

The active fault distribution and their origin based on sonic prospecting in Beppu Bay, Japan

Keitaro Yamada^{1*}, Keiji Takemura², Tsuyoshi Haraguchi³

¹Division of Earth and Planetary Sciences, Graduate School of Science, Kyoto University, ²Beppu Geothermal Research Laboratory, Institute for Geothermal Sciences, Graduate School of Science,, ³Haraguchi Tsuyoshi Department of Geosciences, Graduate School of Science, Osaka City University

Beppu Bay is located at the northeast end of the region called the Beppu-Shimabara graben (Matsumoto, 1979) in the central Kyushu, Japan. According to Itoh et al. (1998), the formation process of Beppu Bay is divided into two stages (Stage 1 and 2); especially pull apart basin was initiated in Stage 2 after 1.5Ma and has been subsiding. Therefore thick Quaternary sediment is preserved and many normal faults develop in the bay. The active fault trace and activity level was discussed using sonic prospecting and piston core in the shallow part (Okamura et al., 1992; Ooita prefecture, 1999), and the structure and tectonics was discussed using reflection survey and gravity prospecting in the deep part (Yusa et al., 1992). However, the relationship between the deep part structure and the shallow part structure are not discussed.

The sonic prospecting used Strata Box manufactured by SyQwest Company which was a portable high resolution sediment imaging instrument. Using frequency was 10 kHz and position was recorded by GPS at the same time. Sonic prospecting was carried out 468 km in total with a focus on reflection survey line in Yusa et al. (1992) on April 2nd, 4th, 13th, 14th, 15th and 16th, 2012.

As a result, the clear faults which cut a reflection surface were confirmed in 120 points in the bay. These faults were concentrated in the north central and western part of the bay. The normal faults around northwest of the bay were several kilometers long indicating parallel distribution including listric fault. Dip direction of these normal faults was opposite to each other. According to reflection survey data in Yusa et al. (1992), these normal faults reached about 300m depth and were located on the anticline topography of the lower unit. The southwest part of the bay was the deepest part, and fault traces are not clear. The indistinctness part attributable to the dispersion with the gas was pointed out by Allis et al. (1989). According to reflection survey data in Yusa et al. (1992), the indistinctness part existed to about 300m depth. In central part of the bay, there was Central Beppu Bay Fault (CBBF) and the indistinctness part along this fault. Folded structure which develops along CBBF was confirmed by distribution and depth of the Kikai-Akahoya tephra (K-Ah). These folded structures reach about several kilometers depth by Yusa et al. (1992). In the western part of CBBF, Many normal faults were distributed on this folded structure. In the mouth of the bay, many normal faults were confirmed. However, the detailed structure distribution did not become clear because of bad weather and the surface strong reflection layer composed of thick sand.

The distribution of the normal fault in the northwest of the bay is similar to active fault distribution of Kuenohira-yama (Chida, 1979) located in the west of the same tectonic province. Therefore, the normal fault in the northwest part is regarded as fracture that developed in the anticline formed Hiji volcano which was estimated around Beppu Bay (Ishizuka et al, 2005). Normal faults on the fold structure in the central part of the bay are fracture which reflected the rollover structure which pointed out by Takemura et al. (1992), because the fold structure reflects the deep part structure. On the other hand, CBBF is related to earthquake which generated in this area because CBBF accords with Beppu Bay Tectonic Line and reaches to the deep part. Lastly, the information of gas distribution is important to consider to tectonic movement in the bay because the indistinctness part attributable to the dispersion with the gas in the layer exists to several hundred meters depth and is distributed along CBBF.

Keywords: Beppu Bay, sonic prospecting, active fault, rollover, pull apart basin