

Abnormal Gas Pressure Caused by Natural Gas Production and Big Earthquake

Katsuhiro FUJISAKI¹, Takashi KUSUDA² and Hisashi NIREI¹

1 NPO Geo-pollution Control Agency, Japan

5-24-1 Makuharihongo, Hanamigawa, Chiba, 2620033, Japan

2 Research Institute of Environmental Geology, Chiba

3-5-1 Inagekaigan, Mihama, Chiba, 2610005, Japan

In Kujukuri area, natural gas reservoirs exist. Natural gas is dissolved in saltwater. 400 million m³ of natural gas and 6 thousand tons of iodine are produced in a year. Land subsidence has occurred by production of saltwater containing natural gas. Maximum accumulated land subsidence rate in 5 years from 1998 to 2003 was 110 mm. Kazusa Formation which is Pleistocene sediments forms the reservoir of saltwater containing natural gas. The reservoir lies at an approximately depth of 300 m and its thickness is 800 - 1300 m. Free natural gases have been generated in the reservoir by decline of groundwater pressure. Piezometric head in the reservoir is 150-300 m below sea level. Therefore, natural gas fields with high gas water ratio (Mobara type) have been produced. The gas water ratio is the ratio of produced gas volume to saltwater volume. It is ordinarily from 1.5 - 2.5, however, it is about 20 - 100 in Mobara type gas fields. Free natural gases discharge to ground surface through fractures and faults. A part of free natural gases is reserved in artificial gas reservoir which is overlain by alluvial formation. Residents use gases in this reservoir as fuel, drilling shallow production wells. Discharged natural gas causes damage to crops and it occasionally explode in houses and buildings.

At the Niigata earthquake on June 1964, damages caused by liquefaction-fluidization were recognized first in Japan. It caused severe damages for lifelines and bridges etc. At the east off Chiba prefecture earthquake on December 1987, sand volcanoes were generated and land subsidence was occurred by liquefaction-fluidization. These phenomena were observed in artificial beds such as reclaimed lands. At the great Hanshin-Awaji earthquake on January 1995, 6300 peoples were dead and infrastructures of Kobe city and others were severely destroyed. Damages by liquefaction-fluidization were widely caused. Also, boulder volcanoes which had never observed were occurred. Boulder volcanoes occurred in reclaimed island with gravels. At a manhole, its lid with 63kg in weight was blown off and boulders with diameter of over 30 cm were ejected from it. In

closed space of reclaimed island surrounded with embankments, high pressurized three phase flow of gravel, water and air was generated, accelerating by strong motion of the earthquake. This high pressurized three phase flow was seemed to spout from weak parts of shallow layer. In Kujukuri area, big earthquake could cause high pressurized three phase flow of natural gas, water and sand and gravel, and it may generate boulder volcano.