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Seismic velocity structure around Izu-Oshima volcano

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Izu-Oshima volcano is one of active volcanoes in Japan, where inflations of volcanic edifice followed by small deflations are observed every two or three years. It shows that magma is stored beneath the volcanoes intermittently. It is important to reveal the effect of seismic velocity structure on the magma storage process, because the upwelling of the magma should be controlled by the underground density structure. Around Izu-Oshima volcano, seismic explorations were carried out in 1999 along NNW-SSE directed survey line. In 2009, the same kind of exploration was carried out along the WSW-ENE directed survey line. The survey lines of the explorations are perpendicular each other and the joint analysis of the both data will be expected to reveal detailed velocity structure beneath the volcano. The data processing of the exploration in 1999 has been completed. In this presentation, we explain the preliminary results from the 2009 exploration.

In the 2009 exploration, we deploy 39 ocean bottom seismometers (OBS) at the interval of around two kilometers along the survey line. The line passes through Izu-Oshima island and the central summit of the volcano. On the island, we also deploy around 300 seismometers with spacing of around 50m. Total length of the survey line is approximately 60km. We explode dynamites of 300kg weight at 9 points along the survey line below sea level. In addition, we also use pressure source (air-gun: capacity 50 litters) around the coast of the Izu-Oshima island and along the survey line. The shot interval is approximately 80m.

In the first step, the velocity is the estimated from onset times of refracted waves generated by pressure source. The spacing of the pressure source is very dense, and the velocity structure can be estimated until the depth of 3km in high resolution. The alignment of the whole survey line is aligned almost linearly, we can safely assume that the data processing based on 2D is valid in our case. Using the 2D ray tracing code by Zelt and Smith (1992), we estimate the P wave velocities in the layers and the top depth of each layer. From the analysis, the velocity in the first layers can be estimated as 1.7-2.0km/s, the second is 2.5-3.2km/s, and the third is 4.0-4.8km/s. In the second step, we estimate the deeper structure using the travel times of refracted waves from the dynamite shots. Here, the shallow structure is fixed one estimated in the previous step. The we can get the velocity of the basement is 5.8-6.2km/s, and the profile of the boundary.

From the above analysis, we can estimate the velocity profile beneath and around Izu-Oshima volcano. The features of the profile are listed below.

1) The subduction of the Philippine Sea plate at Sagami trough can be clearly imaged by the data acquired in the east end of the survey line. The dip angle of the subducting plate is around 20 degrees.

2) The depth of the basement layer with the velocity of around 6km/s is gradually inclined from 4km to 2.5 km in the west side of Izu-Oshima volcano and declined rapidly from 2.5km to 4.5 km in the east side. The convex profile of the basement is common feature beneath the volcanoes.

3) The velocity structure inside of the Izu-Oshima estimated here is almost coincide with the result of the 1999 exploration..

And we will move to process the later phases observed at the station inside of the Izu-Oshima island.

4) The SxP waves reflected at the depth of 8 to 10 kilometers are probably observed at focal distance of around 10 kilometers. More systematic analysis is needed to estimate the precise depth of the reflector.

5) The area of high attenuation of seismic waves is located around central summit of the volcano. And scattered waves are dominant in high frequency components at the stations located inside of caldera region. It shows that the structure beneath the caldera is very heterogeneous.

Keywords: Izu-Oshima Volcano, seismic velocity structure, structure beneath volcanic edfice