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A new species of the genus *Ocadia* (Testudines: Geoemydidae) from the middle Miocene of Tanegashima Island, southwestern Japan and its paleogeographic implications

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Abstract

A new geoemydid turtle, *Ocadia tanegashimensis* (Testudines: Geoemydidae) is described on the basis of a relatively well-preserved shell from the lower middle Miocene of Tanegashima Island, Kagoshima Prefecture, southwestern Japan. This species is clearly distinguished from two congeneric species (extant *O. sinensis* and *O. nipponica* from the middle Pleistocene of eastern Japan) due to the presence of the following character states: length of the entoplastron as long as the interhyoplastral suture, the costals dovetailed with one another in outline, the third pleural overlapping only the sixth and seventh peripherals. The present study suggests that the initial intrageneric diversification of *Ocadia* began not later than the early Miocene in eastern Asia.

Key words: Reptilia, *Ocadia tanegashimensis* sp. nov., Miocene, Kawachi Formation, Kakinaga Group, paleogeography

Introduction

The genus *Ocadia* (Testudines: Geoemydidae) consists of the extant *O. sinensis* from northern Vietnam, southern China, and Taiwan (Iverson 1992) and *O. nipponica*, an extinct species from the middle Pleistocene of Chiba Prefecture, Honshu, Japan (Hirayama *et al.* 2007). In recent molecular phylogenetic studies, this genus has been frequently synonymized with *Mauremys* along with *Chinemys* (e.g., Fritz and Havaš 2007; Turtle Taxonomy Working Group 2007; Lovich *et al.* 2011) because *O. sinensis*, *M. japonica* and *Chinemys* spp. form a monophyletic clade and are included in a major, more inclusive clade with the other species of the genus *Mauremys* sensu stricto (Honda *et al.* 2002; Barth *et al.* 2004; Feldman and Parham 2004; Spinks *et al.* 2004; Sasaki *et al.* 2006; Jiang *et al.* 2011). However, to date, no diagnostic morphological features or synapomorphies are known for the clade embracing *O. sinensis*, *M. japonica*, and *Chinemys* spp. or the more inclusive clade including also all other species of *Mauremys* sensu stricto. To overcome this incongruence between phylogenetic relationships and taxonomic classification, two solutions have been proposed: placing all species into *Mauremys* or to recognize several distinct genera (Barth *et al.* 2004; Spinks *et al.* 2004). The oldest available name for the clade including *O. sinensis*, *M. japonica*, and *Chinemys* spp. is *Ocadia* (Barth *et al.* 2004). In the present study, *Ocadia* sensu stricto is tentatively retained, however.

From a paleontological perspective, lumping *Ocadia* with *Mauremys* and *Chinemys*, as suggested by Spinks *et al.* (2004), appears to eliminate the remarkable morphological differences between the three genera, as well as the long diversification history of the genus *Ocadia*. *Ocadia* is clearly distinct from the latter two genera in having several morphological traits, such as enlarged upper and lower triturating surfaces along with two lingual ridges,