New insights from gas accumulation mechanism in tight sandsotnes

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With the development of exploration and production technology and the increasing demand of natural gas resource, tight sandstone gas reservoirs have been found and widely studied in many basins. Tight sandstone gas reservoirs have made a great deal of progresses in the identification and evaluation of source rocks and reservoir rocks, and the analysis of gas reservoirs characteristics, etc.. However, the gas accumulation mechanism in tight sandstone gas reservoirs is not clear because Darcy flow, as the most important way of gas migration and accumulation, is difficult for tight sandstone reservoirs due to its high capillary force and low driving forces. The driving forces of gas migration by Darcy flow mainly include buoyancy, tectonic stress and excess fluid pressure. However, considering that most tight sandstone gas reservoirs are characterized by low buoyancy, tectonic stress and excess fluid pressure, we suggest that diffusion could be an alternative mechanism of gas accumulation in tight sandstones.

Gas diffusion can occur spontaneously so long as there is concentration difference even in the tight sandstones because the diameter of gas molecule is much smaller than that of pore and throat in the tight sandstones. Furthermore, diffusion has still been taken as one of important mechanisms of gas dissipation in conventional gas reservoirs. Diffusion in gas reservoirs has been studied in the following main aspects, involving (a) measurement of diffusion coefficients, (b) establishment of numerical diffusive models, (c) calculation of diffusive amount, and (d) geochemical characteristics of diffusive migration. However, there are still some aspects needed to be improved. Firstly, the effects of diffusion have been studied sufficiently in gas dissipation, but deficiently in gas expulsion and accumulation. Secondly, the mass-transfer rate of gas diffusion in gas reservoirs has been a matter of dispute. Thirdly, the gas generation, adsorption and desorption should be considered in the study of gas diffusion. Fourthly, measured diffusion coefficients have not been corrected to the actual geological conditions.