Nano-pore analysis of sedimentary rocks at Horonobe Hokkaido by positron anihilation spectroscopy

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For estimating pore size in minerals, mercury porosimetry is generally employed. This technique is unsuitable for closed pores smaller than macro-pores. Gas-absorption porosimetry is thus alternative technique. But closed micro-pores with pore radius smaller than 2 nm can not be detectable with gas-absorption porosimetry. In this study, we employed positron, antiparticle of electron, in order to obtain the information on the micro-pores in minerals and elemental migration through the micro-pores.

Sedimentary rocks in the depth of several meters taken from Hokkaido Horonobe area were measured by positron annihilation lifetime spectroscopy. Samples were annealed at 110 deg. for 12 hours for dehydration. Beta + decay of 22Na was employed as a positron source and the measurements were performed at room temperature.

We observed the positron lifetime spectra similar to glasses and obtained the positron lifetime from 2 to 6 ns corresponding to the closed pore with the pore radius from sub nanometer to nanometer. No pore was observed for quartz, which has high quality of crystalline phase. Closed pores with several % and more than 50 % were observed in chert and fused quartz, respectively. In the samples of sedimentary rock in the depth of 273 m and 625 m, we obtained closed pores with the intensities of 3 % and 5 %, indicating that the amount of pores inside the specimens significantly differs from each other.