

The 2013 Bohol earthquake in central Philippines: Hazards and source fault characteristics

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Outline



Background

Seismotectonic setting
The 2013 Bohol earthquake
Regional geology

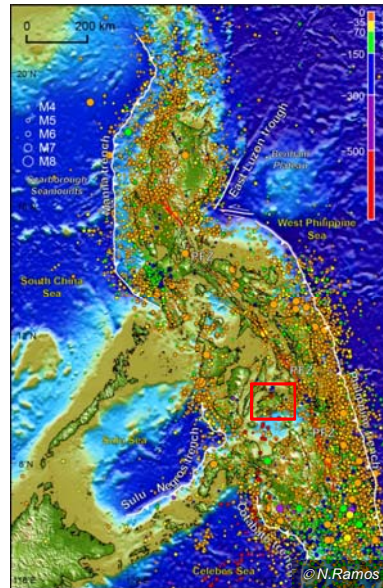
Geological hazards

Surface rupture
Shoreline deformation
Karst collapses

Implications for source fault

Highlights and future work

Seismotectonic setting of the Philippines



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Notable earthquakes in the Philippines

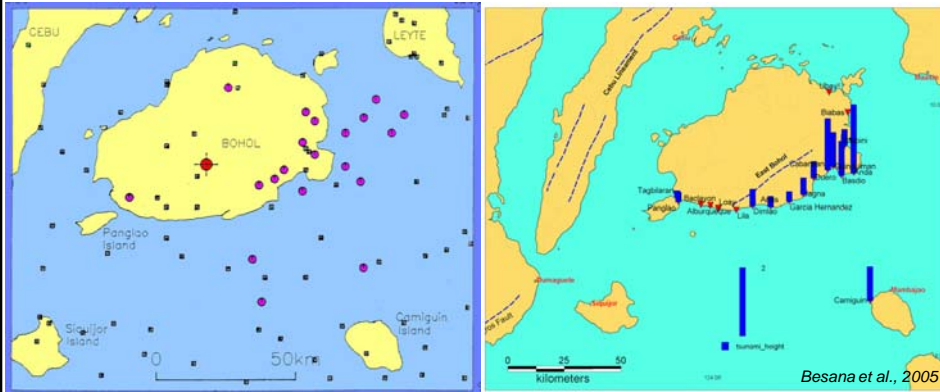


- * 17 Aug 1976 Moro Gulf ($M_S 8.0$)
- * 08 Feb 1990 Bohol ($M_S 6.6$)
- 16 Jul 1990 Luzon ($M_S 7.7$)
- * 17 May 1992 eastern Mindanao ($M_S 7.1-7.5$)
- * 15 Nov 1994 Mindoro (7.8)
- 06 Mar 2002 Sultan Kudarat (6.8)
- 15 Feb 2003 Masbate (6.2)
- 06 Feb 2012 Negros Oriental ($m_b 6.9$)
- 15 Oct 2013 Bohol ($M_W 7.2$)
- *tsunamigenic

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1990 Bohol tsunamigenic earthquake (Ms6.6)

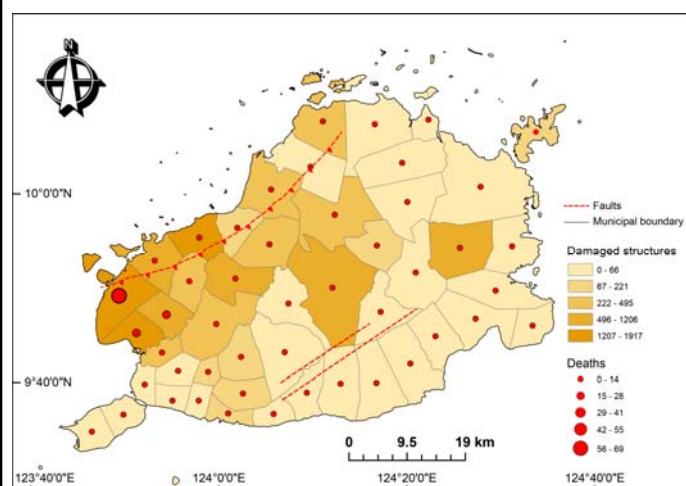


- Southeastern shorelines experienced a regional retreat (10 to 60 m) of sea water several minutes after the quake
- Small to moderate tsunami waves (0.2 to 2 m)

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The 2013 Mw7.2 Bohol Earthquake



222 dead
8 missing
976 injured

73,000 structures damaged (14,500 totally destroyed)
= ~PhP 2.2B
(USD 49M)

NDRRMC, 2013

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Ground rupture



Fault scarp of the Mw7.2 15 Oct 2013 Bohol Earthquake
North Bohol Fault in Inabanga, Bohol, Philippines



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Ground shaking and damages



Loboc Church



Maribojoc Church



Loon Church



Tubigon Church



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Karst collapses



Failure of karst cones
Sagbayan, Bohol, Philippines



Sinkholes
Tagbilaran City, Bohol, Philippines



Slumps
Maribojoc, Bohol, Philippines

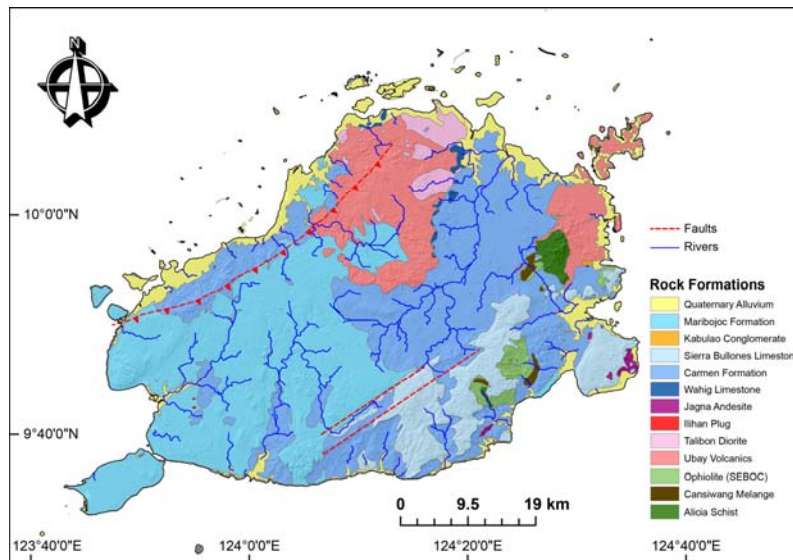


Exposed cave systems
Catigbian, Bohol, Philippines

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Regional geology of Bohol Island

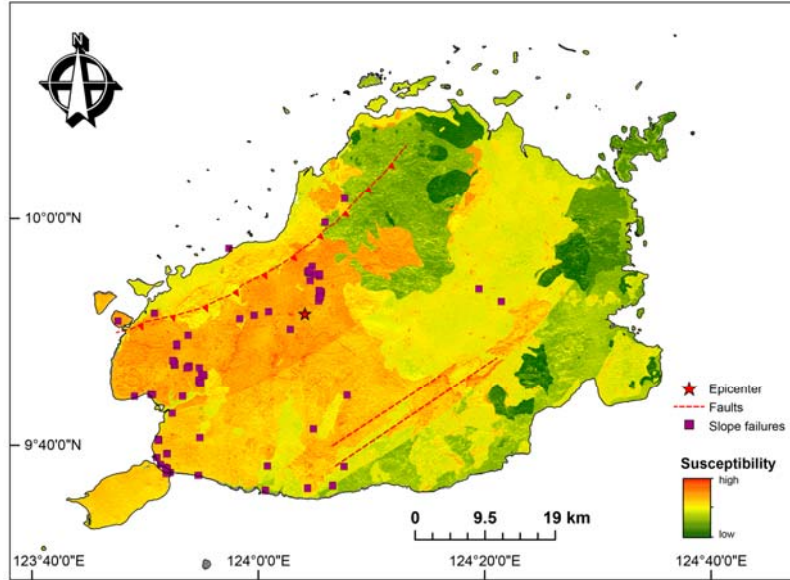


modified from Bureau of Mines and Geosciences (1987) and Faustino et al. (2003)

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Landslide susceptibility map



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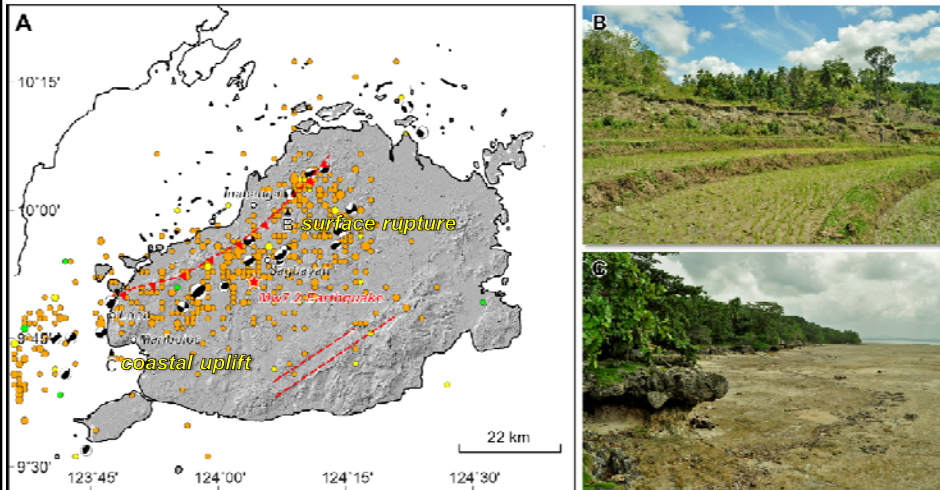
Coastal uplift



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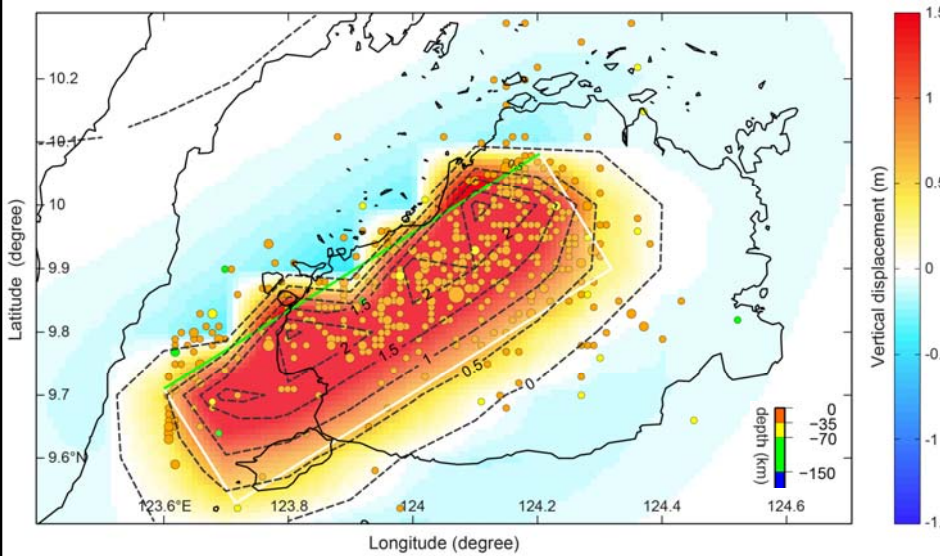
Implications for source fault



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Implications for source fault



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Highlights



- **The 2013 Bohol earthquake is the most damaging surface rupturing earthquake to occur in recent years (after the 1990 Luzon earthquake)**
- **Variable geologic conditions**
 - *Impacts and hazards varied across Bohol Island*
 - *Most damages occurred on karst regions (underlain by the Maribojoc and Carmen Formations)*
- **Field data, focal mechanism solutions and aftershock distribution**
 - *SE-dipping reverse fault*

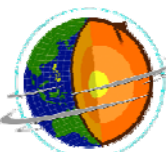
Future work



- **Assessment of karst regions and groundwater conditions**
 - *safer locations and more suitable conditions for evacuation sites and temporary settlements*

Thank you

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