Species diversity of vesicomyid bivalves from the middle Miocene seep carbonates in the Bessho Formation, Nagano Prefecture, Japan

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Vesicomyid bivalves have been dominant animals in submarine cold seeps through the Cenozoic age. Although coexistence of two or more vesicomyid species in a modern single seep site is considered to be due to different preferences in sulfide flux, salinity, and water temperature among species (Barry et al., 1997; Watanabe et al., 2013), co-occurrence of two or more vesicomyid species and its cause have rarely been discussed for ancient seeps. The middle Miocene Bessho Formation in Nagano Prefecture, central Japan is composed of slope mudstone deposited at a back-arc basin and contains many seep carbonates in various sizes. Two fossil vesicomyid species, *Adulomya uchimuraensis* and "*Calyptogena*" *akanudaensis*, were previously recorded from the Bessho Formation. This study makes genus reassignment of "*C*". *akanudaensis* and newly reports two vesicomyid species, *Pliocardia* sp. and *Adulomya* sp. and notes that relative abundance of the four vesicomyid species depends on carbonate size. The large seep-carbonate mounds more than 20 m in diameter is characterized by abundant occurrence of *A. uchimuraensis* with rare occurrences of "*C*". *akanudaensis* and *Pliocardia* sp. From the smaller, about 1 m in diameter carbonate body, "*C*". *akanudaensis* dominantly occur in association with *A. uchimuraensis*. The siltstone containing several cm-sized small carbonate concretions yields abundant shells of *Adulomya* sp. in scattered occurrence. The difference of carbonate size suggests that of fluid flux and/or longevity, and the species diversity of vesicomyid clams in the Bessho Formation might be caused by variation of seep activities among sites.

Keywords: Pliocardia, Adulomya, Vesicomyidae, Middle Miocene, Cold seep

