

Can we predict the distribution of hydrothermalism prior to sea-floor surveys?

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For more than 40 years since the discovery of hydrothermalism in deep-sea, their extraordinary nature has still attracted broad interest in various fields, e.g. (micro)biology, tectonics, geochemistry. In Okinawa Trough, a 2-D less-biased detection of hydrothermalism is possible by focusing acoustic anomaly in water column due to the volatile enriched nature of the hydrothermal fluids. Through such trials, the number of the located high-temperature hydrothermal activities in Okinawa Trough became almost double compared to those recognized in the beginning of this century; and rifting associated hydrothermal activity has also been found at Yaeyama Knoll within Yaeyama Rift, an elongated deep in the southern Okinawa Trough [Miyazaki et al., 2017]. Thus, there are at least two types of hydrothermal activities commonly in the Okinawa Trough: ones on/near volcanic front by the magmatism of trench-arc system, and the others resulted from rifting activities as in the growth processes of back-arc basin. On the other hand, there seems to be a 100-km length gap of such high temperature hydrothermal activity between Irabu Knoll and Nakadomari Hill. Regardless of the insufficient performances of the submarine survey in the area, this irregular distribution is to be investigated in future.

Relative displacements of Nanseishoto to Fukue Station, Kyushu, calculated in GNSS data provided by Geospatial Information Authority, indicated larger displacement in Sakishima Gunto corresponding to the southern Okinawa Trough compared to the middle Okinawa Trough represented as that of Okinawa Shima (the main island of Okinawa) and its vicinity. Especially, the western part of Sakishima Gunto, from Tarama Shima and westward clearly shows larger displacement than those in the eastern part, from Irabu Shima and eastward. It suggests that there are a few independent blocks having different rifting activities in the Okinawa Trough. In terms of the shallow seismicity shallower than 20km catalogued in JMA unified catalogue (Oct 1997 –Mar 2018), 1) it is conspicuous that shallow (<5km in their estimated epicenter depth) and slightly large ($M_j \sim 3-4$) earthquakes occur in the trough axis, 2) such earthquakes forms some clusters approx a few tens kilometers in the diameter. Limited to the seismicity in the trough axes, 3) there is no reverse fault type earthquakes, 4) the number of the earthquake is smaller between Miyako Shima and Kume shima (124.8-126.6°E) compared to both in the western or eastern part of the trough. Contrasting to the equivalent contribution of strike slip-type and normal fault type in the eastern part of the trough (126.6-128.4°E), the normal fault type of earthquakes are dominant in the westernmost part of the studied area (123.0-124.8°E). This tendency seems to be consistent with the GNSS displacement data and with the intrusion structures found in the vicinity of the Yaeyama Knoll, which also suggests that a high potential of high temperature hydrothermal activities in the trough axis in the southern Okinawa Trough. In addition, the gap of known high temperature hydrothermal activity may reflect the lower activity of rifting in the area. It seems not to be consistent the low temperature condition for brittle fracturing with high temperature heat source for hydrothermalism, which may provide some perspectives to recognize areas with high potentials for hydrothermalism through investigation of seismicity.

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