The Armutlu Network: An Investigation on Seismotectonic Setting of Armutlu-Yalova-Gemlik and Surrounding Regions

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Abstract

Yalova-Armutlu-Gemlik region is located on the western-southwestern part of the 1999 Kocaeli rupture. This region is characterized by strong deformations and is located between two main strands of the North Anatolian Fault system. The Armutlu peninsula is believed to be adjacent to the Intra-Pontid Suture Zone or is even a part of it. This zone and region has a key role to understand neo-tectonic feature of the region and the interaction between high seismicity with high thermal activity and neo-tectonic faults originated by ongoing movement of the two branches north and south of Armutlu. A horst and graben structure appears in this region whereby the Armutlu Peninsula represents a horst between this two branches of the North Anatolian Fault System, resulting in a complex dextral tectonic.

In order to have a better understanding of the relation between micro-earthquake activity, hydrothermal activity and recent stress state of the study region, ARNET (Armutlu Network) was installed at September 2005 with 10 broadband seismic stations. After 6 months, another 10 short period REFTEK stations were added to this network. As a result, we now have 23 seismic stations and 5 hydrothermal stations in and around Armutlu peninsula. In June 2009, we replaced REFTEK digitizers with GURALP digitizers at the short period seismic stations. We also could realize ADSL data transmission at 5 seismic stations. Currently, we are in the process of installing online communication system to the remaining seismic stations of our network. We also installed SeisComp software for data acquisition and automatic location procedure. This system is now in the testing phase.

We obtained preliminary micro-earthquake activity of the said region and it shows that the (present) seismic activity increased after the 1999 events at the western part of the 1999 rupture zone while the rupture zone itself is quiet. Micro-earthquake activity shows some clusters but most of them are unexpectedly scattered. This region is highly deformed and is of

a brittle structure with many small, medium-sized faults, and it contains metamorphic rocks. The tectonic structure, geology, and aging of the rocks are still under discussion and there is no consensus about them. We believe that this region has very complex tectonic features and thus seismicity is not showing clear clustering and lineaments along the well-known faults traces. Beside seismicity we monitor hydrothermal activity, pressure changes of hot-springs and natural water wells combined with water leveling, temperature and chemical content in this region to reveal the interaction between micro-earthquake activity with hydrothermal reservoir behavior. We are also trying to obtain 1-D and 3-D velocity structure for this region to improve the location of micro-earthquake activity.

The Armutlu-Yalova-Gemlik region has a very complicated tectonic structure and expresses scattered micro-earthquake activity. Upper part of the crust shows low velocity zone conforming to present tectonic activity and brittle deformed metamorphic rocks. We need to analyze more earthquake data and to improve 1-D velocity models with active seismic by using data from quarry blasts or by conducting seismic experiments. Recent seismic activity is confined to Gemlik Bay, Yalova Termal regions. Therefore, and special attention is needed to monitor seismic activity in these regions to understand likely and forthcoming larger event(s) in the Marmara Region. We believe that this region will play an important role to understand the formation of the next larger earthquake on the western extension of the North Anatolian Fault System.

Keywords: micro-earthquake activity, clustering, 1-D crustal structure, 3-D velocity structure, hydrothermal activity, SeisComp.