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Subsurface plumbing system of the Great South Basin, New Zealand

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Based on the analysis of 3D seismic data from the Great South Basin (GSB), New Zealand we study fluid flow features to investigate the subsurface fluid plumbing system. The fluid flow evidence includes pockmarks, polygonal fault systems, pipes, bright spots and bottom simulating reflections (BSRs), all of which help constrain aspects of the overburden plumbing system and may provide clues to deeper hydrocarbon prospectivity in this frontier region. Fluid flow features recording fluid expulsion at the seafloor and paleo-seafloor (Eocene) are manifested in this area as pockmarks and paleo-pockmarks. Polygonal (lateral shrinkage) fault system has formed as a de-watering of thick mudstone sequences and it is a very common feature and closely related to the pockmarks and the paleo-pockmarks in the GSB. The polygonal fault system can be divided into two types; a simple tier and a complex tier. There are two types of BSR in this basin including diagenetic BSR and gas hydrate BSR. The diagenetic BSR of positive acoustic impedance contrast have been observed providing evidence of silica diagenesis (opal A to opal CT). A BSR of negative acoustic impedance contrast is interpreted as evidence of free gas accumulation beneath gas hydrate stability zone. Both types of BSR are spatially located within the polygonal fault tier, possibly due to early diagenesis of the sedimentary formation. The Eocene paleopockmarks suggests a regional fluid expulsion at Eocene time. Also, the bright spot and the gas hydrate BSR are possibly an evidence of hydrocarbon maturation in the GSB. Polygonal fault systems are considered to be a permeable complex network of pathways that could facilitate the migration of subsurface fluids during early stage of polygonal fault formation. Present-day seafloor pockmarks suggest that the fluid migration is still active in some part of the GSB.