Paper Number: 1370

Petrology and geochemistry characteristics of mudstone interlayer within the paleo-CO_2 reservoirs, in the Southern Songliao Basin, China

Liu, L., Ming, X.R., Liu, N., Yu, L., Bai, H. G., and Hu, C. Y.

College of Earth Science, Jilin University, 130061 Changchun, China (E-mail address: liuli0892@vip.sina.com)

Dawsonite-bearing sandstones series in the Southern Sonliao Basin (China) has been studied as a natural analogue for geological storage of CO_2, and has been proved to be the CO_2 reservoirs in the geologic record. The new investigation is presented, to characterize the mineralogy and geochemistry of mudstone interlayer sandwiched in dawsonite-bearing sandstone series and to determine if there is characteristic mineral and chemical change in the mudstone interlayer affected by CO2-bearing fluids that diffuse from the underlying CO2 reservoir sandstone.

Mudstone interlayer is present as thinner (mainly 0.5-2m) interval in dawsonite-bearing sandstone series, and consists of clay(33.9-68%), quartz plus feldspar (25.8-66.7 %) and non-clay authigenic minerals included calcite, dolomite, siderite, dawsonite, hematite, and pyrite. Four general lithofacies are recognized on the basis of the diagnostic mineral: (1) dawsonite-bearing mudstone; (2) Calcite-dolomite-rich mudstone; (3) siderite-bearing mudstone; and (4) illitic mudstone.

The dawsonite-bearing mudstone is characterized by the occurrence of dawsonite (1.8-5.9%). It contains 35.3-58.3% clay minerals (illite/smectite and illite), 9.7-15.0 % other non-clay authigenic minerals, such as, dolomite, siderite, and pyrite. The $\delta^{13}C$ composition of the calcite has a very narrow range from -0.9 to -1.5‰(PDB), $\delta^{18}O$ composition ranges from-14.8 to-15.2‰(PDB). Calcite(3.4-4.3%) or dolomite (3.4-16.9%) or both(7.8-17.1%) are the dominant minerals in the calcite-dolomite-rich mudstone. Clay mingerals (Iiite/smectite and illite)(33.9-54.3%) are also present, other non-clay authigenic minerals include siderite, hematite, and pyrite. Values of $\delta^{13}C$ and $\delta^{18}O$ for dolomite are $-0.7\sim-5.5$‰(PDB) and$-15.2\sim-20.1$‰(PDB), respectively. Values of $\delta^{13}C$ and $\delta^{18}O$ for calcite are $-0.7\sim-10.0$‰(PDB) and $-13.2\sim-17.7$‰(PDB), respectively. Siderite (2.0-8.6%) is only carbonate mineral in the siderite-bearing mudstones. Illite is the dominant clay mineral, and non-clay authigenic minerals are hematite(0-4.7%) and pyrite(0-4.1%). Values of $\delta^{13}C$ and $\delta^{18}O$ for siderite are $-0.9\sim-6.8$‰(PDB) and $-12.4\sim-$

20.7‰(PDB) , respectively. Illitic mudstone is characterized by rich in illite and absence of carbonate mineral. Non-clay authigenic minerals are also hematite(0-4.0%) and pyrite(0-4.0%).

Based on carbon isotope data, CO_2 used for dawsonite formation is inferred to have derived from magmatic source, whereas the CO_2 consumed for calcite and dolomite precipitation originated mainly from thermal degradation of organic matter and magmatic gas. The occurrence and carbon isotope data show that siderite seems to have formed as an early diagenetic phase under reducing conditions at lower temperatures, CO_2 used for it may have derived from methanogenesis. Dawsonite, calcite and dolomite within the mudstone interlayer may thus be the result of mass transfer from the underling sandstone (paleo-CO_2 reservoir) and CO_2 immobilization through carbonate precipitation. There is no evidence to support similar mass transfer behavior in siderite-bearing mudstone and Illitic mudstone.
This research is funded and supported by the National Natural Science Foundation of China (No. 41172091 and No. 41572082).