Pressure-induced structural phase transitions in natural kaolinite investigated by Raman spectroscopy and electrical conductivity

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As a representative hydrous kaolin-group mineral, kaolinite ($Al_2Si_2O_5(OH)_4$) is widely distributed in the Earth's surface and outcropped in various geotectonic environments (e.g., hydrothermal deposit, altered crustal rock, sedimentary basin, et al.). We investigated the structural, vibrational and electrical transport properties for natural kaolinite and its high-pressure polymorphs by Raman scattering and electrical conductivity measurements at 293–673 K and up to 10.0 GPa using diamond anvil cell. Upon compression, kaolinite underwent two structural transitions from kaolinite I to kaolinite II to kaolinite III phases at pressures of 2.9 GPa and 6.5 GPa, respectively, which was disclosed by the inflexion point in the pressure-dependent Raman shifts and electrical conductivity. Upon decompression, kaolinite III directly transformed to kaolinite I phases at 0.8 GPa without the appearance of kaolinite II phase. Additionally, the influence of temperature on the structural transformation of natural kaolinite was explored by high-temperature and high-pressure electrical conductivity measurements and negative temperature-dependent transition pressure correlations were obtained. A phase diagram of natural kaolinite was established for the first time and the kaolinite I-kaolinite II and kaolinite II-kaolinite III phase transition boundaries were determined: P (GPa) = 4.298 – 0.00462 T (K) and P (GPa) = 8.895 – 0.00799 T (K), respectively. Furthermore, our acquired phase diagram can be applied to understand the stability field of high-pressure polymorphs of kaolinite in the Earth's interior and may provide a phase transition model for other kaolin-group minerals.

参考文献:

[1] Hong Meiling, Dai Lidong*, Hu Haiying* and Zhang Xinyu. Pressure-induced structural phase transitions in natural kaolinite investigated by Raman spectroscopy and electrical conductivity. American Mineralogist, 2021, In press.