$\delta^{13}C_4$. In contrast, the $\delta^{13}C_1$ values of biogenic alkane gases are lighter than −30‰, with a negative isotope sequence (i.e. $\delta^{13}C_1 > \delta^{13}C_2 > \delta^{13}C_3 > \delta^{13}C_4$). Inorganic gases also tend to show less negative $\delta^{13}C_{CO_2}$ values (≥−10‰) than biogenic gases (<−10‰).

06/01556 Geochemistry and origin of sour gas accumulations in the north eastern Sichuan Basin, SW China

Li, J. and Xie, Z. *Organic Geochemistry*, 2005, 36, (12), 1703–1716.

Significant natural gas reserves have recently been discovered in the Lower Triassic oolitic reservoirs from north eastern Sichuan Basin, SW China. In the wake of the December 2003 sour gas well blow-out, this study presents an overview on the petroleum geology and geochemistry of the sour gas accumulations in the study area. Two types of natural gas accumulations were identified in the Lower Triassic oolitic reservoirs, both containing highly mature thermogenic gases, with their hydrocarbon source rocks in Upper Permian strata. Natural gases from the area south of the ancient Kaijiang-Liangping Seaway are generally sweet gases formed as the result of thermal maturation, whereas those discovered from north of the Seaway are products of both thermal maturation and thermochemical sulfate reduction of early accumulated oils in the Feixianguan Formation reservoirs. The proposed origins of the gases are supported by their chemical and stable carbon isotope compositions, as well as the presence or absence of pyrobitumens in the reservoir. The distribution of gas accumulations is controlled predominantly by the combination of lithologic and structural factors. The regional variation in the concentrations of H_2S in the gases appears related to the presence and thickness of anhydrite-bearing evaporitic rocks interbedded or intercalated with the oolitic reservoirs.

06/01557 Geochemistry and origin of the giant Quaternary shallow gas accumulations in the eastern Qaidam Basin, NW China

Pang, X. *et al. Organic Geochemistry*, 2005, 36, (12), 1636–1649.

This study provided an overview of the geological setting and geochemical characteristics of the Pleistocene shallow gas accumulations in the eastern Qaidam Basin, NW China. The five largest gas accumulations discovered in this region have a combined enclosure area of about 87 km^2 and 7.9 trillion cubic feet (tcf) of proven gas reserves. The dominance of methane (mostly more than 99.9%) and the $\delta^{13}C$ and δD values of methane (−68.51 to −65.00‰ and −227.55 to −221.94‰, respectively) suggest that these gases are biogenic, derived from the degradation of sedimentary organic matter by methanogens under relatively low temperatures (<75°C). A sufficient supply and adequate preservation of organic matter in the Pleistocene sediments was made possible by the lake basin's high altitude (2600–3000 m), high water salinity (>15% TDS) and strong stratification. The deposition and extensive lateral occurrence of lacustrine – shoreline sands/silts in beach sand sheets and sand bars provided excellent reservoirs for the biogenic gas generated from adjacent rocks. Effective but dynamic gas seals are provided by a combination of factors, such as the intermittent vertical variation in the sediment lithologies, hydraulic trapping due to the mudstone water saturation, the hydrocarbon gradient created as the result of gas generation from potential caprocks, and the presence of a regional caprock consisting of 400–800 m of muds and evaporites. It appears that the most favorable traps for large gas accumulations occur on structural slopes near the major gas kitchen, and the prolific gas pools are often those large gentle anticlines with little faulting complication.

06/01558 Mixing and separation characteristics of isobutane with refrigeration oil

Fukuta, M. *et al. International Journal of Refrigeration*, 2005, 28, (7), 997–1005.

This paper discusses the transient mixing and separation characteristics of isobutane with/from refrigeration oil. The mixing/separation processes are observed and investigated experimentally in a glass cylindrical vessel. Since liquid isobutane is less dense than refrigeration oil, the mixing process proceeds one dimensionally by diffusion from the interface between isobutane gas and refrigeration oil. The progress of mixing, therefore, is very slow compared with a combination of halocarbon refrigerant and refrigeration oil having convection flow during the mixing process. The diffusion process can be analysed using a one-dimensional diffusion model with an appropriate diffusion coefficient, which increases linearly with temperature. The separation of isobutane from the oil–refrigerant mixture occurs at the interface and the denser oil from which isobutane is separated causes a convective flow. Bubble generation under the depressurized conditions is unstable, but in the most cases, it tends to start when a high super saturation degree is reached. The temperature change during the separation process is estimated using latent heat as the separation heat of refrigerant.

06/01559 Numerical simulation of properties of a LPG flame with high-temperature air

Yang, W. and Blasiak, W. *International Journal of Thermal Sciences*, 2005, 44, (10), 973–985.

This work is connected with properties of a flame obtained by combustion of liquified propane gas (LPG) with highly preheated air using a regenerative burner. The attention is focused on both the size and shape of the flame and the results were obtained in a semi-industrial furnace equipped with a regenerative burner system. Results of the CFD-based mathematical modelling have been compared with measurements of a number of parameters including the furnace-wall temperature and the concentrations of gaseous species in the furnace. The results indicate that the flame spread can be well predicted using the numerical model. A flame entrainment ratio has been proposed here for describing and classifying the physical changes of the flame shape. This ratio can be used to optimize the diameter and length of a combustion chamber for specific applications. It is also found that equipping a furnace with a regenerative burner can provide a high saving energy, a larger flame volume and a lower emission of NO. It has been obtained that a lower excess air ratio leads to a low peak temperature and a larger flame volume, thus a lower NO emission.

06/01560 Origin and accumulation model of the AK-1 natural gas pool from the Tarim Basin, China

Xiao, X. M. *et al. Organic Geochemistry*, 2005, 36, (9), 1285–1298.

The AK-1 gas pool represents the first commercial gas discovery in the Kashi Depression, northwest Tarim Basin. The pool is characterized by dry hydrocarbon gas (dryness index > 0.995), heavy methane carbon isotopic value ($\delta^{13}C_1$ = −25‰), and a lighter $\delta^{13}C_3$ $\delta^{13}C_2 - \delta^{13}C_1$ = 3.9‰). High CO_2 content ($\delta^{13}C_{CO2}$ = −8.6‰) is observed in the main production reservoir. These characteristics indicate that the hydrocarbon gas originated from multiple sources, and that the CO_2 is of mixed inorganic and organic origin. There are two possible source areas: the lower block of the AK-1 overthrust structure and the central area of the Kashi Depression. Two possible source rocks are present in both areas: Lower Carboniferous mudstone and Lower and Middle Jurassic coal measures, typically with type II and type III kerogens, respectively. Both reservoir fluid inclusion data and trap structure evolution indicate that the gas pool was formed during the Pliocene–Quaternary. The authors constructed geological models of methane generation and carbon isotopic fractionation for the two potential source rocks using different geothermal histories of the two possible source areas. By comparing modelled results with the geochemical characteristics of the gas pool, the authors concluded that the source rock of the gas pool is the Lower Carboniferous mudstone, and the main source area is in the lower block of the AK-1 overthrust structure with a secondary source area in the centre of the Kashi Depression. The pool gas is interpreted as a late stage cumulative gas. The structure trapped gas generated from source rock in the lower block of the AK-1 overthrust at a methane fractional conversion of 0.64–1.0 together with inorganic CO_2 from the thermal decomposition of Carboniferous carbonate rocks in the central area of the Kashi Depression.

06/01561 Origin of the Neogene shallow gas accumulations in the Jiyang Superdepression, Bohai Bay Basin

Zhu, G. *et al. Organic Geochemistry*, 2005, 36, (12), 1650–1663.

Natural gas resources occur extensively along the east coast of China, with a number of large and medium-sized gas fields being discovered in recent years. Gas reservoirs include Neogene, Paleogene and the underlying Mesozoic and Paleozoic basement. Of the total proven natural gas reserves in the Jiyang Superdepression, Bohai Bay Basin, almost 89.7% is present in the shallow Neogene gas pools, in traps formed on top of the paleotopographic highs and along the margin of the secondary depressions. These gases are closely associated with heavy oils, occurring as gas caps or associated gases within the heavy oil pools, or in separate gas pools above, or updip from, the heavy oil pools. The gases contain over 95% methane and small quantities of C2+ alkanes, nitrogen and carbon dioxide. The stable carbon isotopes of methane in these gases are up to 10‰ more positive than those of the thermogenic gases in the deep Paleogene reservoirs, with propane more enriched in 13C than butane. This study demonstrated that the majority of the petroleum source rocks in the Jiyang Superdepression tend to be oil-prone, and are currently within or shallower than the conventional oil window (0.45–1.0% Ro). The chemical and carbon isotopic compositions of the gases, together with the moderate to severe biodegradation of the associated heavy oils in the shallow Neogene strata, clearly suggest that the formation of the shallow natural gases in the Jiyang Superdepression result from the anaerobic degradation of accumulated oils in reservoir.

06/01562 Simplified models for predicting the onset of liquid water droplet instability at the gas diffusion layer/gas flow channel interface

Chen, K. S. *et al. International Journal of Energy Research*, 2005, 29, (12), 1113–1132.