Formation of a Large Field of Sub-Circular Depressions Due to Fluid Migration in the Gippsland Basin (Southeast Australia)

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Abstract

The circulation of undersaturated fluids within sedimentary successions may lead to dissolution of occurring carbonate minerals, with the potential to increase effective porosity. We investigated the widespread occurrence of sub-circular depressions in the SW Gippsland Basin (SE Australia) at the contact between the Lakes Entrance Fm. (L. Oligocene) and the overlying Gippsland Fm. (E. Miocene).The interpretation of high-resolution 3D seismic data, calibrated with information from exploration wells, revealed that these depressions occur within the marl of the Lakes Entrance Fm. and do not extend in the overlying carbonates. The sub-circular features delineate invertedconical morphologies extending downwards from a top depression ranging 10s-100s meters across. They commonly have a chaotic internal seismic response, with discontinuous reflections. The dewatering of the Lower Lakes Entrance Fm. led to the development of an extensive field of polygonal faults underlying the sub-circular depressions. No amplitude anomaly or feature in the seismic data indicate the current presence of fluids in the interval of interest. However, it is documented that polygonal faults act as preferential fluid migration pathways within sedimentary successions and have been responsible for the upwards diffusion of deep-sourced fluid along theNW Australian Shelf. The Gippsland basin has a prominent regional fluid migration architecture with a highlyconnected and linked fluid flow system. Analyses suggest that the sub-circular depressions observed in this region of the Gippsland Basin were generated by karstic dissolution inconsequence of upward migration of

pore water released in the deeper areas of the basin duringthe formation of these polygonal faults.