Relevalence of seismic activity between the inland crustal earthquakes in Hidaka district, Hokkaido and the great interplate earthquakes along the southern Kuril Trench

*Tetsuo Takanami[1,2]

1. Hokkaido Research Center of Geology, 2. Carnegie Institution for Science

The Hidaka Mountains in southern Hokkaido may be the result of squeezing deep matter in the collision zone due to the east-west shortening movement of the Kuril forearc since the late Miocene. However, it has been reported that its activity declined in the late Pliocene [1] [2]. On the other hand, the recent activity of inland crustal earthquakes within a depth of about 40 km is high in the Hidaka Mountains and its western region. The 2018 earthquake (Mj6.7) which occurred near the eastern margin fault zone of the Ishikari Lowland, is the largest inland crustal earthquake ever recorded in Hokkaido. According to various observation data, this earthquake is a reverse fault type due to east-west compressive stress, and is a fault motion in harmony with the tectonics of the Hidaka Mountains. So, in order to consider the current tectonics in the Hidaka region, it is important to examine the relationship between the seismic activity along the southern Kuril trench (especially for the interplate earthquake) and that in the Hidaka region. Here, using earthquake data from the 20th century onwards, we examine the chronological relationship of the seismic activity. As a result, it was found that there was a clear difference in seismic activity between the quiet period and the active period each area. However, during the active period of inland seismic activity, there were almost no huge interplate earthquakes along the southern Kuril trench and vice versa and the active periods do not overlap. According to the strain rate map [3] based on the GNSS data from 2005 to 2009, large strain rate values are observed in the coastal area along the southern Kuril trench to the volcanic front, but smaller values are distributed further inland area. Zones where the slightly higher strain rates are locally concentrated include the volcanic belt from Kunashiri island to the Tokachi volcano group, the Abashiri Tectonic Line, the Tokachi Plain adjacent to the epicenter of the 2003 Tokachi-oki earthquake, and the western foothills along the Hidaka mountains, and the epicentral area of the 2018 earthquake. According to the velocity distribution [4] imaged by seismic tomography analysis, the source region of the 2018 earthquake corresponds to the region where the seismic velocity changes significantly. Such a region corresponds to an intensity boundary where a hard part and a soft part are in contact, and implies a region where distortion tends to concentrate. Therefore it can be inferred that a large inland crustal earthquake is likely to occur because the source region is in an environment that accumulated such strains for many years. Moreover the focal mechanism solution supports the westward movement of the Kuril forearc sliver. From the viewpoint of plate tectonics there, the origin of the movement is the collision force acting when the subducting Pacific plate sinks along the southern Kuril trench, which is the combined force of the subducting Pacific plate with slab pull and effective ridge forces [5]. In the case of the southern Kuril forearc, its collision force is decomposed into components parallel and orthogonal to the volcanic front due to oblique subduction of the Pacific plate. The westward movement of the Kuril forearc sliver is caused by a force component parallel to the volcanic front. Therefore, it can be said that the earthquake observed in the west extending area of the southern Kuril forearc, which is moving westward, is closely related to the huge interplate earthquake expected along the southern Kuril trench.

[1] G. Kimura & K. Kusunoki (1997), [2] G. Kawakami et al. (2006), [3] T. Nishimura (2017), [4] M. Matsubara et al. (2017), [5] T. Seno (1999).

Keywords: Inland crustal earthquakes in Hidaka area, Strain concentraiting field in Hidaka area, Huge interplate eartquakes under the southern Kuril forearc.