Evaluation of the Regional Top Seal for Geologic Carbon Sequestration, Gippsland Basin, Southeastern Australia

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GeoScience Victoria and partners have undertaken the first detailed basin-wide study of the regional top seal, the Lakes Entrance Formation, in the Gippsland Basin. The Gippsland Basin is a prolific hydrocarbon province with some major oil fields nearing the end of their productive life. Within the onshore portion of the basin, are the coal-fired power stations, which generate significant greenhouse gas emissions. The Gippsland Basin presents as an attractive site for the possible geologic sequestration of carbon dioxide because of the close proximity to emission sources and the potential for large scale storage projects. This comprehensive assessment of the regional top seal has involved the analysis of the geometry of the seal (the geographic extent, depth to base and thickness of seal); seal capacity (calculated vertical column heights from Mercury Injection Capillary Pressure analysis) and mineralogical composition of the seal (from Automated Mineral Analysis). These datasets have been integrated to produce a qualitative evaluation of the containment potential for geologic sequestration across the basin.

The geometry of the top seal is consistent with deposition in an early post-rift setting where marine sediments have filled palaeo-topographic lows. The thickness and depth to base of the seal are greatest in the offshore central basin and decrease toward the margins. There is a strong positive relationship between seal capacity column heights, the thickness of the regional seal and the depth to the base of the seal. The mineralogical analysis of the top seal has revealed that the Lakes Entrance Formation is principally a smectitic claystone. At greater burial depths and where smectite content is greater than 80%, seal capacity is increased. In the onshore areas at shallow depths of less than about 700 m, diagenesis of seals subsequent to uplift and freshwater flushing has substantially degraded seal capacities.

This study has provided the framework for quantitatively evaluating seal potential at a basin-scale. It has shown that large areas of the basin have very high containment potential, although towards the northern and southern flanks, and along primary migration fairways, containment does decrease to unacceptable low levels. Consequently, the integration of our containment investigation with carbon dioxide migration modeling studies will provide the fundamental basis for the development of sequestration projects in the Gippsland Basin.