Carbon contents in the remnants of oceanic crust from the Japanese accretionary complex

Tatsuo Nozaki[1]; Kentaro Nakamura[2]; Yasuhiro Kato[1]

[1] Geosystem Eng., Univ. of Tokyo; [2] IFREE, JAMSTEC

http://egeo1.geosys.t.u-tokyo.ac.jp/index.htm

In the past couple of decades, global carbon cycle model has been developed and used to interpret several important climate changes including the global warming. In the previous models, oceanic crust formation has been long regarded as a carbon source, whereas Alt and Teagle (1999) pointed out that the amount of carbon fixed into oceanic crust by hydrothermal alteration surpasses the total degassed carbon during new oceanic crust formation. After then, oceanic crust has been considered as an important sink of atmospheric and oceanic carbon (e.g., Sleep and Zhanle, 2001; Frank et al., 2002; Jarrard, 2003). Moreover, much attention has recently been paid to the fate of the carbon in oceanic crust during/after subduction, which is still uncertain and controversial (e.g., Kerrick and Connoly, 2001). Thus in the present contribution, hydrothermally altered oceanic crust included in the Japanese accretionary complex has been investigated in order to clarify the influence of metamorphism and accretion on the carbon contents of the subducted oceanic crust.

The target of this study is greenstones from the Northern Chichibu, Mineoka and Hayachine Belts whose tectonic settings, duration times (eruptional age - accretionary age) and metamorphic grades have been well constrained. The Northern Chichibu Belt shows typical oceanic plate stratigraphy, implying that it was a remnant of the Early Permian oceanic crust (Matsuoka et al., 1998). Its duration time is estimated to be 82 - 128 Myr on the basis of radiolarian biostratigraphy, and the metamorphic grade is prehnite-pumpellyite facies (corresponding to about 10 - 15 km depth). The Mineoka belt is interpreted to be an allochthonous block of obducted oceanic crust (Hirano et al., 2003), and its duration time is estimated to be 36 - 41 Myr that is significantly shorter than the Northern Chichibu Belt. The metamorphic grade is zeolite facies which corresponds to a depth below 10 km. The Hayachine Belt was most likely remnants of the Late Devonian oceanic crust (Nozaki et al., 2004), and the metamorphic grade is pumpellyite-actinolite facies (corresponding to a depth below 20 km). Its duration time is estimated to be 13 - 34 Myr which is the shortest among three study areas.

Alteration mineral assemblage of the greenstones from the Northern Chichibu Belt is plagioclase, clinopyroxene, calcite, chlorite, epidote, pumpellyite and quartz. The greenstones from the Mineoka Belt are characterized by the assemblage of plagioclase, clay mineral, clinopyroxene, calcite and zeolite. The greenstones from the Hayachine Belt are composed of chlorite, albite, epidote, quartz, calcite, sphene, pumpellyite and actinolite, and locally preserve primary clinopyroxene relicts. Carbon in these greenstones is mostly contained as calcite which fills veins and vesicles. Bulk-rock chemical compositions of the greenstone samples indicate that these are of MORB (mid-ocean ridge basalt) origin, which is consistent with previous interpretations based on the field observation. Average carbon contents of the greenstones from the Northern Chichibu, Mineoka and Hayachine Belts are 2.6, 1.3 and 0.9 wt.%, respectively. These carbon contents can be comparable with that of coeval oceanic crust in the Pacific Ocean. This suggests that the carbon contents in the greenstones were not changed during the subduction and accretion. Consequently, it is considered that carbon in the subducted oceanic crust is retained during various geological processes in the subduction zone up to 20 km under the ground. In the future research, carbon behavior at deeper part of subduction zone can be traced by using greenschists from high-grade metamorphic belts such as the Sanbagawa Belt, southwest Japan.