Weathering of diatomaceous mudstone and replacement of pore water at Horonobe, Japan

S. TANAKA[1], T. OYAMA[1], E. ISHII[2] AND T. IWATSUKI[2]

[1]Central Research Institute of Electric Power Industry (CRIEPI), Chiba 270-1194, Japan (*correspondence: tanakasr@criepi.denken.or.jp)

[2]Japan Atomic Energy Agency (JAEA), Hokkaido 098-3224, Japan

Rock under a reducing environment will oxidized rapidly when exposed to the atmosphere. Since this can possibly cause a cavity wall to degrade quickly, it is necessary to understand the mechanism of weathering. This study presents the results of geological and geochemical investigations about the redox front in diatomaceous mudstone of the Neogene Koetoi Formation in the east shaft constructed by JAEA and its outcrop in Horonobe, Japan. The shaft has now reached a depth of 140m below ground level (GL) and is still under construction. The geology of the shaft consists of humic soil and filling (GL-5m and above), unconsolidated breccia of diatomaceous mudstone (GL-5 to -19.3m), and diatomaceous mudstone (GL -19.3m and below). This mudstone is poor in clay and carbonate minerals and contains framboidal pyrite. The shallower part of the shaft is classified into oxidized, dissolved, and transition zones. Oxidized zone (GL-5 to -5.5m): Soil and breccia are brown because of oxidation from the surface. Pyrite and siderite are absent, and Fe, Mn, and P are present in high concentrations. The percentage of clay minerals is slightly elevated. The pore water is rich in SO_4^{2-}, Fe, and Al. Dissolved zone (GL-5.5 to -19.3m): Siderite is absent but pyrite remains. Pore water was replaced by meteoric water. Cl^- in the pore water is about 200–350mg/l. The concentration of whole-rock major elements is relatively low. Transition zone (GL-19.3 to -32m): Cl^- concentration increases rapidly to 2,000mg/l at GL-32m, and increases gradually to 3,500mg/l at GL-100m. The replacement of pore water is advancing. Whole-rock major elements (except for SiO_2) increase gradually. This result suggests the following models: (1) infiltration of meteoric water and an atmosphere containing oxygen from the land surface, (2) generation of acid water by oxidization of pyrite, and (3) dissolution of minerals and progress of weathering inside the rock. Dissolution of minerals is advancing into the Koetoi Formation. Replacement of pore water by meteoric water reached more deeper than GL-19m. On the other hand, oxygen has permeated only to the surface of the breccia. This study is part of a joint research between JAEA and CRIEPI.

Episodic fluid action in continental subduction zones: Geochemical evidence from marble-hosted UHP eclogite in the Sulu orogen

J. TANG* AND Y.-F. ZHENG

School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China (juntang@ustc.edu.cn)

Zircon U-Pb ages and Lu-Hf isotopes, mineral O isotopes, whole-rock major and trace elements were analysed for UHP eclogites within marbles in the Sulu orogen, a Triassic continental deep-subduction zone by collision between the South China Block and the North China Block. The results are used to contrain the protolith nature of eclogites and the metamorphic effects on elemental and isotopic systems in M-type eclogites. The eclogite layers are generally parallel to the marble beddings, and occur as cm-scale pods or lenticular layers. Such M-type eclogites are characterized by: (1) the presence of Triassic metamorphically grown zircons, with two group U–Pb ages at 241±6 Ma and 224±4 to 229±4 Ma, respectively; (2) positive zircon $\varepsilon_{Hf}(t)$ values of 5.4 to 10.4 at t = 230 Ma, with Hf model ages of 774±31 Ma; (3) MORB-like whole-rock REE pattern and large variations of LILE contents and Mg# values; and (4) extremly high $\delta^{18}O$ values of 9.4 to 19.5‰ for whole-rock and 11 to 19‰ for zircon, with preservation of O isotope equilibrium between most of omphacite, garnet and metamorphic zircon at eclogite-facies conditions. These observations suggest that protolith of the M-type eclogites has the same age as those of UHP granitic gneiss and G-type eclogite elsewhere in the Dabie-Sulu orogenic belt, but it was primarily formed as mafic volcanic interlayer during mid-Neoroproterozoic rift magmatism with possible growth of juvenile crust at that time. Their high $\delta^{18}O$ values were caused by low-T water-rock interaction in the volcanosedimentary process, which are in striking contrast to low $\delta^{18}O$ values for the UHP granitic gneiss and G-type eclogite. The two groups of zircon U-Pb ages are interpreted to suggest two episodes of fluid action, respectively, predating and postdating the UHP metamorphism. The volcanosedimentary protolith of the M-type eclogites were primarily rich in aqueous fluid relative to that of the G-type eclogite. Thus it has the great potential to episodically liberate the fluid during the subduction and exhumation of continental crust, with the minimum fluid activity at peak UHP metamorphic phase. Therefore, petrological and geochemical studies of the M-type eclogite provide insights into metamorphic dehydration and partial melting in the continental subduction zone.