

## **Introductory note to Chilean Tectonics**

A massive earthquake has struck Chile, killing more than 700 people. The earthquake hit at 3.34 local time on Saturday 27 February, originating offshore approximately 8km west of Curanipe, and 115 km north-northeast of Concepción, Chile's second largest city. At magnitude 8.8, this was the eighth most powerful ever recorded, considerably more powerful than the Haitian quake (to which it is not related).

Modern cities in Chile are better prepared for seismic activity, having experienced it numerous times in the past, and the capital, Santiago, was relatively slightly affected with the exception of suspended roadways and flyovers. Nevertheless such a powerful earthquake is extremely destructive to older buildings and poorer homes nearer the epicentre. The inland city of Curicó has reportedly lost its historic 18<sup>th</sup> century centre.

Disaster relief force was deployed within hours of the earthquake. As it was the final weekend of Chile's traditional holiday period, many people were still at the coast and were affected by both the earthquake and the resultant tsunami, although many were able to escape to higher ground due rapid local warnings.

Western South America is a classic example of plate tectonic subduction, where the Nazca plate, produced along the East Pacific Rise, descends below the edge of the continent. This process is the direct cause of the uplift of the Andes mountains and the line of coast-parallel volcanoes (part of the 'Pacific Ring of Fire'). Discontinuous slippage between the descending ocean floor and the continental mass above the subduction zone results in persistent earthquake activity; this is most intense along the coast of Chile, where movement of the descending plate is largely orthogonal and hence at the highest relative velocity (up to about 70 mm/year).

Thus Chile has a long record of some of the powerful earthquakes, that of Valdivia in 1960 magnitude 9.5 being the most powerful ever recorded. The country's second city, Concepción, at 36°50'S has been repeatedly hit by earthquakes exceeding magnitude 8 (1570, 1751, and 1835, whose effects were noted by Darwin), and the nearby inland city of Chillán suffered almost total devastation in 1939. This very approximately 100 year cycle has now been tragically repeated by the 8.8 magnitude earthquake centred offshore at 35°50'S. The critical area from Concepción to the town of Constitución, 170 km to the NNE, was recognized as a long-term earthquake-free zone, reflecting the build-up of energy in the coupled plates – up to 10m of potential displacement being stored, so that the magnitude and approximate location of the 2010 earthquake was not unexpected (Ruegg et al., 2009, *Physics of the Earth and Planetary Interiors*, 175, pp 78–85). This, indeed, seems to be a case

of accurate geophysical prediction of such a disaster, although unfortunately the timing could not be defined, nor the appropriate means of avoiding its effects, considering the vast area affected.

Because this earthquake focus was relatively deep (~60 km), the tsunami was smaller than might have been expected from recent events, and the zone affected was more limited. Nevertheless, peak wave heights of more than 10m have been estimated at coastal localities in the region 37°-34°S, greatly adding to the destruction and loss of life in Talcahuano (the commercial port for Concepción), Dichato, Consituación, Iloca and Pichilemu.

Further technical data and information are available at [www.earthquakes.bgs.ac.uk](http://www.earthquakes.bgs.ac.uk)

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5 March 2010