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Soft-sediment deformation structures in the Mio-Pliocene Misaki Formation within alternating deep-sea clays and volcanic ashes (Miura Peninsula, Japan)

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ABSTRACT

The Mio-Pliocene Misaki Formation of the Miura Group (Miura Peninsula, Japan) shows an extremely wide variety of soft-sediment deformation structures. The most common deformation structures are load casts and associated flame structures, dish-and-pillar structures, synsedimentary faults, multilobated convolutions, chaotic deformation structures, sedimentary veins and dykes, and large-scale slides and slump scars. The formation, which accumulated in a deep-sea environment (2000–3000 m), is well exposed in and around Jogashima; it consists of relative thin (commonly dm-scale) alternations of deep-marine fine-grained sediments and volcanic ejecta that are, as a rule, coarse-grained. Since the formation represents fore-arc deposits of the Izu-Bonin and the Honsu arc collision zone, it might be expected that tectonic activity also played a role as a trigger of the soft-sediment deformation structures that abound in these sediments. This is indicated, indeed, by the abundance of soft-sediment deformations over large lateral distances that occur in numerous beds that are sandwiched between undeformed beds. On the basis of their characteristics and the geological context, these layers can be explained satisfactorily only by assuming deformation triggered by seismicity, which must be related to the Izu-Bonin and Honsu arc collision. The layers thus form deep-marine seismites.

1. Introduction

Soft-sediment deformation structures (SSDS) are known from all depositional environments and from rocks of all ages. Seismic shocks are one of the possible causes of their formation. The sediments under study here represent deposits accumulated in convergent plate margins, which areas are known to be commonly associated with seismic shocks that are occasionally strong enough to result in deformed layers (seismites). Post-depositional deformation by tectonic activity and subsequent metamorphism tend to obliterate the delicate primary as well as the secondary (deformational) structures; thus, they are major obstacles for the recognition of the influence of seismicity on the sediments under study. Valuable records of tectono-sedimentary processes can be preserved, however, in the sedimentary successions developed at convergent plate boundaries (Lundberg and Dorsey, 1988; Soh et al., 1991; Hanamura and Ogawa, 1993; Busby and Ingersoll, 1995; Lee and Ogawa, 1998; Yamamoto et al., 2005; Mazumder and Arima, 2013).

The Miura Peninsula, located in south-central Japan, on the northeastern side of the Izu collision zone between the Honshu and Izu-Bonin arcs, has a unique tectonic position (Fig. 1A). The Mio-Pliocene (Kaine et al., 1991) fore-arc succession of this peninsula is an on-land accretionary prism (Fig. 1A, B) (Yamamoto et al., 2005). The succession includes the Misaki Formation, which is characterised by numerous soft-sediment deformation structures and most of these structures are concentrated in seismites (cf. Seilacher, 1984; Van Loon, 2009, and references therein). Detailed sedimentological analyses of this formation have been undertaken by several authors (Soh et al., 1991; Stow et al., 1998; Lee and Ogawa, 1998; Mazumder and Arima, 2013), but the seismites have not yet been studied in any detail, although a few of them have been reported by Van Loon (2009). In the present contribution, we present the geological setting and facies characteristics of the Misaki Formation briefly only, for the sake of brevity, with a detailed

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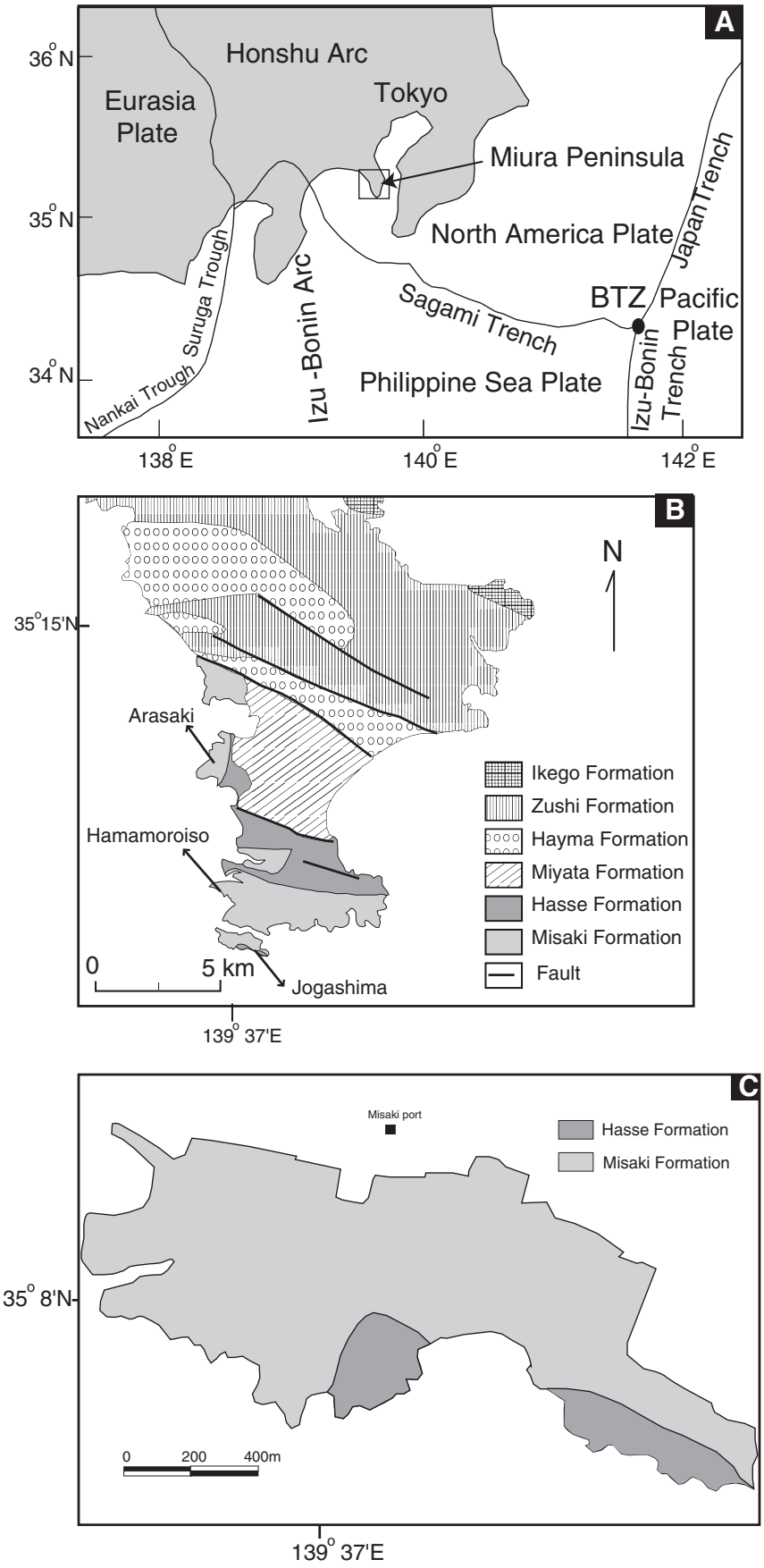

Fig. 1. Location map. (A) The Miura Peninsula in its plate-tectonic setting. (B) Schematic geological map of the Miura Peninsula and Jogashima Island. (C) Outcropping zone of the Misaki Formation in and around Jogashima.