Analysis of Tsunami Hazards in Spain

Article *in* Spatial Science · June 2011

1 author:

Carlos Arteaga
Universidad Autónoma de Madrid

ISSN: 2249-4316

eTraverse

The Indian Journal of Spatial Science

Vol. II No. 2 — 2011

Article 3

Analysis of Tsunami Hazards in Spain

Carlos Arteaga Cardineau

GEOGRAPHICAL INSTITUTE 1949–50

eTraverse
The Indian Journal of Spatial Science

ISSN: 2249-4316

Vol. II No. 2 — 2011

Article 3
Analysis of Tsunami Hazards in Spain

Carlos Arteaga Cardineau

Paper received on 04.06.2011
Paper accepted in revised form on 11.11.2011

Published by
Prof Ashis Sarkar

on behalf of
The Geographical Institute
Department of Geography
Presidency University (formerly College)
86/1 College Street, Kolkata 700073, India
etraverse.ijss@gmail.com
Ph. +91 33 2241 1960 Ext. 206

Typeset and layout by
Computer Club
ccprepress@gmail.com

Analysis of Tsunami Hazards in Spain

Carlos Arteaga Cardineau

The purpose of this paper is to describe the potential risks associated with the 'Tsunamis' or high energy waves, which are often not considered seriously by the people and governments. Studies in recent years in the southern coasts of the Iberian Peninsula (comprising the countries of Spain and Portugal) have shown that in the past, this coastline had been attacked by tsunamis, which affected its people and changed the coastal morphology.

Keywords: Tsunami, Iberia Peninsula.

Introduction

Since the catastrophic event of 2004 in the Pacific and Indian Oceans, the European Union (EU) has launched a project to catalogue and identify the risks associated with tsunami in Europe. Initially it was thought that perhaps only the countries of Italy and Greece are susceptible to tsunami attacks. However, with the progression of palaeogeographical studies of the Holocene Period along the European coastline, somewhat low frequency risks were detected no only in Italy and Greece but also in other areas of southern Europe as well, particularly the Iberian Peninsula i.e in the countries of Spain and Portugal (Fig. 1). With the help of geomorphological and goarchaeological studies, several of such high energy events have been discovered along the Iberian coastline, with the oldest one dating back to be over 7,000 years ago.

Fig 1. Location map. "Red line": areas of greatest risk of tsunami between Spain and Portugal

Geomorphological Setting

One sector of the Iberian coastline that has proved to be particularly sensitive in this regard is the area between Cabo de San Vicente- Gorringe Bank (near Portugal in the Atlantic Ocean) and the Balearic Islands (Spain, Mediterranean Sea). The much renowned Strait of Gibraltar is located somewhat in the middle of this hazard-prone stretch—a strategic point that seems to have been hit by waves of two seas. This location is also quite

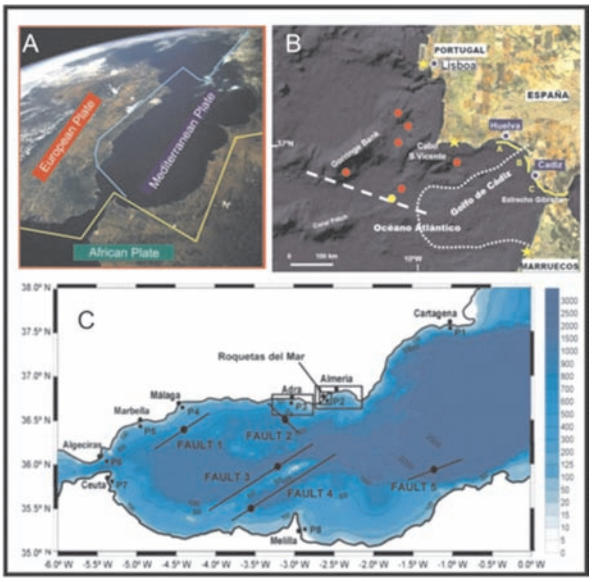

Fig 2. A) Location of plate tectonics;
B) Location map showing the global and detailed grids and the potential tsunamigenic sources in the Mediterranean Coast-Alboran Sea. (Gonzalez et al., 2010); C) Main Epicenter in the Atlantic Coast near Portugal and Spain (Rodriguez Vidal, J., 2010).

close to the contact zone between the African Plate and the Eurasian Plate, the Iberian Peninsula itself being a 'microplate' forming a border between the two continents (Fig.2). The related Plate-tectonics, in turn, explains the formation of the volcanic Canary Islands, or the great reliefs of North Africa (the Atlas Mountains) and the Betic Cordillera in southern Spain.

Methodologies

Two combined methods have been used to investigate the "palaeo-tsunamis" in this region—one is from the sedimentological records (used mainly for those dating from ancient times), and another is the use of documentary sources that have been very effective in the analysis of the latest "tsunamis". The sedimentary records of tsunami in the Iberian Peninsula are usually detected by the following elements:

- The presence of sediments of marine origin (as turbidite deposits) and continental mixed.
- The previous sedimentary stratigraphy (old dunes, spits, marshes and lagoons) which are broken by an erosional surface.
- Marine sediments tend to have significant presence of wildlife (mainly molluscs) and plants (like corals) of seafloor. This differentiates them from storm waves. In some cases, there is even the presence of large stones abnormally far from its original position.
- These deposits are usually found several hundred meters inland.

In relation to documentary sources, the best known case is the 'Lisbon earthquake' and associated tsunami of 1755— perhaps the worst natural disasters in the Iberian Peninsula till date with more than 30,000 deaths. Their effects reached the heart of Europe as there are a large number of documents, books, and even painting of the time time relating the details of what had happened.

On the other hand, what has surprised the scientific community is that sometimes the sedimentary records seem to indicate that tsunamis of some importance, have not been accompanied by any documentary information. For eg, the case of a tsunami in the year 60 AD, which seems to have affected two of the most important Roman cities in southern Spain (Carteia and Baelo Claudia, Cadiz). Despite the modern palaeo-evidences of the earthquake in the Roman city of Baelo, and evidences of a tsunami from the city of Carteia and the Rock of Gibraltar, the Romans left no written testimony about this catastrophic incidence (Lario et al., 2011, Arteaga and Gonzalez, 2004).

In the Atlantic region of the Iberian Peninsula only researchers have found evidence of about 24 tsunamis (see Table 1) which leads to the average assumption of a tsunami in every 300 years. The value would rise significantly if those that had occurred in the Mediterranean side are also added. On the other hand, there is a clear difference between the frequency and intensity depending on the origin of tsunami. According Lario et al. (2011), in the Atlantic zone, the tsunamis are not common but probably very damaging. In the Mediterranean area these had been of lower intensities with short impact over the coast.

Disussion

These low frequencies have meant that the risks have not been properly sensed by the people and governments. Thus in Spain today, there is no plan for prevention and evacuation of the population

Table – 1: High energy events that affected the Iberian Atlantic Coast (compiled from various authors: González, and Medina, 1998; I.G.N., 2003; Arteaga, C. and González, J.A., 2004; Carreño Herrero, E. , 2005; Gonzalez et al., 2010; Lario et al., 2011:)

LOCATION	DATE
Cádiz (Spain)	5.050-4.800 B.C.
Cádiz, Huelva (Spain)	3550-3.450 B.C
Cádiz, Huelva (Spain)	3350 B.C.
Huelva (Spain)	2200 B.C.
Cádiz (Spain)	1950-1650 B.C.
Cádiz, Huelva (Spain)	1400-1050 B.C.
Cádiz (Spain)	218-216 B.C
Cádiz (Spain)	210-209 B.C.
Portugal-Galicia (North Spain)	60 B.C.
Strait of Gibraltar (Spain)	40-90 A.D.
Portugal	382 A.D.
Cádiz (Spain)	881 A.D.
Portugal	949 A.D.
Portugal	1531 A.D.
Canary Islands (Spain)	1705 AD
Portugal	1722 A.D.
Cádiz (Spain)	1731 A.D.
Portugal (Lisbon)-Cádiz (Spain)-Strait of Gibraltar	1755 A.D.
Portugal	1756 A.D.
Portugal- Galicia (North Spain)	1761 A.D.
Portugal	1816 A.D.
Portugal	1848 A.D.
Gorringue (Portugal)	1969 A.D.
Cádiz (Spain)	1978 A.D.

along the coast incase of outbreak of any such hazard. It should also be kept in mind that this is also an area with a high presence of tourists for the quality and quantity of the scenic beaches, the number could be with over 5 million visitors (INE, 2011). Being situated in the seafront and booming European economy, it is also an area with strong pressure of real estate and industrial infrastructure. Therefore, there is a strong need for understanding the data those are coming out from geoarchaeological studies and taking proper measurements and precautions well in advance so that loss of human life and property could be kept at a minimum in case of any such tsunamis.

References

1. Arteaga , C., González, J.A., (2004): Presencia de materiales marinos y dunares sobre un alfar romano en la Bahía de Algeciras (Cádiz, España). In: Benito, G., Díez Herrero, A. (Eds.), Contribuciones recientes sobre Geomorfología. SEG-CSIC, Madrid, pp. 393e400.
2. Careño Herero, E. (2005): La Peligrosidad De Tsunamis En Las Costas Españolas. Simulaciones Tunami Hazard in the Spanish Coasts. Flooding Scenario. Enseñanza de las Ciencias de la Tierra, 2005. (13.1) 60-64
3. GITEC (1995). “Genesis and Impact of Tsunamis on the European Coasts: Tsunami Warning and Observations” (ENV4-CT96-0297).
4. González, M y R. Medina (1998). Probabilistic model for Tsunami-Wave Elevation Along the Alborán Sea. Proc. -26th. Int. Coastal Eng. Conference. ASCE. (pp.1168-1181)
5. Gonzalez, M.; Medina, R.; Olabarrieta, M. & Otero, L. (2010): Tsunami Hazard Assessment on the Southern Coast of Spain. Turkish Journal of Earth Sciences, Vol. 19, pp. 351–366
6. I.G.N. Instituto Geográfico Nacional (2003): Catálogo Nacional de Tsunamis.
7. Universidad de Cantabria (1997). Estudio de Riesgo por Inundación y Evaluación de Daños por Acción de Maremotos en el Litoral Sureste Español (Mar de Alborán). Estudio para el Ministerio de Medio Ambiente.
8. INE, (2011): Información de Turismo en Andalucía para el año 2009. http://www.ine.es/jaxi/tabla.do
9. Lario , J., Za Zo, C., Goy, J. L., Silva , P. G., Bardaji, T., Cabero , A., Dabrio, C. J. (2011): “Holocene palaeotsunami catalogue of SW Iberia”. Quaternary International. doi:10.1016j.quaint.2011.01.036
10. Rodriguez Vidal, J. (2010): Jornada Técnica de Riesgo y Peligrosidad de Tsunamis en España. Predicción y sistemas de alerta. Ministerio del interior.

Carlos Arteaga Cardineau

Department of Geography, Autonoma University of Madrid, Spain;
Visiting Scholar in Charles McBurney Laboratory of Geoarchaeology, University of Cambridge, UK;
Active member of “Geohumedal” Research Group, carteaga2000@yahoo.com