Characteristics of the Ruwai base metal-Ag skarn in Tertiary middle Kalimantan volcanic arc, Indonesia

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This study is dealing with geology and characteristics of mineralogy, geochemistry and physicochemical conditions of hydrothermal fluid responsible for the formation of the Ruwai skarn base metal (Pb-Zn-Cu)-Ag deposit in Tertiary middle Kalimantan volcanic arc, Indonesia. The formation of Ruwai skarn is genetically associated with calcareous rocks consisting of limestone and siltstone (derived from marl?) and controlled by NNE-SSW-trending strike slip faults and localized along N 70° E-trending thrust fault, which also acts as contact zone between sedimentary and volcanic rocks in the area. The Ruwai skarn is mineralogically characterized by prograde alteration (garnet and clino-pyroxene) and retrograde alteration (epidote, chlorite, calcite and sericite). Garnet is of andraditic composition, whereas clino-pyroxene is identified as wollastonite, diopside and hedenbergite. Both garnet and clinopyroxene show a petrographic and chemical zonation. Ore mineralization is typified by sphalerite, Ag-rich galena and chalcopyrite, which formed at the early retrograde stage. Galena is typically enriched in silver up to 0.45 w t% and bismuth of about 1 wt %. Geochemically, SiO_2 is enriched and CaO is depleted in limestone, consistent with silicic alteration (quartz and calc-silicate) and decarbonatization of the wallrock. The measured resources of the deposit are 2,297,185 tonnes at average grades of 14.98 % Zn, 6.44 % Pb, 2.49 % Cu and 370.87 g/t Ag. Ruwai skarn orebody originated at moderate temperature of 250-266 °C and low salinity of 0.3-0.5 wt.% NaCl eq. The late retrograde stage formed at low temperature of 190-220 °C and low salinity of ~0.35 wt.% NaCl eq., which was influenced by meteoric water incursion at the late stage of the Ruwai base metal-Ag skarn formation. Further exploration of the skarn extension in the prospect area should consider the structural setting, lithologic distribution and the presence of the diagnostic calc-silicate minerals.

Pressure-induced phase transitions and H-D isotope effects in portlandite

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$Ca(OH)_2$, portlandite, has a CdI_2 type structure and is one of the simple hydrous minerals. A crystal-to-crystal phase transition ocurrs around 10 GPa at room temperature in various pressure transmitting media [1, 2]. In brucite, which has an iso-structure of portlandite, H-D isotope effect on the compressibility was found from neutron diffraction [3]. In our study, the isotope effect on the pressure-induced responses was studied in order to clarify the phase transition mechanism accompanied by the geometrical change of hydrogen bonding for neutron diffraction studies in future.

Powder samples were synthesized by hydration of CaO powders with water (or D_2O) in a Teflon lined stainless steel autoclave at 240°C for one week. The single-crystals were obtained by recrystallizing from powder. These samples were loaded in clamped DACs with a few small ruby chips. As a pressure medium, 4:1 methanol-ethanol mixture or He gas was used. IR absorption spectra were measured at the IR synchrotron radiation beamline BL43IR at SPring-8. Angular-dispersive synchrotron X-ray diffraction experiments up to 25 GPa were performed on the BL-18C beamline in the Photon Factory (PF), KEK.

No remarkable difference between $Ca(OH)_2$ and $Ca(OD)_2$ samples was found in the compression behaviors from powder XRD patterns. They were consistent with the previous studies [4-7]. The OH(OD) vibration peaks of IR spectra were split at 6-7 GPa for single-crystals in He medium. No significant difference suggesting the isotope effect was found in the phase transition pressure. The hydrostaticity was found to contribute strongly to the process of the phase transition or amorphization. This implies that neutron diffraction of portlandite needs to be carefully measured under controlled stress conditions using large-volume presses.

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