GLOBAL EARTHQUAKE MODEL
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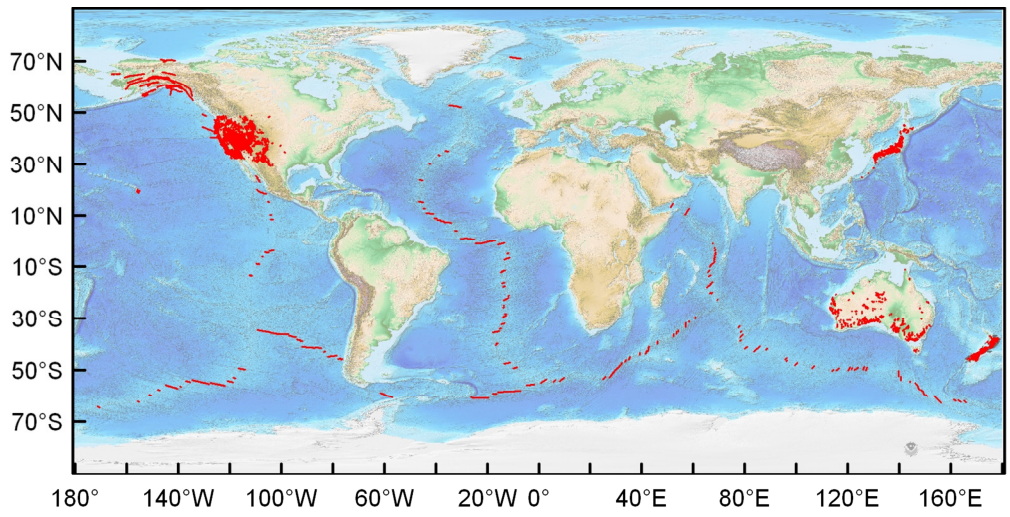
Bulk upload of national and global databases

Report produced in the context of the
GEM Faulted Earth



Version 1.0 – May 2013

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Bulk upload of national and global databases

GEM Faulted Earth

Deliverable 3: Populating the faults and folds layer and upload national seismic sources

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ABSTRACT

This report summarises the bulk upload of national and global active fault and fault source databases into the GEM Faulted Earth global active fault, fold, and fault source database, as at 31 May 2013 (v3.0.0). The report briefly describes the upload process and then for each database: (1) the data (and format) obtained or supplied; (2) the data that was uploaded (or omitted); (3) mapping of attributes from the supplied database to the GFE database; (4) any reformatting required; and (5) any additional data uploaded. The details of items (2) to (5) are contained in tables in the Appendices. The databases uploaded are: active fault databases of Japan, New Zealand, USA (mainland and Hawaii), Alaska and Australia, and fault source databases of New Zealand and global mid-ocean ridge transforms, although the latter also includes some limited active fault data. Not uploaded are global subduction thrusts or the Himalaya Frontal Thrust, which are being supplied to GEM independently. The upload process resulted in some minor modifications to the database schema, which have also been supplied to GEM independently. This report should be particularly useful for any subsequent bulk uploads of these databases.

Keywords: active fault database; fault source database; upload

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1 Introduction

This report summarises the bulk upload of national and global active fault and fault source databases into the GEM Faulted Earth global active fault, fold, and fault source database, as at 31 May 2013 (version 3.0.0; Figure 1.1). It does not include upload of global subduction thrusts or the Himalaya Frontal Thrust, which have been compiled in a slightly different format to the GFE database and are being supplied to GEM independently.

The upload process generally involved some manual reformatting of each database to match the GFE database schema (Thomas et al., 2012), with the actual upload being undertaken using an XML interchange (Thomas, 2012). This report focuses on the manual reformatting, since the latter is supplied in logs accompanying supply of the databases to GEM.

This report describes for each database uploaded to date: (1) the data (and format) obtained or supplied; (2) the data that was uploaded (or omitted); (3) mapping of attributes from the supplied database to the GFE database; (4) reformatting required; and (5) any additional data uploaded. Most of the details for (2) to (5) are contained in the Appendices. GFE attributes are defined by Litchfield et al. (2013) but note some of the attribute names differ slightly between that and this report, as some of the names were modified during development of the fault compilation tool.

The order of the report is in the order the databases were uploaded. The uploading process generally required some minor changes to the GFE database, which were logged and supplied to GEM independently (R. Thomas email communication, May 2013).

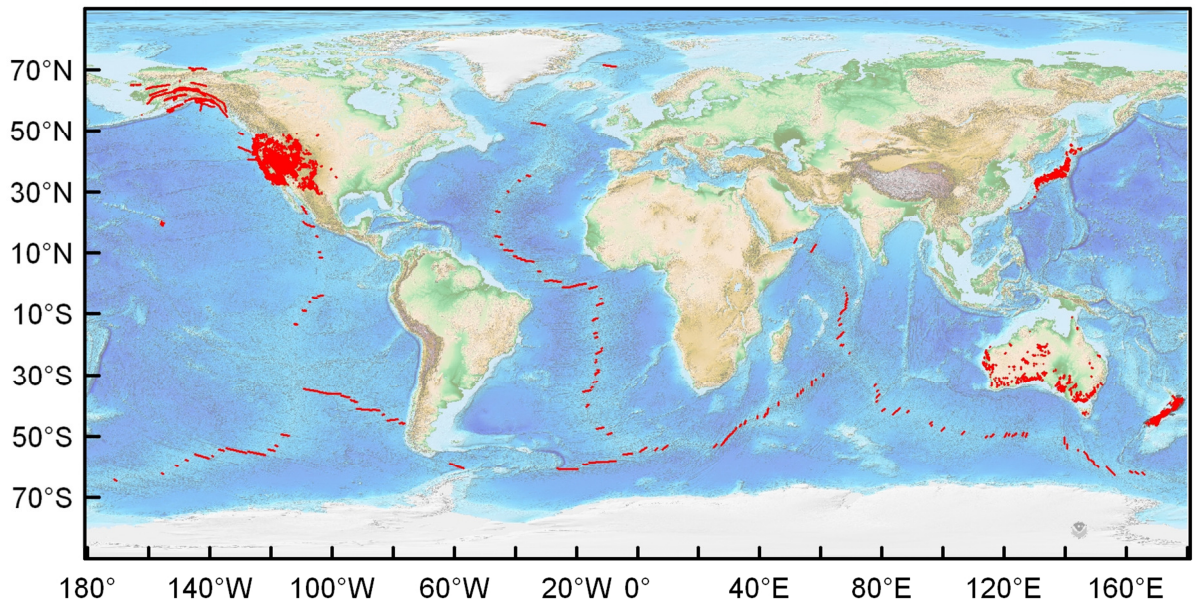

Figure 1.1 Active fault and fold traces, and fault source polygons (red) uploaded to the GFE database as at 31 May 2013

2 New Zealand active faults database

The New Zealand active faults database [1] is a GIS database and was uploaded in March 2012.

12,580 fault traces (there are no folds in the database) were uploaded (Figure 2.1). These are grouped into 377 sections and 344 faults, but the remaining traces (3040) were also uploaded as sections, as in the original New Zealand database.

Not surprisingly, given the GFE database was primarily designed by the authors, most of the attributes mapped exactly from the New Zealand active faults database to the GFE database (Appendix A).

Several attributes were not uploaded (e.g., net trend, earthquake depth), as they had been considered to be unnecessary detailed for inclusion in the GFE database, or are included in other GEM databases (e.g., Global Earthquake History). Most of the attributes not uploaded do not have data in the New Zealand database. Conversely, some extra attributes were added to the GFE database (e.g., aseismic-slip factor, upper seismogenic depth), which are not explicitly stored in the New Zealand active faults database.

Note a new, quality-checked and homogeneous scale (1:250,000) scale version of the database is currently in preparation and GNS Science would like to replace the version of the New Zealand active faults database loaded with this new version when it becomes available. It is currently scheduled for completion in mid 2014.

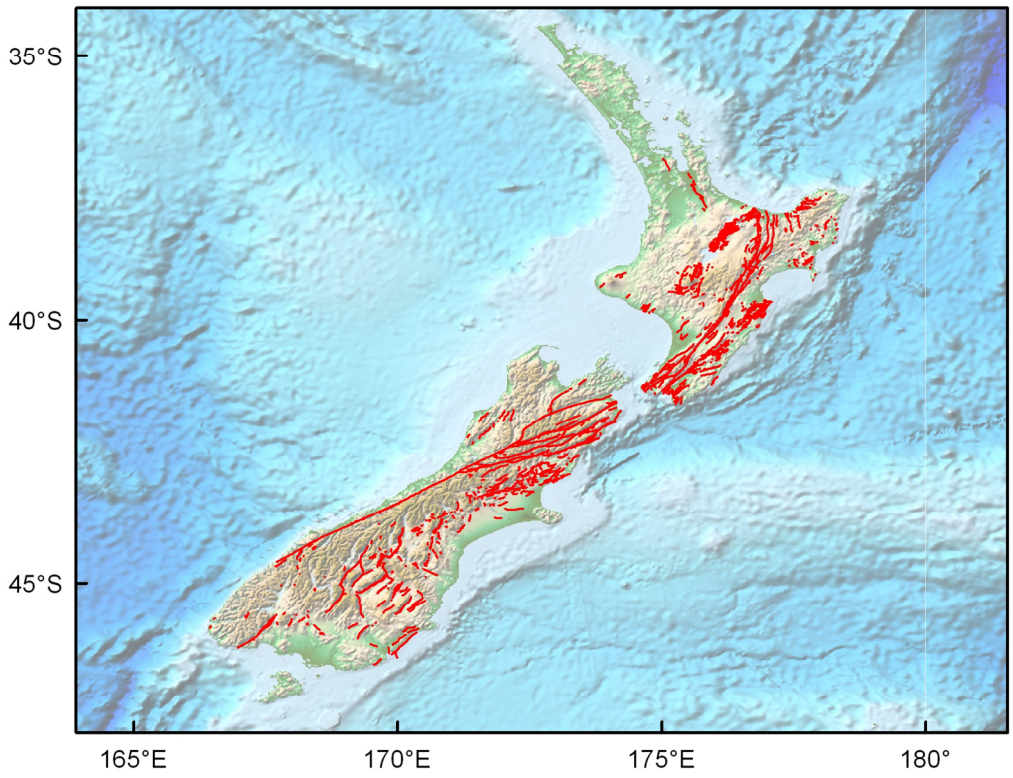

Figure 2.1 New Zealand active fault traces (red) uploaded to the GFE database

3 New Zealand National Seismic Hazard Model

The version of the New Zealand Seismic Hazard Model uploaded is the 2010 model published by Stirling et al. (2012). It was supplied in August 2011 as an excel spreadsheet (attributes) and shapefile of surface traces. The surface traces were then converted to polygons using code supplied by Roberto Basili and now included in the GFE fault compilation tool.

The model contained 537 sources (Figure 3.1), not including subduction zones, which were removed since subduction zones are being supplied to GEM independently.

As for the New Zealand active faults database, most attributes mapped exactly to GFE database attributes (Appendix B).

Some attributes were not uploaded because there were problems with the original data (e.g., minimum and maximum Magnitude and Recurrence Interval have not been quality checked and are sometimes inconsistent with the preferred values), or they are not included as attributes in the GFE database (seismic moment, single event displacement). In this case, the values are calculated as part of another calculation (magnitude, recurrence interval), so don't need to be stored separately. Compiler and Contributer attributes were added.

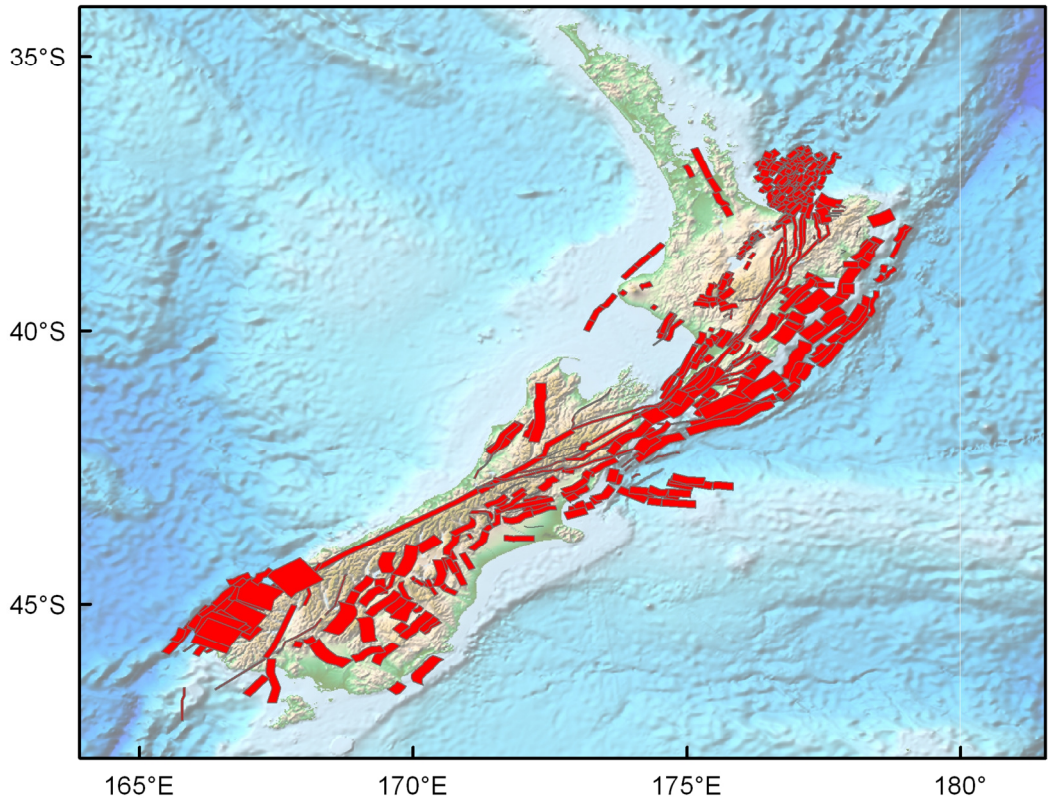

Figure 3.1 New Zealand fault source polygons (red) uploaded to the GFE database

4 Active fault database of Japan

The Active fault database of Japan [2] was supplied in December 2011 by email from Yoshioka Toshikazu, AIST (Geological Survey of Japan) to Kelvin Berryman. The database was supplied as an excel spreadsheet (attributes) and a Google Earth kmz file of fault polygons. The spreadsheet only contained key attributes; more attributes can be viewed on the database website [2].

The supplied database contained 559 fault sections, which were each mapped as a single polygon. All were uploaded and polygons were converted to surface traces (Figure 4.1). The sections were combined into 314 faults, as denoted by fault name. However, few attributes could be assigned to faults without significant input from the database owners. For example, slip rate was supplied for each section, but not for the whole fault, and so combining these would need input as to the appropriate combination method (e.g., averaging or assuming the highest slip rate).

Most of the mapping of the Japan database attributes to the GFE attributes was relatively straight forward (Appendix C), with useful information on attribute definitions and formats obtained from the Japan database website [2]. Some format conversions were necessary (e.g., upthrown side to downthrown side, dip direction from a quadrant to a bearing).

Some attributes were not uploaded because there were no equivalents in the GFE database. Many of these were alternative values (e.g., of slip rate, recurrence interval), and because a preferred value was supplied, this is what was uploaded. No attributes were added.

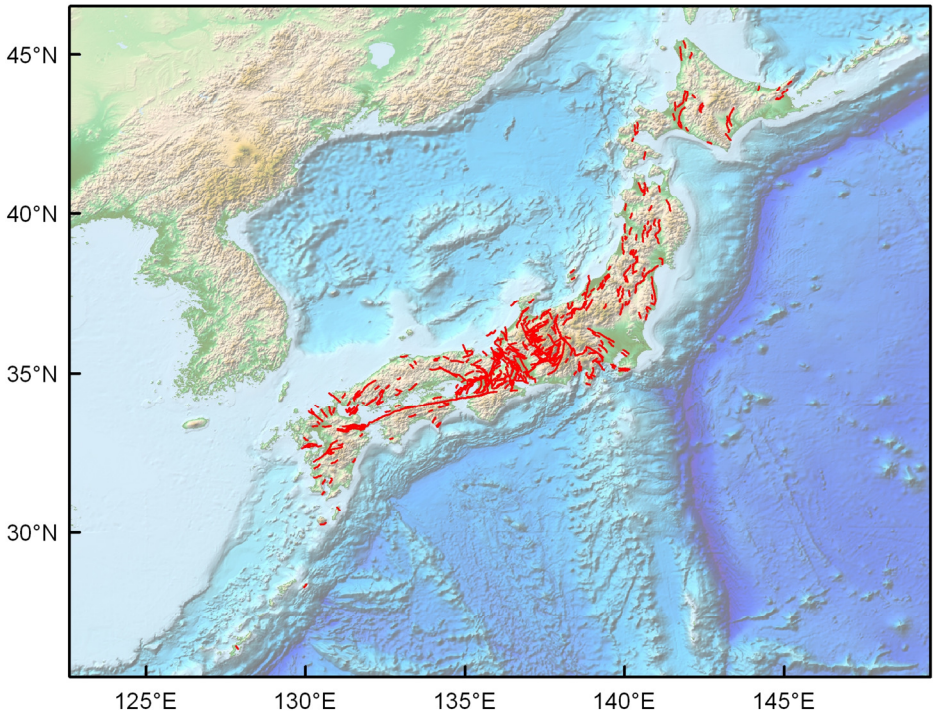

Figure 4.1 Active fault database of Japan traces uploaded to the GFE database

5 Alaska Quaternary faults and folds database

The Alaska Quaternary faults and folds database (Koehler et al., 2012) was downloaded from the database website [3] in August 2012. The data was in the format of a shapefile containing 1527 traces, with attributes for each trace. One fault cuts across the Canadian border.

The database contained subduction thrusts and seismic zones, which were not uploaded (Figure 5.1), since these are being supplied to GEM independently. The database also contained both faults and folds, and these were separated out using the name and Id number (NUM).

The remaining 1516 traces (Figure 5.1) were combined into 118 fault sections and 33 fold sections as defined by section names (given in brackets). The sections were then combined into 94 faults and 30 blind faults. Synclines were included as folds, but not as blind faults. Where individual traces of a section, or sections of a fault, had different attributes, these were combined by: (1) assigning the most common value (dip, dip direction, slip type); (2) assigning the youngest value (age of last movement); or (3) the highest value (slip rate).

Most of the Alaska database attributes mapped reasonably readily to the GFE attributes, with some assistance from Richard Koehler (e.g., geomorphic expression) (Appendix D). The exceptions were codes, which were not uploaded as codes are simply numbers derived from other attributes, and thus are duplicates. For example, the ACode is a number derived from Age, where 1 is <150, 2 is <15,000 etc. In this case Age, but not ACode was uploaded. Some format conversion was required (e.g., categories to values, spelling out abbreviations). Some attributes were added in consultation with Richard Koehler (e.g., upper seismogenic depth, aseismic-slip factor).

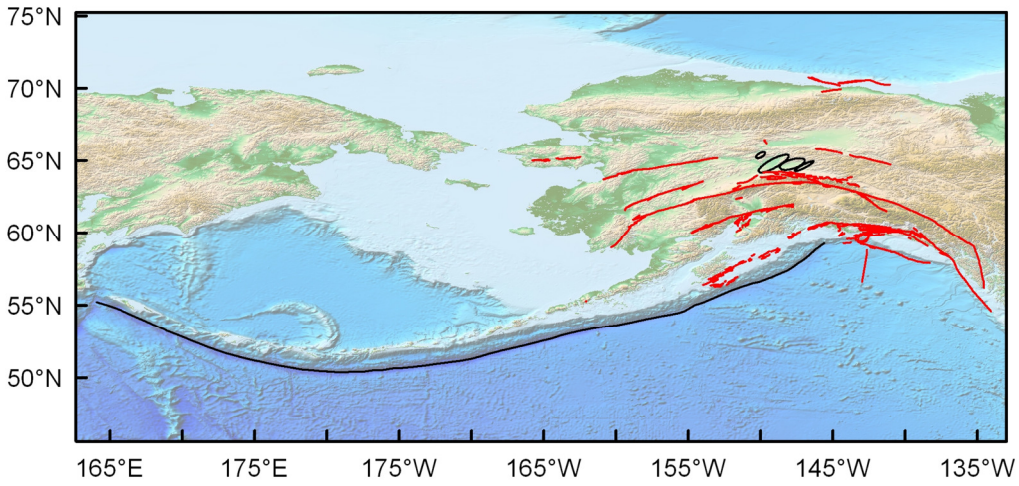

Figure 5.1 Alaska fault and fold traces (red) uploaded to the GFE database. Traces not uploaded are shown in black.

6 USA Quaternary fault and fold database

The USA Quaternary faults and folds database (Machette et al., 2005) was downloaded from the database website [4] in February 2013. The website states that the data was last updated 3 November 2010. The format was the same as the Alaska database – a shapefile containing 10,021 traces, with attributes for each trace. Many traces were grouped together as multi-part features however, and so had to be ungrouped. The database covers the mainland USA (not including Alaska) and Hawaii (Figure 6.1). The data available for download on the website is not the entire contents of the USA database – there are additional information, particularly descriptions, available on the website.

The database contained the Cascadia subduction thrust, which was not uploaded (Figure 6.1), since subdction thrusts are being supplied to GEM independently. Fault areas were also not uploaded (Figure 6.1) as they were not included in the GFE database design and are considered to be included in other GEM databases (e.g., Global Instrumental Earthquake Catalogue). The database contained both faults and folds, and these were separated out using the name and Id number (NUM).

The remaining 10,005 traces (83,591 when ungrouped) were combined into 3188 fault sections and 35 folds using the ID number (NUM – letters denote sections). Where individual sections of a fault had different attributes, these were combined by either: (1) assigning the most common value (dip, dip direction, slip type); (2) assigning the youngest value (age of last movement); or (3) the highest value (slip rate). If was not possible to use these assumptions (e.g., there were commonly conflicting dip directions), then the attributes were not uploaded. Combined attributes were also checked against the values reported on the database website.

The attribute mapping (Appendix E) was essentially the same as for the Alaska database. However, in this case no single compiler could be added (i.e., the data were compiled by many un-named people), and so “USA compiler” was uploaded as a nominated person instead.

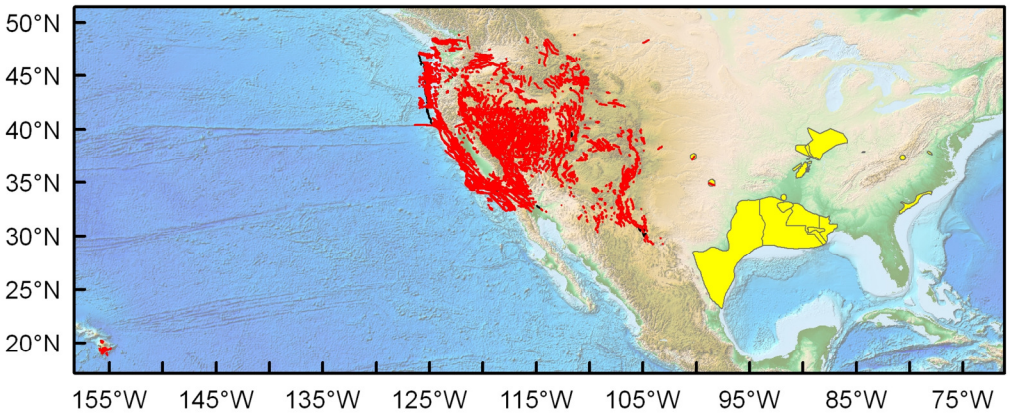

Figure 6.1 USA active fault and fold traces uploaded to the GFE database (red). Traces not uploaded are shown in black, and fault areas not uploaded in yellow.

7 Australia neotectonic feature database

The Australia neotectonic feature database [5] was supplied in April 2013 by email from Andrew McPherson, Geoscience Australia, to Nicola Litchfield. The database consisted of an excel spreadsheet (attributes of each fault) and a shapefile of 1381 traces. The database is notable for having the greatest number of populated attributes of all those uploaded, including significant descriptions of many attributes. These included many more faults and attributes than are available on the website.

Two neotectonic features (Michelago sediment deformation and Narongo Fault) were removed from the database because, after consultation with Dan Clark (Geoscience Australia), they had a confidence level of none, meaning there is no evidence of activity.

1336 traces were uploaded (Figure 7.1). These were combined into 294 sections and 44 folds. No sections were identified in the original data, so sections were duplicated as faults.

Mapping of attributes was relatively straight forward (Appendix F), although as noted above, the Australia database contains many descriptions, most of which had to be combined into notes or synopses. Some format conversion was needed, much of which was done in consultation with Dan Clark (e.g., converting geological periods into years before present, converting slip rate categories into minimum and maximum values). Aseismic slip factor and upper seismogenic depth were added in consultation with Dan Clark.

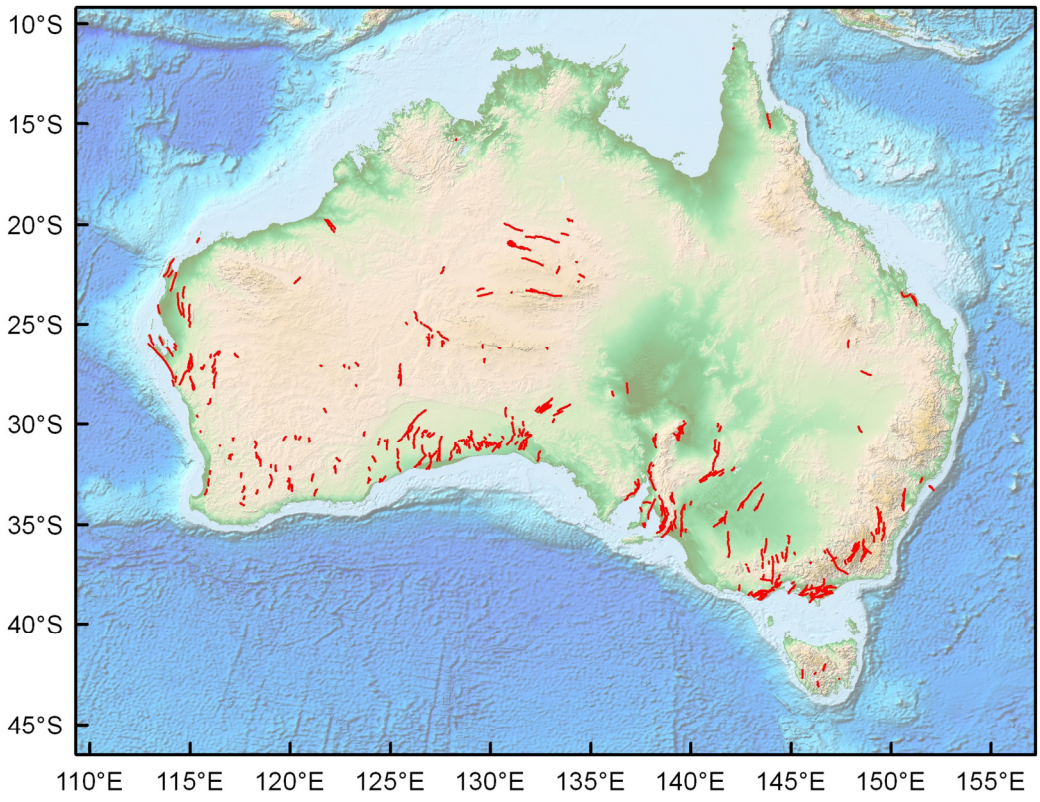

Figure 7.1 Australia active fault traces (red) uploaded to the GFE database

8 Mid-ocean ridge transform database

The global mid-ocean ridge transform database was supplied in April 2013 by email from Monica Wolfson-Schwehr, University of New Hampshire, to Nicola Litchfield. The database is an unpublished, updated version of that of Boettcher and Jordan (2004). The data format was an excel spreadsheet (attributes) and a shapefile of traces.

This database is considered to primarily be a fault source database, but some of the data was supplied as sections, so the data was uploaded as sections, faults, and fault sources. Sections were defined in the original database by highlighting and are defined as: if they are separated by an intra-transform offset that is shorter than either of the two adjacent fault segments and shorter than a maximum length of 50 km (Readme notes accompanying the database). 201 traces (Figure 8.1) were combined into 147 faults and 147 fault sources.

Attribute mapping was relatively straight forward (Appendix G), with some reformatting required (e.g., spelling out tectonic regions). Several attributes were not uploaded because they were either not required (e.g., latitude, longitude) or are part of calculations (e.g., seismic moment). Several attributes were added from the notes supplied with the database (e.g., slip rate and recurrence interval description), or in consultation with Monica Wolfson-Schwehr (e.g., dip, magnitude description).

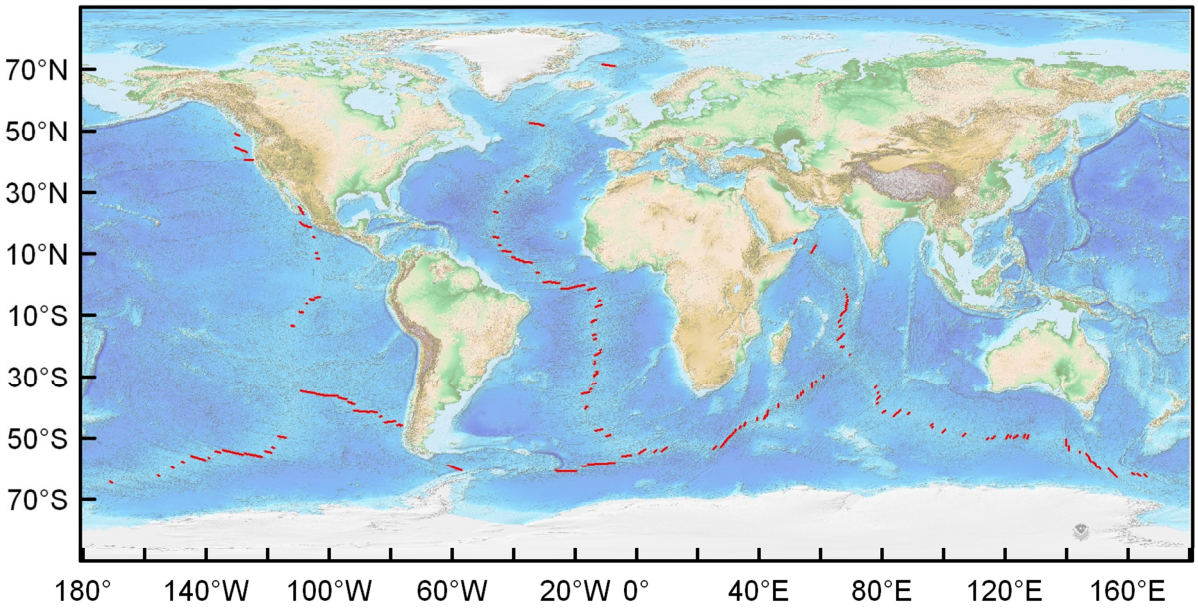

Figure 8.1 Mid-ocean ridge transform traces and sources (red) uploaded to the GFE database. Traces and sources appear identical because all are vertical.

REFERENCES

Document References

Boettcher, M.S., Jordan, T.H. [2004]. Earthquake scaling relations for mid-ocean ridge transform faults. *Journal of Geophysical Research,* Vol. 109, B12303, doi:10.1029/2004JB003110.

Koehler, R.D., Farrell, R.-E. Burns, P.A.C., Combellick R.A. [2012]. Quaternary faults and folds in Alaska: A digital database. *Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication,* Vol. 141.

Litchfield, N., Berryman, K., Thomas, R. [2013]. *Data Dictionary*, GEM Faulted Earth, Available from www.nexus.globalquakemodel.org/gem-faulted-earth/posts/

Machette, M., Haller, K., Wald, L. [2004] "Quaternary Fault and Fold Database for the Nation", *United States Geological Survey Fact Sheet*, Vol. 2004-3033.

Stirling, M., McVerry, G., Gerstenberger, M., Litchfield, N., Van Dissen, R., Berryman, K. Barnes, P., Wallace, L., Bradley, B., Villamor, P., Langridge, R., Lamarche, G., Nodder, S., Reyners, M., Rhoades, D., Smith, W., Nicol, A., Pettinga, J., Clark, K., Jacobs K. [2012]. National Seismic Hazard Model for New Zealand: 2010 Update. *Bulletin of the Seismological Society of America*, Vol. 102, pp. 1514-1542.

Thomas, R. [2012]. *GEM Faulted Earth Database XML Interchange*, GEM Faulted Earth, Available from www.nexus.globalquakemodel.org/gem-faulted-earth/posts/

Thomas, R., Litchfield, N., Christophersen, A. [2012]. *GEM Faulted Earth Database Design*, Available from www.nexus.globalquakemodel.org/gem-faulted-earth/posts/

Website references

1. New Zealand active faults database
[Available at http://riodb02.ibase.aist.go.jp/activefault/index_e.html]

2. Active fault database of Japan
[Available at http://riodb02.ibase.aist.go.jp/activefault/index_e.html]

3. Alaska Quaternary faults and folds
[Available at http://www.dggs.alaska.gov/pubs/id/24956]

4. USA Quaternary faults and folds
[Available at http://earthquake.usgs.gov/hazards/qfaults/]

5. Australia neotectonic features

[Available at http://www.ga.gov.au/earthquakes/staticPageController.do?page=neotectonics]

APPENDIX A New Zealand active faults database (afdb) – attribute mapping, formatting and upload

New Zealand afdb attribute	GFE database table	GFE database attribute	Comments
Feature ID	Section, Fault	Original ID	
Feature name	Trace, Section, Fault	Name	
Dominant sense	Section, Fault	Slip type	
Subordinate sense	Section, Fault	Slip type	Combined with dominant sense as a single attribute
Down Quadrant	Section, Fault	Downthrown side	
Dip	Section, Fault	Dip – pref, min, max	
Dip direction	Section, Fault	Dip direction	
Net trend			Not uploaded because no equivalent GFE attribute.
Net plunge			Not uploaded because no equivalent GFE attribute.
Strike displacement			Not uploaded because no equivalent GFE attribute.
Strike time			Not uploaded because no equivalent GFE attribute.
Strike slip rate	Section, Fault	Strike slip rate – pref, min, max	
Strike events			Not uploaded because no equivalent GFE attribute.
Strike single event displacement			
Vertical displacement			Not uploaded because no equivalent GFE attribute.

New Zealand afdb attribute	GFE database table	GFE database attribute	Comments
Vertical time			Not uploaded because no equivalent GFE attribute.
Vertical slip rate	Section, Fault	Vertical slip rate – pref, min, max	
Vertical events			Not uploaded because no equivalent GFE attribute.
Vertical single event displacement			
Dip displacement			Not uploaded because no equivalent GFE attribute.
Dip time			Not uploaded because no equivalent GFE attribute.
Dip slip rate			
Dip events			Not uploaded because no equivalent GFE attribute.
Dip single event displacement			
Net displacement			
Net time			Not uploaded because no equivalent GFE attribute.
Net slip rate	Section, Fault	Net slip rate – pref, min, max	
Net events			
Net single event displacement	Section, Fault	Displacement – pref, min, max	
Recurrence interval	Section, Fault	Recurrence Interval – pref, min, max	
Last event	Section, Fault	Age of last movement – pref, min, max	
Bibliographic ID			

New Zealand afdb attribute	GFE database table	GFE database attribute	Comments
Method	Trace	Scale	
Method accuracy			Not uploaded because no equivalent GFE attribute.
Accuracy			Not uploaded because is incorporated into Geomorphic Expression.
Expression	Trace	Geomorphic expression	
Zone			Not uploaded because no equivalent GFE attribute.
Age			
Earthquake name			Not uploaded because no equivalent GFE attribute.
Earthquake date			Not uploaded because no equivalent GFE attribute.
Earthquake magnitude			Not uploaded because no equivalent GFE attribute.
Earthquake depth			Not uploaded because no equivalent GFE attribute.
Rupture type			Not uploaded because no equivalent GFE attribute.
Rupture length			Not uploaded because no equivalent GFE attribute.
Last event strike displacement			Not uploaded because no equivalent GFE attribute.
Last event dip displacement			Not uploaded because no equivalent GFE attribute.
Other information			
Date			
Source			
Owner			
-	Trace	Accuracy	
-	Section, Fault	Aseismic-slip factor	Added 0 for all sections/faults as there is no evidence of creep on any New

New Zealand afdb attribute	GFE database table	GFE database attribute	Comments
			Zealand active faults.
-	Section, Fault	Is active	Added t (true) for all sections/faults as all faults in the database are considered active.
-	Section, Fault	Is episodic	Added f (false) for all sections/faults as no faults in the database are considered episodic. This is not strictly true, as some Otago faults may be, but this data is incomplete and not compiled.
-	Section, Fault	Upper seismogenic depth – pref, min, max	Added 0 for all sections/faults as all faults in the database reach the ground surface.
-	Section, Fault	Created date	Added the date the upload was completed.
-	Section, Fault	Modified date	Added the date the upload was completed.
-	Section, Fault	Compiler	Added Nicola Litchfield as the compiler. Is not strictly true, but Nicola compiled most of the attributes when she was database administrator (2004-2008).

APPENDIX B New Zealand National Seismic Hazard Model (NSHM) – attribute mapping, formatting and upload

New Zealand NSHM attribute	GFE database table	GFE database attribute	Comments
Fault	Source	Name	Expanded the abbreviated names
Sense	Source	Slip type	Spelled out: ss= dextral; nn=nv=normal; rv=reverse; sr=dextral-reverse; sn=dextral-normal; rs=reverse-dextral; ns=normal-dextral.
Sense index	Source		Not uploaded because no equivalent GFE attribute.
Length min	Source	Length – min	
Length pref	Source	Length – pref	
Length max	Source	Length – max	
Dip min	Source	Dip – min	
Dip pref	Source	Dip – pref	
Dip max	Source	Dip – max	
Dip direction	Source	Dip direction	
Depth min	Source	Lower seis depth – min	
Depth pref	Source	Lower seis depth – pref	
Depth max	Source	Lower seis depth – max	
Top	Source	Upper seis depth – pref	
Slip rate min	Source	Net slip rate – min	
Slip rate pref	Source	Net slip rate – pref	

New Zealand NSHM attribute	GFE database table	GFE database attribute	Comments
Slip rate max	Source	Net slip rate – max	
Width min	Source	Width – min	
Width pref	Source	Width – pref	
Width max	Source	Width – max	
Area min	Source	Area – min	
Area pref	Source	Area – pref	
Area max	Source	Area - max	
Magnitude min			Not uploaded because are some problems in the calculations in the original database.
Magnitude pref	Source	Maximum magnitude – pref	
Magnitude max			Not uploaded because are some problems in the calculations in the original database.
Moment min			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Moment pref			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Moment max			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Single event displacement min			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Single event displacement pref			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Single event displacement max			Not uploaded because no equivalent GFE attribute (is part of a calculation).
Recurrence interval min			Not uploaded because are some problems in the calculations in the original database.

New Zealand NSHM attribute	GFE database table	GFE database attribute	Comments
Recurrence interval pref	Source	Recurrence interval - pref	
Recurrence interval max			Not uploaded because are some problems in the calculations in the original database.
-	Source	Compiler	Added Nicola Litchfield as the compiler. Is not strictly true in that others were involved too, but Nicola was involved in compiling nearly all sources.
-	Source	Contributer	Added Mark Stirling as the contributer. Is not strictly true as there are many contributers to the 2010 model, but Mark undertook all calculations.

APPENDIX C Active fault database (afdb) of Japan – attribute mapping, formatting and upload

Afdb Japan attribute	GFE database table	GFE database attribute	Comments
Fault no.	Fault	Original Id	
Fault name	Fault	Name	
Fault length	Fault	Length - pref	
Section name	Section	Name	
Section no.	Trace, Section	Original Id	
Section length	Section	Length – pref	
Seismic depth upper	Section	Upper seismogenic depth – pref	
Seismic depth lower	Section	Lower seismogenic depth - pref	
Strike N to E	Section	Strike	Converted to 0-360°
Dip degree	Section	Dip – preferred	
Dip direction	Section	Dip direction	Converted from a quadrant to a bearing in degrees: N = 0°, E = 90°, S = 180°, W = 270°. V (vertical) was left blank.
Slip type	Section	Slip type	Spelled out: N = normal, R = reverse, SL = sinistral, SR = dextral

Afdb Japan attribute	GFE database table	GFE database attribute	Comments
Upthrown side	Section	Downthrown side	Converted to opposite quadrant.
Slip rate vertical min	Section	Vertical slip rate - min	
Slip rate vertical max	Section	Vertical slip rate - max	
Slip rate horizontal min	Section	Strike slip rate - min	
Slip rate horizontal max	Section	Strike slip rate - maximum	
Slip rate net min	Section	Net slip rate - min	
Slip rate net max	Section	Net slip rate - max	
Slip rate net ave			Not uploaded in favour of Slip rate adopted.
Slip rate D/R			Not uploaded because no equivalent GFE attribute. Very few values supplied.
Slip rate geomorphic expression			Not uploaded because no equivalent GFE attribute available. Most values identical to Slip rate adopted values.
Slip rate adopted	Section	Net slip rate - pref	
Aseismic-slip factor	Section	Aseismic-slip factor	
Displacement min	Section	Displacement - min	
Displacement max	Section	Displacement - max	
Displacement ave			Not uploaded in favour of Displacement adopted.
Displacement surface rupture			Not uploaded because no equivalent GFE attribute. Most values identical to Displacement adopted values.
Displacement S/R			Not uploaded because no equivalent GFE attribute. Most values identical to Displacement adopted values.
Displacement scaling law			Not uploaded because no equivalent GFE attribute. Most values identical to Displacement adopted values.

Afdb Japan attribute	GFE database table	GFE database attribute	Comments
Displacement (adopted)	Section	Displacement - pref	
Recurrence interval min	Section	Recurrence interval - min	
Recurrence interval max	Section	Recurrence interval - max	
Recurrence interval ave			Not uploaded in favour of Recurrence interval adopted.
Recurrence interval D/S			Not uploaded because no equivalent GFE attribute. Most values identical to Recurrence interval adopted values.
Recurrence interval adopted	Section	Recurrence interval - pref	
Age of last movement oldest	Section	Age of last movement – max	Changed from AD/BC to a number relative to 1950 AD.
Age of last movement youngest	Section	Age of last movement - min	Changed from AD/BC to a number relative to 1950 AD.
Age of last movement historical record	Section	Age of last movement – pref	Changed from AD/BC to a number relative to 1950 AD.
Compiled by	Section, Fault	Compiled by	
Last updated	Section, Fault	Last updated	

APPENDIX D Alaska Quaternary fault and fold database (Qffdb) – attribute mapping, formatting and upload

Alaska Qffdb attribute	GFE database table	GFE database attribute	Comments
Name	Fault trace, Fold trace, Section, Fault, Fold, Blind Fault	Name	Many names were accompanied by another name in brackets. Some were section names, so were separated out as such. Others were fault system or individual fault names, which were uploaded in notes. Blind fault names were created by adding “fault” after the associated fold name. Those parts of the Denali Fault and Toschunda sections which ruptured in 2002 had “2002 rupture” added to them.
Code			Not uploaded as is a duplicate (combination) of other codes (ACode, Slip Code, FCode), which in turn are duplicates or other attributes
Num	Fault trace, Fold trace, Section, Fault, Fold, Blind Fault	Original Id	Some typos corrected. A few which had the same NUM and yet different names and were geographically separated, so were assigned new numbers.
Age	Section, Fault, Fold	Age of last movement – max	Did not upload “Class B” age
Acode			Not uploaded as is a duplicate of Age

Alaska Qffdb attribute	GFE database table	GFE database attribute	Comments
Slip rate	Section, Fault, Fold, Blind fault	Section, Fault: Net slip rate – min, max Fold: Growth rate – vertical – min, max Blind Fault: Vertical slip rate – min, max	Converted from a category (<0.2, 1-2 etc) to min and/or max values. Because all the slip rates supplied for folds are vertical, these were duplicated as fold growth rate and vertical blind fault slip rate.
Slip code			Not uploaded as is a duplicate of slip rate
Slip sense	Fault, Section, Blind Fault	Slip type	Spelled out, assumed: LL = Left lateral; N = normal; R = Reverse, RL = Right lateral; SS = strike-slip; T = thrust; Unk = Unknown (left this blank).
Dip direction	Fault, Section	Dip direction	Converted from a quadrant to a bearing in degrees: North = 0°, East = 90°, South = 180°, West = 270° etc. Some had two dip directions, but were modified in consultation with Richard Koehler.
FCode			Not uploaded as is a duplicate of Ftype
Ftype	Trace (section/fault and fold)	Geomorphic expression	Ftpe (and FCode) reflect the accuracy of mapping of the original authors (1 = fault landforms are more continuous than discontinuous and mapping is accurate at given MAPPED SCALE (solid); 2 = fault landforms are more discontinuous than continuous and mapping is accurate at given MAPPED SCALE (dashed); 3 = location of fault is inferred (dotted) After consultation with Richard Koehler, mapped this to section/fault geomorphic expression: 1 = surface trace, 2 = eroded scarp, 3 = concealed. Richard Koehler provided some values for individual folds.
Mapped Scale	Trace	Scale	Spelled out abbreviated number by adding 3 zero's to end.

Alaska Qffdb attribute	GFE database table	GFE database attribute	Comments
Secondary sense			Combined with slip sense
-	Section, Fault, Fold, Blind Fault	Compiled by	Added Richard Koehlers name for all faults and folds after consultation with him
-	Section, Fault, Fold, Blind Fault	Last Updated	Added date downloaded for all faults and folds after consultation with Richard Koehler that there had been no updates since then.
-	Section, Fault, Fold, Blind Fault	References	Added Koehler et al. (2012) report reference for all folds and faults.
-	Section, Fault	Upper seismogenic depth	Added after consultation with Richard Koehler
-	Section, Fault, Blind Fault	Aseismic-slip factor	Added after consultation with Richard Koehler, who said there is little data for creep on any Alaskan faults.
-	Fold	Fold type	Derived from the name
-	Blind Fault	Name	Added “fault” after the fold name (e.g., Beaver Creek Anticline “Fault”)
-	Trace	Accuracy	Calculated by multiplying the scale by 2.

APPENDIX E USA Quaternary fault and fold database (Qffdb) – attribute mapping, formatting and upload

USA Qffdb attribute	GFE database table	GFE database attribute	Comments
Name	Fault trace, Fold trace, Section, Fault, Fold, Blind Fault	Name	Note there are several faults with the same name. A very few were typos, but most are genuinely the same name (are geographically separated and have different Num = ID's).
Code			Not uploaded as is a duplicate (combination) of other codes
Num	Trace, Section, Fault, Fold	Original Id	Some typos corrected.
Age	Section, Fault, Fold	Age of last movement – max	Did not upload "Class B" age. Where different traces of the same section/fault have different values, chose the youngest.
Acode			Not uploaded as is a duplicate of Age
Slip rate	Section, Fault, Fold, Blind fault	Section, Fault: Net slip rate – min, max Fold: Growth rate – vertical – min, max Blind Fault: Vertical slip rate – min, max	Converted from a category (<0.2, 1-2 etc) to min and/or max values
Slip code			Not uploaded as is a duplicate of slip rate
Slip sense	Fault, Section, Blind Fault	Slip type	Spelled out, assumed: AC = Anticline; LL = Left lateral; MC = Monocline; N = normal; R = Reverse, RL = Right lateral; SC = Syncline; SS = strike-slip; T = thrust; Unk = Unknown (left this blank).

USA Qffdb attribute	GFE database table	GFE database attribute	Comments
			Where different traces of the same section/fault have different values, chose the most common and/or checked the value on the website.
Dip direction	Fault, Section	Dip direction	Converted from a quadrant to a bearing in degrees: North = 0°, East = 90°, South = 180°, West = 270° etc. If traces dip in opposite directions, checked value on website or (especially if a graben), deleted direction.
FCode			Not uploaded as is a duplicate of Ftype
Ftype	Trace (section/fault and fold)	Geomorphic expression	After consultation with Kathy Haller: For Sections/FaultsWell constrained = surface trace, Moderately constrained = subtle feature, Inferred = concealed. Folds assumed the same as the Alaska database.
Mapped Scale	Trace	Scale	
Secondary sense			Combined with slip sense
-	Section, Fault, Fold, Blind Fault	Last Updated	Added date noted on USGS website (3 Nov 2010).
-	Section, Fault, Fold, Blind Fault	References	Added USGS (2013) as instructed on the USGS website
-	Section, Fault	Upper seismogenic depth	Added assuming as for Alaska database
-	Fold	Fold type	Derived from the name
-	Blind Fault	Name	Added “fault” after the fold name (e.g., Beaver Creek Anticline “Fault”)
-	Trace	Accuracy	Calculated by multiplying the scale by 2.

APPENDIX F Australia neotectonic feature database (nfdb) – attribute mapping, formatting and upload

Australia nfdb attribute	GFE database table	GFE database attribute	Comments
Entity number	Fault trace, Fold trace, Section, Fault, Fold, Blind Fault	Original Id	
Name	Fault trace, Fold trace, Section, Fault, Fold, Blind Fault	Name	
Feature type			Not uploaded, but used to separate faults and folds
Originator	Section, Fault, Fold	Contributed by	
Compilation date	Section, Fault, Fold, Blind fault	Created date	
Compiler name	Section, Fault, Fold, Blind Fault	Compiled by	
Last update	Section, Fault, Fold, Blind fault	Last updated	

Australia nfdb attribute	GFE database table	GFE database attribute	Comments
Updated by			Not uploaded because no equivalent GFE attribute.
QA date			Not uploaded because no equivalent GFE attribute.
QA by			Not uploaded because no equivalent GFE attribute.
QA status code			Not uploaded because no equivalent GFE attribute.
Access code			Not uploaded because no equivalent GFE attribute. Used by GA to denote which are shown on their website.
Activity code			Not uploaded because no equivalent GFE attribute.
Confidence level	Section, Fault, Fold	Data completion factor	Following consultation with Dan Clark, mapped these as: Definite = 1 (High); High = 2 (Moderate); Moderate = 3 (Low). Two features with confidence level none were deleted as discussed above.
Domain	Section, Fault, Fold	Notes	
Latitude			Not uploaded because faults and fold locations are denoted by their traces.
Longitude			Not uploaded because faults and fold locations are denoted by their traces.
Location method	Fault trace, Fold trace	Location method	
Location remark	Section, Fault, Fold	Synopsis	
Location precision	Fault trace, Fold trace		Not uploaded because no equivalent GFE attribute.
Synopsis	Section, Fault, Fold	Notes	
Geological setting	Section,	Notes	

Australia nfdb attribute	GFE database table	GFE database attribute	Comments
	Fault, Fold		
Geomorphic expression	Fault trace, Fold trace	Notes	
Length	Section, Fault, Fold	Length - pref	
Displacement	Section, Fault, Fold	Total displacement	Converted from metres to kilometres. Note this is a vertical, not a net displacement.
Sense of movement	Section, Fault, Fold	Slip type	
Average strike	Section, Fault, Fold	Strike	
Dip	Section, Fault, Blind fault	Dip	
Direction of dip	Section, Fault, Blind fault	Dip direction	Converted from a quadrant to a bearing in degrees: North = 0°, East = 90°, South = 180°, West = 270° etc.
Historic events	Section, Fault	Historical earthquake	Converted calendar date to number relative to 1950
Prehistoric events	Section, Fault, Fold	Pre-historical earthquake – min, max	Converted kiloyears (ka) into years BP and from a range to min and max values. Some were given as an incomplete range, but confirmed with Dan Clark that these are minimum values.
Seismicity remarks	Section, Fault, Fold	Event descriptions	
Largest single event	Section, Fault	Displacement - pref	

Australia nfdb attribute	GFE database table	GFE database attribute	Comments
displacement			
Age of youngest deformed deposit	Section, Fault, Fold, Blind fault	Age of last movement – max	Converted into yrs BP from geological period using the IUGS ages as follows: Holocene = 11,700; Late Pleistocene = 126,000; Middle Pleistocene = 781,000; Pleistocene = 2,588,000; Quaternary = 2,588,000; Pliocene = 5,332,000; Early Pliocene = 5,332,000; Late Miocene = 11,608,000.
Deformed deposit description	Section, Fault, Fold	Marker age description	
Slip rate category	Section, Fault, Fold, Blind fault	Section, Fault: Net slip rate – min, max Fold: Growth rate – vertical – min, max Blind Fault: Vertical slip rate – min, max	Converted from a category (<0.01, 0.01-0.1 etc) to min and/or max values
Slip rate remarks	Section, Fault, Fold	Slip rate description	
Bibliographic references	Section, Fault, Fold	References	
-	Section, Fault, Blind Fault	Aseismic-slip factor	Added after consultation with Dan Clark that there is no evidence for creep on any faults or folds.
-	Fault, Section	Upper seismogenic depth - pref	Added after consultation with Dan Clark that all faults mapped in the database reach the ground surface.

APPENDIX G Mid-ocean ridge transform database (Mortdb) – attribute mapping, formatting and upload

Mortdb attribute	GFE database table	GFE database attribute	Comments
Transform name	Trace, Section, Fault, Source	Name	Where sections were combined into faults, the fault was given a name combining the two sections – e.g., the combined "Tasman A" and "Tasman B" sections were renamed as the "Tasman A-B" fault and fault source.
Latitude			Not uploaded because fault locations are denoted by their traces.
Longitude			Not uploaded because fault locations are denoted by their traces.
MOR	Source	Tectonic region	Spelled out abbreviated names, assumed: AAR = America Atlantic Ridge; CIR = Central Indian Ridge; EPR = East Pacific Rise; MAR = Mid-Atlantic Ridge; PAR = Pacific Antarctic Ridge; SEIR = South East Indian Ridge; SSR = South Scotia Ridge; SWIR = South West Indian Ridge.
Start latitude			Not uploaded because fault locations are denoted by their traces.
Start longitude			Not uploaded because fault locations are denoted by their traces.
End latitude			Not uploaded because fault locations are denoted by their traces.
End longitude			Not uploaded because fault locations are denoted by their traces.
Length	Section, Fault, Source	Length - pref	Lengths were calculated for faults by summing the component section lengths.
Sinistral/Dextral	Section, Fault, Source	Slip type	
GRSM slip rate	Section, Source	Net slip rate – pref	
Seismogenic area			Not uploaded as is area for sections only, and area is not included as a

Mortdb attribute	GFE database table	GFE database attribute	Comments
			section attribute in the GFE database.
Whole fault system seismogenic area	Source	Area - pref	
Max expected seismic moment			Not uploaded because is a step in magnitude calculation and is no equivalent GFE attribute.
Max expected Mw	Source	Maximum magnitude	
Expected repeat time	Source	Recurrence interval	
Scaling/Real	Source	Notes	
-	Section, Fault, Source	Compiled by	Added database administrators names
-	Section, Fault, Source	Last updated	Added date received (was updated immediately before delivery).
-	Section, Fault, Source	Upper seismogenic depth - pref	Added because all sections/faults were mapped from seafloor bathymetry (thus they reach the ground surface).
	Source	Lower seismogenic depth - pref	Calculated from area divided by length (assuming all sources are vertical - see dip).
	Source	Width	Added from area (assuming all sources are vertical – see dip).
-	Section, Fault, Source	Dip	Added 90° for all after confirming with Monica Wolfson that all are vertical.
-	Section	Slip rate description	Added from the readme notes supplied with the database.
-	Source	Seismogenic area description	Added from the readme notes supplied with the database.
-	Source	Magnitude description	Added from the readme notes supplied with the database and in consultation with Monica Wolfson.

Mortdb attribute	GFE database table	GFE database attribute	Comments
-	Source	Recurrence interval description	Added from the readme notes supplied with the database.
-	Trace	Location method	Added description of location method from the readme notes supplied with the database.