SGL40-01 会場:201A 時間:5 月 19 日 14:15-14:30

レーザ加熱 40Ar/39Ar 法によるプレート沈み込み開始プロセスに関する研究
Application of laser-heating 40Ar/39Ar dating to the studies of subduction initiation process

石塚 治[1*]
Osamu Ishizuka[1*]

[1] 産業技術総合研究所
[1]Geological Survey of Japan/AIST

Submarine volcanic rocks are known to give ages different from their true eruption ages in some cases (e.g. Seidemann 1977). This is due to the existence of excess ^{40}Ar in the rapidly quenched glass or Ar loss and K remobilization caused by reaction with seawater or hydrothermal fluids. Stepwise-heating analysis in ^{40}Ar/^{39}Ar dating is particularly useful for dating submarine volcanics because:1)it can provide means of detecting contribution of non atmospheric component (isochron plot), 2)extensive pre-analysis sample treatment (i.e., acid leaching, pre-heating of samples at relatively high temperature before analysis) is possible to reduce contribution from alteration phases, 3) by combined with laser-heating procedure, it can be applied on very limited amount of suitable material for dating.

We are applying this dating technique to reveal time scale and timing of process of subduction initiation along the Philippine Sea Plate, i.e., initiation of Izu-Bonin-Mariana arc. Dating of forearc crustal section of this arc revealed that the first basaltic magmatism at subduction initiation was produced by decompression melting of the mantle and took place at 51-52 Ma. The change to flux melting and boninitic volcanism took 2-4 m.y., and the change to flux melting in counterflowing mantle and more normal arc magmatism took 7-8 m.y.

These dating results also provide implication about the location and cause of subduction nucleation. The 51-52 Ma age of subduction nucleation in the IBM system strongly implies that the IBM arc initiated before the onset of sea-floor spreading in the West Philippine Basin. The potential location of subduction nucleation could be along the Mesozoic-aged arc terrane that is now found along the margins of the West Philippine Basin. This implication could be significant when along-strike variation of crustal structure and geochemical characteristics of arc magma are considered.

The contemporaneousness of IBM forearc magmatism with the major change in plate motion in Western Pacific at ca. 50 Ma suggests that the two events are intimately linked. Published numerical models of subduction initiation require at least 100km of convergence before a subduction zone nucleates, and self-sustaining subduction occurs (Hall et al., 2003). During the earliest stage of subduction, rapid trench retreat causes extension and decompression melting to generate forearc basalts from asthenospheric mantle. If this is correct, then 51-52 Ma age for onset of the basaltic magmatism can be considered as the age of initiation of slab sinking followed by self-sustaining subduction.

This age nearly coincides with the best estimate of the change in motion of the Pacific Plate deduced from the age of the Hawaiian-Emperor bend (c. 50 Ma: Sharp and Clague, 2006). Because the volcanism appears to be nearly synchronous with the change in plate motion, it appears that it was the onset of subduction that changed the plate motion. But it is still too early to reach this conclusion since we need to understand the period of subduction nucleation along the entire length of western Pacific margin with better precision. Systematic chronological study of ophiolite sequence (corresponding to early arc crustal section) in this area as well as the submarine forearc section will provide critical constraints to this discussion, and could contribute to finalize the discussion about whether subduction initiation is spontaneous or induced (e.g., Stern, 2004).

Keywords: 40Ar/39Ar dating, subduction initiation, Izu-Bonin-Mariana arc