MINERALOGY AND MORPHOLOGY OF AUTHIGENIC PYRITE AND
GYPSUM FROM A HYDRATE-POTENTIAL GEOSYSTEM IN
SOUTH CHINA SEA

Lei Xie1, Jiasheng Wang1,2*, Zhou Wang1, Jun Hu1, Hongren Chen1 and Qi Lin1
Faculty of Earth Sciences of China University of Geosciences, Wuhan, Hubei1
& Key Laboratory of Biogeology and Environmental Geology of Ministry of
Education, P. R. China2 430074, P. R. CHINA

Methane hydrate-bearing sediments were drilled and cored in 2007 by an
international group from China and Russia at Shenhu area in the northern slope of
South China Sea. Four shallow piston cored sediments depth to 9 mbsf were sampled
in 2009 near the Shenhu area and subdivided by a high resolution of 5 to 7 cm. Based
on the study of the grain-sized particles, scanning electron microscopy (SEM) and
electron energy spectrum (EES) analyses, we found pyrite and gypsum co-exist within
the sediments, besides authigenic carbonate in the hydrate geosystem.

Pyrite appearances are mainly of paleyellow spheroids, robs, foraminifera-
infillings, granular sheet-like masses and framboids/polyframboids. Individual framboid
varies in diameter from about 10 to 50 μm, and is formed of small octahedral ranging
between 0.5 to 3 μm or of pyritohedral. Some pyrite are in bright crystal, while other
crystal faces are adhered with a number of spherulites and colloform aggregates.
Gypsums are in the form of transparent-semi-transparent euhedral single or twinned
crystals, such as swallowtail double gypsum, and of rosettes or radial aggregates.
These crystals are intact and unabraded, characterizing clear crystal faces, boundaries
and edges.

SEM observation shows that gypsum inter-grows with pyrite aggregates or grows
on the surface of pyrite crystals. The formation of pyrite acquires excessive HS⁻,
acting with Fe²⁺ in pore water. Microbially mediated anaerobic oxidation of methane
(AOM) moderates the input of methane, and releases HS⁻ to interstitial water. The
gypsum precipitates in situ, when the value of SO₄²⁻ and Ca²⁺ excluded during the gas
hydrate formation, exceeds the solubility product of anhydrite.

The occurrence of octahedral pyrite crystal may suggest sufficient sulfate flux,
abundant ion supply and relatively steady temperature. Authigenic gypsum is assumed
as a potential indicator to the gas hydrate geosystem during the AOM. The
swallowtail double gypsum crystal forms possibly in a relatively motionless medium
environment with less intent of fluid activity. The co-existence of the authigenic
gypsum and pyrite is regarded as a geologic recognition indicator for the potential
cold seep and could be believed as one of the parameters indicating the presence of
gas hydrate in marine sediment.

* Corresponding author: Phone: +86 (0)27 6788 3001 Fax +86 (0)27 6788 3002 E-mail: js-wang@cug.edu.cn