

Seismic and geodetic evidence for the existence of hot materials beneath the Wakayama swarm activity

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Hypocenters of Wakayama swarm earthquakes are very shallow. Their average depth is 6km. This is exceptional, for the depth of the seismogenic layer in plain areas is usually deep compared to that in mountainous regions (Takayama et al., 2004). Another notable thing is that the b-value for earthquakes in the eastern part of the swarm region is anomalously high. In addition to these seismic features, we found, by analyzing GEONET data of the Geographical Survey Institute, that land around the swarm region has been upheaving and a dilatational source exists just beneath the area where the high b-value anomaly is observed. These facts strongly suggest that hot materials exist beneath the source region.

Since the Wakayama swarm area is located far from the volcanic front toward the forearc side, it is difficult to regard the hot materials as the ordinary magmas observed at volcanoes in subduction zones. What, then, are they? The Wakayama swarm area is situated in the Sanbagawa belt extending along the Median Tectonic Line. The metamorphosed rocks that outcrop in the belt are believed to have been formed under a high pressure condition in the mantle wedge and uprose at 100 to 70 Ma (Takasu and Dallmeyer, 1990) while the Kula-Pacific ridge subducted (Maruyama and Seno, 1986). Although it is improbable that the hot materials that uprose 100 to 70 Ma remain that hot, the newly born Shikoku Basin began to subduct 15 Ma (Okino et al., 1994), and the oceanic crust subducting there is estimated to be 300 to 500C warmer than beneath northeast Japan (Peacock and Wang, 1999). The fact that the seismogenic layer along the Median Tectonic Line is as shallow as that along the volcanic front in northeast Japan (Takayama et al., 2004) also demonstrate that the crust around the region is at a relatively high temperature. It is therefore possible that serpentinized masses reaching near the surface are newly dehydrated underneath the area. We propose here that the hot material beneath the Wakayama swarm activity indicated by the seismological and geodetic evidence may be a serpentine diapir or hot water and volatiles extracted from the magmas.