Defining Deep Circulation Pathways

The Gulf Stream Encounter Tail of the Grand Banks

The Gulf Stream encounters the Tail of the Grand Banks at a dramatic topographic ridge that separates two currents: the Gulf Stream (GS) and the Deep Western Boundary Current (DWBC). The collision of these two currents is a critical location for the North Atlantic circulation because it is where the major branches of the GS and DWBC exchange water. The interaction of these currents is a key to understanding the deep water formation and transport in the North Atlantic.

The Tail of the Grand Banks is a topographic ridge that separates the GS and DWBC. The GS approaches the Tail along an isobath that penetrates to 5000 m, with deep water west of the ridge. The DWBC approaches the Tail along an isobath that penetrates to 3000 m, with deep water east of the ridge. The collision of the two currents occurs at the Tail, where the GS descends and crosses under the DWBC as it rounds the Tail, much like the crossing at the Washington Gap, WG, to the south. The hypothesis that the GS and DWBC will follow the path of least resistance is confirmed by the current meter data downstream and upstream of the Tail. The result of a head-on encounter will depend on the eastward penetration scale of both the deep GS and its adjacent flows in concert with the detailed bathymetry and location of the GS. The cross-line orientation of the GS and DWBC flow is critical to the deep water exchange.

Where does the deep water go?

The deep water formed at the collision of the GS and DWBC moves into the North Atlantic and contributes to the formation of the North Atlantic Deep Water (NADW). The NADW is a critical component of the global ocean circulation and plays a key role in the exchange of heat, salt, and nutrients between the North Atlantic and the world ocean. The NADW is formed when the GS descends and crosses under the DWBC at the Tail of the Grand Banks. The NADW is a result of the density stratification in the North Atlantic, where the GS and DWBC exchange water and form a density front. The NADW is a critical component of the deep ocean circulation and plays a key role in the exchange of heat, salt, and nutrients between the North Atlantic and the world ocean.

The Tail of the Grand Banks is a critical location for understanding the deep water formation and transport in the North Atlantic. The interaction of the GS and DWBC is a key to understanding the deep water formation and transport in the North Atlantic. The Tail of the Grand Banks is a critical location for understanding the deep water formation and transport in the North Atlantic. The interaction of the GS and DWBC is a key to understanding the deep water formation and transport in the North Atlantic.