

Spatial distribution of slab-related fluid in Japan - Relation to inland earthquakes -

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Recently, possibility that fluids are involved in earthquakes has been pointed out. Activity of the deep low frequency (DLF) earthquakes and the shallow inland microquakes in Japan have been precisely monitored by the Hi-net for the last decade. The DLF earthquakes are well-determined for hypocenter having feature of very deep (20-40km depth) and thought to be related with hydrothermal fluids. In this study, we show the spatial distribution of crustal fluid and discuss the role of fluids in the occurrences of the DLF earthquake and the inland microquake.

Saline waters found close to the hypocenter of the DLF events show characteristic isotopic composition and chemistry; 1) similar to magmatic water or Arima-type thermal water indicated by isotopic composition of water, 2) NaCl-CO₂-type, and 3) high Li/Cl ratio (>0.001 in wt. ratio). The flow rate of these saline waters were hydrologically investigated at 6 places in Kinki district to be 8.5 kgH₂O/sec in total. Calculated dehydration rate of subducting slabs given from literatures ranged from 4 to 36 kgH₂O/sec for the arc length of 100km (SW Japan), which corresponds to our observational results, indicating they are of slab dehydration origin. The fluid involved in DLF events is likely either a magmatic fluid released during solidification of a magma at lower crust or a slab fluid directly supplied by slab dehydration.

The spatial distribution of slab-related fluids also agree well with that of shallow microquake occurrences (depth < 20km) or areas showing shallower D90 as well as that of DLF events. Upwelling of slab-related fluids seems to be one of the cause of shallow microquake activities. Fluids needs a path for upwelling such as a fissure existing at faults, and then the upwelling fluids will reduce the friction of fault planes. Furthermore, the recent large inland earthquakes (M >7) occurred close to the area of DLF events where the slab-related fluid exists. And some areas (a part of Chugoku district and the Abukuma granitic province), where no slab-related fluids are found, has relatively less earthquake activity. In conclusion, the NaCl-CO₂-type slab-related fluid widely exists but is localized in Japan, and play a role on inland earthquake activity.

Keywords: crustal fluid, slab-related, inland earthquake, deep low frequency event