Bottom Water Currents and Seafloor Erosion as a Triggering Mechanism

The nearest bottom current measurements were made ~ 60 km to the east of the 3-D survey by Fukasawa et al., (1987), who measured mean current speeds of 0.03 – 0.07 m/s heading east at three stations moored 400 m above the sea bottom along the slope due south of the Kii peninsula (Fig. DR1). Although these measurements unfortunately do not directly overlie the notch, they are sufficiently close to indicate a strong near seafloor counter current associated with the Kuroshio current. Presently the Kuroshio flows NE above the notch and the lower slope of the accretionary complex and could have an associated W-SW−flowing counter current in the vicinity of the notch similar to that noted to the west by Fukasawa et al., (1987).

Evidence for strong bottom-water currents and seafloor erosion is observed 5-10 km east of the 3-D volume. Here wavy patterns in the seafloor form ridges with a form similar to sediment waves observed along other margins where strong bottom currents exist (Holbrook et al. 2002). Two 2-D seismic profiles acquired by Park et al. (2003) span this region (Figs. DR1 and DR2). Numerous truncated horizons are seen coincident with the wavy seafloor across the top of the ridge on both profiles, which is consistent with seafloor erosion. More significantly, the BSR is particularly shallow across the ridge in both these profiles. The BSR is expected to be 150 m deeper assuming the regional thermal gradient is constant (43 ºC/km) from the Kumano Basin across the ridge (Fig.
We presume that bottom currents are responsible for recent erosion of the seafloor and the BSR remains anomalously shallow because temperature profiles have not yet readjusted. These profiles provide excellent evidence for active seafloor erosion, probably by seafloor counter currents related to the strong Kuroshio current at the surface.

**Numerical Diffusive Heat-Flow Model of BSR**

We present a numerical diffusive heat-flow model of BSR positions following instantaneous formation of the notch. We assume a smooth, continuous seafloor as an initial condition (Fig. DR3), a constant regional heat flow pattern before and after formation of the notch, and instantaneous removal of material in the notch. The 2-D diffusive heat-flow model assumes no-flux side boundary conditions, a constant basal boundary condition, and a constant thermal conductivity of 1.3 W/m/K, consistent with IODP drilling results values across the region (further details are described in the figure caption for Fig. DR3).

**REFERENCES**


Figure DR1. Regional location map of the study area. Black circles indicate positions of tethered buoys 400 m above the seafloor that recorded bottom currents indicated in m/s (Fukasawa et al., 1987). These are the nearest sea bottom buoys available in the vicinity of the notch. They are 60 km to the west of the notch, but are directly downstream along the Kuroshio current. Contours in meters.
Figure DR2. Seismic lines D7 and D6 (see Figs. 1 and DR1 for location). Truncated horizons at the seafloor and small seafloor ridges across the top of the anticline are interpreted as scouring and reworking by bottom currents. Solid blue line is the steady-state BSR position assuming a thermal gradient of 43 °C/km. We assume recent seafloor erosion is the reason for the difference between the current BSR and the BSR at thermal equilibrium, which forms the basis for estimating a pre-erosion seafloor position (blue dashed line).
Figure DR3. Thermal models of the BSR following excavation of the “notch”. Blue dashed line is the assumed initial seafloor profile set to mimic the paleo BSR interpreted in Fig. 2. The paleo BSR (red line marked as BSR at \( t = 0 \)) is assumed to be the initial condition and the notch was eroded instantaneously. Red lines mark BSR positions at 1,000 and 10,000 yrs. after erosion. The steady-state BSR (black lines) is modeled with two thermal gradients (36 °C/km and 43 °C/km), which was required to match the current BSR. The model reached steady state in \(~ 40,000 – 50,000\) yrs.