Using ground-penetrating radar for detection of geological evidences of intraplate & subduction earthquakes in Kamchatka, Russia.

T.K. Pinegina (1), E.A. Kravchunovskaya (1), V.V. Ponomareva (1), J. Bourgeois (2), M.E. Korovin (3), S.A. Chirkov (1)

1) Institute of Volcanology & Seismology RAS, Petropavlovsk-Kamchatskiy, Russia, 2) University of Washington, Dept. of Earth and Space Sciences, Seattle, USA, 3) Institute of Marine Geology & Geophysics, RAS, Yuzno-Sakhalinsk, Russia (pinegtk@mail.ru / Fax: +7(415-22) 51323 / +7(415 -22) 59577)

The Kamchatka segment of the Pacific "Ring of Fire" is one of the most active seismic and volcanic regions in the world. On Kamchatka are located 30 active volcanoes. During historical time records (since 1737) here occured more than 20 large explosive eruptions. Kamchatka's subduction zone can generate catastrophic earthquakes & tsunamis. For example, 1952 earthquake was one of the largest in the world in 20-th century. Kamchatka's catalogue includes more than 10 strong & destructive tsunami events.

Earthquakes on Kamchatka occur not only on the plate-boundary, there are also evidences of strong intraplate earthquakes. However their recurrence interval is comparable to the period of historical observations or even longer, this is why there is not enough data about them. Since the historical catalogue for Kamchatka is quite short, paleoseismologycal studies are the only opportunity to obtain the data about intensity, recurrence interval and spatial distribution of seismic events and the phenomena associated with them.

Specific methods of paleoseismologycal investigations on Kamchatka include: 1) application of tephrochronology and tephrostratigraphy for dating and correlation of various types of coastal deposits and landforms; 2) study of paleotsunami deposits in order to determine their ages and recurrence rate and to estimate the magnitude of large tsunami and tsunamigenic earthquakes; 3) analysis of geological structure, age and paleo-topography of marine terraces in order to determine the direction and rate of seismotectonic movements over different time intervals 4) study of landslides along coast - to determine their age and genesis; 5) study displacements along the fault systems – to understand the age and frequency of intraplate earthquakes.

During last few years we began to use ground-penetrating radar (GPR) "OKO" (made in Russia) for our field research. We use 3 aerials with the central frequency 700, 250 and 50 MHz. Depth of sounding is 3, 8 and 25 m accordingly, with 0.1, 0.2 & 1 m resolution. With GPR we investigate geological evidences of both types of earthquakes

- subduction and intraplate.

Studying intraplate earthquakes traces we carry out georadar profiling directly through a faults. Using GPR profiles we can choose the best place for trenches and excavations, predict the necessary depth of them and estimate displacement at the different parts of faults. Moreover, in some cases we can preliminary define the fault mechanism.

When we study subduction earthquakes, it is impossible to carry out GPR measurements directly through the faults, because the seismic source is offshore. However during the strong subduction earthquakes the coasts, which are close to the source, are co-seismically subsided or uplifted. In a case of coastal subsidence, the GPR help us to make geological excavations in the exact place to find the buried scarps, which were formed after earthquakes. This data give us possibility to get the information about the age of strong earthquakes along the subduction zone and about the amplitude of co-seismic deformations, associated with them. Comparing data about paleo-tsunamis and co-seismic deformations on the coast, we can identify the largest earthquakes, which occured along Kamchatka subduction zone in Holocene.

Using GPR in paleoseismology is comparatively new method, however in a complex with the other geological methods it is an excellent tool, which considerably expand our opportunities.