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Submesoscale instabilities of an oblique anticyclonic eddy in the Gulf of Alaska investigated by marine seismic survey

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Mesoscale eddies are ubiquitous in the global ocean and can be captured by marine multi-channel seismic surveys. In this study, an anticyclonic eddy is presented along the seismic line STEEP11 acquired on 30 SEP 2008 at the head of the Gulf of Alaska. The eddy's layered structure with alternative strong striae and weak layers is regarded as a typical eddy nature of the study region. The eddy centers at different depths are displaced with a NW tilted axis of 1.9+/-0.2 degree from the horizontal. Submesoscale instabilities like fronts and filaments are coexisting around the eddy periphery. The estimated geostrophic current is asymmetric and the ageostrophic components must play an important role in balancing the eddy system. The nonlinearity of the eddy is extremely strong as its rotation speed is much higher than its translation speed. It is suggested that the Ekman transport is responsible for the skewed shape with the asymmetric geostrophic current and asymmetric submesoscale processes. The deflected density field due to tilted axis may enhance the energy conversion and accelerate the eddy dissipation. With the pervasive submesoscale instabilities as the transitional dynamic process, a forward cascade of energy could be expected from the mesoscale vortex to the finescale wave-breaking.