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Preliminary study of the Cretaceous tephrochronology in Japan and its application to biostratigraphic study

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Tephrochronology is a useful tool for high-resolution stratigraphic correlation and age determination for Quaternary marine and non-marine sediments. However, this method is very difficult to apply to the old sediments such as Paleozoic and Mesozoic because glass in tephra is very sensitive to diagenetic alteration. On the other hand, several heavy minerals in tephra are resistant to diagenetic alteration, and their variations in chemical composition are useful to distinguish individual tephra (Lowe, 2011). Recently, the validity of such mineral analysis as a tool for tephra fingerprinting was supported by Ordovician K-bentonites in North America and Scandinavia (Sell and Samson, 2011).

We analyzed biotite and apatite chemistry of 100-80 Ma tuffs in the Yezo Group exposed in Haboro, Kotanbetsu, Yubari, Hobetsu and Urakawa areas in Hokkaido in order to confirm their efficacy for tephrochronology. Both minerals occur in most tuffs of the Yezo Group. Although some biotites from the lower part of the Yezo Group in Yubari section are mostly altered to chlorite, apatite is always well preserved in all areas and horizons. Binary plot of Mg# vs TiO_2 of biotite and those of MgO vs FeO and F vs Cl of apatite analyses obtained using EPMA are proven to be useful indicators to distinguish individual tuff beds.

Using above method, we identified widely traceable two tuffs in the Yezo Group that are intercalated near the Albian/Cenomanian and the Santonian/Campanian boundaries. These two tuffs from various sections in Hokkaido are plotted in the same field on above mentioned binary plots of biotite and apatite, respectively, and show same U-Pb ages within the margin of error. Correlation of tuffs of the Albian/Cenomanian and the Santonian/Campanian boundaries demonstrate that horizons of first and last occurrences of several age-diagnostic fossils are not always synchronous among areas in Hokkaido. This may attribute to the differences in sedimentary environments and preservation of calcium carbonate among areas. Therefore, tephrochronology using heavy minerals is very useful method to identify ”true” biostratigraphic datum, and will improve resolution of biostratigraphy.

References

Sell, B. K. and Samson, S. D., 2011. Apatite phenocryst compositions demonstrate a miscorrelation between the Millbrig and Kinnekulle K-bentonites of North America and Scandinavia. Geology, 39, 303-306.

Lowe, D. J., 2011. Tephrochronology and its application: A review. Quaternary Geochronology, 6, 107-153.

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