RDM and SEW for support from ARC grant FL0992245, and PW for support from US National Science Foundation grant 0752543. CG acknowledges the Geological Survey of Canada and Geological Survey of Norway for their support and access to digital magnetic databases.

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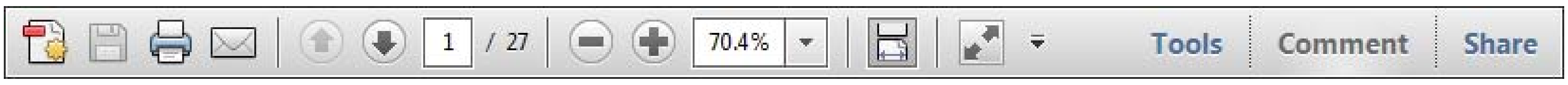


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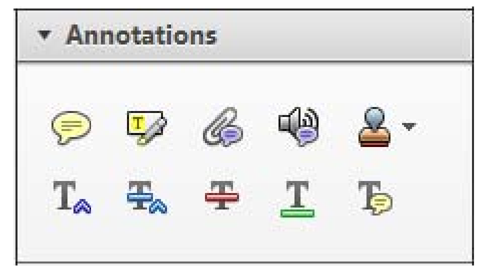


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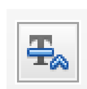

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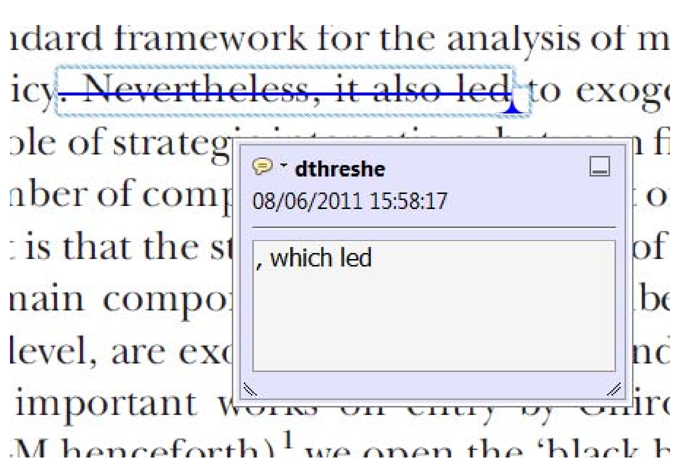
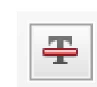
- Highlight a word or sentence.
- Click on the Replace (Ins) icon in the Annotations section.
- Type the replacement text into the blue box that appears.



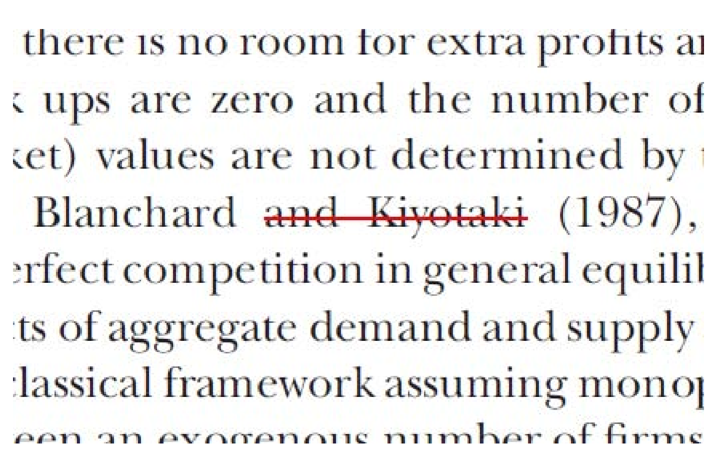

### 2. Strikethrough (Del) Tool – for deleting text.



Strikes a red line through text that is to be deleted.

**How to use it**

- Highlight a word or sentence.
- Click on the Strikethrough (Del) icon in the Annotations section.

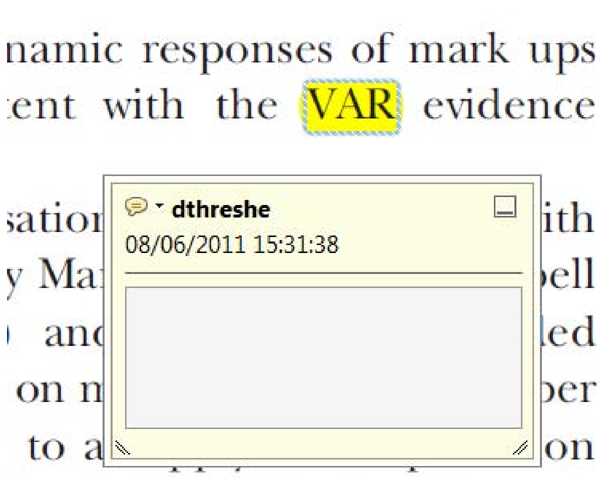


### 3. Add note to text Tool – for highlighting a section to be changed to bold or italic.

Highlights text in yellow and opens up a text box where comments can be entered.

**How to use it**

- Highlight the relevant section of text.
- Click on the Add note to text icon in the Annotations section.
- Type instruction on what should be changed regarding the text into the yellow box that appears.

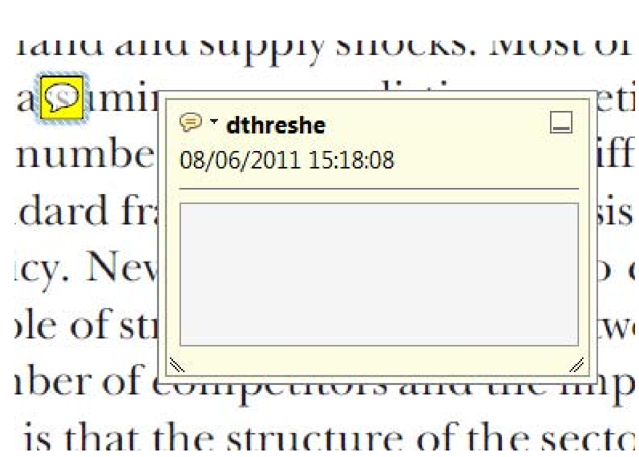



### 4. Add sticky note Tool – for making notes at specific points in the text.

Marks a point in the proof where a comment needs to be highlighted.

**How to use it**

- Click on the Add sticky note icon in the Annotations section.
- Click at the point in the proof where the comment should be inserted.
- Type the comment into the yellow box that appears.



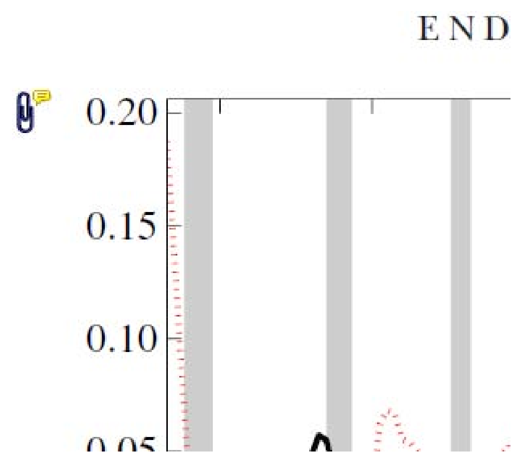
## USING e-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

### 5. Attach File Tool – for inserting large amounts of text or replacement figures.

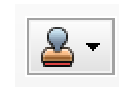
Inserts an icon linking to the attached file in the appropriate pace in the text.

**How to use it**

- Click on the Attach File icon in the Annotations section.
- Click on the proof to where you'd like the attached file to be linked.
- Select the file to be attached from your computer or network.
- Select the colour and type of icon that will appear in the proof. Click OK.



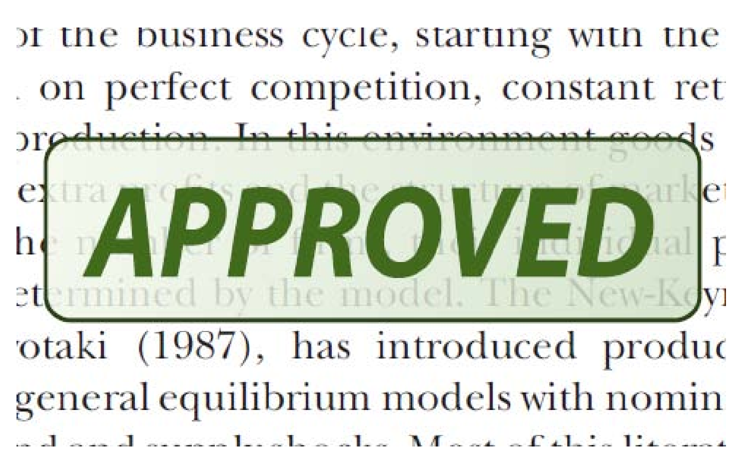

### 6. Add stamp Tool – for approving a proof if no corrections are required.

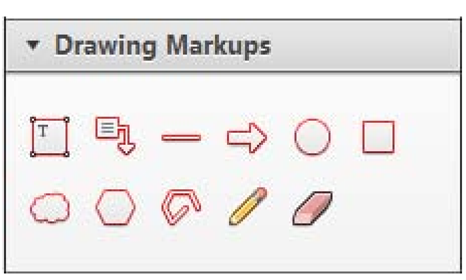


Inserts a selected stamp onto an appropriate place in the proof.

**How to use it**

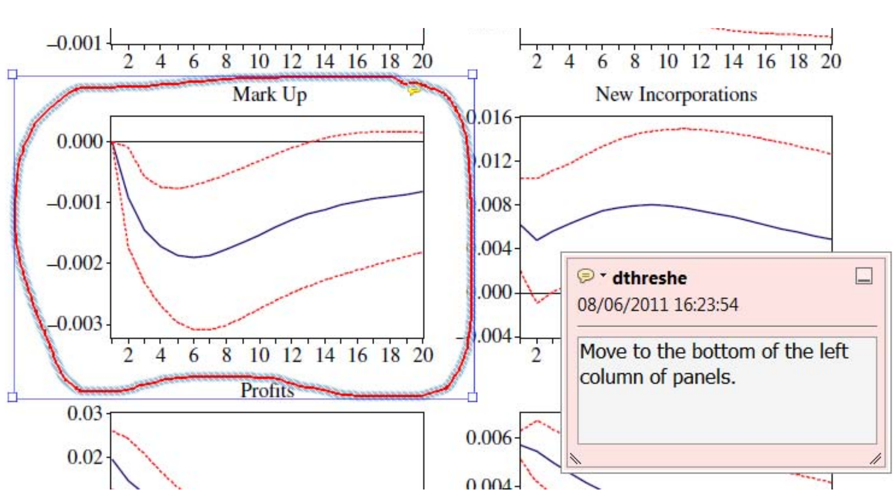
- Click on the Add stamp icon in the Annotations section.
- Select the stamp you want to use. (The Approved stamp is usually available directly in the menu that appears).
- Click on the proof where you'd like the stamp to appear. (Where a proof is to be approved as it is, this would normally be on the first page).




### 7. Drawing Markups Tools – for drawing shapes, lines and freeform annotations on proofs and commenting on these marks.

Allows shapes, lines and freeform annotations to be drawn on proofs and for comment to be made on these marks..




**How to use it**

- Click on one of the shapes in the Drawing Markups section.
- Click on the proof at the relevant point and draw the selected shape with the cursor.
- To add a comment to the drawn shape, move the cursor over the shape until an arrowhead appears.
- Double click on the shape and type any text in the red box that appears.

**For further information on how to annotate proofs, click on the Help menu to reveal a list of further options:**