2nd seismic and temperature measurements using DAS and DTS measurements at the Medipolis geothermal field, Kyushu, Japan

*Junzo Kasahara[1,2], Yoko Hasada[1,3], Hiroyasu Kuzume[1], Hitoshi Mikada[4], Yoshihiro Fujise[1,5]

1. ENAA, 2. Shizuoka Univ., 3. Daiwa Exploration and Consulting Co. Ltd., 4. Kyoto Univ., 5. Welma Co.Ltd.

To obtain highly efficient geothermal sources, great efforts to use supercritical water reservoirs have been done by many countries including Japan. To investigate presence of any supercritical water zones, we deployed optical fiber systems in the borehole at the Medipolis geothermal field in the southern Kyushu, Japan. We measured temperature and seismic waves by DTS and DAS modes using optical fiber system, respectively. The optical fiber system was deployed to the depth of 977 m and 1,545 m in 2018 and 2019, respectively. We also deployed 3C surface seismometers in the test field. Using DTSs, the temperature was measured as 272.8˚C at 918-m deep (Fig.1).

In 2018, seven natural earthquakes were observed by DASs and surface seismometers for four and a half days (Kasahara *et al.* 2019). Through the comparison of the DASs and 3C seismometers records, we recognized the presence of the P-to-S conversion phases on the NS and EW components of surface seismometers. The P-to-S conversion phases can be explained by the structure model with a zone of *Vp/Vs*~3 at approximately 4-km deep (Kasahara *et al.*, 2020b).

In 2019, we conducted DAS-VSP measurements for five source locations along the 2-km long EW line using a MiniVib seismic source (Kasahara *et al.*, 2020a). We used 10-m gauge length for the DAS measurements and the seismic data were obtained with the 1-m spacing. We used the MiniVib for 10 to 75 Hz frequency sweep during 30 s at every minute. Because the power of the MiniVib seismic source was not powerful enough to obtain deep penetration of seismic waves, we stacked the seismic data for 480-960 times to improve the S/N. By the 960 times stacking, the S/N ratio could be improved as 30 times.

Analyzing the DAS waveforms, we obtained the velocity structure models of *Vp* and *Vs* down to 4-km deep (Fig. 2). Using migration of reflected arrivals of DAS records, we obtained the reflection image near the well. The reflection image is superposed on *Vp/Vs* profile as seen on Fig. 2. The results suggest the presence of high *Vp/Vs* zone at the depth of approximately 3.6 km (Kasahara *et al.*, 2020a).

This high *Vp/Vs* zone is probably identical as that suggested by the interpretation of the P-to-S conversion phase. The *Vp/Vs* value corresponds to Poisson’ s ratio being equals to 0.467, and it might be caused by high water saturation zone, possibly supercritical water.

Acknowledgements

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Keywords: geothermal area, DAS, geothermal reservoir , supercritical water, offset VSP, DTS

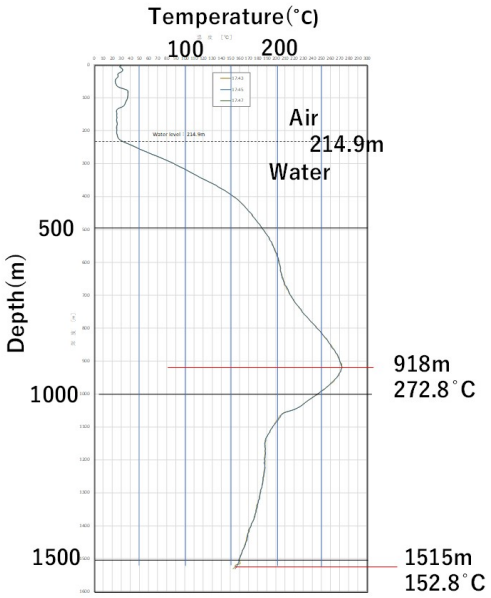

Figure 1: Temperature distribution in the IK-4 well

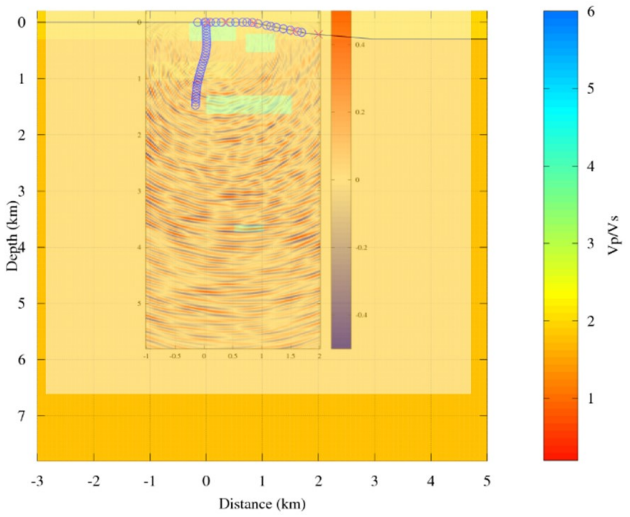

Figure 2: *Vp/Vs* and reflection image using DAS-VSP data.

