Kyanite dating - 16 Ga Ar/Ar age -

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The Barrovian type metamorphic sequence that contains commonly kyanite was significantly different in P/T condition from the andalusite-sillimanite type metamorphic sequence. The Abukuma Mountains in northeastern Japan, a typical andalusite - sillimanite type has been under debate from a geological viewpoint as the kyanite - staulorite assemblage has been observed. Although the kyanite-bearing rocks are extremely rare, kyanite and staurolite are common in the river sand of the sequence, suggesting a paleo-Barrovian-type of metamorphism. The similar approach to find a Barrovian terrain has also been carried out in the Kitakami Mountains, resulting in new occurrence of kyanite and staurolite in the river sand around the Tono granitic mass 200 km north of the Abukuma Mountains. Since the dating of kyanite can make some constraints for the Barrovian type metamorphism, a laser fusion Ar-Ar technique using a single kyanite crystal was applied.

Uruno and Kitakami River Sand Research Group found kyanites from 27 sites among about 500 sites around the Tono granitic mass. The kyanite was always accompanied by staurolite, suggesting that the host rocks had kyanite-staurolite assemblage of Barrovian type. Kyanite was concentrated from the river sand in K670 site of the Ohbata village using heavy liquid technique and systematic acid treatment (mixed acid of H2SO4, HCl and HF and then HCl). Finally, it was handpicked under microscope. It occurs generally as a single crystal with clear and planer shape with cleavage and sometimes as a crystal aggregate of kyanite. Kyanites analyzed have the extinction angle of 28 -31 (cZ') in degree and the optical plane of 78 to 89 (2Vx) in degree. Their chemical composition was also semi quantitatively checked by EMP, indicating nearly pure Al2SiO5. Ar-Ar analyses of each kyanite crystal were carried out using laser fusion technique. The ages are 7.7 +- 0.4, 9.9 +- 0.4, 11.1 +- 0.4, 11.1 +- 1.1, 15.1 +- 0.7 and 16.3 +- 1.5Ga, which are two or three times older than the age of the earth. The aggregate type is younger than the single crystal type.The ages are geologically meaningless, but the large amount of excess argon in kyanites may play an important role to reveal the tectono-metamorphic history of the ultra high pressure (UHP).

The recent information on the UHP rocks and the associated gneisses provide us a new concept on metamorphic terrains in the world that the Barrovian-type metamorphic rocks were retrograded from the UHP rocks. Kyanite coexisting with jadeite in the UHP rocks decomposes to paragonite during the adiabatic exhumation. It will be able to recrystallize under the Barrovian-type P/T condtion in the crust and to acquire excess argon during the recrystallization. The kyanite studied may be recrystalized under a specific environment with ultra-high argon pressure derived from radiogenic argon in phengites during the Barrovian type retrogression of UHP rocks. It should be noted that kyanite with excess argon of 0.0017 ccSTP/g has a potential for extremely high argon retentivity and plays an important role to reveal the tectono-metamorphic history of the UHP rocks.