Mineralogical and oxygen isotope studies of skarn type tungsten deposit at the Date-Nagai, NE Japan

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The Date-Nagai skarn type tungsten deposit locates at the Abukuma Mountain. The Iidateyama body, an ilmenite series granodiorite (102-106 Ma), distributes widely in the area and lenticular hornfelses are accompanied as roof pendant. Small limestone layer is included in hornfels. Skarn develops between hornfels and limestone as a thin layer. Three types of skarn, garnet-vesuvianite skarn, green skarn and fine-grained skarn are distinguished from their appearance and mineral assemblage. Scheelite is accompanied in all these skarns. Paragenetic study suggests that mineral assemblage in skarn differed between early and late stages. Early stage garnet is optically isotropic, whereas that of later stage shows anisotropy. Sheelite precipitated in relatively later stage of mineralization.
Chemical compositions of skarn minerals were examined by EPMA. Garnet of early stage has compositions near grossular, whereas those of later stage contain pylarspite moles up to ~70 %. Andoradite mole in both garnets is very low (<8.0 mole %), which suggests reduced environments since Fe^{3+} in skarn-forming solution was very low. Chemical composition of clinopyroxene is approximately middle between diopside and hedenbergite. Powellite mole in scheelite is very low (<1.4 mole %).
Oxygen isotope compositions of minerals were analyzed by means of CO_2-laser ablated BrF_5 technique. Garnet and scheelite have variable delta^{18}O, 4.6-8.2 ‰and 0.8-2.9 ‰, respectively. Temperature of skarn formation was calculated using oxygen isotope fractionation factor between quartz and scheelite, and T= 283˚C was obtained. Using this temperature, delta^{18}O of skarn-forming solution was calculated. Early stage solution had delta^{18}O values of 6-8 ‰and most garnet precipitated from this solution. While later stage solution had lighter delta^{18}O values 1-5 ‰, and this solution was responsible for precipitation of scheelite and quartz. Origin of skarn-forming solution of early stage was mostly magmatic water, while contribution of meteoric water increased in later stages.

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