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Thorpe Scales in the “Largest” Oceanic Reynolds Number Flow (but still stratified) on the Planet

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In a 1999 paper looking back at the first shear probe measurements Stewart and Grant (1999. J. Tech.) described the flows in Discovery Passage as sustaining Reynolds Numbers (Re) amongst the largest in the universe! True or not, it is still a useful benchmark. Cook Strait, coincidentally, where HMS Discovery spent a some time, has comparable flow speeds but is around 4 times the depth, suggesting an even larger Re. More importantly, despite this highly turbulent large scale flow, stratification clearly persists through the strait. Here we explore the tidal drivers, background stratification and stratified boundary layer response, mainly through vertical microstructure profiles. Thorpe scales, often as much as one quarter of the water depth (~300 m full depth), are compared with dissipation rates and background flow speed. Dissipation rates do not get particularly high, around $5 \times 10^{-5} \text{ W kg}^{-1}$, and vertically integrated energy dissipation does not strongly correlate with a power function of bulk velocity. A characteristic of Cook Strait is the system has a “narrows” (23 km wide) so that conditions change rapidly from a Lagrangian perspective. A consequence of this is horizontal heterogeneity is roughly comparable to that seen in the vertical dimension. Implications of enhanced diapycnal diffusion for regional oceanography are examined.