GCOE&AOB Seminar

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Date : June 19, 2009 (10:00-11:30)

Place: Research Center for Earthquake and Volcanic Eruption, Annex Bldg, Meeting Room #1

Title: GPS and Seismicity Analysis of Tectonics and Stress in the Cascadia Subduction Forearc

Abstract

In western USA and Canada, the Cascadia Subduction Zone produces different tectonics and seismicity patterns in the forearc region. The central forearc is migrating northward along the margin as a rigid block. The northern segment of the forearc can be divided into two very distinct regions based on the deformation style and seismicity. In the eastern side forearc, both intense seismicity and active faults indicate N-S shortening of the Puget Lowland. The western forearc is marked by the presence of the Olympic Mountains accretionary complex, where the main direction of long-term shortening is debated. We compare the stress and strain derived from active faults, GPS velocities, and seismicity to constrain the present-day and long-term deformation patterns of the northern Cascadia forearc. Continuous GPS velocities show that the present-day deformation is dominated by the interseismic locking of the Cascadia subduction fault. After correction for this elastic transient deformation, the GPS velocities show a clear long-term N-S shortening rate of 3.2 ± 0.8 mm/yr. This rate is in good agreement with the shortening rate estimated by integration of earthquake statistics (Gutenberg-Richter statistics), which yields a seismic shortening rate of 2.9 ± 1.2 mm/yr. Paleoseismic studies on 11 fault zones provide a total N-S shortening of ~36 meters during the Holocene. Thus, in the northern Cascadia forearc region, we find a good agreement between rates of N-S horizontal shortening estimated using GPS, catalogue seismicity and Holocene paleoseismic data. About 50% of the total Holocene shortening occurred during large earthquakes on several faults at or about the same time as the penultimate Cascadia subduction zone earthquake. This suggests that abrupt shortening in the northern Cascadia forearc region follows great subduction zone earthquakes and could trigger earthquakes on shallow crustal faults, like the Seattle fault.

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