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The Accumulation and Seismic Identification Methods of Shallow Gases

Guoping Zuo, Guozhang Fan
Petrochina Hangzhou Research Institute of Geology, HangZhou, ZheJiang province, China

The shallow gases contain biogas and thermogenic gas. They are derived from organic matter as a result of bacterial activity or by thermogenic processes.

Numerous faults in Bengal Bay suggest that the deep, thermogenic gases migrated toward the seafloor along the fault. The upward-migrating gases may accumulate in porous debrite and turbidite beds of the upper layers. In seismic profiles, many chimneys and faults indicate that the thermogenic gas could migrate upwards form deeper surface to the seafloor. The upper impermeable shale sediments overlying these reservoirs may act as a barrier to prevent further upward migration of these gases. Therefore, the shallow gases often accumulated near faults, dome structures, and piching out of lithology.

These shallow gases can create variable reflectivity, and lead to coherent reflections of increased intensity. Consequently, in seismic profiles, they often represent high amplitude reflection, which is called bright spot. When acoustic waves penetrate these shallow gases, the energy reduces significantly, and the polarity may be changed from positive to negative. They cause blank reflections below the shallow gases. In addition, the frequency of seismic data also decrease rapidly, there is a low frequency shadow below these enhanced reflectors. Therefore, the shallow gas indicators include reversed polarity, low frequency enhanced reflectors and acoustic blanking.

In Bengal Bay, a variety of acoustic anomalies in seismic profiles are observed at shallow depths. Acoustic turbidity is frequently present in the upper sedimentary sequence and can be explained by the scattering of acoustic energy due to the presence of gases in the sediments. They often show bright spot in seismic profile.

There are four methods to identify these shallow gas mentioned in this study, including AVO method, bright spot method, low frequency shadow method and polarity reverse method. If the reservoir contains gas, in AVO method, the amplitude enhances fast with the increasing offset in gathers, therefore, the amplitude of far offset stack is higher than that of near offset stack. In other three methods, it presents significant bright spot, low frequency shadow and reversed polarity. These methods have achieved remarkable effect of identifying shallow gas in the area under study.

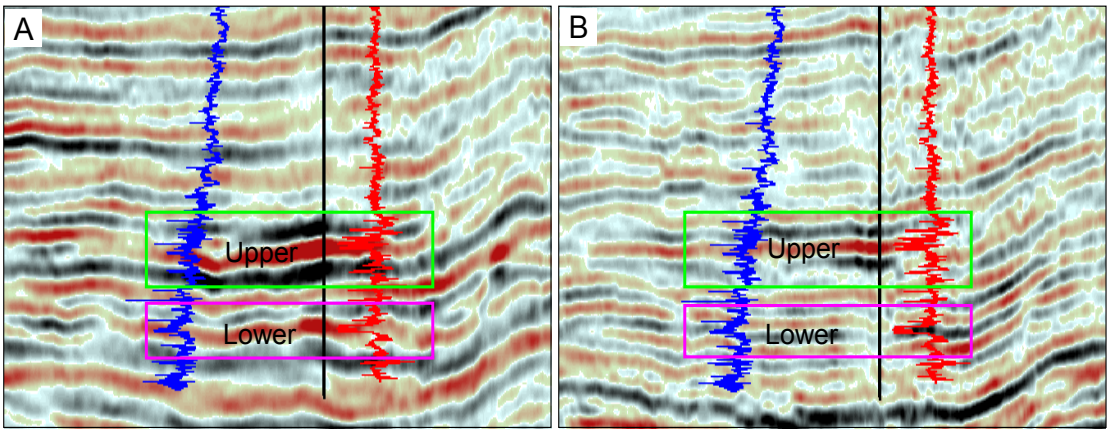

Figure 1 Seismic profiles. A）Far offset stack；B）Near offset stack. The Upper part shows very strong amplitude in the far offset stack seismic profile, however, it's much weaker in near offset stack seismic profile. The lower part presents negative amplitude in Fig 1 A, nevertheless, it's positive amplitude in Fig 1 B. All of these features are very good indicators of shallow gas.

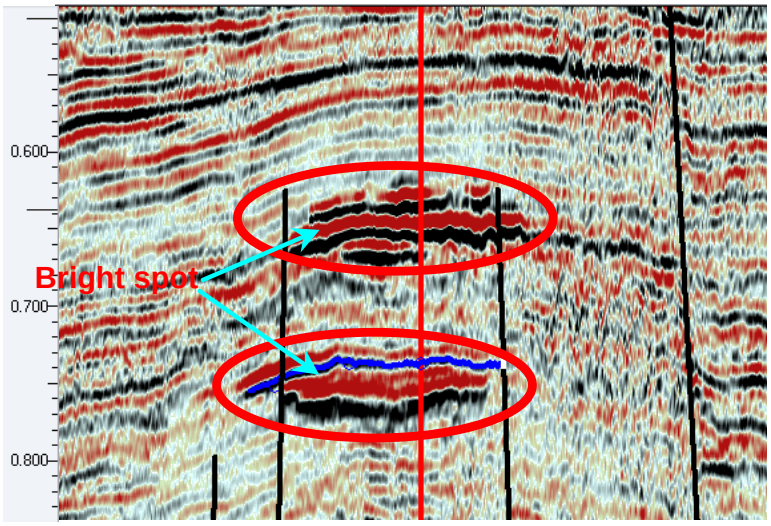

Figure 2 Seismic profile. There are bright spots in the red ellipse areas. These bright spots indicate shallow gas.