Variation in surface characteristics of clay minerals in diagensis processes and their relationship to the generation and primary migration of hydrocarbon

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In order to investigate the generation and primary migration of hydrocarbon in clayey source rocks comprehensively and attempt to determine the amount of hydrocarbon expelled approximately, some surfacial analytical technologies, including XPS, nitrogen adsorption method, XRD, FTIR and TG, are employed to discover the combination pattern between organic matter and clay minerals and its variation during diagensis processes. Both clay minerals and organ-clay complexes were isolated respectively from the tertiary clayey source rocks sampled from Dongying Basin, Bohai Depression. The calculation based on N_2 adsorption-desorption isotherm discovers that the BET area and the surface energy of clay isolation decrease gradually as the illitization of smectite ocurred in diagenesis processes. But the change pattern of organ-clay complexes is quite different, the variation of BET area, pore-width-distribution and surface energy are influenced remarkably by the amount of soluble hydrocarbon in source rockes. It is of significance to find that the relative high energy sites on clay minerals take precedence over low ones disappear as the generation of hydrocarbon, and reappeare lattermost as the primary migration of hydrocarbon. And it is also revealed that the hydrocarbon generated, especially low-molecular-weight hydrocarbon, could be absorbed in interlamellar space of smectite and on mineral surface as well, which decreased in BET area of organ-clay complexes and reduced amount of micropore because of screening and blocking effect of organic moleculars absorbed. As the results of XPS, TG and DFT analysis of isotherm, the organic moleculars generated prefer to be absorbed on the high energy site, and the desorption occurs in the latter stage of primary migration accordingly. In conclusion: a possible method employing the surface energy analysis of organ-clay complexes is proposed to determine the amount of hydrocarbon expelled from source rocks roughly.

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Geochemical anomalies possibly indicating occurrence of hydrate in the northeast of the South China Sea

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Gas hydrate, mainly composed of hydrocarbon gas and water, is considered to be the 21th clean energy. Many indicators such as BSRs which are thought to be related to gas hydrate are found in the South China Sea (SCS) in recent years. However, the northeastern part of the SCS are taken as one of the most potentials by many scientists in the area. It is situated in the conjunction of the northern divergent continental margin and the eastern convergent island margin, whose geological settings are much preferable for gas hydrate to occur.

Through our work, the bright temperature anomaly recorded by satellite-based thermal infrared scanning image before or within the imminent earthquake, the high content of hydrocarbon gas acid-degassed from subsurface sediment and the high radioactive thermoluminescence value of subsurface sediment are found in the region Sometimes the bright temperature anomaly isolatedly exists in the surrounding of Dongsha island. The highest content of hydrocarbon gas amounts to 393 µl methane per kilogram sediment and the highest radioactive thermoluminescence value is 31752 unit, whereas their geometric averages are 60.5 and 2688.9 respectively. What is more inspiring is that there are three sites where the methane contents are up to 243, 268 and 359 µl/kg and their radioactive thermoluminescence values are 8430, 9537 and 20826 unit respectively, and which are in the very vicinity of one of the highest confident BSR locations identified by Chi (1998). In the paper, the reasons of these anomalies are preliminarily discussed. In allowance for other indicators such as headspace gas anomaly in the sediment and chloride anomaly in the interstitial water in the site 1146 of Leg 184, the above mentioned anomalies are possibly indicating the occurrence of gas hydrate in the northeast of the SCS.

References

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