Option C: The Dynamic Earth

Either

5 **(a)** Study **Resource 5** (page 8 of the Resource Booklet) concerning a legal case following an earthquake. Using the resource **to help you**, discuss the problems of accurately predicting earthquake events in terms of their timing and scale. [7]

(b) With the aid of a diagram, explain the tectonic activity (volcanic and seismic) associated with a destructive plate margin. [8]

(c) With reference to a small-scale case study of a MEDC, discuss how knowledge, perception and stage of development have influenced the management of the effects of earthquake activity. [15]

Or

6 **(a)** Study **Resource 6** (page 9 of the Resource Booklet) which concerns the use of satellites in the monitoring of tectonic plate movement. Using the resource **to help you**, describe this and other evidence for plate movement at constructive plate margins. [7]

(b) Explain the causes and impacts of **any two** of the following effects of earthquake activity:

- ground deformation;
- liquefaction;
- seismic shaking. [8]

(c) With reference to places for illustration, describe and evaluate the social and economic benefits and hazards of volcanic activity. [15]

RESOURCE 5

JAILING OF ITALIAN SEISMOLOGISTS RAISES QUESTIONS OVER EARTHQUAKE PREDICTION

Six Italian scientists and a government official were jailed for multiple manslaughter, after they mistakenly reassured residents of the town of L'Aquila that an earthquake was unlikely. At 6.3 on the Richter scale, the L'Aquila earthquake of April 2009 is by no means the largest to have struck the country – there were 35 tremors of ≥ 6.7 in the preceding century. Nor is it the most damaging – the loss of over 300 lives, though certainly significant, is small compared to the numbers lost as a result of previous events.

All seven of the defendants, members of the Serious Risks Committee, were part of the seismic risk monitoring process; their role was to evaluate the risk of a significant tremor and advise the population accordingly.

A week before the earthquake of 6 April, the seven met to discuss the implications of a number of minor tremors and "*issued a reassuring statement, while also saying that it was not possible to predict whether a stronger quake would occur.*" The meeting also concluded that "*just because a number of small tremors had been observed, it did not mean that a major earthquake was on its way.*"

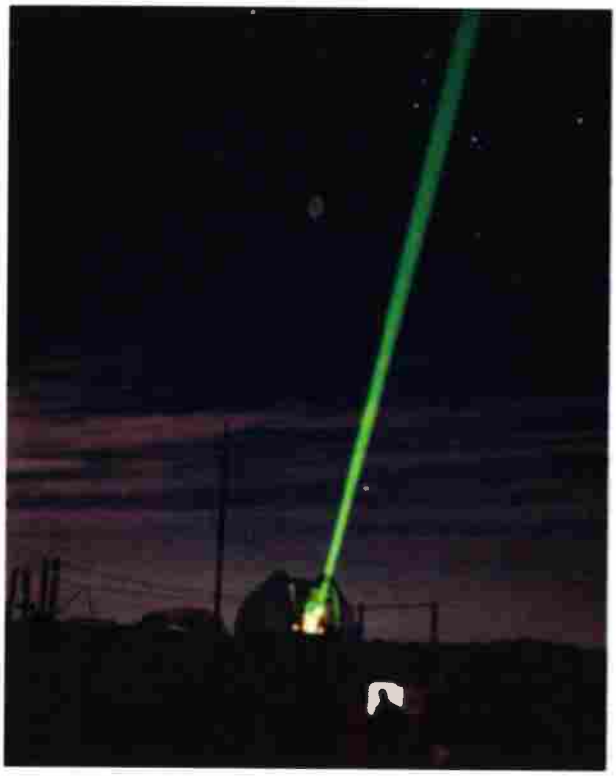
In the trial, the prosecution's case rested on the fact that these 'false reassurances' led some people to remain in their homes rather than evacuate to a place of safety. The defence argued that the accurate prediction of major earthquakes is impossible – a fact which had been noted by the scientists in the minutes of their meeting. The United States Geological Service (USGS) confirms this view. In the FAQ section of its website it answers the question 'Can scientists predict earthquakes?' with "*No, and it is unlikely they will ever be able to predict them.*"

Jennifer Young, 24th October 2012

Source: adapted from http://www.decodedscience.com/jailing-of-italian-seismologists-raises-questions-over-earthquake-prediction/19157

RESOURCE 6

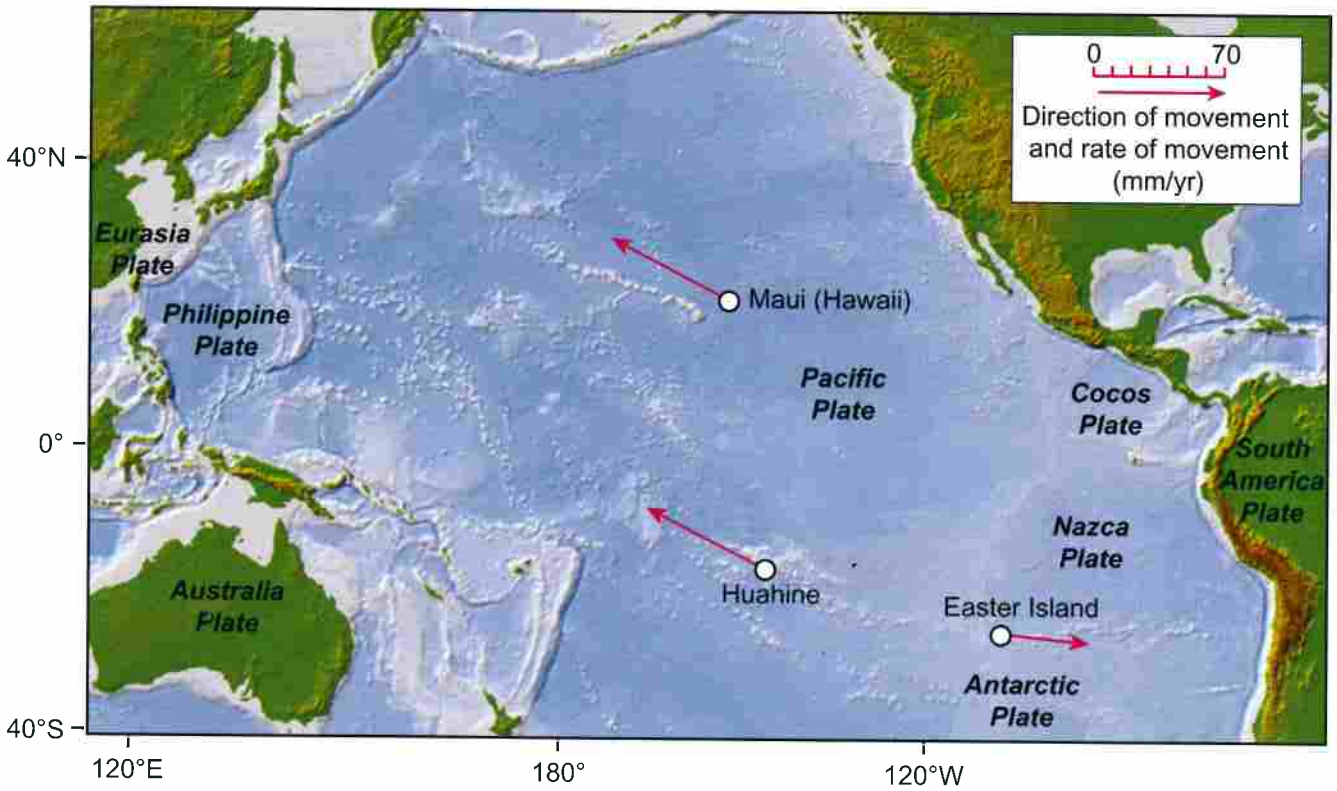
THE USE OF SATELLITES IN THE MEASUREMENT OF PLATE TECTONIC MOVEMENT



A global network of stations uses Satellite Laser Ranging (SLR) to measure the round trip time of ultra-short pulses of light to satellites equipped with special reflectors.

This produces data on the location of ground stations accurate to one mm per year. The results have been used to measure plate movement as evidence of convection currents within the Earth's mantle. Data for a station in the Hawaiian Islands (Maui) shows it is moving north-west at a rate of 70 mm each year. The map below, of the Pacific Ocean basin, shows this and other plate movements calculated using SLR data.

Plate movement on the Pacific Ocean Basin



Source: Principal Examiner adapted from on-line sources including the USGS website

SECTION A: PHYSICAL GEOGRAPHY

RESOURCE 1A

SHORELINE MANAGEMENT, SEATON, DEVON

Seaton is a small seaside town in Devon, situated in a UNESCO World Heritage Site and an Area of Outstanding Natural Beauty. At the front of the town, a 1.5 km esplanade walk lies above a long, shingle beach, easily accessed and enjoyed by visitors of all ages. However, a large number of the town's tourism facilities, commercial and residential properties are at risk from coastal erosion.

A Shoreline Management Plan sets out a "Hold the Line" policy, through which existing defences will be maintained to protect the commercial heart of the seaside town. The short-term policy (until 2025) is to maintain existing seawalls and revetments. The medium-term policy (2025–2055) is to rebuild existing defences to be much larger, in order to provide adequate long term protection as sea levels rise. Beach nourishment may also be required. The long-term policy (2055–2105) is to maintain these enlarged defences.

It is recognised, however, that it may not be economically justified or environmentally acceptable, to prevent coastal erosion in the less commercialised areas of the town's coastline. In these areas, the long-term policy is to allow limited cliff erosion to occur with some risk to cliff top properties.

Source: adapted from www.seatonbay.com and www.sdadcag.org

RESOURCE 1B

COASTAL DEFENCES, SEATON, DEVON

Source: Principal Examiner

RESOURCE 1C

COASTAL DEFENCES, SEATON, DEVON

Source: Principal Examiner

RESOURCE 2A

CHRISTCHURCH HARBOUR MANAGEMENT PLAN

The town of Christchurch lies in the lower sections of the flood plains of the Rivers Avon and Stour, where they reach Christchurch Harbour. Housing developments line the banks of both rivers. The town's existing river defences are designed to cope with a 1 in 100-year flood event – a one percent probability. However, should an even more serious event take place, defences would be overtopped and properties put at risk.

Christchurch is a popular tourist and recreational venue. It offers leisure boating, windsurfing and rowing facilities and nearby Mudeford Quay is the centre of the local sea fishing industry.

Source: Principal Examiner

RESOURCE 2B

HIGH DENSITY RESIDENTIAL DEVELOPMENT ADJACENT TO THE RIVER STOUR, CHRISTCHURCH, DORSET

Source: Principal Examiner

RESOURCE 2C

MARINA FACILITIES, CHRISTCHURCH, DORSET

Source: Principal Examiner