AEES NEWSLETTER

March 2013

Contents

President's Report

Firstly I would like to wish all our members a healthy and enjoyable 2013. Time really flies. It has come into the third year of my AEES presidency. I would like to thank all the members for your wonderful support, especially Kevin McCue, Sharon Anderson, Adam Pascale and Bill Boyce, who are full of initiatives and have done a lot of work to make our society a better and more prominent one among the general community.

To those of you who could not attend the AEES conference and AGM in Tweed Heads in last December, I would like to report that the conference and AGM were both very successful. During the AGM we discussed a number of issues. One is the possibility of combining our annual conference into the EA convention in 2014 at Melbourne Convention and Exhibition Centre (MCEC). EA intends to hold a biennial National Convention. The first one will be on Sunday 23 ~ Saturday 29 November 2014 at MCEC. Each technical society can join the Convention with its conference as a stream in this big event. It will have a flexible registration model to allow delegates who attend the Convention to select individual streams such as AEES that sit within the Convention umbrella, the Gala dinner, a major keynote presentation, and so forth. It was agreed that joining our annual conference with the Convention will help promoting AEES. It will also provide our members great opportunities for networking. However, it was also acknowledged that this might lead to a few side effects such as higher registration fees and uncontrollable conference program, etc. It was agreed in the AGM that we should consider attending the Convention in 2014 and discuss afterwards whether to continue doing so in 2016. I submitted the online form last December, expressing our interests in joining the EA Convention in 2014, but have not received any feedback yet. We are likely to have a different conference format in 2014. I will keep you informed once further information becomes available.

Kevin and Sharon have been busy looking for venue, host and possible sponsors for the 2013 annual conference in Tasmania. I am sure a decision will be reached very soon. I am looking forward to meeting all of you in Tasmania at the end of the year.

As you are aware, AEES, among more than 30 national societies, endorsed the IAEE declaration on the sentencing of six scientists and one public administrator in Italy over accusations of having made a falsely reassuring statement before the L'Aquila Earthquake in 2009. Dr George Walker prepared a report on the L'Aquila Trial and its possible implications for AEES members. The report was circulated to all our members on 14 December 2012. It includes a Code of Practice for the presentation of expert opinions and information on how to interact with the media. The report is a very useful reference to all of us. I thank George for preparing this report and sharing his experience on this very important issue with all of us.

It has been two years since the Christchurch earthquake that killed 185 people and resulted in an estimated loss of more than $30 billion. Much of the city's central area still remains cordoned off and nobody knows when the city will be fully functional again. Despite the great attention many Australians paid to this devastating event and a lot of media coverage when it occurred, it appears that the general

public tends to forget about such things quickly and not many lessons have been learned. We are lucky in Australia that the chance of a destructive earthquake hitting one of our major cities is low, but no one can completely rule it out. It seems no government organization or city council in Australia has initiated any risk analysis of earthquake threats or any study on the consequences should a similar earthquake hit Australia. I read in the news that city councils like Seattle and San Francisco intend to make it mandatory for property owners to retrofit seismically vulnerable buildings after learning the lessons from the Christchurch earthquake. In Australia, however, due to the general ignorance of the seismic risk and the lack of political will, making it mandatory for property owners to retrofitting their buildings is not likely to happen in the near future.

I recently learned from Kevin McCue that Australia does not havea strong motion Database Management System. Rather they are sent to a Database Management Centre managed by IRIS in the United States. I am in support of international data sharing, but at the same time I strongly believe that Australia should archive the seismic data recorded in Australia. On behalf of AEES, I have written to Dr Chris Pigram, the Chief Executive Officer of Geoscience Australia to express our concerns.

Lack of resources could be one of the reasons for the data not being archived in Geoscience Australia. In fact lack of research support is a common problem impacting Australian universities and research organizations. According to a recent study by Robyn May from Griffith University, many talented young PhD graduates in Australia could not find a stable academic position in universities or research institutes, and many senior academics are over stressed due to the lack of public funding for universities. The poor job prospect has resulted in fewer young talented Australians willing to do postgraduate study. This will eventually have a negative impact on Australian competitiveness.

Once again, happy belated new year, and I am looking forward to working with all of you for another successful year of AEES!

Hong Hao

President, AEES

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The 2013 AEES Committee

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Northern Territory	tba

Death of Professor Ambraseys

One of the 13 'Legends' of Earthquake Engineering, Professor Nicholas Ambraseys died on 28th December 2013, the 105th anniversary of the Destructive Messina, Italy earthquake.

See the obituary written by Professor John Douglas on page 9.

Fukushima– damaged before tsunami hit

Tepco lied to Fukushima meltdown investigators

http://www.abc.net.au/news/2013-02-08/tepco-lied-to-fukushima-meltdown-investigators/4507786

TONY EASTLEY: In a further blow to its already battered credibility, the operator of the crippled Fukushima nuclear plant has been caught out blatantly misleading investigators appointed by the Japanese parliament to probe the meltdowns.

An audio recording heard by AM reveals that a TEPCO official gave false testimony in an apparent bid to stop an investigation being carried out inside the shattered reactor one building.

North Asia correspondent Mark Willacy reports from Tokyo.

MARK WILLACY: It remains one of the biggest mysteries of the Fukushima meltdowns - was the cooling system in the plant's oldest reactor, reactor one, damaged by the massive earthquake before it was even swamped by the tsunami?

That was what the investigation panel appointed by the Japanese parliament wanted to know during its cross examinations of TEPCO officials last year.

And to get to the bottom of this mystery the investigators wanted access to the reactor one building.

But as this recording of a meeting between TEPCO official Toshimitsu Tamai and investigation panel member Mitsuhiko Tanaka makes clear, the company wanted none of it.

"Now there's a cover over the building," says TEPCO's Mr Tamai. "There are no lights. So I'd like you to understand that the building is completely dark. You won't see anything," he tells investigator Mitsuhiko Tanaka.

To support his case the TEPCO official produces some images showing shafts of light inside the reactor one building. Those pictures, explains Mr Tamai, were taken before the roof cover went on the shattered structure.

Now, he explains again, the building is in complete darkness. In fact, as the tape recording obtained by Japan's Asahi newspaper reveals, Toshimitsu Tamai spent one hour and nine minutes insisting that there was no way investigators could see anything inside.

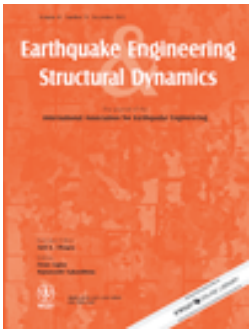
"If you get lost in there, you'll enter a terribly high radiation area," warns the TEPCO official. "You won't know how to get back again," he says.

But this was all false. So what does TEPCO say in response to the allegation that one of its officials lied to parliament-appointed investigators? Well in a statement to the Asahi newspaper the company apologised, admitting there had been a mistake and saying it had no intention of making a false statement.

And as to the mystery of the reactor one building and the possibility that it was damaged before the tsunami hit, in its report the parliamentary panel found that there was a possibility that pipes had burst during the earthquake causing a cooling problem.

It called for a full investigation - one that still has not been carried out.

Earthquake Engineering & Structural Dynamics



Edited by: Anil K. Chopra, Peter Fajfar, Masayoshi

Research Articles

Structural pounding between adjacent buildings subjected to strong ground motions. Part II: the effect of multiple earthquakes

Sofia Efraimiadou, George D. Hatzigeorgiou and Dimitri E. Beskos

Article first published online: 15 FEB 2013 | DOI: 10.1002/eqe.2284

Structural pounding between adjacent buildings subjected to strong ground motions. Part I: The effect of different structures arrangement

Sofia Efraimiadou, George D. Hatzigeorgiou and Dimitri E. Beskos

Article first published online: 15 FEB 2013 | DOI: 10.1002/eqe.2285

Evaluation of the response modification coefficient and collapse potential of special concentrically braced frames

Po-Chien Hsiao, Dawn E. Lehman and Charles W. Roeder

Article first published online: 14 FEB 2013 | DOI: 10.1002/eqe.2286

Fracking and earthquakes

Subject: Small volume of injected wastewater suggests deep disposal can set off large quakes that might not have occurred naturally for centuries.

Science 21 December 2012: Vol. 338 no. 6114 p. 1523 DOI: 10.1126/science.338.6114.1523-b
NEWS & ANALYSIS - FALL MEETING OF THE AMERICAN GEOPHYSICAL UNION
Snapshots From the Meeting

1. *Richard A. Kerr*

Making a bigger Big One.

The burgeoning subsurface injection of wastewater—mostly derived from "fracking" for oil and gas—has been setting off sizable earthquakes from New Mexico to Arkansas to Ohio (Science, 23 March, p. 1436). But the biggest suspected induced quake—the magnitude-5.7 Prague quake that struck central Oklahoma in November 2011—came long after the start of nearby injection. That cast doubt on any link to deep disposal. The 5.7 Prague was the second of three related quakes, however, and at the meeting, seismologist Katie Keranen of the University of Oklahoma, Norman, and colleagues reported that the first fault segment to rupture was less than 200 meters from two active injection wells and broke to the depth of the injection. They think known geological barriers delayed the quake by temporarily holding back the injected wastewater. The large size of the Prague quake relative to the small volume of injected wastewater suggests deep disposal can set off large quakes that might not have occurred naturally for centuries.

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L'Aquila Earthquake

Six scientists/engineers and one government official have been sentenced to six years in prison for manslaughter, for making "falsely reassuring" comments before and after a meeting of the National Commission for the Prediction and Prevention of Major Risks held at L'Aquila a week before the earthquake.

Earthquake Proof Buildings - Italy 1908

The Argus, Wednesday 13 January 1909

EARTHQUAKE PROOF.

NEW STYLE OF BUILDING.

After the severe earthquake shock of 1905 a design for the construction of earthquake-proof buildings was supplied by Dr. Capacci, in Reggio. The feature of the new method was hollow bricks laced with vertical and horizontal wires, by which great elasticity was secured.

Since 1906 a number of buildings have been constructed, and these are the only buildings remaining intact in Reggio.

BODY OF MRS. OGSTON FOUND.

Amongst the pathetic stories told by survivors of the disaster none was more pathetic than that of Mr. Ogston, the British vice-consul in Messina. Mr. Ogston, with his wife and little daughter, escaped through a window, but as they reached the footpath the balcony fell, and crushed Mrs. Ogston to the ground, killing her. Mr. Ogston escaped into the country with his child.

A party of British bluejackets, working under the direction of Colonel Radcliffe, military attache to the British embassy at Rome, has now extricated the body of Mrs. Ogston from the ruins.

Ed. The 1905 earthquake Calabrian earthquake, magnitude 7.1, killed an estimated 557 people in Calabria. Three years later the Messina earthquake, magnitude 7.2, caused 120,000 causalties, the worst earthquake disaster in Italy since records have been kept in the 12th century. These two earthquakes were about the same size as the 1906 earthquake offshore WA.

40th Anniversary of the Picton NSW Earthquake

On 10 March 1973 a magnitude 5.5 earthquake rattled the southern highlands south of Sydney. URM buildings, particularly old structures, were cracked and some chimneys partially collapsed at Berrima, Karrare Homestead, Mittagong, Nattai River, Picton, Tahmoor and Wollongong. The shaking was felt throughout the Sydney Metropolitan area. Denham (1976) suggested the total loss was of the order of $0.5M.

None of the major structures in Sydney such as the nuclear reactor at Lucas Heights or the Sydney Harbour Bridge were instrumented with accelerographs so there is no record of the strong ground shaking or their response to it.

The focal depth of this event was estimated to have been about 20 km which helped minimise the epicentral intensity.

The following is a personal recollection of the earthquake:

"My father, mother and I were living in West Wollongong in 1973 when a magnitude 5.5 earthquake struck in the early hours of the morning. Not only were we shaken but the noise was amazingly loud. The ceiling was damaged in one room at The Illawarra Grammar School where I was teaching at the time, the local radio station was off the air for several minutes, the lights went out at the Steelworks and in the coal mines – that would have been scary – and a large crack appeared in the front of the Department of Education building in Wollongong. One woman reported being thrown out of bed and afterwards laughed that this was a rather extreme way for her boss to make sure she got up early enough for work. At TIGS we joked that the quake was a "punishment" for the previous night's rather pleasant wine tasting in the very room that was damaged; the Reverend Gentleman who founded the school was of evangelical persuasion and his portrait had fallen off the wall in presumed disapproval."
http://neil2decade.wordpress.com/2010/01/20/australia-not-earthquake-free/

The editor's family home in Manuka ACT was slightly damaged by the early morning shake, a piece of masonry from the lintel above the back door of the brick cavity wall fell out onto the floor.

Reference

Denham, D., 1976. Effects of the 1973 Picton and other earthquakes in eastern Australia. Bureau of Mineral Resources, Geology and Geophysics. Bulletin 164 p15-31.

Conferences/ Workshops

26-28 April 2013. The NZSEE 2013 Conference will be held in Wellington at the Michael Fowler Centre.

Theme: *Same Risks – New Realities*

Abstract submission deadline – Monday 26th November 2012 - Submissions can be made online via the conference website www.confer.co.nz/nzsee.

29-31 May 2013. International Conference on Earthquake Engineering Skopje Macedonia, c/o Macedonian Association for Earthquake Engineering.

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Dr. Polat Gulkan, Professor at METU, editor of Earthquake Spectra and President of IAEE.

Dr. Amr Elnashai, Professor at the University of Illinois, co-editor of the Journal of Earthquake Engineering.

Dr. Kazuhiko Kawashima, Professor at the Tokyo Institute of Technology, associate editor of Journal of Earthquake Engineering.

Dr. Roger D. Borcherdt, geophysicist at the U.S. Geological Survey, past editor of Earthquake Spectra.

Dr. Mauro Dolce, Professor at the University of Naples, Director General of the Italian Department of Civil Protection – Seismic Risk Section.

Dr. Yi-Qing Ni, Professor at the Hong Kong Polytechnic University, member of the editorial board for 8 international journals.

11-14 August 2013 23rd International Geophysical Conference & Exhibition 2013 'Eureka Moment' (ASEG-PESA2013), which will be held in Melbourne, Victoria, Australia.

www.aseg-pesa2013.com.au

20-23 November 2013 the 19th NZGS Symposium "Hanging by a Thread – Lifelines, Infrastructure and Natural Disasters". Queenstown, New Zealand.

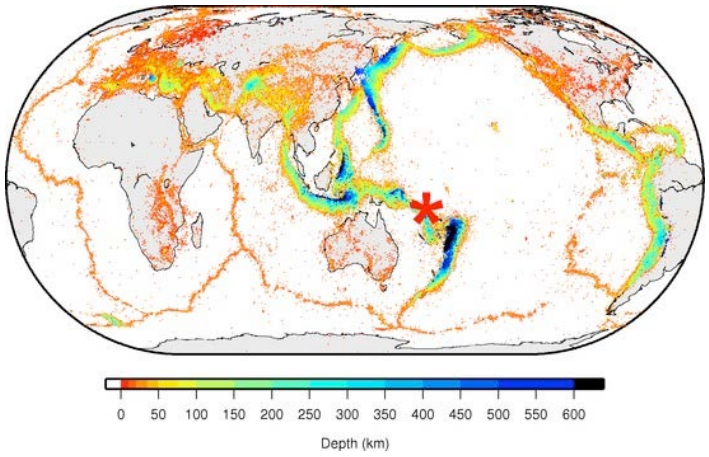
www.nzgs13.co.nz

Great earthquake strikes Santa Cruz, Solomon Islands

Origin Time 01:12UTC, 06 FEB 2013

Location 10.9°S, 165.1°E, Depth Shallow, Magnitude Mw 8.0

The earthquake epicenter was 80 km west of the town of Lata, the main town on the island of Santa Cruz in Temotu, the easternmost province in the Solomons, about 590km from from the capital, Honiara. Temotu has a population of around 30,000.



At least 8 people are thought to have died and, at 8th February, others are still missing following the tsunami generated by this the largest earthquake of 2013.

A Pacific-wide tsunami alert was issued by authorities but soon cancelled for more distant coasts in the Pacific.

A spokesman for the prime minister of the Solomon Islands reported that two 1.5-metre waves hit the western side of the Santa Cruz island on Wednesday, damaging 70 to 80 properties. Many villagers had headed to higher ground as a precaution after feeling the earthquake (which was not felt in Honiara). Tsunami recordings are listed below.

Four villages on Santa Cruz were hit by the tsunami and two of them severely damaged. Other areas of the Solomons did not appear to have been seriously affected. The airstrip at the nearest airport was inundated and littering it with debris.

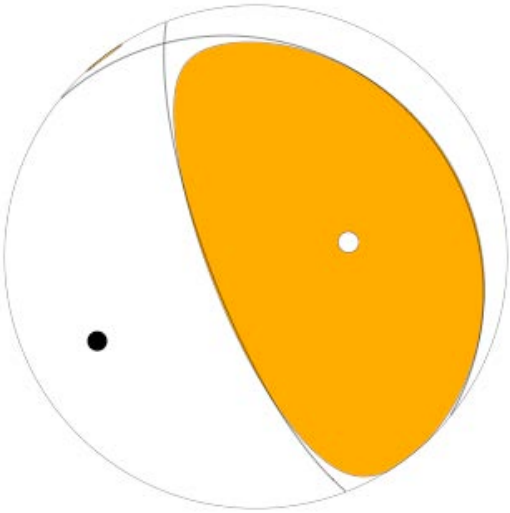
The Pacific Tsunami Warning Centre said a tsunami of about a metre high was measured on the Lata wharf – smaller waves were recorded in Vanuatu and New Caledonia. In Honiara, the warnings prompted residents to flee for higher ground. Given the shallow focal depth and thrust mechanism it is puzzling that the tsunami was so small.

Mobile patients at the National Referral Hospital in Honiara were asked to leave and stay with family or friends as a precautionary measure because of the hospital's location near the shoreline. The others stayed, but the hospital was ready to evacuate them.

More than 50 people were killed and thousands lost their homes in April 2007 when a magnitude 8.1 earthquake hit the western Solomon Islands causing a tsunami which flattened coastal villages.

http://earthquake.usgs.gov/earthquakes/eventpage/usc000f1s0#summary

Seismotectonics The eastern margin of the Australia plate is one of the most seismically active areas of the world due to the high rates of convergence between the Australia and Pacific plates. Since 1900 two great earthquakes occurred near the southern section of the plate boundary, the Macquarie Ridge, in 1989, M8.2 and in 2004 M8.1. The largest recorded earthquake in New Zealand itself was the 1931 M7.8 Hawke's Bay earthquake, which killed 256 people.



North of New Zealand, the Australia-Pacific boundary stretches east of Tonga and Fiji to 250 km south of Samoa. For 2,200 km the trench is approximately linear, and Pacific oceanic lithosphere rapidly subducts westward under the Australian Plate. Near Samoa, the boundary curves sharply westward to a left lateral transform across to the Kermadec Trench where the direction of subduction is reversed.

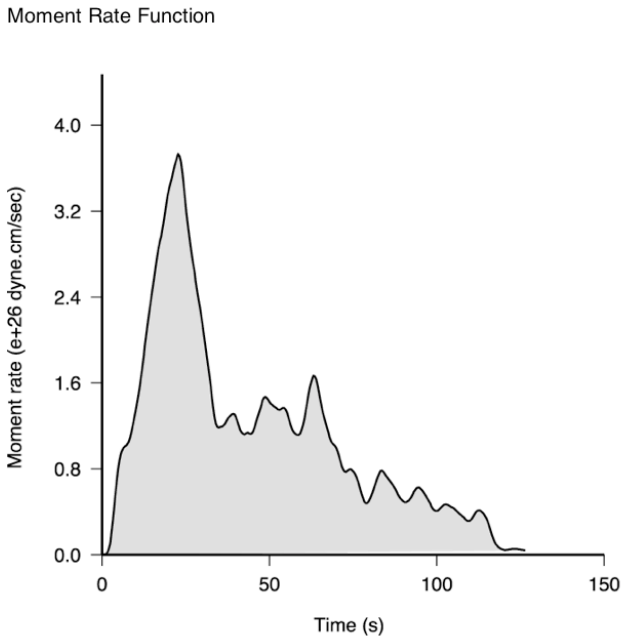
The Australia-Pacific convergence rates increase northward from 60 mm/yr at the southern Kermadec trench to 90 mm/yr at the northern Tonga trench; however, significant back arc extension (or equivalently, slab rollback) causes the consumption rate of subducting Pacific lithosphere to be much faster. The overall subduction velocity of the Pacific plate is the vector sum of Australia-Pacific velocity and back arc spreading velocity: thus it increases northward along the Kermadec trench from 70 to 100 mm/yr, and along the Tonga trench from 150 to 240 mm/yr.

The Kermadec-Tonga subduction zone generates many large earthquakes on the interface between the descending Pacific and overriding Australia plates, within the two plates themselves and, less frequently, near the outer rise of the Pacific plate east of the trench. Since 1900, 40 M7.5+ earthquakes have been recorded, mostly north of 30°S. However, it is unclear whether any of the few historic M8+ events that have occurred close to the plate boundary were underthrusting events on the plate interface, or were intraplate earthquakes. On September 29, 2009, one of the largest normal fault (outer rise) earthquakes ever recorded (M8.1) occurred south of Samoa, 40 km east of the Tonga trench, generating a tsunami that killed at least 180 people.

The Australia plate subduction velocity ranges from 120 mm/yr at the southern end of the North New Hebrides trench, to 170 mm/yr at the northern end of the trench.

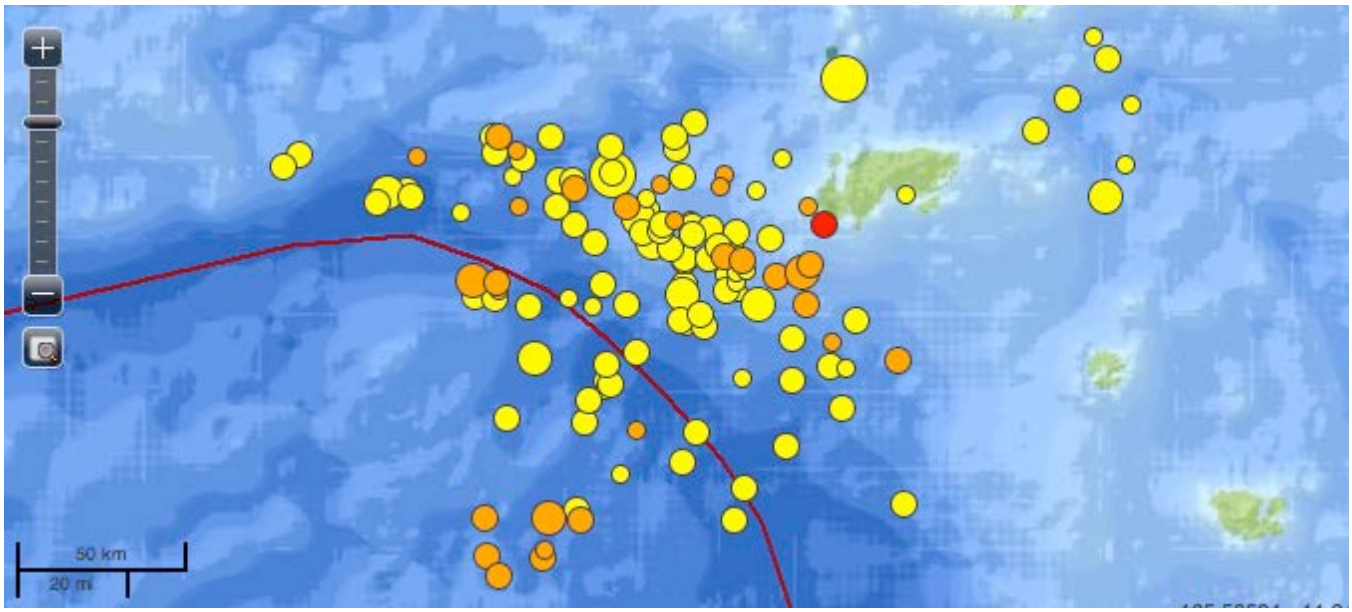
The February 6th, 2013 M 8.0 earthquake in the Santa Cruz Islands occurred as a result of shallow thrust faulting on or near the plate boundary interface between the Australia and Pacific plates. Here, the Australia plate converges with and subducts beneath the Pacific plate, moving towards the east-northeast at a rate of approximately 94 mm/yr.

The moment rate function shown here from the USGS, indicates that the faulting was about 300 km long and the aftershock distribution (from the USGS below) supports that, their locations bending around parallel to the trench boundary marked by the red line. Most of the energy was released between 10 and 30 seconds after the initiation of faulting.



The February 6th earthquake is located approximately 700-750 km ESE of the Mw 8.1 Solomon Islands earthquake of April 1, 2007, adjacent to a complex section of the Australia-Pacific plate boundary, where the Solomon Trench to the west bends around to the New Hebrides (Vanuatu) Trench to the south.

Over the month leading up to the February 6th earthquake, there were seven foreshocks larger than M6. Faulting mechanisms for these earthquakes suggest a mixture of strike-slip, normal and thrust faulting events.



Many aftershocks have been felt in the Santa Cruz islands, their magnitudes ranging up to magnitude 7.0. and they are widely distributed, both along strike and perpendicular to the strike direction in in the focal mechanism above. They seem to have occurred in both plates across the trench boundary, in the foot wall and hanging wall.

Since 1904, M8+ earthquakes have occurred near Santa Cruz every 15 years or so on average, a very high rate of activity.

http://ptwc.weather.gov/ptwc/text.php?id=pacific.TSUPAC.2013.02.06.0347

Measurements of tsunami wave height

GAUGE LOCATION	LAT	LON	TIME	AMPL	PER
LUGANVILLE VU	15.5S	167.2E	0319Z	0.26M	28MIN
DART 55023	14.8S	153.6E	0326Z	0.05M	06MIN
HIENGHENE N CALEDONIA	20.7S	164.9E	0319Z	0.55M	14MIN
LIFOU N CALEDONIA	20.9S	167.3E	0309Z	0.48M	10MIN
VANUATU	17.8S	168.3E	0255Z	0.15M	16MIN
DART 52406	5.3S	165.1E	0206Z	0.04M	10MIN
DART 55012	15.8S	158.5E	0237Z	0.17M	06MIN
LATA WHARF SB	10.7S	165.8E	0129Z	0.91M	18MIN

The photographs available (such as that below) of damage in the coastal villages of Santa Cruz bear a striking resemblance to those taken in Papua New Guinea following the destructive earthquake and tsunami at Sissano Lagoon in 1998, the earthquake smaller but the tsunami much larger.

Professor Nicholas Ambraseys, 1929 - 2012

IASPEI Newsletter February 2013

Nicholas (Nick) Ambraseys was born in Athens, Greece on 19th January 1929 and died peacefully at his home in Putney (United Kingdom) on 28th December 2012 at the age of 83.

Nick Ambraseys attended the National Technical University of Athens, receiving his diploma in Rural Engineering in 1952. Following this and service in the Royal Hellenic Navy he moved to Imperial College in London to study for his Diploma of Imperial College and later his PhD, which he was awarded in 1958.

Following a few years at universities in Greece and in the United States of America (working with Nathan Newmark, one of the fathers of earthquake engineering) he returned to Imperial College and remained there until his death. He became Professor of Engineering Seismology in 1974. In 1968 he established the Engineering Seismology Section in the Department of Civil Engineering and from 1971 to 1994 he led this section. In 1994 he officially retired from this position but he remained very active as an Emeritus Professor. Even during the last few months of his life he continued working and collaborating on various research topics, including the stability of ancient Greek columns.

His research covered many problems connected with earthquakes and their effects on the ground, structures and populations. His PhD and early articles were concerned with the response of earth dams to earthquakes, in connection with the construction of large dams in the Himalayas (e.g. at Mangla). However, early on in his career he began studying historical accounts of earthquakes, particularly those occurring in the eastern Mediterranean region, and it is in this field where he arguably made his greatest contributions. His meticulous study of historical documents on earthquakes that occurred in the eastern Mediterranean and elsewhere (e.g. Central America) is second-to-none and he published many dozens of articles and books on this painstaking work. In 2009 his *magnum opus* on eastern Mediterranean seismicity (entitled 'Earthquakes in the Mediterranean and Middle East: a multidisciplinary study of seismicity up to 1900'), comprising almost 1000 pages, was published by Cambridge University Press.

Since he remained, at heart, an engineer he continued to work in geotechnical earthquake engineering, the assessment of earthquake ground motions and various other topics, in addition to his historical research. For example, he made significant advances in the collection and analysis of strong-motion (accelerometric) data. He started the routine collection, processing and assessment of these data and associated parameters (metadata) in 1971. In those days collection and use of strong-motion data was difficult, time consuming and, in Europe, uncommon due to analogue instruments and the lack of electronic communications to facilitate data transfer but through Nick's contacts and tenacity the collection of data grew. This task continued through various projects and initiatives from the 1970s to early 2000s and culminated with the publications in 2000 and 2004 of freely-available CD ROMs of strong-motion data and their reassessed parameters and in 2002 the establishment of the Internet Site for European Strong-motion Data. This work was conducted within the frameworks of the Strong-Motion Working Groups of the European Seismological Commission and the European Association of Earthquake Engineering, which Nick led for much of the past forty years. These strong-motion archives remain important resources for research and engineering practice and significantly help seismic hazard assessments in Europe and the Middle East.

All of Nick's publications were infused with wisdom, learning and wit, making them a joy to read. For those who are not familiar with his work, his 1988 Earthquake Engineering & Structural Dynamics article entitled simply 'Engineering Seismology' is recommended as a good place to start. In all his works he

sought to act as a bridge between earth sciences and engineering and between research and practice. These studies were enlightened by the knowledge and insights he gained during dozens of post-earthquake field missions in various parts of the world, many of which were under the aegis of UNESCO. These missions led to a series of reports that had an impact on the reconstruction of the cities affected (e.g. Skopje and Managua). He was awarded in 1998 the Freedom of the City of Skopje in recognition of the field work that he undertook in the aftermath of the devastating 1963 Skopje earthquake and the advice that he provided to the local authorities. His great ability with languages (fluent in three or four and comprehension of many others) helped all of these works and to sustain good contacts with people of many nationalities. As well as conducting research himself, he supervised many masters and PhD students and he collaborated with numerous workers worldwide. His vast experience of practical earthquake problems was put to good use through consultancy for large-scale engineering projects, such as dams and bridges in seismically active regions.

In recognition of his lifetime of achievements he was given numerous awards and fellowships from prestigious institutions, for example: Busk Medal for Scientific Discovery from the Royal Geographical Society (1975), Mercenary Award of the European Association of Earthquake Engineering (1975), Fellowship of the Royal Academy of Engineering (1985), Honorary Fellowship of the Society of Earthquake Engineering & Structural Dynamics (1986), Honorary Fellowship of the International Association of Earthquake Engineering (1992), Honoris Causa from University of Athens (1993), Member of the European Academy (1997), Award of the Freedom of the City of Skopje (1998), Harry Fielding Reid Medal of the Seismological Society of America (2006), Fellowship of the Institution of Civil Engineers, Fellowship of the Geological Society and Fellowship of the Royal Geographical Society. From his election in 2003, he was an active member of the First Section of the Academy of Athens and he divided his time between London and Athens.

His great scholarship, practical insight and wisdom were best demonstrated during relaxed discussions in small groups, often accompanied by him cleaning and refilling his pipe. He peppered his conversation with interesting and amusing asides, anecdotes and observations. He had a great ability to simplify scientific and engineering problems with the use of enlightening analogies. Two that come to mind are: when he used the permanent vertical displacement (or lack of) at a canal north of Athens to constrain the fault slip in the 1999 earthquake and he compared the canal to photographic trays used in darkroom development; and when he compared the behaviour of particles undergoing soil dilatancy to the behaviour of commuters trying to get off a packed Tube (London Underground) train.

Nick Ambraseys contributions to engineering seismology and earthquake engineering were immense, wide-ranging and spanned almost 60 years. The worldwide community in these fields owes him a great debt and he will be greatly missed. He is survived by his wife, Xeni.

John Douglas

Note: Professor Douglas is coordinating a special issue of the Bulletin of Earthquake Engineering in memory of Nick Ambraseys. In addition, at the Vienna Congress on Recent Advances in Earthquake Engineering and Structural Dynamics (VEESD2013), which will take place at the end of August, 2013 a half-day special session in memory of Professor Ambraseys is being organised.

Major World Earthquake 2013

Magnitude 7.5 SOUTHEASTERN ALASKA January 05, 2013
Magnitude 8.0 SANTA CRUZ ISLANDS February 06, 2013
Magnitude 7.1 SANTA CRUZ ISLANDS February 06, 2013
Magnitude 7.0 SANTA CRUZ ISLANDS February 06, 2013
Magnitude 7.0 SANTA CRUZ ISLANDS February 08, 2013

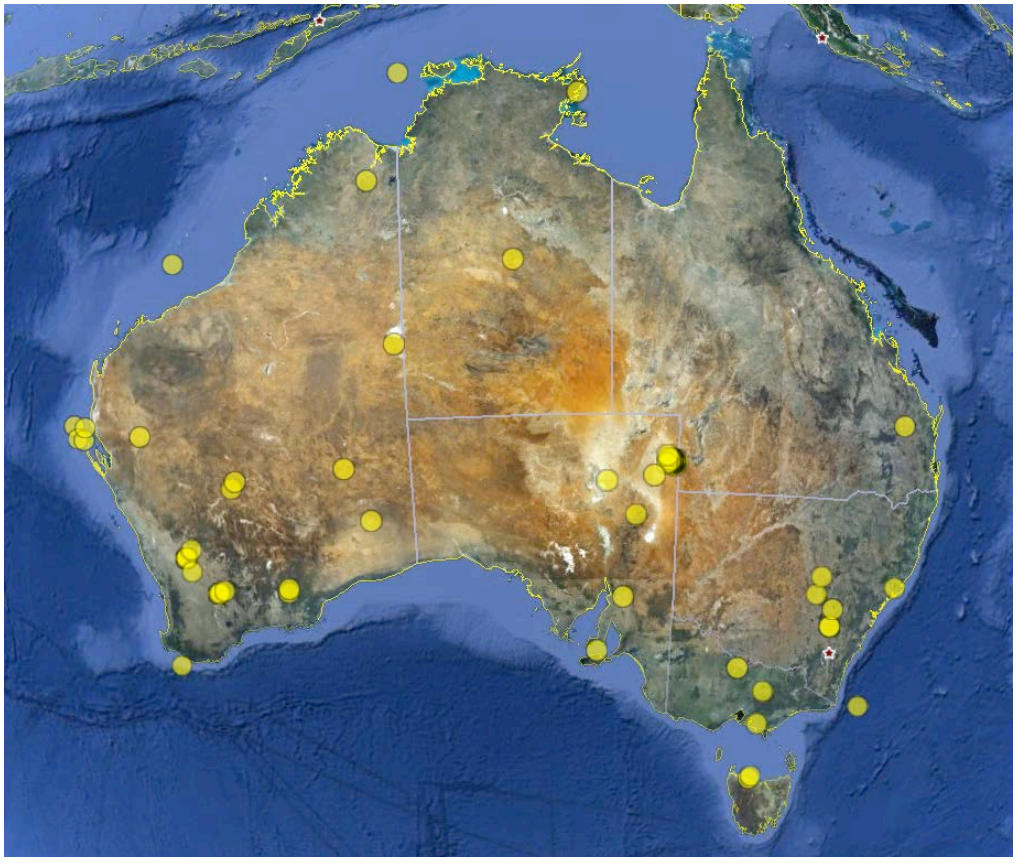
Australian Earthquakes Nov 2012 to Feb 2013

Table Earthquakes in the Australian region, magnitude 2.5 or greater, located by Geoscience Australia

UTC Date	UTC Time	Latitude	Longitude	Approximate location	Depth (km)	Magnitude	Source
2012-11-05	19:31:49	-11.55	129.05	Off Bathurst Island, NT.	39	4.5	AUST
2012-11-08	03:56:55	-29.90	126.99	Nullarbor Plain, WA.	0	3.6	AUST
2012-11-13	07:47:42	-28.38	139.91	SW Innamincka, SA.	10	3.0	AUST
2012-11-14	20:23:03	-30.32	117.80	Near Beacon, WA.	2	2.8	AUST
2012-11-16	03:16:19	-33.39	138.45	Port Pirie	11	2.6	DMITRE
2012-11-20	19:12:51	-27.82	140.66	Near Innamincka, SA.	18	3.0	AUST
2012-11-21	12:17:20	-27.76	140.85	Innamincka, SA.	10	2.8	AUST
2012-11-21	06:21:45	-22.97	128.60	Lake Mackay, WA.	10	3.3	AUST
2012-11-22	02:48:38	-27.78	140.92	Near Innamincka, SA.	10	2.9	AUST
2012-11-23	17:11:24	-27.82	140.79	Near Innamincka, SA.	10	2.7	AUST
2012-11-23	17:03:58	-28.60	137.80	Lake Eyre, SA.	10	2.7	AUST
2012-11-25	15:06:56	-27.97	140.82	Near Innamincka, SA.	10	2.7	AUST
2012-11-25	06:53:24	-27.79	140.72	Near Innamincka, SA.	5	2.6	AUST
2012-11-27	08:02:59	-27.84	140.71	Near Innamincka, SA.	5	3.2	AUST
2012-11-27	07:13:07	-27.79	140.75	Near Innamincka, SA.	0	3.6	AUST
2012-11-27	04:26:09	-27.82	140.62	Near Innamincka, SA.	0	2.5	AUST
2012-11-27	04:01:26	-27.59	140.48	Near Innamincka, SA.	0	2.6	AUST
2012-11-28	22:35:22	-27.76	125.94	SW Warburton, WA.	0	4.0	AUST
2012-11-28	17:09:29	-27.83	140.70	Near Innamincka, SA.	10	2.8	AUST
2012-11-28	16:46:38	-27.87	140.66	Near Innamincka, SA.	10	2.8	AUST
2012-11-28	16:37:17	-27.90	140.46	Near Innamincka, SA.	10	2.9	AUST
2012-11-29	22:26:52	-27.76	140.59	Near Innamincka, SA.	10	3.3	AUST
2012-11-29	22:08:19	-27.79	140.63	Near Innamincka, SA.	12	3.3	AUST
2012-11-29	20:31:30	-27.81	140.59	Near Innamincka, SA.	8	3.5	AUST
2012-11-29	20:05:08	-27.73	140.67	Near Innamincka, SA.	10	3.0	AUST
2012-11-29	19:45:35	-27.76	140.69	Near Innamincka, SA.	10	3.2	AUST
2012-11-29	19:29:25	-27.74	140.65	Near Innamincka, SA.	10	3.2	AUST
2012-11-29	19:21:18	-27.76	140.66	Near Innamincka, SA.	5	3.9	AUST
2012-11-29	18:19:24	-27.82	140.68	Near Innamincka, SA.	12	3.2	AUST
2012-11-29	17:48:46	-27.84	140.76	Near Innamincka, SA.	10	3.0	AUST
2012-11-29	17:03:01	-27.87	140.74	Near Innamincka, SA.	10	2.8	AUST
2012-11-29	15:21:07	-27.80	140.79	Near Innamincka, SA.	10	2.9	AUST
2012-11-29	14:53:40	-27.83	140.76	Near Innamincka, SA.	14	3.3	AUST
2012-11-29	08:55:37	-27.89	140.74	Near Innamincka, SA.	10	2.9	AUST
2012-11-29	07:32:34	-27.93	140.67	Near Innamincka, SA.	0	2.8	AUST
2012-11-29	03:57:10	-27.83	140.61	Near Innamincka, SA.	0	2.7	AUST
2012-11-30	16:24:45	-32.37	122.56	SE of Norseman, WA.	14	3.1	AUST
2012-11-30	07:52:42	-27.70	140.53	Near Innamincka, SA.	0	3.1	AUST
2012-12-01	18:48:03	-27.84	140.68	Near Innamincka, SA.	10	3.0	AUST
2012-12-01	17:19:07	-16.20	127.66	SW Kununurra, WA.	10	3.4	AUST
2012-12-04	20:17:43	-25.79	151.47	Near Gayndah, Qld.	10	3.5	AUST
2012-12-04	17:51:04	-29.94	139.12	NW Yudnamutana, SA.	10	2.9	AUST
2012-12-09	07:41:04	-31.23	117.61	SE Wyalkatchem, WA.	0	2.6	AUST
2012-12-12	20:48:35	-32.26	118.82	N Hyden, WA.	10	2.5	AUST
2012-12-12	08:30:48	-32.19	119.18	Hyden, WA.	0	2.6	AUST
2012-12-14	04:14:55	-19.83	133.82	SW Tennant Creek, NT.	11	3.6	AUST
2012-12-15	17:11:53	-37.53	151.25	SE of Pambula, NSW.	0	2.7	AUST
2012-12-19	23:50:01	-24.92	112.50	W of Carnarvon, WA.	10	3.0	AUST
2012-12-20	23:30:42	-32.04	138.73	Hawker SA	11	2.5	
2012-12-21	15:26:20	-32.40	152.04	Near Bulahdelah, NSW.	9	2.9	AUST
2012-12-22	09:29:16	-32.53	122.51	SE Norseman, WA.	10	2.8	AUST
2012-12-22	07:41:20	-38.46	145.82	Near Korumburra, Vic.	10	2.6	AUST
2012-12-25	02:45:58	-32.53	1138.70	Peterborough	2	2.5	DMITRE

2012-12-26	20:46:15	-35.11	115.81	Off Windy Harbour, WA.	2	2.7	AUST
2012-12-28	12:04:44	-24.34	112.40	Offshore WA.	3	3.7	AUST
2012-12-29	17:43:56	-24.53	113.02	NW Carnarvon, WA.	10	3.0	AUST
2013-01-05	02:32:15	-27.81	120.61	Near Leinster, WA.	0	3.0	AUST
2013-01-05	00:22:30	-33.22	138.60	Jamestown, SA.	15	3.3	AUST
2013-01-06	17:02:50	-28.08	120.38	SW of Leinster, WA.	10	2.7	AUST
2013-01-07	08:14:03	-25.38	116.00	SE Carnarvon, WA.	13	3.1	AUST
2013-01-12	23:27:44	-40.82	145.92	Off Wynyard, TAS.	10	2.5	AUST
2013-01-12	20:21:16	-40.94	145.81	Off Wynyard, TAS.	10	3.4	AUST
2013-01-12	16:10:53	-34.19	148.92	Near Frogmore, NSW.	9	3.2	AUST
2013-01-14	03:31:43	-32.89	148.02	NW Parkes, NSW.	0	2.5	AUST
2013-01-15	07:11:07	-25.04	112.86	Off Carnarvon, WA.	0	3.4	AUST
2013-01-18	17:26:14	-34.20	148.92	Near Frogmore, NSW.	9	2.9	AUST
2013-01-18	15:35:44	-18.49	118.56	SW Broome, WA.	5	3.7	AUST
2013-01-22	14:22	-33.25	138.74	Jamestown	10	2.7	DMITRE
2013-01-31	20:24:30	-32.28	118.83	N of Hyden, WA.	10	2.5	AUST
2013-02-01	22:52:45	-30.62	117.46	N of Koorda, WA.	1	2.8	AUST
2013-02-01	09:49:46	-30.65	117.43	N of Koorda, WA.	2	3.2	AUST
2013-02-01	03:00:18	-30.65	117.42	N of Koorda, WA.	2	2.5	AUST
2013-02-09	22:21:02	-30.64	117.41	NW of Koorda, WA.	0	2.6	AUST
2010-02-10	01:32	-32.81	139.37	Peterborough SA	10	2.6	DMITRE
2013-02-13	16:49:40	-12.80	136.59	Near Gove, NT.	10	3.6	AUST
2013-02-15	12:32:28	-37.05	145.90	W of Mansfield, Vic.	12	2.9	AUST
2013-02-16	14:38:53	-32.25	118.88	N of Hyden, WA.	6	2.6	AUST
2013-02-16	11:01:00	-32.16	148.18	Near Narromine, NSW.	1	2.5	AUST
2013-02-18	09:23:58	-33.47	148.95	SW Orange, NSW.	0	3.0	AUST
2013-02-20	09:57:19	-35.43	137.38	N Kangaroo Island, SA.	5	3.4	AUST
2013-02-21	13:36:49	-36.15	144.45	Near Echuca, Vic.	11	2.9	AUST

Figure *Epicentres of earthquakes M≥2.5 in Australia and the region, 01 November 2012 – 21 February 2013, locations by Geoscience Australia.*



The significant seismic event sequence at Innaminka was caused by hydro-fracturing at about 4 km depth to enhance the geothermal energy source. Another mining-induced seismic event occurred at the Cadia gold and copper mine near Orange on 18th February and was widely recorded. The largest natural earthquake, magnitude 4.5, was that west of Bathurst Island, NT., the only other magnitude 4 earthquake occurred near Warburton in the WA/SA border region. Only the ACT escaped earthquakes above magnitude 2.4 in the period documented.