# Kinetic study of brucite carbonation

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Increasing evidence suggests that the widespread used of fossil fuels has led to a rapid increase in carbon dioxide concentration in atmosphere. One method to prevent $CO_2$ in the atmosphere from rising to unacceptable levels is carbon dioxide sequestration. Of all the options proposed so far, mineral carbonation is the one that offers advantages in the stablity of the final products and hence the elemination of legacy issues. However, this approach faces the problem of slow reaction kinetics and the difficulty of recycling leaching agents used to extract cations [1].

We present an experimental study of mineral carboation using $NH_4Cl$ solution as leaching agent and brucite as raw material. The acidic environment resultant from caused by $NH_4^+$ hydrolysis facilitates mineral dissolution and the release of $NH_3$, which will be collected as a base agent for pH adjustment during the carbonate process and form $NH_4Cl$ again. Recycle use of the leaching agent lowers the total cost and increases the commercial potential of the process. Furthermore, most magnesium-rich layer silicon minerals have similar structures and brucite-like magnesium-oxygen octahedral layers exist between silicon-oxgen tetrahedrons, it is reasonable to believe that brucite and magnesium-rich layer silicon minerals have similar dissolution mechanism.

Kinetic experiments show that the convertion-time followed the Avrami model, and that the reaction rate increased with increasing temperature and ammonium chloride concentration, decreasing solid/liquid ratio, and particle size. The following mathematical equation is found to fit the relationship between the reaction constant(k) and various experimental parameters:

$$k=5.22\times10^{5}C^{0.12}(S/L)^{-0.22}D^{-0.31}e^{-5710/T}.$$

The reaction activiation energy calculated by the Arrhenius equation 47.47kJ/mol, in agreement with the reported value for surface controlled brucite dissolution [2].

[1] Sipiläet *al*. (2008) *Greenhouse Issues* **90**, 3-4. [2] Huang *et al*. (2009) *The Chinese Journal of Process Engineering* **9**, 1121-1126 (in chinese).

# Large area multi-stage quasi-layer petroleum accumulation in carbonate reservoirs in Tazhong area, Tarim Basin

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Tazhong area is an important exploration domain in the Tarim basin with abundant petroleum. Ordovician carbonate reservoir is the major exploration target. The formation and distribution of those reservoirs were major controlled by high energy sedimentary facies, dissolution and faults. Reef-shoal complex in the Lianglitage Formation in Upper Ordovician and karst weathering crust reservoir in the Yingshan Formation in Lower Ordovician were both distributed quasi-layered in large area. The Hydrocarbons were complex accumulated in multi-layer. Those reservoirs were composed of carbonate rocks with low porosity and low permeability, and buried in 4500~6500m depth with intensive heterogeneity. The spatial distribution of effective reservoirs controlled the occurrence of hydrocarbon and accumulated in large area, which showed an integral enrichment characters.

Detailed oil-source rock correlation indicates that the crude oils were mix-oils originated from both Cambrian source rocks and Ordovician source rocks, nevertheless, the natural gases were major oil-crack gases from Middle-Lower Cambrian sources. The analysis of accumulating process shows that the Tazhong area experienced three stages of hydrocarbon accumulation. The first stage occurred in the Late Caledonian tectonic cycle and the hydrocarbons originated from Cambrian-lower Ordovician source rocks, and were severely degraded in the Early Hercynian tectonic movements in large areas. The second stage occurred in the Late Hercynian tectonic cycle which was the most important hydrocarbon charging stage, the oils and gases were from Middle-Upper Ordovician source rocks. The third stage occurred in the late Himalayan tectonic cycle, Cambrian oil-crack gases began to generated in depth, charged into Ordovician reservoirs along faults, gas-washed the oil pools and then formed condensate gas reservoirs which is now extensively occurred in Tazhong area.