

## **Crustal stress in central Tasmania**

### *Summary*

On 11th May 2010, Dr Holgate asked me (ASC) by email to do a focal mechanism solution for a small magnitude 3.8 earthquake that occurred in central eastern Tasmania on 7th December 2009. I acquired seismological data from Geoscience Australia (GA), Environmental Systems and Services (ES&S) and the University of Tasmania (Dr Anya Reading) to accurately locate the earthquake and determine its mechanism.

The resulting mechanism is predominantly a thrust with an approximately east-west horizontal principal stress direction.

This accords with the only other mechanism determined for an earthquake in Tasmania, an approximately 30,000 yr old major prehistoric earthquake in central western Tasmania which was determined from a paleoseismological study of the surface fault scarp.

### *Method*

*Focal coordinates* A small magnitude 3.8 earthquake occurred in central eastern Tasmania on 7th December 2009 at 13:30 UTC (12:30 am ESST). GA and ES&S computed the earthquake focal coordinates as listed below but neither used a combined dataset. There is more than 25 km between proffered epicentres. Fortunately KUTh Energy and UTas had deployed a network of 16 seismographs in the region, and all but two of them (#4 and #6) were working when the earthquake occurred.

**Table 1** Reported earthquake parameters

<b>Organisation</b>	<b>Origin Time</b>	<b>Lat °S</b>	<b>Long °E</b>	<b>Depth km</b>
GA	1330 03	42.106	147.700	-
ES&S	1330	42.34	147.56	Normal
ASC #1	1330 03.9 $\pm$ 0.3	42.19 $\pm$ 0.01	147.72 $\pm$ 0.02	9.8 $\pm$ 2.0
ASC #2	1330 03.9 $\pm$ 0.3	42.18 $\pm$ 0.01	147.74 $\pm$ 0.02	8.6 $\pm$ 2.4

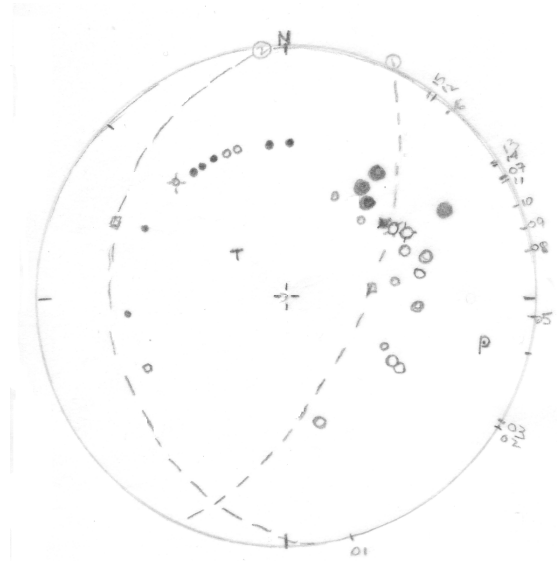
My ASC solutions were obtained using a Vic5a model developed by Vaughan Wesson for Victoria, there being no suitable Tasmanian crustal model in my location program. I did subsequently obtain a crustal model for Tasmania from Clive Collins at GA but haven't had time to install it. This will be available for the 2nd stage of the study should it eventuate. ASC#1 uses all the KUTh/UTas data and ES&S data for Tasmanian stations plus a few stations in southern Victoria whereas the ASC#2 model used only the KUTh/UTas data. Unfortunately only the vertical components were provided by UTas and it can be quite tricky picking the 'S' phase arrival from a vertical seismogram. An accurate estimate of the focal coordinates is essential using close-in stations.

The focal mechanism shown below was obtained using all reported first arrivals even though I personally read only the KUTh/UTas Z component data. The solution shows a thrust event with nearly horizontal P axis and near vertical T axis, parameters are tabulated below. Seven of the 29 stations do not accord with this interpretation, and station polarities have not been checked by me using a suitable deep, large SW Pacific earthquake. The solution would have to be rated only fair.

Focal mechanism of the 7 December 2009 Swansea Tas earthquake, magnitude ML 3.8. The filled circles are compressions, the open circles dilatations whilst the open squares

are poles of the nodal planes, either of which could be the fault plane. The circles with a cross through them were identified as near nodal (emergent). Larger diameter circles are the KUTh/UTas stations, the smaller circles are the GA and ES&S stations.

This mechanism and interpreted principal stress direction are typical of earthquakes in continental SE Australia.



	strike	dip
Plane 1	25	64
Plane 2	0	30
P axis	103	20
T axis	315	68

It is interesting that this solution is similar to that of a prehistoric Tasmanian earthquake, dated at approximately 30,000 years BP, that caused the Lake Edgar Fault Scarp now partly submersed under Lake Pedder and which has been extensively studied using paleoseismology techniques (McCue and others, 1996, Van Dissen and others, 1997).

#### References

- McCue, K.F., Boreham, B., Van Dissen, R., Gibson, G., Jensen, V., and McKavanagh, B., 1996 — A Paleoseismology Case Study: the Lake Edgar Fault Scarp in Tasmania, in Proceedings of the 13th AGC, Canberra, 19-23 February 1996, GSA Abstracts 41, Geoscience for the Community.
- Van Dissen, R., McCue, K.F., Gibson, G., Jensen, V., Somerville, M., Boreham, B., McKavanagh, B., and Goede, A., 1997 — The Lake Edgar Fault: Evidence for Repeated Quaternary Displacement on an Active Fault in Southwest Tasmania. in Proceedings of the Seminar 'Earthquakes in Australian Cities - can we ignore the risks?' Australian Earthquake Engineering Society, Brisbane 2-3 Oct 1997.

#### Acknowledgment

The KUTh data was provided by Dr Anya Reading UTas as SAC files whilst ES&S kindly made available their data.

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21 May 2010