

## Duplexes and other structures in the Misaki Formation of Shonan-Ubajima and their significance

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The Hirajima and Ubajima Islands in Sagami Bay off the Chigasaki fishly port are part of ridges arranged in a WNW-ESE line from the Hayama district in the Miura Peninsula. Although lithostratigraphic and nannofossil biostratigraphic analyses have been studied in the Ubajima Islands, geologic structures of the Ubajima and Hirajima Islands remain incompletely understood. Our stratigraphic and structural study revealed that Ubajima Islands have distinctive structures characteristic in an accretionary complex, represented by a decollement zone with duplexes, thrust-anticlines and bedding-parallel shortening structures.

The Hirajima Islands located immediately on the south of the Chigasaki port is composed of tuffaceous fine sandstones correlated with the Oyama Formation of the Hayama Group. The Ubajima Islands located 2 km southeast from the Hirajima Islands is of tuffaceous muddy sandstones, more than 290 m in thickness, intercalating pumiceous and scoriaceous tuff beds. Middle to lower horizons of the Eboshi Honto and Odaira Island are dated at between 8.2-9.9 Ma based on co-occurrence of radiolarian species *Stichocorys delmontensis* and *S. peregrina* and no occurrence of *Cyrtocapsella japonica*, the combination of which is correlated with the Misaki Formation of the Miura Group. Geologic structure of the Ubajima Islands is divided largely into eastern part and western part. Eastern part strikes N-S with dips to west showing an anticline trending WNW-ESE and western part strikes E-W to ENE-WSW with dips to north. The thrust faults trending E-W at the central and south areas of western part bound its geologic structures and stratigraphy. At the southern area across the thrust fault in the Odaira Island in the western part of Ubajima Islands, decollement zone is identified, as consisting of the main share zone, fold and share zone, from the north to south, being accompanied with some duplex structures and layer parallel faults. On the other hand, the northern area of the thrust showing an anticline trending WNW-ESE that thrusts up onto southward, representing sinistral strike-slip fault in appearance. The decollement zone with thrust-anticlines observed in the Ubajima Islands is characteristic within accretionary margin in many toe areas of the Nankai Trough (Kawamura *et al.*, 2009; Michiguchi and Ogawa, 2011). Normal fault trending NNW-SSE cut these duplexes and thrust trending E-W.

The structures observed at the Ubajima Islands should be formed in the following steps. Stage 1 (formation of multiple fault-bend folds (duplex structures)): The formation of the antiformal stack underneath resulted in development of multiple fault-bend folds for a series of duplexes during a period of N-S trend compression. Stage 2 (formation of fault-propagation fold): Fault related deformation induced by large scale folding and associated thrust was formed. Synclines of the Odaira Island in western area and the Ujima Island in eastern area and anticline in intermediate area were developed at this stage. Stage 3: Normal faults trending N-S were formed under an E-W compression after the changes of stress field, which is thought to stem from collision of Izu Arc, and is correlated with an E-W trending normal fault observed in Sagami Bay (Mori *et al.*, 2010).

Maximum principal stress axis ( $\sigma_1$ ) inferred from the fold axis (average N36E) is oriented NE-SW, which is corrected N-S compressional stress field considering rotational angle of 55 degrees in a clockwise direction estimated at the Oiso Hills (Koyama *et al.* 1986). It corresponds with stress field in the South Fossa Magna before 1 Ma (Mori *et al.*, 2010, 2012)

### [Reference]

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