Pore Pressure Prediction for Unconventional Play Through Basin Modelling

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Abstract

Predictive Pore Pressure (PP) models need to be based on an understanding of the entire basin evolution, and on the identification of primary controls of PP build-up and its dissipation. Knowing the geo-history of different variables such as stresses, heating rate, temperature, and hydrocarbon (HC) generation is crucial to address when higher pressure build-up is expected in a source rock. The interplay between tectonic stresses, uplift events, and geo-mechanical properties of the rocks that set the failure conditions, determines how much pressure is preserved up to present day. Large heating rates can enhance HC generation so that pore pressure exceeding the fracture pressure could be expected at the source. The induced fractures in the source can speed up pressure dissipation by the time of present day, dissipating part or all the pore pressure build-up. In this case, present-day PP will be controlled by other mechanisms like disequilibrium compaction and uplift and tectonic stresses, even if an active HC production was in place at the source. On the other hand, if just enough heating rate was sustained for a long enough time close or up to present day, PP build-up would not have time to dissipate, so larger overpressure may be expected at present day. The Neuquén basin, with a complex tectonic development, is the case study where we conducted a pressure analysis of the Vaca Muerta unconventional play using a basin model. Our data confirms that for the Vaca Muerta basin, the largest overpressures are not necessarily associated with a depression's depocenter. To match present day pore pressure within the source rock, secondary cracking of liquid oil in lighter components needs to be included, assigning the correct in-situ compressibility. In this case, lighter components are going to occupy larger volumes and are going to build-up larger overpressure compared

to heavy liquid components. Other source rock parameters like retained HC, TOC, and HI can also modulate pressure build-up in the source. Sweet spot maps accounting for large overpressure should be derived looking at the time of the peak generation rate and the time since the contribution of HC generation to PP build-up stopped.