Geofacts

MEASURING CRUSTAL DEFORMATION ON CANADA'S WEST COAST

The Restless Earth

The crust of the earth is made up of plates the size of continents that are in constant motion. The movements are only a few centimetres each year but are the cause of such spectacular geological events as earthquakes and volcanic eruptions. Over millions of years, these small movements form ocean basins and mountain chains.

The plates of the crust are rigid and as they rub against each other they create strain — especially at their edges. If the strain builds quickly, the earth's crust may suddenly shift by several metres causing an earthquake. If it builds gradually, there is often a slow deformation that can be measured at the surface.

The patterns of this deformation can tell scientists how fast, how consistently and in what direction the plates are moving. This information can also be used to decide if an area could have earthquakes and perhaps whether or not a large earthquake is imminent.

Measuring Changes

There are several ways of measuring crustal deformation.

- Levelling surveys can measure elevation differences between points to an accuracy of a few millimetres. Repeated surveys are used to locate areas of local uplift or subsidence. For example, levelling surveys in Japan have found three phases in an earthquake cycle: (1) high rates of crustal tilting preceding an earthquake; (2) sudden uplift or subsidence during an earthquake; (3) gradual recovery after an earthquake.

- Gravity surveys measure changes in the strength of earth's gravity field. These can be due to changes in elevation because the local gravity field is related to the distance from the centre of the earth. They can also be due to changes in the density of the underlying rocks as minute cracks are created, filled with water or squeezed shut. Elevation changes of a few centimetres or density changes as small as 0.01% can alter the surface value of gravity by tens of microgals (1 microgal = 10^{-8} metres per second per second).

- Horizontal control surveys measure angles (triangulation) and distances (trilateration) between fixed points. Small changes in the positions of reference points can be detected with great precision. Horizontal crustal deformation in active earthquake areas can be large enough to be detected by surveys repeated at three to five year intervals.

.../2

Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

A tool for Understanding Earthquakes

Deformation measurements now taking place in Canada are focused in the areas of highest earthquake risk. Central Vancouver Island is one of these areas, having had three large (magnitude 6) earthquakes in this century. Surveys begun in 1977 have indicated that the region could be in the first phase of an earthquake cycle.

Although the deformation measured is small, it is similar in size to that seen in many of the world's most active earthquake zones. Scientists hope that by making more surveys in greater detail they will be able to improve their understanding of the plate movements in the region. This could lead to better estimates of when and where future large earthquakes will occur on Canada's south-west coast.

For further information, please contact the Geological Survey of Canada:

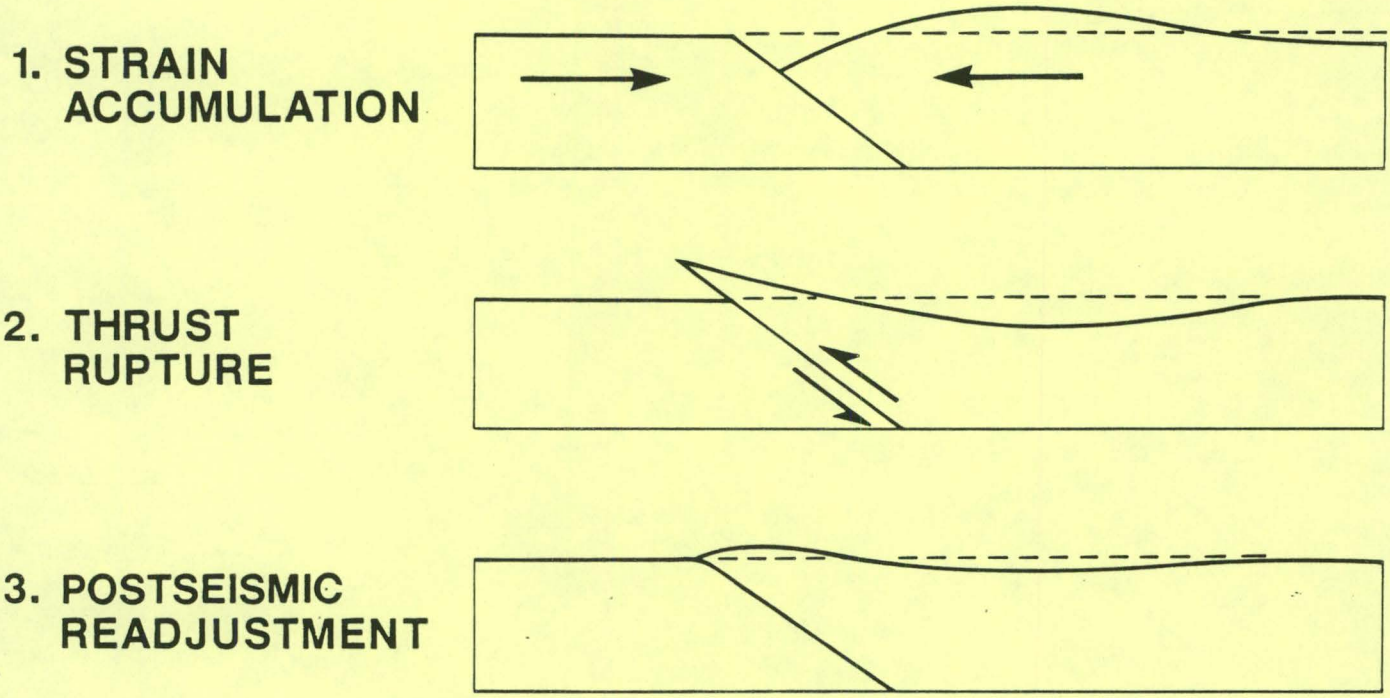
Pacific Geoscience Centre
Geological Survey of Canada
Box 6000
Sidney, B.C.
V8L 4B2
(604) 363-6500

or

Geophysics Division
Geological Survey of Canada
1 Observatory Crescent
Ottawa, Ontario
K1A 0E8
(613) 995-5548

June 1991

DEFORMATION CYCLE FOR A SUBDUCTION THRUST ZONE



1976 TO 1985 OBSERVED TILTING ACROSS CENTRAL VANCOUVER ISLAND