Tellurium-bearing minerals from the Teine mine, West Hokkaido - Japan

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The Teine mine is located at the Teine-Chitose District, West Hokkaido which is well known for the occurrence of many epithermal ore deposits of Neogene period. There are about 30 veins mapped by previous study in the mining area. Based on their localities and composition of the veins, they were grouped into three mineralized zones: Koganesawa (Au-Ag-Cu-bearing realgar-carbonate-quartz veins), Bannosawa (Au-Ag-Cu-bearing realgar-quartz-barite veins) and Mitsuyama (Au-Ag-Cu-bearing tellurium-barite-quartz veins) deposits. Present study is to identify some tellurium minerals from the Mitsuyama and the Koganesawa mineralized zones. Combination of microscopic, electron-microprobe and BSE-based image analyses for polished section were used to evaluate the composition of ore minerals from the Mitsuyama and the Koganesawa mineralized zones such as Takinosawa, Toriyabe, Otoyo and Hanjo veins. In both mineralized zones, tellurium is significant and probably acted as gold carriers and as indicator for P–T conditions. Based on the microscopic observation and EPMA analysis, there were described the occurrence of some tellurium-bearing minerals associated with other various kinds of sulfide minerals. Identified tellurium-bearing minerals are altaite [PbTe], goldfieldite [$Cu_{12.22-12.39}(Te_{2.47-2.61}Sb_{0.00-0.27}As_{0.14-0.81})S_{13.22-13.42}$], hessite [$Ag_{1.83-1.93}Te_{0.93-0.99}$], native tellurium [Te], petzite [$Ag_{2.75-2.83}Au_{0.79-0.82}Te_{1.82-1.83}$], silvanite [$(Au_{0.98}Ag_{1.79})_{2.77}Te_{3.11}$], stutzite [$(Ag_{3.94}Au_{0.24})_{4.18}Te_{3.26}$], tellurobismuthite [$Bi_{1.77-1.88}Te_3$], tetradymite [$Bi_{1.97-2.03}Te_{1.96-2.00}S_{0.85-0.92}$], rickardite [$Cu_7Te_5$], tellurite [$TeO_2$] and teineite [$Cu(TeO_3).2H_2O$]. Those tellurium minerals generally show chemical compositions close to stoichiometric. Thus, the composition of some hessite, stutzite, petzite and silvanite never reach the ideal composition because of some substitution of some other elements, such as Cu at the Ag site, As or S at the Te site etc. Microscopic observation determined tellurium mineral paragenesis is as follows : (Native Te) – petzite – hessite – (tetradymite, altaite, tellurobismuthite) - goldfieldite. The measurement of homogenization temperature and salinity of fluid inclusions in some gangue minerals such as quartz associated with ores suggests that the formation temperature are around 208 – 255°C with salinity 1.9 – 2.1 wt.% $NaCl_{equiv.}$. Evidence of boiling was recognized for fluid inclusions from Teine quartz samples which could be the efficient mechanism for precipitation gold and silver. Mineral assemblages and measurement of fluid inclusions homogenization temperature and salinity are used to estimate the formation condition of the mineralization. Using the applicable reaction of tellurium mineral associations such as Te saturation, Au-hessite, hessite-stutzite, altaite-galena and tellurobismuthite-bismuthinite, the thermodynamic constrains supported by fluid inclusion data indicate that the formation of tellurium-bearing minerals in Teine was likely to be result of temperature decrease from around 250 to 200°C with fS_2 and/or fTe_2 drops.