# VELOCITY AND POTENTIAL VORTICITY STRUCTURE OF A KUROSHIO EXTENSION COLD CORE RING

OS45G-06

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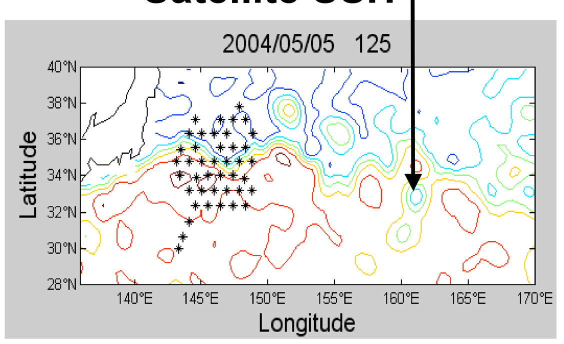
## 1. "What is the history of Ring 04A interactions with the Kuroshio?"

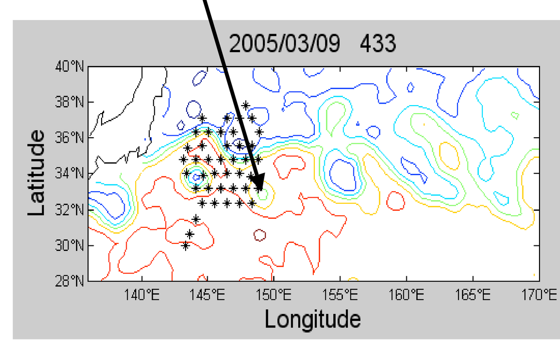
**May 2004**

Cold core ring 04A formed

04A stalled for nearly 100 days

Satellite SSH



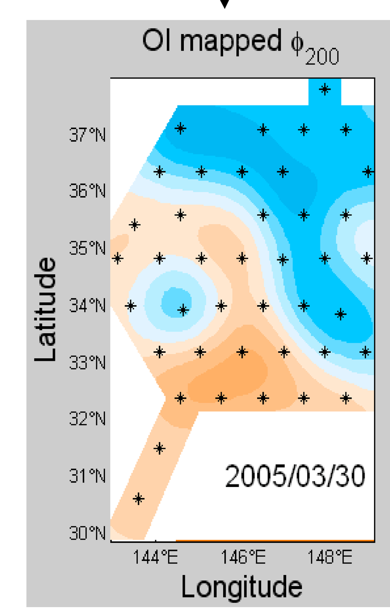




Geopotential height $\phi$ was mapped from round-trip acoustic travel times by an array of Inverted Echo Sounders

**April 2005**

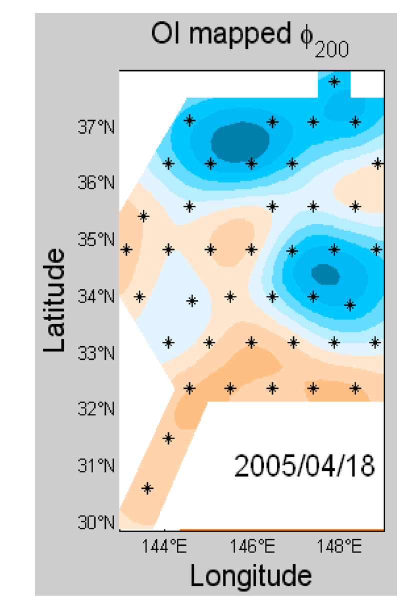
Interaction 1

04A attached to the Kuroshio Extension (KE)




04A inflated and intensified during its interaction with the KE.

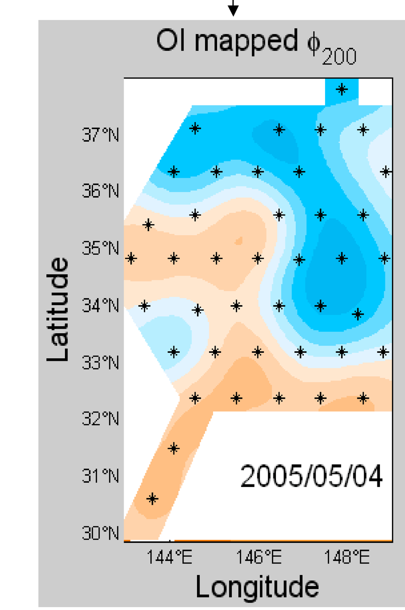
04A detached from KE



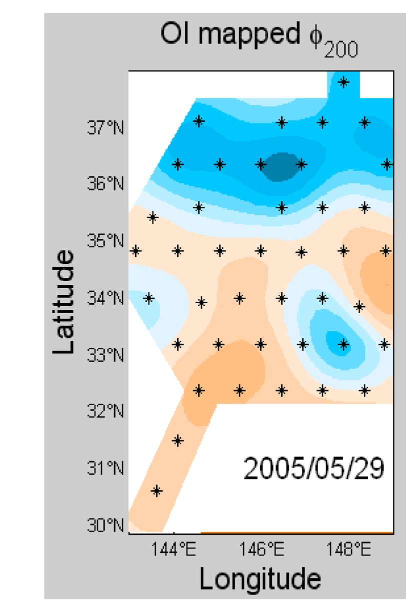

**May 2005**

Interaction 2

04A reattached to the KE




04A detached from KE




**July 2005**

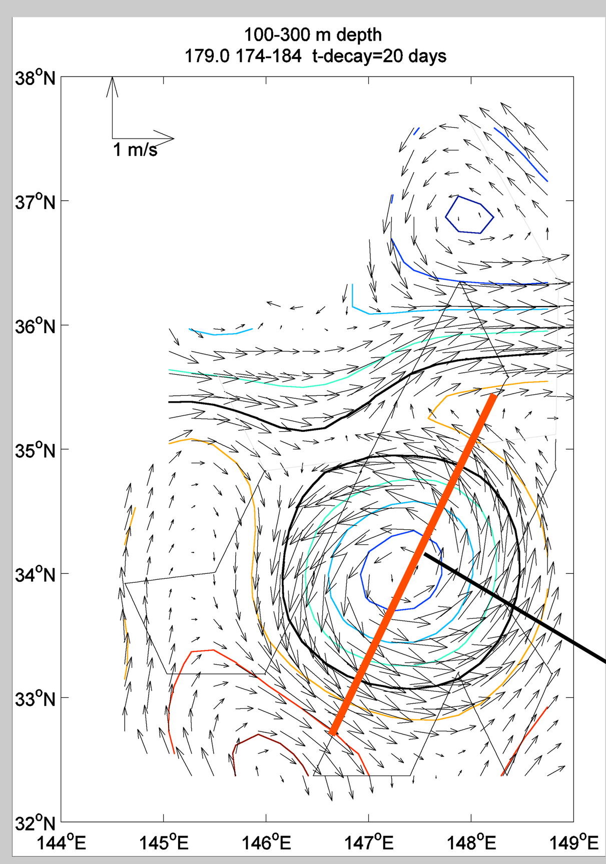
ADCP and CTD survey of ring 04A

**Sept. 2005**

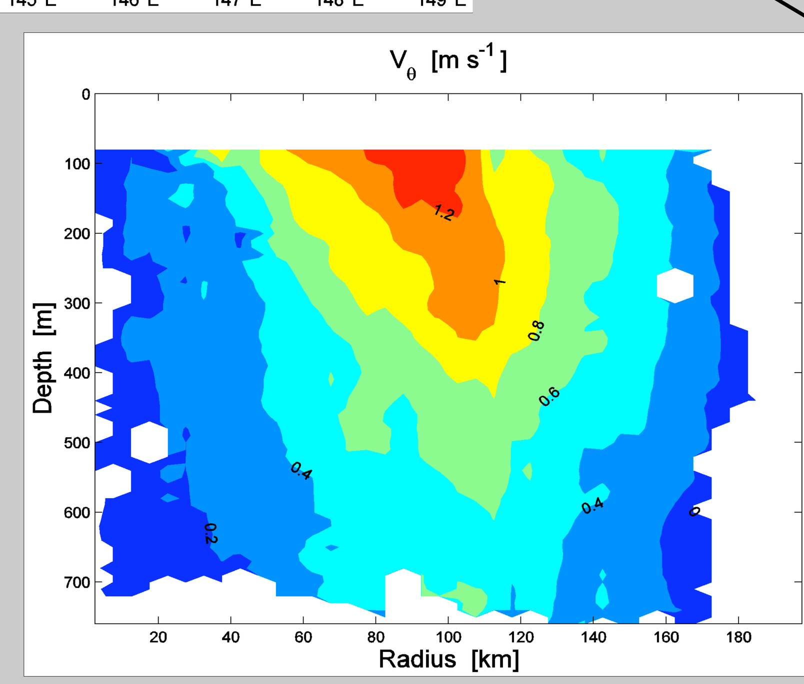
In mid August 04A was absorbed by the KE for the final time

## 2. What is the velocity structure of a Kuroshio Ring?

a.) Mapped July 2005 ADCP survey.



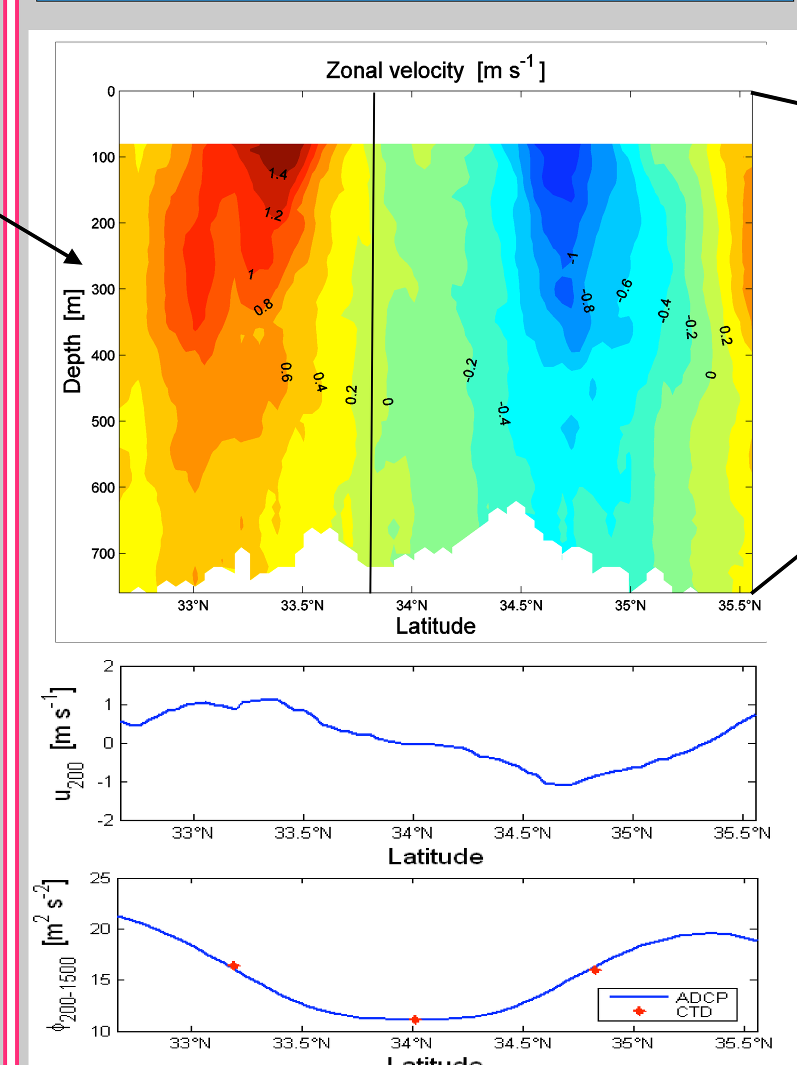

b.) Average section from two radial transects.



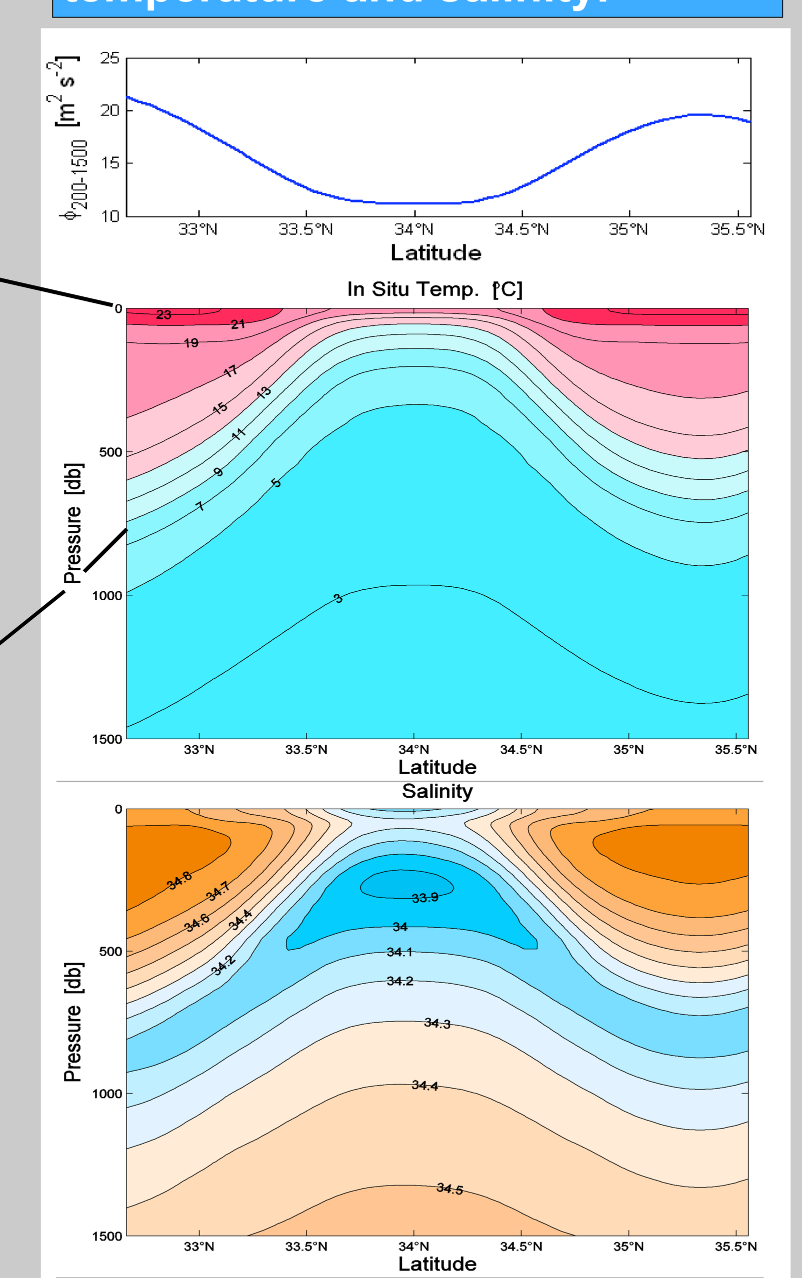

- Net volume transport 50 Sv between 80 and 670 m depth out to *r* = 160 km.
- Rotational Rossby number ~ 0.25.
- Core of the ring is in nearly solid body rotation with a 7-day period from 100 m to 300 m depth out to *r* ~ 50 km.
- Subsurface velocity maximum around warm periphery.

## 3. What can the $\psi_{200}$ streamfunction tell us about subsurface structure?

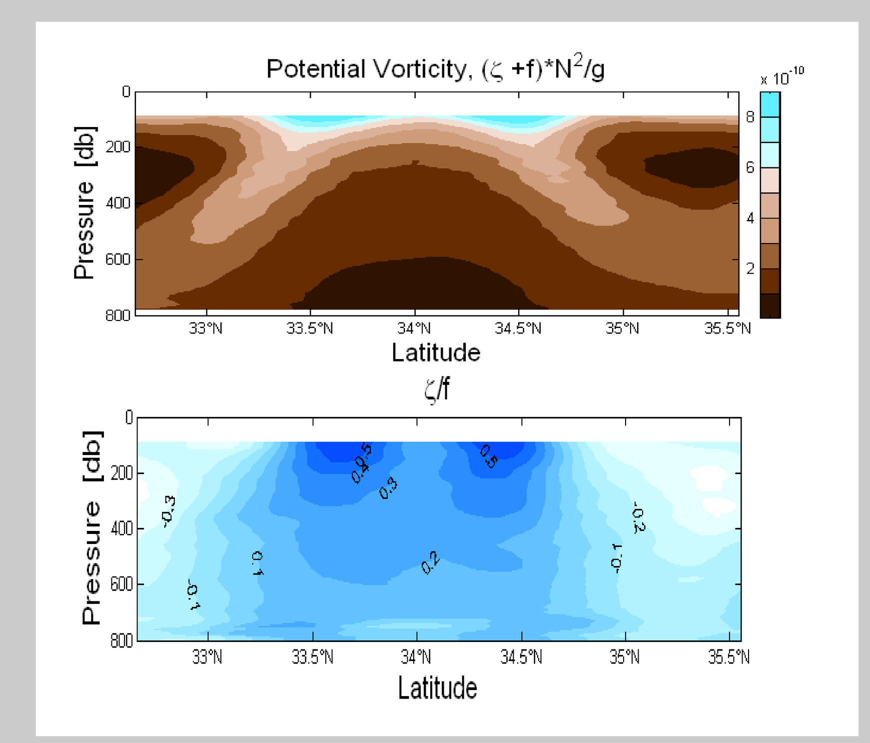
An optimal interpolation of ADCP velocities across the ring estimated a streamfunction at 200 m $\psi_{200}$. $\phi_{200} = \psi_{200} * f$ was referenced by CTD geopotentials $\phi_{200\text{-}1500}$.




Using this referenced $\phi_{200}$ as an index for an empirical lookup table from historical CTDs, we constructed the ring transect of temperature and salinity.

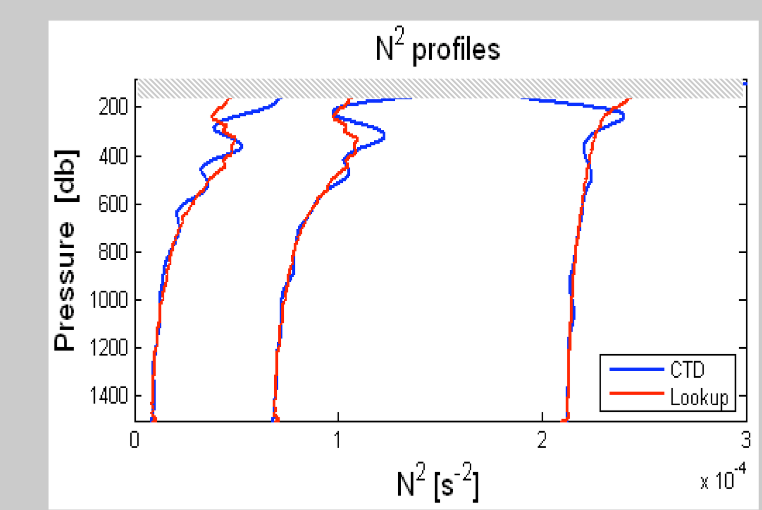



The temperature and salinity sections determined the buoyancy frequency N. The ADCP velocities determined the relative vorticity $\varsigma$. Combined, these estimated the Ertel Potential Vorticity (PV) field across the ring.




- The core of high PV coincides with the high stratification, supplemented greatly above 300m by $\varsigma$.
- A large portion of the core has $0.2*f < \varsigma < 0.3*f$. This corresponds to rotational period 6 d < T < 8 d.

How well can this technique estimate $N^2$? Agreement is good below seasonal pycnocline.




**Applications/Questions:**

1.) What can the ring core PV tell us about the origin of the ring?

2.) What role do rings play in the cross-frontal exchange of heat and salt across the KE front?

3.) What is the PV flux into surrounding waters from Kuroshio Rings? (Qiu et al. 2006)

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