Estimation of provenance rocks of the Toki Sand and Gravel Beds, the Tokai Group, based on EPMA analyses of the heavy minerals –a case study of the Byobuyama fault

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Heavy minerals generally show variation in chemical composition with rock bodies. Chemical compositions of heavy minerals as well as their classifications and abundance ratios have the potential to be leveraged for provenance analysis (Takeuchi, 1994). In this study the quantitative analysis method of minerals using EPMA by Shimizu et al. (2016) has been applied to the sediment samples from an outcrop of the active, Byobuyama fault (Research Group for Active faults of Japan, 1991). Here the swiftness of measurement is prioritized over accuracy. The measurement time for a spot is about 3.5 min.
The studied samples (By-M1, By-M2, By-M3, By-M4) were obtained from the outcrops of sand and gravel. The outcrops are located near a fault outcrop of the Byobuyama fault (Katori et al., 2015, 2016). On the fault outcrop the Inagawa granite (Late Cretaceous) of the southeast side overlies the Toki Sand and Gravel Beds (Pliocene), Tokai group. By-M1 was obtained from a medium-sand layer in the Toki Sand and Gravel Beds (Outcrop 1), composed of gravels of the sedimentary rocks of the Mino terrane and the Nohi rhyolite, and the location is about 5 m apart toward the west from the fault. Sampling location of By-M2, By-M3 and By-M4 (Outcrop 2) is at about 10m down along a stream toward north from Outcrop 1. At Outcrop 2 the white and unconsolidated sand layer is dominant and the sediment may be younger than the Toki Sand and Gravel Beds. The sediment consists mainly of medium sand, in which fine gravels of the sedimentary rocks of the Mino terrane are partly included.
The mineral identification shows that all of the four samples are rich in ilmenite, rutile and zircon. The compositions of heavy minerals are similar among these four samples. Alternatively the contents of MnO in ilmenites and Y_2O_3 in zircons are used as the indexes of provenance rocks and charted as histograms. The histograms of the four samples show approximately the same patterns. The MnO contents in ilmenites show bimodal distributions of about 1 wt.% and about 3 wt.%. The Y_2O_3 contents in zircons are 0 to 0.5 wt.%. The group of ~3 wt.% MnO in ilmenites shows similar to those dominant in the host rock of the Nohi rhyolite rather than the Inagawa granite. No zircon grains containing Y_2O_3 of >3 wt.%, which is characteristically contained in the Naegi-Agematsu granite (Suzuki and Yogo, 1986) were identified in all the four samples. The Y_2O_3 contents in zircons are similar to that of the Nohi rhyolite.
These results are consistent with the fact that there is no granite gravel in the outcrops. Furthermore, the heavy-mineral compositions of By-M2, By-M3, and By-M4 are similar to that of By-M1. This shows the possibility of redeposition of the Toki Sand and Gravel Beds.
The Inagawa granite is widely distributed in the southern side of the Byobuyama fault where is topographically high. This study suggests that the deposition of the Toki Sand and Gravel Beds completed prior to the recent upthrust of the Byobuyama fault.
This study was carried out under a contract with Agency of Natural Resources and Energy, part of Ministry of Economy, Trade and Industry of Japan as part of its R&D supporting program for developing geological disposal technology.

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Keywords: EPMA, heavy mineral, provenance analysis

