

## A discussion on the synthetic reflection seismogram derived from the sonic log obtained at the academic drilling hole in

TSUTSUI, Tomoki<sup>1\*</sup> ; OSHIMA, Hiromitsu<sup>2</sup> ; TANISE, Masazumi<sup>3</sup> ; YAHATA, Masahiro<sup>4</sup>

<sup>1</sup>Akita University, <sup>2</sup>Hokkaido University, <sup>3</sup>Oyo Corporation, <sup>4</sup>MY-Geol

A synthetic reflection seismogram derived from well-logging at the drill hole in 2000's craters of Usu volcano is presented. The purpose is understanding shallow structure which controls volcanic phenomena at the surface through correlating with the seismic section. Such direct correlation has not done in the vicinity of active crater.

An academic drilling project in 2000's crater of Usu volcano has run since 2009 to 2013, as a part of Observation and Research Program for Prediction of Earthquakes and Volcanic Eruptions. The drilling point is located at the maximum upheaval point in the swelling area associating 2000's activity. The seismic reflection profiling is executed through the drilling point in order to detect structural evolution associating decaying volcanic activity. The drilling point is located at 350m from the north end of the seismic profile.

Core samples and logging data were fully obtained down to 500m depth from 90m below the surface. P-wave and S-wave velocity was measured at each 1m with suspension type sonde in the hole. Typical specimens were chosen from the core samples and their seismic velocity and density were measured in the laboratory under natural, wet and dry states.

Density is necessary to derive synthetic seismogram from logging data. However the logging data does not include direct measurement of density. Then, empirical formulas were derived from laboratory measurement of the specimens and used to estimate density from velocity at depths.

Although the target zone was beneath the water table, the formula for the natural condition is used to derive the density for the actual calculation. In the density derivation, typical velocities at the depth are obtained through the median filtering with 10 point length. Surface velocity down to top of logging data is interpolated linearly from the result of seismic profiling in the vicinity.

Synthetic reflection coefficient was calculated for each 1ms over 0.288s from 0.134 to 0.422s, whose input was the logging velocities and derived densities. Bandpass filtered seismogram were compared with the seismic profile, whose passband is 12-48Hz with refer to predominant frequency about 24Hz in 0.1 to 0.2s of the seismic profile. Four clear reflection events at 0.161, 0.209, 0.279, 0.307s are found in the filtered synthetic seismogram.

Although clear event at 0.27s is observed in the profile, the latest event at the same time in the synthetic is not clear. Lateral variation in little bit later reflection horizon is observed at 0.307s in the profile. The event at 0.209s in the synthetic is correlated clearly in the profile. The event at 0.16s in the synthetic looks clearer than that in the profile.

Because discrepancy in the appearance may be caused by choice of the empirical formula for the density derivation, Other formulas were tested in the obtained synthetics. There was no clear amplitude difference in the obtained synthetics except for that of 0.279s. It is concluded that the empirical formular is acceptable and synthetic is fair approximation of the zero-offset seismogram at the site.

Keywords: Usu Volcano, Academic drilling, Well-logging, Synthetic seismogram, Active crater