Geological and thermal structures along the Butsuzo Tectonic Line in the eastern Kyushu

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INTRODUCTION The age gap of 20-30 My exists between the Butsuzo Tectonic Line (BTL), bounding the Southern Chichibu and Shimanto Belts distributed in the outer zone of southwestern Japan. The cause of the gap has been explained by tectonic erosion with the subduction of the plateau (Wakita et al., 2018) or reactivation of the BTL (YORG, 2012), but no clear conclusion has been found. Recently, the thermal structure has been estimated along the BTL in the Kanto Mountains and Shikoku region (Sakaguchi, 1996; Hara et al., 1998).
In the eastern Kyushu region, the gap of maximum temperature exists across the BTL (Ohmori, 1999). Elucidation of the causes of these gaps is important to understand the tectonics of the Jurassic to Cretaceous accretionary complexes. However, the thermal structure along the BTL has not been investigated enough. Then, in this study, geological survey and Rm measurement were carried out to investigate the thermal structure of the Southern Chichibu and Shimanto Belts distributed in the Saiki area, Oita Prefecture.

GEOLOGICAL SETTING The Southern Chichibu Belt (the Shakumasan and Yukagi units, with Tsui formation) is separated from the Cretaceous Shimanto Belt (Lower Saiki subgroup) on the south by the BTL. The Shakumasan unit (the imbrication of oceanic plate stratigraphy) and the Yukagi unit (the mé lange facies) are overlain by the Tsui formation (the shelf and forearc facies). The U-Pb ages of each unit are 158 Ma for the Shakumasan unit, 144 Ma for the Yukagi unit, 140 Ma for the Tsui formation, and 108 Ma for the Lower Saiki subgroup.

METHOD 1-8 samples were collected from the sandstone of each unit for the Rm measurement. The pulverized samples were sieved and the carbonaceous materials were separated using heavy liquid. The carbonaceous materials were observed by a reflection microscope, and the reflectance of vitrinite was measured. The equation of Sweeney and Burnham (1990) was used for temperature conversion.

RESULTS In the Southern Chichibu Belt, the Rm values were 3.14% for the Shakumasan unit and 2.83-3.04% for the Yukagi unit. The Rm values of the Tsui formation were 1.24-2.03%, those are 0.8-1.9% lower than those of the Shakumasan and Yukagi units. On the other hand, the Rm value of the Lower Saiki subgroup was 2.08%, that is 0.75-0.96% lower than those of the Yukagi unit.

DISCUSSION The thermal structure of the central Shikoku indicated no change in the Rm values across the BTL. This is explained that the previous thermal structure was overprinted by the subduction of the Kula-Pacific ridge under the Cretaceous accretionary prism (Sakaguchi, 1996).
On the other hand, in the eastern Kyusyu, the Rm values drastically changed across the BTL. This suggests that the BTL cut the original thermal structure. This thermal structure could be explained by two possible scenarios. The first one is that the timing of heating due to the subduction of the Kula-Pacific ridge or the young oceanic plates was different. Kinoshita and Ito (1986) proposed the model of the Kula-Pacific ridge subduction, which assumes that the ridge moves from west to east in relation to the trench. Based on this model, it is possible that the subduction of the oceanic ridges and the associated overheating of geology occurred earlier in the eastern Kyusyu than in the central Shikoku. The second one is that the timing of

the BTL activity differs. Although the BTL has not been active after the subduction of the oceanic ridges or the young oceanic plates in the central Shikoku, it had been active after the subduction of them in the eastern Kyusyu. The reactivation of the BTL has been reported in the Kii Mountains (YORG, 2012). These findings suggest the possibility of regional heterogeneity in the activity of the BTL.

Keywords: Eastern Kyusyu, Southern Chichibu Belt, Butsuzo Tectonic Line, Vitrinite reflectance, Thermal structure, Ridge subduction

