# Bedforms produced by the Kuroshio current over the Izu Ridge: side-scan sonar survey around Niijima, Kozushima and Miyake Islands

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During the high-resolution side-scan sonar survey off Niijima and Kozushima Islands, bedforms such as sand ribbons, 2D and 3D dunes were observed on the sea floor at a depth 100-400m. These bedforms display sharp profiles and are interpreted as products of the Kuroshio and tidal currents. The bedform distribution indicates that the Kuroshio is blocked by the Onoharashima Island and the Kozu-Nakase Knoll west to the surveyed area, and passes a narrow channel between the terrace and the Kozushima Island. The surface current velocity of about 1m/s is estimated in the 2D dune field from the bedform features.

During the high-resolution side-scan sonar survey off Niijima and Kozushima Islands, a various kind of bedforms was observed on the sea floor at a depth 100-400m. The distribution of these bedforms is controlled by the variation in the flow velocity, flow direction, water depth and topography, reflecting the pattern of the oceanic and tidal currents in the area. The observed bedforms are summarized as follows:

(1) Sand ribbons of type B and type C (Kenyon, 1970) are located in the >6km long and 4km wide area off southern Kozushima Is. as flow parallel structures. Some streaks of type-C sand ribbons of 500m wide are possibly attributed to sand shadow deposits by small knolls.

(2) Two-dimensional dunes having straight crests with the wavelength of tens to hundreds of meters are ubiquitous in the area. Most of them are interpreted as the products of NE-directed current, while some in the shallow (<200m deep) zones indicate the flow opposite or perpendicular to such current. The wavelength of 2D dunes increases with the water depth, reaching the maximum of >500m with the height of >20m, while replaced by the smaller 3D dunes in the deepest area.

(3) Three-dimensional dunes of smaller dimensions are developed in the surrounding area of the 2D-dune field. The 3D structures result from transitional deformation of 2D dunes or from well-developed superimposed bedform on 2D dunes.

These bedforms display sharp profiles and are interpreted as active or fresh structures. The oceanographic setting in the studied area is dominated by Kuroshio current, which is flowing to NE with the average speed of 0.5m/s. Tidal current is also influential: the maximum of >6m/s of the surface current velocity has been observed. Such a strong current can produce and keep the large-scale bedforms observed in this survey.

The distribution of the bedforms indicates that the Kuroshio between the Miyake and Kozushima Islands is blocked by the Onoharashima Island and a knoll (Kozu-Nakase; 162m deep) on the west of the surveyed area, and passes a narrow channel between the terrace and the Kozushima Island. The current passes out of the channel, extending ahead to form the largest dunes, and diverges along the contour lines. The sonar image of the sea floor showed little evidence indicative of the flows over the Kozu-Nakase and from south between the Miyake and Onoharashima Islands.

The bedforms features on the sea floor can be used to estimate the flow conditions. Based on the dimensionless shear stress for dune and upper-stage-plane-bed boundary and the bed roughness due to the wavy bedform, representative values for 2D-dunes in two different fields (wavelength L=150m, wave height H=4m, water depth D=290m; L=500m, H=10m, D=370m) yield the layer averaged flow velocity of 0.93m/s and 0.62m/s, respectively, giving the water surface flow velocity of 1.05 m/s and 1.02 m/s. The dimensions of dunes are, therefore, interpreted to depend on the local water depth, rather than the water surface flow velocity.

References

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