NMR Spin-spin Relaxation in Unconventional Source Rocks

Z. Harry Xie[1*]

[1]Core Laboratories, 6316 Windfern Road, Houston, Texas 77040, USA

Abstract. NMR spin-spin relaxation, often known as T2 relaxation or transverse relaxation, has been successfully used in well logging and core analysis. The T2 is commonly measured using the Carr-Purcell Meiboom-Gill (CPMG) sequence. Such an experimental method is based on a key factor that the actual NMR signal decay rate (intrinsic T2) is significantly longer than the decay rate of the free induction decay (T2*). In other words, the CPMG echo train technique is mostly applicable to less restricted liquid cases. When dealing with unconventional tight rocks, where the spin-spin relaxation has much faster rates of sub-milliseconds range, the traditional CPMG method of measuring T2 faces challenges. In this work, the general conditions of using the CPMG pulse sequence is reviewed. Examples of T2 distributions with various inter-echo spacing times (TE) from unconventional shale samples demonstrate the non-exponential nature of the spin-spin relaxation in source rocks. Simply shortening TE is not a solution. The early-time NMR signals from rigid solids in source rocks provide further evidence of the non-exponential characteristics of the spin-spin relaxation process. The experimental observations of this work will lead to more accurate interpretations of NMR data of both well logging and core analysis for unconventional reservoirs.