



## **Geological evidence for historical and older earthquakes and tsunamis along the Nankai Trough, Japan**

Ed Garrett (1,2), Marc De Batist (3), Vanessa M.A. Heyvaert (1,4,5), Aurélie Hubert-Ferrari (6), Osamu Fujiwara (7), Yusuke Yokoyama (8), Helmut Brückner (9), Philip Garrett (10), and the QuakeRecNankai Team

(1) Geological Survey of Belgium, Royal Belgian Institute of Natural Sciences, Belgium, (2) Department of Geography, Durham University, United Kingdom, (3) Renard Centre of Marine Geology, Department of Geology and Soil Science, Ghent University, Belgium, (4) RU Quaternary Environments and Humans, Royal Belgian Institute of Natural Sciences, Belgium, (5) Department of Geology and Soil Science, Ghent University, Belgium, (6) Department of Geography, University of Liège, Belgium, (7) Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, Japan, (8) Atmosphere and Ocean Research Institute, University of Tokyo, Japan, (9) Institute of Geography, University of Cologne (Köln), Germany, (10) Faculty of Asian and Middle Eastern Studies, University of Cambridge, United Kingdom

In the wake of the devastating 2011 Tōhoku earthquake and tsunami, the Central Disaster Management Council of the Japanese Cabinet Office issued new guidance for assessing seismic hazards in Japan. Before 2011, seismic hazard assessment relied on source models developed from knowledge of a small number of well-documented historical earthquakes. Less well-known historical earthquakes, including the AD 869 Jōgan Sanriku earthquake, were largely disregarded as their seismic intensities or tsunami heights could not be reconciled with the chosen seismic sources. Following the unexpectedly large size of the Tōhoku earthquake, the Cabinet Office advocated renewed investigation of earthquake and tsunami occurrence over historical and longer timescales, with a particular focus on defining the largest possible magnitudes. The new guidelines pay close attention to the Nankai Trough, the subduction zone where the Philippine Sea Plate dives beneath the Eurasian Plate. The Nankai Trough faces the densely populated and highly industrialised coastline of south central Japan and harbours a widely-known seismic gap along its eastern Tōkai segment. A full-length rupture of the Nankai Trough, including the Tōkai segment, could produce an earthquake with a magnitude approaching that of the 2011 event, with tsunami travel times to the closest shorelines of less than 30 minutes. We review geological evidence for historical and older earthquakes and tsunamis along the Nankai Trough. This evidence comes from a wide variety of sources, including uplifted marine terraces, subsided marshes, liquefaction features, turbidites and tsunami deposits in coastal lakes and lowlands. Examining papers published before and after 2011, we investigate the impact of the new Cabinet Office guidelines on attempts to understand the magnitude and recurrence of these events. Additionally, we introduce the Belgian Science Policy Office funded QuakeRecNankai project, a collaboration aiming to supplement existing records by generating a long time series of earthquake and tsunami recurrence from sites at the eastern end of the Nankai Trough. The project uses a diverse range of geophysical, sedimentological, geochemical and microfossil approaches to investigate records of Holocene paleotsunamis in and around Lake Hamana and records of seismic shaking from the Fuji Five Lakes.