Dynamic Palaeo-Fluid Flow within Giant Gas Fields from the Browse Basin, Australia

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An investigation of the fluid flow history of reservoir sandstones from a series of giant gas fields in the Browse Basin has revealed significant changes in the palaeo-hydrology of the basin through time. Salinity measurements on aqueous inclusions within diagenetic quartz document substantial changes in formation water salinity involving ingress of highly saline waters that have become progressively diluted with time. Fluid inclusions with the highest palaeo-salinities (>200,000 ppm) have the lowest trapping temperatures whilst inclusions with salinities that are closer to the current formation waters (generally <20,000 ppm) have trapping temperatures that are similar to the current reservoir temperature. These data imply that formation water salinity decreased throughout a period of continuously increasing burial and temperature probably reflecting flow of the denser, more saline fluids into the deeper parts of the basin and replenishment by waters of lower salinity.

Hydrocarbon charge consisted of an early oil charge, filling only the crestal parts of these structures before being displaced or absorbed by a volumetrically more significant gas charge. A subset of fluid inclusion salinity measurements collected on inclusions that contain both oil and formation water have a much narrower salinity range (25,000–35,000 ppm) than those that are purely water filled, but are more saline the current formation waters. These oil-water inclusions have trapping temperatures that are consistent with trapping prior to the subsequent gas charge. The reservoirs complex charge and fluid flow history has major implications for irreducible water salinity, the accurate estimation of Rw and ultimately reserves.