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Geological Storage of CO_2 for Production of Methane from Gas Hydrates

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Abstract—*The tendency of gas hydrates to dissociate and release methane, which can be a hazard, is the same characteristic that research and development efforts strive to enhance so that methane can be produced. The potential rewards of releasing methane from gas hydrate fields must be balanced with the risks. Most methane hydrate deposits are located in seafloor sediments. That means drilling rigs must be able to reach down through more than 1,600 feet (500 meters) of water and then, because hydrates are generally located far underground, another several thousand feet before they can begin extraction. Even if you can situate a rig safely, methane hydrate is unstable once it's removed from the high pressures and low temperatures of the deep sea. Methane begins to escape even as it's being transported to the surface. Unless there's a way to prevent this leakage of natural gas, extraction won't be efficient. The extraction of methane from natural gas hydrates while simultaneously storing carbon dioxide in them seems to be a promising approach to solve both problems at the same time. The objective of this paper is to identify the possible risks in production of methane gas from permafrost regions is studied in Both aspects of risk and benefit as well as the balance are very important in understanding the feasibility of CO_2 geological storage at specified situation of enhanced recovery of gas hydrates. Where the methane could be extracted and transported safely and efficiently.*

Keywords: *crystalline, permafrost, production, geological, storage, extraction*

1. INTRODUCTION

Earth's huge deposits of natural gas hydrates hold the promise of gathering the world's natural gas requirements far into the 21st century if they can be tapped. Currently they are at most excellent sub economic supply, but understanding of even a little part of their potential would afford an extremely important innovative source of natural gas to assemble future energy along with environmental necessities. In addition to rich minerals, there are huge amounts of methane hydrate underneath the sea floor. Several countries hope to develop to become

Independent of energy imports by extraction of marine gas hydrate deposits near their own coasts. The technology for production is not yet available. Moreover, the risks to climate steadiness and hazards to marine habitats linked with extraction of the methane hydrates must be clarified first. Equal aspects of risk as well as advantage and the balance are extremely important in understanding the feasibility of CO_2 geological storage at particular condition. Present there is a gigantic amount of gas trapped in gas hydrate deposits worldwide. The estimates vary but it is supposed to facilitate the quantity of carbon in hydrates is double the size of the carbon equivalent of all conventional fossil fuel deposits in the world [Kvenvolden et al (1988)]. The overall energy demand is anticipated to rise by one third as of 2011 to 2035 by means of an estimated 48% increase in natural gas utilization [IEA (2013)]. Due to the predicted rise in global energy utilization, gas hydrates have achieved increased attention from the last decade with esteem to create a potential future energy source [Graue et al (2014)]. More than a few methods have been planned in regards to gas recovery from gas hydrates. This includes thermal stimulation, chemical/inhibitor injection and depressurization wherever the future is the mainly promising [Sloan (2008)]. A further recent recovery technique is based on exchanging the CH_4 molecules in hydrates by means of CO_2 molecules [Ebinuma (1993)]. This recovery method had consequently gained improved awareness in the last decade where the recovery of CH_4 and the next CO_2 sequestration may eventually result in a carbon neutral energy source. There has been wide research on the CO_2-CH_4 exchange method for extraction of natural gas from gas hydrates.

1.1. Physical properties of methane

Methane (CH_4) may be a colorless, odorless, combustible gas that smolders for a faintly blue fire. "Natural gas," utilized by numerous North Americans to warming Furthermore cooking, may be essential methane (>90%). Those 'gas odor' is from an included substance there about that gas breaks might be distinguished. Hazardous mixtures of methane for air hold between 5 - 14 % methane. Mixtures holding more than 14% smolder without blast.

1.2. Physical properties of Carbon dioxide

Carbon dioxide (CO_2) is a boring and unscented gas fundamental will an aggregation for world. Carbon dioxide exists over Earth's climate concerning illustration a follow gas in centralization from claiming regarding 0.04 percent (400 ppm) by volume. Characteristic sources incorporate volcanoes, hot springs also geysers, What's more it will be liberated from carbonate rocks by disintegration for water and acids. As a result carbon dioxide may be dissolvable clinched alongside water, it happens commonly on groundwater, streams and lakes, on ice caps also glaciers and likewise for seawater. It will be display in stores of petroleum Furthermore characteristic gas.

2. GAS HYDRATE STABILITY ZONE

Gas hydrate reliable zone, abbreviated as GHSZ, Likewise alluded should similarly as methane hydrate solidness zone (MHSZ) or hydrate solidness zone (HSZ), alludes on a zone Furthermore profundity of the marine earth during which methane clathrates characteristically exist in the earth's outside. Gas hydrate Strength principally relies upon temperature also pressure, not withstanding different variables for example, such that gas creation and ionic impurities for water impact solidness limits. [Keith et al (1993)] the presence and profundity of a hydrate store will be often shown towards the vicinity of a bottom simulating reflector (BSR).The bottom simulating reflector is an seismic reflection demonstrating those more level utmost from claiming hydrate Strength previously, sediments because of those separate densities from claiming hydrate immersed sediments.[MacKay et al(1994)].

2.1. Seismic Detection Methods for hydrate bearing sediments

The vicinity for gas hydrates clinched alongside seaward mainland edges need been inferred primarily starting with seismic preparing strategies. Seismic image transforming visualizes the subsurface structure eventually Tom's perusing method for reflected acoustic signs .The seafloor indicators are stamped towards a white/black reflection, which implies that those subsurface volume is harder over the volume over. To acoustic terms, that acoustic impedance (the result about medium thickness and speed about sound) beneath that seafloor in the silt is higher over those impedance of the water section. Clinched alongside contrast, the bottom simulating reflector (BSR) may be denoted towards a black/white reflection demonstrating potentially secondary hydrate impedance over gas filled sediments for low impedance. Likewise the determination of the seismic picture will be constrained Eventually Tom's perusing those seismic sourball data transfer capacity and concerning illustration the physical parameters describing those seismic subsurface reaction need aid recurrence dependent, various surveys with separate procurement parameters need aid required should acquire all the more finish information of the silt parameters [D. Klaeschen et al (2004)].Seismic measuring arrays would created of a callous source for example, air weapons (usually An dozen or A greater amount of them), Also moving or stationary receivers those reflected heartless waves give acceptable a 2D picture of a cut through the earth's surface. The heartless waves head out through those water section and back Likewise layering or waves, speaking to the verthandi movement through the different materials [R. A. Duncan et al (1996)].

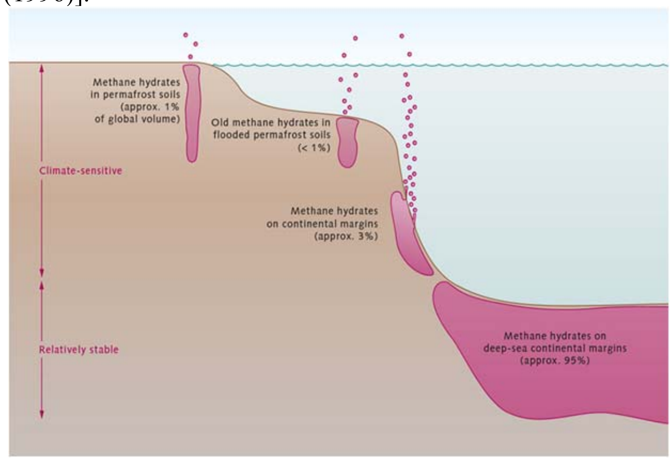

Figure explains the methane hydrate stability at different depths

3. GAS HYDRATE HAZARDS

Gas hydrates are a important hazard for drilling as well as production operations [Timothy S. Collett et al(2002)]. Gas hydrate Production is hazardous in itself, and for predictable oil and gas actions that leave wells along with pipelines into permafrost or marine sediments. For actions in permafrost, two general types of problems have been identified as uncontrolled gas releases during drilling and damage to well casing during and after installation of a well. Related troubles might occur during offshore drilling into gas hydrate bearing marine sediments. Offshore drilling operation that disturb gas hydrate bearing sediments could break or disrupt the foundation sediments as well as compromise the wellbore, pipelines, rig supports, and extra equipment occupied in oil and gas Production from the seafloor[George J et al(2006)].

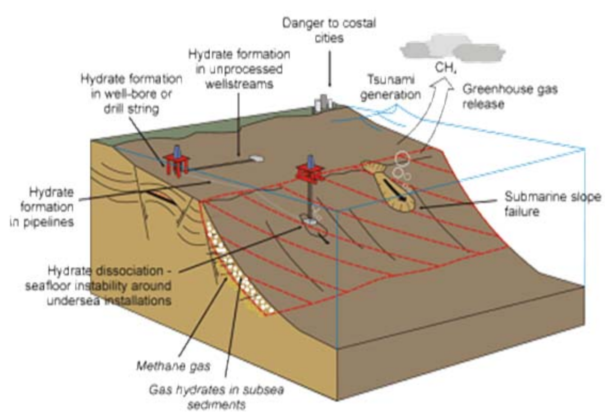

Figure explains the faults while extracting gas. This describes landslide disaster

3.1. Environmentalists warn of risk in extracting gas from methane hydrate

The trillions of cubic feet of methane hydrates are available in the ocean's floor are in geologically unbalanced regions. The fear of extracting is one incorrect move and an underwater landslide could send huge amounts of a particularly strong greenhouse gas to the ocean's floor and into the atmosphere. Tapping methane hydrate for natural gas may have an optimistic impact on global energy making, but critics say the potential fuel resource could have a negative impact on global warming."Accumulating more amount of methane to the environment is a really bad idea," said Kert Davies, research director at Greenpeace. Even though methane remains in the environment for a lesser time than carbon dioxide, "Rupee for rupee”, the relative impact of methane on climate change is over 20 times better than carbon dioxide over a 100 year term," according to the US Environmental Protection Agency. Japan, the country making the mainly destructive push into methane hydrate growth, will focus its efforts on comparatively flat stretches of the seafloor off its coast. That will reduce the probability of a landslide, according to the Research Consortium for Methane Hydrate Resources in Japan, a group with council from government agencies and universities.

4. DRILLING PROBLEMS IN EXTRACTING GAS HYDRATES

Hydrate bearing sediments would penetrated through a progress to weight also temperature might happen and result in the hydrates should get weak [Khabibullin et al (2006)]. Whether 1 m^3 about methane hydrate dissociate, it will generate 164 m^3 methane gas. The point when a volume transform in that happen it will bring about a kick or done most exceedingly bad instance situation a blow out. In the shallow depths the place gas hydrates as a rule are encountered, those blow out preventer (BOP) riser, choke and execute lines would typically not introduced [Amodu, a. A et al (2008)]. Hydrate separation arrangement might make issues for wellbore strength moreover subsurface equipment. Gas hydrates may also aggravate encountered at more staggering depths the purpose when the individuals would in addition riser might acquainted. Supplies around surface In accumulation subsurface might extra exhibited with hazard in this chance for light of the fast grow secured close by volume will incorporate a tremendous strain on the supplies[Amodu, An. A et al (2008)]. Wellbore reliability because of hydrate separation will be basically created toward two issues would when those hydrates separate in the wellbore, the boring mud will background a diminishment in thickness also a progress clinched alongside rheology because of broken down gas. Those including sediments may experience a development to permanganic destructive and diminishing of nature. [Khabibullin et al (2006)].

4.1. Did hydrates cause hazard in deep water horizon?

The individual semi submersible rig deepwater horizon encountered gas release also a following impact at 21:49 hours central duration of the time on the 12th for April 2010 [rogers (2010)]. The individuals, Triumph struck them the purpose at infiltrating an exploratory incredible again. Those Macando Bield in the Gulf for Mexico throughout 1500 meters of sea profundity. There were 126 persons endeavouring on the rig in the people off chance at of the accident, done to the extent that eleven persons lost. A champion around the workers motivations of the incident Throughout Deepwater horizon Halliburton performed that bond Specific occupation [jones j (2010)]. Precisely 20 hours at the individuals accident, security might bring been pumped down the individuals great on set bundling. [shoe gren 2012]. The quality for gas hydrates in the formation, heading them ought to melt. An extra will a chance to be that liquefying to Hydrates the sum around infiltrating settled on wide holes in the well, something comparative to that that the side of the side of the point those purpose The point when security might bring been pumped, it might be not necessary for expansion will security the workers total packaging set up. Throughout that point of view prompt a gas kick outside those casing [Schwartz (2010)]. Gas hydrates thus relied upon a accurate a piece in the disappointment over recognizing the oil spill for infiltrating of the moving high flow.

4.2. Drilling techniques to help prevent problems with hydrates

4.2.1. Managed pressure drilling:

Managed pressure drilling contains a unique appliance. It is a drilling process used to control the pressure profile for the well bore. Managed pressure drilling techniques may avoid formation in flux by ascertaining the weights in the well bore inside the environment limits. It allows or faster corrective action. Concerning illustration it may include organize of back pressure fluid density.

4.2.2. Slim and Insulated Marine Riser:

Drilling in deep sea and cold water, there is a need for insulated risers. Slimmer riser means the returns will have higher velocity. When drilling through hydrate bearing sediments there will be less time for heat transfer to warm the returns, which again minimizes the dissociation of hydrates.

4.2.3. Drilling with casing:

The formation might be rather fragile and the wellbore should be cased as quickly as possible. A one trip drilling system that carries casing with it and the possibility for fast cementing could be the answer. Drilling with casing solves this. Instead of drill pipe, casing is used and cemented in place as soon as the section is drilled. This protects wellbore from the formation and Hydrate bearing sediments and prevents influx.

5. THE IMPACTS OF HYDRATE MINING

For a lengthy time the risks connected with methane hydrate mining were doubtful. At present there is well known consensus that drilling is responsible for neither tsunamis nor leaks in sea floor sediments through which huge amounts of climate harmful methane could run away into the ocean and the environment.

5.1. Panic of disasters

In present existence there is potentially harmful impact of methane hydrate mining on the marine location and weather has been a source of heated question in professional circles. Concerns have been articulated that extracting the hydrates could discharge huge quantity of methane into the environment. In this occasion the penalty would be disastrous. As methane is a greenhouse gas about 20 times extra effective than carbon dioxide. A few scientists have claimed that such a better release of methane from the oceans could hurry climate change. The opportunity that hydrate mining might generate submarine landslides on sharp continental slopes and avalanches in mountain regions, submarine landslides are normal events. They occur on continental limits where thick layers of soft sediment have accumulate, such as near river mouths.

5.2. In onshore permafrost region:

Such methane hydrate reserves are found in regions that they contain only approximately 1 percent of the overall volume of the globe. Their impact on the weather would be equally irrelevant. In the majority of these regions the deposits are located at depths of more than 300 meters. Scientists trust that global warming would, at most, reason the higher layers of methane hydrate to melt. This method is expected to take some thousand years. Deposits at lowest point of about 20 meters would be much more responsive to Global warming.

6. CONCLUSION

Almost two decades of drilling along with coring program have decided that gas hydrates take place in large volumes in nature. But, the structure in which these resources take place varies generally, mostly influenced by the environment of the enclosing sediment. As of those variations which contain gas hydrate absorption, burial depth, and many other factors only a division of the global in place source is potentially in principle recoverable during the application of identified innovations. This separation consists mainly of gas hydrates housed in sand rich sediments. Overall reserve volume in sand reservoirs remains as badly forced as the global in place estimates, but may be lying on the order of 285 to more than 1400 trillion cubic meters of gas. Huge volumes are also likely there in muddy system, mainly in connection with chimney structures, other than the lack of any possible production come near for such deposits resources that these sources cannot at present be measured as a part of the rectifiable resource floor. The unique technique for enhanced extraction of gas hydrates is planned, based on the mechanism of CO_2-CH_4 substitution in the extraction of gas from gas hydrates. A variety of kinds of profit of geological carbon storage studied with ocean and also atmospheric discharge can be easily implicit in the scientific feature of global surroundings and the economical aspects. Equal aspects of risk as well as benefit and the stability are very significant in accepting the feasibility of CO_2 geological storage at particular condition. The assessment of risks affected by carbon capture and storage would be hardly undertaken, due to some difficulties in shaping the end point and parameters for estimating environmental and individual risks. In order to attain clear risk authority for any stakeholders, it is needed to extend the common support for facilitating to fully communicate between any stakeholders.

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