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Mineralogy and thermal properties of kaolin from the San José (Oruro, Bolivia)

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The San José mine, Oruro, Bolivia is known for provided a broad diversity of minerals. The San José Sn deposit is a Sn-Ag deposit composed of veins hosted in a complex of Miocene domes from monzonitic to dioritic composition within rhyolitic volcanic rocks hosted in Tertiary sedimentary rocks. Advanced argillitic alteration. is widespread in the surroundings of the deposit. Kaolinitization reach industrial importance and the kaolinitized rock is exploited, however it was not already been characterised. In this study we present a preliminary mineralogical and thermal characterization to determine the industrial applications of these kaolinitic materials.
A sampling of the kaolinitized rocks in outcrops from the mining area was undertaken. The chemical composition of major and trace elements was determined by X-ray fluorescence (XRF). Mineralogy was obtained by powder diffraction X-ray (XRD) and infrared spectroscopy (FTIR). Quantitative determination of phases was obtained by the Rietveld refinement method using the Fullprof software. Thermal properties were determined by differential thermal analysis-thermo gravimetry (DTA -TG) and dilatometry.
Mineral phases determined are mainly quartz (54-55 wt. %), kaolinite (7-8 wt. %), K-feldspar (8-19 wt. %), muscovite (16-17 wt. %), plagioclase up to 3 wt. %, alunite up to 8 wt% and gypsum up to 4 wt%.
DTA -TG show a first endothermic event related to the dehydration of gypsum, with a loss weight of 0.4 wt%. An endothermic peak corresponding to the loss of the OH- groups of kaolinite occurs about 520 °C and an exothermic, at 980 °C, due to the crystallization of the mullite phase. The endothermic peak is attributed to the transformation of kaolinite in metakaolinite: Al2Si2O5 (OH)4 [U+F0E0] Al2Si2O7 + $2H_2O$ and the dehydroxilation of alunite; the loss weight associated with this event is 2.9-3.2 wt%. The exothermic peak is caused by the formation of mullite: 3Al2Si2O7 [U+F0E0] Al6Si2O13 + $4SiO_2$. Another loss weight, of 3wt%, is produced by the alunite decomposition. Finally, the mass loss continues up to 1150 °C due the muscovite dehydroxilation.
The dilatometric curve shows a shrinkage about 900 ºC produced by the collapse of metakaolinite into a spinel-like structure. Another shrinkage starts at 1000 ºC, when the spinel-like phase is transformed to mullite and the beginning of the sintering.
The studied kaolititized rocks present a low content in kaolinite, then without a beneficiation process the possible applications should be those typical of feldspars, as ceramics.