The uraniferous groundwaters and minerals in the two-mica granite of the Daejeon area, South Korea

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Daejeon is the most worrisome area for U-contaminated groundwater in South Korea. Many workers have deep concerns about the geological environment and sources of uranium in the groundwater of the Daejeon area. The regional geology is dominated by Mesozoic two-mica granite and Paleozoic meta-sedimentary rocks composed of metamorphic black slate, mica-schist, and carbonate rock. The black slate includes low grade U ore up to 0.11%, but has not been mined. The U concentration in groundwater is high in the two-mica granite area, but the U-minerals have not yet been described. To elucidate the source of U in groundwater, the geochemistry and environmental isotopes of the groundwater, as well as the U-minerals of the source rock, are examined in this study.

The groundwater in uraniferous meta-sedimentary rocks has a very low U concentration, less than 10μg/L. Meanwhile, the maximum level of U in two-mica granite is as high as 402μg/L. The ranges in Eh values of groundwater in granite and meta-sedimentary rocks are +202~+385 mV and -50~+225 mV, respectively. Granite aquifers are mostly subject to oxidizing conditions but meta-sedimentary aquifers are subject to relatively reducing conditions. Despite the high content of U in black slate, very little U is extracted into groundwater due to the reducing environment. The ranges in the $^{87}Sr/^{86}Sr$ ratios for groundwater in granite and meta-sedimentary rocks are 0.7111~0.7201 and 0.7112~0.7620, respectively. The consistent $^{87}Sr/^{86}Sr$ ratios of groundwater in granite indicate that the aquifer has remained a closed system. The $^{87}Sr/^{86}Sr$ ratios of uraniferous groundwater are similar to those of granite in the Daejeon area. The geochemical and isotopic data indicate that the U in groundwater in this area is genetically associated with the granite and not with the U-ores in black slate.

To examine the U-minerals in granite, a gamma ray spectrometry survey was conducted and U-count anomalies were identified along the contact zone between the two-mica granite and mica-schist, and fracture-filling quartz veinlet. The U-mineralization is dominated by uraninite, coffinite, uranophane and is commonly accompanied by hydrothermal alteration. The mica schist in contact with granite include graphite and sulphide, which provide a reducing environment favorable for U deposition. The redox condition is the critical factor for the formation of U-ores and uraniferous groundwater in the Daejeon area.

The charateristics of tremolite asbestos occurred in abandoned asbestos mines in South Korea

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Recently, asbestos health risk and mining restoration become a big issue in the abandoned asbestos mine area. Tremolite asbestos has been known as the most toxic one causing lung cancer and mesothelioma. Tremolite asbestos mines are rarely found in the world, but four mines (Sinsuk mine and Daebosuksan mine in Boryeong area, Chungcheongnam-do, Bonghyeon mine in Yeongju area, Gyeongsangbuk-do and Ewha mine in Yeongwol, Gangwon-do) were operated up to 1980's in South Korea. The geological and mineralogical informations are needed for the asbestos health risk evaluation and mine restoration. In this study, the origin and characteristics of tremolite asbestos and the property changes by weathering process were examined with ores and soils in abandoned mine areas.

All the mines are formed in metamorphic rock strata consisting of the Precambrian mica schist and gneiss. Tremolite asbestos deposits are known to be formed by hydrothermal alteration of dolomitic limestone or ultramafic rocks intercalated in the Precambrian metamorphic rock strata. Associated minerals are significantly different with different mines. Tremolite in ores and soils were analyzed with optical microscope and SEM/EDS. Tremolite asbestos fibers have the average length of 12~38μm. The aspect ratio varies significantly and have range of 7.4~19. The significant morphological difference is observed with different mines. Tremolites found in soils of mine area shows similar morphological properties with ores. The distribution in soil is limited to the transportation ranges by stream water and sediments. The properties of tremolite asbestos are not varied with weathering process and closely related to the parent rock types. In all mines, prismatic tremolites are also commonly occurred with asbestos form tremolites. Although some of asbestos form tremolites may be formed by splitting through the cleavage of prismatic tremolite, those are mainly formed by crystal growth habit regulated by the environmental condition at the time of formation.

As described above, the associated minerals and crystal morphology are significantly different among the mines in the Boryeong area and the Yeongju and Yeongwol areas. It is considered that the differences in associated minerals and crystal morphology are caused by the degree of hydrothermal alteration and parent rock type.