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## Unusual preservation of fossil mantis shrimp (Stomatopoda): occurrence of mandibles from the Pleistocene Ogushi Formation, Kyushu, Japan

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Stomatopoda Latreille, 1817 are known from the late Devonian to Holocene strata around the world (e.g., Hof & Briggs 1997; Schram 2010; Haug C. *et al.* in press). However, the Pleistocene record of Stomatopoda comprises only one species, *Squilla empusa* Say, 1818 from Maryland and Connecticut, U.S.A. (Rathbun 1935; Blake 1953; Waage *et al.* 2001). The authors collected some fossil mandibles associated with fragments of the raptorial claw of Stomatopoda from the Pleistocene Ogushi Formation, Kumamoto Prefecture, Japan. Fossil stomatopod mandibles have been reported from the Carboniferous of U.S.A. (Jenner *et al.* 1998), Carboniferous of Belgium (Schöllmann 2004) and Jurassic of Germany (Haug J.T. *et al.* 2008, 2010). The purpose of the present paper is to record the occurrence of stomatopod mandibles, first found in the Cenozoic deposits. The figured specimens are deposited in the Mizunami Fossil Museum (MFM) and Goshoura Cretaceous Museum (GCM-IVP).

The specimens reported here were collected from the Ogushi Formation in Ogushi, Itsuwa-machi, Amakusa City, Kumamoto Prefecture, Japan (Fig. 1). This formation consists of sandy mudstone which contains Ata-Th tephra (Shimoyama *et al.* 1999) and yields rich marine mollusks (Ugai *et al.* 2010), ostracodes and foraminifers (Kawano *et al.* 2011). Ugai *et al.* (2010) suggested that the Ogushi Formation was deposited under a subtidal zone to 20 m deep. Additionally, Kawano *et al.* (2011) showed that the Ogushi Formation had deposited under a muddy middle bay (about 10 m deep) and indicated that open sea water flowed into the depositional site during deposition. This formation is correlated with the marine oxygen isotope stage 7 (250 to 230 ka) based upon the Fission-Track dating of the Ata-Th tephra (Danhara 1995). A fossil specimen of the stomatopod mandible (MFM214701) was found from the outcrop by our fieldwork, and other seven specimens were found under the binocular microscope after unconsolidated muddy sediments were washed through a 16-mesh sieve (1.0 mm).

The specimens comprise several mandibles and raptorial claws (Fig. 2). Within the mandible of MFM214701 (Figs. 2A–C), the incisor and molar processes are well preserved but the mandibular palp is not preserved. In the mandible of GCM-IVP3141 (Figs. 2D, E), the incisor process is preserved but molar process and mandibular palp are not preserved. A fragment of the mandible is shown in Fig. 2F (GCM-IVP3142). These specimens are similar to that of the mandible of the recent species, *Oratosquilla oratoria* (de Haan, 1844) (Fig. 2G: MFM214702) which is common in Japanese waters. However, the present specimens cannot be conclusively identified to family level because stomatopod taxa are usually identified by the rostral plate, carapace, thorax, abdomen, telson and maxilliped rather than the mandibular characters (e.g. Ahyong 2005). The dactylus of raptorial claws associated with mandibles are shown in Figs. 2H–L (MFM214703, 214704, GCM-IVP3143–5).

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