Diagenetic evolution of clay minerals of Jiyang Basin, China

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The nature, relative abundance, crystallinity and composition of clay minerals in the Tertiary Jiyang basin (Shengli Oilfield) were studied by X-ray diffraction analysis and electron microprobe. The clay diagenetic evolution is characterized by the mineral assemblage changes from smectite and kaolinite, then random (R = 0) I/S and kaolinite, and then ordered (R = 1) I/S, kaolinite and chlorite, to illite and chlorite with increasing depth.

The illite crystallinity results of this study were calibrated to the Crystallinity Index Standard (CIS) of Warr and Rice (1994), the values range from 1.40 to 1.05 $^{\circ}\Delta 2\theta$ in well PS3 and 1.31 to 0.79 $^{\circ}\Delta 2\theta$ in well HK1, and show a generally decrease with increasing depth. Chemical analysis of chlorites shows an increase in Al (IV) in tetrahedral sites and Fe/(Fe+Mg) ratio with increasing depth, from 0.751 to 1.074, 0.439 to 0.447 in well PS3 and from 0.864 to 1.344, 0.458 to 0.488 in well HK1 respectively.

Increased temperature from burial is thought to be the primary factor controlling the evolution of clay mineral, illite crystallinity and chlorite composition. The geothermal gradient calculated at maximun burial temperature, determined from changes in the ordering of I/S, chlorite composition and illite crystallinity data, is about 36~39°C/km. It is higher than the geothermal gradient established by present-day borehole temperature (30~33°C /km).

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Methane-derived authigenic carbonates in the northern Gulf of Mexico and their possible relations with the underlying gas hydrates

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Sampling

Authigenic carbonate sediments were collected from different depths (0 to 26.95mbsf) in sediments of 2 sites on the continental slope of northern Gulf of Mexico (GOM) by the giant Calyps piston corers during the *Marion Dufresne* cruise (MD02) in July 2002. Carbonates were observed as nodules, a slab (3.5cm thick) with a hole, hardgrounds, porous crusts, and carbonate cemented shell fragments. They occurred either in close association with underlying massive or dispersive gas hydrates, or in gas hydrate free sediments.

Results and Discussion

Textures, chemical compositions, and $\delta^{13}C$ and $\delta^{18}O$ values of 18 specimens were carried out by different methods. Results from X-ray diffraction and EMPA analyses show that the almost all carbonates are predominated by high-magnesian calcite (~5 to 21.4 mol% $MgCO_3$) with some pyrites and very few dolomites. Barite crystals are also fobserved in association with low-Mg calcite. In general, high-Mg calcite tends to be more enriched in ^{18}O and depleted in ^{13}C.

The extremely negative $\delta^{13}C$ (-31.5 to –61.9 ‰PDB) of calcites indicates that the calcites precipitation is strongly related with the methane oxidation. While the heavier $\delta^{18}O$ values (+3.4 to +5.9 ‰PDB) suggest that some carbonates were precipitated either at lower temperatures or from heavier oxygen fluids. Especially the carbonate nodules associated with fine-crystallined, dispersive gas hydrates are thought to have been precipitated in conditions far away from equilibrium with the ambient waters, perhaps under strong effect of gas hydrate dissociation, However carbonate nodules associated with underlying massive gas hydrates are in equilibrium with its ambient sea waters, with little influences from gas hydrates.

Conclusions

This study indicates that isotopically heavy oxygen and light carbon containing, high-Mg calcites were formed under a strong methane flux. Also integrated geochemical signatures of authigenic carbonates can offer a new means to study the states of the stability of the underlying gas hydates.